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Aras 6, Blok D4, Kompleks D
Pusat Pentadbiran Kerajaan Persekutuan
62530 W.P. Putrajaya, Malaysia

Tel.: 03- 8886 5555
Faks: 03- 8889 2417/12
email: jtm@mohr.gov.my

www.jtm.gov.my

PROSIDING PERSIDANGAN KEBANGSAAN TEKNOLOGI KEJURUTERAAN 2011

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PROSIDING

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(NATIONAL CONFERENCE ON ENGINEERING TECHNOLOGY (NCET) 2011)

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Pusat Pentadbiran Kerajaan Persekutuan
62530 Putrajaya
Tel.: 03-8886 5555
Faks: 03-8889 2412
Website: http://www.jtm.gov.my

Diurus Cetak Oleh:

Percetakan Nasional Malaysia Berhad
Jalan Chan Sow Lin
50554 KUALA LUMPUR

PROSIDING

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National Conference On Engineering Technology (NCET) 2011
'Engineering Technology Application Towards Innovation'

11 – 12 April 2011
Sunway Carnival Convention Centre, Seberang Jaya, Pulau Pinang

EDITOR

Tn. Hj. Norman bin Kusin
Encik Sarman bin Rawan
Encik Ab. Rahman bin Mohd Said
Encik Mohd Abd. Fatah bin Mohd Ramly
Puan Rosnah binti Muhamad Tahir
Encik Mohd Zaidy bin Mohd Nasir
Puan Nor Azlina binti Ismail
Encik Tuan Mohd Kamal bin Tuan Aziz
Encik Zafrul Azman bin Osman

URUSETIA PENERBITAN

Bahagian Perancangan dan Penyelidikan
Jabatan Tenaga Manusia

Penganjur:

Jabatan Tenaga Manusia (JTM), Kementerian Sumber Manusia

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PRA KATA
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Terlebih dahulu saya mengucapkan kesyukuran kehadrat Ilahi kerana dengan izinNya JTM telah berjaya mengadakan Persidangan Kebangsaan Teknologi Kejuruteraan (NCET) 2011 pada 11 dan 12 April 2011, bertempat di Sunway Carnival Convention Center, Seberang Jaya, Pulau Pinang. Saya mengucapkan setinggi-tinggi penghargaan dan merakamkan terima kasih kepada semua pihak yang terlibat dalam menjayakan persidangan tersebut.

Dengan pembentangan sebanyak 58 kertas kerja pada persidangan tersebut, maka JTM telah berjaya mencungkil bakat pensyarah ILJTM dalam aktiviti penyelidikan, pembangunan dan inovasi, merangkumi bidang Mekanikal dan Pengeluaran, Teknologi Maklumat, Elektrik dan Elektronik, Sivil dan bangunan serta lain-lain bidang termasuk Percetakan dan Bukan Logam.

Bagi menghargai usaha pensyarah terlibat dalam menyumbangkan idea dan bakat tersebut, Jabatan berbesar hati menjilid dan menerbitkan semua kertas kerja yang telah dibentangkan pada persidangan tersebut. Penerbitan yang julung kali diadakan ini diharap dapat menjadi medan penyebaran dan perkongsian ilmu serta kepakaran pensyarah ILJTM dalam bidang teknologi kejuruteraan.

Penerbitan prosiding persidangan ini juga merupakan inisiatif Jabatan bagi menggalakkan lebih ramai pensyarah untuk terlibat dalam bidang penulisan ilmiah sekaligus memartabatkan profession Pegawai Latihan Vokasional.

Akhir kalam, tahniah serta syabas saya ucapkan kepada semua yang telibat dalam menjayakan penerbitan Prosiding Persidangan Kebangsaan Teknologi Kejuruteraan (NCET) bagi tahun 2011.

Sekian

Romli Bin Hj. Hassan
Ketua Pengarah

Jawatankuasa Perlaksanaan Persidangan

Penaung : En. Romli bin Haji Hassan
(Ketua Pengarah Jabatan Tenaga Manusia)

Pengerusi : Tn. Hj. Syed Mohamad Noor bin Syed Mat Ali
(Timbalan Ketua Pengarah Jabatan Tenaga Manusia)

Naib Pengerusi : En. Suimi bin Abd.Majid
(Pengarah, Bahagian Pembangunan Kemahiran JTM)

Jawatankuasa Teknikal

Pengerusi : Tn. Hj. Norman bin Kusin
(Pengarah ADTEC Batu Pahat, Johor)

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En. Sarman bin Rawan
Pn. Rosnah binti Muhamad Tahir
En. Mohd Abd. Fatah bin Mohd Ramly
Pn. Suriani binti Hasan
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Cik Wan Zateel Aqmaer binti Wan Ab. Halim
En. Mohd Sharmizi bin Abu Bakar
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Jawatankuasa Tapak, Pengangkutan dan Makanan

Pengerusi : En. Zaihan bin Shukri
(Pengarah JMTI, Pulau Pinang)

Ahli :
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Ahli	:	Pn. Nurashikin bt Ismail Pn. Rd Khairina bt Khirotdin Pn. Intan Sharfinas bt Mohd Nasir

UCAPTAMA

U1 – Aplikasi Teknologi Kejuruteraan Memacu Inovasi

Ucaptama Yang Disampaikan Oleh :

Yang Berbahagia Jeneral Dato' Professor Dr. Kamarudin bin Hussin
(Naib Canselor Universiti Malaysia Perlis (UniMAP))

1.0 SENARIO TEKNOLOGI KEJURUTERAAN

Kementerian Pengajian Tinggi telah diamanahkan untuk melahirkan ramai modal insan berkualiti kelas pertama melalui Rancangan Malaysia Kesepuluh (RMK10) dan Model Baharu Ekonomi (MBE). Modal insan berilmu serta kemahiran tinggi dapat meningkatkan keupayaan pengetahuan dan inovasi negara untuk mentransformasi negara menjadi negara maju berpendapatan tinggi dan mempunyai peranan penting dalam ekonomi global.

Statistik Unit Perancangan Ekonomi, Jabatan Perdana Menteri pada 2009 telah menunjukkan kira-kira 77% dari tenaga kerja sedia ada di negara ini mempunyai taraf pendidikan tertinggi di peringkat Sijil Pelajaran Malaysia sahaja. Sepertimana sedia maklum Negara kita memerlukan peratusan tenaga kerja berkemahiran tinggi meningkat daripada 23% kepada 37% menjelang 2015. Usaha kerajaan untuk mengarusperdanakan Pendidikan Teknikal dan Latihan Vokasional (TVET) adalah merupakan langkah tepat pada masanya.

Sejak 1969, sejumlah 27 Politeknik telah menghasilkan 338,391 graduan lulusan menerusi program Diploma Lanjutan, Diploma dan Sijil. Bidang pengajian yang ditawarkan adalah dalam bidang kejuruteraan, teknologi, perdagangan dan perkhidmatan. Kini Politeknik menjalankan 4 program peringkat Diploma Lanjutan, 50 program Diploma, 20 sijil dan 5 Sijil Kemahiran Khas (OKU).

Sehingga kini, sejumlah 911 pusat bertauliah menawarkan 5639 program latihan kemahiran yang meliputi Sijil Kemahiran Malaysia (SKM) Tahap 1 hingga 3, Diploma Kemahiran Malaysia (DKM) dan Diploma Lanjutan Kemahiran Malaysia (DLKM). Daripada jumlah tersebut, 337 adalah institusi Latihan Kemahiran Awam yang bernaung di bawah Sembilan kementerian seperti Pusat Latihan Pengajar dan Kemahiran Lanjutan (CIAST), Institut Teknikal Jepun Malaysia (JMTI), Institut Kemahiran Belia Negara (IKBN), Pusat GIATMARA dan lain-lain.

Malaysia memerlukan lebih banyak pekerja tenaga mahir khususnya Teknologis. Sehingga tahun 2010 sebanyak 124 program ijazah sarjana muda berasaskan teknologi dan kejuruteraan yang ditawarkan di 18 Institut Pengajian Tinggi (IPT) yang sebenarnya menjurus kepada kejuruteraan konvensional. Hanya IPTS sahaja menawarkan program berbentuk teknikal seperti Universiti Kuala Lumpur, (UniKL) menghasilkan Teknologis Kejuruteraan yang bertaraf Incorporated Engineers dan Practical Engineers, IPTS lain adalah German-Malaysia Institute (GMI), Japan Malaysia Technical Institute (JMTI) dan Universiti Tenaga Nasional (UNITEN).

Data perangkaan KPTM (2009) menunjukkan bilangan graduan dalm bidang teknologi yang dihasilkan oleh IPTA dari tahun 2008-2009 adalah seramai 6400. Berbanding dengan jumlah jurutera dihasilkan oleh IPTA seramai 20,442 untuk tahun yang sama. Mengikut rekod sehingga April 2011 hanya 9800 jurutera berdaftar dengan Lembaga Jurutera Malaysia (BEM).

Hasil kajian '*Study on Status And Future Direction of Engineering Technology In Malaysia*' (Abang Abdulah et. Al, 2009) menunjukkan daripada 100,000 jurutera yang dihasilkan, 80% menjalani kerja sebagai teknologis kejuruteraan. Ini bermakna 80% bidang pekerjaan dalam kejuruteraan di negara ini memerlukan teknologis kejuruteraan, tetapi peluang pekerjaan untuk graduan berkenaan terhad kerana telah diambil oleh jurutera konvensional berikutan kerjaya ini tiada pengiktirafan oleh mana-mana badan profesional.

Kajian yang dijalankan oleh Kementerian Pengajian Tinggi (2006) dan Universiti Kuala Lumpur (2009) menunjukkan 90% majikan dalam sektor perindustrian memerlukan jurutera yang berasaskan aplikasi berbanding jurutera konvensional.

Lembaga Jurutera Malaysia (BEM) pada tahun 2003 membuat kajian bertajuk '*The Engineering Technology Path: Blueprint For A Highly Competent Engineering Technical Force*" (Abang Abdulah et. al, 2003) dan hasil kajian Universiti Malaysia Pahang (UMP) menunjukkan bidang teknologi kejuruteraan sama penting dengan bidang kejuruteraan.

Berdasarkan kajian terhadap kepentingan teknologi kejuruteraan, Kementerian Pengajian Tinggi telah mengamanahkan Universiti Teknikal (*Malaysian Technical University Network, MTUN*) seperti Universiti Malaysia Perlis, Universiti Malaysia Pahang, Universiti Teknikal Melaka dan Universiti Tun Hussein Onn Malaysia untuk mengekalkan enrolmen program kejuruteraan konvensional sedia ada serta meningkatkan enrolmen program teknologi kejuruteraan kepada 60% menjelang 2015. Ini bermakna, kesemua Universiti Teknikal/MTUN harus meningkatkan enrolmen pelajar teknologi kejuruteraan sejumlah 36,000 pada tahun 2015 dan seterusnya 72,000 pada tahun 2020, iaitu peningkatan 100% bagi tempoh 5 tahun akan datang.

Mesyuarat Jawatankuasa Kabinet Mengenai Pembangunan Modal Insan (JKMPMI) Bil.3/2010 pada 20 Ogos 2010 yang dipengerusikan oleh YAB Timbalan Perdana Menteri telah bersetuju menubuhkan **Malaysian Board of Technology (MBOT).** Jemaah Menteri dalam mesyuarat pada 29 September 2010 juga bersetuju dengan keputusan Mesyuarat JKMPMI tersebut. MBOT ditubuhkan **untuk mengiktiraf kerjaya teknologis serta mengakreditasi program teknologi kejuruteraan dan kemahiran** di dalam Rancangan Malaysia Kesepuluh (RMK 10). Pengiktirafan kerjaya teknologis ini akan menggalakkan Pendidikan dan Latihan Teknikal dan Vokasional (*Technical Educational and Vocational Training, TVET*) yang menawrakan kursus berkaitan teknologi selaras dengan keperluan ekonomi berpendapatan tinggi.

Ketika ini, Kementerian Sains dan Teknologi sedang berusaha untuk menubuhkan MBOT. Dengan penubuhan MBOT dalam masa terdekat membolehkan IPT menawarkan lebih banyak program berbentuk teknologi yang diperlukan oleh negara.

2.0 FUNGSI DAN TUGAS JURUTERA DAN TEKNOLOGIS KEJURUTERAAN

Kejuruteraan adalah disiplin atau profesion yang menguasai dan mengaplikasi ilmu sains dan matematik termasuk penggunaan undang-undang semulajadi dan sumber alam untuk merekabentuk produk, proses atau sistem di mana dapat menambahbaik kualiti kehidupan.

Jurutera ditugaskan untuk menyelesaikan masalah. Jurutera menggunakan asas ilmu sains dan teknologi baru dimana mengevolusi cara kita mengurus informasi. Mereka merekabentuk dan membangun perlatan, permainan, perabot, komputer dan hampir kesemua pembuatan produk yang kita gunakan. Mereka menambahbaik bangunan, jalan dan kenderaan kita. Mereka membangunkan sistem untuk merawat air, memproses makanan, membuat bahan api membakar dengan lebih berkesan dan kitaran bahan buangan. Jurutera dapat mengimbangi keperluan pembangunan, binaan persekitaran dan keperluan pemeliharaan persekitaran semulajadi. Jurutera juga memastikan penyediaan produk, proses dan sistem di dalam keadaan selamat, berkesan , ekonomikal dan lestari. Kursus kejuruteraan memperluaskan kreativiti, kemahiran menyeleaikan masalah dan memahami teknologi.

Teknologi kejuruteraan pula adalah sebahagian daripada bidang teknologikal yang memerlukan aplikasi pengetahuan saintifik dan kejuruteraan, dan gabungan metod dengan kemahiran teknikal untuk menyokong aktiviti kejuruteraan. Teknologis bertugas sebagai pelaksana. Teknologis menzahirkan apa yang diilhamkan oleh jurutera. Teknologis terlatih dalam bidang kejuruteraan yang khusus. Oleh itu, teknologis bukan sahaja didedahkan dengan teori, tetapi mereka mahir di dalam praktikal.

Graduan kejuruteraan teknologi selalunya diambil berkerja sebagai teknologis kejuruteraan di dalam pelbagai sektor merekabentuk produk, ujian dan pembangunan, sistem kejuruteraan, kejuruteran lapangan, operasi teknikal dan kawalan mutu. Teknologis biasanya bekerja bersama jurutera, pereka dan juruteknik. Teknologis juga terlibat dalam kerja-kerja merancang, melaksana serta memantau sesuatu projek sebagai pelengkap kepada satu kumpulan kerja yang terdiri daripada pelbagai disiplin.

Teknologis merekabentuk peralatan, proses atau sistem, menjelaskan dan menyediakan spesifikasi lukisan teknikal atau garis panduan , menyediakan anggaran dan mengurus projek. Menjelaskan ujian, melaksanakan ujian, membangunkan prototaip, mengoperasi kilang, troubleshoot peralatan kompleks, menyelesaikan masalah pengeluaran atau pembinaan, kompilasi data ujikaji atau menyediakan laporan. Menyelia, melatih, mengkoordinasi dan memegang pentadbiran, terlibat dalam perancangan jangka pendek dan panjang.

Teknologi telah berevolusi sangat pantas meniti masa selari dengan keperluan pasaran. Program Pengajian Teknologi dibangunkan ke arah aplikasi dan membekalkan pelajar berkenaan dengan kursus matematik dan sains, dan pengenalan kualitatif kepada asas kejuruteraan dan sains gunaan. Pelajar didedahkan hampir sama dengan kursus yang ditawarkan oleh kurikulum kejuruteraan tetapi sedikit berlainan di dalam pengagihan teori dan kemahiran. Dengan maksud, bidang teknologi merupakan pengajian berorientasikan aplikasi, kurang teori dan menguasai sedikit matematik berbanding dengan program kejuruteraan konvensional.

Teknologi kejuruteraan juga dibekalkan dengan pegurusan teknikal sebagai tambahan kepada pengetahuan asas di dalam bidang teknologi khusus. Pengurusan teknikal dilihat sebagai pengkhususan sangat penting di dalam bidang berkenaan, dan kebanyakan teknologis membangunkan kerjaya mereka ke arah ini. Contoh pengkhususan lain yang dibekalkan kepada teknologis kejuruteraan adalah seperti pembangunan produk, pembuatan, pengurusan penerbangan dan penyelenggaraan kilang pemprosesan, perkhidmatan bangunan dan ujian makmal. Kesemua ini menjadikan teknologis sebagai disiplin kejuruteraan yang sangat istimewa. Ini menyebabkan teknologis sangat diperlukan sebagai pemangkin untuk memacu wawasan negara maju berpendapatan tinggi.

Accord antarabangsa yang memberi pengiktirafan kelayakan dalam bidang kejuruteraan adalah Washington Accord dan Sydney Accord pula untuk bidang teknologi teknologi kejuruteraan. Washington Accord ditandatangani pada tahun 1989 untuk pengiktirafan profesion jurutera profesional dan program kejuruteraan yang biasanya diberi untuk tempoh empat tahun. Sydney Accord pula bermula pada tahun 2001 untuk pengiktirafan profesion jurutera teknologi professional dan program kejuruteraan teknologi yang biasanya diberi untuk tempoh tiga atau empat tahun.

3.0 HALA TUJU MALAYSIAN TECHNICAL UNIVERSITY NETWORK

Kejuruteraan adalah satu bidang yang amat penting dalam pembangunan sesebuah negara. Kepesatan pembangunan di negara-negara maju telah menyebabkan perkembangan semasa yang cukup dramatik, terutama dalam sektor tenaga manusia yang melibatkan kejuruteraan. Kesedaran baru telah mempercambahkan perkembangan ilmu kejuruteraan dan kaedah pembangunannya dalam aspek pembangunan modal insan. Akibatnya, kini telah wujud dua aliran pengajian kejuruteraan di Malaysia, sepertimana di negara-negara maju, iaitu kejuruteraan konvensioal dan kejuruteraan teknologi.

Institut Pengajian Tinggi Awam Teknikal bermula dengan penubuhan kolej Universiti pada awal tahun 2000 yang mengkhususkan di dalam penawaran program pengajian tinggi bidang kejuruteraan dan teknologi yang cenderung kepada praktikal dan amali. Keempat-emapt kolej universiti teknikal tersebut ialah KuiTTHO, KUTKM, KUKTEM dan KUKUM. Bagi menjaga kepentingan bersama *Technical University Colleges Network (TUCN) at* Malaysia, telahpun ditubuhkan secara rasmi pada Mac 2006. Pada Februari 2007, keempat-empat kolej universiti ini telah melalui penjenamaan semula sebagai universiti penuh. Universiti tersebut UTHM, UTeM, UMP dan UniMAP. Susulan dari penjenamaan semula ini TUCN telah ditukar kepada MTUN atau *Malaysian Tehnical University Network* (MTUN).

Misi penubuhan universiti teknikal MTUN ini adalah bagi mendidik serta melatih tenaga manusia yang berkemahiran tinggi bagi menyumbang kepada perindustrian termaju negara (*world class industrial nation*). Perhubungan universiti MTUN juga melengkapi sistem konvensional yang sedia ada. Universiti MTUN yang dipacu oleh industri (*industry driven*) ini seharusnya berbeza dan unik berbanding IPTA yang sedia ada.

Sistem pendidikan di universiti teknikal MTUN ini berteraskan '*Practical Oriented*' yang mengfokuskan kepada '*problem centered teaching, action and experiential learning*'. Penubuhan Pusat Industri Universiti (PIU) sebagai *teaching factory* yang mempunyai konsep yang sama dengan '*teaching hospital*' membantu pelajar memperolehi latihan dan pengalaman industri yang secukupnya.

Graduan universiti MTUN bukan sahaja berketrampilan tinggi, tetapi juga berkemahiran dari segi teori yang menjurus ke arah gunaan (*applied*) dengan penekanan khusus kepada komponen praktikal yang lebih berbanding universiti konvensional. Faktor ini memberikan kelebihan kepada graduan universiti MTUN kerana tidak perlu menjalani latihan dalaman seperti dilalui oleh graduan universiti konvensional lain. Graduan universiti MTUN juga tidak memerlukan '*retooling*' semasa memulakan kerja dan ini menjimatkan kos latihan oleh majikan.

Sejumlah 71% dari keseluruhan program yang ditawarkan di universiti MTUN di dalam kategori kejuruteraan dan 29% terdiri program-program lain seperti Teknologi Maklumat, Pengurusan dan Keusahawanan, Pendidikan Teknikal dan Vokasional serta lain-lain. Mengikut enrolmen pula, 78% pelajar mengikuti program kejuruteraan.

Hasrat universiti MTUN untuk melahirkan jurutera berasaskan '*practical oriented flavour*' tidak dapat diteruskan sepenuhnya. Ini kerana kurikulum yang dibangunkan tidak dapat diterima oleh *Engineering Accreditation Council* (EAC), *Board of Engineers Malaysia* (BEM). Justeru itu, kesemua program kejuruteraan berasaskan '*practical oriented favour*' terpaksa diubahsuai mengikut keperluan akreditasi program kejuruteraan konvensional, Lembaga Jurutera Malaysia.

Sehubungan dengan itu, kesemua program kejuruteraan yang ditawarkan oleh universiti MTUN terkini adalah berteraskan akademik dengan amalan skala pengajian sekitar 20:80 bagi amali dan teori. Secara keseluruhan terdapat 89 program akademik peringkat Sarjana Muda Kejuruteraan yang menampung sejumlah 24,558 pelajar di keempat-empat universiti MTUN.

Sebagai sebuah universiti yang bernaung di bawah *Malaysian Technical University Network* (MTUN), Universiti Malaysia Perlis (UniMAP) sentiasa memastikan misi dan visi yang dilaksanakan di dalam struktur pentadbiran dan pengajian adalah selaras dengan hala tuju penubuhan MTUN; iaitu mendidik serta melatih tenaga manusia yang berkemahiran tinggi bagi menyumbang kepada keperluan perindustrian negara.

Menerusi Laporan Kemajuan Semasa dan Hala Tuju MTUN yang dikemukakan kepada Y.A.B Menteri Pengajian TInggi Malaysia, keempat-empat universiti telah menghantar laporan kemajuan masing-masing disamping memperincikan unjuran pelajar, keperluan kewangan dan sumber manusia bagi lima tahun akan datang (2011-2015). Antara perkara yang diketengahkan termasuklah keperluan yang mendadak terhadap usaha ke arah mempertingkatkan graduan teknologi kejuruteraan.

Di dalam laporan tersebut yang dihantar pada 22 Mac 2011 telah menyarankan bahawa teknologi kejuruteraan adalah sangat relevan dan penting didalam membina generasi berilmu, berkemahiran tinggi dan menyumbang kepada agenda pendapatan tinggi negara. Hasil kajian telah menunjukkan bahawa industri amat memerlukan lulusan kejuruteraan teknologi yang lebih ramai berbanding lulusan kejuruteraan konvensional. Malah, adalah menjadi hasrat Kementerian Pengajian Tinggi Malaysia untuk menjayakan nisbah teknologi kejuruteraan dengan kejuruteraan konvensional daripada nisbah 30:70 kepada 60:40 menjelang tahun 2015.

Memandangkan keperluan yang meningkat bagi modal insan teknologi kejuruteraan, UniMAP telah mensasarkan hanya program kejuruteraan teknologi akan di perkenalkan sebagai program akademik baru,

manakala program kejuruteraan konvensional sedia ada dikekalkan. Unjuran enrolmen bagi pelajar teknologi kejuruteraan akan disasarkan sejumlah 9,000 pada tahun 2015 dan 18,000 pada tahun 2020. Untuk mencapai enrolmen berkenaan sebanyak 16 program baru Ijazah Sarjana Muda Teknologi Kejuruteraan akan ditawarkan bermula pada tahun 2012.

4.0 KERJASAMA ANTARA UniMAP DAN UNIVERSITI LUAR NEGARA DALAM KONTEKS TEKNOLOGI KEJURUTERAAN

Selari dengan dasar Kementerian Pengajian Tinggi (KPT), bagi melahirkan ramai teknologis, UniMAP merancang untuk mengadakan program teknologi kejuruteraan dalam masa terdekat. Oleh itu, UniMAP juga sedang menyediakan struktur kurikulum program teknologi kejuruteraan yang mantap bertaraf antarabangsa. Bagi merealisasikan harapan ini, UniMAP telah mengadakan lawatan kerjasama dengan (3) buah universiti antarabangsa. Universiti antarabangsa itu adalah *University Institute of Technology* (UIT), *Belfort,* Perancis, *Dublin Institute of Technology (DIT),* Ireland dan *State University New York di Utica (SUNY), New York,* Amerika Syarikat.

Hubungan baik kerjasama UniMAP dengan ketiga-tiga universiti antarabangsa ini akan membolehkan UniMAP menghasilkan beberapa kebaikan. **Pertama** iaitu UniMAP mampu menghasilkan program teknologi yang terkini dengan kurikulum teknologi yang mantap yang bersesuaian dengan kehendak pasaran dan keperluan negara. **Kedua,** membolehkan UniMAP mendapatkan pensyarah dan professor antarabangsa sebgai Pemeriksa Luar (*External Examiner).* Bantuan dan bimbingan universiti antarabangsa yang telah lama berpengalaman dalam menjalakan program teknologi ini akan mampu melatih dan meningkatkan tahap pencapaian Pengajaran dan Pembelajaran (*Teaching and Learning*) pensyarah tempatan. **Ketiga**, jalinan kerjasama antarabangsa membolehkan penambahbaikan dilakukan dalam aspek *benchmarking* program teknologi supaya program yang ditawarkan oleh UniMAP mempunyai kualiti yang tinggi. Dan **keempat,** berhasrat meningkatkan tahap pencapaian UniMAP dalam bidang Penyelidikan dan Pembangunan (*Research & Development*) dalam peringkat antarabangsa. UniMAP berhasrat meningkatkan kerjasama dalam bidang Nanoteknologi.

Jalinan yang akrab serta kerjasama yang bermakna antara universiti tempatan dan universiti antarabangsa akan melahirkan pensyarah yang berkualiti di peringkat antarabangsa yang mampu menghasilkan ciptaan produk kejuruteraan di peringkat global, serta mampu menghasilkan graduan yang kompeten dan berkemahiran tinggi.

5.0 TEKNOLOGI KEJURUTERAAN MEMACU INOVASI

Inovasi adalah sangat kritikal bukan sahaja bagi negara-negara maju untuk mengekalkan pertumbuhan, malah negara-negara sedang membangun juga berlari seiring dengan negara-negara maju (OECD & World Bank, "*Innovation & Growth: Chasing a Moving Frontier*").

Kerajaan melalui Program Transformasi Ekonomi (ETP) telah mensasarkan untuk menjadi negara berstatus pendapatan tinggi dengan perolehan GNI RM 48,000 per kapita menjelang 2020. Inovasi telah digariskan sebagai penggerak utama ekonomi negara untuk mencapai hasrat ini. Hasrat ini telah terbukti dengan usaha kerajaan yang telah menubuhkan Unit Inovasi Khas (UNIK) pada 2010. Unit ini bertanggungjawab merealisasikan perkembangan inovasi di negara kita. Negara tidak boleh berada di tahap lama dimana dengan berinovasi membolehkan kita bergerak seiring bengan negara maju di abad ini.

Struktur program teknologi kejuruteraan meliputi kursus-kursus yang membabitkan elemen teori kejuruteraan dan teknologi. Di universiti, pelajar dididik untuk menyelesaikan masalah yang praktikal dan releven dengan perkembangan teknologi terkini. Tambahan, projek-projek yang tetlibat dalam program teknologi kejuruteraan,

terutamanya projek tahun akhir, melibatkan projek yang kreatif dan inovatif di dalam bidang kejuruteraan dan teknologi. Ini membantu dalam menghasilkan graduan yang kompeten dan peka dengan penggunaan dan perkembangan teknologi terkini.

Graduan yang kompetitif dalam bidang teknologi, satu bidang yang menyaksikan arus perubahan drastik semenjak 1980an, akan membantu sektor industri negara. Graduan-graduan Teknologi Kejuruteraan yang diterap dengan minda kreativiti din inovasi dapat membantu negara dalam menghasilkan produk atau solusi yang berdaya saing di peringkat global. Teknologi Kejuruteraan dilihat sebagai satu pelengkap bersama bidang-bidang kejuruteraan lain dalam mencapai hasrat kerajaan untuk menuju ke arah negara berpendapatan tinggi menjelang 2020. Usaha-usaha yahg sedang dilakukan untul pengiktirafan status profesional bagi graduan bidang teknologi dilihat sebagai langkah yang tepat pada waktunya dalam menggerakkan negara ini melalui aktiviti ekonomi yang berinovatif.

Bagi memastikan graduan teknologi UniMAP sentiasa bersedia untuk menghadapi alam pekerjaan, pihak UniMAP telah mewujudkan Kilang Mengajar. Penubuhan Kilang Mengajar ini adalah untuk mensimulasikan keadaan sebenar sesebuah kilang beroperasi. Ini akan dapat meningkatkan pengetahuan dan kemahiran di kalangan pelajar-pelajar UniMAP. Disamping itu, pelajar juga didedahkan dengan kaedah pengurusan di sesebuah kilang memandangkan Kilang Mengajar telah menerima pengiktirafan MS1732 dan OSHA 18001 yang mana pengamalan sistem kesihatan dan keselamatan pekerjaan amat ditekankan. Kilang mengajar ini mempunyai 5 buah mesin mekanikal berteknologi tinggi yang beroperasi menggunakan komputer seperti CNC Milling, CNC Turning, Super Drill, CNC EDM Wirecut dan satu set lengkap mesin Surface Mount Technology bagi menyokong pemasangan komponen elektronik. Kesemua mesin ini merupakan mesin utama yang digunakan di dalam industri pembuatan di dalam negara kita. Kos pembangunan Kilang Mengajar ini yang mencecah hampir RM 3 juta di dapati amat bermanfaat kepada pelajar dan juga universiti. Sehingga hari ini, lebih daripada 30 projek setiap tahun dijalankan di Kilang Mengajar ini dan terdapat beberapa projek lain yang diklasifikasikan sebagai sulit telah dijalankan bersama industri seperti Modenas.

Kepentingan peranan industri dan aktiviti-aktiviti hubungan industri yang melibatkan pihak industri dan institusi pengajian tinggi secara langsung atau tidak amat perlu bagi memastikan keberkesanan sumbangan teknologi kejuruteraan terhadap pembangunan daya inovasi negara. Penglibatan industri dalam aktiviti bersifat akademik dan bukan akademik adalah perlu bagi memastikan kejuruteraan teknologi ini selari dengan kehendak dan keperluan semasa.

Dengan mengambil UniMAP sebagai contoh, UniMAP mempunyai hubungan yang erat dengan rakan industri terutamanya industri berkaitan elektronik. Contohnya seperti Intel, Silterra, Infineon dan sebagainya. Hubungan industri berkaitan akademik bermula dari penglibatan pihak industri di peringkat awal pembentukan kurikulum untuk setiap program yang ditawarkan. Selepas itu, pihak industri juga terlibat dalam proses penambahbaikan program secara berterusan. Antara aktiviti berkaitan akademik yang dilaksanakan di UniMAP adalah seperti Panel Penasihat Industri, pensyarah pelawat (dari industri), sumbangan industri dalam kecemerlangan akademik pelajar dan lain-lain lagi. Selain itu, pihak industri turut dijemput dan di"interview" semasa proses audit berkaitan akademik seperti audit APA, EAC dan sebagainya.

Aktiviti-aktiviti berkaitan akademik yahg melibatkan pelajar dan industri secara langsung juga dilaksanakan di UniMAP. Program "*industrial exposure* (IndEx)" yang mempunyai empat peringkat dengan melibatkan pendedahan yang berbeza. la bermula dengan pendedahan secara umum pada tahun pertama pelajar, tahun kedua pula melibatkan komunikasi secara terus pelajar dan industri, pada tahun ketiga lebih menumpukan kepada pendedahan pelajar kepada alam perkerjaan sebenar di industri melalui Latihan Industri. Pada tahun keempat pula, pendedahan adalah lebih kepada penyediaan pelajar ke alam pekerjaan.

UniMAP juga melaksanakan aktiviti bukan akademik dengan pihak industri. Antaranya, program dialog bersama industri, program-program pembangunan kerjaya pelajar, *"career exposure",* Program Job Camp dan

juga Degree ++ program. Selain itu, aktiviti perundingan juga dilaksanakan oleh staf akademik UniMAP kepada pihak industri. Antaranya adalah seperti aktiviti-aktiviti seperti khidmat nasihat, perkhidmatan pengujlan, khidmat latihan dan sebagainya.

6.0 KESIMPULAN

Melalui program-program teknologi, kejuruteraan yang ditawarkan, Malaysia akan dapat merealisasikan aspirasi untuk menjadi sebuah negara berpendapatan tinggi.

Melalui teknologi kejuruteraan, inovasi tidak akan tinggal sebagai retorik sahaja, tetapi akan menjadi realiti. Teknologi kejuruteraan akan menjadi pemangkin serta pemacu untuk pelaksanaan inovasi itu sendiri.

Sebagai contoh, idea-idea baru dan bernas akan dapat dihasilkan melalui projek-projek yang dijalankan di universiti-universiti yang menawarkan teknologi kejuruteraan. Ini dapat dicapai kerana para pelajar yang akan mengikuti program-program berkenaan adalah mereka yang telah terlatih secara praktikal untuk menghasilkan produk. Mereka mahir dalam mengaplikasi pengetahuan dan kemahiran di dalam kejuruteraan untuk menzahirkan produk.

Melaluai program-program pengajian di dalam bidang teknologi kejuruteraan, pelbagai idea teknologi baru serta idea-idea yang berasaskan inovasi akan dapat dilaksanakan. Melalui program-program pengajian yang ditawarkan, pendekatan penyelesaian masalah melalui inovasi akan menjadi sebagai satu budaya.

Banyak projek-projek yang berunsur inovasi boleh dilaksanakan oleh para pelajar di dalam program pengajian teknologi kejuruteraan. lni akan dilaksana dari mula pengajian, sehingga mereka menjalankan projek tahun akhir mereka.

Seperkara yang menguntungkan para graduan itu sendiri serta pihak industri ialah Latihan Industri yang akan dilaksanakan sebahagian dari keperluan . Latihan Industri akan dilaksana setelah pelajar menjalankan pengajian mereka selama 7 semester di universiti. Di semester akhir, mereka akan membuat latihan di industri.

Penawaran program teknologi kejuruteraan memberi banyak kelebihan. Program ini mendedahkan pelajar dengan latihan secukupnya sebelum mereka mula menjalani latihan di industri. Pihak industri akan mendapat manfaat daripada prosedur ini kerana para pelajar yang datang kepada mereka setelah dibekalkan dengan secukup ilmu yang diperlukan, baik dari segi teori mahupun praktikal. Pihak industri seperti melakukan *test drive* atau *trial run* terhadap pelajar-pelajar ini. Sekiranya mereka merasakan bahawa para pelajar ini menepati kriteria yang diperlukan, industri boleh terus menawarkan peluang pekerjaan kepada pelajar tanpa perlu menunggu pelajar tamat pengajian. Apabila tamat pengajian, pelajar akan terus bekerja di industri tersebut.

Bagi para pelajar pula, mereka akan dapat "*transition time*" dari universiti kepada industri. Mereka juga akan lebih bersedia kerana telah menjalankan semua pengajian mereka sebelum memulakan latihan industri. Mereka juga boleh menggunakan platform latihan industri ini untuk menunjukkan segala pengetahuan serta kemahiran yang telah dipelajari dan didapati di universiti. Mereka dapat menunjukkan bakat serta kemahiran mereka kepada pihak industri secara lebih dekat. Ini dapat menaikkan peluang mereka untuk mendapatkan pekerjaan setelah tamat pengajian.

Para graduan yang dihasilkan akan boleh terus menjalankan tugas di industri tanpa perlu '*retooling'*. Mereka tidak akan kaku berada di *factory floor*. Mereka tidak kaku berdepan serta mengendalikan mesin-mesin canggih. Mereka juga tidak akan kaku berinteraksi bersama mereka yang lain dalam pasukan kerja.

Keuntungan kepada negara dengan penghasilan graduan dari bidang Teknologi Kejuruteraan adalah amat banyak. Malaysia akan dapat menawarkan suatu keadaan yang kondusif bagi pelaksanaan industri berteknologi tinggi.

Ini kerana para graduan teknologi kejuruteraan akan memenuhi permintaan tenaga mahir yang diperlukan oleh industri. Malah, bukan sahaja industri sedia ada, tetapi industri teknologi tinggi juga akan mendapat manfaat daripada penghasilan graduan-graduan ini.

Pelabur asing juga tidak akan mempunyai masalah keperluan tenaga kerja yang professional dan mahir. Malaysia juga tidak akan lagi bergantung kepada kepakaran luar. Senario tenaga kerja profesional akan dipenuhi seperti yang terdapat di negara-negara maju.

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U2 – Pembudayaan Inovasi Sebagai Peneraju Pembangunan Negara

Ucaptama Yang Disampaikan Oleh :

Yang Berbahagia Dato' Muhammad bin Ismail
(Naib Pengerusi Persekutuan Pekilang - Pekilang Malaysia (FMM)
Cawangan Pulau Pinang)

Kreativiti, inovasi, pengetahuan dan kecapaian terhadap maklumat telah dikenalpasti sebagai peneraju yang penting di dalam pembangunan sesebuah negara. Komitmen yang ditunjukkan oleh semua pihak menerusi aplikasi-aplikasi teknologi kejuruteraan akan dapat menyumbang ke arah pembentukan modal insan yang inovatif serta mencipta sinergi untuk meningkatkan produktiviti, kualiti dan inovasi negara.

Persidangan ini bertemakan "*Engineering Technology Application Towards Innovation*". Kerajaan telah meletakkan inovasi sebagai agenda utama negara. Kerajaan akan mentransformasikan Malaysia melalui proses inovasi yang menyeluruh, merangkumi inovasi tadbir urus dalam sektor awam dan swasta, inovasi dalam kemasyarakatan (*societal innovation*), inovasi bandar, inovasi desa, inovasi korporat, inovasi industri, inovasi pendidikan, inovasi penjagaan kesihatan, inovasi pengangkutan, inovasi jaringan keselamatan sosial dan inovasi penjenamaan. Sebahagian daripada proses inovasi ini sedang dilaksanakan melalui pelbagai cara dan pendekatan seperti Gagasan 1Malaysia, Bidang Keberhasilan Utama Negara (NKRA), Penunjuk Prestasi Utama (KPI), model ekonomi baru dan pewujudan PEMUDAH, PEMANDU dan NEAC. Kerajaan amat komited dan serius untuk memastikan inovasi dapat dilaksanakan secara menyeluruh di peringkat sektor swasta mahupun sektor awam untuk membawa negara ke tahap ekonomi yang lebih maju.

Laporan Produktiviti terbaru yang dikeluarkan oleh MPC menunjukkan bahawa pada suku tahunan ke empat 2009 (*4th quarter* 2009), produktiviti Malaysia berkembang sebanyak 2.2%, kesan dari peningkatan produktiviti sektor perkilangan dan perkhidmatan yang masing-masing mencatatkan pertumbuhan 3.2% dan 2.5%. Untuk terus kekal berdayasaing dan meninggikan tahap produktiviti negara, syarikat dan perniagaan di seru untuk terus proaktif dalam melaksanakan amalan pengurusan yang baru selaras dengan kehendak pasaran yang sentiasa berubah-ubah. Saya percaya produktiviti Malaysia pasti akan dapat dipertingkatkan sekiranya elemen-elemen kreativiti dan inovasi terus diberi perhatian.

Komitmen serta penyertaan penuh rakyat juga sangat perlu dalam usaha untuk merealisasikan Malaysia sebagai sebuah negara yang berpaksikan inovasi (*innovation-led economy*). Oleh itu, daya kreativiti dalam masyarakat perlu dipupuk kerana kreativiti adalah asas kepada inovasi. Di dalam Laporan "*The Global Competitiveness Report 2009-2010*" yang dikeluarkan oleh *World Economic Forum* telah meletakkan Malaysia di tangga ke 24 daripada 133 negara. Di dalam "*pillar*" Business Sophistication dan Innovation, Malaysia berada pada kedudukan ke 24 dari 133 negara, ini merupakan kedudukan yang tinggi yang telah menyumbang kepada pertumbuhan ekonomi negara selama ini. Kedudukan Malaysia telah mengatasi New Zealand iaitu (tempat ke 27), China di (tempat ke 29) dan Italy (tempat ke 34).

Inovasi adalah kunci kejayaan kepada banyak organisasi. Organisasi yang berjaya bersaing dan menang adalah organisasi yang menggunakan inovasi dan kreativiti untuk untuk mencari kaedah menghasilkan produk dan perkhidmatan yang baru dan lebih baik. Ini bermakna setiap organisasi samada yang berasaskan keuntungan atau tidak, tidak akan membenarkan pekerja mereka berpuas hati dengan apa yang ada, terutama sekali apabila pesaing mereka akan menghasilkan idea yang lebih kreatif. Sesebuah organisasi tidak lagi boleh beroperasi dengan hanya menunggu permintaan dari pelanggan, sebaliknya mereka perlu menghasilkan sesuatu yang unik dan pantas sejajar dengan kehendak dan keperluan pelanggan. Inovasi juga adalah kunci sesebuah organisasi untuk terus bertahan dalam jangka masa panjang di dalam keadaan persaingan yang sengit. Oleh itu, organisasi di seru untuk menggalakkan kakitangan mereka menjadi lebih kreatif dan inovatif dengan menerapkan budaya ini di dalam pejabat.

Kita juga boleh melihat dari kalangan individu yang berinovatif dan kreatif di negara kita ini yang bukan sahaja dikenali di sini bahkan juga di pentas antarabangsa. Mereka ini boleh kita anggap sebagai tokoh atau ikon untuk memotivasikan diri untuk terus melakukan inovasi dalam melaksanakan tugasan di organisasi kita.

Pelaksanaan aktiviti inovasi di industri dan pusat latihan termasuk:

1. pembudayaan inovasi di industri
2. projek-projek inovasi di institusi latihan serta hubungannya dengan industri
3. dan lain-lain yang berkaitan

- Budaya Inovasi (Innovation Culture)

    1. Budaya dan Inovasi
    2. Perkongsian pengalaman budaya inovasi di industri
    3. Bagaimana membina dan mencipta (build and create) budaya inovasi

- Kerjasama industri dan institusi latihan dalam memastikan aplikasi teknologi kejuruteraan ke arah projek-projek inovasi terus berkembang

Inovasi adalah kunci kejayaan kepada banyak organisasi. Organisasi yang berjaya bersaing dan menang adalah organisasi yang menggunakan inovasi dan kreativiti untuk untuk mencari kaedah menghasilkan produk dan perkhidmatan yang baru dan lebih baik. Ini bermakna setiap organisasi samada yang berasaskan keuntungan atau tidak, tidak akan membenarkan pekerja mereka berpuas hati dengan apa yang ada, terutama sekali apabila pesaing mereka akan menghasilkan idea yang lebih kreatif. Sesebuah organisasi tidak lagi boleh beroperasi dengan hanya menunggu permintaan dari pelanggan, sebaliknya mereka perlu menghasilkan sesuatu yang unik dan pantas sejajar dengan kehendak dan keperluan pelanggan. Inovasi juga adalah kunci sesebuah organisasi untuk terus bertahan dalam jangka masa panjang di dalam keadaan persaingan yang sengit. Oleh itu, organisasi di seru untuk menggalakkan kakitangan mereka menjadi lebih kreatif dan inovatif dengan menerapkan budaya ini di dalam pejabat.

KATEGORI TEKNOLOGI KEJURUTERAAN MEKANIKAL

M1 - Mesin Pengasing Dan Penjumlah Duit Syiling (MP2S)

Ahmad Fauzi Shah Bin Mohd Arifin; *Suffian Bin Ayob*
Pusat Latihan Teknologi Tinggi (ADTEC) Kulim
fauzi@adteckulim.gov.my; suffian@adteckulim.gov.my

Abstrak

Projek yang bertajuk Mesin Pengasing Dan Penjumlahan Duit Syiling sebenarnya meliputi kajian tentang latar belakang dan fungsi – fungsi pengawal mikro (PIC) dan akan digunakan didalam mengawal pengasingkan duit syiling dan mengira jumlah syiling yang telah diasingkan. Projek ini dapat menyelesaikan masalah penjumlahan duit syiling dengan jumlah yang banyak serta menjimatkan masa dan memudahkan proses untuk mengira serta menjumlahkan duit syiling. Kaedah yang digunakan untuk pengasingan duit syiling adalah mengikut saiz yang berbeza – beza pada setiap duit syiling iaitu 5 sen, 10 sen , 20 sen dan 50 sen. PIC 16F877A digunakan sebagai unit kawalan ia bertindak untuk mengasingkan serta mengira duit syiling, PIC 16F877A memerlukan input daripada sensor dan mengeluarkan output iaitu mengerakkan Motor dan LCD display memaparkan jumlah syiling yang telah berjaya dikira.

Keyword: *Duit Syiling, Pengasingan , Saiz, Jumlah , PIC 16F877A*

1. Pengenalan

Duit Syiling secara umumnya adalah sejenis material yang keras, biasanya besi berbentuk bulat dan digunakan sebagai matawang digunakan bersama-sama wang kertas. Syiling digunakan untuk nilai wang yang rendah dan wang kertas digunakan untuk nilai wang yang tinggi. Duit Syiling telah digunakan sebagai matawang sejak dahulu lagi, tamadun dunia terdahulu mempunyai duit syiling bentuk yang berbeza-beza. Zaman kesultanan Melaka juga mempunyai duit syiling yang tersendiri digunakan sebagai matawang. Di zaman moden kebanyakan duit syiling diperbuat daripada besi dan nilai syiling akan dicetak diatas permukaannya. Duit syiling yang dikeluarkan dan nilai duit syiling akan ditetapkan oleh kerajaan, duit syiling perlulah mempunyai saiz dan berat yang sama mengikut nilai sesuatu duit syiling . Bank Negara Malaysia mengeluarkan duit syiling bernilai 5 sen , 10 sen , 20 sen dan 50 sen dan duit syiling inilah yang digunakan di Malaysia.

Mesin ini direkabentuk hanya untuk kegunaan di Malaysia dan fokus adalah untuk mengasing dan menjumlahkan duit syiling bernilai 5 sen, 10 sen, 20 sen dan 50 sen berdasarkan objektif berikut:

- Menjimatkan masa dan tenaga kerja ketika proses pengasingan. Dimana duit syiling dapat diasingkan dan dijumlahkan lebih cepat dengan menggunakan mesin tanpa menggunakan tenaga manusia.

Pendekatan atau skop yang digunakan dalam rekabentuk mesin ini ialah:-

- Menbangunkan struktur mekanikal yang sesuai dengan konsep pengasingan duit syiling.
- Membangunkan litar kawalan yang mampu operasi keseluruhan mesin pengasingan duit syiling.
- Menghasilkan pengaturcaraan yang fleksibel dan efektif dalam memastikan keluaran tercapai.

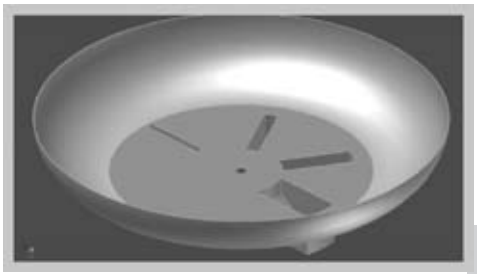
2. Metodologi Projek

2.1 Rekabentuk Mekanikal

Rekabentuk Mekanikal untuk Mesin pengasing duit syiling (MP2S) ini adalah difokuskan pada bahagian pengasingan yang menggunakan mangkuk bentuk silinder dan berputar secara menegak di tengah

– tengah mesin MP2S tersebut . Bahagian pengasingan tersebut di sambung dengan aci dan melekat pada motor, bahagian yang lain untuk MP2S ini akan disambung dengan permukaan plat dasar (Base). Diatas Mesin MP2S ini terdapat corong (Coin Hopper) untuk memasukkan syiling kedalam mesin ini, pintu di corong (coin hopper) dikawal oleh motor untuk buka dan tutup, konsep graviti diaplikasikan dalam proses memasukkan duit syiling ke dalam mesin MP2S ini. Duit syiling yang telah masuk kedalam mesin MP2S ini akan jatuh kedalam mangkuk yang berlubang- lubang yang berputar untuk proses pengasingan duit syiling. Pengasingan ini akan dibuat menggunakan perbezaan saiz duit syiling diantara 5 sen, 10 sen, 20 sen dan

Rajah 1: Lapisan atas proses pengasingan duit syiling



Rajah 2: Lapisan Bawah proses pengasingan duit syiling

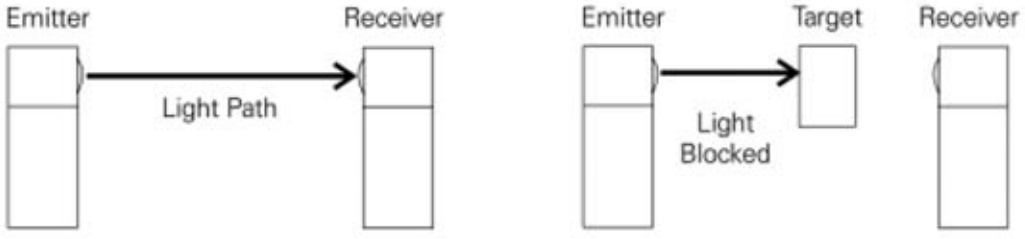
50 sen. Duit syiling akan masuk kedalam lubang-lubang mengikut saiz yang sesuai.

Duit – duit syiling akan berputar dan akan jatuh kedalam lorong/ruang yang telah disusun iaitu lubang 5 sen , lubang 10 sen, lubang 20 sen dan lubang 50 sen. Duit syiling yang tepat akan dibenarkan untuk melewati lubang ini dan akan mendarat di corong diposisikan pada sudut yang akan menangkap syiling dan melalui lubang terus ke bekas syiling yang telah ditetapkan. Proses ini akan berulang sehingga duit syiling yang dimasukkan tadi telah habis diasingkan. Setiap duit syiling yang melalui ruang akan mengaktifkan LED Thru Beam sensor maka duit itu akan menjadi input kepada pengawal dan akan digunakan oleh atucara untuk mengira dan menjumlah duit syiling tersebut.

2.2 Sensor dan Litar Kawalan

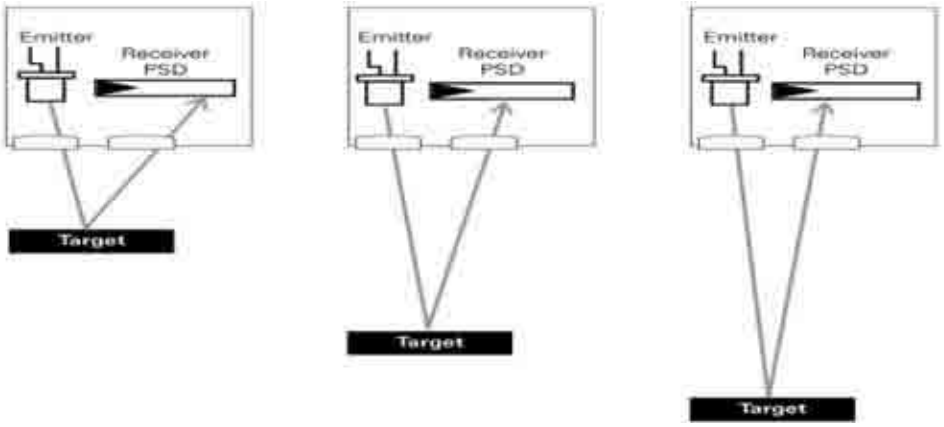
2.2.1 LED Thru Beam Sensor

Sensor Thru-beam memerlukan unit pemancar (emitter) dan penerima (receiver) yang berasingan. Unit sensor ini akan diletakkan sepasang dengan jarak yang manusabah supaya jumlah denyutan cahaya daripada pemancar (Transmitter) sampai ke penerima (receiver). Objek (target) akan menghalang cahaya daripada pemancar(transmitter) diterima oleh penerima (receiver) keluaran daripada penerima akan berubah . Manakala bila objek (target) tidak lagi menghalang cahaya keluaran daripada penerima akan kembali kepada normal. Sensor Thru-beam sesuai digunakan untuk mengesan objek yang memantulkan cahaya tetapi ia tidak sesuai digunakan untuk mengesan objek yang lutsinar. Jarak pengesanan maksima adalah 300 kaki.



Rajah 3: Rajah Pemancar (Emitter) & Penerima (Receiver)

Sensor yang digunakan untuk mengawal pergerakkan silinder pada projek ini ialah jenis LED thru beam sensors (QVA11234) yang mana dapat mengesan pergerakkan duit syiling dan seterusnya menghantar isyarat dan mengoperasikan system. Ia dikeluarkan mengikut saiz dan keupayaan untuk mengesan. Saiz magnetic proximity switches yang digunakan ialah 80 x 30mm x 20mm. Setiap sensor dibekalkan 5 volt tenaga elektrik dengan rintangan sebanyak 300 ohm. L.E.D. Indicator pada komponen ini digunakan untuk memberi isyarat bahawa ia telah mengesan pergerakan sebarang komponen khususnya pergerakan besi.Gambarajah dibawah merupakan gambar LED thru beam sensors (QVA11234) yang digunakan.



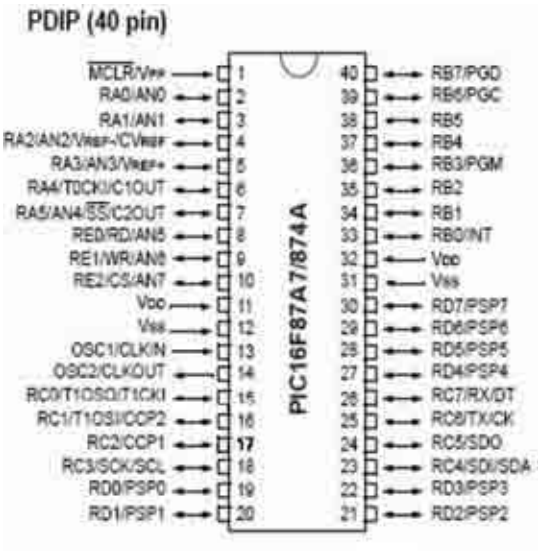
Rajah 4: Skematik LED thru beam sensors

Setiap komponen mempunyai binaannya dan keistimewaannya yang tersendiri. LED thru beam sensors (QVA11234) juga tidak terketinggalan dengan binaan yang sistematik dan mampu menyaingi perkembangan teknologi pada masa kini. Komponen ini dibina dengan menggunakan prinsip elektro-magnet yang berfungsi untuk mengesan logam khususnya pergerakan duit syiling atau besi.

2.2.2 PIC Controller

Sistem kawalan yang digunakan dalam penghasilan projek ini adalah menggunakan PIC controller. PIC ini digunakan untuk alat pengawal kepada mesin ini dan ia berfungsi setelah program dimasukan kedalamnya. Mesin ini mengunakan PIC jenis 16F877A. Berikut merupakan contoh gambar dan spesifikasi PIC 16F877A yang digunakan

Key Features	PIC16F877A
Operating Frequency	DC – 20 MHz
Resets (and Delays)	POR, BOR (PWRT, OST)
Flash Program Memory (14-bit words)	8K
Data Memory (bytes)	368
EEPROM Data Memory (bytes)	256
Interrupts	15
I/O Ports	Ports A, B, C, D, E
Timers	3
Capture/Compare/PWM modules	2
Serial Communications	MSSP, USART
Parallel Communications	PSP
10-bit Analog-to-Digital Module	8 input channels
Analog Comparators	2
Instruction Set	35 Instructions
Packages	40-pin PDIP 44-pin PLCC 44-pin TQFP 44-pin QFN



Rajah 5: Kegunaan Setiap Pin PIC 16F877A

Merujuk kepada spesifikasi diatas, kajian telah dibuat bahawa PIC ini menggunakan bekalan kuasa sebanyak 5V ac dan berfrekuensi DC-20 MHz. Ia mempunyai 368 bit data memori dan 256 data memori simpanan. PIC ini mempunyai 40 pin, 5 port dan 33 diital I/O pin. Setiap port pada PIC ini mempunyai 2 control register iaitu TRISx dan PORTx. Kelebihan penggunaan PIC adalah ia boleh diprogam berulang kali mengikut kehendak pengguna.

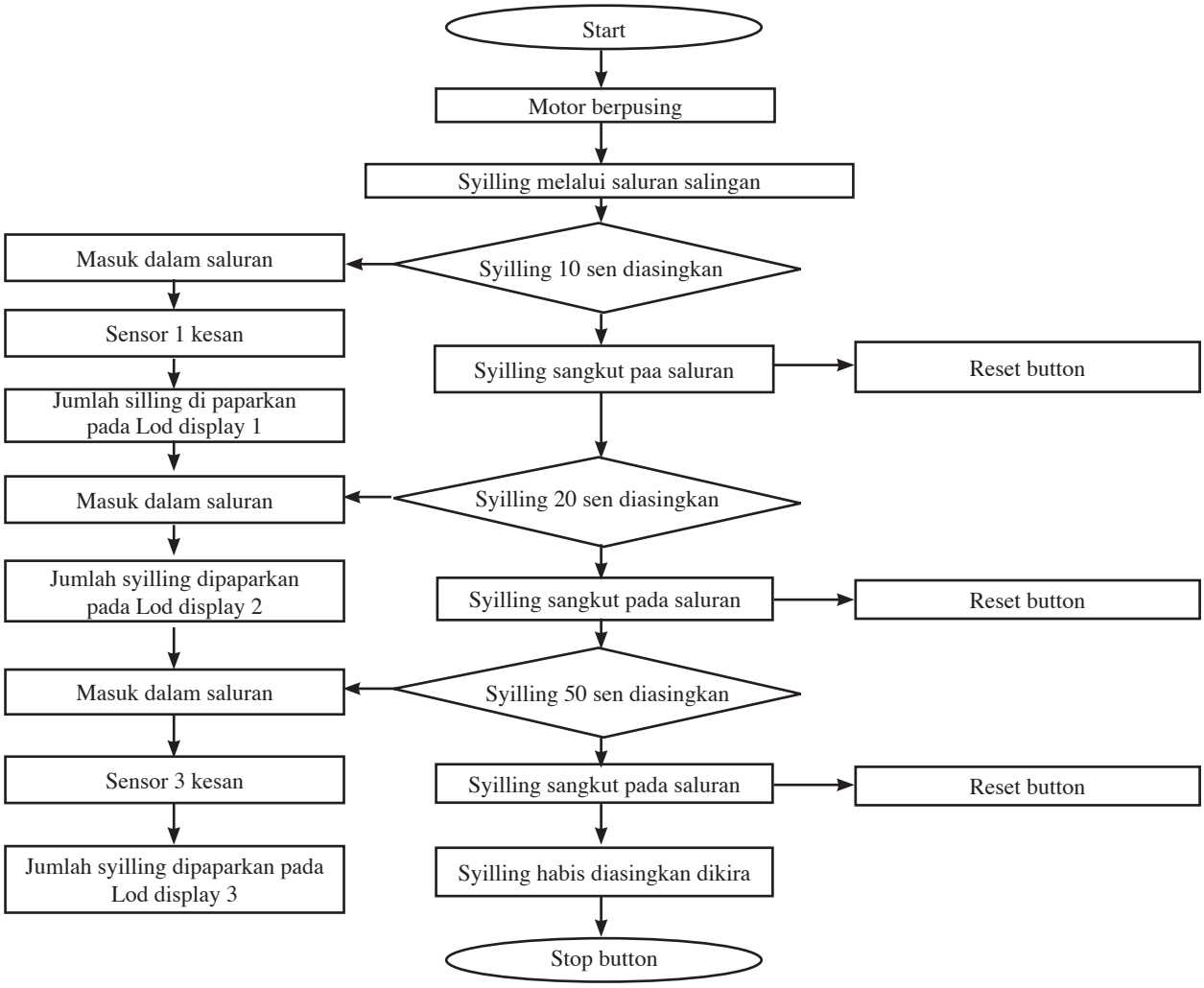
2.3 Penulisan Aturcara

Mesin MP2S mempunyai cara yang sangat unik mengira jumlah keseluruhan duit syiling. Pengiraan bermula dengan mengira jumlah duit syiling untuk setiap lubang / lorong. Jumlah setiap lubang / lorong iaitu lubang 5 sen , lubang 10 sen, lubang 20 sen dan lubang 50 sen. Setiap lubang akan dijumlahkan duit syiling dan jumlah setiap lubang akan ditambah untuk mendapatkan nilai semua duit syiling. Berikut aturcara yang digunakan untuk membuat penjumlah tersebut.

```
5sen = sensorCount[0] – sensorCount[1];10sen = sensorCount[1] – sensorCount[2];

20sen = sensorCount[2] – sensorCount[3]; 50sen  = sensorCount[3];

sortTotal = (float)5sen*.005 + (float)10sen*.01 + (float)20sen*.02 + (float)50sen*.05;
```



Rajah 6: Carta alir penulisan aturcara

3.0 Hasil Projek

3.1 Spesifikasi MP2S

Bil	Perician Spesifikasi	Spesifikasi MP2S
1	Kapastiti Corong Masukan	Sehingga 800 keping duit syiling
2	Saiz Diameter Duit Syiling	Max: 34mm, Min:14mm
3	Paparan Pengiraan	5 LED
4	Ukuran Projek	330x499x167mm
5	Berat	8 KG
6	Punca Kuasa	240V/50HZ
7	Kos Pembuatan	RM 550.00

Jadual 1: Spesifikasi MP2S

3.2 Keputusan (Manual Vs MP2S)

Jumlah Syiling (Keping)	Masa Pengasingan dan penjumlahan (secara Manual)	Masa Pengasingan dan penjumlahan (Menggunakan MP2S)	Ralat Pengasingan Duiit Syling (Secara Manual)	Ralat Pengasingan Duit Syling (Menggunakan MP2S)
50	55.00 Saat (RM 14.60)	25.61 Saat (RM 14.60)	Tiada	Tiada
100	1 minit 30 Saat (RM 30.15)	50.53 Saat (RM 30.15)	Tiada	Tiada
193	2 minit 40 Saat (RM 39.60)	1 minit 16 Saat (RM 39.60)	Tiada	Tiada
413	4 minit 25 Saat (RM 39.80)	2 minit 33 Saat (RM 39.80)	Ada	Tiada
587	6 minit 13 Saat (RM 173.35)	4 minit 44 Saat (RM 173.35)	Ada	Tiada
800	14 minit 20 Saat (RM 183.55)	7 minit 53 Saat (RM 183.55)	Ada	Tiada

Jadual 2: Data Perbezaan Masa Pengasingan dan penjumlahan Duit Syiling Secara manual dengan mengunakan MP2S

4. Kesimpulan

Secara keseluruhan, projek MP2S mampu menyelesaikan tugas yang dikehendaki (mengasingkan duit syiling dan mengira) tetapi pada skala yang kecil dan kelajuan yang sederhana . MP2S akan lebih cekap berfungsi jika corong (coin hopper) tidak terlalu penuh atau menjadi tersumbat. Namun, beberapa percubaan menunjukkan bahawa MP2S mampu memaparkan secara tepat nilai jumlah duit syiling dan proses pengasingan duit syiling selesai tanpa kesalahan.

Keputusan percubaan ujian terhadap MP2S menunjukkan bahawa aspek sensor, rangkaian, punat tekan dan atucara untuk menjumlahkan duit syiling bekerja dengan cukup baik. Setiap duit syiling yang melewati garis-optical sensor dikira dan direkod oleh PIC16F877a supaya atucara akan mengambil ia sebagai maklumat untuk mendapatkan jumlah yang tepat. Data yang telah berjaya diambil membuktikan MP2S berjaya menjimatkan masa dan tenaga kerja ketika proses pengasingan. dimana duit syiling dapat diasingkan dan dijumlahkan lebih cepat dengan menggunakan mesin tanpa menggunakan tenaga manusia.

5. Rujukan

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M2 - Automated Fruits Salad Machine

Mohd Sani bin Saian
Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam

Abstrak

Setelah beberapa kajian dijalankan, adalah didapati sektor industri pemakanan dapat dikembangkan menerusi penghasilan mesin/robot berteraskan makanan. Oleh itu, projek ini dicipta untuk memberi kesenangan dan memudahkan manusia untuk mendapatkan makanan secara cepat dan tidak membebankan. Mesin ini dapat digunakan pelbagai tempat seperti di hospital, di kampus–kampus, pejabat, industri, stesen kemudahan awam (LRT, komuter, bas), di kedai–kedai makan dan sebagainya. Mesin ini dinamakan ***AUTOMATED FRUITS SALAD MACHINE (AFSM)****. Projek ini dicipta untuk menjimatkan masa dan tenaga kerana ia hanya memerlukan pengawasan dan pergerakkan manusia yang minima. Pengendaliannya adalah secara automatik untuk menentukan sebarang pergerakkan yang dilakukan. Hasilnya adalah sebuah mesin yang mampu menghasilkan salad buah yang sedap secara automatik dengan mudah dan cepat.*
Keyword: *robit, automatik, mesin*

1. Pengenalan

Dalam perkembangan teknologi pada hari ini, pelbagai ciptaan dihasilkan bagi memenuhi keperluan harian agar lebih sempurna. Makanan merupakan satu keperluan hidup manusia. Oleh itu, inovasi dalam teknologi penyediaan makanan untuk menjimatkan masa dan tenaga adalah perlu. Antara aspek yang penting untuk tujuan ini adalah ianya menjimatkan masa dan kos, mudah dan selamat pengendaliannya, produk yang dihasilkan bermutu, terjamin kebersihan dan kualitinya dan makanan yang dihasilkan berkhasiat. Projek ini menggunakan aspek-aspek kejuruteraan asas seperti unsur mekanikal, elektrikal, elektronik, dan automasi yang digabungkan dalam satu system yang dikawal oleh sebuah *Programmable Logic Controller (PLC)*. Dengan adanya mesin ini penjimatan Kos dapat dilakukan kerana peralatan yang digunakan adalah berpatutan tanpa mengabaikan kualiti.

Terdapat banyak kebaikan mesin salad buah ini antaranya ia sesuai untuk kegunaan kedai yang menyediakan menu salad dalam kuantiti yang banyak, dapat menyediakan pelbagai jenis salad dengan mudah, dapat menyediakan salad dengan potongan rapi dan konsisten, menjimatkan masa, penyelenggaraan yang mudah, dan barang ganti yang mudah didapati, dan harga yang berpatutan. Projek ini bertujuan untuk menghasilkan makanan berkhasiat yang mengandungi pelbagai jenis buah-buahan dan sayuran dan makanan ini bukan sahaja berkhasiat malah halal .Antara cadangan buah- buahan segar yang boleh digunakan adalah seperti apple, nenas, pear, strawberi, pisang kaki, anggur, dan sayuran seperti salad hijau. Bahan perasa pula adalah seperti mayonis salad dan sos bijan.

2. Objektif Projek

2.1 Mencipta satu inovasi baru dalam teknologi pemakanan yang menghasilkan makanan berkhasiat.

2.2 Mencipta satu mesin yang dapat memudahkan kerja dan menjimatkan kos serta masa

2.3 Menghasilkan satu mesin automatik yang dapat beroperasi dengan kawalan minima.

3. Pernyataan Masalah

Menggunakan kaedah tradisional dalam pemprosesan salad buah pada masa kini amatlah meletihkan dan melecehkan. Lebih-lebih lagi untuk suatu kuantiti yang banyak. Kebanyakkan manusia tidak ada masa dalam penjagaan kesihatan. Ini kerana kesibukan bekerja seharian. Dengan itu, mereka lebih suka menikmati snek-snek segera yang tidak sihat. Tetapi dengan adanya mesin yang dicipta ini maka kesenangan untuk menikmati hidangan lazat dapat diimpikan semula. Tiada lagi alasan tiada masa dalam penjagaan kesihatan. Mesin yang dicipta ini adalah sebuah mesin penghasilan buah-buahan dan sayuran secara automatik dan boleh juga secara manual.

4. Methodologi Projek

4.1 Kaedah Dalam Melaksanakan Projek

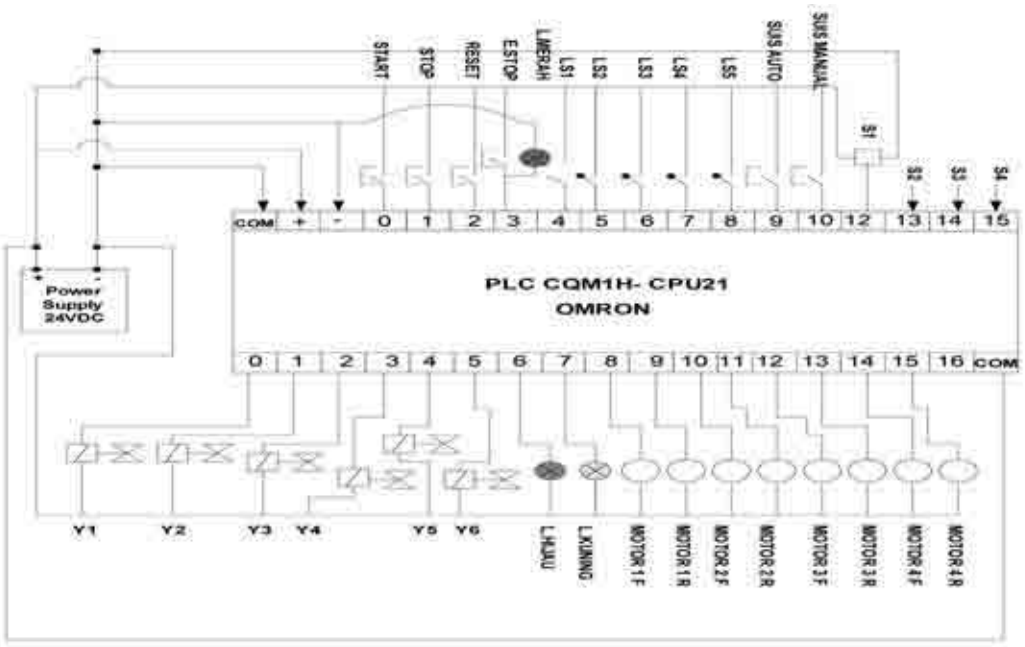
Bagi menjalankan projek inti, satu perancangan sistematik perlu dibuat bermula dengan ***Brainstorming.*** Dari sini kita dapat ***Mengenalpasti keperluan projek*** dan ***Menentukan objektif Projek.***Langkah seterusnya adalah untuk ***Melaksakan Projek***. Setelah siap, ***Penilaian Projek*** akan dibuat dan ***Kelemahan projek*** akan dikesan dan diatasi.

4.2 Penerangan Projek

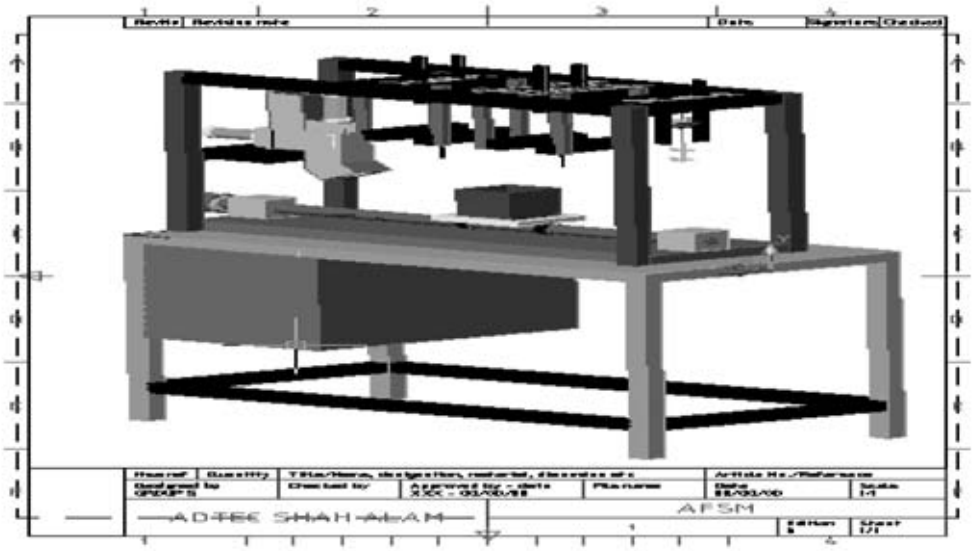
4.2.1 Operasi Mesin

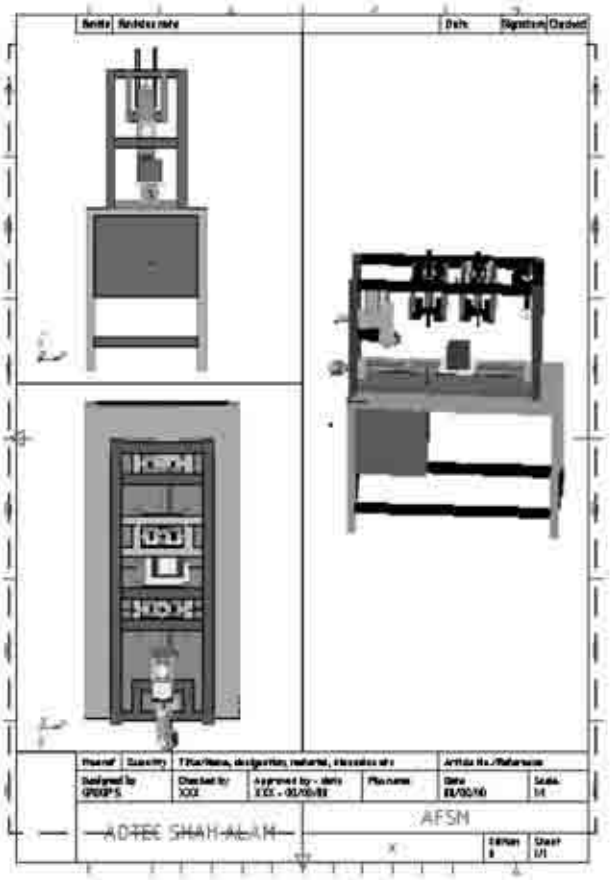
Mesin akan dimulakan dengan menghidupkan suis utama. Ia dilengkapi dengan enam butang utama iaitu *"Selector Auto", "Selector Manual"*, *"Start"*, *"Stop", "Emergency Stop*" dan "*Reset*" Operasi mesin boleh dibahagi kepada operasi Auto atau Manual. Untuk operasi automatik, pusing suis pada ***auto***. Kemudian tekan butang S***tart. Lampu hijau*** akan menyala tanda proses *running* dan mesin akan berada dalam keadaan sedia pada proses *mixer.* ***Motor 1*** akan *reverse* dan *bowl cup* salad akan bergerak. Ia akan berhenti pada ***Sensor 1*** (Proses memotong buah). Kemudian buah yang telah dimasukkan ke dalam *main cup* akan dipotong. Kemudian ***Silinder*** A+ akan menolak buah ke dalam mata pisau pertama dan memotong. Kemudian ***Silinder*** B+ akan menolak buah ke mata pisau yang kedua, dan buah keluar mengikut saiz yang telah dispesifikasikan lalu jatuh kedalam *bowl cup* tersebut. Proses akan berulang dengan pergerakan (A+B+A-B-). Apabila silinder berhenti membuat pusingan pergerakan yang di program melalui *counter,* ***Motor 1*** akan bergerak *forward* bersama mangkuk berisi salad ke proses seterusnya (proses mayonis). ***Motor 1*** akan berhenti pada ***Sensor 2.*** *Limit switch* 4 akan *energizes* dan kemudian motor 2 (M2) akan *forward* selama *10 sec.* Mayonis akan keluar masuk ke dalam *bowl cup* yang berisi buah yang telah siap dipotong. *Kemudian* ***Motor 1*** akan gerak *forward* ke proses seterusnya (proses sos bijan) dan berhenti pada ***Sensor 3***. Kemudian *limit switch* 2 akan *energizes* dan motor 3 (M3) akan *forward* selama *10sec*. Sos bijan akan keluar selama *10 sec* ke dalam *bowl cup* yang terdapat salad buah, dan mayonis. Selepas itu, ***Motor 1*** akan bergerak *forward* ke bahagian proses terakhir (proses *mixer)*dan akan berhenti pada ***Sensor 4***. L*imit switch* 1 akan *energizes* dan menggerakkan ***Silinder*** (C+) . ***Motor 4*** pula akan bergerak *forward* selama 20 saat. Di proses ini salad buah yang siap dipotong, beserta mayonis dan sos bijan akan di gaul oleh *rode blend*. Apabila M4 berhenti silinder akan *retract* (C-) dan mengangkat *rode blend* ke tempat asal. Proses akan berhenti di sini. Salad buah siap untuk dimakan. Bagi operasi manual, pusing suis pada manual dan tekan ***start***. Setiap motor dan ***silinder*** mempunyai ***suis manual***. Jika mayonis habis *limit switch* 5 akan *energizes* dan menyebabkan M2 *reverse*. Begitu juga apabila sos bijan habis, *limit switch* akan *energizes* dan menghidupkan M3 untuk *reverse*. Ketika salah satu proses ini berlaku lampu kuning akan menyala. Bagi butang *emergency stop* ianya digunakan sebagai *safety* jika terdapat masalah ketika mengendalikan mesin ini. Butang *Reset* pula digunakan untuk reset-kan semula silinder. Walaupun mesin ini *fully automatic* tetapi kami juga menyediakan penggunaan secara manual.

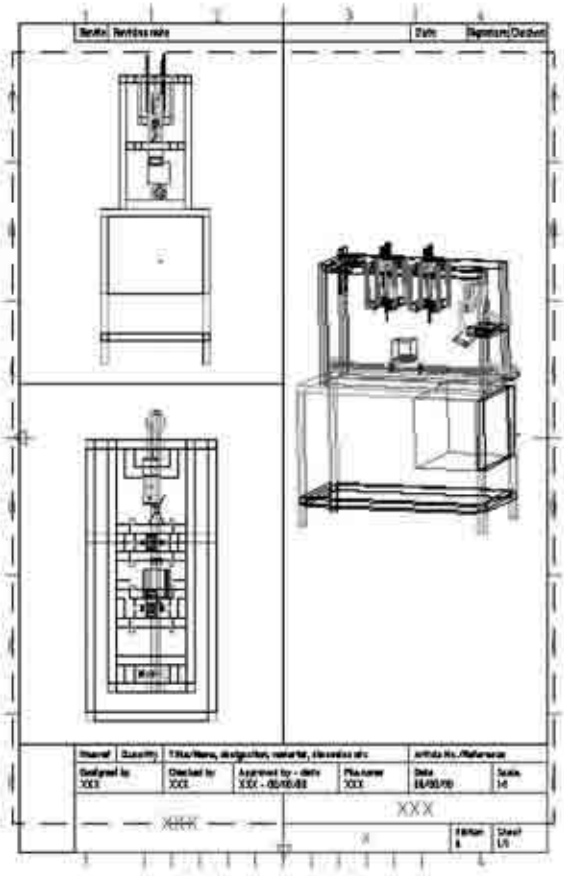
Gambarajah 1 : Pendawaian PLC



Gambarajah 2 : Lukisan projek







Pengujian

Setelah siap kerja–kerja merekabentuk, pendawaian dan juga program ke dalam "Automated Fruits Salad Machine", mesin yang dibina hendaklah diuji supaya berada dalam keadaan yang baik sebelum ianya digunakan. Antara alat yang digunakan adalah ***Analog Multimeter*** untuk menyukat arus rintangan dan voltan dalam litar. Multimeter juga digunakan untuk menguji komponen elektronik dan ketelusan litar. Alat lain ialah ***Pena ujian (test pen)*** untuk menguji kebocoran arus, menentukan punca bekalan arus elektrik berkeadaan baik mahupun mengalami kerosakkan . Selain daripada itu pena ujian juga boleh digunakan untuk memasang dan menanggalkan skru kecil.

4.3 Kaedah Pengujian Dan Kalibrasi

Pengujian yang dijalankan terbahagi kepada 3 bahagian utama iaitu Rekabentuk Mekanikal, Pendawaian elektrik dan PLC dan akhir sekali Program PLC. Pengujian juga dilakukan ke atas komponen – komponen yang digunakan seperti PLC, sensor, relay, bateri 12v, motor power window, lampu dan suis. Proses ini dilakukan untuk mengetahui komponen tersebut berada dalam keadaan baik atau sebaliknya.Pengujian dilakukan ke atas pendawaian elektrikal yang telah siap dan dipastikan keluaran serta operasinya adalah tepat. Setelah komponen dan pendawaian adalah betul, ujian juga dijalankan untuk komponen-komponen mekanikal. Kemudian, ujian program PLC akan dijalankan. Akhir sekali, adalah ujian keseluruhan sistem untuk menguji kebolehfungsian setiap station.

4.3.1 Analisa Masalah.

Jadual 1 : Analisa Masalah Rekabentuk Mekanikal

Masalah Yang Dihadapi	Cara Penyelesaian
Mangkuk salad buah yang diletakkan di shaft tidak laju dan bergoyang – goyang membuat mangkuk terbalik dan menumpahkan isi di dalamnya.	Letakkan minyak pada shaft, supaya ia bergerak laju sedikit, dan roller diletakkan pada tempat letak mangkuk supaya mangkuk dalam keadaan seimbang dan tidak lagi menumpah isi didalamnya.
Roda yang digunakan kecil dan tidak dapat menampung meja besi menyebabkan mesin tidak dapat ditolak ke tempat lain.	Kami menukar roda yang saiznya lebih besar dari sebelum ini. Dan AFSM sekarang mudah dibawa kemana – mana.
Mayonise part dan sos bijan part tidak seimbang dan membuatkan skru yang diikat kuat menjadi longgar semula apabila pengujian di lakukan, dalaman part menjadi haus dan tersekat kerana tidak seimbang.	Skru semula part setelah diimbangkan. Dan membuat mekanikal semula sehingga part untuk mayonise dan sos bijan berfungsi dengan baik.
Buah yang dimasukkan ke dalam corong buah telah ditekan ke mata pisau yang direka bentuk tetapi buah tersekat dan tidak dipotong habis membuatkan proses pemotongan buah yang kedua tidak berlangsug baik.	Buah yang terlalu keras dan muda ditukar dengan buah lembut dan ranum masaknya. Tekanan angin di betulkan mengikut kelajuan yang sesuai supaya buah dipotong dengan baik dan proses berlangsung dengan baik.

4.3.2 Pendawaian Elektrik Dan PLC

Jadual 2 : Analisa Masalah Pendawaian Elektrik dan PLC

Masalah Yang Dihadapi	Cara Penyelesaian
Solenoid tersalah masukan angin iaitu terbalik masukannya.	Cabut *hose* tersebut dan masukkan *hose* kepada tempat yang betul. Solenoid bergerak seperti biasa setelah *hose* dibetulkan.
Sensor tidak dapat mengenalpasti objek dan berfungsi sempurna.	Melaraskan sensor sehingga dapat mengenalpasti objek dan berfungsi sempurna
Sensor tidak dapat berfungsi mengikut kehendak yang diingini.	Membuat pemeriksaan pada penyambungan plc.
Pendawaian PLC yang tidak teratur dan penyambungan PLC yang tidak betul akan menyebabkan input dan output di plc mudah terbakar dan rosak.	Membuat pendawaian yang teratur dan penyambungan yang betul agar tiada berlakunya sebarang kerosakkan pada PLC.

4.3.3 Program PLC

Jadual 3 : Analisa Masalah Program PLC

Masalah Yang Dihadapi	Cara Penyelesaian
Program yang dibuat tidak menjadi	Perlu melakukan troubleshoot pada program berkenaan.
Address untuk timer, counter, output tidak dapat dibaca oleh program.	Rujuk buku manual.

4.4 Kebaikan Automatic Fruits Salad Machine

1. Sesuai untuk kegunaan industri pemakanan berkhasiat .
2. Pelbagai jenis salad boleh disediakan dengan mudah dengan menggunakan mesin ini
3. Menjimatkan masa dan kos
4. Harga yang berpatutan.
5. Memberi keselesaan kepada pengguna.
6. Mudah dikendalikan.

4.5 Keburukan Automatic Fruits Salad Machine

1. Kos tenaga elektrik bertambah jikalau penggunaanya berterusan.
2. Buah – buahan dan sayuran tidak dapat bertahan lama serta mudah rosak.

5. Cadangan Dan Penambahbaikan

5.1 Membuat *casing* luar

Membuat *casing* luar untuk menutup rangka Automated Fruits Salad Machine agar kelihatan lebih kemas dan menarik perhatian pelanggan.

5.2 Menukar mata pisau

Menukar mata pisau yang lebih berkualiti, tahan karat, dan tidak merbahayakan pelanggan serta supaya tidak menghancurkan buah.

5.3 Menukar *shaft*

Tukar shaft supaya mangkuk salad dapat bergerak dengan laju dari proses ke proses.

5.4 Membuat sistem sejuk beku

Membuat sistem peyejukbekuan supaya buah dan salad dapat bertahan lebih lama dan tidak busuk.

6. Kesimpulan

Adalah dapat dirumuskan bahawa perancangan kerja yang bersistematik dapat menghasilkan produk yang berkualiti dan mampu memberikan pulangan yang baik. Projek ini berjaya dilaksanakan dengan baik dan menekankan aspek kejuruteraan asas mekanikal, elektrik/elektronik juga program untuk menghasilkan suatu mesin automatik bersepadu yang bergerak harmoni antara satu sama lain sesuai dengan bidang mechatronik. AFSM ini mampu menghasilkan salad buah yang lazat dan berkhasiat dengan mudah dan cepat dan ia merupakan satu inovasi kreatif dalam teknologi penyedian makanan pada hari ini.

7. Rujukan

[1] http://www. festo.com.my
[2] http://www. RS.com.my
[3] http://www. automation robot.com.my
[4] Teknologi kejuruteraan Mekatronik “Automatical Guidline vehicles”.
[5] Teknologi kejuruteraan Mekatronik “Automatic Vacum”.

M3 - Alat Portable Flexible Compressor Bagi Memudahkan Operasi Mengeluarkan *'Keep Valve Spring'*

Reza Hanif bin Darhaman, Rani Ak. Kaba, Agus Aming
ILP Kota Samarahan
reza@ilpks.gov.my, rani@ilpks.gov.my, agus@ilpks.gov.my

Abstrak

Alat ini merupakan ciptaan untuk memudahkan operasi keluar masuk 'keep valve spring' daripada blok enjin secara manual. Alat ini boleh digunakan hampir pada semua blok enjin di pasaran kerana fleksibiliti alat ini berbanding alat yang sama di pasaran. Alat ini boleh diubah mengikut keperluan dan saiz enjin dan bahagian-bahagian utama seperti meja kerja yang boleh diubah mengikut saiz dan kerataan permukaan tempat kerja, 'Angle Slot Remover' yang boleh diubah mengikut saiz 'keep valve spring', dan pengubah ketinggian yang boleh diubah bergantung kepada ketinggian enjin. Alat ini digunakan secara manual dan ditekan ke dalam blok enjin yang seterusnya dikunci untuk mengeluarkan 'keep valve spring'. Fleksibiliti alat ini membolehkan alat ini digunakan di pelbagai bengkel dan ianya sudah digunakan di bengkel Automatif di ILP Kota Samarahan menggantikan alat sedia ada di pasaran kerana fleksibiliti, kos dan ketahanan alat tersebut.

Katakunci: *valve opener, valve spring, compressor*

1. Pengenalan

Penghasilan alat ini diilhamkan daripada kesukaran yang dihadapi oleh pengajar Bengkel Teknologi Automasi di ILP Kota Samarahan menggunakan peralatan yang sedia ada di pasaran iaitu *'Compressor Spring Valve (CSV)'. 'CSV'* yang digunakan sebelum ini hanya boleh digunakan pada blok enjin kereta tertentu sahaja. Kualiti *'CSV'* juga bergantung kepada harga yang ditawarkan kerana semakin murah harganya semakin cepat peralatan tersebut rosak. "*Portable Flexible Compressor (PorFlexComp)'* telah dicipta kerana ia mampu mengendalikan pelbagai jenis saiz blok enjin kereta dengan lebih cepat dan mudah. Peralatan ini mudah dibawa ke mana-mana dan boleh dilaras mengikut kesesuaian saiz blok enjin, ketinggian dan tempat penggunaannya. Pembinaan awal peralatan ini hanya menggunakan sisa-sisa besi terbuang dan pelan rekaan berdasarkan kreativiti pengajar semata-mata. Namun setelah model siap dan diuji keberkesanannya terbukti keputusannya seperti yang diharapkan. Pencapaian yang amat memberangsangkan ini terus digunapakai sehingga kini dalam pengajaran dan pembelajaran pelatih di bengkel tersebut. Tumpuan utama kini adalah untuk mengkomersilkan peralatan ini di pasaran dengan mensasarkan pemilik bengkel kereta berskala kecil.

2. Bahan dan Kaedah

2.1 Kajian melalui Pemerhatian

'*PorFlexComp'* sesuai digunakan di tempat membaiki kereta yang mana mekanik akan membaiki pelbagai saiz blok enjin kereta pelanggannya. Produk ini direka untuk mencakupi semua jenis spring tanpa perlu menggunakan pelbagai jenis *'CSV'* yang dijual di pasaran untuk menolak spring yang berlainan saiz bagi mengeluarkan '*keep valve spring*'. Blok enjin diletakkan di atas meja kerja mudah alih *'PorFlexComp'* dan dengan menggunakan kekuatan tangan, *'ASR Handle'* ditolak ke bawah. Pada masa yang sama *'Angle Slot Remover'* akan diarah tepat menuju ke spring blok enjin supaya tekanan yang dikenakan dapat mengeluarkan dan memasukkan '*keep valve spring*'. Cara pengendalian yang mudah dan ringkas pasti memaksimumkan mutu kerja, menjamin penjimatan masa dan tiada pembaziran tenaga.

2.2 Perbandingan antara Portable Flexible Compressor Spring Valve dan Compressor Spring Valve (sedia ada di pasaran)

Gambarajah 1: Perbandingan antara Portable Flexible Compressor Spring Valve dan Compressor Spring Valve (sedia ada di pasaran)

Jadual 1.1. Perbandingan Proflexcom dan CSV

Portable Flexible Compressor Spring Valve (Porflexcomp)	**Compressor Spring Valve (CSV)**
'Angle Slot Remover' boleh ditukarkan mengikut saiz spring blok enjin	Hanya boleh digunakan pada blok enjin tertentu
Kedudukan darjah *'Angle Slot Remover'* pada lubang pelaras mudah diselaraskan mengikut kedalaman spring blok enjin.	Bahagian-U *'CSV'* sukar untuk mencapai spring blok enjin sekiranya kedudukan spring terlalu ke dalam
Ketinggian meja kerja mudah alih boleh dilaras berdasarkan kedudukan dan tempat pengendalian	Memerlukan tempat yang rata dan separas pinggang penggunanya
Meja kerja mudah alih boleh digerakkan ke depan dan belakang mengikut saiz blok enjin	Saiz blok enjin hendaklah disesuaikan dengan bahagian-U *'CSV'*
Hanya menggunakan kekuatan sebelah tangan untuk menolak spring blok enjin	Memerlukan kekuatan kedua-dua belah tangan untuk menolak spring blok enjin
Memerlukan daya yang optimum untuk menolak spring bagi mengeluarkan dan memasukkan '*keep valve spring*'	Memerlukan daya yang maksimum untuk menolak spring bagi mengeluarkan dan memasukkan '*keep valve spring*'
Proses mengeluarkan dan memasukkan *'keep valve spring'* lebih cepat dan mudah	Proses mengeluarkan dan memasukkan *'keep valve spring'* mengambil masa yang lama kerana bahagian-U harus dikunci dengan ketat terlebih dahulu

Portable Flexible Compressor Spring Valve (Porflexcomp)	Compressor Spring Valve (CSV)
Tahan lasak	Tidak tahan lasak
Tahan lama kerana menggunakan bahan yang berkualiti	Ketahanan berdasarkan harga produk (Semakin mahal harga, produk semakin tahan)

3. Keputusan dan Perbincangan

PorflexComp merupakan alat alternatif yang dicipta untuk memudahkan kerja-kerja mengeluarkan '*keep valve spring*' yang merupakan salah satu komponen penting untuk '*overhaul*' enjin kereta. Banyak peralatan yang dijual di pasaran mempunyai fungsi yang sama tetapi ianya terhad kepada jenis enjin dan cara pengoperasiannya juga tidak semudah PorFlexComp. Kelebihan alat ini berbanding alat yang sedia ada terletak kepada fleksibiliti alat tersebut untuk mengeluarkan '*keep valve spring*' pada hampir semua jenis dan saiz enjin kecuali enjin yang besar seperti enjin trak dan lori. ASR ataupun Angle Slot Remover boleh diubah saiz mengikut saiz enjin dan sudut operasi juga boleh dilaraskan mengikut keperluan dengan mengubah kedudukan pada plat ASR Handle. Tenaga yang digunakan untuk mengeluarkan '*keep valve spring*' juga kurang berbanding peralatan lain kerana ASR Handle yang digunakan untuk menekan spring direka panjang. PorFlexComp juga perlu diikat pada meja kerja untuk mengukuhkan lagi peralatan tersebut untuk menjalankan operasi mengeluarkan '*keep valve spring*'.

Terdapat perancangan untuk penambahbaikan peralatan ini pada masa akan datang iaitu untuk membuatkannya separa automatik dan seterusnya automatik sepenuhnya dengan bantuan silinder pneumatik dan mekanisma penguncian. Walaubagaimanapun apabila penambahbaikan ini dilaksanakan, ianya akan meningkatkan lagi kos peralatan ini dan kajian perlu dilakukan untuk membuatkan ianya lebih ekonomi. Pada masa ini, rekaan ini adalah yang terbaik, iaitu pengoperasian secara manual dengan kos yang rendah dan efektif. PorFLexComp ini telah digunakan di Bengkel Teknologi Automatif di ILP Kota Samarahan selama hampir setahun dan terbukti keberkesanannya kerana tiada lagi peralatan dengan fungsi yang sama dibeli dan digunakan di bengkel tersebut.

4. Kesimpulan

Kesedaran terhadap rekacipta yang praktikal, kos rendah, ekonomi dan mampu menggantikan peralatan dengan fungsi yang sama di pasaran mengilhamkan penciptaan PRoFlexCom. Keupayaannya mempercepatkan kerja mengeluarkan '*keep valve spring*' daripada pelbagai jenis saiz enjin dengan kerja yang kurang telah memudahkan proses latihan dan kerja overhaul kenderaan yang memberikan faedah serta produktiviti kepada pengajar dan pelajar Bengkel Automotif. Peralatan ini telah terbukti keberkesanan penggunaanya di bengkel tersebut dan boleh diperkenalkan secara komersial kepada pemilik bengkel kereta atau orang perseorangan. Penciptaan ini adalah langkah pertama untuk mempermudah pengoperasian overhaul dan dirancang untuk penambahbaikan untuk membuatkan ianya berfungsi secara automatik dengan kos yang ekonomi

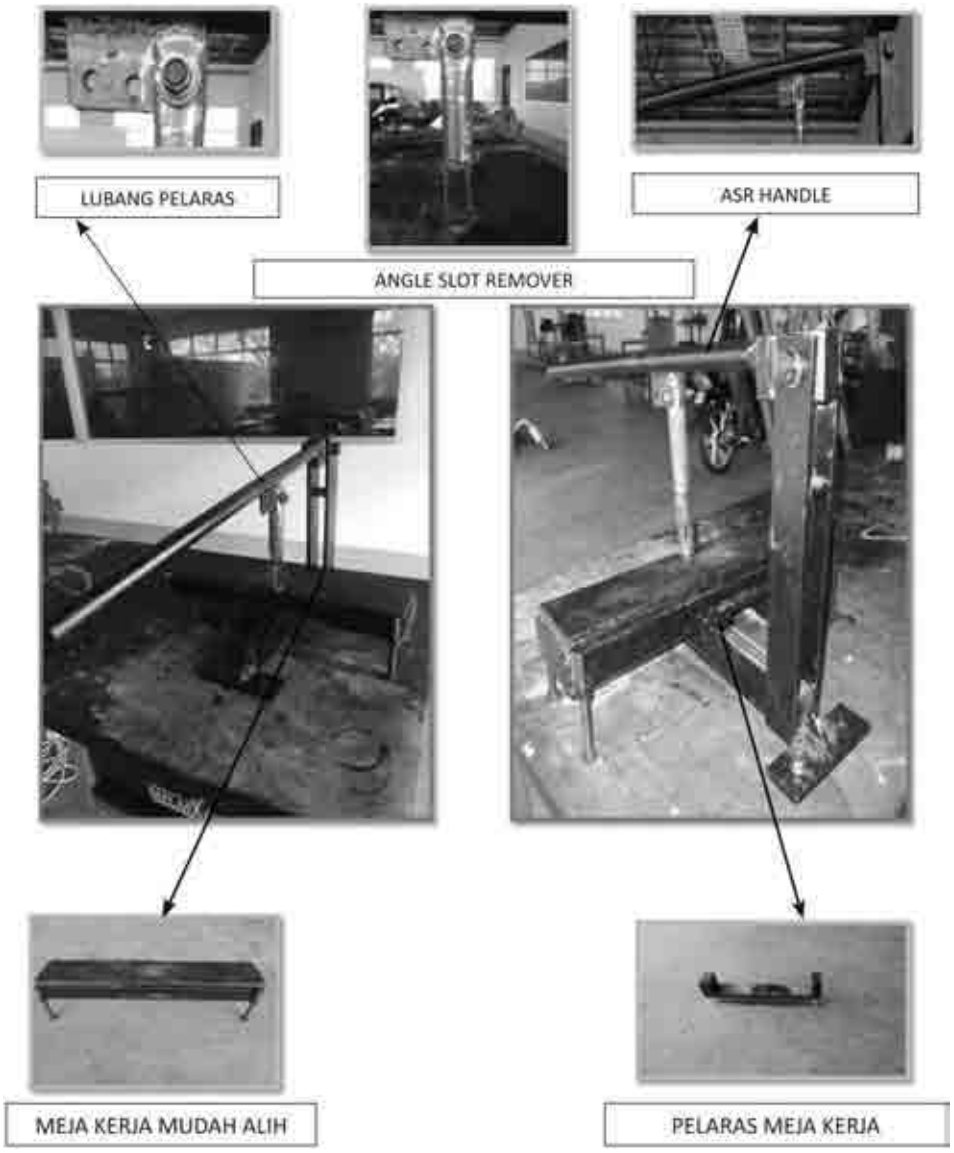
5. Rujukan

[1] '*How to Use a Valve Spring Compressor'* http://www.ehow.com/how_4710419_use-valve-spring-compressor.html Dilayari pada 7 Januari 2011.

[2] '*Valve Spring Compressor-Compare Price, Reviews and Buy'* http://www.nextag.com/valve-spring-compressor/stores-html Dilayari pada 7 Januari 2011

[3] '*How to use Valve Spring Compressor Tool on Small Engines for Removing Valves'* http://www.youtube.com/watch?v=c3ZecZW68E8

LAMPIRAN


LUBANG PELARAS
ASR HANDLE
ANGLE SLOT REMOVER
MEJA KERJA MUDAH ALIH
PELARAS MEJA KERJA

M4 - Kesan Geometri Mata Alat Terhadap Haus Mata Alat Menggunakan Kaedah Unsur Terhingga

Abdul Rahim Bin Mustafa Khalid
Insitut Latihan Perindustrian Mersing
abdulrahim@ilpmsg.gov.my

Abstrak

Kajian ini akan membincangkan pembangunan model unsur terhingga dua dimensi mengenai kesan geometri mata alat terhadap haus mata alat dalam proses pemotongan logam. Pemerhatian mengenai kesan beberapa parameter seperti sudut sadak dan sudut kelegaan terhadap hasil keputusan akan dilakukan. Pada akhir ujian simulasi, taburan suhu, tegasan mata alat, pembentukan serpihan dan pembentukan haus boleh dianggarkan. Keadaan yang optimum bagi geometri mata alat karbida untuk memesin besi tuang akan dimodifikasi dengan menggunakan perisian terbantu komputer. Kesan perubahan sudut-sudut pada geometri mata alat akan dikaji. Parameter geometri mata alat yang akan dikaji adalah sudut sadak dan sudut kelegaan. Selain itu, mekanisma dan jenis haus mata alat yang berlaku akan dikenalpasti dan dikaji untuk menghasilkan satu geometri mata alat yang baik. Ini sangat penting untuk mendapatkan penggunaan dan hayat mata alat yang optimum. Sifat-sifat fizik dan kimia bahan yang digunakan untuk membuat mata alat akan dianalisis di samping penentuan bagi pemilihan bahan yang sesuai untuk mata alat bersalut.

Katakunci: *mata alat, haus, geometri mata alat, kaedah unsur terhingga*

1. Pendahuluan

Sejak kebelakangan ini, teknologi pemesinan kejituan tinggi telah berkembang maju secara pantas untuk memenuhi keperluan pelbagai bidang dalam industri. Pemotongan logam merupakan proses pembuatan yang paling lazim untuk menghasilkan bahagian dan komponen mengikut dimensi dan spesifikasi yang dikehendaki. Pemotongan logam adalah proses tak terbalik, mengandungi ubah bentuk plastik menghubungkan kenaikan suhu pada kadar terikan yang tinggi. Daripada sudut pandangan mekanik kontinum, teori konstitutif atau persamaan penentu yang sesuai yang boleh menggambarkan fenomena ini amat diperlukan untuk meramal aliran serpihan, daya pemotongan, suhu pemotongan, haus mata alat dan sebagainya.

Untuk meningkatkan ketepatan dimensi dan permukaan menyeluruh, kesan sudut sadak alat pemotong semasa pemesinan ke atas pembentukan benda kerja yang dimesin, bentuk serpihan, daya pemotongan, dan taburan tegasan perlu difahami secara mendalam. Walaupun telah banyak kajian dijalankan tentang model pemesinan mendatar, tetapi kebanyakannya terhad kepada tajuk tertentu seperti taburan tegasan baki, suhu benda kerja yang dimesin, dan tegasan ke atas antaramuka serpihan-mata alat. Hanya sedikit usaha penyelidikan dilakukan untuk mengkaji kesan sudut sadak mata alat terhadap proses pemesinan.

Pendekatan secara pengkomputeran menggunakan kaedah unsur terhingga kini telah menjadi satu keperluan penting untuk analisis pemesinan selepas ia dibangunkan. Ini disebabkan, ia memberi penghampiran yang hampir tepat dan medan halaju yang bergantung kepada anggapan yang dibuat semasa membina model untuk operasi pemotongan logam ortogon. Semestinya, usaha terus dijalankan untuk mencari kaedah yang lebih tepat seiring dengan perkembangan revolusi teknologi komputer.

2. Pembangunan permodelan simulasi pemesinan dengan kaedah unsur terhingga

2.1 Reka bentuk eksperimen

Dalam kajian ini, kaedah yang digunakan dalam membuat analisis bagi pengoptimuman geometri mata alat adalah berdasarkan kepada kaedah rekabentuk eksperimen (Design of Experiment, DOE). Analisa rekabentuk eksperimen akan dibina di atas suatu asas analisis varians, di mana pemerhatian varians satu koleksi model-model disekat ke dalam komponen-komponen disebabkan oleh berbeza faktor-faktor yang dianggarkan atau diuji.

Jadual 1. Parameter-parameter yang digunakan dalam analisis dan permodelan simulasi.

Simbol	Geometri mata alat	Paras 1	Paras 2	Paras 3
A	Sudut sadak (º)	3,-7	5,-5	7,-3
B	Sudut kelegaan (º)	5	7	9
C	Radius hujung mata alat (mm)	0.5	0.8	1

2.2 Pengumpulan dan penganalisaan data eksperimen tatasusunan ortogon L9

Semua keputusan yang diperolehi daripada data dan analisis simulasi kaedah unsur terhingga akan dikumpulkan. Selepas itu, graf yang mewakili setiap analisis akan diplot untuk mendapatkan hubungan antara pembolehubah dan parameter yang ditetapkan. Selain itu, perbandingan akan antara analisis akan dilakukan. Perubahan akan dilakukan dari segi sudut sadak mata alat agar nilai yang paling optimum dapat diperolehi. Nilai yang paling optimum akan dipilih untuk mendapatkan daya dan haus yang paling kecil. Keputusan yang diperoleh hasil daripada analisis data dari simulasi perisian unsur terhingga menggunakan kaedah Taguchi melibatkan beberapa parameter seperti sudut sadak, sudut kelegaan dan radius hujung mata alat untuk mengkaji kesannya ke atas taburan tegasan dan daya pemotongan pada mata alat itu. Simulasi pemotongan dijalankan dengan pelbagai parameter seperti kelajuan pemotongan, kadar suapan dan ukur dalam pemotongan. Pengolahan data daripada keputusan akan dipersembahkan dalam bentuk jadual bagi menjelaskan peratusan setiap aspek yang dianalisis dan memudahkan proses menilai keputusan dan perbincangan.

Jadual 2. Keputusan nilai tegasan mata alat dan daya pemotongan bagi sudut sadak positif untuk parameter pemotongan yang berpadanan.

No. eks	A	B	C	Tegasan mata alat (MPa)	Daya pemotongan (N)
1	1	1	1	1238.32164	490.4546
2	1	2	1	1223.98529	320.4368
3	1	3	1	1235.68754	387.3471
4	2	1	2	1237.74611	301.7534
5	2	2	2	1202.76465	316.7984
6	2	3	2	1228.14467	410.9875
7	3	1	3	1198.43489	351.3756
8	3	2	3	1199.66521	384.3574
9	3	3	3	1227.35475	292.3127

Jadual 3. Keputusan nilai tegasan mata alat dan daya pemotongan bagi sudut sadak negatif untuk parameter pemotongan yang berpadanan.

No. eks	A	B	C	Tegasan mata alat (MPa)	Daya pemotongan (N)
1	1	1	1	1221.68416	352.4813
2	1	2	1	1228.32645	298.4681
3	1	3	1	1187.61548	324.3412
4	2	1	2	1225.36442	307.3471
5	2	2	2	1230.46875	322.4461
6	2	3	2	1220.75415	344.8126
7	3	1	3	1222.46847	390.2664
8	3	2	3	1234.1278	327.6741
9	3	3	3	1220.9854	284.3786

Keputusan simulasi bagi tegasan yang dialami oleh mata alat dan daya pemotongan (F_c) untuk setiap eksperimen sudut sadak positif, sudut sadak negatif, sudut kelegaan dan radius hujung mata alat yang telah dijalankan dalam tatasusunan ortogon L9 berdasarkan parameter- parameter yang ditunjukkan dalam Jadual 2 dan Jadual 3.

3. Keputusan dan Perbincangan

Keputusan yang diperoleh hasil daripada data dari simulasi perisian unsur terhingga,akan dianalisis menggunakan kaedah Taguchi melibatkan beberapa parameter seperti sudut sadak, sudut kelegaan dan radius hujung mata alat untuk mengkaji kesannya ke atas taburan tegasan dan daya pemotongan pada mata alat itu. Kaedah Taguchi adalah kaedah pengoptimuman dan parameter. Objektif kaedah Taguchi ialah untuk menggabungkan parameter dan mengurangkan variasi untuk kualiti.Peringkat paling penting dalam rekabentuk satu ujian bergantung kepada pilihan faktor-faktor kawalan. Taguchi membentuk satu tatasusunan ortogon yang standard untuk menampung keperluan ini. Taguchi menggunakan nisbah S/N sebagai ciri untuk membuat pilihan. Nisbah S/N adalah digunakan sebagai suatu nilai yang boleh diukur daripada sisihan piawai. Jika min berkurang,sisihan piawai juga berkurang dan juga sebaliknya. Pengolahan data daripada keputusan akan dipersembahkan dalam bentuk jadual bagi menjelaskan peratusan setiap aspek yang dianalisis dan memudahkan proses menilai keputusan dan perbincangan.

Jadual 4: Hasil analisis ANOVA untuk tegasan mata alat pada sudut sadak positif.

Parameter	Darjah Kebebasan (f)	Jumlah Kuasa Dua (S)	Varian (V)	Jumlah Bersih	Peratus Pengaruh(%)
Sudut sadak	2	887.6740	443.8370	887.6740	52.79%
Sudut kelegaan	2	699.6454	349.8227	699.6454	41.60%
Radius hujung mata alat	2	94.3372	47.1686	94.3372	5.61%
Jumlah		1681.6566		1681.6566	100

Jadual 5: Hasil analisis ANOVA untuk tegasan mata alat pada sudut sadak negatif.

Parameter	Darjah Kebebasan (f)	Jumlah Kuasa Dua (S)	Varian (V)	Jumlah Bersih	Peratus Pengaruh(%)
Sudut sadak	2	346.1572	173.0786	346.1572	28.62%
Sudut kelegaan	2	723.6167	361.8084	0.00037	59.45%
Radius hujung mata alat	2	141.9433	70.9722	0.00007	11.93%
Jumlah		0.00062		0.00062	100

Bagi sudut sadak positif, didapati bahawa mata alat mengalami tegasan yang paling minimum pada langkah eksperimen ketujuh iaitu tegasan sebanyak 1198.43489 MPa pada sudut sadak tertinggi. Mata alat pula mengalami tegasan maksimum sebanyak 1237.74611 MPa pada langkah eksperimen yang keempat apabila ujikaji dijalankan dengan sudut sadak 5º, suapan sudut kelegaan 5º dan radius hujung mata alat 0.8 mm. Melalui analisis ANOVA didapati bahawa sudut sadak mempunyai kesan yang paling besar dalam menentukan tegasan yang dialami oleh mata alat semasa proses pemotongan dengan 52.79%. Ini diikuti dengan parameter sudut kelegaan yang mempunyai faktor pengaruh sebanyak 41.60%.

Selain itu, bagi sudut sadak negatif pula didapati bahawa mata alat mengalami tegasan yang paling minimum pada langkah eksperimen ketiga iaitu tegasan sebanyak 1187.61548 MPa pada sudut sadak tertinggi. Mata alat pula mengalami tegasan maksimum sebanyak 1234.1278 MPa pada langkah eksperimen yang kelapan apabila ujikaji dijalankan dengan sudut sadak -3º, sudut kelegaan 7º dan radius hujung mata alat 1 mm.. Analisis ANOVA mendapati bahawa sudut kelegaan mempunyai kesan yang paling besar (59.45%) dalam menentukan tegasan yang dialami oleh mata alat karbida semasa proses pemotongan.

Jadual 6: Hasil analisis ANOVA untuk daya pemotongan mata alat pada sudut sadak positif.

Parameter	Darjah Kebebasan (f)	Jumlah Kuasa Dua (S)	Varian (V)	Jumlah Bersih	Peratus Pengaruh(%)
Sudut sadak	2	6380.8045	3190.4022	6380.8045	70.96%
Sudut kelegaan	2	2494.7342	1247.3671	2494.7342	27.74%
Radius hujung mata alat	2	116.6647	58.2322	116.6647	1.3%
Jumlah		8992.2033		8992.2033	100

Jadual 7: Hasil analisis ANOVA untuk daya pemotongan mata alat pada sudut sadak negatif.

Parameter	Darjah Kebebasan (f)	Jumlah Kuasa Dua (S)	Varian (V)	Jumlah Bersih	Peratus Pengaruh(%)
Sudut sadak	2	166.5595	83.2798	166.5595	9.03%
Sudut kelegaan	2	454.4991	227.2496	454.4991	24.63%
Radius hujung mata alat	2	1223.9015	611.9508	1223.9015	66.34%
Jumlah		1844.9602		1844.9602	100

Bagi analisis sudut sadak positif melalui analisis ANOVA didapati bahawa parameter sudut sadak mempunyai kesan yang paling besar (70.96%) dalam menentukan daya pemotongan mata alat. Selain itu, parameter sudut kelegaan turut mempunyai kesan pengaruh yang tinggi, iaitu sebanyak 27.74%. Daya pemotongan akan berkurang apabila sudut sadak bertambah. Ini kerana ketajaman mata alat bertambah dengan penambahan sudut sadak. Pada ketajaman yang tinggi, kawasan sentuhan mata alat pada bahan kerja akan berkurang.

Selain itu,bagi sudut sadak negatif pula didapati bahawa parameter radius hujung mata alat mempunyai kesan yang paling besar (66.34%) dalam menentukan daya pemotongan mata alat. Selain itu, parameter sudut kelegaan turut mempunyai kesan pengaruh yang tinggi, iaitu sebanyak 24.63%.

4. Kesimpulan

Berdasarkan analisis keputusan dan perbincangan yang telah dibuat, beberapa kesimpulan boleh dibuat berdasarkan hubungan di antara parameter- parameter proses pemesinan yang dikaji iaitu sudut sadak, sudut kelegaan dan radius hujung mata alat dengan tegasan mata alat dan daya pemotongan yang dialami oleh mata alat. Antara beberapa kesimpulan yang boleh dibuat daripada kajian ini adalah:

i. Berdasarkan kepada keputusan isyarat kepada hingar (S/N ratio) untuk pemesinan bersudut sadak positif, boleh disimpulkan bahawa A3B2C2 (sudut sadak 7°, sudut kelegaan 7°, radius hujung mata alat 0.8 mm) dan A2B2C3 (sudut sadak 5°, sudut kelegaan 7°, radius hujung mata alat 1 mm) adalah kombinasi parameter bagi keadaan pemotongan logam yang optimum.

ii. Berdasarkan kepada keputusan isyarat kepada hingar (S/N ratio) untuk pemesinan bersudut sadak negatif, boleh disimpulkan bahawa A1B3C (sudut sadak -7°, sudut kelegaan 9°, radius hujung mata alat 1 mm) dan A1B2C3 (sudut sadak -7°, sudut kelegaan7°, radius hujung mata alat 1 mm) adalah kombinasi parameter bagi keadaan pemotongan logam yang optimum.

5. Penghargaan

Sekalung penghargaan kepada Pengarah ILP Mersing yang telah memberi dorongan dan galakan untuk menyiapkan projek ini. Tidak lupa juga rakan-rakan sekerja dan seluruh kakitangan Institut Latihan Perindustrian Mersing yang telah menjayakan projek ini.Terima Kasih.

6. Rujukan

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M5 - Rekabentuk Alat Penyemburan Air Dalam Sistem Unit Penyamanan Udara

Mohamad Hazmi Noordin
Jabatan Mekanikal & Pengeluaran
ILP Kuala Lumpur
hazmi@ilpkl.gov.my

Abstrak

Rekabentuk alat penyemburan air dalam sistem unit penyamanan udara adalah merupakan satu kajian berkaitan dengan alat yang menggunakan air sebagai bahan penyejuk untuk membantu proses penyingkiran haba di pemeluwap. Dalam kajian ini, semburan air digunakan untuk mempercepatkan lagi proses penyingkiran haba. Bidang kajian ini lebih tertumpu kepada rekabentuk, pemasangan dan pengujian alat penyemburan air. Melalui kajian ini satu alat penyemburan air dipasangkan pada unit luar penyaman udara jenis pisah. Kajian dilakukan melalui kaedah eksperimen di mana data-data yang diperolehi menunjukkan keberkesanan alat penyemburan air. Hasil dapatan daripada eksperimen yang dijalankan sememangnya terdapat penjimatan tenaga elektrik dan juga penjimatan kos penggunaan tenaga elektrik. Walaupun peratusan penjimatan tenaga elektrik yang agak kecil iaitu 3.76% namun kesan yang diperolehi melalui kajian ini dapat menjelaskan kebenaran teori.

Katakunci: *Rekabentuk, alat penyemburan air, penyaman udara, penyingkiran haba dan penjimatan tenaga elektrik.*

1. Pendahuluan

Sistem penyamanan udara bertujuan memelihara keadaan udara di dalam ruang dan meliputi pengawalan suhu, kelembapan relatif, kecepatan pengaliran udara mahupun kualiti udara [1]. Penyamanan udara adalah suatu proses untuk mengekalkan keadaan kenyamanan suhu dan kelembapan dengan mengalirkan udara bersih dalam satu ruang tertentu yang bertujuan untuk menggantikan udara yang telah dipergunakan [2]. Tujuan utama sistem penyamanan udara adalah untuk mengawal suhu, kelembapan, pergerakan, peredaran dan pembersihan udara [3].

Penggunaan penyamanan udara pada hari ini banyak tetumpu kepada sektor-sektor domestik, komersial, industri, awam, pengangkutan dan sebagainya. Apabila banyak unit penyamanan udara dipasang maka banyaklah juga tenaga elektrik yang digunakan oleh pengguna. Lebih kurang 45% daripada permintaan tenaga elektrik di negara ini adalah daripada sektor domestik (18%) dan komersial (27%). Kebanyakan daripada tenaga elektrik ini digunakan untuk lampu, penyaman udara dan pemanas air dalam bangunan [4]. Penyaman udara menggunakan bahagian terbesar tenaga iaitu 50% hingga 60% digunakan dalam pejabat. Tenaga paling banyak diserap pada sistem bangunan dan industri melalui pencahayaan, sistem penyamanan udara, lif dan motor elektrik [5]. Sebanyak 72 % tenaga elektrik digunakan oleh sistem penyamanan udara [6].

Penyaman udara merupakan keperluan yang mesti dimiliki oleh semua lapisan masyarakat memandangkan keadaan cuaca yang panas dan tidak selesa semasa berada di dalam pejabat atau tempat kediaman. Hampir kesemua bangunan pada hari ini menggunakan penyaman udara untuk mengawal persekitaran dalaman. Sistem penyamanan udara sedia ada menggunakan tenaga elektrik yang tinggi akan meningkatkan lagi kos harian [7]. Dengan adanya kesedaran tentang penjimatan tenaga dan masalah yang dihadapi oleh pengguna, maka pengkaji ingin mengemukakan satu alat baru yang boleh dijadikan sebagai projek inovasi. Biasanya alat baru yang dihasilkan akibat; *dorongan permintaan* - pengguna memerlukan satu ciptaan baru untuk menyelesaikan sesuatu masalah dan; *perubahan teknologi*-penghasilan atau penemuan teknologi baru mencetuskan permintaan produk baru [8].

Rekabentuk Alat Penyemburan Air Dalam Sistem Unit Penyamanan Udara ini juga adalah merupakan idea baru yang perlu diketengahkan bagi mengatasi masalah penggunaan unit penyamanan udara yang tinggi. Disamping mengurangkan penggunaan tenaga elektrik, projek ini juga diharapkan dapat membantu mengurangkan kos penyenggaraan dan memanjangkan jangka hayat unit penyamanan udara.

2. Bahan dan Kaedah

Alat penyemburan air yang dimaksudkan ini ialah merupakan alat yang digunakan untuk membantu proses penyejukan dalam unit penyamanan udara melalui proses pemindahan haba secara tidak langsung. Air digunakan sebagai bahan penyejuk dimana pemindahan haba berlaku apabila air dialirkan atau disemburkan pada tiub pemeluwap unit penyamanan udara.

2.1 Pemasangan Alat Penyemburan Air

Membina alat penyemburan air dengan melakukan proses pembuatan dan pemasangan di bengkel. Rajah 1.1 di bawah menunjukkan model alat penyemburan air yang telah siap dipasang dan langkah seterusnya ialah membuat pegujian.

Rajah 1.1 : Model Alat Penyemburan air

2.2 Proses Pengujian Alat Penyemburan Air

Proses pengujian alat penyemburan air dilakukan pada unit penyamanan udara di Bengkel Penyejukan dan Penyamanan Udara, ILP Kuala Lumpur (Rajah 1.2). Peralatan yang digunakan ialah *Energy Analyser* dan alat penyukat suhu (Rajah 1.3) Tujuan ujian ini dilakukan adalah untuk melihat kefungsian alat penyemburan air dalam sistem unit penyamanan udara. Setelah diuji dan didapati sesuai untuk dipasang pada unit penyamanan udara di Bilik *Server* ILP Kuala Lumpur.

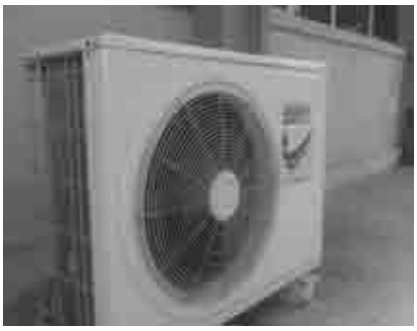
Rajah 1.2 : Pengujian Alat Penyemburan air

Rajah 1.3 : Alat Pengujian

2.3 Eksperimen

Proses eksperimen dilakukan pada unit penyamanan udara di Bilik *Server* ILP Kuala Lumpur. Bilik ini perlu sentiasa dalam keadaan sejuk bagi memastikan peralatan komputer di dalam bilik tersebut dapat berfungsi dengan baik. Bilik ini dilengkapi dengan unit penyamanan udara yang berfungsi 24 jam.

Eksperimen dilakukan pada unit penyamanan udara berdasarkan gambarajah skematik seperti di lampiran (Rujuk Lampiran: Gambarajah A**)**. Pemasangan alat penyemburan air pada unit luar penyamanan udara perlu dilakukan terlebih dahulu sebelum menjalankan eksperimen. Unit luar penyamanan udara Bilik *Server* seperti yang ditunjukkan pada Rajah 1.4.



Rajah 1.4 : Unit Luar Penyamanan Udara Bilik *Server*

Proses pengujian alat penyemburan air pada unit penyamanan udara adalah sama kaedah seperti yang telah dijelaskan di atas. Peralatan yang digunakan juga sama. Eksperimen ini mengambil masa lebih kurang satu jam dan setiap minit bacaan direkodkan oleh alat *Energy Analyser dan* alat penyukat suhu.

3. Keputusan dan Perbincangan

Jadual 1.1 menunjukkan bacaan yang diambil oleh penyelidik semasa dalam keadaan biasa iaitu tanpa menggunakan alat penyemburan air manakala Jadual 1.2 menunjukkan bacaan yang diperolehi dengan memasang alat penyemburan air pada bahagian luar penyaman udara. Tujuannya ialah untuk melihat perbandingan dan keberkesanan alat penyemburan air dalam sistem unit penyamanan udara.

Jadual 1.1 : Sistem Unit Penyamanan Udara (Tanpa Alat Penyemburan air)

No.	Unit Luar				Unit Dalam
	Arus (A)	Voltan (V)	Kuasa (W)	Masa (minit)	Suhu (°C)
1	3.92	238.10	917.40	16:01	17.1
2	3.98	237.80	932.00	16:02	17.2
3	4.05	238.10	947.10	16:03	23.5
4	4.08	237.90	953.70	16:04	20.1
5	4.05	237.40	942.90	16:05	18.5
6	4.05	237.10	948.30	16:06	18.7
7	4.07	238.00	950.10	16:07	18.8

Jadual 1.2 : Sistem Unit Penyamanan Udara (Dengan Alat Penyemburan air)

No.	Unit Luar				Unit Dalam
	Arus (A)	Voltan (V)	Kuasa (W)	Masa (minit)	Suhu (°C)
1	3.88	237.70	907.80	15:50	19.7
2	3.90	238.00	914.00	15:51	17.2
3	3.97	237.50	925.90	15:52	16.6
4	3.93	238.20	919.00	15:53	16.1
5	3.93	237.70	918.60	15:54	17.1
6	3.81	238.50	891.70	15:55	17.2
7	3.70	238.20	866.50	15:56	23.5

3.1 Analisis Data Eksperimen

3.1.1 Analisis Penggunaan Tenaga Elektrik

a) Pengiraan Penjimatan Arus Elektrik

$$\frac{\text{Arus Elektrik (normal) - Arus Elektrik (alat penyemburan air)}}{\text{Arus Elektrik (normal)}} \times 100\%$$

$$= \frac{4.03 - 3.87}{4.03} \times 100\%$$

$$= \mathbf{3.97\ \%}$$

b) Pengiraan Penjimatan Kuasa Elektrik

$$\frac{\text{Kuasa Elektrik (normal) - Kuasa Elektrik (alat penyemburan air)}}{\text{Kuasa Elektrik (normal)}} \times 100\%$$

$$= \frac{941.64 - 906.21}{941.64} \times 100\%$$

$$= \mathbf{3.76\ \%}$$

Ini jelas menunjukkan bahawa jika alat penyemburan air dipasang pada unit luar penyamanan udara, arus elektrik purata pemampat berkurangan sebanyak 3.97% berbanding arus elektrik pemampat yang tidak memasang alat penyemburan air (seperti yang dijelaskan secara teori). Manakala kuasa purata pemampat pula berkurangan sebanyak 3.76%.

Graf keputusan eksperimen di **Lampiran B** menunjukkan perbandingan kuasa diantara unit penyamanan udara yang dipasang dengan alat penyemburan air dan tanpa alat penyemburan air. Graf menunjukkan bahawa terdapat pengurangan kuasa sebanyak 3.76%.

3.1.2 Analisis Kos Penggunaan Tenaga Elektrik

Berdasarkan kepada keputusan eksperimen menunjukkan bahawa ada pengurangan penggunaan arus elektrik dan kuasa pemampat setelah dipasangkan dengan alat penyemburan air pada unit penyamanan udara. Penjimatan kos penggunaan tenaga elektrik boleh dikira menggunakan kaedah seperti berikut;

a) Unit Penyamanan Udara (Normal)

Jumlah purata kuasa unit penyamanan udara = 941.64 W
= 0.94164 kW

Tenaga elektrik yang digunakan dalam masa 24 jam = 0.94164 kW x 24jam
= 22.599 kWj (22.599 unit)

Kadar bayaran bagi satu unit elektrik yang telah ditetapkan ialah RM 0.296

Maka kos penggunaan penyamanan udara = 22.599unit x RM 0.296
= RM 6.69 sehari.

Kos penggunaan penyamanan udara sebulan = RM 6.69 x 30 hari
= **RM 200.68**

b) Unit Penyamanan Udara (Alat Penyemburan Air)

Jumlah purata kuasa unit penyamanan udara = 906.21 W
= 0.90621 kW

Tenaga elektrik yang digunakan dalam masa 24 jam = 0.90621 kW x 24jam
= 21.749 kWj (21.749 unit)

Kadar bayaran bagi satu unit elektrik yang telah ditetapkan ialah RM 0.296

Maka kos penggunaan penyamanan udara = 21.749 unit x RM 0.2
= RM 6.43 sehari.

Kos penggunaan penyamanan udara sebulan = RM 6.43 x 30 hari
= **RM 193.13**

Penjimatan kos penggunaan tenaga elektrik sebulan ialah

RM 200.68 - RM 193.13 = RM 7.55

Oleh itu penjimatan kos penggunaan tenaga elektrik setahun ialah

RM 7.55 x 12 = RM 90.60 (3.76%)

4. Kesimpulan

Hasil daripada keputusan eksperimen yang telah diperolehi menunjukkan terdapat perbezaan penggunaan arus elektrik dan kuasa masukan bagi unit penyamanan udara yang menggunakan alat penyemburan air dan tanpa menggunakan alat penyemburan air. Maka bolehlah disimpulkan bahawa rekabentuk alat penyemburan air dalam sistem unit penyamanan udara dapat mengurangkan penggunaan tenaga dan kuasa elektrik.

Ini bermakna keupayaan alat penyemburan air dalam sistem unit penyamanan udara hanya mampu mengurangkan penggunaan tenaga elektrik sebanyak 3.76% sahaja. Keputusan yang diperolehi jauh lebih rendah penjimatannya jika dibandingkan dengan kajian yang telah dibuat oleh pengkaji sebelum ini. Ada beberapa faktor yang perlu dibuat kajian semula untuk memastikan alat penyemburan air dapat berfungsi dengan lebih efisyen lagi.

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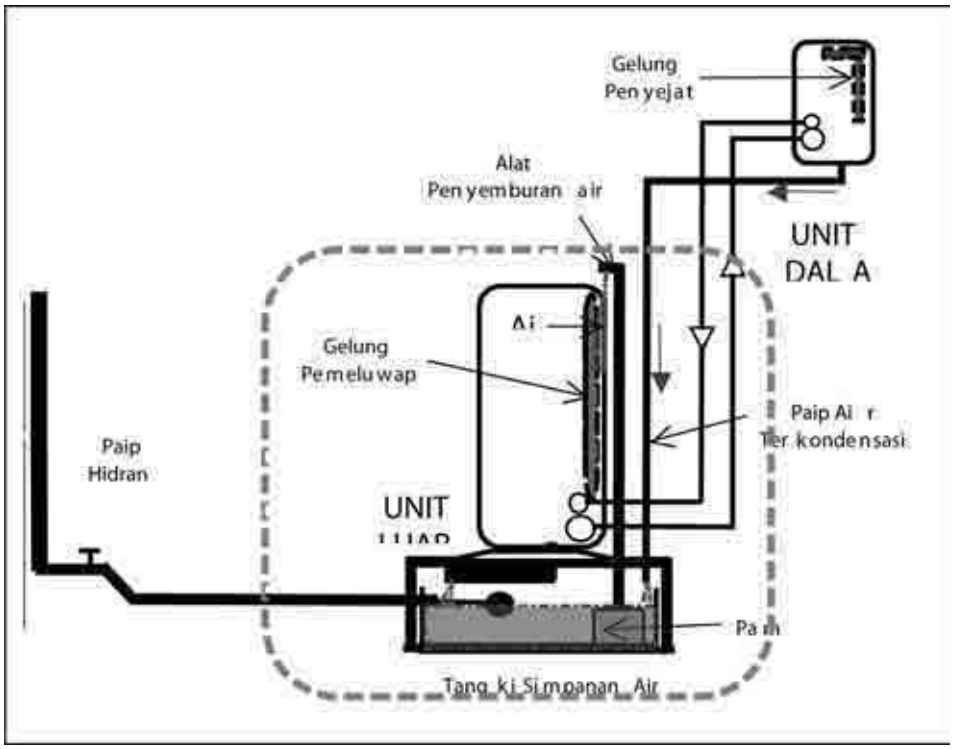
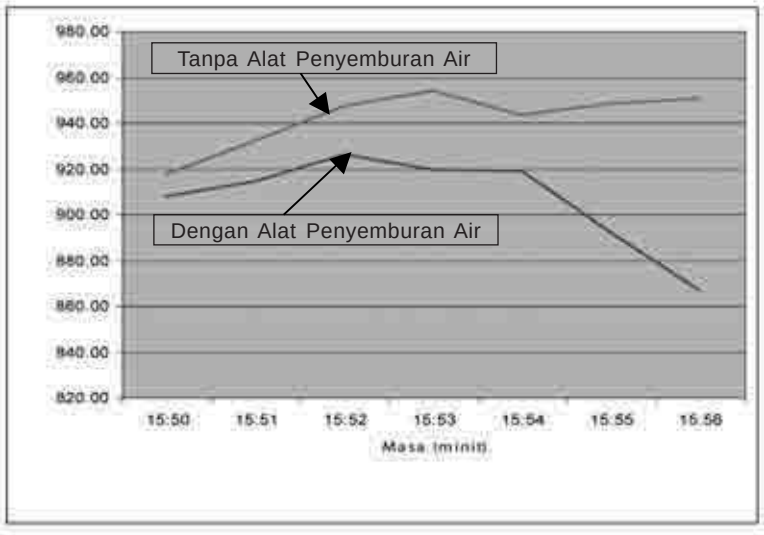
Gambarajah A : Gambarajah Skematik Unit Penyamanan Udara Menggunakan Alat Penyemburan Air



Gambarajah B : Graf Keputusan Eksperimen



M6 - Analyse Performance And Emissions Of Diesel Engine Using Biofuel With Catalytic Converter

Rostam Bin Hamzah
Institut Latihan Perindustrian Kuala Lumpur

Abstract

Global warming highly concentrated in certain regions of the world, Malaysia government not left to become important country to reduce the global warming, therefore in this paper reviews the characterization and potential of vegetable oil (crude jatropha) and biodiesel by blending with the diesel. It can be used in compression ignition engines with no engine modifications. The vegetable oil has properties similar to mineral diesel. This paper presents the results of investigations carried out on a four-cylinder, four strokes and indirect-injection.The experimental touches gas emissions, efficiencies, energy, power, engine performance and etc. Vegetable oils present a very promising alternative to diesel oil since they are renewable and have similar properties. Besides the potential for environment pollution by using vegetable oil as a fuel is quite low.

This paper also shows detail Catalytic Converter device attached operating to convert harmful product of combustion, and others converter process.

Keywords*: Vegetable oils, crude jatropha oil, diesel engines, performance, emissions control(Catalytic Converter).*

1. Introduction

Alternative fuel as a substitute for diesel based fuel have become increasingly important, due to environment concerns, exhausting of crude oil reserves, unstable costs and also transportation problems. Now bio-fuel getting a renewed attention because of global pressure on greenhouse reduction gas (GHGs) and net development mechanism (CDM). Variety of effort that has been undertaken by government to resolve this problem especially focused on reducing emissions from motor vehicles and in relation.

The researchers concluded that there is great potential for biodiesel use in Malaysia. The country's sole producer of biodiesel, can sell and market biodiesel as a sustainable, environmentally beneficial, and economical fuel. Through aggressive educational programs, pilot programs, and government encouragement, Malaysia can comply with EU regulations for biofuels while simultaneously supporting a renewable fuel industry.

1.1 Objective

i. Determine the performance and emissions of diesel engine using blended Biofuel.

ii. Compare the result obtained from crude jatropha oil Bio-Diesel without Catalytic Converter with diesel oil.

1.2 Scope of Study

i. To study, Blended 20% crude jatropha oil(CJ20) with diesel and 20% Jatropha Biodiesel(B20) with diesel.

ii. Analyze the engine performance by the brake power, brake specific fuel consumption (BSFC), thermal efficiency, brake mean effective pressure, air fuel ratio and emission using appropriate methods.

iii. Measure the exhaust emission using gas analyzer.

iv. Analyze performance and exhaust emission with/out Catalytic Converter.

2. Literature Review

2.1 Deepak Agarwal and Avinash Kumar Agarwal (2006); ***"****Performance and emissions characteristics of Jatropha oil (preheated and blends) in a direct injection compression ignition engine****"***;

This experiment used a single cylinder, four strokes, constant speed, water cooled and direct injection diesel engine. The engine operated at a constant speed of 1500 rpm. Experiments were also conducted using various blends of Jatropha oil with diesel (Jatropha–diesel blend). The fuels (Diesel and Jatropha oil) were analyzed for several physical, chemical and thermal properties. Density, cloud point, flash points and pour point of Jatropha oil was found higher than diesel. Higher carbon residue from Jatropha oil may possibly lead to higher carbon deposits in combustion chamber of the engine. Nitrogen content of the fuel also affects the NOx emissions (by formation of fuel NOx). Brake specific fuel consumption was found to increase with higher proportion of Jatropha oil in the blend compared to diesel in the entire load range. Therefore increasing proportion of Jatropha oil in blend decreases the calorific value of the blend which results in increased Brake specific fuel consumption.

3. Methodology

3.1. First Process: Step Prepared the Composition Biodiesel.

This process is produce of crude jatropha oil and diesel fuel in various compositions of bio diesel (CJ20, and B20). From the literature it is evident that dilution or blending of vegetable oil with other fuels like alcohol or diesel fuel would bring the viscosity close to diesel fuel specification. Therefore, crude jatropha oil was blended with diesel oil in varying pro-portions with the intention of reducing its viscosity to the diesel fuel. The important physical and chemical properties of the biodiesel thus prepared are given in. The various blends were stable under normal conditions.

3.2 Second Process : Performance and Emissions Test

The diesel engine 2.0L model which is kind of four cylinders, four stroke and indirect Injection Fuel System was used in this project as shown in Figure 3.1. Measurement equipment fitted on the engine to gauge the engine performance and emissions. Table 3.1 shows the specifications of engine were used in this project. The test will be conducted at Automotive Workshop, Universiti Tun Hussein Onn Malaysia. Engine operated with the compositions biodiesel (CJ20 and B20) and compare with diesel fuel operate with and without Catalytic Converter. Data are being recorded when engine speed at rpm1000, 1500, 2000, 2500 and 3000 for the performance and the emissions.

3.3 Third Process: Perform Emission Test with Catalytic Converter.

The emission test, gas analyzer are provides the reading for composition of hydrocarbon (HC), nitrogen dioxide (NOx), carbon monoxide (CO), carbon dioxide (CO2), and oxygen (O2) which is compared with/ out Catalytic Converter .

4. Result And Discussion

4.1 Fuel properties

The fuels (Bio diesel, Diesel and crude jatropha oil) were analyzed from references in several physical, chemical and thermal properties and results are shown in **Table 4.1.** Density, cloud point and pour point

of crude jatropha oil and Bio Diesel were found higher than diesel. Higher cloud and pour points reflect unsuitability of crude jatropha oil as diesel fuel in cold climatic conditions. The higher viscosity in crude jatropha oil leads to difficulty in atomizing the fuel and cause higher emission of hydrocarbon. The flash point of crude jatropha oil was quite high compared to diesel. Hence, crude jatropha oil is extremely safe to handle. Higher carbon residue from B20 oil may possibly lead to higher carbon deposits in combustion chamber of the engine. Presence of oxygen in fuel improves combustion properties and emissions but reduces the calorific value of the fuel. Nitrogen content of the fuel also affects the NOx emissions (by formation of fuel NOx). Higher viscosity is a major problem in using vegetable oil as fuel for diesel engines. In the present investigations, viscosity was reduced by blending the oil with mineral diesel. (Table 4.1: Properties of Mineral Diesel, Jatropha Oil and Biodiesel)

4.2 Diesel Catalytic Converter

This part analyzed how perfect engine is operating with Catalytic Converter as part as filtering device, Diesel engine always produce harmful by products of combustion. That is what necessitates the use of a Three-Way Catalytic (TWC) converter.
This device is located in-line with exhaust system and is used to cause a desirable chemical reaction to take place in the exhaust flow. Essentially, the catalytic converter is used to complete the oxidation process of hydrocarbon (HC) and carbon monoxide (Co), in addition to reduce of Nitrogen (NOx) back to simple Nitrogen and Carbon dioxide. Detail discussion on data analysis will discuss cause and effect of emission using catalytic converter as a emission control device.

4.3 Engine performance

From the result engine testing carried out, data grouped and scheduled in tabular form and graph. Graph achieved was analyzed for evaluate and compare engine performance on different fuel use namely CJ20, B20 and with reference fuel Diesel (Conventional mineral diesel). Data of torque, power and others derivative is plotted in graph form against speed engine.

4.4 Torque

Torque values of CJ20 and B20 with diesel are nearly same to diesel fuel values in all revolutions; however these values are a little lower and average decrease of torque values for both fuel. CJ20 was a lower value compared others fuel, using Catalytic converter also contributed to causes of dropping value. The greater differences value was at range 2000rpm it may caused of high viscosity and density of all the tasted fuel. In addition, heating value of B20 and CJ20 is higher than diesel fuel and has got a bad combustion become of its higher viscosity and big atomized injection. In bad circumstance can be oil and clogs fuel filters and injectors in engines.

4.5 Brake power

In general, although maximum power values of both fuels are very close, crude jatropha oil blend's power value were lower than diesel fuel. This lower engine power obtained for blended crude jatropha oil an bio diesel fuel could be due to fuel flow problems, as higher density, higher viscosity, decreasing combustion efficiency as bad fuel injection atomize and lower thermal efficiency than diesel fuel. Then reason, why the engine power increases at low speeds and decreases at high speeds, It because the higher density of jatropha oil and bio diesel fuel blends increases from mixture momentum and consequently penetration depth in-cylinder, whereas higher viscosity and surface tension of biodiesel prevents sufficient breaking of the biodiesel during injection process.

4.6 Brake-Specific Fuel Consumption

The graph obtained shown the brake specific fuel consumption increases due to fuel consumed amount compared on speed. From that it is figure up that using catalytic converter as a filtering device

not disturbing any value in term of fuel consumption. Through experiment and data collected before this clearly understood from horse power, torque and specific fuel consumption express power characteristics of engine performance can be measured.

4.7 Brake Mean Effective Pressure

Maximum brake mean effective pressure was showed from B20 (without catalytic converter) and also B20 (using catalytic converter) compared to Diesel brake mean effective pressure, the lowers value from CJ20 in both conditions. This situation contribution from value of Cloud Point each oil, Calorific Value and Air Fuel ratio compared diesel fuel. The quantity known as lower heating value or net calorific value is determined by subtracting the heat of vaporization of the water vapor from the higher heating value. Another factor contribution due lowers value of brake mean effective pressure from B20 and CJ20 is cloud point of the both fuel B20(13^0c) and CJ20(6^0c) compared diesel (3^0c) were mean the temperature at which dissolved fuel from both fuel are no longer completely soluble, precipitating as a second phase giving the fuel a cloudy appearance.

4.8 Exhaust Temperature

Exhaust temperatures for blended crude jatropha oil concentration were lower at all test periods than diesel fuel different with bio diesel full. Catalytic Converter always shown that decreasing exhaust gas temperature for all fuel, the reason may be due to the presence of constituents energy that each fuel has converted to Calorific Value, hence Exhaust gas temperature trends were consistent with lower thermal efficiencies and lower power observed for Crude oil compared with Bio fuel oil. Loss Calory of exhaust gas depended mixed percentage of air with fuel measured by value of discharged as exhaust gas after burnt in cylinder.

4.9 Carbon Monoxide Emissions,(CO)

Without Catalytic Converter : CO emission is the ideal emission product assessor. The differences Air fuel ratio, Viscosity and Flash Point where helps to understanding the characteristic of complete combustion for all fuel tested. In detail view the CO emissions decrease greatly since both physical and chemical take place during the ignition delay. CO emissions were formed when carbon in fuel is not burned completely. The higher viscosity and poor atomization tendency of blended crude jatropha oil leads to poor combustion and lower carbon monoxide emission. So by lower CO emissions were cause the good environment.

With Catalytic Converter : In term of variation conversion efficiency Catalytic Converter graph pattern showed value was converted from lower engine revolution, CJ20 dropped about 51%, B20 dropped about 10% and diesel about 81%. For higher engine revolution, CJ20 dropped about 45%, B20 dropped about 93% and diesel about 94%. The conversion efficiency of Catalytic Converter to convert CO gases from all tasted fuel showed that this experiment successful achieve

4.10 Nitrogen Oxide emissions(Nox)

Without Catalytic Converter : Higher thermal efficiencies, lower bsfc and higher exhaust temperatures are reported for all blends of biodiesel compared to mineral diesel. The emission of NOx increased by 5% for B20 blend. B20 was found to be the optimum biodiesel blend giving maximum increase in thermal efficiency, lowest BSFC and advantage in terms of lower emissions.

With Catalytic Converter : In term of variation conversion efficiency Catalytic Converter graph pattern showed value was converted from lower engine revolution, CJ20 no dropped found, but B20 dropped about 3.4% and diesel about 3.9%. For higher engine revolution, CJ20 dropped about 6.97%, B20 dropped about 10% and diesel about 8.6%.

4.11 Opacity

Without Catalytic Converter : This studies show that smoke opacity for biodiesel is generally within Diesel fuel value. Due this experimental investigations are performed on 4-stroke DI diesel engines found that hydrocarbon emissions are much lower in case of CJ20 compared to diesel. This is also due to oxygenated nature of CJ20 where more oxygen is available for burning and reducing hydrocarbon emissions in the exhaust. Opacity from B20 fuel pattern graph value always showed higher than diesel.

With Catalytic Converter : In term of variation conversion efficiency Catalytic Converter graph pattern showed value was converted from lower engine revolution, CJ20 soot without catalytic converter earlier had redundant problem on smoke smoothly filtered by catalytic converter, B20 dropped about 3.4% and diesel about 3.9%.

For higher engine revolution, CJ20 dropped about 6.97%, B20 dropped about 10% and diesel about 8.6%. The conversion efficiency of Catalytic Converter to convert smoke gases from all tasted fuel showed that this experiment very much successful achieve target.

5. Conclusion

Generally during this research experiment covered all about Compression Ignition Engine (CI) such as Type of Combustion engine, Phenomenological of Compression Ignition Engine (CI), Analysis of cylinder, Fuel spray Behavior and Ignition Delay. Catalytic Converter always shown that decreasing exhaust gas temperature for all fuel, the reason may be due to the presence of constituents energy that each fuel has converted to Calorific Value, hence Exhaust gas temperature trends were consistent with lower thermal efficiencies and lower power observed for Crude oil compared with Bio fuel oil. At last out put from this project concentration of pollutions and renewed energy achieved target to become an alternative fuel as a substitute for diesel and healthy environment living.

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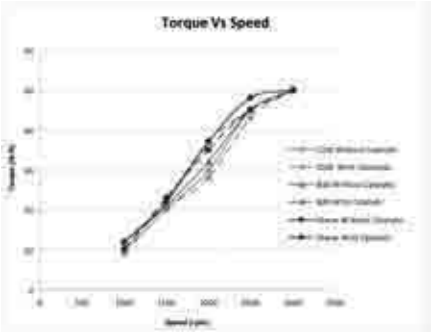

Figure 1: Torque Versus Engine Speed

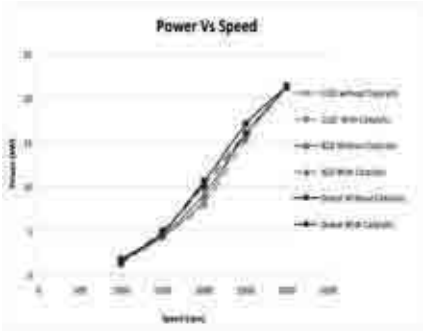

Figure 2: Power Versus Engine Speed

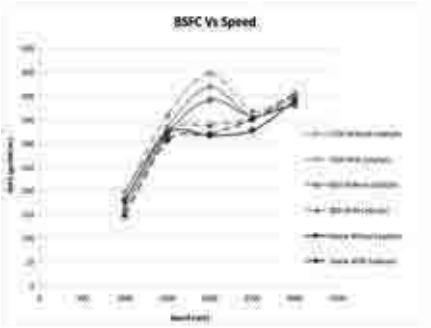

Figure 3: BSFC Versus Engine Speed

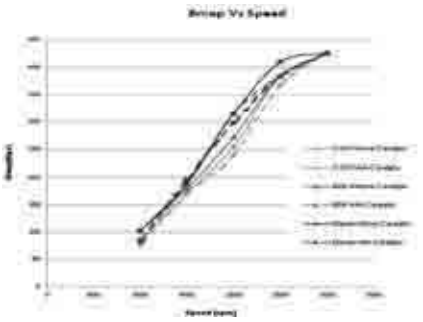

Figure 4: Bmep Versus Engine Speed

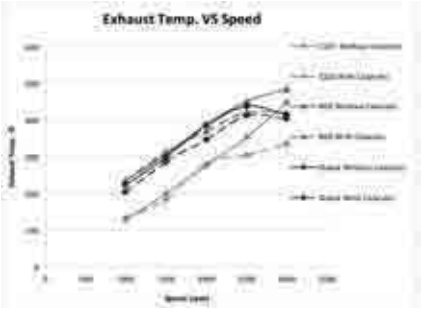

Figure 5 : Exhaust Versus Engine Speed

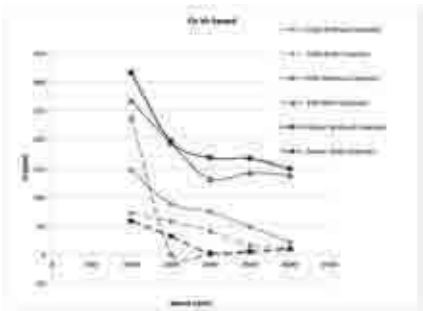

Figure 6 : CO Versus Engine Speed

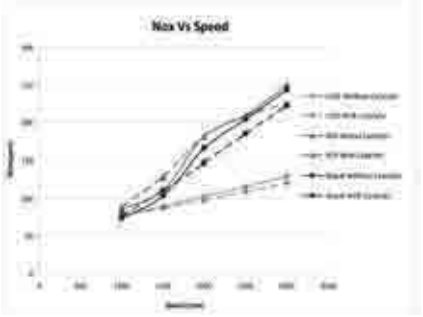

Figure 7: NOx Versus Engine Speed

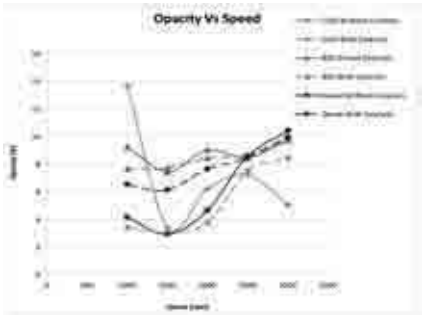

Figure 8: Opacity Versus Engine Speed

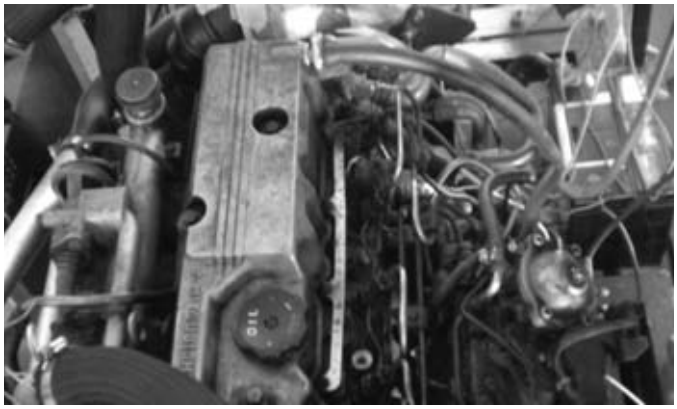

Figure 8: Mitsubishi 4D68T 2.0L Model

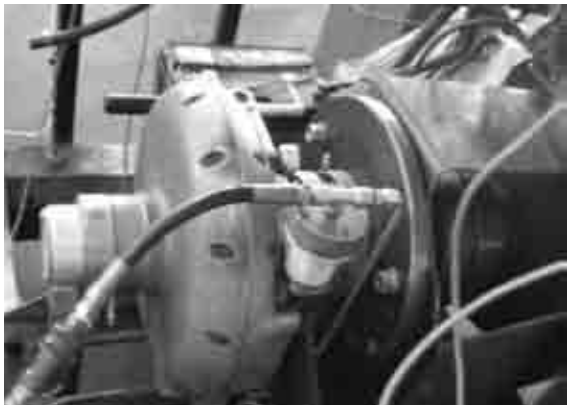

Figure 9: Hydraulic Dynamometer DA316

Table 1: Properties for the composition of jatropha oil blend and diesel fuel

Properties	Diesel	CJ20	B20
Density(kg/m^3)	840	856.2	847.1
Kinematic viscosity at 40^{0}c	2.44	6.8	4.1
Cloud point (^{0}c)	3	6	13
Flash point (^{0}c)	71	158	143
Calorific value (MJ/kg)	45.387	40.1	41.9
Ash(%)	0.01	0.05	0.04
Pour Point(^{0}c)	-6	12.7	14
Water Content(%,w/w)	0.05	0.01	0.001
Carbon (%)	0.1	0.13	0.16

M7 - EDM WIRECUT OF TITANIUM ALLOY (Ti-6A14V) USING BRASS COATED WIRE ELECTRODE

Mohd Faisal Othman
Advanced Technology Centre (ADTEC) Kulim.
E-mail: phye_zarl@yahoo.co.uk

Abstract

Among non conventional machining methods which nowadays find a wide range of applications, electro discharge machining (EDM) is the most extensively used cutting technique in the production floor for die making, precision machining, the cutting separation of sheet materials and for manufacturing prototypes. Wire electro discharge machining (WEDM) is an important non traditional machi9ning process, widely used for machining a variety of difficult to machine materials such as Titanium (Ti6Al4V) with intricate shape. The process is essentially a thermal process and the nature of surface produced is studied in this paper.

Keywords:. *Wire electro discharge machining (WEDM) , Titanium (Ti6Al4V).*

1. Introduction

EDM wires cut using brass wire have been established long ago. With the introduction of new materials progressively a wire EDM has evolve into a highly disciplined process. Wire manufactures has come with a brass coating technology that promote speed and performance. However studies on EDM wire cut using coated wire electrode were somehow limited. Manufactures claimed that the outstanding performance is achieved through their lab test. Sadly the tests are not disclosed to the public and researcher for further study. These makes rather the machine materials information and the WEDM parameter set for the subjected wire somehow limited. “The parameter settings given by the manufacture are commonly applicable to the common steel grades [2].

Titanium has been perceived as a material that is difficult to machine. Due to titanium’s growing acceptance in many industries, along with the experience gained by progressive fabricators, a broad base of titanium machining knowledge now exists. However, the parameter settings on WEDM of titanium alloy are still lacking. The available technological data which is based on manufactures for in house experimentation is helpful but insufficient.

“The manufacture guidelines for the selection of machining parameter are conservatively in nature and do not lead to optimal economically effective use of the machine”. [10].

2. Wire – electro discharge machining

Wire-electro discharge machining has been defined as the process of material removal of electrically conductive materials using the thermo-electric source of energy. The material removal is by controlled erosion through a series of repetitive sparks between electrodes, i.e., workpiece and tool

The material removal mechanism of WEDM is very similar to the conventional EDM process involving the erosion effect produced by the electrical discharges (sparks). In WEDM, material is eroded from the workpiece by a series of discrete sparks occurring between the workpiece and the wire separated by a stream of dielectric fluid, which is continuously fed to the machining zone [21]. In case of WEDM, a wire electrode is trailing vertically through the workpiece which usually is fed horizontally. This process utilizes a continuously traveling wire electrode made of thin copper, brass or tungsten of diameter 0.05 – 0.3 mm,

which is capable of achieving very small corner radii [20]. The wire is kept in tension using a mechanical tensioning device reducing the tendency of producing inaccurate parts. During the WEDM process, the material is eroded from the workpiece by a series of discrete sparks, ahead of the wire. A varying degree of taper ranging from 15° for a 100 mm thick to 30° for a 400 mm thick workpiece can be obtained on the cut surface material. The microprocessor which is used to continuously feed thin wire will constantly maintains the gap between the wire and the workpiece, which usually varies from 0.025 to 0.05 mm [22]. In WEDM process, there is no direct contact between the workpiece and the wire thus, eliminating the mechanical stresses during machining the work materials. The electrode used in this process is renewed constantly in order to avoid rapture (Figure 2.1).

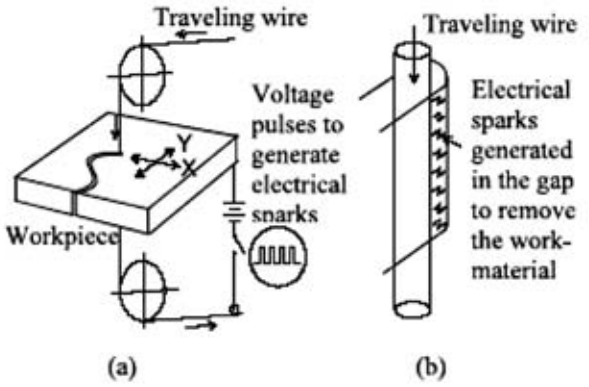

Figure 2.1: (a) Conventional wire EDM. (b) Close-up view of the gap and continuous electrical sparks.

The advantages of this process are the wire used is cheaper than the complex electrodes used in die sinking electric discharge machining, less cost of machining are required due to no electrode wear occurred and very little wastes of workpiece material is provided. Nevertheless, the drawbacks of this operation are it is possible only for ruled surfaces and the wire may bend or break during machining, which cause substantial shape errors and drastically reducing the efficiency and accuracy of the WEDM operation. Therefore, today's WEDM process is commonly conducted on workpieces that are totally submerged in a tank filled with dielectric fluid. A submerged method of WEDM is used as it is promotes temperature stabilization and efficient flushing especially in cases where the workpiece has varying thickness [20].

Although WEDM can be conducted in both methods such as submerged in tank filled with dielectric or dry machining, most important is to get a good quality of machined surface and dimensional accuracy. As such, a significant amount of research has explored the different methodologies of achieving the ultimate WEDM goals of optimizing the numerous process parameters analytically with the total elimination of the wire breakages thereby improving the overall machining reliability.

3. Experiment

Surface roughness is an important process reaction, which dictates the condition of the surface component which has to be machined. If the surface finish of the machined work material was the decisive factor due to its application requirements, then the work material must be machined with low material removal rate

In this study, four-factor experiment design will be employed with two levels of full factorial design experiment. The total number of experiments (combinations) required is 16 (2^4) experiments. This experiment design will include all the possible combinations factors at two levels which are called low and high value for each parameter. The notation used to denoted this levels is "plus" for high value and "minus" for low value (Table 3.1). The arrangements of the factors for this project will be based on Minitab R13® software. This program will randomly choose the combination of factors to run the experiment. This software also

will automatically analyze all the experimental results in order to investigate the influence of machining parameters on the surface integrity of the work piece material. The results of the experiments were presented as the combination of four factors with four responses such as micro-cracks, surface finish, recast layer and spark gap.

Machining parameters and machining characteristics were the two groups of variables that are studied. Machining parameters are classified as all the data or source that belongs to such machines involved in this study. Machining parameters or also known as the independent variables that involved in this research are pulse duration (ON, µs), pulse interval (OFF, µs), peak current (IP, ampere) and servo voltage (SV, volt). These parameters were denoted as ON, OFF, IP and SV respectively. The machining characteristics are the dependent variables which are the output of the experiment during machining operation. The dependent variables investigated in this study are surface roughness, MRR and spark gap.

Table 3.2: The design machining parameters and their levels.

Machining Parameters	Level	
	1	2
	Low	High
Pulse Duration ON (µs)	0.65	0.75
Pulse Interval OFF (µs)	4	8
Peek current IP (Ampere)	8	12
Servo Voltage (Volt)	30	60

Exp. No.	Factor			
	Servo Voltage (SV) (V)	Peak Current (IP) (A)	Pulse Duration (ON) (µs)	Pulse Interval (OFF) (µs)
1	-	-	-	-
2	+	-	-	-
3	-	+	-	-
4	+	+	-	-
5	-	-	+	-
6	+	-	+	-
7	-	+	+	-
8	+	+	+	-
9	-	-	-	+
10	+	-	-	+
11	-	+	-	+
12	+	+	-	+
13	-	-	+	+
14	+	-	+	+
15	-	+	+	+
16	+	+	+	+
17	cp	cp	cp	cp
18	cp	cp	cp	cp
19	cp	cp	cp	cp
20	cp	cp	cp	cp

+ for high value
- for low value Cp ** Centre points

Table 3.1: Two-level full factorial experiment with four factors.

Parameter	Setting Value
Main power supply voltage, V (Volt)	80
Servo speed, SF (mm/min)	1 (at no load) - normal servo control
Wire tension, WT (g)	1000
Wire speed, WS (M/min)	6
Flushing pressure, WP (bar)	4
Wire electrode	Brass (hard brass) wire (Ø 0.25mm)
Polarity	Work piece: Positive Wire electrode: Negative
Dielectric fluid	Submerge Deionizer water

Table 3.5: List of machine parameters.

After WEDM operations, the machined work piece were cut into smaller specimens perpendicular to the EDMed surface with the same wire-cut machine (refer to Figure 3.8). This is to reveal the section of EDMed surface layer for measuring the surface roughness. The machined surface roughness was then measured using Mitutoyo Formtracer CS-5000 .

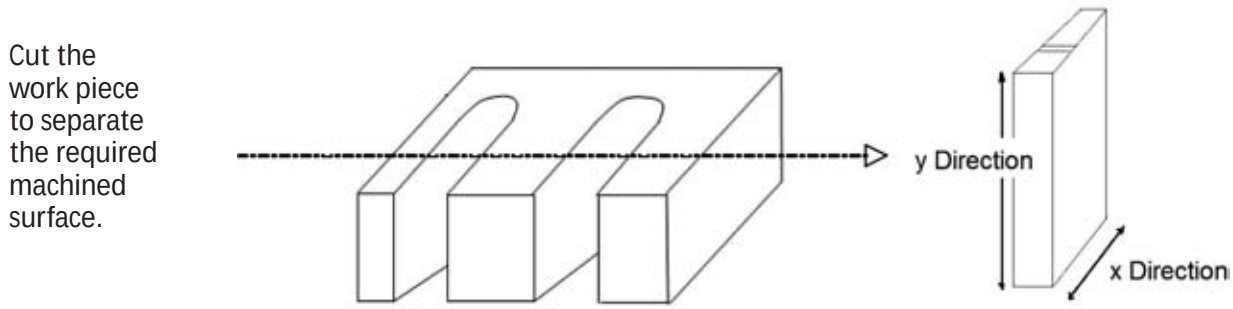

Figure 3.8: The diagram of cutting direction on the work piece.

In accordance to the researched made on measuring the surface roughness, Mustafa et.al [14] reported that the measurement must consider the x an y-direction which are perpendicular to lay direction. Horizontal (x direction) is expected to be more crucial than the average surface roughness along the vertical direction (y direction) due to the position of lay direction , the average of surface roughness along horizontal and vertical direction is used as an indication of the total surface roughness of each test section.

$$\text{Roughness on X-axis } (R_x) = (R_{x1} + R_{x2} + R_{x3})/3$$
$$\text{Roughness on Y-axis } (R_y) = (R_{y1} + R_{y2} + R_{y3})/3$$
$$\text{Overall Roughness } (R_{av}) = (R_x + R_y)/2 \quad \text{.....(4)}$$

3. Results : analysis of Overall Surface Roughness, Ra

In these analysis, data from Ra X and Ra Y were combined to produced the overall data based on Mustafa et.at [14] approached.Below is the DOE analysis results for overall Ra.

With the aid of Minitab R13 , the experiments were done with a random order with a selected parameter setting. The design chosen is full factorial experiments of four factors with two levels each (2^4 = 16 sets of experiments). Added up with a single replication with four center points that makes 4 runs; a total of 20 experiments or run has been conducted. All 20 runs of WEDMing was performed on a linear motor Sodick AQ325L WEDM machine using Ø 0.25mm Zinc coated wire. The work piece used in the experiments was a 25mm thick bar with a 30 mm in width and 60 mm in length.

	SV	**IP**	**ON**	**OFF**	**CS**	**MRR**	SG av	**Ra x av**	**Ra y av**	**Overall Ra**
Exp. No.	Servo Voltage (V)	Peak Current (A)	Pulse Duration (µs)	Pulse Interval (µs)	Time Travel (10mm) M/min	Note: Titanium Density (rho) 4507 Kg/m3); X = Weight (g)	Spark Gap (mm)	Surface Rough. X Direction	Surface Rough. Y Direction	(Rx+Ry) /2
1	**30**	**8**	**0.65**	**4**	1.725	0.0569	0.049	1.79	1.73	1.76
2	**60**	**8**	**0.65**	**4**	0.366	0.0124	0.053	1.9	1.49	1.695
3	**30**	**12**	**0.65**	**4**	1.937	0.0641	0.050	1.68	1.88	1.78
4	**60**	**12**	**0.65**	**4**	0.481	0.0163	0.053	2.19	2.15	2.17
5	**30**	**8**	**0.75**	**4**	2.256	0.0770	0.054	2.43	2.1	2.265
6	**60**	**8**	**0.75**	**4**	0.437	0.0159	0.064	2.57	1.86	2.215
7	**30**	**12**	**0.75**	**4**	1.836	0.0622	0.053	2.27	2.387	2.3285
8	**60**	**12**	**0.75**	**4**	0.736	0.0268	0.065	2.26	2.01	2.135
9	**30**	**8**	**0.65**	**8**	1.605	0.0531	0.049	1.67	1.8	1.735
10	**60**	**8**	**0.65**	**8**	0.276	0.0095	0.055	1.95	1.76	1.855
11	**30**	**12**	**0.65**	**8**	1.723	0.0583	0.053	1.84	2.11	1.975
12	**60**	**12**	**0.65**	**8**	0.459	0.0155	0.053	1.77	1.89	1.83
13	**30**	**8**	**0.75**	**8**	2.118	0.0743	0.058	1.89	2.24	2.065
14	**60**	**8**	**0.75**	**8**	0.344	0.0121	0.059	2.63	2.13	2.38
15	**30**	**12**	**0.75**	**8**	1.773	0.0614	0.056	2.33	2.21	2.27
16	**60**	**12**	**0.75**	**8**	0.670	0.0238	0.060	2.31	2.09	2.2
17	**45**	**10.4**	**0.7**	**6**	1.657	0.0590	0.061	1.98	2.31	2.145
18	**45**	**10.4**	**0.7**	**6**	1.631	0.0571	0.058	2.1	1.95	2.025
19	**45**	**10.4**	**0.7**	**6**	1.641	0.0569	0.057	2.1	1.96	2.03
20	**45**	**10.4**	**0.7**	**6**	1.629	0.0572	0.059	1.9	1.88	1.89

Factorial Fit: Overall Ra versus SV, IP, ON, OFF

Estimated Effects and Coefficients for Overall Ra (coded units)

Term	Effect	Coef	SE Coef	T	P
Constant	**2.04116**	**0.02607**	**78.29**	**0.000**	
SV	0.03769	0.01884	0.02607	0.72	0.522
IP	0.08981	0.04491	0.02607	1.72	0.183
ON	**0.38231**	**0.19116**	**0.02607**	**7.33**	**0.005**
OFF	-0.00481	-0.00241	0.02607	-0.09	0.932
SV*IP	-0.04231	-0.02116	0.02607	-0.81	0.476
SV*ON	-0.03731	-0.01866	0.02607	-0.72	0.526
SV*OFF	0.01731	0.00866	0.02607	0.33	0.762
IP*ON	-0.08769	-0.04384	0.02607	-1.68	0.191
IP*OFF	-0.02981	-0.01491	0.02607	-0.57	0.608
ON*OFF	-0.00231	-0.00116	0.02607	-0.04	0.967
SV*IP*ON	-0.08981	-0.04491	0.02607	-1.72	0.183
SV*IP*OFF	-0.12019	-0.06009	0.02607	-2.31	0.105
SV*ON*OFF	0.10481	0.05241	0.02607	2.01	0.138
IP*ON*OFF	0.04019	0.02009	0.02607	0.77	0.497
SV*IP*ON*OFF	0.05981	0.02991	0.02607	1.15	0.335
Ct Pt	-0.01866	0.05830	-0.32	0.770	

S = 0.104283 PRESS = *
R-Sq = 96.20% R-Sq(pred) = *% R-Sq(adj) = 75.96%

Analysis of Variance for Overall Ra (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	4	0.622691	0.622691	0.155673	14.31	0.027
2-Way Interactions	6	0.048262	0.048262	0.008044	0.74	0.656
3-Way Interactions	4	0.140448	0.140448	0.035112	3.23	0.181
4-Way Interactions	1	0.014310	0.014310	0.014310	1.32	0.335
Curvature	1	0.001114	0.001114	0.001114	0.10	0.770
Residual Error	3	0.032625	0.032625	0.010875		
Pure Error	3	0.032625	0.032625	0.010875		
Total	19	0.859450				

Figure 4.6a DOE analysis for Overall Ra

Using the p value less 0.05 in figure 4.6a, the only significant factor is the Pulse Interval, ON. No 2 way , 3 way or 4 way interaction is critical for overall Ra.

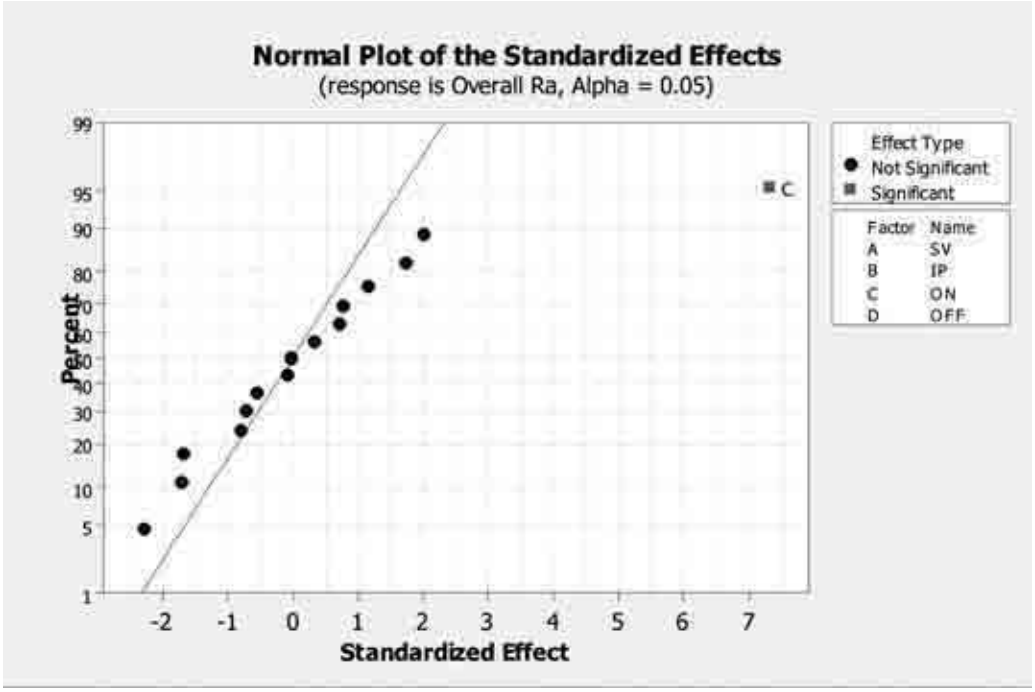

Figure 4.6b Normal Plot for Overall Ra

The normal plot chart on figure 4.6b shows that the critical main effect is the Pulse Interval (ON).

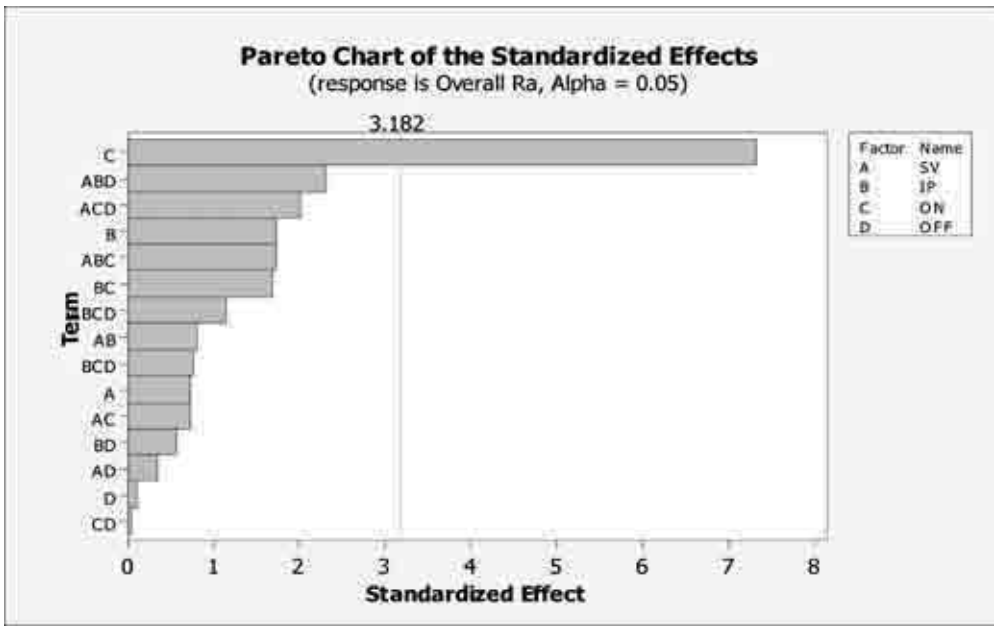

Figure **Figure 4.6c** Pareto Chart Overall Ra

* The Pareto chart shown of figure 4.6c also shows that the critical main effect is the Pulse Interval, ON.

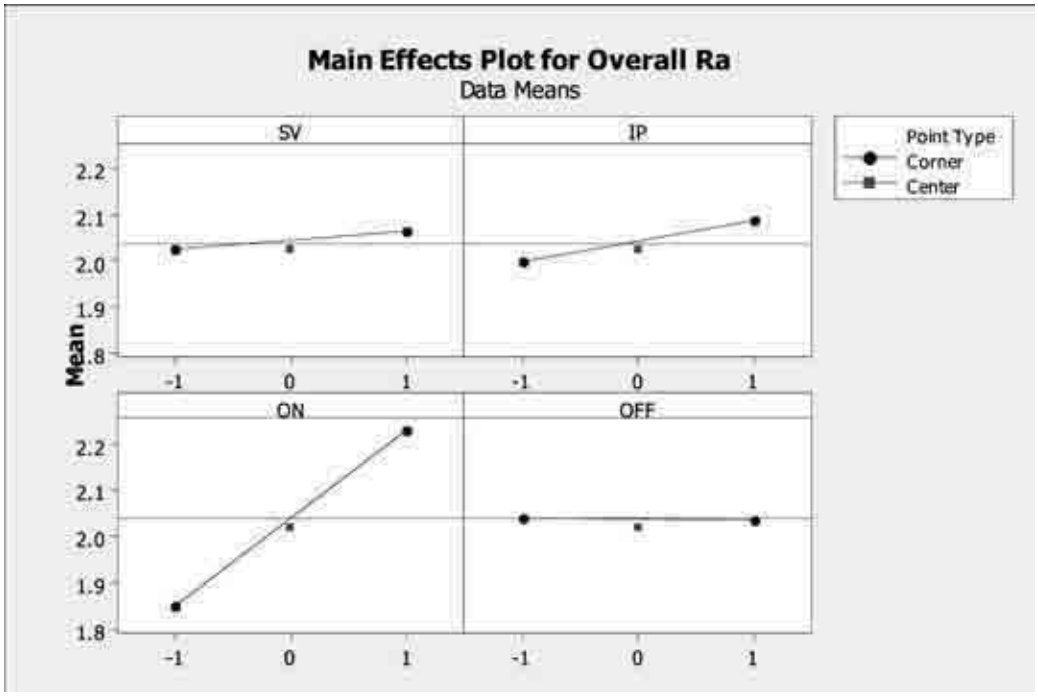

Figure 4.6d Main effect Plot Overall Ra

The Main effects plots shown in figure 4.6d shows that the Pulse Interval, ON has greater impact on the overall surface roughness.

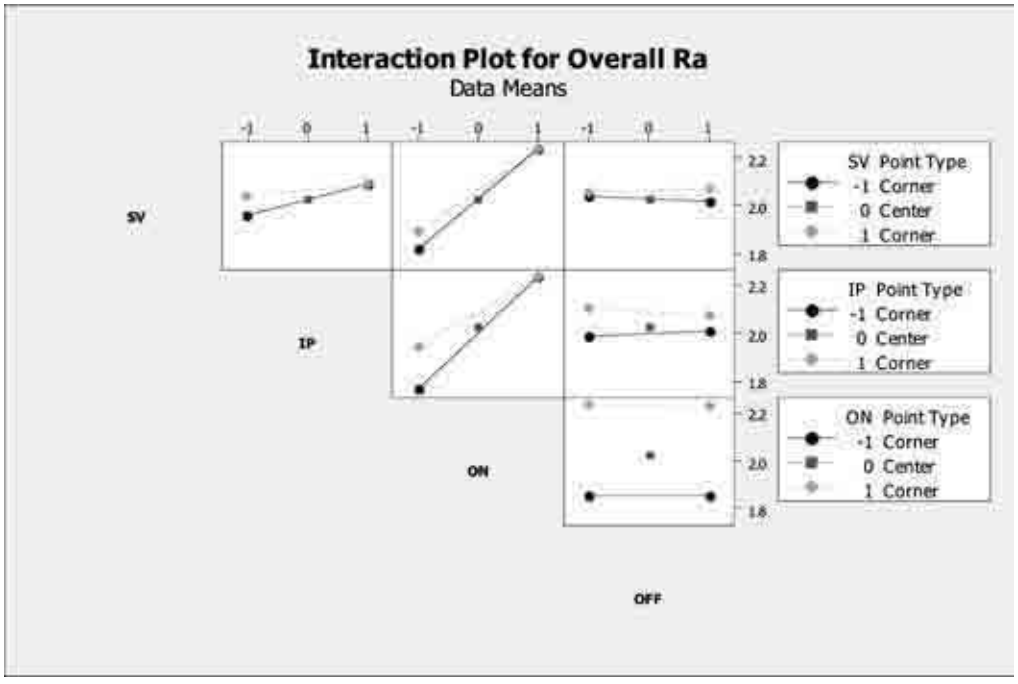

Figure 4.6e Interaction PLOT Overall Ra

The interaction plots on figure 4.6e shows no obvious interaction between the main effects.

Based on the significant factors and interactions the mathematical model is reduced to the below formula.

Overall Ra = 2.04 + 0.19ON

4. Conclusions

Servo voltage (SV) and Pulse Duration (ON) is the most significant factor of all four parameter used in the experiments since it is appeared to be the main effects of all three responds.Higher Servo Voltage (SV) will leads to a higher resistance with respects of given amount of Current (IP) that makes the cutting speed become slower and the MRR becomes lower.

(V(voltage) = I(current) X R(resistance))

Pulse Duration (ON) let the Current through the wire in a specified time. Pulse Interval (OFF) is the most insignificant factor among four machining parameter in submerge WEDM Ti6Al4V.Other factors compliment each other. “Large pulse duration time ON leads to higher discharging energy which will generate more heat energy, resulting thicker surface oxidation” – Shajan Kuriokose etal.

5. Recommendations.

A few area to study and extensive discussion was encountered and recommended to be further study are as follows:

Different wire material to be considered for better understanding of the effect on surface characteristics of wire material plunged into the work piece surface consequent upon wire pitting. For example a study on two different wires with Zinc Coated and Uncoated Brass wires. The effects and interaction between wire material and Ti6Al4V can be identified.

A study on improving the spark distribution on Coated Wire which has known for producing a crater on the edge of a kerfs. To minimized the numbers of possibility of the work piece being subjected to secondary process i.e. lapping , machining etc. As a results, better understanding on the machining a work piece within a dedicated orientation can be accomplished.

Study concerning on microstructure also reasonable for further study in order to have a better understanding o the effect of power density and spark distribution especially from variation of peak current, Ip and servo voltage , SV and Microstructure.

Process parameters design ,Factors affecting the performance measures, Effects of the process parameters on the cutting rate. Wire Wear Ratio, Surface Integrity etc

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M8 - Hand Riveting Gun

Ahmad Nizam bin Yaacob
Pusat Latihan Teknologi Tinggi (ADTEC) SHAH ALAM

Abstrak

Projek yang dihasilkan ini adalah salah satu peralatan tangan rivet yang diperbaharui dari segi reka bentuk dan kekuatan tekanan. Setelah mengkaji hand rivet yang terdapat dipasaran, kami dari kursus Teknologi Pembuatan telah membuat penambahbaikan hand rivet di mana matlamatnya adalah untuk memudahkan menjalankan proses rivet Mesin rivet tangan ini merupakan salah satu keperluan yang penting bagi proses rivet. Ianya dapat membantu melakukan kerja dengan lebih mudah dan pantas tanpa menggunakan tenaga yang banyak. Mesin rivet tangan ini menggunakan sistem pneumatik dengan gabungan bahagian mekanikal bagi menjayakan proses ini. Selain itu juga, pengguna dapat mengendalikan mesin rivet tangan ini dengan mudah serta memberikan keselesaan kepada pengguna seterusnya dapat menjimatkan masa serta dapat meningkatkan produktiviti pengeluaranya.

1. Pengenalan

Pada zaman kini, teknologi semakin maju dari pelbagai aspek dari pelbagai jenis bidang. Tidak terkecuali juga dari sektor perindustrian amnya dan proses pembuatan serta pengeluaran khasnya yang mempunyai peralatan baru yang sentiasa dievolusikan bagi memudahkan pengguna. Pelbagai rekaan rekabentuk peralatan yang telah dicipta bagi memberi kemudahan yang ciri-ciri keselamatan diutamakan kepada pengguna dalam penghasilan produk. Antara peralatan dalam sektor pembuatan yang sentiasa diperbaharui antaranya jig, pemegang bendakerja(vise), *hand drill,* dan lain-lain.

Oleh yang demikian, kami telah mengkaji beberapa jenis alatan yang terdapat dipasaran seperti *hand drill, hand skru* dan *hand rivet.* Dimana diantara ketiga-tiga alatan tangan tersebut kami telah memilih untuk memperbaharui alatan tangan untuk proses rivet yang memerlukan tenaga serta kurang ciri-ciri keselamatan yang banyak berbanding alatan tangan skru dan gerudi.

Mesin rivet tangan ini menggunakan sistem pneumatik serta gabungan bahagian mekanikal untuk membuat memberikan tekanan kepada rivet. *Hand Riveting Gun* ini boleh disesuaikan dengan rivet jenis *blind rivet, csk type blind rivet,blind rivet(coaled)* dan *mono bolt.* Saiz rivet adalah dari 1/8 inci sehingga 3/16 inci.

Dengan terhasilnya mesin rivet tangan ini dapat memudahkan pengguna melakukan proses merivet seterusnya dapat menjimatkan masa pembuatan dan dapat meningkatkan produktiviti sesebuah organisasi atau individu tersebut. Hasil kerja lebih kemas dan teliti. Ia juga tidak akan membahayakan kepada pengguna.

2. Objektif

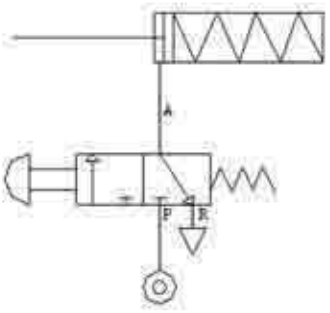
Sesuatu produk atau projek yang dihasilkan adalah bertujuan untuk mengatasi pelbagai permasalahan yang berlaku. Hasil dari kajian dan analisa yang dijalankan seperti *hand rivet gun.*

Di antara objektif utama penghasilan projek ini adalah untuk:-

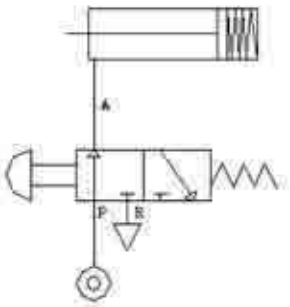
i. Memudahkan penggunaan bagi proses rivet seterusnya dapat mengurangkan tenaga kerja bagi sesebuah organisasi atau individu.
ii. Meningkatkan produktiviti pengeluaran.
iii. Mengurangkan masa pembuatan.
iv. Mengurangkan kesalahan proses "*reviting*".
v. Mengaplikasikan semua pengetahuan dan kemahiran yang dipelajari sepanjang tempoh pengajian di ADTEC Shah Alam.

3. Konsep *Hand Rivet Gun*

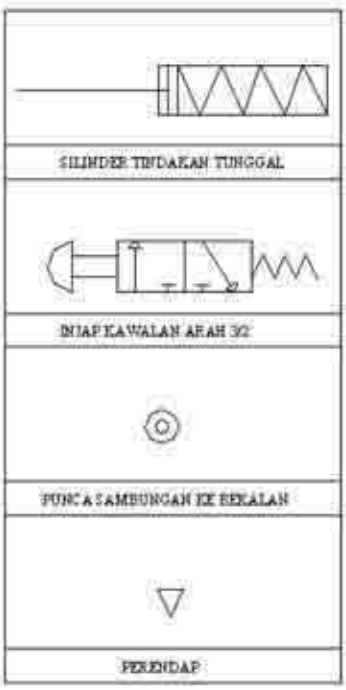
- Produk yang terhasil daripada kajian dan pemerhatian yang dibuat secara teliti ke atas proses merivet benda kerja dipelbagai sudut.
- Amat praktikal digunakan dan menjimatkan masa penggunaan.
- Mengurangkan risiko kerosakan pada hasil kerja yang dijalankan.



KEADAAN AWAL INJAP SEBELUM DITEKAN



KEADAAN AWAL INJAP SELEPAS DITEKAN



4. Proses Pembuatan

4.1 Metodologi

- Ialah kaedah bagi perlaksanaan sesuatu tugas, projek dan sebagainya yang mengikut setiap turutan proses bagi menjamin hasil akhir dapat menepati sasaran yang telah ditetapkan.

- Proses metodologi sangat penting bagi proses penghasilan projek ini antaranyan ialah;-
  i. Proses perbincangan dan pemilhan projek
  ii. Proses merekabentuk projek
  iii. Proses pemilihan bahan
  iv. Proses pengukuran
  v. Proses penandaan
  vi. Proses pemotongan
  vii. Proses pemesinan
  viii. Proses pemasangan
  ix. Proses pemeriksaan dan pengujian
  x. Proses kemasan

4.2 Proses Perbincangan dan pemilihan Projek

- Membuat perbincangan bersama ahli kumpulan dan membuat pemilihan projek yang akan dilaksanakan.
- Membuat pemilihan dari segi pelbagai aspek antaranya ialah bahan mentah, mesin, peralatan, masa, kos, dan sebagainya.

4.3 Proses Merekabentuk Projek

- Ialah proses membuat lakaran bebas, lakaran konsep, *drawing detail*, lukisan pemasangan untuk mendapatkan rekabentuk yang bersesuaian dengan projek ini.

4.4 Proses Pemilihan Bahan

- Pemilihan bahan mentah amatlah penting bagi menghasilkan projek yang berkualitidan menepati kriteria dan spesifikasi yang dikehendaki.
- Menjimatkan kos pembuatan dan memastikan projek yang dihasilkan dapat diguna pakai dalam jangka masa yang lama.

4.5 Proses pengukuran

- *Hand Rivet Machine* ini menggunakan peralatan pengukuran yang bersesuaian dengan projek yang dihasilkan.
- Antaranya ialah *vernier caliper,die test indicator,* dan sebagainya.

4.6 Proses Penandaan

- Proses yang dilakukan sebelum proses pemesinan dan pemotongan dijalankan ke atas benda kerja.
- Menggunakan *venier high gauge*.dan *paint maker.*

4.7 Proses Pemotongan

- Proses pemotongan yang dilakukan menggunakkan *power hack saw* bagi memotong benda kerja mengikut saiz yang telah ditetapkan.

4.8 Proses Pemesinan

- Proses pemesinan merupakan proses membentuk bendakerja mengikut saiz dan rekabentuk yang telah ditetapkan.
- Melibatkan penggunaan *vertical milling machine, high speed precision lathe* dan *cnc lathe* dan *manual grinding machine.*
- Selain penggunaan mesin, ada beberapa proses hanya menggunakkan peralatan hand *tap & die, hand drill* dan *hand grinder.*

4.9 Proses Pemasangan

- Proses pemasangan merupakan proses yang mencantumkan bahagi-bahagian tertentu untuk menjadikan satu produk yang lengkap.
- Ia juga merupakan proses yang sangat penting.

4.10 Proses Pemeriksaan dan Pengujian

- Proses ini dilakukan untuk memeriksa produk samaada mengikut ukuran dan spesifikasi yang telah ditetapkan.
- Proses pengujian ini bertujuan menguji tahap kemampuan produk yang dihasilkan.
- Dalam proses ini, dapat mengetahui masalah yang terjadi dan penambahbaikan dijalankan untuk memastikan produk yang dihasilkan mempunyai kualiti yang tinggi.
  Gambar 22-

4.11 Proses Kemasan

- Proses ini adalah proses terakhir yang dijalankan sebelum produk ini digunakan.

5. Kesimpulan

Bagi setiap proses pembuatan bagi penghasilan sesuatu produk, ketepatan dan kejituan sangat penting dan merupakan ciri-ciri produk yang sangat dititikberatkan. Untuk menghasilkan produk yang berkualiti tinggi bergantung kepada pemilihan material yang bersesuaian, peralatan yang lengkap dan kemahiran yang tinggi dalam bidang pembuatan khasnya dalam bidang pengendalian mesin.

Sepanjang tempoh penghasilan produk ini adalah lancar dan sentiasa mengikut jadual perancangan yang telah ditetapkan dari perbincangan ahli kumpulan serta penyelia kumpulan dan rakan-rakan. Ia sangat memenuhi kehendak dan keperluan seperti yang dirancangkan. Pelbagai jenis rekaan yang bersesuaian dengan produk boleh dijalankan mengikut keselesaan pengguna. Sepanjang menjalankan proses merivet ini, pengguna tidak perlu memerlukan bantuan dari luar untuk menyokong bahagian belakang bendakerja, dengan menngunakkan tekanan angin yang tinggi tidak menggunakan *hand rivet gunt* disamping mengguranakan tenaga kerja.

Disepanjang tempoh penghasilan produk ini, ia dapat menguji kemampuan pelatih untuk membuat sebarang keputusan dengan cara dan teknik yang betul untuk digunakan. Selain itu, pelatih dapat mengaplikasikan kemahiran yang dipelajari untuk beberapa perkara dan proses untuk menghasilkan produk inI.

M9 - Perlaksanaan & Penyelenggaraan Sistem Pengurusan Kualiti MS ISO 9001:2008 / TS 16949 Di Industri

Badrul Khizam Bin Salimon
Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam

Abstrak

ISO TS 19649 merupakan satu sistem pengurusan secara menganalisis yang di digunakan secara meluas dan diiktiraf secara global dalam bidang automotif. Setiap organisasi automotif perlu mempunyai sistem piawai ISO TS 16949 di organisasi meraka supaya organisasi mereka diiktiraf oleh badan-badan organisasi secara globalisasi.

Dalam produktiviti harian, pihak syarikat perlu sentiasa peka dan mengambil tindakan susulan berdasarkan jadual produktiviti syarikat mengikut masa yang ditetapkan. Mereka perlu memenuhi keperluan dan kehendak pelanggan mereka. Syarikat juga perlu mengutamakan pada keadaan sesuatu masa yang kritikal bagi menyiapkan produktiviti dalam satu-satu masa yang ditetapkan.

Perlaksanaan melalui sistem ISO TS 16949 dapat mengurangkan masalah produktiviti produknya untuk dihantar kepada pelanggan. Mereka dapat menggunakan mengikut spesifikasi dan garis panduan yang ditetapkan dalam sistem. Syarikat juga dapat menggunakan masa sebaik mungkin kerana mempunyai sistem jadual produktiviti yang mana dapat menunjukkan status produk yang dikeluarkan mengikut masa. Fungsi jadual produktiviti ini berperanan untuk memberi maklumat semasa atau status pada produktiviti harian, masa kritikal pengeluaran, rujukan untuk stok tambahan jika diperlukan, jumlah pengeluaran yang dapat dihasilkan, mengetahui samada proses selesai atau memerlukan tambahan pada pengeluaran serta stok.

***Keyword** : ISO TS 19649, produktiviti, sistem, kualiti*

1. Objektif Kajian.

Dalam pengurusan produktiviti yang baik mampu mengatasi masalah-masalah seperti penyediaan stok tambahan, penghantaran barang, masalah produk dapat diketahui secara segera, mengurangkan rungutan oleh pelanggan, mengetahui kadar kerosakan produk dengan tepat dan mudah menguruskan setiap tingkat produktiviti samada yang telah siap atau tempahan dari pelanggan.

1.1 Objektif kajian :

1.1.1 Mengkaji faedah daripada perlaksanaan system pengurusan ISO TS 16949.

1.1.2 Mengkaji secara berterusan keatas proses-proses kritikal dan membuat tindakan pembetulan.

1.1.3 Mengenalpasti status atau standard yang digunakan syarikat

1.1.4 Mengkaji cara untuk menguruskan produktiviti dengan baik dan sistematik.

1.1.5 Mengurangkan masa kritikal dalam produktiviti.

2. Penyata Masalah

Industri automotif merupakan satu industri yang kian pesat dan menyumbang dalam percambahan serta merangsang ekonomi negara. Ini dapat dilihat melalui peluang-peluang pekerjaan dan mencari bidang baru untuk membentuk satu era permodenan teknologi pengeluaran automotif negara. Oleh itu, produk atau

komponen kebiasaan mempunyai kontraktor-kontraktor yang berlainan melalui tugas dan peranan sehingga sampai ke firma. Golongan ini dikenali sebagai vendor (membekalkan peralatan dan komponen asas atau bahan mentah untuk membentuk kenderaan siap dan lengkap)

Apabila mempunyai pegangan syer pada bidang automotif, sesebuah organisasi memerlukan satu pengiktirafan dan kepercayaan untuk memikul tanggungjawab sebagai vendor. Vendor perlu merancang dan memiliki persijilan ISO TS : 16949 (2009) bagi membolehkan produk meraka boleh dipasarkan secara global dan mempunyai satu "trade mark" dan mempunyai pengaruh untuk memasarkan produk mereka selain kepada firma sahaja. Apabila memiliki persijilan ini, meraka dapat mengembangkan perniagaan dalam sektor automotif di dalam dan luar negara.

Syarikat memerlukan satu penjadualan produktiviti yang sentiasa dikemaskini dari semasa ke semasa serta status produk yang ingin dihasilkan. Ini membolehkan syarikat dapat menumpukan pada masa kritikal serta dapat menumpukan dan menyelesaikan dengan segera. Syarikat juga boleh menyediakan satu stok tambahan untuk sokongan pengeluaran meraka untuk menjimatkan masa pengeluaran.

Bagi mendapatkan persijilan ini, pihak syarikat perlu mengukur tahap permasalan yang dihadapi. Selain itu, bagaimana syarikat itu mengaplikasikan ISO TS : 16949 dalam pengeluaran, analisa, halangan yang dihadapi ketika menjalankan sistem pengurusan tersebut.

3. Kepentingan Kajian

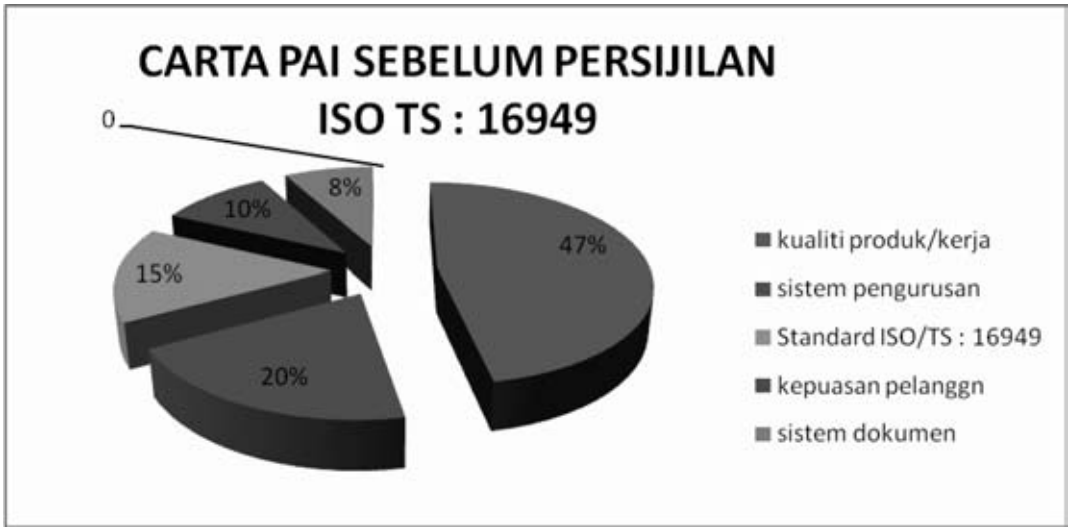
Sistem pengurusan ISO TS : 16949 memainkan peranan yang penting di dalam sektor automotif. Tanpa pengurusan yang berketepatan dan berkualiti boleh menyebabkan banyak kelemahan dan kekurangan dalam menguruskan sistem ini. Sekali gus memberi persepsi yang negatif pada syarikat. Selain itu, kelemahan yang kritikal seperti hilang kepercayaan kerana tidak memiliki persijilan ini boleh mengurangkan pengeluaran serta merugikan. Oleh itu, syarikat ini memerlukan persijilan ISO TS : 16949 untuk membolehkan mereka bergerak bersaing dengan firma-firma berteraskan bidang automotif yang diiktiraf.

Kajian ini adalah kajian mengenai kepentingan dalam pengurusan dalam pengeluaran dan memastikan tiada masalah yang dihadapi serta alternatif dengan memberi cadangan dan mengkaji samada perancangan yang dibuat mengikut garis panduan yang ditetapkan. Selain itu, kajian ini juga berperanan untuk membentuk satu objektif yang memastikan vendor ini mematuhi kehendak dan merangkumi secara menyeluruh mengikut prosedur. Melalui kajian ini, satu pengurusan yang sistematik yang dirangka dapat membantu proses pengeluaran dan produktiviti dapat diatur dengan baik.

Penyusunan yang sistematik bertujuan untuk membolehkan syarikat boleh menilai status dan merangka pelan untuk menyiapkan produk mengikut masa yang ditetapkan. Melalui jadual produktiviti ini, syarikat boleh menganggarkan jangka masa untuk menyiapkan salah satu produk mengikut jangka masa. Oleh itu, syarikat mampu menjangka samada masa kritikal dapat dikenalpasti.

CARTA PAI PERBEZAAN SEBELUM PERSIJILAN ISO TS :16949

PERKARA	KOD WARNA	PERATUSAN
Kualiti produk/ kerja	**BIRU LAUT**	**47%**
Sistem pengurusan	**COKLAT**	**20%**
Standard ISO/TS 16949	**HIJAU**	**15%**
Kepuasan pelanggan	**UNGU**	**10%**
Sistem dokumen	**BIRU CAIR**	**8%**



4. Kesimpulan

Carta pai diatas menunjukkan peratusan bagi sistem pengurusan produktiviti disyarikat Masasinar Holdings Sdn Bhd (Vendor) sebelum perlaksanaan sistem ISO/ TS:16949.

Rajah menunjukkan masalah bagi kualiti produk menjukkan peratus tertinggi kerana terdapat tunjang permasalahan yang tidak dapat diatasi seperti:

1. Masalah kualiti produk yang dihasilkan.
2. Kelewatan penghasilan produk.
3. Tidak cekap.
4. Tidak mencapai objektif dan kapasiti permintaan pelanggan.
5. Menggunakan mesin *stamping* secara manual dan dijalankan lebih berhati-hati.

M10 - Semi Auto Murukku Machine

Ahmad Nizam Bin Yaacob
Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam
any_utm@yahoo.com

Abstrak

Kajian adalah berkisar kepada pembikinan mesin pembuat kuih marukku yang menggunakan tenaga elektrik dari bekalan bateri. Dalam kajian yang dijalankan ini, penekanan diberikan kepada bagaimana untuk menghasilkan sebuah mesin pembuat kuih marukku yang produktif, mudah dioperasikan, mempunyai kadar pengeluaran yang tinggi dan selamat untuk digunakan. Bagi melaksanakan tugasan ini, kaedah-kaedah yang digunakan adalah termasuklah soalselidik, kajian lapangan, pemantauan produk sedia ada di pasaran, perancangan rekabentuk dan proses pemesinan, pemasangan dan proses penyudahan. Proses terakhir yang paling penting dalam penilaian kebolehfungsian produk berbanding piawaian yang ditetapkan adalah proses pengujian. Produk / prototaip yang dihasilkan mestilah mampu memenuhi piawaian seperti boleh berfungsi dengan baik, selamat untuk digunakan, dapat memudahkan pengguna berbanding produk yang telah ada di pasaran dan menjimatkan kos pengeluaran.

Keyword: *Marukku, semi-auto, mesin, motor elektrik, pembuatan.*

1. Pengenalan

Murukku adalah sejenih kuih yang berasal dari Selatan India. Murukku dihasilkan daripada tepung beras dan urad, garam serta bahan perasa seperti cili, asafotieda, ajawain dan cumin. Campurannya dibentuk doh lembut dan dibentuk menjadi gelung membulat seperti gelung benang yang kasar dan digoreeng rangup. Murukku juga boleh digelek menjadi seperti reben nipis atau dibentuk menggunakan tangan. Namun begitu kaedah di atas memakan banyak tenaga dan masa. Mesin manual memang banyak di pasaran tempatan, namun begitu mesin ini adalah terlalu konvensional sehinggakan sangat-sangat memakan masa dan tenaga pengguna. Manakala mesin pembuat marukku elektrik pula hanya digunakan dalam industri pembuatan kuih ini dan tidak sesuai untuk surirumah kerana saiz dan harganya yang mahal. Oleh itu, Semi Auto Murukku Machine dihasilkan bertujuan membantu pengguna yang terdiri daripada suri rumahtangga dalam penyediaan kuih marukku dalam jumlah yang sederhana banyak. Mesin ini dhasilkan bukan untuk kegunaan industri tetapi hanya untuk kegunaan di rumah-rumah sahaja. Mesin ini menggunakan kuasa motor elektrik DC dan bahagian badan mesin dihasilkan daripada bahan aluminium. Dengan menggunakan mesin ini, daya dan tenaga yang dikeluarkan oleh pengguna dapat dikurangkan dan ini dapat menjimatkan tenaga dan masa kerana pengguna dapat melakukan kerja dengan lebih cepat dan mudah. Kajian yang telah dibuat mendapati para pengguna mesin manual menghadapi kesukaran untuk menghasilkan kuih dalam kuantiti yang banyak menjelang perayaan disebabkan faktor masa dan kesukaran dalam mengoperasikan mesin manual. Hasil soalselidik yang dijalankan kepada para surirumah mendapati, jika diberi pilihan, mereka akan memilih untuk menggunakan mesin dengan bantuan tenaga elektrik untuk membuat kuih marukku. Oleh yang demikian, kajian dalam menghasilkan mesin marukku akan lebih tertumpu kepada bagaimana untuk mendapatkan bantuan kuasa elektrik kepada mesin dengan memilih mekasima yang paling sesuai untuk digunakan dalam perlaksanaan projek ini.

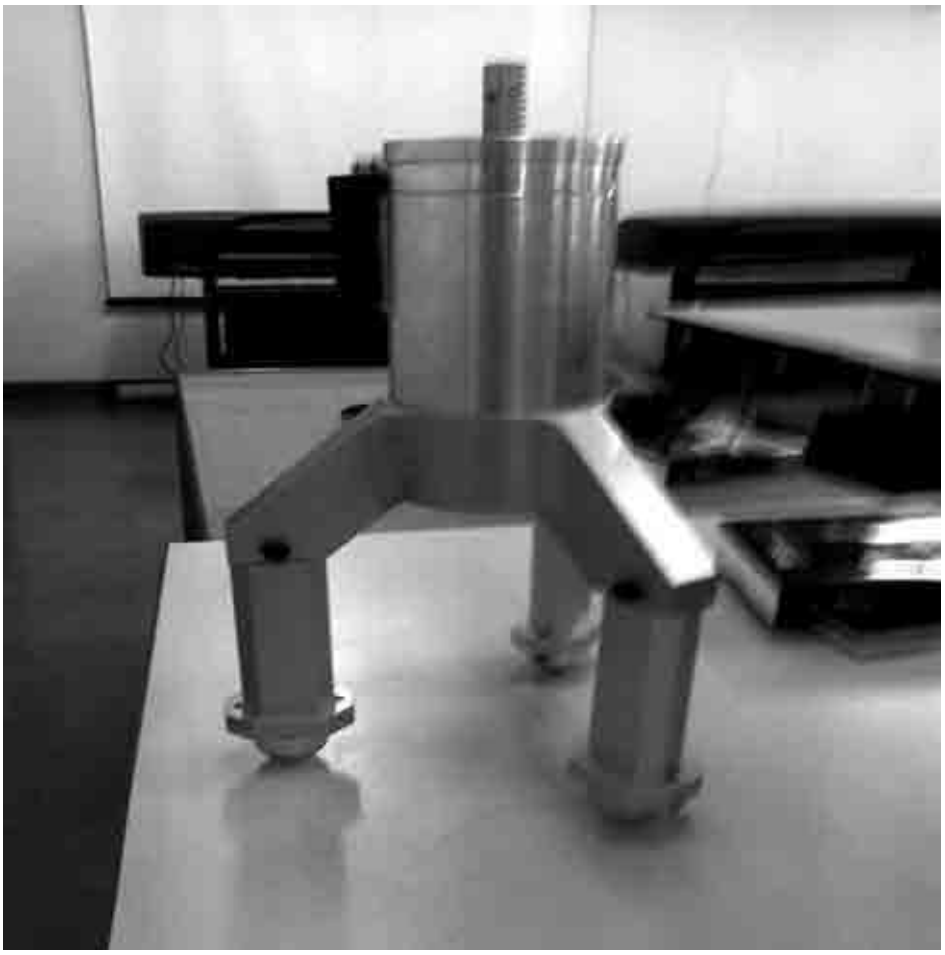
Mesin Marukku Tersedia Di Pasaran

2. Kaedah

Kajian dijalankan dengan turutan seperti berikut:

1. Soalselidik berkaitan permasalahan yang dihadapi oleh para surirumah.
2. Kajian produk yang telah ada di pasaran samada jenis manual atau automatik.
3. Analisis keperluan bahan dan peralatan untuk penghasilan produk.
4. Perisian yang digunakan seperti perisian rekabentuk dan simulasi.

Mesin *Semi Auto Marukku Machine*



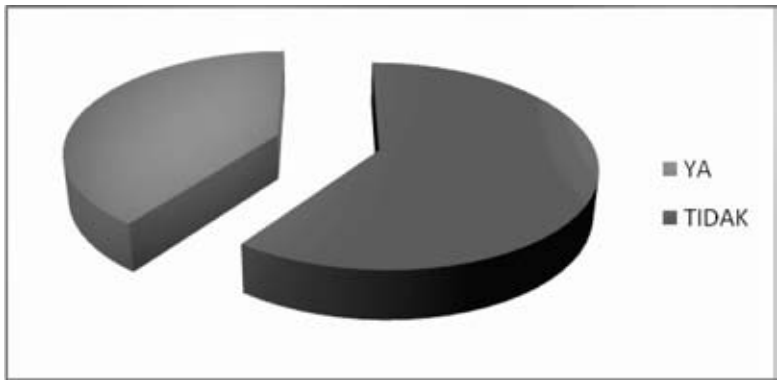
3. Keputusan Dan Analisa

Data yang diperlukan adalah komen-komen yang diberikan oleh pengguna khasnya surirumah yang terlibat secara langsung dalam pembikinan kuih ini. Bagi mendapatkan komen-komen ini, satu borang kajiselidik telah dihasilkan dan diedarkan kepada para surirumah dan dikumpulkan untuk dianalisa satu demi satu. Satu eksperimen juga dijalankan menggunakan mesin manual yang sering digunakan oleh para surirumah bagi mengenalpasti jumlah daya yang diperlukan dalam menghasilkan kuih marukku. Dari eksperimen itu juga, pengkaji dapat mengetahui cara mesin manual bekerja apabila dioperasikan.

4. Statistik Soal Selidik

■ Soal selidik yang dijalankan melibatkan 30 orang responden bagi mendapatkan maklum balas sebelum penghasilkan produk dijalankan. 'Ya' adalah mewakili jawapan surirumah yang inginkan produk baru yang lebih menjimatkan tenaga. 'Tidak' adalah mewakili jawapan surirumah yang tidak kisah samada ada produk baru atau tidak walaupun tidak selesa dengan produk manual yang mereka ada.

Berikut merupakan statisitk yang diperoleh selepas menjalankan soal selidik :-



Carta Pai Menunjukkan Komen Para Surirumah

Hasil Soal Selidik Terhadap Produk Lama (30 orang respondan)

Bil	Soalan	Jawapan	
		Ya	Tidak
1	Adakah mengalami sebarang kesukaran semasa mengendalikan mesin yang sedia ada ?	26	4
2	Adakah menggunakan tenaga/daya yang banyak semasa melakukan proses mengeluarkan murukku dari acuan sebelum ini?	22	8
3	Adakah responden memerlukan lebih daripada 1 orang untuk melakukan proses kerja semasa mengendalikan mesin ?	18	12
4	Pernahkah responden melihat rekabentuk produk yang hampir sama dengan produk yang kami cipta ini ?	18	12
5	Adakah responden tertarik dengan Semi Auto Marukku Machine ini ?	25	5
6	Jika produk Semi Auto Marukku Machine ini dihasilkan, adakah anda akan membelinya ?	22	8
7	Pernahkah responden memiliki produk yang hampir sama sebelum ini ?	5	25
8	Adakah responden mempunyai masalah dan kekurangan yang pernah dihadapi pada produk sebelum ini ?	27	3
9	Adakah respondan menghadapi kesukaran bagi mendapatkan produk dari jens automatik ?	28	2
10	Adakah faktor kesukaran mendapatkan mesin automatik menjadikan respondan tidak dapat menjalankan proses pembuatan dengan baik ?	28	2

5. Perbincangan

Daripada soalselidik dan pemerhatian yang dijalankan terhadap operasi mesin yang dijalankan terhadap para respondan, didapati mesin rekaan terbaru ini telah menepati cirri-ciri yang dikehendaki oleh pengguna. Oleh itu, penghasilan mesin ini menjadi sangat sesuai dan bertepatan dengan masa dan ketikanya. Kebolehfungsiannya yang baik dapat menjadikan proses pembuatan kuih marukku dijalankan dengan bersistematik dan teratur serta produktif. Jika produk konvensional hanya menggunakan 100% tenaga manusia bagi memastikan bancuhan doh marukku keluar melalui lubang acuan mesin, produk baru ini akan memastikan 100% kuasa elektrik digunakan bagi menekan doh dengan bantuan motor elektrik sebagai penggerak. Produk baru ini juga mempunyai tahap keselamatan yang tinggi kerana ia hanya menggunakan bekalan kuasa 12 VDC yang mana tidak akan memudaratkan manusia khususnya pengguna.

Hasil Soal Selidik Terhadap Produk Baru (5 orang respondan)

Bil	Soalan	Jawapan	
		Ya	Tidak
1	Adakah mengalami sebarang kesukaran semasa mengendalikan mesin yang sedia ada ?	0	5
2	Adakah menggunakan tenaga/daya yang banyak semasa melakukan proses mengeluarkan murukku dari acuan sebelum ini ?	0	5
3	Adakah responden memerlukan lebih daripada 1 orang untuk melakukan proses kerja semasa mengendalikan mesin?	0	5
4	Adakah responden tertarik dengan Semi Auto Marukku Machine ini ?	5	0
5	Adakah responden mempunyai masalah dan kekurangan yang pernah dihadapi pada produk sebelum ini ?	0	5
6	Adakah respondan berpuashati dengan cirri-ciri dan spesifikasi yang ada pada mesin baru ini ?	0	5

6. Kesimpulan

Dalam proses pembuatan sesuatu produk,ketepatan dan kejituan yang tinggi amatlah diperlukan.Untuk menghasilkan produk yang berkualiti tinggi, ianya bergantung kepada beberapa faktor seperti penggunaan jenis material, peralatan yang sesuai dan juga kemahiran individu itu sendiri.Kemahiran yang tinggi dalam bidang kejuruteraan teknikal terutamanya dalam kaedah pengendalian mesin amatlah penting kerana ianya dapat menghasilkan produk yang berkualiti.Kemahiran yang tinggi dapat diperoleh dari pengetahuan hasil dari pembelajaran teori yang kukuh serta latihan yang berterusan.

Secara keseluruhan,projek ini telah berjalan dengan lancar serta mengikut jadual perancangan yang telah ditetapkan hasil dari perbincangan dan kerjasama sesama ahli kumpulan,penyelia dan rakan-rakan seperjuangan.Ianya telah berjalan dengan baik dan memenuhi kehendak serta keperluan seperti yang telah dirangka.Penghasilan produk ini di dalam sektor industri tempatan dapat dipelbagaikan kehendak dan keperluan pengguna.Dengan adanya produk *Semi Auto Murukku Machine* ini sedikit sebanyak dapat membantu pengguna dalan menghasilkan Kuih Murukku tanpa menggunakan tenaga,dan kos yang banyak di samping mengurangkan tenaga kerja.

Di dalam melaksanakan projek ini, kemampuan pelatih untuk membuat keputusan dan cara serta teknik yang betul untuk menyelesaikan masalah juga dapat diuji serta mengaplikasikan pelajaran teori dan amali yang telah dipelajari sebelum ini. Semua perkara dan proses semasa menyiapkan projek ini,telah dibukukan di dalam laporan akhir ini.

7. Rujukan

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M11 - Mesin Pembakar Lemang Elektrik

Mohd Rozaini Bin Ramli
Institut Teknikal Jepun Malaysia
E-mail: mrozaini@gmail.com

Abstrak

Mesin pembakar lemang elektrik merupakan idea yang terhasil daripada masalah semasa proses pembakaran lemang secara tradisional. Pembakaran secara tradisional perlu menyediakan dapur pembakaran lemang, kawasan yang luas, bekalan kayu api, pemantauan yang kerap serta terdedah kepada bahang panas. Untuk itu satu alternatif dicari bagi menyelesaikan masalah tersebut iaitu dengan membakar menggunakan pemanasan tenaga elektrik. Pembakar lemang elektrik ini hanya memerlukan tenaga elektrik untuk pemanasan pemanas dengan dibantu oleh motor bagi memusingkan lemang dan menggunakan termoheater bagi menyeragamkan suhu. Terdapat juga penutup bagi mengelakan dari habuk dan ia masih menggunakan buluh dan daun pisang bagi mengekalkan keasliannya. Dengan penggunaan pembakar lemang ini masa untuk pembakaran, ruang dan tenaga kerja dapat dijimatkan.

Keyword : *termoheater, pemanas, motor*

1. Pengenalan

Lemang merupakan sejenis makanan tradisional orang melayu yang amat popular terutamanya ketika menyambut hari Raya Aidilfitri atau hari Raya Aidiladha. Namun begitu lemang juga dihidangkan sepanjang tahun[1]. Lemang diperbuat daripada beras pulut dan santan yang dimasukkan ke dalam ruas buluh yang dilapik dengan daun pisang, sebelum dibakar sehingga masak. Kaedah memasak menggunakan buluh merupakan kaedah kaum asli memasak di Malaysia[1]. Pembakaran lemang memerlukan pemansan pada suhu yang tinggi diantara suhu 200 hingga 250 darjah Celsius dan masa yang diperlukan bagi pembakaran lemang menggunakan kaedah tradisional selama 8 hingga 12 jam[1].

Namun begitu beberapa masaalah didapati melalui kaedah pembakaran lemang secara tradisional iaitu untuk menyediakan dapur pembakaran lemang, terdapat banyak faktor yang perlu diambil kira seperti memerlukan kawasan yang luas, perlu mencari bekalan kayu api, memerlukan pemantauan yang kerap serta pengusaha terdedah kepada bahang panas dan faktor cuaca[3].

Untuk memasak lemang seseorang itu memerlukan penelitian yang rapi iaitu memerlukan api yang seragam, keseluruhan lemang dimasak dengan seragam, api yang tidak terlalu kuat, santan yang sentiasa perlu ditambah dan lemang itu sediri perlu dihentak bagi mendapatkan pulut yang padat. Semua aktiviti ini memerlukan tenaga manusia untuk menjalankanya. Ini akan meyebabkan seseorang itu menjadi letih dan tenaga yang banyak diperlukan. Oleh itu bagi mendapatkan pembaharuan terhadap kaedah pembakaran lemang ini perlu diambil kira bagaimana kaedah mengekalkan keaslian rasa lemang itu. Pembaharuan juga perlu menilai bagaimana kaedah bagi mengurangkan penggunaan tenaga manusia. Oleh itu mesin yang direka mesti mampu mendapatkan pembakaran yang seragam, hentakan dan mudah untuk menambah santan. Ia juga mestilah dapat mengekalkan penggunaan buluh dan daun pisang semasa pembakaran. Fungsi daun pisang dan juga buluh bagi menaikan aroma lemang yang dimasak. Daun pisang juga digunakan bagi mengalas pulut dari terkena miang buluh.

2. Mesin pembakar lemang elektrik

Mesin membakar lemang elektrik ini menggunakan tenaga elektrik 240V bagi memanaskan lemang melalui pemanas yang terdapat pada mesin. Untuk memusingkan lemang supaya lemang dapat dimasak dengan seragam, motor elektrik *single phase* digunakan. Motor yang mendapatkan bekalan elektik ini akan memusingkan lapan *sporket* yang kemudianya disambungkan kepada mangkuk lemang. Konsep yang digunakan dalam mesin pembakaran lemang ini ialah lemang yang dimasak perlu pemanasan yang seragam. Pemanasan dilakukan oleh empat batang pemanas yang dipasang pada bahagian tengah ruang pembakaran. Oleh itu bagi mendapatkanya keseragaman, lemang yang dimasak perlu sentiasa berpusing supaya ia masak secara seragam. AC motor digunakan bagi memusingkan lemang. Termoheater diletakkan pada ruang pemanasan bagi menyeragamkan suhu dimana apabila suhu yang dikehendaki diperolehi maka pemanasan dari pemanas dihentikan dan dimulakan apabila suhu kurang dari suhu yang dikehendaki.

Setiap lemang akan disusun secara condong iaitu pada sudut diantara 11° hingga15°. Ini dilakukan supaya pulut di dalam buluh akan menjadi lebih padat dan jika dirujuk kapada kaedah konvensional, kaedah condong digunakan. Oleh itu garis pusat bagi pemegang buluh pada bahagian atas lebih kecil iaitu 210mm dan garis pusat pada bahagian bawah 330mm. Bagi membolehkanpajang lemang dapat disesuaikan dengan mesin, maka ketinggian pemegang atas lemang ini dibuat dalam bentuk yang boleh laras[2]. Ini dapat dilakukan dengan melonggar atau mengetatkan nut yang terdapat pada tiang pemegang. Ketinggian minimum yang dibenarkan ialah 500mm (1 ½ kaki) iaitu bepandukan panjang pemanas dan tinggi minimum ialah 700mm (2 kaki) iaitu berpandukan kajian saiz buluh bagi pembuatan lemang. Ia juga diambil kira dari segi saiz ruang kereta jika ia hendak dialihkan.

Dari segi pemilihan bahan untuk ruang pembakaran alumanium digunakan. Alumaniun dipilih kerana bahan ini tahan karat dan kadar pengaliran haba yang kurang jika dibandingkan dengan besi[5]. Untuk ruang kebuk pemanasan bahagian dalam dilapis dengan kepingan *stainless steel* dan kepingan alumanium pada bahagian luar[6]. Ruang diantara kepingan tersebut diletakkan *asbestos* untuk menghalang haba dari menyerap keluar. Bahagian penutup dibuat dari kepingan alumanium. Untukbahagian lain seperti rangka dan tapak bawak hanya besi ferus digunakan[6].

Mesin ini juga direka supaya penggunaan ruang dapat dijimatkan, pengguna juga tidak terlalu terdedah kepada bahaya api semasa memasak, ganguan dari cuaca hujan dan mudah alih.. Terdapat juga penutup bagi mengelakan dari habuk. Ciri tradisi memasak lemang dengan menggunakan buluh dan daun pisang bagi mengekalkal keaslianya masih digunakan.

Mesin ini mampu memasak lapan (8) batang lemang dalam satu-satu masa. Masa yang diperlukan untuk memasak bagi lapan batang lemang ialah 1 jam 40 minit pada suhu 210°C.

Spesifikasi	
Jenis mesin	Mesin Membakar Lemang
Nama komersial	Mesin Pembakar Lemang Elektrik
Bilangan Coil Element	4
Bilangan buluh lemang yang dapat di bakar	8 batang dalam 1 jam 40 min
Panjang Lemang	Min 500mm – 700mm (1 ½ - 2 kaki)
Sumber kuasa	Elektrik
Panjang (mm)	630
Lebar (mm)	500
Tinggi (mm)	930
Weight (kg)	50 - 70
Sumber Pemanas	Coil Element
Suhu Pemanasan(^oC)	0-350
Kuasa Pemanas(Watt)	660 X 4
Pemutar lemang	AC Motor 240V
Torque motor dengan gearhead (kg.cm)	100
Horsepower motor dengan gearhead (HP)	4.132

3. Analisa/Uji Kaji

Dari pengujian yang dijalankan didapati lapan batang lemang dapat dimasak dalam 1jam 40 min berbanding kaedah tradisional selama 6 jam. Oleh itu bagi masa selama 6 jam mengikut kaedah tradisional mesin ini dapat memasak sebanyak 24 batang[4]. Pengiraan t*orque* seperti dibawah digunakan bagi menguji kemampuan mesin supaya kecekapan dicapai.

Torque motor = 1.30 kg.cm
Gear head ratio = 1/130
Oleh itu, *Torque motor* selepas pasang *gear head* = 100 kg.cm

$$HP = \frac{TxN}{5252}$$

Where,T = Torque(lb.ft)
N = Speed (rpm)

Bagi *main motor* (guna *gear head*):
Torque = 100 kg.cm = 7.231 lb.ft

$$HP = \frac{TxN}{5252}$$

$$= \frac{7.231 \times 3000}{5252}$$

= 4.132 HP

Bagi menetapkan harga pasaran bagi model pertama mesin pembakar lemang elektrik ini pengiraan dibawah digunakan bagi mendapatkan kos keseluruhan.

Kos Bahan
Jumlah keseluruhan kos bagi bahan di atas
= RM 438.00 + RM 943.00
= RM 1,381.00 untuk sebuah Mesin Pembakar Lemang.

Jumalah Kos
Kos Buruh = (24 jam X RM 6.00) X 2 Orang pekerja = RM 288.00
Jumlah Kos = Kos Bahan + Kos Buruh + Kos Rekabentuk(10%)
= 1,381.00 + 288.00 + 166.90 = RM 1,835.9
Harga Jualan = Jumlah Kos + Keuntungan (25%) = RM 2,294.87

Jika diambil kira sebatang lemang berharga RM 10 maka dengan 230 batang lemang yang dimasak oleh mesin ini pengguna telah mendapat pulangan modal. Jika diambil kira sebanyak 230 batang maka pengguna memerlukan 48 jam 34min penggunaan mesin ini untuk mendapat pulangan modal.

4. Keputusan

Dengan terhasilnya mesin pembakar lemang elektrik ini diharap masaalah seperti hujan, ruang yang sempit, asap, pencarian kayu api dan ketidak mahir seseorang dapat diatasi . Diharap seseorang yang tidak mahir masih mampu untuk membakar lemang dengan sendiri. Ia juga boleh digunakan semasa perkemahan dan untuk penggunaan hotel. Ia juga merupakan jawapan penyelesaian kepada mereka yang tinggal di taman perumahan dan bandar.

Selain itu motif utamanya bagi memendekkan masa semasa memasak lemang dapat dicapai dan penggunaan tenaga manusia dapat dikurangkan. Selain itu ia juga dapat menjaga alam sekitar kerana asap yang dikeluarkan dalam kuantiti yang sedikit dan asap ini dikeluarkan bersama wap air. Oleh itu wap air ini akan memendapkan gas-gas yang berbahaya ke bawah. Lemang yang dimasak juga tidak rentung dan sekata[1]. Diharap dengan berkembang inovasi baru ini kaedah dan cara masakan lemang dapat dikembangkan.

5. Rujukan

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M12 - Design of Mobile Quarter-Car Test Rig (MoQCarT-Rig)

Sisu Arman Amir
Institut Latihan Perindustrian Kota Kinabalu
sisu@ilpkk.gov.my

Abstract

Design of Mobile Quarter-Car Test Rig (MoQCarT-Rig) is a new conceptual idea to support our industry especially in automotive field. The technology that will be used is a not the high technology but the concept to develop the idea and the result of the scope is the main important thing that we must consider. Nowadays, most of the manufacturers used are static quarter car test rig, not ergonomic and unfriendly user to investigate the performance and the characteristic of the suspension system for vehicle ride analysis. This idea purposed to design a new idea of the rig especially to improve the existing rigs. This paper consists of the introduction, comparison for the existing rigs, overview of the new rig and the design of the rig by using CATIA V5R10 software to design the conceptual drawing. The equations of motion for the quarter-car model are derived in state space as well as a transfer function form that applied at the Simulink programmer of Matlab.

Keywords: *Test Rig, Quarter-Car Rig, Mobile Rig, Vehicle Ride Analysis Rig, Car Test Machine*

1. Introduction

Automobile frame body is mounted on the front and rear axle not directly but through some form spring, mountings and shock absorber that is called suspension. The function is to prevent damage to the working parts and also to provide riding comfort, suspensions is used in the vehicle it also prevent road shocks reaching the frame and other units. Suspension also functions to provide good road holding while driving, cornering and braking and at the same times it purpose to maintain proper steering geometry.

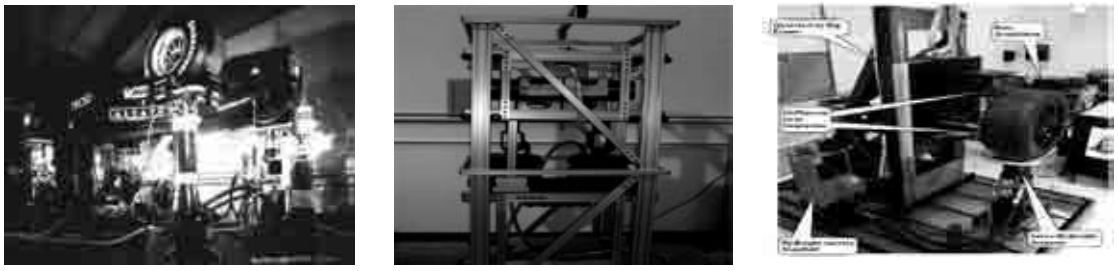
A quarter car test rig is used to study the behaviour of vehicle due to the variation in road profile which is commonly known as ride vehicle analysis. The performance criteria in designing vehicle suspension system are body acceleration, suspension travel and wheel acceleration. Performance of the suspension system is characterized by the ability of the suspension system in reducing those three performances of criteria effectively. The quarter car test rig should be developed in such as way that closely resembles the quarter car part of real vehicle. The quarter car test rig should have the ability to mount several different designs of actual car suspensions, able to perform a wide range of tests which include variation on body loads and the frequency of road disturbance, and still have the ability to expend for future developments. The main scope for this project is to design a new modified of full scale mobile quarter car test rig. The design will be focused to the main frame that it has friendly user, easy to carry and install also more ergonomic rig based on the concept needed. The full design will be shown the concept, apparatus and certain main components that involved operating the rig.

2. Literature Review

Nowadays, most of industrial sector especially for automotive field used a static test rig and do not have the functionality desired for the current and the future research projects, whereas the commercially available rigs are quite expensive. In most of the existing quarter car test rig, the tire vertical dynamics are omitted or just represented by a simple linear spring and the effects or the tire rotational dynamics are also neglected. At the same times it is difficult to move for other place and unfriendly user because the construction very complicated.

Among of the currents quarter car test rig is different based on the design and structure but all the concept and function is almost same and it must have the ability to mount several different designs of actual car suspension.

Other limitations of conventional quarter-car rigs include the inability to introduce dynamics such as lateral forces and weight transfer of the vehicle in events such as cornering, braking, acceleration, and aerodynamic loading. Also, during such cornering events the vehicle may roll causing geometry orientation of the suspension to change. This will, in turn, alter the kinematics and dynamics of the suspension.



Conventional Quarter-car Test Rig from VirginiaTech Advanced Vehicle Dynamics Laboratory

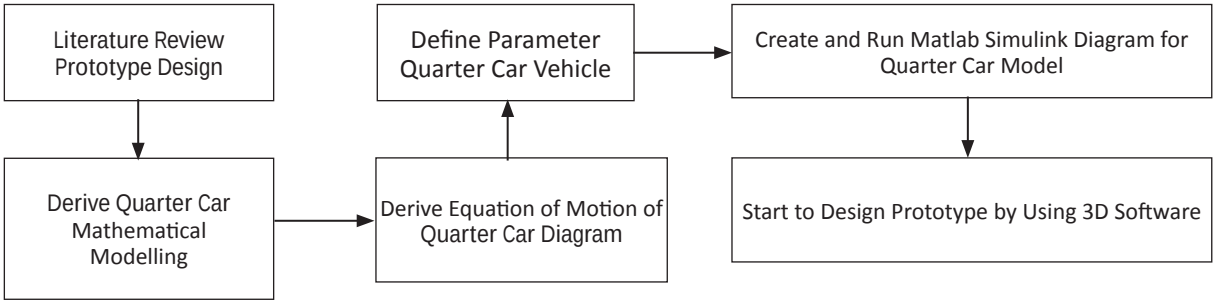
A new modified of full scale mobile quarter car test rig will be improved the outcomes of previous design of quarter car test rig. Overview of the physical quarter car rig was designed with consideration of some factors that has not involved at previous design of quarter car rig such as dynamic of wheel rotation, tie rod and dynamic of ball joint are not neglected. Based on this project, it comes with more advantages and the potential application of the full scale of the quarter car test rig. Among of the advantages of this project is the design of the main frame is more flexible and friendly user by means the rig easy to move everywhere and easy to install part by part, it has been designed and constructed to offer increased the accuracy and testing flexibility at a reasonable cost which has the following features such as this rig more realistic in representing the quarter portion of real vehicle compared with the existing quarter car test rig. Another that is the frequency of road disturbance can be easily is simulated. Variation in vehicle body and passenger masses also can easily be simulated at the same time vertical and rotational dynamics of the tire are considered. This rig also has the flexibility to test a multitude of suspension designs. Among of the potential applications of the full scale quarter car test rig is to investigate the vehicle response in a presence of road disturbance and to study the damping characteristics of suspension system. It also has potential to perform a study on the application of a control system to the rig for reproducing test vehicle response. The main advantage of this rig is capability the rig operated during run the simulation. This is because it some inherent deficiencies with many of the existing test rigs. Often, the tire for previous design will not rotate but only in static condition and just move upward and downward when the hydraulic servo actuator run. In this situation dynamic of the wheel rotation has been neglected so it comes to unreal condition for vehicle dynamic. Thus, to outcome this situation, this project will be designed with the tire will be rotate along the road surface at the main frame. Based on this reaction, dynamic for wheel rotation are not neglected and at the same time it more closed to real condition of the vehicle. Another that, this project also designs with more cheaply than the current test rig at the market.

3. Approach

To achieve these goals the following approach is taken. Among of the approach is running the simulation for quarter car mathematical modeling and design of a new quarter car test rig by using 3D software.

Current quarter-car test rigs and the state parameter of quarter car testing in general are first evaluated. The approach is to design and develop a prototype mobile quarter-car test rig that addresses many of the shortcomings found with the latest design while trying to minimize expense. After determined the parameter

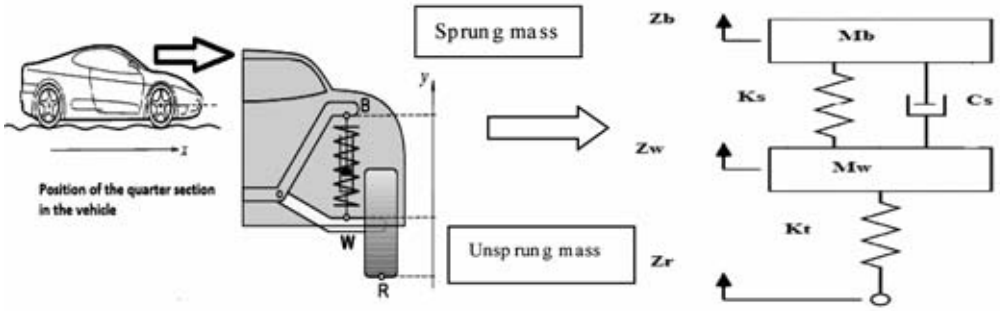
of quarter car test rig, the next step is run the simulation of the quarter car mathematical modeling by using Matlab Simulink and the result will be shown at the next chapter. After that is design of the construction concept for the new modified rig by using 3D software that we called CATIA.



Flow chart of the approach to design the new modified of quarter car test rig

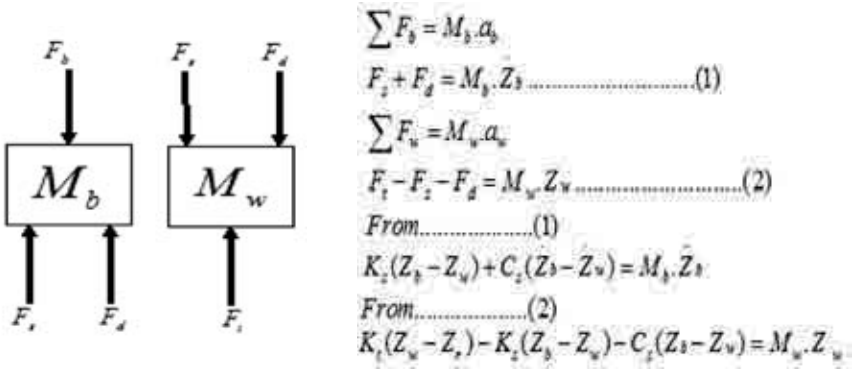
4. Result and Analysis of Quarter Car Model

Quarter car diagram modeling is solution to investigate and to simplify the complexities of the nonlinear dynamics of a full vehicle while providing meaningful results which the model called as 2 DOF (Degree of Freedom) quarter car model shown at figure below.



Components and area of 2 DOF Quarter Car Model

Thus, free body diagram and equation of motion formula for quarter car model derived as such as below;



Equation of motion for quarter car model

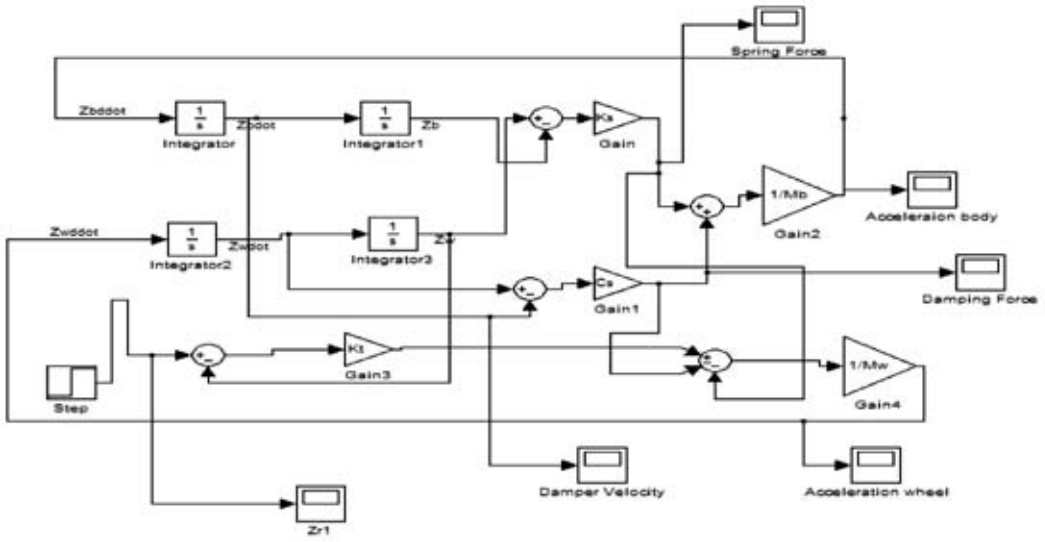
Based on the equation of motion above, the input to this model is a displacement which is representative of a typical road profile. The input excites the first degree of freedom (the unsprung mass of a quarter of the vehicle, representing the wheel, tire, and some suspension components) through a spring element which represents the tire stiffness. The unsprung mass is connected to the second degree of freedom (the

sprung mass, representing the body of the vehicle) through the primary suspension spring and damper. The transmissibility of the 2DOF system, if all the elements of the quarter-car are passive, is shown in Fig. 7 for various damping coefficients. The first plot shows the displacement of the sprung mass (Zb) with respect to the input (Zr), while the second plot shows the displacement of the unsprung mass (Zw) with respect to the input (Zr). The parameters used in the simulation of this model are the actual system parameters of the physical quarter-car apparatus. These system parameters, which closely model actual vehicle parameters, are shown in table 1 below.

Real component in the car	Representative name in the rig	Parameter of body diagram	Value
Quarter weight of car	Circle metal mass	Sprung Mass (Ms)	300 kg
Passenger	Circle metal mass	Unsprung Mass (Mu)	45 kg
Coil spring	Coil spring	Suspension Stiffness (Ks)	17,000 N/m
Tire	Tire	Tire Stiffness (Kt)	200,000 N/m
Damper	Damper	Damper Stiffness (Cs)	1500 N/m

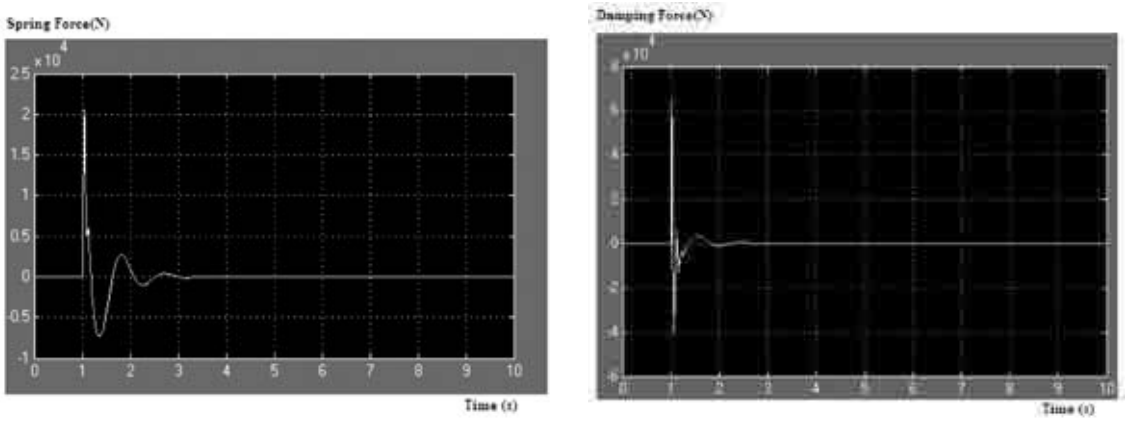
The parameter of quarter car test rig

By using the Matlab Simulink software, block diagram for 2 DOF quarter car model as shown below which all the parameters are closely actual with vehicle parameters.



Block diagram 2 DOF Quarter car vehicle

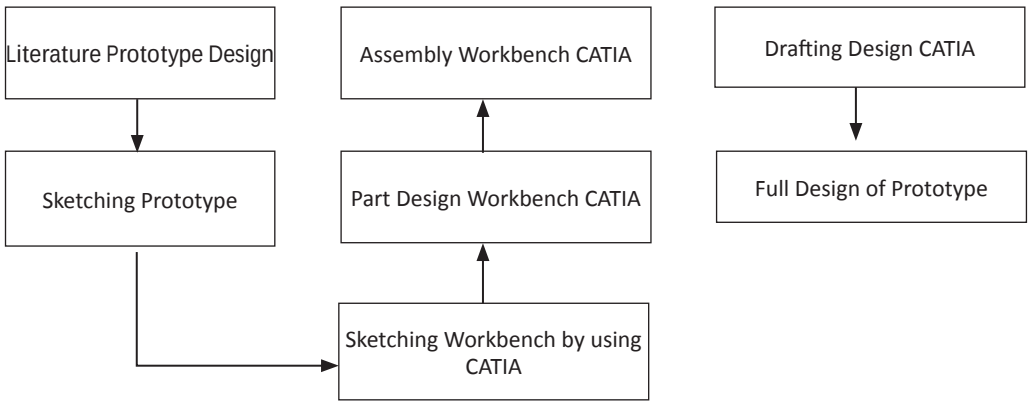
Thus, the result for the simulation above is shown at figure below;



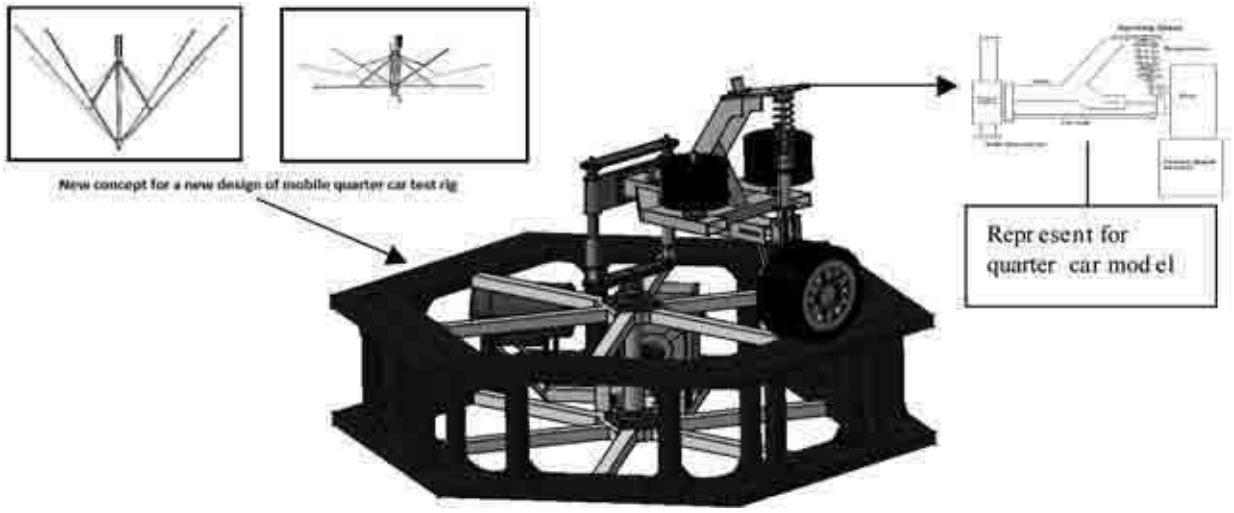
Graph for spring and damping force

5. Schematic and Design of The New Modified Mobile Quarter Car Test Rig

For a new conceptual design, this prototype will be operate with have more functions is same with a real condition of the quarter car test rig to perform such as real vehicle, this rig should be having the ability to mount several different design of actual car suspension which the result will be shown as analysis of simulation of Matlab Simulink. Among of the criteria that perform to a new of quarter car test rig is it able to perform a wide range of test includes variation in body loads and the frequency of road disturbance and still have the ability to expand for the future developments.



For a new conceptual design for the mobile quarter car test rig is based on the frame of the umbrella. This concept has taken because the flexibility of the frame to easy carries, ergonomic to put any place and standby to use and also friendly user.



The conceptual design for a new modified quarter car test rig

This representation shows the primary components of the rig. Those components are the sprung mass, body simulator, body arm, vehicle suspension, tire, tie rod, lower arm and ground or main frame. The sprung mass, suspension, and body arm is fixed at the body simulator and it constrained with bearings to move in the vertical direction. The actual suspension of the vehicle is attached to the sprung mass via the body arm connector. The road profile represents at the surface of the main frame and it fixed to the ground. To determine the displacement of the suspension, a displacement command signal is input from the tire disturbance that occurred when the body simulator rotate around the frame and to the system through the tire contact produce the suspension response matches the measured signal. Since the sprung mass is free to move in the vertical direction only, the vertical dynamic response of the specimen may be tested. To ensure that the requirements of the new rig were fulfilled, special attention was paid to the specifications and design of the key components.

The result of this design was a state-of-the-art quarter-car rig that is able to fulfill many of the functional requirements listed, and yet flexible enough to allow for implementation of hardware that will allow for fulfillment of the remaining and added requirements. The special thing of this design is the ability to fix all of types of the suspension and the latest capabilities it will be operate by using double acting cylinder of suspension. This prototype also is the first one in the world that the tire will be move around the frame such as the condition of the real vehicle, so directly it not neglected are dynamic rotation for the tire, tie rod and lower arm. Figure 16 is picture of the solid model of the new design. This model was created in CATIA V5R10.

6. Conclusion

The objective of this project is to design a new modified mobile quarter car test rig for vehicle ride analysis. The technology that will be used is a not the high technology but the concept to develop the idea and the result of the scope is the main important thing that we must consider. Based on the new idea of the rig, it has improve certain design if we compare to the current test rig especially about the structure and design but it still used the actual concept to investigate vehicle ride analysis and to come out with a new invention in the future. In order to reach this objective, much preparation work was completed. A full-scale mobile quarter-car test apparatus was designed and built so that the single suspension system could be excited with any desired input and the output could be measured with a data acquisition system. Based on objectives project, the new idea to design a new modified a new mobile quarter car test rig has been achieved. This is because more of the existing rigs develop with static condition of the tire whereby this situation gives more effect for dynamics motion of the part vehicle. Thus, through the new modified

of this rig, it more realistic in representing the quarter portion of real vehicle. Via this research, we will success to identify the instrumentations system from system to quarter car test rig.

Another that, based on the result of Matlab simulation, it's shown both of the suspension system which spring and damper will produce a same sine wave but the value of the maximum force is different. This occurred because of the position of the damper is too closed with the road profile compare then the spring, the damper also has more critical function to support high acceleration from road profile response. This is because at the real situation during drive a car, the driver will be decrease the velocity of the car when through to the bump area so in this simulation result, it proof that a lower frequency will be create a real behavior to close with a real vehicle ride analysis. The analysis from this experimental result shown the system at the quarter car test rig has been success to achieve the objectives based on the experimental simulation. Thus, in this project, the technology that will be used is a not the higher technology but the concept to develop the idea and the result of the scope is the main important thing that we must considered especially to reduce costing, for friendly user and also to minimize of the area and flexible to operate the machine.

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M13 - Pengujian Pada Sistem Pengalihudaraan Eksoz Setempat, LEV Di Stesen Kimpalan

Shikh Ismail Fairus Bin Shikh Zakaria*; Jasmadi Bin Sahadan** *Pusat Latihan Teknologi Tinggi (ADTEC)Melaka* Alloyplas Technology Sdn. Bhd. ***

Abstrak

Pendedahan melampau kepada wasap kimpalan amatlah memudaratkan kesihatan disebabkan kandungan logam berat yang bertoksik. Kaedah kawalan kejuruteraan yang popular dan efektif adalah penggunaan Sistem Pengalihudaraan Eksoz Setempat (Local Exhaust Ventilation System, LEVS). Sistem LEV yang dipasang perlulah diperiksa keberkesanannya agar mematuhi mematuhi Peraturan–peraturan Keselamatan dan Kesihatan Pekerjaan (Penggunaan dan Standard Pendedahan Kepada Bahan Kimia Berbahaya) 2000 (USECHH, 2000).

Keywords: *wasap kimpalan, risiko, pengawalan, LEV*

1. Pengenalan

Proses kimpalan merupakan satu proses pencantuman sesuatu bahan dengan bahan yang lain dengan menggunakan suatu bahan khas, contohnya logam atau termoplastik. Proses pengimpalan ini melibatkan pencairan sesuatu jenis logam tersebut untuk menjadikannya sebagai *pengikat* di antara sesuatu struktur dengan struktur yang lain. Aplikasi kimpalan sangat meluas merangkumi bidang industri perkapalan, industri minyak dan gas, industri pembinaan, industri automotif, industri elektronik dan sebagainya. Kimpalan arka dan kimpalan oksi-asetalina merupakan dua jenis kimpalan yang biasa digunapakai.

Hazard utama dalam proses kimpalan adalah wasap kimpalan yang bertoksik. Wasap kimpalan merupakan zarah-zarah halus yang sukar dilihat dengan mata kasar yang terbentuk apabila cairan logam dan juga cairan flux dari elektrod kimpalan bertukar menjadi wap dan tersejat di udara yang mana lama kelamaan membentuk satu gumpalan asap yang dapat dilihat. Kesan kepada kesihatan berkait dengan wasap logam ini adalah bergantung kepada unsur logam yang khusus hadir dalam wasap tetapi mungkin berbeza iaitu dari kesan jangka pendek seperti demam wasap logam (symptom seperti selsema), hinggalah kepada penyakit jangka panjang seperti gangguan neurologi barah paru-paru dan penyakit Parkinson. Rajah 1 menunjukkan unsur-unsur logam yang biasa hadir dalam wasap kimpalan serta kesannya terhadap kesihatan manusia.

Jenis proses kimpalan adalah sangat berkait rapat dengan kuantiti wasap dan juga gas yang dihasilkan. Oleh itu adalah sangat signifikan pemahaman asas setiap proses kimpalan bagi menilai risiko pendedahan. Secara umumnya, kimpalan arka teras lakur (flux core arc welding, FCAW) mengahasilkan wasap dan gas pada kadar yang tinggi diikuti kimpalan arka logam berperisai (shield metal arc welding,SMAW) , kimpalan arka logam gas (gas metal arc welding, GMAW) dan kimpalan arka tuggsten gas (gas tusngsten arc welding, GTAW). Selain daripada itu, kadar penghasilan wasap juga dipengaruhi oleh arus elektik, voltan arka, diameter elektrod, sudut elektrod, gas perisai, kelajuan mengimpal dan juga arus malar ataupun arus denyutan.

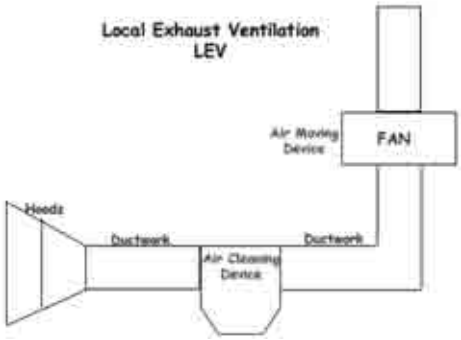
Apabila terdapat risiko yang tinggi terhadap pendedahan wasap kimpalan kepada pekerja, langkah yang berkesan sejauh mana mungkin perlu diambil bagi mengelakkan pendedahan yang melampau. Pemeriksaan yang menyeluruh pada amalan kerja adalah penting. Sekiranya kaedah penggantian atau modifikasi pada proses tidak dapat dilaksanakan, langkah seterusnya yang boleh diambil adalah kawalan kejuruteraan. Penggunaan sistem pengalihudaraan eksoz setempat, LEV merupakan kaedah yang efektif dalam mengawal bahan-bahan cemar udara yang berbahaya.

Metal Constituent	Common Source(s)	Health Effect(s)
Aluminum	Component of some alloys (such as Inconel®, copper, zinc, steel, copper, zinc, steel, magnesium, brass, and filler materials).	Lung damage, irritation
Beryllium	Hardening agent found in copper, magnesium, and aluminum alloys.	Cancer (lung), beryllosis
Cadmium	May be contained in plated materials and/or zinc alloys and sometimes used in the manufacture of fluxes in flux-cored electrodes.	Kidney damage
Chromium	Contained in most stainless steel and high-alloy materials. Also used as plating material.	Irritation, dermatitis, liver, kidney, respiratory, cancer (hexavalent chromium insoluble compounds)
Copper	Included in alloys such as Monel®, brass, bronze.	Irritation, damage to the gastrointestinal tract, metal fume fever
Fluorides	Common ingredient in electrode coatings and flux material for both low- and high-alloy steels.	Irritation, bone damage, fluorosis
Iron	The major contaminant in all steel-welding processes.	Siderosis (i.e., pigmentation of the lungs)
Lead	Common in solder, brass and bronze alloys. May also be contained in the primer/coating on steels.	Central nervous system, blood, kidney, reproductive
Magnesium	Found in light metal alloys.	Irritation, metal fume fever
Manganese	Contained in most welding processes.	Central nervous system, lung damage, reproductive
Molybdenum	Contained in some steel alloys, stainless steel, and nickel alloys.	Irritation, lung damage, central nervous system
Nickel	Contained in stainless steel, Inconel®, Monel®, Hastelloy® and other high-alloy materials, welding rods, and plated steel.	Dermatitis, pneumoconiosis, central nervous system, cancer, lung damage
Silicon	Present in most welding consumables.	Irritation, fever
Tin	Used in some solder alloys and bronzes.	Stannosis (i.e., benign lung disease), central nervous system, irritation, immunotoxicity
Titanium	Common ingredient in many flux-cored electrodes and in the coating of covered electrodes.	Lung damage
Vanadium	May be contained in some steel alloys, stainless steel, and nickel alloys.	Irritation, lung damage
Zinc	Common component of galvanized and coated metal.	Metal fume fever

(ACGIH; Antonini)

Rajah 1 Unsur umum hadir dalam wasap kimpalan

Sistem ventilasi LEV terdiri daripada hud, salur udara, peranti pembersih udara dan peranti penggerak udara (Rajah 2 Sistem ventilasi LEV). Selepas sesebuah sistem LEV direka dan dipasang, sistem tersebut perlu diuji sejauh mana keberkesanan sistem yang telah dipasang berbanding dengan sistem yang direkabentuk. Antara parameter yang perlu ditentukan adalah halaju muka, halaju penangkapan, halaju pengangkutan, laju kipas, tekanan statik dan tekanan halaju.



Rajah 2 Sistem Ventilasi LEV

Objektif utama kajian ini adalah memeriksa, menguji dan membuat penilaian akan keberkesanan sistem ventilasi LEV yang telah dipasang pada sesebuah bengkel kimpalan. Ia nya juga bertujuan agar kepatuhan terhadap Seterusnya input daripada kajian ini boleh dijadikan panduan kepada majikan dan institusi latihan yang terlibat secara langsung dalam aktiviti kimpalan agar mematuhi Peraturan–peraturan Keselamatan dan Kesihatan Pekerjaan (Penggunaan dan Standard Pendedahan Kepada Bahan Kimia Berbahaya) 2000 (USECHH, 2000).

Mengikut USECHH 2000 Peraturan 17- Peralatan Kawalan Kejuruteraan, sebarang peralatan kawalan kejuruteraan (LEV) perlu diperiksa dan diuji keberkesanannya oleh juruteknik higen pada sela masa yang sesuai, setiap sela masa tidak lebih dari dua belas (12) bulan.

2. Methodologi

Alloyplas Technology Sdn. Bhd. Telah dilantik oleh Institut Latihan Perindustrian (ILP) Jitra bagi melakukan pengujian Sistem Pengalihudaraan Ekzos Setempat, LEV terhadap empat (4) unit LEV di bengkel kimpalannya.

2.1. Peralatan pengujian

Bagi tujuan pengujian, alat yang digunakan adalah seperti tiub asap bagi memeriksa kebocoran udara, aliran udara (turbulen atau tidak bergerak), takometer utuk menguji kelajuan kipas. Tiub pitot dan hotwire anemometer untuk mengukur halaju muka/penangkapan dan kadar alir. Manometer digital untuk mengukur tekanan statik, tekanan halaju dan tekanan keseluruhan.

2.2. Jenis pengujian

Jenis pengujian dilaksanakan pada tiga komponen berikut:-

a) Hud – halaju muka/penangkapan, tekanan statik hud dan ujian tiub asap

b) Salur – tekanan statik dan tekanan halaju

c) Kipas – tekanan statik dan tekanan keseluruhan/halaju

2.3 Penilaian dan pengujian pada hud

Ujian pengesan tiub asap dilakukan bagi menilai penyerakan bahan cemar iaitu dengan cara menghalakan asap pada punca bahan cemar. Tiub asap akan membantu mengesan titik awal halaju bahan cemar menjauhi hud. Selain itu, kajian juga dilakukan pada aliran turbulen pada bukaan , sebarang kebocoran atau tumpahan pada hud.

2.4. Ujian prestasi pada salur

2.4.1. Pengukuran tekanan halaju salur

Pengukuran tekanan halaju salur diambil pada titik yang sesuai di sepanjang salur bagi menentukan halaju pengangkutan, kadar alir ispadu udara dalam salur. Seboleh-bolehnya, jarak rentas titik tersebut mestilah 7.5 kali atau lebih diameter salur dari sebarang gangguan utama udara. Purata halaju yang diukur, seterusnya digunakan bagi menghitung halaju pengangkutan pada titik tersebut pada salur.

2.4.2. Pengukuran tekanan statik salur

Titik pengukuran tekanan statik salur adalah sama seperti pengukuran tekanan halaju. Data pengukuran digunakan bagi mengira prestasi dan mengesan sebarang ketidakfungsian. Lokasi pengukuruan adalah pada cabang masukan kepada salur utama, pada setiap sisi pembersih udara, pada setiap titik pada kipas dan beberapa titik disepanjang salur.

2.5. Ujian pada kipas

Tekanan halaju dan statik diukur sebelum dan selepas kipas menggunakan tiub Pitot dan manometer sekiranya dapat diakses.

3. Keputusan

Daripada pemeriksaan dan pengujian kepada keempat-empat sistem LEV, data keputusan diringkaskan seperti dalam Rajah 3 dibawah. Manakala data pengujian pada kipas diringksakan dalam Rajah 4.

Sistem LEV	Jumlah Hud	No. Bay	Keberkesanan	Halaju Muka (fpm)	Halaju Tangkapan		Halaju Pengangkutan (fpm)
					(fpm)	Jarak dari hud (inci)	
Sistem-1	19	1 - 19	Sangat Berkesan	700 ~ 900	> 50	7 ~ 12	> 2000
Sistem-2	20	20- 39	Sangat Berkesan	800 ~ 1000	> 50	8 ~ 13	> 2000
Sistem-3	20	40- 59	Sangat Berkesan	700 ~ 900	> 50	7~ 12	> 2000
Sistem-4	12	60- 71	Sangat Berkesan	700 ~ 900	> 50	9~ 12	> 2000

Rajah 3- Pemeriksaan dan Pengujian Pada Sistem LEV

Spesifikasi		Sistem LEV1	Sistem LEV2	Sistem LEV3	Sistem LEV4
Kadar Alir Udara, **Q**	m3/sec	4.5048	3.8321	4.2733	2.023
	cfm	9545	8119	9054	4286
Tekanan Statik Kipas, **FSP**	Pa	+1326	+1204	+1096	906
Tekanan Keseluruhan Kipas, **TP**	Pa	1467	1342	1247	1018
	w.g	5.895	5.393	5.011	4.091
Laju putaran kipas, **RPM**	rpm	1470	1420	1430	1440
Kuasa kuda brek, **BHP**	h.p	14.755	11.481	11.897	4.598

Rajah 4- Pemeriksaan dan Pengujian Pada Kipas

4. Perbincangan

Secara umumnya, daripada pemeriksaan secara fizikal iaitu melalui ujian tiub pengesan asap bagi mengesan kebocoran dan titik tangkapan didapati tiada kebocoran ataupun halangan dijumpai disepanjang hud.

Ujian mendapati halaju penangkapan pada kesemua hud adalah melebihi 50 fpm ataupun 0.254 m/sec (saranan American Conference of Governmental Industrial Hygienists, ACGIH) dari 8" ke 13" bukaan hud.

Data ujian menunjukkan halaju pengangkutan dalam sistem salur bagi keempat-empat seistem adalah melebihi 2000 fpm atupun 10.16 m/sec iatu melebihi had minimum halaju pengangkutan yang disaran oleh ACGIH.

Kipas yang digunakan adalah jenis kipas empar dimana tiada masalah pada kelajuan kipas ditemui. Keseluruhan prestasi kipas adalah sangat baik dan tiada bunyi yang tidak normal dijumpai.

5. Kesimpulan

"Halaju Muka" dan "Halaju Penangkapan" bagi kesemua system eksos setempat , LEV 1,2,3 dan 4 bagi stesen kimpalan adalah sangat efektif untuk membawa bahan cemar keluar mengikut saranan ACGIH.

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M14 - Analysis The Influence Of EDM Parameters On Material Removal Rate Of Copper Beryllium Alloy Using Graphite And Copper Electrode

[1]Nor Mohamad Sulong*, [2]Mohd Razali Mohamad
Advanced Technology Training Centre (ADTEC) Melaka.

Abstract

Electrical discharge machining (EDM) is one of the important non-traditional machining processes and it is widely accepted as a standard machining process in the manufacture of forming tools to produce moulds and dies. Electrode and workpiece are the basic components of EDM and the electrode plays an important role, which affects the results of the machining process. Graphite and copper are the chosen materials by the majority of EDM users. In this paper, material removal rate (MRR) study on the electrical discharge machining (EDM) of copper beryllium alloy (CuBe) has been carried out. The workpiece and the electrode were mounted on an EDM machine, Sodick model AQ35L, and kerosene was used as the dielectric fluid. A study was carried out on the influence of the factors of polarity, current, pulse on time and voltage over the listed technological characteristics. Design of experiments (DOE) technique, two levels full factorial design will be use to select the condition of the machining process.

Keywords: *EDM, Graphite, Copper, Material Removal Rate, DOE.*

1. Introduction

CuBe alloys are widely used for injection moulding tools, as well as cores and inserts in steel moulds. CuBe alloys have a good machinability in conventional metal cutting. However, EDM offers a good alternative, as the process is carried out in wet and submerged media, thereby reducing the health risks associated with machining beryllium and its alloys [1,2].

EDM technology is increasingly being used in industry for high-precision machining of all types of conductive materials used in tool, die and mould making industries, for machining of heat treated tool steels and advanced materials, complex shapes and high surface finish [4]. Material with any hardness value that is electrically conductive can be cut [5]. The materials that commonly used as electrode for EDM are graphite, copper, brass, copper tungsten, copper graphite, zinc alloys and carbon. Graphite has a much lower density than copper, which makes it the best material for large electrodes [8]. Graphite does not melt, but rather a sublime, meaning it goes from a solid state directly into gas without melting and going through a liquid state [6]. The design of experiments (DOE) technique is a powerful work tool which allows us to model and analyse the influence of determined process variables over other specified variables, which are usually known as response variables. Within the design of experiments, there are various types that can be considered. One of the most widely known ones is the factorial design; this consists in experimenting with all the possible combinations of variables and levels [3,9].

2. Experimental details

2.1 Experimental equipment and setup

The work material used in this study was CuBe alloy. The chemical compositions of the work material are as follows: Be = 1.84%, Co+Ni = 0.26%, Ni+Co+Fe = 0.29%, Cu+Be+Ni+Co+Fe = 99.92. The dimensions of the 25mm X 25mm X 5mm square shape were used. The EDM experiments were performed by using CNC EDM Sodick, model AQ35L. Copper and graphite were selected as the electrodes. The size of each electrode 15mm X 15mm X 50mm. The precise quantification of material removal rate (MRR) was

possible by using a precise balance (resolution of 0.0001g) to weight the tool electrode and work piece before and after machining process. Kerosene was selected as dielectric because of its high flash point, good dielectric strength, transparent characteristics, low viscosity and specific gravity [7].

2.2 Experimental design

During experimental design, the input parameters (factors) were pulse on time (pulse on duration), peak current, pulsed voltage and polarity. The response variables selected for this study refer to the speed of EDM process which is material removal rate (MRR). The design of experiments (DOE) was performed through two level full factorial approach of experimental design. The design finally chosen was 2^4 full factorial with two replications, where a total of 32 experiments for each electrode was made and 64 runs of experiment were done.

The graphs that are to be presented were produced using MINITAB 14 software. The low and high levels selected for pulse on time, peak current, pulsed voltage and polarity were: 50 and 300□s, 20 and 64A, 120 and 200V and –ve (negative) and +ve (positive) respectively. Appendix A shows the design matrix as well as the value obtained in the experiments for the response variables studied in this work which is MRR. The MRR study have been made using the statistical techniques of design of experiments (DOE). The design of experiments (DOE) technique allows us to model and analyse the influence of determined process variables over other specified variables which are response variables [9]. The response variables chosen are amongst variables that are very important in studying EDM process besides surface roughness. Equation below show how to measure response variables of MRR.

MRR =Volume of material removed from part/Time of machining

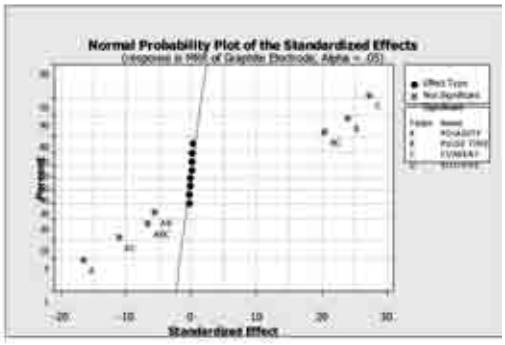
Although other ways of measuring MRR do exist, in this work the material removal rate has been calculated by the weight difference of the sample before and after undergoing the EDM process [3].

3. Results and Discussion

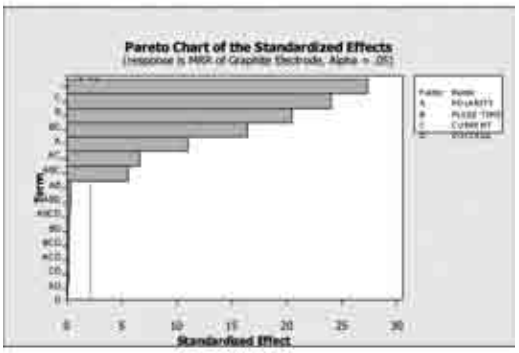
The data obtained from the experiment was analysed using Minitab software. The machining parameter studied were the polarity, pulse on time, current and voltage whilst the machining characteristic evaluate was machined material removal rate.

3.1 Analysis of Material Removal Rate (MRR) of Graphite Electrode

Figure 1(a) illustrates the normal probability plot of standardized effect for MRR. The graph shows that factors A (polarity), B (pulse on time), C (current) and interaction between factors AB, AC, BC and ABC is statistically significant at 95 percent significance level because the plots far away from a straight line that is approximately zero on the X axis. In others words, these parameters have large impact on the MRR of the CuBe alloy. Figure 1(b) shows the Pareto chart of standardized effect for MRR. The pareto chart displays the absolute value of the effect and draw a reference line on the chart. As can be clearly seen, all the bars of the diagram which go beyond the reference line (2.12) are statistically significant at a confidence level of 95%. Therefore, the significant factors which affect the MRR in descending order are: current(C), pulse on time (B), interaction between pulse on time and current, polarity (A), interaction between polarity and current, interaction between polarity, pulse on time and current and interaction between polarity and pulse on time. It is quite clear that from the graph, the interaction factors (ABCD, ABD ACD, BCD and AD) and D factor (voltage) have very little or even no impact on material removal rate (MRR) of CuBe alloy.



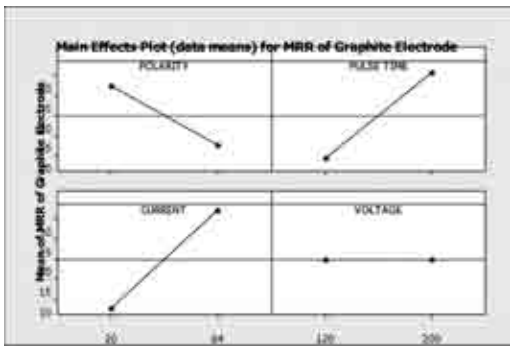
(a)



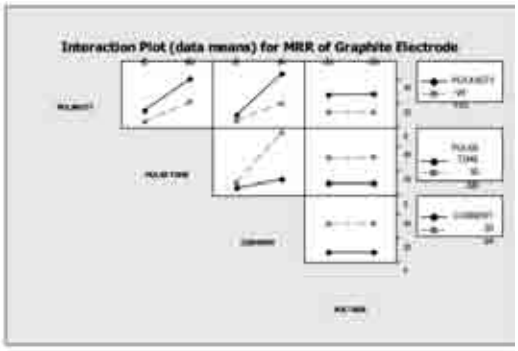
(b)

Figure 1: a) Normal probability plot of the Standardized Effect for MRR
b) Pareto chart of Standard Effect for MRR

Figure 2(a) shows the main effects plot for MRR. As can be seen in this plot, the value of MRR increase significantly with the factor of pulse on time and current. The plot also shows that the MRR is higher when using graphite electrode with negative polarity than a positive polarity. Even though the factor of voltage is not significant at the 95% confidence level. From Figure 2(b), the interactions between polarity and pulse on time, polarity and current and pulse on time and current. The lines of the graph have slopes that differ significantly indicating an interaction between polarity and pulse on time, polarity and current and also pulse on time and current have significant effect to the MRR of CuBe alloy. For low levels of pulse on time, the MRR is much better for the high level of current. For high level of pulse on time, the results are quite same. The MRR is higher for high level of current than for low level of current.



(a)



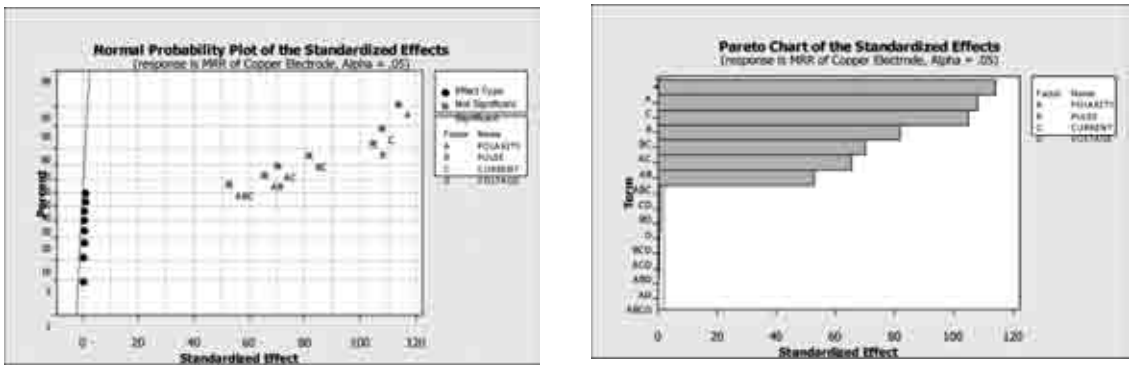
(b)

Figure 2: a) Main effect plot for MRR
b) Interaction plot for MRR

Turning to the interaction of polarity and current, the average MRR is better for negative polarity of electrode and high level of current. The MRR is worse when there is positive polarity of electrode and low current use. However, the interaction of polarity is different for each of the two levels of pulse on time. Apart from that, there are no significant interaction between other factor with voltage because the slope of line almost equal. The interaction between these factors indicates that to get the MRR as higher as possible, design or setting for polarity, pulse duration and current must be always at the negative polarity and high level.

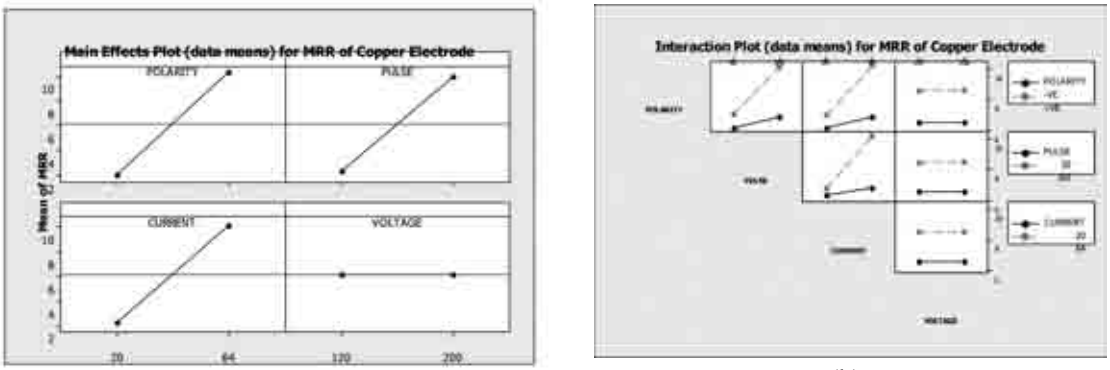
3.2 Analysis of Material Removal Rate (MRR) of Copper Electrode

Figure 3(a) illustrates the normal probability plot of standardized effect for MRR. The graph shows that factors A(polarity), B(pulse), C(current) and interaction between factors AB, AC, BC and ABC are statistically significant at 95 percent significance level. Figure 3(b) shows the Pareto chart of standardized effect for MRR. As can be clearly seen, all the bars of the diagram which go beyond the reference line (2.1) are statistically significant at a confidence level of 95%. Therefore, the significant factors which effect the MRR in descending order are: polarity(A), current(C), pulse duration(B), interaction between pulse and current, interaction between polarity and current, interaction between polarity and pulse and interaction between polarity, pulse and current. It is quite clear that from the graph, the interaction factors (ABCD, ABD ACD, BCD and AD) have very little or even no impact on material removal rate (MRR) of CuBe alloy. Figure 4(a) shows the main effects plot for MRR. As can be seen in this plot, the value of MRR increase significantly with the factor of polarity, pulse duration and current. Even though the factor of voltage not be significant at the 95% confidence level. Positive polarity of copper gives high MRR because copper more stable as anode due to its thermo physical properties is high. As can be seen in this plot, the value of MRR increase significantly with the factor of polarity, pulse duration and current. Even though the factor of voltage not be significant at the 95% confidence level. From figure 4(b), single interaction plot graphically shows the interaction between polarity and pulse duration, polarity and current and pulse duration and current. The lines of the graph have slopes that differ significantly indicating an interaction between polarity and pulse duration, polarity and current. Apart from that, there are no significant interaction between other factor with voltage because the slope of line almost equal.



(a) (b)

Figure 3: a) Normal probability plot of the Standardized Effect for MRR of copper electrode
b) Pareto chart of Standardized Effects for MRR of copper electrode



(a) (b)

Figure 4: (a) Main effect plot for MRR of copper electrode
(b) Interaction plot for MRR of copper electrode

The interaction between these factors indicates that to get the MRR as higher as possible, design or setting for polarity, pulse duration and current must be always at the positive polarity and high level. Parameter of polarity, current and pulse on time is individually significant to the machining process. Higher pulse on time gives longer effective period of spark reaction on the workpiece, MRR will increase because the energy is high. Combination of suitable polarity and higher pulse on time gives same result which is higher MRR. High pulse on time and high current will make machining process at the spark area become longer and with higher energy of spark due to high current and produced bigger MRR.

4. Conclusions

In this work, a study on the influence of the most relevant EDM operating parameters over material removal rate (MRR) has been carried out. The study has been made for CuBe alloy on rough machining using graphite and copper electrode. In order to achieve this, DOE has been used to analyse all response variables.The following conclusions can be drawn from the analysis of the results:

i) The interaction between pulse on time and current, polarity and current, polarity and pulse on time, pulse on time and current are significant in the case of MRR for electrode copper and graphite.

ii) Factor of voltage and any other factors that have interaction with voltage don't have any significant effect to the MRR of the EDM machining process.

iii) The best combination to get high MRR (71.94mm^3/min) by using graphite electrode is negative polarity electrode, high pulse on time and high current.

iv) Using copper as an electrode to machine CuBe alloy gives low material removal rate (MRR) compare to graphite electrode.

v) The interaction between factors indicates that to get the MRR (28.25mm^3/min) as higher as possible with copper electrode, design or setting for polarity, pulse duration and current must be always at the positive polarity and high level.

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APPENDIX A: Results of the experiment

RUN ORDER	POLARITY	PULSE ON TIME	CURRENT	VOLTAGE	Graphite Electrode, MRR (mm^3/ min)	Copper Electrode, MRR (mm^3/ min)
1	+VE	50	20	120	3.33	2.56
2	+VE	50	20	200	3.19	2.47
3	+VE	50	64	120	5.42	5.71
4	-VE	50	20	120	8.90	0.27
5	-VE	300	64	200	71.94	5.97
6	+VE	300	64	120	34.40	28.25
7	+VE	50	64	120	5.42	5.69
8	+VE	300	20	120	7.22	5.11
9	-VE	50	20	200	8.83	0.27
10	+VE	300	20	200	7.41	5.14
11	+VE	300	64	200	34.67	27.73
12	-VE	300	20	120	11.20	1.03
13	-VE	50	64	120	19.38	0.91
14	+VE	300	64	200	33.83	28.15
15	+VE	300	20	120	7.41	5.15
16	-VE	50	64	200	18.69	0.91
17	+VE	300	20	200	7.19	5.12
18	-VE	300	20	200	11.34	1.03
19	+VE	50	64	200	5.39	5.57
20	+VE	50	20	120	3.12	2.55
21	-VE	50	20	120	9.24	0.27
22	+VE	300	64	120	34.61	27.21
23	-VE	300	64	200	69.09	5.88
24	-VE	300	20	200	11.03	1.01
25	+VE	50	20	200	3.13	2.54
26	-VE	50	64	200	19.14	0.91
27	-VE	300	64	120	76.21	5.87
28	+VE	50	64	200	5.65	5.83
29	-VE	50	20	200	9.03	0.28
30	-VE	300	20	120	11.31	1.02
31	-VE	300	64	120	62.20	5.75
32	-VE	50	64	120	19.28	0.91

M15 - Mesin Pengupas Kulit Tebu : Perbandingan antara Penggunaan Pisau dan Mekanikal bagi Tujuan Penghasilan Jus Tebu

Mohd Aidil Shah bin Abdul Rahim; Mohd Hafizal bin Mokhtar
Pusat Latihan Teknologi Tinggi (ADTEC) Batu Pahat
aidil@adtecbp.gov.my; hafizal@adtecbp.gov.my

Abstrak

Kajian ini memberi fokus kepada dua kaedah dan perbandingan teknik mengupas kulit tebu. Objektif kajian ini adalah untuk mengenalpasti teknik terbaik mengupas kulit tebu. Mesin pengupas kulit tebu ini mampu mengupas tebu dalam julat diameter antara 20mm-45mm. Ia berupaya meningkatkan produktiviti sebanyak 50% dalam pengeluaran pukal. Namun begitu, keputusan eksperimen di mana kaedah 'cylindrical grinder' sebagai mata pengupas yang digunakan menunjukkan bahawa tebu perlu dikupas dengan satu mekanisma yang tidak berlawanan dengan serat memanjang yang membina kulit tebu. Juga menunjukkan bahawa penggunaan 'pully' sebagai pemegang mata pengupas dan penghubung kepada motor adalah kurang efisien dan menjurus kepada masalah sekatan tebu semasa proses pemotongan. Gegaran dan bunyi bising mesin juga merupakan salah satu faktor kepada ketidaksuaian penggunaan secara komersial. Penggunaan spring pada hujung mata pemotong juga kurang menghasilkan impak yang diharapkan.

Katakunci: *Tebu, mengupas kulit tebu, mengupas, pisau pemotong*

1. Pengenalan

Tebu (Saccharum spontaneum) terdiri daripada 6 ke 37 spesis merupakan tumbuhan menyerupai rumput yang tinggi. Tumbuhan ini mempunyai ruas yang bersambung dan serat memanjang yang kaya dengan gula berukuran 2 ke 6 meter panjang. Penanaman tebu di Malaysia dalam skala yang kecil. Ia lebih tertumpu di kawasan Utara Semenanjung Malaysia iaitu Kedah dan Perlis. Kawasan ini mempunyai musim kering yang membantu kepada kos penghasilan tebu [9].

Tanaman tebu di Perak dan Negeri Sembilan tidak berjaya kerana kos unit yang tinggi dan keadaan penghasilan yang tidak sesuai. Kawasan yang berpotensi untuk dikembangkan adalah Johor dan juga Sarawak dan beberapa projek telah pun berjalan [8]. *Federal Agricultural Marketing Authority* (FAMA) telah bekerjasama dengan beberapa pengusaha tebu sebagai satu inisiatif untuk mengekalkan bekalan tebu yang berterusan terutamanya bagi tujuan ekspot iaitu Singapura dan Dubai (Quest Agrobiz)[7]. Singapura misalnya, telah menetapkan beberapa standard yang perlu dipatuhi. Antaranya adalah tebu harus dikupas kulitnya sebagai salah satu syarat yang telah ditetapkan oleh pihak *Agri-Food & Veterinary Authority of Singapore* (AVA) [1].

Jus tebu adalah minuman popular di kebanyakkan negara di Asia termasuk China, India, Malaysia, Singapura dan Thailand kerana rasanya yang manis dan harga yang murah. Banyak dijual oleh pengusaha kecil di tepi jalan dan juga hotel lima bintang. Jus tebu juga digunakan sebagai bahan perubatan bagi tujuan menyembuhkan penyakit kuning dan penyakit yang berkaitan dengan limpa manusia [3]. Bahan yang terkandung dalam tebu mempunyai keupayaan untuk mempertahankan *cell* daripada proses penuaan dan mengurangkan risiko penyakit seperti kanser dan jangkitan kuman yang menyebabkan *cardiovascular* [2].

1.1 Tebu di Batu Pahat

Satu kajian berkaitan jenis tebu yang digunakan dijalankan di sekitar Bandar Selatan Batu Pahat, Johor . Tebu yang biasa terdapat di kawasan mengikut keutamaan ialah tebu hitam (30%), tebu telur (25%), tebu buluh (17%), dan tebu air (10%). Walaubagaimana pun, jenis tebu yang biasa digunakan bagi tujuan

ekstrak jus tebu ialah tebu telur (45%) kerana mudah didapati dipasaran dengan kos yang rendah. Tebu air sebanyak 20% dan tebu hitam, tebu buluh dan lain-lain mewakili sebanyak 35% sahaja. Dalam kajian ini, hanya tebu madu dan tebu telur sahaja yang digunakan.

Melalui kajian juga didapati 100% pengusaha tebu (yang melibatkan eksport) masih menggunakan kaedah konvensional bagi proses pengupasan kulit tebu. 60% pekerja yang ditemubual menyatakan bahawa penggunaan pisau pemotong/pengupas mengundang bahaya jika tidak biasa digunakan. 40% pekerja yang mengatakan bahawa penggunaan pisau pemotong adalah tidak berbahaya adalah dari kalangan mereka yang berpengalaman.

Masih banyak yang perlu diketahui berkenaan penyediaan jus tebu seperti pengupasan, pemerahan dan teknik-teknik lain yang perlu dipelajar bagi menambahkan pengetahuan sediada [10].

2. Bahan dan Kaedah

2.1 Kajian melalui Pemerhatian

Kajian melalui pemerhatian yang merupakan salah satu cabang yang terletak antara kategori *'survey'* dan kategori 'ethnografik' boleh digunakan samada bagi kajian berbentuk kualitatif dan juga kuantitatif [11]. Bagi kajian kualitatif, pengkaji akan menterjemahkan hasil kajian dalam bentuk penerangan berbanding nombor/nilai atau ukuran [4]. Pendapat ini juga disokong bahawa banyak perkara tidak dapat dijelaskan hanya dengan merujuk pada data numerika sebaliknya memerlukan data-data kualitatif yang dipungut melalui kaedah temubual atau pemerhatian yang teliti secara mendalam [5].

Kajian bagi projek ini tidak melibatkan ukuran *'turbidity'* ekstrak tebu atau pun kualitinya seperti kandungan ekstrak, pH, warna dan kelikatan yang perlu diukur dengan *refractometer, pH meter, color meter* atau *rheometer* [10]. Kajian ini hanya bersandar kepada pemerhatian hasil pengupasan yang hadir pada permukaan tebu yang selesai dikupas kulitnya. Pemerhatian lebih tertumpu kepada keadaan *stem* tebu (luaran) dan bukannya hasil (jus) yang dihasilkan melalui proses pemerahan dan sebagainya.

2.2 Perbandingan antara Pengupasan Menggunakan Pisau Pemotong dan Mesin Pengupas.

Pada masa ini, pekerja masih menggunakan peralatan tajam seperti pisau atau parang untuk mengupas kulit tebu bagi tujuan penghasilan jus tebu. Adakalanya pekerja perlu menggunakan sarung tangan bagi mengelakkan tangan daripada terluka. Kaedah secara konvensional ini banyak membantutkan perkembangan industri ini dan beberapa kerja dan kos tambahan terlibat menyebabkan kekangan kepada jumlah eksport yang sepatutnya.

Rajah 1. Pisau pengupas kulit tebu moden

Rajah 2. Pisau pengupas kulit tebu konvensional

Jika tebu dikupas dalam kuantiti banyak, kerja yang dilakukan turut bertambah, malah lebih sukar jika tiada alat bantuan yang boleh memudahkan kerja. Pisau pengupas moden yang digunakan (Rajah 1) mempunyai dua mata bertentangan dan satu daripadanya tajam yang digunakan untuk memotong kulit tebu mengikut alur serat tebu secara selari. Berbeza sedikit dengan pisau pemotong konvensional (Rajah 2) yang hanya bersandarkan pada satu mata sahaja. Proses pengupasan ini (Rajah 3) digunakan secara meluas samada pengusaha jus tebu secara kecil-kecilan mahupun di industri kecil dan sederhana. Dengan kaedah ini, tebu yang paling sesuai dikupas adalah tebu Gred C berukuran 3 kaki. Bagi tebu Gred AA (12 kaki), Gred A (9 kaki) , Gred B (6 kaki) , pekerja harus menggunakan alat tambahan bagi memudahkan kerja pengupasan.

Rajah 3. Pisau pengupas kulit tebu
(Sumber: Quest Agrobiz Sdn Bhd)

Penggunaan pisau pemotong bagi tujuan pengupasan kulit tebu menjurus kepada beberapa masalah. Permintaan tinggi daripada pengguna serta syarat yang ketat ditambah dengan kaedah konvensional menggunakan pisau pemotong menyebabkan keluaran tebu yang siap diproses terhad. Ini menyumbang kepada produktiviti yang rendah. Proses mengupas kulit tebu adalah proses terawal selain daripada proses menggred. Ini mengakibatkan proses seperti membersih, menjemur dan proses lain terganggu dan seterusnya mengakibatkan permintaan tidak dapat dipenuhi dan terpaksa dibeli daripada pihak ketiga sebelum dihantar semula kepada pelanggan.

Industri penghasilan jus tebu mempunyai potensi yang luas tetapi disebabkan oleh kajian yang terhad berkaitan tebu dan teknologi pada sudut pengupasan yang masih ketinggalan dan sekiranya ada pun masih tidak dikomersialkan menyebabkan penghasilan dan penjualan jus tebu masih pada tahap mendatar [6] & [12]. Mesin pengupas kulit tebu (Rajah 4) berfungsi untuk menyelesaikan masalah yang menghadkan kadar produktiviti yang rendah seterusnya membantu pengusaha tebu untuk melengkapkan bekalan yang diminta oleh pelanggan.

Rajah 4. Mesin pengupas kulit tebu

Rajah 5. Proses mengupas kulit tebu

Rajah 6. Proses mengupas selesa

Mesin pengupas kulit tebu terdiri dari 3 bahagian utama iaitu kabinet mesin, suis kawalan motor mesin dan bahagian pengupas kulit tebu. Keseluruhan rangka kabinet mesin dibuat daripada *angle iron* (*cast iron).* Mesin ini dikawal melalui sistem elektrikal yang dikawal melalui *pust button, start* dan *stop* serta *emergency stop button* bagi tujuan kecemasan. Mesin ini menggunakan konsep *cyclindrical grinding* (3 unit yang dipasang pada *shaft*) yang bertindak sebagai mata pemotong *(6 flute)* dalam masa yang sama menolak tebu yang diproses keluar semasa proses pengupasan. Sebanyak 3 (tiga) buah mata pemotong (Rajah 7) diameter luar 60 mm dan panjang tiap satu 137 mm dan 3 *pully* diameter luar bersaiz 50 mm yang disambung pada setiap satu hujung mata pemotong yang dihubung dengan sistem *belting V (A-17).* Keseluruhan bahagian ini disambungkan melalui sistem sproket dan rantai kepada motor utama 240W yang terletak dibahagian bawah mesin.

Rajah 7. Mata pengupas kulit tebu.

Diameter tebu yang sesuai digunakan antara Φ20mm hingga Φ45mm. Tebu yang siap dikupas akan keluar pada hujung bahagian pengupas yang dikawal oleh 3 (tiga) spring yang akan merenggang mengikut diameter tebu yang melaluinya.

3. Keputusan dan Perbincangan

3.1 Perbandingan Antara Pengupasan Menggunakan Pisau Pemotong dan Mesin

Tebu yang digunakan secara amali dalam kajian ini hanya melibatkan dua jenis tebu iaitu dari jenis tebu telur dan tebu madu. Pisau pemotong yang digunakan adalah seperti yang ditunjukkan dalam Rajah 1. Tebu perlu dipotong sepanjang lebih kurang 3 kaki bagi memudahkan proses kupasan dan pemerahan. Jenis tebu yang sama juga dikupas menggunakan Mesin Pengupas Kulit Tebu yang direka oleh Bahagian Pembuatan, ADTEC Batu Pahat. Mesin ini digerakkan oleh motor 0.26 HP. Hasil yang didapati daripada kaedah pengupasan menggunakan pisau pemotong dan Mesin Pengupas Kulit Tebu ditunjukkan seperti rajah dibawah.

Rajah 8. Tebu madu yang dikupas menggunakan pisau pemotong.

Rajah 9. Tebu madu yang dikupas menggunakan Mesin Pengupas Kulit Tebu.

Rajah 8 menunjukkan hasil daripada pengupasan tebu madu yang sekata melalui proses menggunakan pisau pemotong. Hasil berbelang yang terhasil merupakan *'standard'* minima yang membolehkan batang tebu dieksport ke luar negara terutamanya Singapura yang begitu mementingkan kualiti kupasan. Dengan menggunakan mesin pengupas kulit tebu, hasil yang didapati tidak berapa kemas di mana terdapat serpihan kulit dan isi tebu yang terkeluar. Permukaan tebu yang dihasilkan juga tidak sekata dan berserabut jika dibandingkan dengan hasil yang diperolehi melalui pisau pemotong ianya jauh daripada *'standard'* yang dikehendaki oleh pasaran. Ini ditunjukkan dengan jelas dalam Rajah 9. Keadaan serabut yang terhasil berpunca daripada pergerakkan mata alat pemotong yang bertentangan dengan alur *stem* tebu. Stem tebu adalah kategori fiber yang kuat pada satu arah sahaja dan lemah pada arah yang bertentangan dan ini menyumbang kepada keadaan ini.

Rajah 10. Tebu telur yang dikupas menggunakan pisau pemotong.

Rajah 11. Tebu tebu yang dikupas menggunakan Mesin Pengupas Kulit Tebu.

Tebu telur memberikan hasil yang sama dengan tebu madu jika diproses menggunakan pisau pemotong seperti Rajah 10. Hasil yang konsisten dan memenuhi *'standard'* bagi tujuan pasaran. Namun melalui proses mesin, tebu telur menunjukkan implikasi yang lebih ekstrem dimana proses pengupasan menyebabkan permukaan batang tebu telur menjadi hancur dan pecah. Ini kerana secara biologinya keadaan tebu telur yang lebih lebih rapuh berbanding tebu madu yang lebih keras menyebabkan hasil yang demikian (Rajah 11).

4. Kesimpulan

Keputusan yang diperolehi menunjukkan bahawa proses mengupas kulit tebu bagi tujuan penghasilan jus tebu harus menggunakan pisau pemotong bagi mendapatkan hasil yang lebih *'standard'* dan memenuhi permintaan pelanggan. Penggunaan mata alat pengupas yang mengambil kira konsep *'cyclindrical grinder'* merupakan pendekatan yang tidak sesuai digunakan bagi tujuan pengupasan kulit tebu bagi penghasilan jus tebu. Penggunaan rantai sebagai penyambung antara motor dan *pully* mata alat pengupas juga merupakan teknik yang tidak efisien dari segi teknikal dan keselamatan. Rekabentuk yang dihasilkan juga tidak berapa ergonomik dan memerlukan beberapa perubahan.

Kajian lebih mendalam mengenai teknik penghasilan jus tebu dan fizikal tebu itu sendiri perlu bagi menghasilkan sebuah mesin yang lebih efisien dari segi teknikal dan ergonomik agar sesuai digunakan bagi semua jenis tebu di Malaysia agar penghasilan jus tebu yang dihasilkan lebih bersih, berkualiti dan lebih asli. Melalui kajian lanjut, *stem* tebu yang terdedah mengundang kerosakan dan menjejaskan kualiti tebu yang bakal dieksport. Kajian yang menyeluruh dan terperinci berkenaan tebu adalah wajar kerana kulit tebu mengandungi anti oxidant yang tinggi yang boleh meningkatkan kualiti jus tebu. Adalah wajar perlunya sebuah mesin yang berfungsi dengan baik dari segi pengupasan yang optima pada *stem* tebu.

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M16 - Rekabentuk dan Fabrikasi Acuan Suntikan Plastik : Penggulung Wayar

[1]Amir Giman, [2]Noor Hisham Jalani, [3]Junaidah Sulaiman
Pusat Latihan Teknologi Tinggi (ADTEC)Batu Pahat
[1]*amir@adtecbp.gov.my*, [2]*jnhisham@adtecbp.gov.my*, [3]*junaidah@adtecbp.gov.my*

Abstrak

Kertas ini membentangkan proses menghasilkan satu acuan suntikan plastik tiga plat untuk menghasilkan satu produk, iaitu penggulung wayar. Ia dibahagikan kepada tiga bahagian iaitu: bahagian rekabentuk, bahagian fabrikasi dan bahagian analisa. Proses rekabentuk dibantu dengan Rekabentuk Terbantu Komputer (CAD) menggunakan perisian komputer AutoCAD. Untuk Pembuatan Terbantu Komputer (CAM), Pro/ Manufacturing (Pro/MFG) daripada perisian komputer Pro/Engineering (Pro/E) digunakan untuk menjanakan beberapa kod kawalan berangka untuk proses pemesinan. Proses pembuatan acuan plastik tiga plat di mesin konvensional melibatkan kerja-kerja mencanai, melarik dan mengisar. Selain itu, penggunaan mesin Kawalan Berangka Komputer (CNC) juga digunakan untuk kerja mengisar. Acuan yang telah disiapkan diuji kebolehoperasiannya menggunakan mesin suntikan plastik jenis Battenfeld. Manakala jenis bahan mentah plastik yang digunakan ialah polypropylene. Setelah beberapa penambahbaikan dijalankan ke atas acuan dan juga pelarasan mesin suntikan, produk penggulung wayar telah berjaya dihasilkan.

Katakunci: *rekabentuk produk, acuan suntikan plastik*

1. Pengenalan

Zaman kini, teknologi berkaitan alat tekan dan acuan suntikan plastik berkembang dengan begitu pantas kerana ia merupakan teknologi terpenting yang digunakan di seluruh dunia. Plastik terutamanya, merupakan bahan yang paling popular digunakan sebagai barangan kegunaan harian dan industri, meliputi peralatan dapur, permainan, sukan, pembungkusan, pengangkutan, perubatan dan juga digunakan dalam teknologi angkasa lepas. Secara umumnya, acuan suntikan plastik adalah proses pembentukan plastik kepada bentuk yang dikehendaki dengan mencairkan bahan plastik tersebut dan menolaknya masuk ke dalam kaviti acuan pada tekanan yang tertentu [5].

Proses rekabentuk dan pembuatan acuan plastik melibatkan teknologi tinggi pada kos yang bukan sedikit. Ia melibatkan penggunaan *computer aided engineering* (CAE) untuk analisa dan simulasi, *computer aided design* (CAD) untuk rekabentuk dan *computer aided manufacturing* (CAM) untuk menjana kod kawalan berangkan bagi proses pemesinan. Kebanyakan pengeluar mula menggunakan perisian tersebut untuk mengurangkan masa dan kos rekabentuk kerana simulasi acuan dan pembuatan dapat dikesan diperingkat awal lagi. Ini mampu mengurangkan masalah-masalah kelewatan pengeluaran yang mengakibatkan lebihan kos, terutamanya kos bahan dan pekerja [9]. Jelasnya, penggunaan perisian-perisian komputer tersebut sangat membantu dalam menghasilkan acuan suntikan plastik yang berkualiti dan mampu meningkatkan produktiviti.

Di dalam projek ini, produk yang dipilih untuk dibangunkan adalah penggulung wayar perkakasan elektrik. Wayar yang boleh digulung hanya terhad kepada yang bersaiz kecil iaitu di antara ø2mm hingga ø5mm.

2. Rekabentuk

2.1 Produk : Penggulung Wayar

Penggulung wayar atau dikenali sebagai *cord shortener* mempunyai tiga bahagian berasingan. Bahagian pertama adalah "**badan**" berfungsi sebagai tempat penyimpanan wayar. Bahagian kedua adalah "**penggulung**" berfungsi untuk menarik dan menggulung wayar ke dalam produk. Bahagian ketiga adalah "**penutup**" yang berfungsi sebagai pemutar untuk memutarkan bahagian penggulung.

Gambarajah 1: Rekabentuk Penggulung Wayar

Produk ini mempunyai sistem *autolock* yang berfungsi untuk memastikan penutup/pemutar diputar pada satu hala sahaja. Di tepi bahagian produk terdapat *tab* yang perlu ditekan untuk melepaskan kunci *autolock* jika pengguna mahu mengeluarkan wayar tersebut. Tujuan *autolock* ini dibuat adalah untuk memastikan wayar tidak dapat ditarik keluar dengan sengaja mahupun tidak sengaja. Rekabentuk penggulung wayar adalah seperti yang ditunjukkan dalam Gambarajah 1. Cara pengendaliannya adalah wayar dibentuk seperti U dan disangkut pada lengkok yang terdapat pada penggulung. Kemudian bahagian penutup diputar supaya wayar digulung masuk dan disimpan kemas di dalam badan produk.

Jadual 1: Spesifikasi Produk

Nama Produk	Cord Shortener
Cara Penghasilan	Acuan Tiga Plat
Bahan Binaan	Plastik *Polypropylene*
Saiz	70mm (dia) x 26mm (t)
Proses Terlibat	*Injection Moulding*
Fungsi Produk	Menggulung wayar

Proses merekabentuk acuan plastik dibantu dengan Rekabentuk Terbantu Komputer (CAD) menggunakan perisian komputer AutoCAD dan *Solidwork*. Perisian *Solidwork* digunakan untuk mendapatkan usulan terbaik kedudukan *gate* dan melihat aliran masuk plastik yang memberi kesan kepada ketahanan produk.

2.2 Pemilihan Bahan

Bahan yang dipilih untuk menghasilkan produk ini adalah jenis *polypropylene* dari kumpulan termoplastik. Sifatnya yang ringan, keras, menghasilkan sudahan permukaan yang licin dan mudah diproses menjadikannya sesuai sebagai bahan produk. Warna bahan asal ialah natural dan boleh diwarnakan. Mempunyai takat lebur dan suhu pesongan yang tinggi. Rintangan yang baik terhadap bahan kimia, haba dan lembapan. Bahan ini mempunyai ketumpatan yang rendah (0.9-0.91g/cm kiub) dan boleh dilentur berulang kali tanpa patah disamping kos yang rendah (murah) [6]. Kegunaannya adalah seperti membuat peralatan dapur, barangan sukan, barangan permainan kanak-kanak, botol, bahagian mesin basuh, badan pengering rambut, komponen kereta, *bumper* dan peralatan hospital.

2.3 Pemilihan Acuan

Acuan yang dipilih untuk proses penghasilan produk adalah Acuan Suntikan (*Injection Mould*). Leburan atau plastik (*plasticised)* disuntik atau dipaksa ke dalam acuan di mana ia disimpan sehingga dikeluarkan dalam keadaan pepejal dan menyerupai kaviti acuan yang digunakan [1].

Dalam pemilihan acuan pula, acuan tiga plat digunakan. Ia tidak mempunyai banyak perbezaan dengan acuan dua plat, cuma ianya ditambah dengan satu plat sahaja iaitu plat terapung fungsinya bertujuan untuk memutuskan *runner* dan *gate* dengan produk secara automatik. Penggunaan acuan tiga plat ini adalah bersesuaian bagi menghasilkan produk dalam kuantiti yang banyak dan seragam semasa proses pengeluaran produk dilakukan [2].

Acuan tiga plat ini kebanyakan digunakan di industri kerana proses pengeluaran produk adalah cepat berbanding acuan dua plat kerana operator pengeluaran tidak perlu memisahkan *runner* dari produk secara *manual*. Ini adalah kerana acuan tiga plat mempunyai kelebihan iaitu mempunyai *floating plate* yang terletak di antara *top plate* dan *caviti plate* yang berfungsi memutuskan *gate* dan memisahkan *runner* dari produk secara automatik apabila acuan dibuka. Selain itu, kelebihan acuan tiga plat ini ialah *gate* boleh diletakkan pada mana-mana bahagian pada produk, pengeluaran cepat kerana *scrap* diasingkan dengan sendiri, tidak memerlukan masa untuk memotong *gate* dan tiada kesan *gate*. Tetapi acuan ini lebih mahal jika dibandingkan dengan acuan dua plat. Selain itu, pembuatan acuan ini adalah rumit dan kos penyelenggaraan lebih tinggi.

2.4 Teori Rekabentuk Acuan

Dalam pembuatan acuan, terdapat beberapa perkara dititikberatkan untuk menghasilkan acuan yang berkualiti dan mendapat hasil produk berkualiti tinggi. Antara perkara yang dititikberatkan adalah pengiraan untuk kadar pengecutan, berat produk, tekanan apitan, saiz *runner* dan saiz *gate*.

Rumus-rumus yang biasa digunakan adalah:-

i. Berat produk, W = Sg x Vt
Di mana;
Sg = *Specific gravity*, Vt = isipadu produk
Unit = *g/shot*

ii. *Clamping force* = (*resin pressure in cavity*) x (*projection area*)
Unit = *kg @ tonne*

iii. Saiz *runner*, D = 0.2654 x $\sqrt{w}\sqrt{w}$ x $\sqrt{L}\sqrt{L}$
Di mana;
W = berat, L = panjang *runner*

iv. *Gate*, h = n x t
Di mana;
n = *material constant,* t = tebal dinding produk

v. Pengecutan
Pengecutan adalah pengurangan dimensi produk dengan dimensi produk pada rongga. Pengecutan adalah bergantung kepada kemampatan dan pengembangan haba plastik. Ianya memberi kesan pada beberapa perkara pada parameter mesin iaitu tekanan, suhu, kadar penyuntikan plastik, tebal dinding, jarak daripada *gate* dan jenis plastik. Plastik yang telah disuntik akan mengalami proses pengecutan tersendiri dikenali sebagai *shrinkag*e. Pengecutan bertambah apabila bahan bertambah, suhu acuan bertambah dan ketebalan dinding bertambah. Pengecutan akan berkurang sekiranya tekanan tinggi, masa pengecutan lama dan pencampuran *fillers*. Nilai pengecutan dikira mengikut spesifikasi yang telah ditentukan [3].

Rumus pengecutan yang digunakan adalah:

$$M_{caviti} = \frac{A \quad A \quad A \quad A}{1-B\,1-B^{1-B}\,1-B} \qquad M_{core} = \frac{A \quad A}{1+B\,1+B}$$

Di mana;
A = saiz sebenar
B = peratus pengecutan

Untuk Pembuatan Terbantu Komputer (CAM), Pro/Manufacturing (Pro/MFG) daripada perisian komputer Pro/Engineering (Pro/E) digunakan untuk menjanakan beberapa kod kawalan berangka untuk proses pemesinan. Proses pembuatan acuan plastik tiga plat di mesin konvensional melibatkan kerja-kerja mencanai, melarik dan mengisar. Selain itu, penggunaan mesin Kawalan Berangka Komputer (CNC) juga digunakan untuk kerja mengisar.

3. Pengujian Acuan

Selepas proses pemasangan, acuan tersebut akan melalui proses suntikan plastik untuk mengeluarkan produk. Proses ini memerlukan kepakaran untuk mengendalikan mesin suntikan tersebut. Ini kerana semasa melakukan proses suntikan ini, pelbagai perkara penting perlu dititikberatkan antaranya ialah paramater, tahap kepanasan resin, dan tempoh suntikan yang akan dilakukan. Dengan terkawalnya perkara tersebut, maka produk yang dihasilkan adalah baik dan memuaskan. Dengan menggunakan mesin suntikan plastik jenis Battenfeld 80 tan, pelarasan parameter mesin diperolehi seperti yang ditunjukkan di Jadual 2.

Jadual 2: Pelarasan Parameter Mesin

Parameter	Bacaan
Clammping force	200kN
Zero offset injection unit	154 mm
Zero offset ejector unit	2.0 mm
Zero offset clamping unit	300 ton
Cooling time	30 g

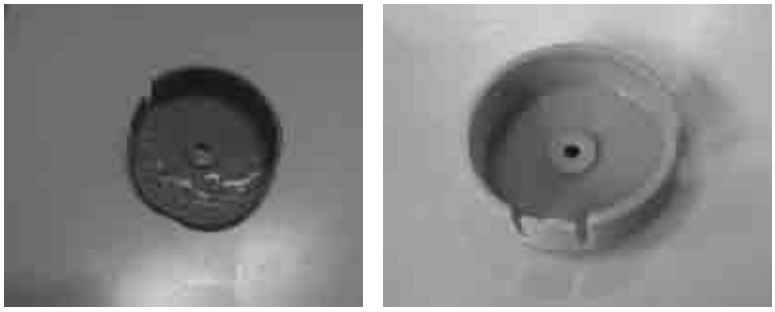
Jadual 3 pula menunjukkan masalah yang dihadapi ketika pengujian acuan di mesin Battenfeld.

Jadual 3: Masalah dan Penyelesaian Pengujian Acuan

KOMPONEN	MASALAH	PENYELESAIAN
Core insert & cavtry insert	Acuan yang tidak sejajar menyebabkan kerosakan *core insert* dan *cavtry insert*	Meningkat semula acuan dan memastikan acuan sejajar
Ejector pin	Kelihatan kesan *injector* pada produk	Semasa pemotongan *ejector* pin pastikan kedudukan *ejector* dan inserts betul-betul rapat supaya tiada ruang di dalamnya bagi memudahkan jarak *ejector* tepat semasa suntikkan
Island core	Island pada bahagian core bengkok	Disebabkan ukuran yang tidak epat semasa proses pemesinan. Tukarkan island core mengikut ukuran yang ditetapkan

Gambarajah-gambarajah berikut menjelaskan keadaan kecacatan produk semasa ujian suntikan.

3.1 Bahagian Badan



Gambarajah 2: Kecacatan produk (badan)

Cara pengujian:

- Membuat suntikan pertama pada acuan untuk mengeluarkan produk.
- Lihat perubahan produk pertama dengan kerosakan yang di alami.

Masalah:

- Pengujian pada peringkat pertama telah dijalankan pada acuan tiga plat (*three plate mould*) dengan menggunakan plastik *polypropylene* (PP) dan hasilnya produk yang keluar mengalami kecacatan iaitu *short-shot*.

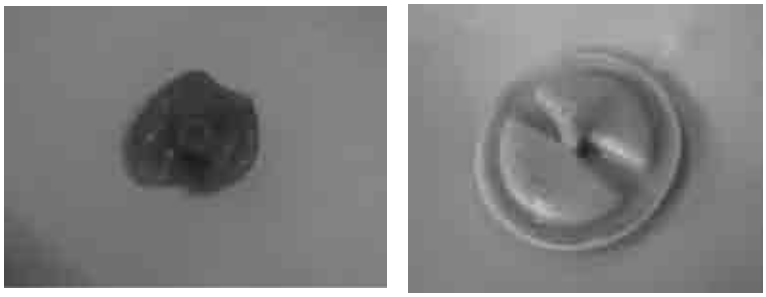
Punca:

- Keadaan resin sejuk (190°C).
- Tekanan apitan tidak sesuai (200kN)

Kaedah penyelesaian:

- Tingkatkan *injection pressure* dan *injection speed* (300kN)
- Tingkatkan suhu *barrel* (210°C)

3.2 Bahagian Penutup



Gambarajah 3: Kecacatan produk (penutup)

Cara pengujian:

- Membuat suntikan plastik pada acuan untuk mengeluarkan produk pertama.

Masalah:

- Pengujian pada peringkat kedua telah dijalankan pada acuan tiga plat dengan menggunakan plastik *polypropylene* (PP) dan hasilnya produk yang keluar mengalami kecacatan iaitu *shot-short.*

Punca:

- Isipadu resin tidak mencukupi (10g)
- Tekanan apitan tidak sesuai (200kN)

Kaedah penyelesaian:

- Tinggikan isipadu resin (20g)
- Tingkatkan *injection speed* dan *injection pressure* (300kN)
- Tinggikan suhu *barrel* dan suhu acuan (215°C)

3.3 Bahagian Penggulung

Gambarajah 4: Produk (penggulung)

Cara pengujian:

- Melihat perubahan suntikan pertama pada mesin *injection mould.*

Masalah:

- Tiada.

4. Kesimpulan

Secara umumnya kecacatan pada produk adalah disebabkan oleh keadaan pelarasan parameter mesin acuan plastik iaitu sebanyak 70%, manakala kecacatan yang disebabkan kerosakan pada acuan sebanyak 30%. Ujian dan pemeriksaan yang dilakukan ke atas acuan dan produk siap menunjukkan ia berada pada tahap kebolehterimaan. Keputusan ini jelas menunjukkan bahawa kerja-kerja merekabentuk, pemesinan, pemasangan dan pengujian acuan plastik telah berjaya dilaksanakan.

5. Rujukan

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M17 - Experimental and Numerical Analyses of Residual Stress Distributions in TIG Welding Process for 304 Stainless Steel

Muhamad Anuwar Bin Jusoh*, Hj. Nordin Abdullah, Soleha Rosdy
Pusat Latihan Teknologi Tinggi (ADTEC) Batu Pahat
**E-mail:anuwar_j@yahoo.com*

Abstract

Welding is most widely used in metal joining. It can give significant problem to engineers, researchers and manufacturers. In Tungsten Inert Gas (TIG), defining the process and appropriate values for process is essential in order to control heat-affected zone (HAZ) and get the required effect of residual stress. In this investigation, experimental was carried out to study of heat affected zone and thermal analysis will be investigated by using finite element analysis(FE). Also, the effects of process variables and heat input, HAZ region, weld interface, and weldment characterization will be studied. The metallurgy technique and response surface methodology were also used. In the present paper, the characterization of the macrostructure, microstructure, hardness and residual stress distribution are highlighted and discussed to achieve a better understanding of the welded quality which is crucial in determining the welded products. Direct and interaction effects of the process variables and residual stresses were presented in graphical forms.

Keywords*: Fusion welding, macrostructure, microstructure, hardness and residual stress*

1. Introduction

The cryogenic gases are needed to be stored in special containers, which are usually thermally insulated containers, specifically designed to bear rapid temperature changes and extreme differences in temperature. These tanks are suitable for the storage and delivery of liquid oxygen, nitrogen or argon at a maximum allowable working pressure of 18.5 bar. They are also suitable for the delivery of gaseous product with an optional vaporizer. Cryogenic materials include the liquids argon, nitrogen, oxygen and helium, and solid carbon dioxide (dry ice). Carbon dioxide and nitrous oxide, which usually have slightly higher boiling points are also included in the category of cryogenic gas. One of the most commonly used element in cryogenics is Liquid nitrogen. Liquid helium is also used. Infact liquid helium allows for the lowest attainable temperature to be reached. It is to be noted that all types of cryogenic liquids are gases at normal temperatures and pressures. These gases are then cooled below room temperature and this should be done before an increase in pressure can liquefy them. Under different conditions of temperature and pressure, different cryogens become liquids

1.0 Mathematical Formulation

The governing equation for heat transfer in a three dimensional solid body is governed by:

$$-\left(\frac{\partial q_x}{\partial x}+\frac{\partial q_y}{\partial y}+\frac{\partial q_z}{\partial z}\right)+Q=\rho c\frac{\partial T}{\partial t} \qquad (2.1)$$

Where, q_x, q_y, q_z are the heat flow rate per unit area and Q is the rate of internal heat generation per unit volume. Then ρ is metal density,c is the specific heat, T is the current temperature and t is the time.

Heat conduction boundary conditions frequently encountered are specified surface temperature, specified surface heat flow, convective heat exchange and radiation heat exchange. The boundary conditions illustrated in Figure 2.4 can be written as:

$$T_s = T_1(x, y, z, t) \quad on\ S_1$$
$$q_x n_x + q_y n_y + q_z n_z = -q \quad on\ S_2$$
$$q_x n_x + q_y n_y + q_z n_z = h(T_s - T_e) \quad on\ S_3$$
$$q_x n_x + q_y n_y + q_z n_z = \sigma \epsilon T_s^4 - \alpha q_r \quad on\ S_4$$

Where, T_1 is the specified surface temperature which may vary with position and time, n_x, n_y, n_z is the direction cosines of the outward normal to the surface, q_s is the specified heat flow rate per unit area, h *is* the convective heat transfer coefficient as function of the convective exchange temperature and T_s *is* the surface temperature, ϵ is the Stefan-Boltzman constant, $\epsilon\epsilon$ is the surface emissivity as function of surface temperature, ϵ is the surface absorptivity and q_r is the incident radiant heat flow rate per unit area.

The finite element equations in the mechanics of materials analysis is formulated by considering the potential energy Π of the solid. For each discretized element,

$$\Pi^{(e)} = \frac{1}{2}\int_{\Omega^{(e)}} \left(\{\delta\}^{(e)} [B]^T [C][B]\{\delta\}^{(e)} - 2\{\delta\}^{(e)} [B]^T [C]\{\epsilon_o\} \right) d\Omega$$
$$- \int_{\Omega^{(e)}} \{\delta\}^{(e)} [N]^T \{F_b\}^{(e)} d\Omega - \int_{S_2{}^{(e)}} \{\delta\}^{(e)} [N]^T \{T\}^{(e)} d\Gamma \qquad (2.5)$$

Where $\{F_b\}\{F_b\}$ and $\{T\}\{T\}$ are vectors of force component per unit volume and surface traction component per unit area, respectively. Since the potential energy of a discretized system assumes a minimum value when the first variation of the functional vanishes, thus,

$$\int_{\Omega^{(e)}} [B]^T [C][B]\{\delta\}^{(e)} d\Omega - \int_{\Omega^{(e)}} [B]^T [C]\{\epsilon_o\}\, d\Omega$$
$$- \int_{\Omega^{(e)}} [N]^T \{F_b\}^{(e)} d\Omega - \int_{S_2{}^{(e)}} [N]^T \{T\}^{(e)} d\Gamma = 0 \qquad (2.8)$$
$$[K]^{(e)}\{\delta\}^{(e)} = \{F\}^{(e)} \qquad (2.9)$$

2. Numerical Simulations

The results of finite element simulation are presented in this chapter. Predicted stress, elastic plastic region and model deformation at various points are compared and discussed. The corresponding inelastic strains and stresses are presented and discussed.

Overall result after develop FE model is shown in below figure. The location of failure is edge corner of welding section or joint portion between shell layer and head layer of pressure vessel. The maximum value of failure result from von Mises stress simulation is 3.162E+08 Pa and the minimum value of failure result is 1.397E+08 Pa.

Both critical point are shown in section view of isometric model from figure 3.1 below. Then the element is project to see the contour plot without element mesh and the result is shown as figure 3.1.1 and figure 3.1.2 for solid model and figure 3.1.3 and 3.1.4 for shell model.

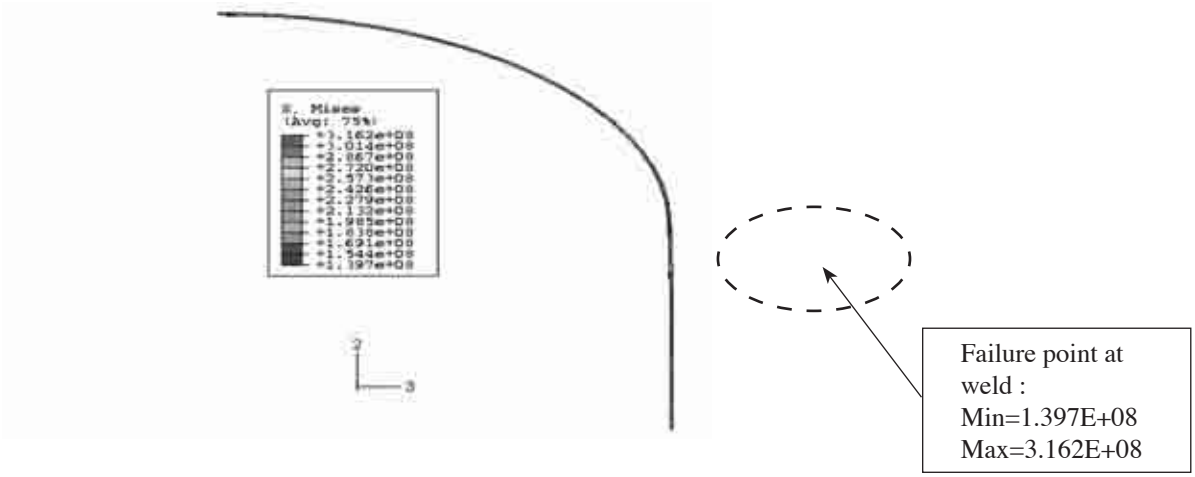


Figure 3.1 : Failure at weld point from section view of isometric model

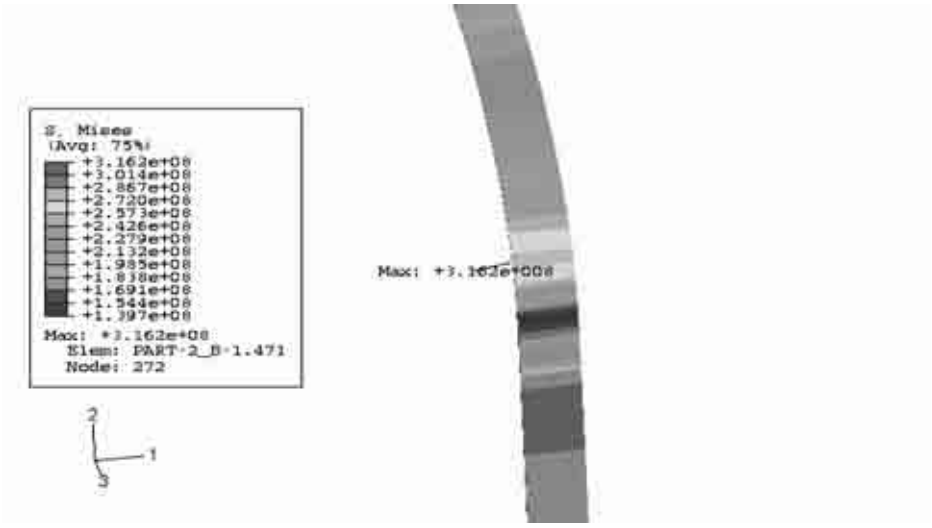


Figure 3.1.1 : Failure at weld point of contour plot for Solid Model

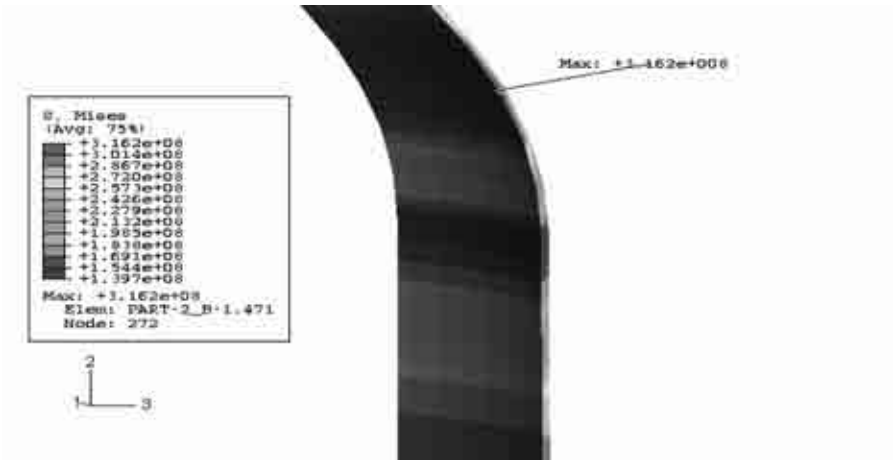


Figure 3.1.2 : Failure at weld point with zooming of contour plot for Solid Model

The result for shell elements are shown in figure 4.1.3 and 4.1.4 below. From cross section of isometric model below, the result showing that the failure point is outside and not inside of tank structural. The von Mises stress analysis results are given the maxima value is 3.094E+08 Pa and the minima value is 1.229E+08 Pa. So from both of result, the shell model result is not acceptable due to low reading of failure and wrong location of failure point. Beside that, the shell result is rejected due to the element developed to build the shell which is lower node compare to the solid node.

Figure 3.2.1 and 3.22 illustrates the distribution of result displacement of the shell and solid model geometry of the cryogenics storage tank. The maximum deflection is referring to the solid model compare to the shell model. The maximum corresponding deflection is 4.886E-3 meter for shell and the failure is occur at the wall of shell and not at the weld point. This is likely due to the gravity pull effect on the plate for regions near the far corners of the welded portion.

The solid model is observed to have a smaller deflection of 4.628E-3 meter. The failure is still occur at the weld portion and the result is acceptable compare to the shell model.

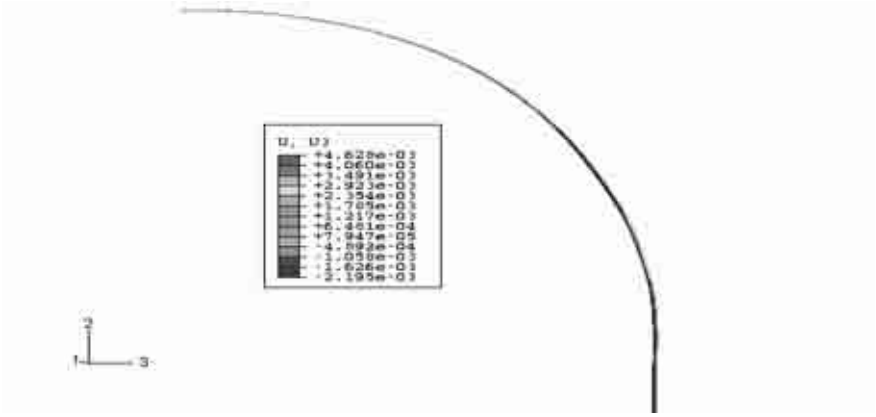
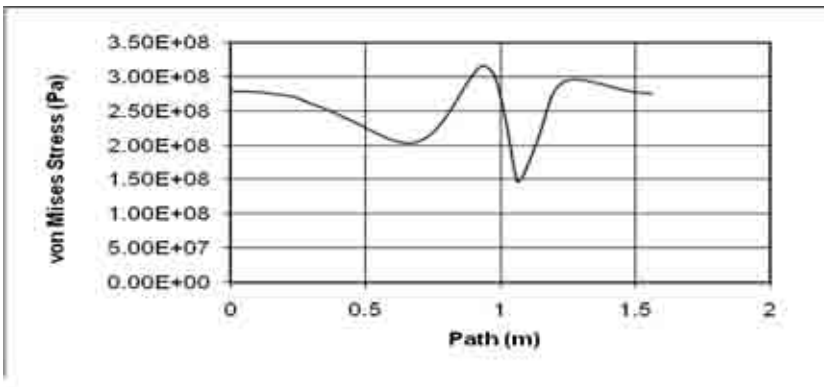
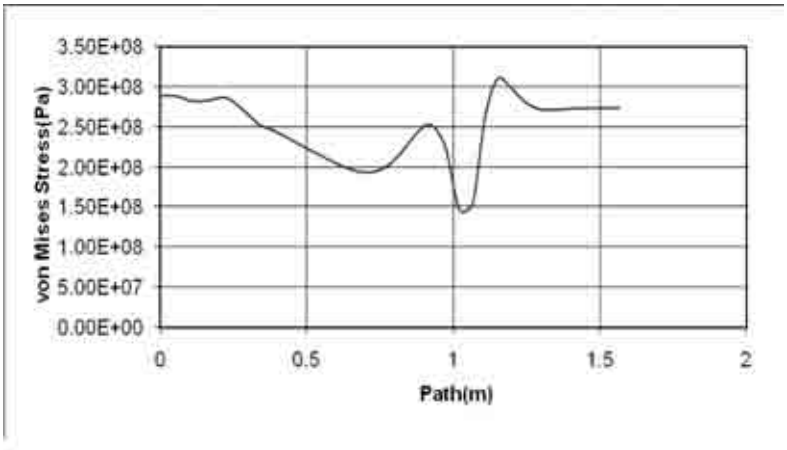


Figure 3.2.2 : Deformation at weld point for Solid Model

The calculated von mises stress value compare to the path of element deformation are shown in figure 3.3.1 and 3.3.2 below. Result shows that various value of deformation for shell and solid model with the changes value of stress.



Graph 3.3.1 : Von Mises stress (Pa) versus path(m) for shell model



Graph 3.3.2 : Von Mises stress (Pa) versus path(m) for solid model

3. Conclusions

In this paper, The material selected is AISI 304 Stainless Steel or X5 Cr Ni 18-10 (1.4301) that has been used in fabrication of cryogenic storage tank with 11000 liter design capacity. The failure at weld portion will crack due to low toughness because of low temperature.The head & bottom of tanks need to be similar or higher thickness compare to the shell plate. The failure result without residual stress and unloading is 3.163E+08 Pa.The model will be changed to elastic plastic region with 32bar of pressure loading.

4. Acknowledgements

The authors wish to thank ADTEC Batu Pahat for supporting this research activity.

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M18 - Cooling Load, Power Consumption And Performance Evaluation In Design Of Air Conditioning System For Main Hall ILP Kepala Batas

Azman H.[1], Mohd Yusoff S.[2], Ulul Azumi A.H.[1] & Abdul Rani S.[1]
Institut Latihan Perindustrian Kepala Batas
[2]Department of Thermo-Fluid, Faculty of Mechanical Engineering
Universiti Teknologi Malaysia, 81310 Skudai Johor
azmanhussien@yahoo.com

Abstract

Water-cooled package chillers and air-cooled condenser systems are being used for medium and large buildings but their optimal performance depends on the EER values and refrigerant used. Systematic design saves capital and operating costs. This paper describes a case study where good system design can result in improvement in energy efficiency, performance and power consumption. The study is focused on cooling load methodology, power consumption and performance between R410A and R22 systems at the design stage. R410A system is found to have comparable performance to the soon to be phased out R22 system.

Key-Words: *- Refrigerant, cooling load, EER, system performance, power consumption*

1. Introduction

The energy efficiency ratio (EER) has increased substantially around the world. In the US, the average EER has increased from 5.98 in 1972 to 9.08 in 1996. By 2001, this average is likely to rise above 10.0. Energy efficiency in buildings refers to the ability of a building to operate and function with minimum energy consumption. Energy consumption is related to energy efficiency of the air conditioner. In Malaysia, there has been a dramatic increase in energy consumption due to growth in population, enhanced comfort levels and the rise in time spent inside buildings for working purpose [1]. To overcome the problem, air conditioning system design at the design stage should be considered. A high quality system design gives good thermal comfort and low energy consumption [2]. Thermal comfort is always related to cooling load of the buildings. Therefore, several methods have been developed for load estimation in order to give accurate results, save times and be user friendly. The most basic approach is by manual calculation [3]. It is a scientific approach but time consuming and too lengthy. The lengthy method makes theoretical approach more of academic interest and quite often the engineers do not prefer. The standard approach is using the load estimation form [4, 5] while advance method requires using computer software which has been validated as a fairly accurate method as manual cooling loads calculations [6]. System such as water cooled chillers and air cooled condensers are always selected for medium and large buildings but their performance depends on the EER value and refrigerant use. EER refers to energy consumption of the machine. Previous study stated a minimum EER value for all room air conditioners irrespective of size in the market should be 10.0 and above [7]. There are many types of refrigerants in the market. R22 is a commonly used refrigerant but will be phased out due to its high ozone depleting potential (ODP). R410A is currently accepted as a suitable replacement of the R22 refrigerant [8]. It has an ODP of 0.0, operating pressure 1.6 times higher and boiling point (-51.5 °C) lower than R22 (-40.8 °C). The objective of this study is to explore the possible ways of improving the system design in order to give effective energy efficiency strategy. This paper will report the different cooling load calculation methods used, power consumption and performance between R410A and R22 refrigerant at the design stage for the air conditioning of the main hall of Institut Latihan Perindustrian (ILP) in Kepala Batas, Pulau Pinang.

2. Materials And Methods

Air conditioning design has been made for the main hall of ILP in Kepala Batas. The standard indoor design condition is 78 °F dry bulb (DB) and 50 % relative humidity (RH) and the outside design condition is 95 °F DB and 65 % RH. Air conditioning is from 9.00 AM to 5.00 PM, the main facade is facing West , the daily range is 18 °F and the design month is July. The existing air conditioning system is an air cooled system with ducted air system. Data of the system was recorded and the calculated load is assumed as the total cooling load of the building from previous design condition. Calculation of new building total cooling load was made using Rule of Thumb estimation load (RTEL) [9], Cooling Load Estimation Form (CLEF) [5], Cooling Load Temperature Difference with correction (CLTDc) [10] and Abbas et.al approach [6]. Two different refrigerants compared in the study were R410A and R22. The refrigeration system was assumed to work in an ideal single stage compression with standard temperature control. Evaporating temperature was assumed at 5.5 °C and condensing temperature was 46 °C. Discharge temperature (compressor outlet) was constant at 90 °C and evaporator outlet has 0 °C superheat while the condenser outlet has subcooling of 5 °C. These data were plotted on the pressure-enthalpy chart using Refrigerant utilities *(Cool Pack)* Version 2.84 [11] in order to determine enthalpy properties. Figure 1, illustrates the cycle on p-h chart.

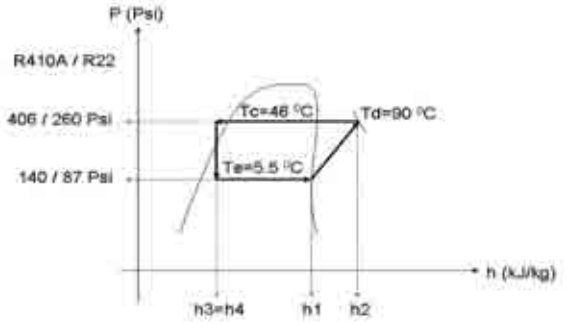

Figure 1: Properties of system on p-h chart.

The mass flow rate, power required by compressor and coefficient of performance (COP) are obtained from:

1) Mass flow rate of refrigerant $(m_{ref}) = \dfrac{(q_{ref.\ capacity})}{60(h1 - h4)}$

2) Power required by compressor

$$(W_{in}) = (m_{ref}) \times (h2 - h1)$$

3) Coefficient of Performance $(COP_{ref}) = \dfrac{(q_{ref.\ capacity})}{(W_{in})}$

Applying the relationship between EER and COP gives,

4) Energy efficiency ratio (EER)

$$EER = COP \times 3.413$$

5) Operating cost (OC) $OC = \dfrac{CC \times OH \times PE}{EER \times 1000}$

where, CC = Cooling capacity or Total cooling load (Btu per hr)
OH = Operating hours
PE = Price of electricity
EER = Energy efficiency ratio

3. Results And Discussions

Table 1 shows the maximum heat gain between 2 PM to 5 PM obtained from the CLTDc method. The results indicated that the highest peak load time is at 4 PM with heat gain of 120853 Btu/hr. This finding is similar to that reported in previous study [12] where peak load time is at 4 PM. Thus, this peak time was selected for calculation of Total Building Cooling Load (TCL) using different methods.

Table 1: Maximum heat gain base on peak load time from 2 PM – 4 PM

Hour	Items	Heat gain types	Heat gain (Q) (Btu/hr)
14.00 (2.00)	Roof	Conduction	Q=U x A x CLTDc =63146.6
	Glass	Conduction	Q=U x A x CLTDc =10251.0
	Glass	Solar radiation	Q=SHGF x A x SC x CLF =28303.2
	TOTAL HEAT GAIN		**101700.8**
15.00 (3.00)	Roof	Conduction	73051.4
	Glass	Conduction	10983.2
	Glass	Solar radiation	28671.7
	TOTAL HEAT GAIN		**112706.3**
16.00 (4.00)	Roof	Conduction	80480.4
	Glass	Conduction	10983.3
	Glass	Solar radiation	29389.4
	TOTAL HEAT GAIN		**120853.1**
17.00 (5.00)	Roof	Conduction	84194.8
	Glass	Conduction	10251.0
	Glass	Solar radiation	22741.9
	TOTAL HEAT GAIN		**117187.7**

Table 2 shows the TCL for the main hall obtained from four different methods. Results indicated the TCL for RTEL is 250 kW, followed by CLEF (239 kW), CLTDc (161 kW) and Abbas et.al (173 kW) approach. When compared to previous design load, it is found that the four different calculation methods give different results. Percentage of increment is highest by RTEL (51.2%), followed by CLEF (48.9%), Abbas et.al (28.9%) and CLTDc (24.2%). This indicated that new total building cooling load is substantially higher than the previously calculated TCL. This can contribute to system operating in overload condition which can cause machine (refrigeration system) breakdown. This situation will also increase the maintenance cost especially for repairing job and replacement of parts.

Table 2: Comparison of total cooling load in different approach

Calculation Method	Total Cooling load (TCL)		
	kW	Btu per hr	TR
Previous design load	122	415836	35
RTEL	250	856064	71
CLEF	239	818328	68
CLTDc	161	549703	46
Abbas et.al	173	590443	49

Results from RTEL and CLEF indicated total cooling load increment of 100 % of the previous design load with a 100 % increase in capacity of air the conditioning system. This contributes to extra initial cost. CLEF method is the easy and fast way to estimate total cooling load of the building but not much different compared to RTEL calculation method where percentage difference is only 4%. Thus, instead of using CLEF method that used more time and extra work, the RTEL method is much easier and time saving. For Abbas et.al approach, the calculation method was easier and not complicated as the CLTDc approach. The result shows only 6% of difference. Since CLTDc calculation method gives the lowest total building cooling load (161 kW = 46 TR = 549703 Btu/hr), this new TCL is selected as a reference of cooling capacity of system for evaluating the performance and operating cost.

Table 3 shows the performance of refrigeration system after analysis in p-H Chart software. It is found that the R410A system has higher specific enthalpies compared to R22 system.

Table 3: Performance of refrigeration system in p-H Chart

Cycle stage	R22 refrigerant (kJ/kg)	R410A refrigerant (kJ/kg)
h1	407.325	426.821
h2	457.919	484.159
h3=h4	251.00	272.101

Table 4 shows the results of power requirement, mass flow rate and coefficient of performance (COP) for both R22 and R410A refrigerants. The power required to drive the compressor is lowest and the COP is highest when using R22. COP for R410A is lower than R22 and this result similar reported by Payne (2002) where COP for R410A was approximately about 15% lower than R22 system.

Table 4: Comparison of power, mass flow rate and COP for R22 and R410A

Items	R22	R410A	Unit
Power required by compressor (W_{in})	*69.37*	*79.93*	*Horse Power*
Mass flow rate of refrigerant (m_{ref})	*1.02*	*1.04*	*kg/s*
Coefficient of Performance (COP)	*3.12*	*2.71*	*W/W*

Operation cost was evaluated between R22 and R410A refrigeration systems. Table 5 shows the EER values and operating costs of both refrigerants. The EER value for R22 system is 10.6 which over the minimum setting proposed by Department of Standards Malaysia. Operating cost for R22 gives saving of RM 19.42 per day and RM 3939.47 per year when compared to the R410A system. It can be concluded that using a high EER machine (air conditioning system) will contribute to energy saving and reduced electricity bills.

Table 5: EER values and operating costs for both refrigerants

Parameters	Values
Cooling capacity, CC	549703 Btu per hr (46 TR)
Operating hour, OH (hr)	8
Average operate per month(day)	20
Price electricity, PE (RM/kWhr)	0.26
EER R22	10.6
EER R410A	9.2
Operating Cost R22	RM 25887.89 per year
Operating Cost R410A	RM 29827.36 per year

4. Conclusion

The total cooling load of the main hall comes from direct solar radiation, transmission load, ventilation or infiltration load and internal load. It was found that there is no absolutely correct method for load estimation either by computer or manual calculation due to a lot of assumptions that need to be considered, and the results of the calculation will be influenced by the quality of the assumptions. The ILP building is located at five degrees and tweenty four minutes north of the equator for which the CLTDc method gave the maximum load at 4.00PM.

The replacement R410A system has a slightly inferior performance when compared with the soon to be phased out R22 system. The additional operating cost of RM 3939.47 per year for the R410A system is unavoidable since the system has lower COP compared to R22 system.

On EER issues, it will be a benefit to consumers by implementing the energy efficiency standard in air conditioning in Malaysia. It is a trend in the market where new products that give extra features such as high EER and energy saving will increase the selling price but consumers will get lower electricity consumption.

5. Acknoledgement

The authors wishe to express their sincere thanks and gratitude to Tuan Haji Mohd Sukimi Bin Mohd Salleh, Director of Institut Latihan Perindustrian Kepala Batas for encouregement and supporting the facilities during study period.

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M19 - Sistem Dan Kaedah Mengupas Nanas Dengan Mengunakan Mesin Pengupas Nanas Automatik

Asziman Bin Sukran, Azrul Hisam Bin Abdul Aziz, Saiful Bahrin Bin Mohd Said
Pusat Latihan Teknologi Tinggi (ADTEC) Batu Pahat,
asziman@adtecbp.gov.my , azrulhisham@adtecbp.gov.my , saiful_bahrin@adtecbp.gov.my

Abstrak

Mesin Pengupas Nanas Automatik mampu membantu dalam pemasaran produk berasaskan nanas di Malaysia, khususnya kepada industri kecil dan sederhana bagi meningkatkan produktiviti pengeluaran seperti jus anas, nanas tin, tat nanas, halwa nanas, nanas kering, skuas nanas, sos nanas, jeruk nanas, jem nanas dan kerepek nanas. Mesin Pengupas Nanas Automatik menggunakan Sistem Pneumatik yang direka bentuk menggunakan kaedah baru dan mekanisma yang sesuai, berupaya dan mempercepatkan proses pengupasan kulit dan empulur nanas yang mengambil masa kurang daripada 10 saat setiap biji buah yang dikupas. Mesin ini juga dilengkapkan dengan ciri –ciri keselamatan yang mana pengguna perlu menggunakan kedua-dua belah tangan untuk menekan suis mata pengupas . Teknik pengendaliannya mudah dan senang juga selamat kepada pengguna.

Katakunci : proses pengupasan kulit dan empulur, sistem pneumatik

1. Pengenalan:

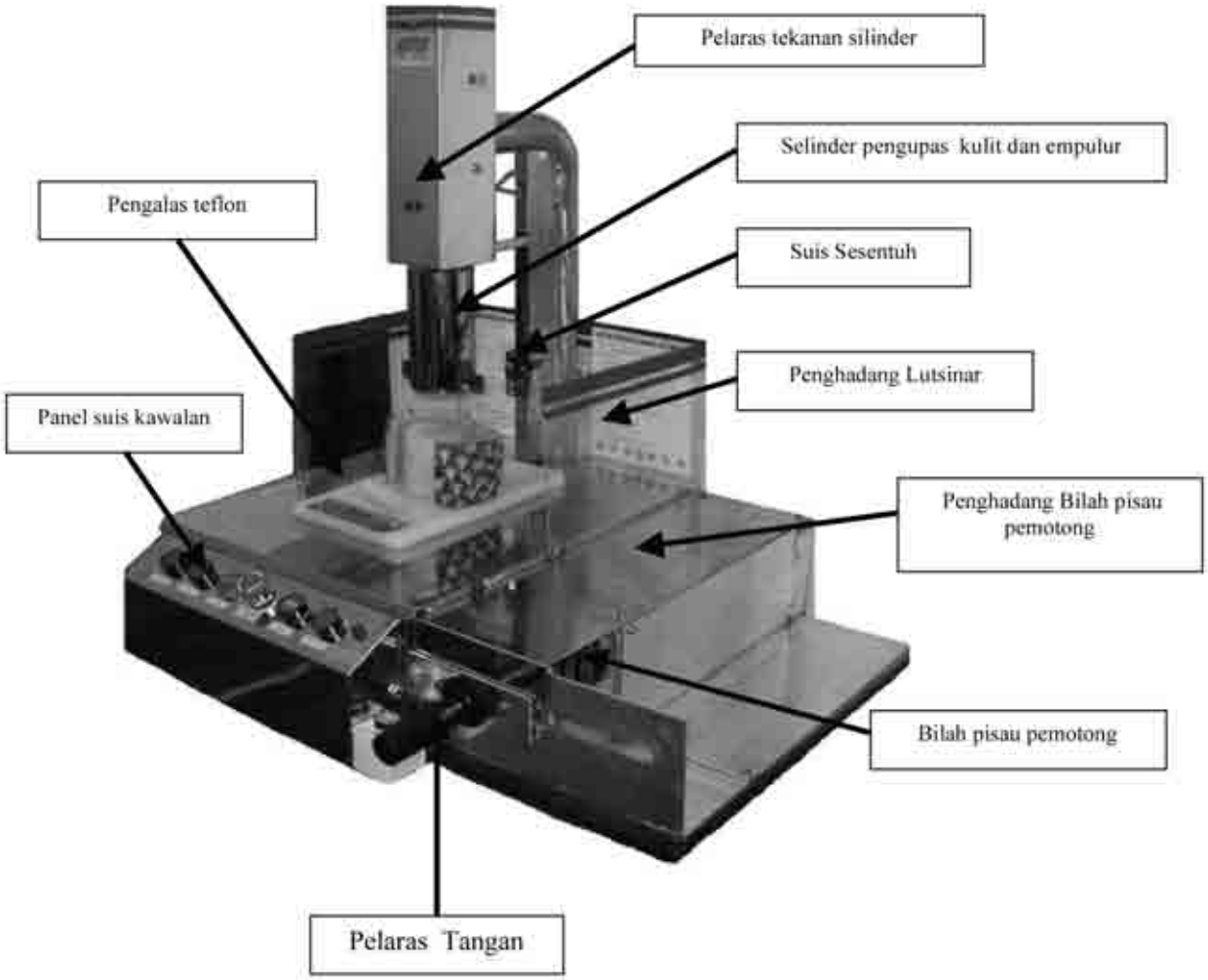
Nanas atau nama saintifiknya Ananas Comosus adalah merupakan tanaman kontan dan seterusnya berkembang menjadi tanaman secara perladangan. Nanas juga boleh didapati sepanjang tahun kerana ia bukanlah tanaman bermusim. Lembaga Perindustrian Nanas Malaysia sedang meningkatkan industri nanas Negara sebagai salah satu pengeluar utama nanas dunia dengan sasaran 10 % syer pasaran dunia daripada 2% pada masa kini.sumber petikan program dan projek dari laman web LPNM [1]. Secara umumnya , Pengusaha syarikat industri kecil dan sederhana (IKS), JJ Teratai Makmur Enterprise dan NS Food Manufacturing & Trading di selatan Johor masih menggunakan kaedah lama iaitu (tradisional) menggunakan pisau untuk mengupas kulit nanas. Jestru itu satu penemuan baru bagi pengupasan kulit nanas telah terhasil dengan terciptanya **MESIN PENGUPAS NANAS AUTOMATIK**. Mesin ini direkabentuk dengan mekanisma yang digerakkan menggunakan sistem pneumatik, Ianya berupaya mengasingkan kulit dan empulur dalam masa yang sama .Proses pengupasan adalah cepat iaitu kurang dari 10 saat untuk satu biji buah. Rekabentuk Mesin Pengupas Nanas Automatik telah dimulakan pada tahun 2008 dan siap sepenuhnya pada tahun 2009.

2. Rekabentuk Dan Kaedah

Mesin Pengupas Nanas Automatik ini difabrikasikan 90 % dengan bahan daripada jenis stainless steel. Keupayaan beroperasi dengan menggunakan sistem pneumatik [2]. Terbahagi kepada dua bahagian utama (gambar 1) iaitu:-

1. Rekabentuk Mekanikal
2. Bahagian Kawalan

Gambar 1 : Mesin Pengupas Nanas Automatik



2.1 Rekabentuk Mekanikal

2.1.1 Selinder Pengupas Kulit dan Empulur

Berfungsi untuk mengupas kulit dan empulur dalam satu masa . panjang selinder pengupas 200 mm , menpunyai dua garispusat selinder yang berbeza . Selinder bahagian luar untuk mengasingkan kulit dan selinder bahagian dalam bergarispusat 25 mm untuk mengasingkan empulur . Selinder bahagian luar mempunyai dua saiz yang berbeza iaitu bergarispusat 100 mm dan 75 mm. Ianya juga mudah untuk ditukar mengikut saiz yang diperlukan.

2.1.2 Pengalas Teflon

Sebagai pengalas buah nanas sewaktu operasi pengupasan dilakukan ,bersaiz panjang 300 mm lebar 200 mm dan tebal 15 mm. Dibahagian muka pengalas mempunyai tiga lurah bulatan bersaiz 100 mm, 75 mm dan 25 mm . Lebar dan dalam setiap lurah adalah 5 mm.

2.1.3 Penghadang Bilah Pisau Pemotong

Bahagian untuk melindungi bahagian bilah pisau pemotong semasa operasi pemotongan dijalankan.

2.1.4 Bilah Pisau pemotong

Mempunyai 8 bilah pisau pemotong ,jarak antara setap satu bilah 20 mm. Panjang dan tinggi bilah 110 mm.

2.1.5 Pelaras Tangan

Bertindak menggerakan pepandu masuk dan keluar dari bahagian bilah pisau pemotong.

2.1.6 Penghadang Luksinar

Melingkungi bahagian selinder pengupas dan bahagian pengalas teflon sebagai langkah keselamatan.

3. Bahagian Kawalan

3.1 Panel Suis Kawalan

Panel kawalan bekalan kuasa dan sistem pneumatik sewaktu operasi mesin dijalankan.

3.1.1 Button ON -Terima bekalan kuasa letrik untuk litar dan lampu hijau akan kelihatan secara automatik.

3.1.2 Button 1 - Tekan kedua-dua button 1 secara serentak untuk operasi selinder pengupas kulit dan empulur.

3.1.3 Button 2 - Button operasi bilah pisau pemotong.

3.1.4 Emergency stop - Button untuk keselamatan sewaktu kecemasan

3.1.5 Button Stop – Button untuk mematikan bekalan kuasa.

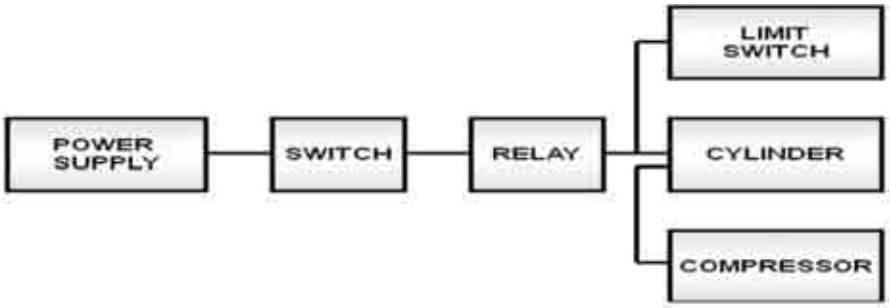
3.2 Pelaras Tekanan Selinder

Melaras tekanan angin untuk selinder pengupas kulit dan empulur.

3.3 Suis Sesentuh

Menghadkan perjalan operasi selinder pengupas dan bilah pemotong dan kembali ketempat asal.

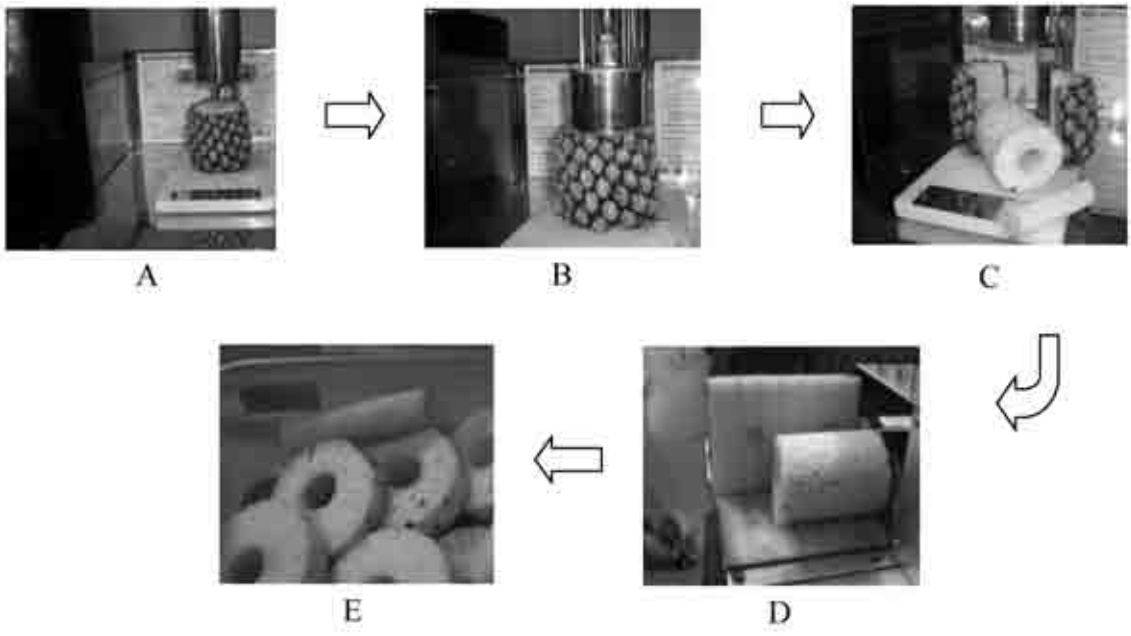
Gambar 2 : Kawalan Litar



4. **Kaedah Pengandalian**

Mesin Pengupas Nanas Automatik ini menggunakan Sistem pneumatik dengan tekanan 7- 8 bar untuk menggerak silinder pneumatik **.**Mesin ini dapat mengupas kulit dan empulur nanas dalam satu masa . Mudah dan senang untuk proses operasi pengupasan dilakukan.(Gambar 3). Buah nanas dipotong pada bahagian atas dan pangkal terlebih dahulu. Buah nanas diletakkan pada meja dimana mata pengupas digerakan kebawah kearah nanas menggunakan silinder pneumatik berkedudukan menegak sehingga berlaku proses mampatan buah nanas diantara meja dan selinder pengupas (A) . Dua button 1 di bahagian panel operasi ditekan serentak untuk mengerakan mata pengupas turun kebawah dan mata pengupas akan dinaikan semula ketempat asal apabila terkena suis sesentuh (gambar B) .Kulit dan isi nanas serta empulur akan dipisahkan dalam masa yang sama(gambar C) . Selepas itu Isi nanas (dalam bentuk selinder) diletakkan di tempat pemotong di bahagian mata pemotong(gambar D).Button 2 ditekan untuk mengerakkan bilah mata pemotong dan akan kembali semula ketempat asal apabila terkena suis sesentuh.Isi nanas dipotong 20 mm tebal mengikut jarak bilah mata pemotong (gambar E).

Gambar 3 : Carta Alir



5. Ciri-Ciri Keselamatan

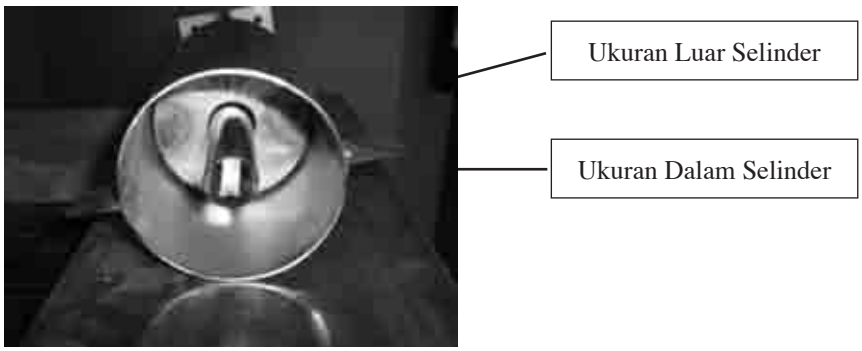
Ianya juga dilengkapkan dengan ciri –ciri keselamatan untuk pengguna ,iaitu pengguna perlu menggunakan kedua-dua belah tangan untuk menekan suis mata pengupas , ini bagi mengelakkan tangan pengguna berada di bahagian mata pemngupas sewaktu operasi pengupasan dijalankan . Dilengkapi juga panghadang luksina dibahagian belakang meja mata pengupas untuk melingkungi bahagian selinder pengupas .

6. Perbincangan Dan Keputusan

Mesin ini berupaya mengupas kulit dan empulur nanas dalam satu masa .Semua jenis nanas boleh dikupas iaitu Morris, Josaphine , N 36 dan Nanas Sarawak . Selinder Pengupas mempunyai dua saiz berbeza iaitu :-

- Saiz Ø 75 mm x panjang 200 mm - untuk nanas gred B dan C
- Saiz Ø 100 mm x panjang 200 mm - untuk nanas gred A

Kaedah pengupas menggunakan sistem pneumatik , ukuran saiz untuk setiap buah yang dikupas adalah sama mengikut ukuran saiz selinder pengupas yang digunakan. Hasil buah yang sudah dikupas berbentuk selinder saiz ukuran Ø 75 mm dan Ø 100 mm ukuran luar dan Ø 25 mm bahagian dalam . Nanas Morris dan Nanas Sarawak 7.3 bar tekanan angin amat sesuai untuk mengupas menggunakan selinder bersaiz Ø 75 mm , dan 7.6 sesuai untuk Saiz Ø 100 mm .Untuk nanas N 36 dan Josaphine tekanan angin 7.6 bar , sesuai untuk selinder bersaiz Ø 75 mm dan tekanan angin 8.0 bar sesuai untuk selinder pengupas bersaiz Ø 100 mm , ini kerana nanas jenis ini mempunyai sedikit kekerasan pada empulur dan isi . Pengupasan mengambil masa kurang daripada 10 saat untuk setiap biji buah nanas , ini member kelebihan dari segi peningkatan produktiviti pengeluaran.



Gambar 4 : Selinder Pengupas

6.1 Perbezaan Kaedah

Kaedah secara manual mengambil masa 1 minit untuk setiap biji nanas yang dikupas dan 60 biji untuk jangka masa 1 jam . Manakala dengan kaedah pneumatik yang digunakan mengambil masa 10 saat untuk setiap biji pengupasan dan 300 biji pengupasan untuk 1 jam jangka masa yang diambil.

7. Kesimpulan

Mesin Pengupas Nanas Automatik yang dihasilkan ini adalah untuk memudahkan lagi proses mengupas kulit nanas. Ianya bertujuan mempercepatkan proses mengasingkan kulit,empulur dan isi nanas. Kualiti pengeluaran hasil produk berasaskan nanas juga dapat dipertingkatkan kerana kaedah pengendaliannya lebih efektif dan seragam. Semua golongan berkeupayaan mengendalikan mesin ini kerana teknik pengendaliannya

mudah dan selamat. Dengan harapan **Mesin Pengupas Nanas Automatik** mampu membantu mengubah pola pemasaran nanas di Malaysia dari pasaran dalam negeri kepada pasaran antarabangsa dengan meningkatkan produktiviti pengeluaran .

8. Rujukan

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M20 - Design And Fabricate Dual Sistem Trishaw (Beca 1 Malaysia)

Hj. Abd. Rahim Md. Tahir
Pusat Latihan Teknologi Tinggi (ADTEC) Batu Pahat

Abstrak

Dengan inovasi terbaru ini, pengunaan beca dapat di tingkatkan pengunaanya agar ia dapat di guna oleh semua golong masyarakat peringkat umur, jantina serta dapat menjaga alam sekitar kerana tiada mengeluarkan asap dan tidak mengunakan petrol yang mana kini mahal harganya. Inovasi terbaru ini di namakan BECA 1 MALAYSIA bermaksud hanya satu sahaja yang ada di Malaysia ini dengan beberapa keistemewaan seperti ianya ringan dan boleh di guna oleh kanak-kanak untuk membawa orang dewasa dengan mudah. Selain daripada itu Beca 1 Malaysia ini mengunakan DUAL SISTEM TRISHAW iaitu secara Manual dan juga solar dengan DC Motor dan juga di kenali sebagai SOLAR TRISHAW. Ia mempunyai gear untuk tujuan kelajuan serta ringan apabila membawa beban yang berat selain mempunyai sistem audio sebagai penerangan kepada penumpang terutama yang di gunakan untuk membawa pelancong ke destinasi pelancongan. Walaupun ianya di ubahsuai untuk meningkatkan prestasi pengunaanya namun ciri-ciri tradisional dan keselamatan masih di kekalkan bertujuan mengekalkan sejarah kewujudan beca dengan identiti negeri di mana beca ini di gunakan.

Katakunci: *beca, dual system trishaw, gear, solar*

1.0 Pengenalan

Beca merupakan pengangkutan alternatif yang di gunakan sebilangan orang awam samada untuk tujuan ke pasar atau ke destinasi tertentu dalam jarak dekat dengan kos yang murah selain secara santai. Di Malaysia pengunaan Beca ini hanya dapat di lihat di pekan kecil dan di lokasi terdapatnya industri pelancongan namun ianya di dominasikan oleh golongan tua sahaja sebagai pembawa namun persepsi ini perlu di ubah supaya ianya dapat di komersilkan serta tidak terhad kepada golongan tua sahaja.

Beca merupakan pengangkutan awam awal yang di gunakan mengantikan lancar yang mana menggunakan dua roda dan di tarik oleh manusia secara berjalan manakala Beca pula mengunakan tiga roda dan mengunakan pedal yang di kayuh oleh manusia untuk mengerakkan roda untuk berjalan samada mengangkut penumpang atau barangan. Pengunaan Beca sebagai atrenatif pengangkutan awam sehingga kini masih popular terutamanya di distinasi pelancongan di negara ini seperti Pulau Pinang,Melaka Kelantan,Terengganu dan lain – lain namun ciri ciri rekabentuk nya masih tradisional dan banyak mengunakan tenaga dan tidak hairanlan ianya di monopoli oleh kaum lelaki sahaja sebagai pembawanya .Dengan sedikit kreativiti dan inovasi perubahan perlu di lakukan di samping mengekalkan ciri-ciri tradiosional tetapi mempunyai nilai tambah yang dapat membantu keberkesananya serta dapat di guna oleh semua peringkat umur dan golongan masyarakat di samping mengambil kira faktor alam sekitar,keselamatan ,keselesaan serta mesra pengguna.

2.0 Kajian Ilmiah

Di Malaysia rekabentuk beca berbeza di antara setiap negeri ini di sebabkan oleh faktor alam sekitar serta kegunaan Beca itu sendiri selain faktor identiti sesebuah negeri itu sendiri .Jika di buat perbandingan di antara Beca Satu Malaysia yang di Reka Khas ini dengan Beca sedia ada memang banyak perbezaanya

2.1 Beca Negeri Johor

Beca yang terdapat di Johor ruang tempat duduk penumpang bersebelahan dengan penarik agak sempit iaitu dengan keluasan 12 inci lebar dan 24 inci panjang dan agak rendah menyebabkan pemandangan akan terhad jika berselisih dengan kereta dengan ruang letak kaki yang sedikit

terangkat sehingga 10º dengan satu kelajuan dan satu pacuan roda ,selain daripada ruang menyimpan barang yang terhad begitu juga tempat duduk pemandu juga kecil.Beca ini merupakan beca pacuan satu roda yang di gerakan dengan mengayuh pedal secara manual menyebabkan agak berat jika dalam muatan samada penumpang atau barangan.

2.2 Lanca Negeri Pulau Pinang

Berbeza dengan beca di negeri lain walaupun mempunyai 3 roda perbezaan yang ketara ialah tempat duduk penumpang berada di hadapan manakala penarik berada di belakang.Ia juga mengunakan satu pacuan roda dengan kayuhan pedal dan pemanduan dua roda di hadapan menyebabkan beban yang berat untuk membelok ke kiri atau ke kanan selai tiada ruang simpan barang di sediakan.

2.3 Beca Negeri Kelantan

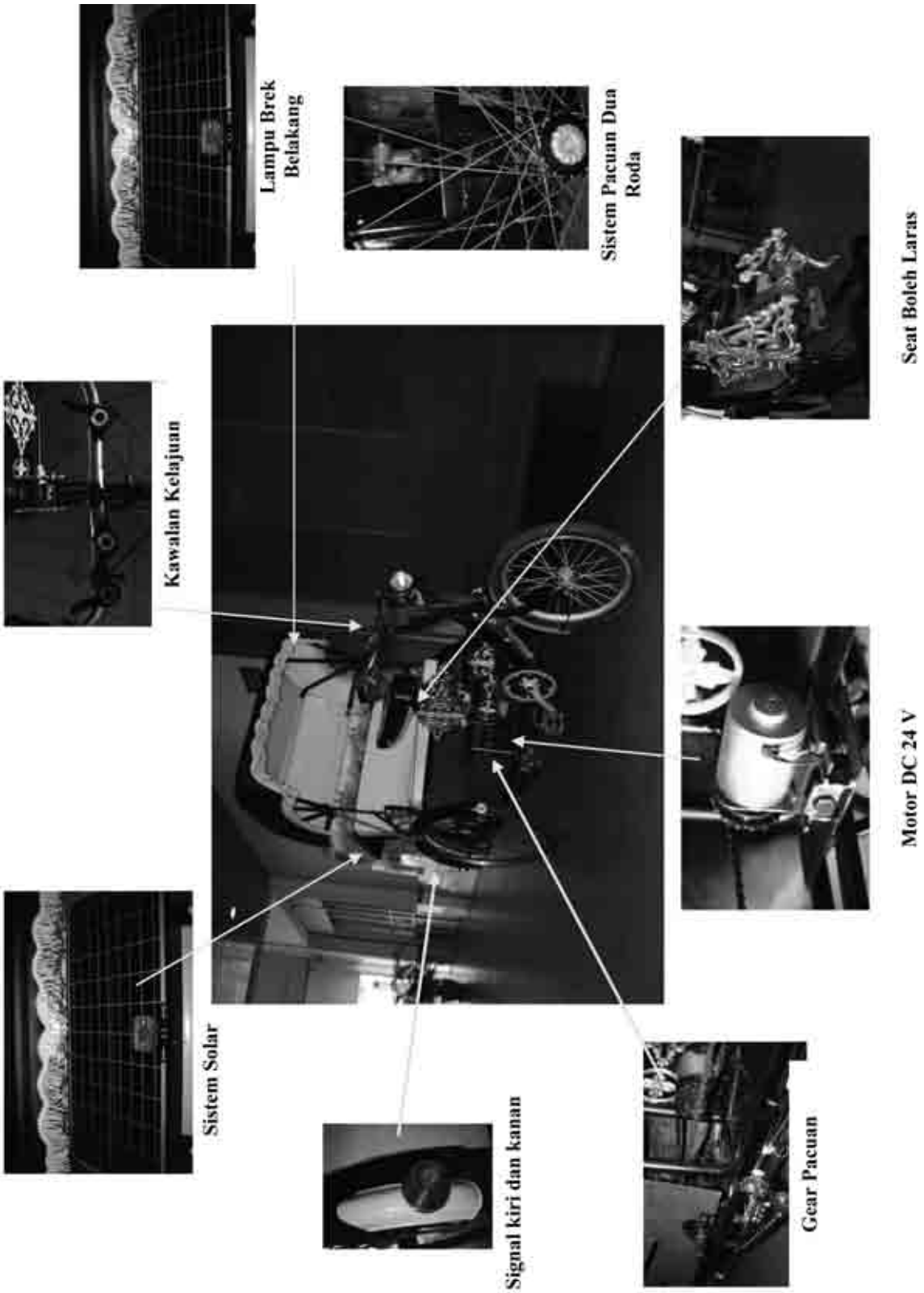
Mempunyai tiga roda tetapi kelainan beca negari ini ialah tempat penumpang agak tinggi sedikit bersebelahan dengan penarik berbanding beca negeri johor.Dengan tempat letak kaki yang ter jongkit ke atas serta ruang simpan barang yang terbuka .

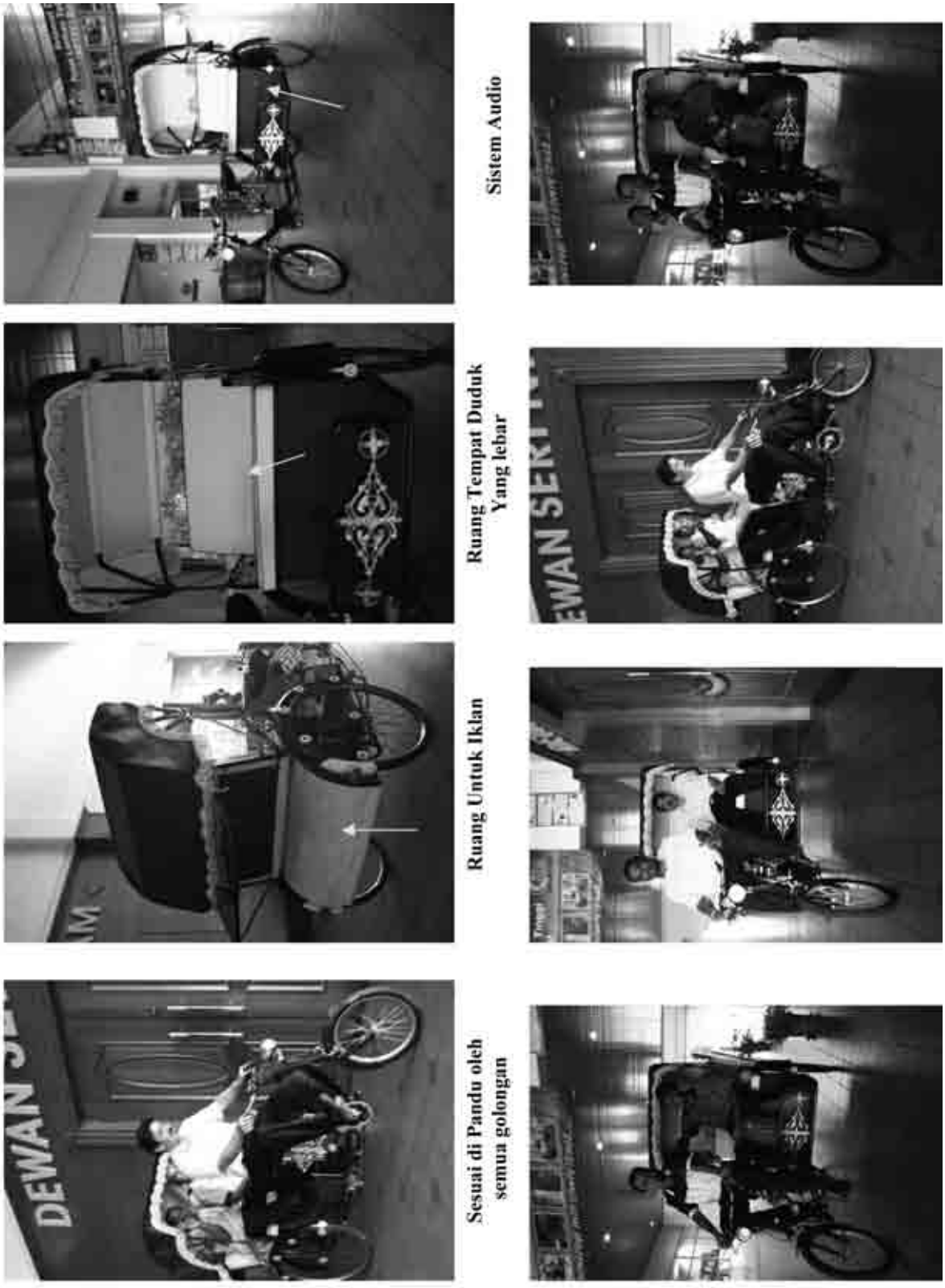
2.4 Beca Negeri Melaka

Tidak banyak perbezaan yang ketara namun ketidak selesaan penumpang jelas apabila di lindungi dengan papan iklan dan kelainan beca negari ini di hias dengan banyak bunga-bunga di bahadian bumbung setra di sekeliling nya .Masih juga mengunakan satu pacuan roda dengan kayuhan pedal oleh penarik yang berada di sisi penumpang

3.0 Beca Satu Malaysia

Keujudan Beca Satu malaysia telah membuktikan bahawa keberkesanan dan kecekapan terhadap beca versi baru ini seiring dengan perkembangan teknologi masa kini di mana ia di lengkapi dengan Audio sistem bagi tujuan penerangan kepada penumpang yang sampai ke lokasi Pelancongan tanpa perlu panduan daripada Pemandu pelancong untuk menerangkanya serta hiburan muzik.Serta di lengkapi dengan Speed Gear untuk tujuan penukaran kelajuan dan gear reducer untuk tujuan meringankan beban ketika manaiki bukit .Pengunaan DC Motor 24 V dengan bantuan kuasa solar sebagai alternatif jika pemandu mengunakanya tanpa perlu mengayuh di samping mengamalkan teknologi hijau dan mesra alam kerana tidak mengeluarkan asap selain dapat di guna oleh semua golongan peringkat umur termasuk lelaki,wanita,kanak-kanak kerana tempat duduk pemandu yang boleh laras mengikut ketinggian yang di perlukan dan semua bangsa kerana ianya dapat di kayuh dengan begitu ringan .Dengan rekabentuk yang hampir sama dengan Beca sediada tetapi ianya di ubansuai supaya tempat duduk penumpang lebih tinggi serta lebar dan sangat selesa serta kuasa pemandangan lebih baik berbanding yang lama.Beca Satu Malaysia ini di lengkapi dengan ruang untuk Iklan sesuatu produk sebagai pendapatan sampingan pemilik Beca tersebut untuk di sewa oleh Syarikat syarikat yang berminat untuk mengiklankan produk syarikatnya. Selain daripada keselesaan terhadap penumpang perkara paling utama ialah ciri-ciri keselamatan di mana Beca ini di lengkapi dengan lampu untuk tujuan kegunaan waktu malam ,lampu brek dan lampu signal kiri dan kanan bagi memudahkan keenderaan lain mengetahui arah tuju beca tersebut tanpa menganggu keenderaan awam yang lain.Keistemewaan Beca ini ialah masih mengekalkan cirri-ciri tradisional tetapi mempunyai pacuan dua roda berbanding pacuan satu roda pada beca sediada dan di lengkapi dengan Disc Brake untuk tujuan cemkaman lebih baik.Tempat simpan barang yang luas dan tertutup di bahagian belakang antara kelebihan Beca ini


Lampu Brek Belakang
Sistem Pacuan Dua Roda
Seat Boleh Laras
Kawalan Kelajuan
Motor DC 24 V
Sistem Solar
Signal kiri dan kanan
Gear Pacuan


Sistem Audio
Ruang Tempat Duduk
Yang lebar
Ruang Untuk Iklan
Sesuai di Pandu oleh
semua golongan

4.0 Struktur Bahan

Keseluruhan Beca ini di bina mengunakan keluli lembut yang mudah di kimpal serta di bentuk di samping bahan bukan ferrous dan arcylic di bahagian tertentu bagi memudahkan kerja fabrikasi selain membantu mengurangkan berat di samping mengunakan Kanvas jenis PU sebagai bumbung yang boleh di lipat .

4.1 Spesifikasi

Panjang	:	85”
Lebar	:	42”
Tinggi	:	Terbuka 41” Tertutup 64”
Berat	:	76 Kg
Gear	:	9 Kelajuan
Kuasa	:	Motor DC 24 V.
Bekalan Kuasa	:	Bateri 24 V (Kuasa Solar atau Letrik)
Pacuan	:	Dua Pacuan.

5.0 Keputusan Dan Rumusan

Hasil daripada ujikaji yang di lakukan keatas beca tersebut rata-rata pemandu yang menguji guna beca tersebut memberi input yang sangat positif terutama dari segi kayuhannyang ringan di samping boleh di gunakan oleh pelbagai peringkat umur serta jantina termasuk kanak-kanak dan orang perempuan.selain keselesaan terhadap penumpang di mana ruang tempat duduk yang luas berbanding beca sediada.Ruang iklan yang strategic juga dapat membantu mempromosikan sesuatu produk untuk pengkomersialan.Secara keseluruhanya Beca satu Malaysia ini amat sesuai untuk di komersialkan untuk tujuan pelancongan di samping mengekalkan identity Negara Malaysia yang kaya dengan khazanah lama dan terpelihara selain ianya mesra alam dengan teknologi hijau .

6.0 Rujukan

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M21 - BAKOBAT 1

Hasri B. Abd Hamid
Pusat Latihan Teknologi Tinggi (ADTEC) Kulim
hasrihamid@gmail.com

Abstrak

Rekacipta ini mengabungkan kaedah dan peralatan untuk memampatkan dan memasak acuan gigi, ianya terdiri daripada bahagian mampatan yang mengunakan satu 'bottle jack' dan penahan mekanikal apabila ditekan 'bottle jack' acuan tersebut akan termampat apabila ditahan oleh penahan, seterusnya satu lengan mekanikal akan memindahkan terus acuan ini kebahagian pemanas untuk tujuan dimasak pada suhu 90®selama 10 minit , barulah kemudianya acuan ini sedia untuk dibuka dan diambil hasilnya.

Keywords : *Kementerian Kesihatan , peralatan mampatan , peralatan pemanas, penjimatan masa, penjimatan tenaga.*

1. Pengenalan

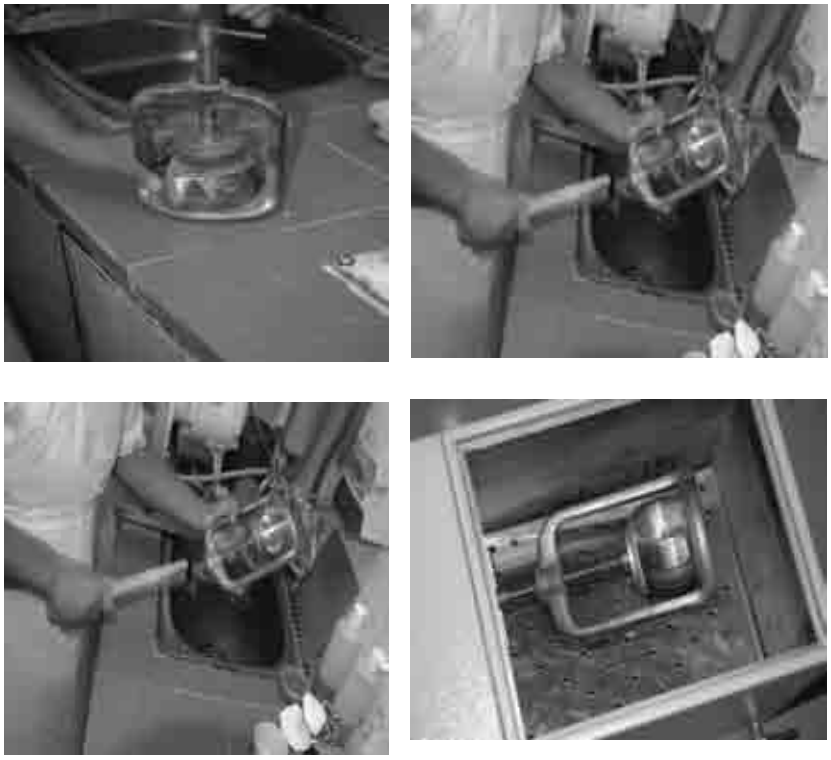
Di Malaysia, masalah kerosakan gigi adalah satu perkara yang biasa disebabkan oleh faktor pemakanan dan penjagaan gigi yang tidak diambil berat. Masalah ini biasanya dihadapi oleh golongan-golongan yang sudah berusia. Hasil kajian didapati bahawa dalam 20 orang akan terdapat 4 orang yang mengalami masalah ini. Disebabkan faktor umur gigi mereka ini apabila apabila dicabut ianya tidak dapat tumbuh kembali , oleh itu gigi – gigi ini perlu digantikan dengan gigi palsu.

Didalam sektor klinik pergigian kerajaan satu hari sekurang-kurangnya akan terdapat 5 kes, yang terdapat diselesaikan hanya 3 kes, yang selebihnya akan dibawa kehadapan dimana pesakit-pesakit ini perlu menuggu selama 2 minggu untuk mendapatkan gigi palsu yang baru . Ini disebabkan oleh proses kerja dan kelengkapan yang banyak.

Disebabkan ini kami telah menjalankan kajian bagaimanakah untuk menyelesaikan masalah tersebut.

2. Material dan method

Didalam proses pembuatan gigi palsu ini berlangsung apabila doktor pergigian melakukan autopsy dengan menghasilkan acuan 'lelangit' sementara ini. Juruteknik pergigian akan membuat acuan, secara amnya untuk operasi ini mempunyai 4 operasi asas dan kesemuanya memerlukan tenaga-tenaga ataupun kudrat insan yang banyak. Seperti dalam gambarajah dibawah:



Rajah 1: Operasi menghasilkan 'lelangit' sementara

Daripada kajian-kajian yang kami jalankan bagi mengatasi masalah tersebut maka terhasilah ciptaan kami yang kami panggil bakobat.

Rajah 2: Bakobat

Ianya adalah projek yang mengandungi dua stesen iaitu mampatan dan satu lagi stesen untuk dapur bagi memasak acuan gigi ini.

3. Quality Determination

Kami telah berjaya menjalankan beberapa siri ujikaji bagi melihat samada projek ini boleh berfungsi atau tidak dan hasilnya amat memberangsangkan dimana ianya boleh membantu juruteknik pergigian untuk memudahkan lagi kerja beliau.

4. Kesimpulan

Daripada hasil ciptaan kami ini, kami dapati ianya boleh mengurangkan beban kerja juruteknik pergigian dan secara tidak langsung ianya membolehkan pengeluaran produktiviti (gigi palsu) dengan lebih banyak berbanding sebelumnya dan rakyat Malaysia boleh tersenyum dengan cepat.

M22 - Substrate Removal Technology of Vertical Cavity Surface Emitting Laser (VCSEL)

Mohd Hezri bin Abdullah and Mohd Nasir bin Said
Pusat Latihan Teknologi Tinggi (ADTEC) Kulim
hezri7577@gmail.com /hezri@adteckulim.gov.my, nasir@ymail.com

Abstract

The removal of a large proportion of GaAs substrate was performed because optical devices are normally made on GaAs substrate but the electronics to which they will be connected are made on silicon. Method A, B and C are the methods of removing the first glass slide from the 30μm sample and to put the thinned sample on a melted indium. Method 1 and 2 are the calculation methods for finding the values of shift in temperature . Method 1 uses a specific equation relating temperature of a device with injection power used. Method 2 uses a relationship between wavelength of the emitted light and the change in temperature. Method 1 and 2 were used so that the shift in temperature values of the samples could be compared. In future , electrical and mechanical properties should be analyzed as well so that the complete characteristic of the VCSEL can be achieved.

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Keywords: VCSEL, GaAs, substrate, indium, optical devices, silicon.

1. Introduction

During the last 10 years, since VCSELs are commercially available, the continual technical developments in VCSEL technology have been driving forces in modern transceiver design. Step by step the forecasted benefits of this technology have been translated into technical reality and commercial success. It has been their excellent fiber coupling that opened the way to low cost single channel Gigabit Ethernet transceiver era. On the other hand, computers and computing system have affected almost every aspect of life. Computers are generally involved in work, healthcare , recreation, transportation, entertainment ,household management ,etc. Computer processors have generally been fabricated using silicon semiconductor technology. Silicon semiconductor technology is rapidly approaching its limit in term of speed and device size. Specifically there is a physical limit in transistors size on silicon substrates. So there is a corresponding limit to the speed at which electronic signals can be transmitted. One of the proposed solutions is to use optical signal for some data transmission on a chip . Signals that are transmitted across the chip are sent using optical paths as opposed to the current electrical paths. This would help to alleviate the electromagnetic limitations of copper based transmission lines and thus increase the speed at which signals could be sent. This background is only provided to illustrate one exemplary technology area where some embodiments herein may be practiced. The invention is generally related to integrating laser with silicon integrated circuits. The invention is specifically directed to integrated VCSEL with silicon integrated circuits.

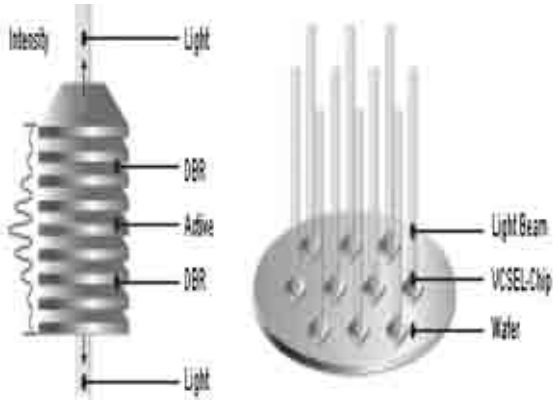

Figure 1.0 Schematic VCSEL structure | Schematic of completed VCSEL wafer

2. Project Methodology

Theoretically, the project was done in order to remove completely gallium arsenide (GaAs) substrate at the back surface of the device. However if the whole GaAs substrate is removed, a lot of problems will occur. For instances, aluminium oxide forms immediately if it is exposed in air. The aluminium oxide film may easily increase the contact resistance because most metallic oxide films are non- conductive or semiconductive. So this can cause a serious problem when current is going to be injected into the device.

Furthermore, if the whole substrate is removed, the total thickness will become very thin. For example, the total thickness of the real device like QT 1061 without GaAs substrate is about 9µm. So the device is very fragile and can break easily at this thickness. As a result, an alternative was taken in order to leave about 20 µm of GaAs substrate after etching in order to avoid all the mentioned problems. Then the device with 20 µm of GaAs substrate was put on a new substrate. Meanwhile an indium solder ball was put in between this substrates in order to stick both substrates together. Finally, the VCSELs were tested in order to ensure they will behave as required.

Actually 2 different types of practiced samples and 2 different types of real samples had been used. The first and second practiced sample were a p-type distributed-Bragg reflector (DBR). The aim of using the practiced samples was to observe whether the etchant used can etch or not until reaching aluminium arsenide layers. The first etchant used , was the ratio of 1:8:1 H_2O :H_2O_2: H_2SO_4 which will etch both gallium arsenide (GaAs) and aluminium arsenide (AlAs) layers[1]. The second etchant was a ratio of 95:5 of H_2O_2 and NH_4OH which will etch AlAs layers only [1]. The real samples were used after the practiced samples had proven that the etchants really could be used to etch selectively and non-selectively the required layers.

Aim of the projects:

a) To remove the GaAs substrate until reaching about 30 µm thickness.
b) To examine whether an indium solder ball could stick well or not with both substrates.
c) To check whether the wax on the front surface could be removed or not using trichloroethylene.

The second type of real sample was used after all the above aims for the first real sample had been accomplished. Actually, 3 different methods namely method A,B and C had been tried at this stage in order to remove the first glass slide from the thinned sample. In Method A, the indium ball used wasn't thoroughly melted on the glass slide even though the sample had been heated at 175 ºC. Furthermore in Method A , the loose thinned sample in the trichloroethylene had to be picked up using tweezer and placed it on melted indium . The process itself was a very delicate procedure . Method B (Refer Figure 3.0) was nearly successful but unfortunately the indium which was heated at 210 ºC didn't stick very well with glass slide. So in Method B both glass slides were undeliberately separated from the sample whenever being put into the warm trichloroethylene.

Method C had proven to be successful. The successful method was done by heating the indium ball at 380 ºC prior to be put into warm trichloroethylene . This was done so that the indium would melt thoroughly although the melting point of pure indium was ~ 156.6 ºC [7] .

Finally, the real sample was tested in order to ensure that its electrical, optical and thermal properties will be as required.

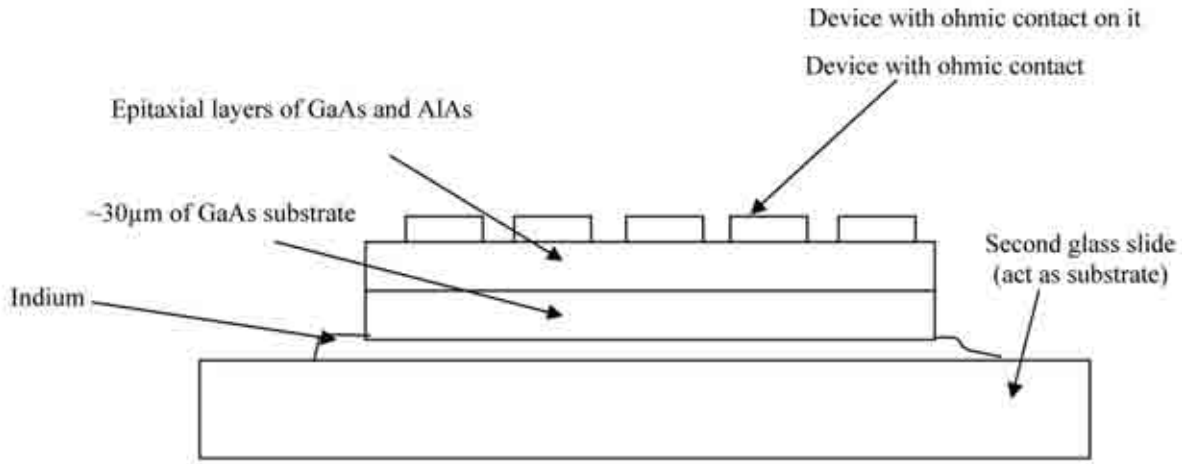

Figure 2.0 : Side view of finished VCSEL attached with second glass slide

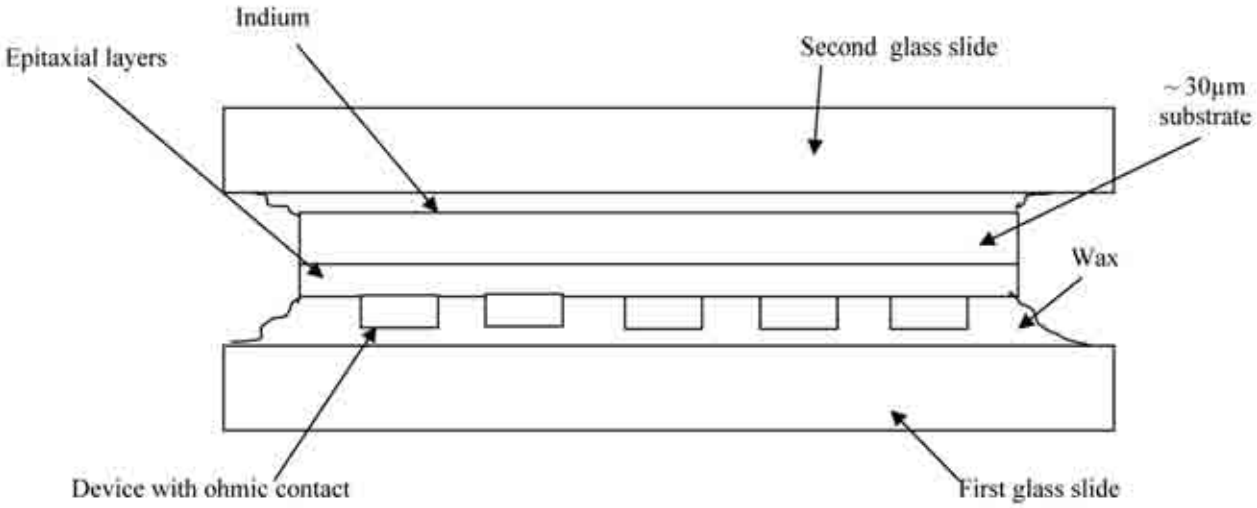

Figure 3.0 : Side view of VCSEL prior to removing first glass slide.
(Method B and Method C)

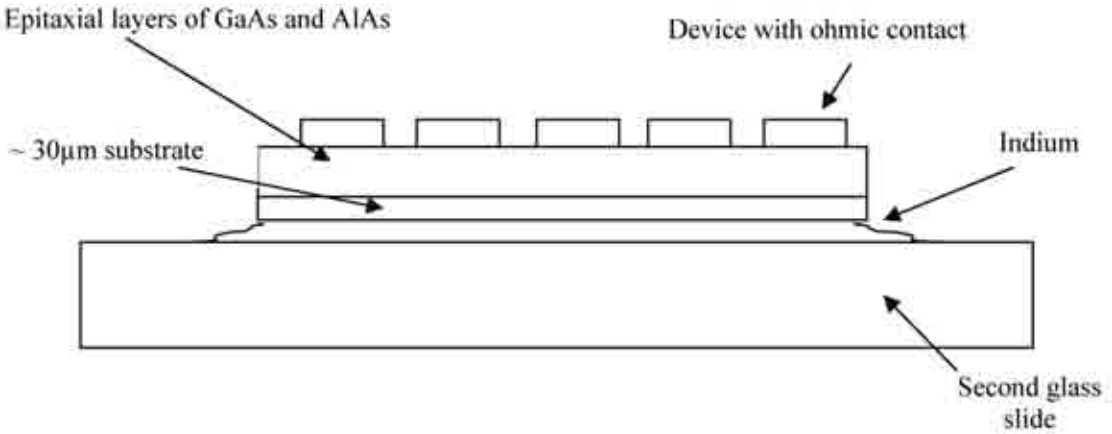

Figure 4.0 : Side view of VCSEL after removing the first glass slide.(Method A)

3. Results and discussions

Beside laser quality itself, thermal management of the VCSEL connection is most important to achieve high performance and highly reliable operation. Heat removal from the opto chip has to be considered carefully, since laser characteristic depend strongly on the laser chip temperature.

3.1 Analysing the thermal temperature

a) Method 1

$T = P/2d\sigma$ [4]

Where T= Temperature in ºC
d= diameter of the device used.
σ = thermal conductivity of the substrate
P = electrical power injected

Measurement were done at current , I= 5 mA dc, voltage 1.163V and diameter of device ,d= 122.4 µm.

$T_1 = \frac{1.163\ (5 \times 10^{-3})}{2\ (122.4 \times 10^{-6})15} = 1.58$ ºC

$T_2 = \frac{1.393\ (15 \times 10^{-3})}{2\ (122.4 \times 10^{-6})15} = 5.69$ ºC

$T_2 - T_1 = 5.69 - 1.58 = 4.11$ ºC

b)Method 2

Theoretically, for structure resonance at λ = 1000nm, it is expected a shift of

$\frac{\partial \lambda}{\partial T} = 0.0505\text{nm ºC}^{-1} \sim 0.5\text{ A ºC}^{-1}$ [4]

An increase in the temperature of a device will be detected as a shift in the wavelength of the emission spectrum.

For thinned sample, the shift of wavelength was from 9142 A (i.e ~ 923nm) at 5 mA to 9158A (i.e ~ 925nm) at 15 mA.

A change in wavelength = 9158-9142 = 16 A. By using a shift of 0.5 A ºC^{-1},
Hence 16/0.5 x 1= 32 ºC

Theoretically at higher voltage, an increase in temperature caused a drop in device resistance.[4] As a result, the optical gain deteriorated at higher temperatures and most devices would stop emitting light when the amount of injected current was too high. Based on the results obtained, by using 2 different methods of calculation, the shift in temperature values do not differ too much.

3.2 Assumptions for both Method 1 and 2

a) Device is assumed to be a mesa etched type having a circular disc shape heat source of diameter d on a semi-infinite GaAs substrate as shown above.

b) The substrate thickness is assumed to be 8 times the diameter of the large 50 µm device.

c) The temperature of the device is assumed to be approximately uniform.

Properties of the sample used.

a) The physical properties of the samples used
Thinner GaAs substrate using indium layer as interface between GaAs substrate and the second glass slide (which act as silicon substrate). As a result, the heat distribution of the glass slide will slightly deviate from the actual properties of silicon.

Note: Glass slide was not a good heat conductor.

4. Recommendations

A new substrate such as silicon or copper block can be used instead of glass slides. In theory, silicon and copper block are better heat conductor than glass slides. So the thinned sample can avoid overheating when larger current is injected into the device.
Optical, electrical and mechanical properties shall be analyzed further in the future so that the properties of VCSEL can be better understood.

5. Conclusion

The success of achieving the total sample thickness of about 30 μm shows that the etchants can be used reliably for etching the GaAs substrate.
By using 2 different methods of calculation , the shift in temperature values do not differ too much considering glass slides were used instead of silicon or copper block.

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M23 - Self-Adjusting Window Shade

Muhamad Nabil Bin Mansor; Muhammad Farhan Bin Mohd Adenan;
Mohd Iqbal Bin Alias
Pusat Latihan Teknologi Tinggi (ADTEC) Kulim
nabil_penangbridge@yahoo.com.my

Abstrak

Projek 'SELF-ADJUSTING WINDOW SHADE' merupakan satu sistem yang berfungsi mengawal tirai secara automatik untuk memudahkan pengguna dipejabat ataupun didalam kelas. Sistem ini dikawal menggunakan PIC16F877A. Sistem ini akan mengesan cahaya melalui sensor photodiode dan menghantar isyarat analog kepada PIC16F877A. PIC16F877A akan memproses isyarat analog ini dan memaparkannya pada paparan LCD16x2. Pada masa yang sama PIC16F877A akan memproses isyarat analog ini bagi mengerakkan stepper motor untuk mengawal bukaan kemasukan cahaya pada tirai. Stepper motor akan berputar mengikut arahan yang telah diprogramkan. Bukaan kemasukan cahaya pada tirai adalah berkadar sonsang dengan kecerahan cahaya diluar tingkap.

Keywords: PIC16F877A, Sensor Photodiode, LCD16x2, Stepper motor.

1. Pengenalan

Projek ini dihasilkan bagi menyelesaikan masalah suasana di dalam bilik yang mempunyai tirai dan bergantung kepada cahaya dari luar. Masukan cahaya dari luar yang terlalu cerah menyilaukan mata pengguna bilik. Masukan cahaya dari luar yang kurang cerah menyebabkan bilik menjadi gelap. Self-Adjusting Window Shade dicipta untuk membantu pengguna atau orang ramai memudahkan kerja-kerja seharian dan menikmati suasana kecerahan bilik yang lebih selesa.

Self-Adjusting Window Shade merupakan sebuah sistem tirai automatik yang dikawal sepenuhnya oleh microcontroller PIC16F877A. Masukan cahaya di luar tingkap dikesan melaui sensor photodiode. Kecerahan cahaya dari luar kemudian dipaparkan pada paparan LCD. PIC 16F877A akan mengerakkan stepper motor Ia berfungsi apabila masukan daripada sensor diterima dan dihantar ke bahagian pengawalan iaitu microcontroller untuk diproses dan motor menghasilkan keluaran dan menyebabkan tingkap berfungsi secara automatik. Ia berupaya mengesan aspek cuaca iaitu kadar cahaya. Projek ini menggunakan program PIC. Oleh kerana projek ini banyak tertumpu pada bahagian sensor dan pengawalan motor, maka ia perlu diberi perhatian.

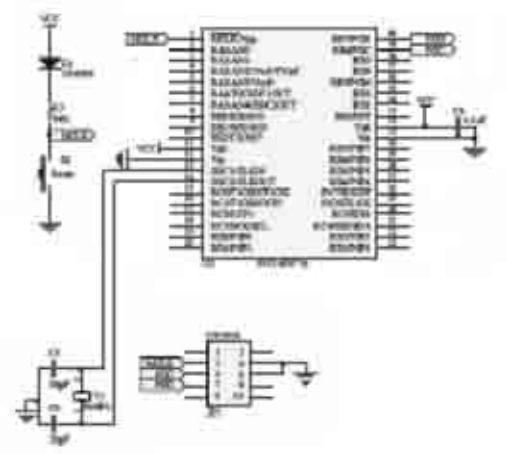
2. Rekabentuk Elektronik

Sistem *Self-Adjusting Window Shade* terdiri daripada beberapa bahagian elektronik yang utama. Bahagian-bahagian utama ini digambarkan di dalam gambarajah blok seperti Rajah 1:-

Rajah 1: Blok Diagram Sistem Elektronik *Self-Adjusting Window Shade*

2.1. Microcontroller (PIC 16F877A)

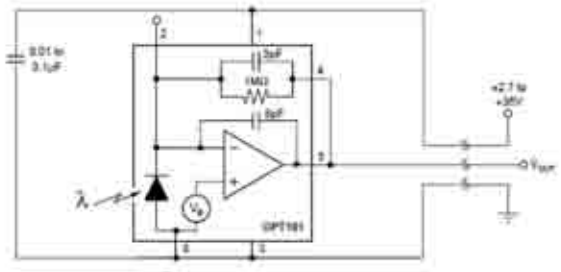
Projek ini menggunakan mikrocontroller jenis PIC 16F877A. PIC 16F877A diprogram menggunakan bahasa C. Bahasa C dipilih kerana lebih mudah difahami dan lebih fleksibel untuk dimanipulasi. Program ditulis menggunakan perisisan MPLAB IDE v8.30. Compiler yang digunakan untuk menukar bahasa C kepada bahasa mesin ialah HITECH C PRO. Bahasa C ditulis dalam file '.c' akan ditukar kepada bahasa mesin dalam file '.hex'. Program yang dimuat turun ke dalam PIC 16F877A adalah file '.hex'. File '.hex' ini kemudian dimuat turun kepada PIC 16F877A dengan menggunakan perisian PICkit2. Litar PIC 16F877A dihubungkan dengan komputer dengan menggunakan kabel USB ICSP PIC programmer UIC00A. Litar asas bagi memuat turun program adalah seperti Rajah 2.



Rajah 2: Litar Asas PIC 16F877A

2.2. Sensor Photodiode (OPT 101)

Sensor photodiode jenis OPT 101 digunakan dalam projek ini untuk mengesan kecerahan cahaya. Sensor ini mengeluarkan isyarat analog mengikut kadar cahaya yang terkena padanya. Isyarat analog ini di hantar kepada PIC 16F877A untuk memproses maklumat yang diberikan oleh sensor. Litar sensor photodiode adalah seperti Rajah 3.



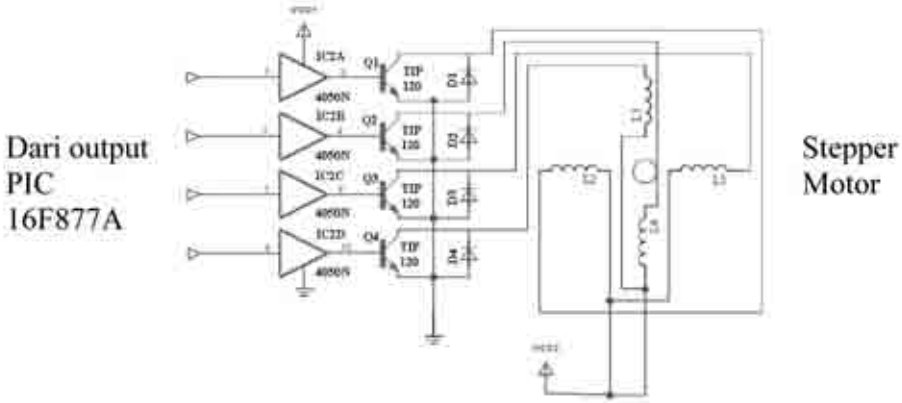
Rajah 3: Litar Skematik Sensor Photodiode

2.3. Paparan LCD (16x2)

Paparan LCD 16x2 digunakan dalam projek ini bagi memaparkan nilai yang dibaca oleh sensor photodiode. Ini bertujuan bagi memudahkan program ditulis. Paparan LCD juga berfungsi sebagai penunjuk untuk pengguna mengetahui kedudukan sebenar tirai pada sesuatu masa.

2.4. Stepper Motor

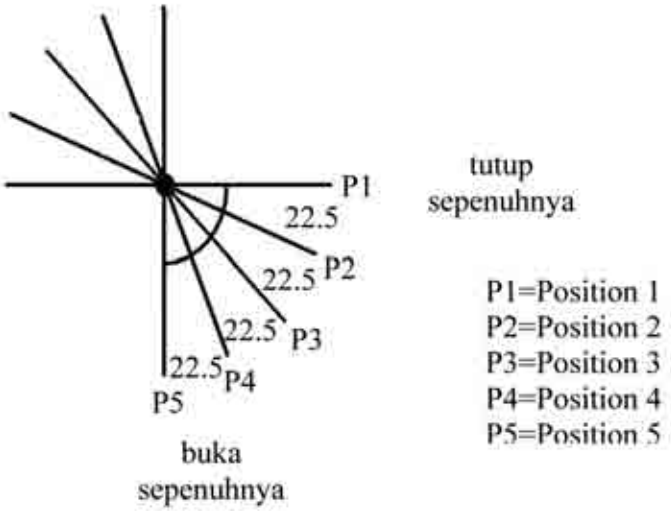
Stepper motor tidak dapat berfungsi hanya dengan 5VDC yang dihantar oleh PIC. Oleh sebab itu litar ini dicipta untuk membolehkan stepper motor dapat berfungsi seperti yang dikehendaki. Litar stepper motor terdiri daripada TIP 120 dan IC4050 yang disambung berdasarkan Rajah 4.



Rajah 4 : Litar Perantara Stepper Motor

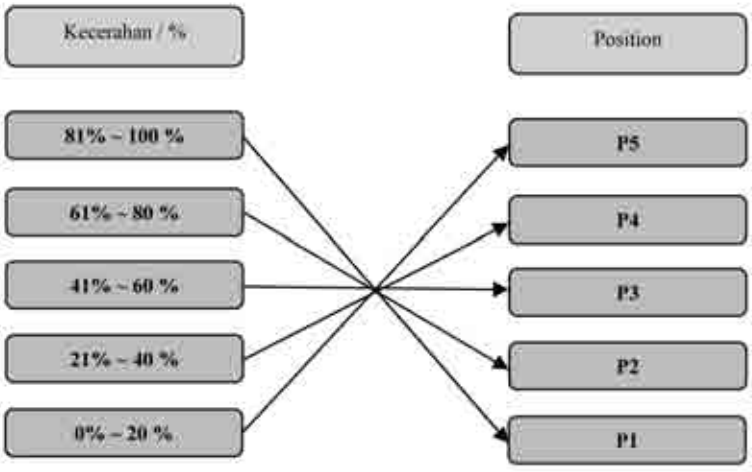
3. Pengaturcaraan

Seperti diterangkan di atas program bagi projek ini ditulis mengunakan bahasa C. Isyarat analog dari sensor photodiode diproses melalui port ADC pada PIC 16F877A. Sudut pada bukaan tingkap di gambarkan seperti Rajah 5.



Rajah 5 : Gambaran Bukaan Pada Tirai

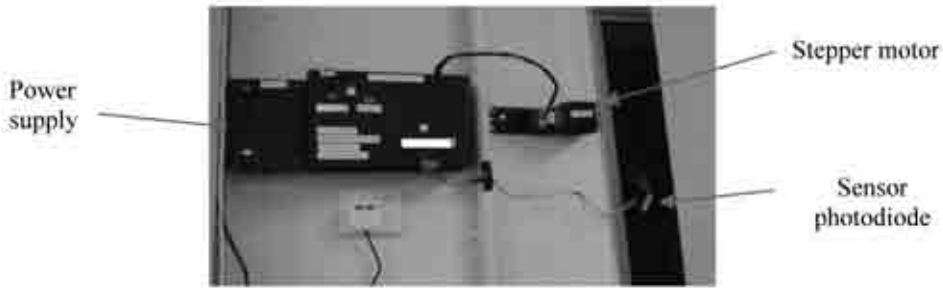
Stepper motor kemudian diprogramkan mengikut sudut dalam Rajah 5. Jarak antara position ditentukan oleh bilangan kitaran denyut yang diberikan kepada stepper motor. Hubungkait antara kecerahan cahaya dengan position di ilustrasikan seperti Rajah 6.



Rajah 6: Hubungkait antara kecerahan cahaya dengan position

4. Keputusan

Setelah semua analisis dan kajian yang telah dilakukan untuk projek ini, keputusan yang diperolehi ialah projek ini dapat berfungsi dengan baik dan sesuai untuk di pasang pada tirai. Cahaya di dalam bilik menjadi lebih sekata dan lebih selesa untuk pengguna bilik.



5. Kesimpulan

Berdasarkan projek yang dihasilkan ini, pelbagai yang telah kami pelajari boleh dipraktikkan untuk kegunaan masa depan. Dengan ilmu yang telah dipelajari juga, ia boleh menjadi asas untuk perekaan suatu sistem yang baru pada masa depan.

6. References

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[2] http//www.datasheet.com.my.
[3] http//www.instruc.cornell.com.

M24 - Study On Mechanical And Chemical Properties Of High Carbon Steel Boride Layer

Ghazali N. M. A. M., Ramdan R. D., Jauhari I.
Mechanical Engineering Department, Faculty of Engineering University Malaya, Malaysia.
E-mail: nikmohdazim@yahoo.com

Abstract

Boronizing of high carbon steel is a thermochemical treatment in which boron atoms are diffused into the surface of high carbon steel substrate to form boride layer. Boronizing on high carbon steel has long been used to improve the surface properties of dies and tools because boride layer has high hardness, good wear resistance, and good corrosion and oxidation resistance. The aim of this study is to observe the influence of kinetic parameters during boronizing of high carbon steels. The high carbon steel substrate plate was sectioned to a rectangular shape with nominal dimensions of 10×10×5 mm^3 and then polished progressively up to 600-grit emery paper to obtain desired surface condition. Then, ground specimens were embedded with boronizing agent in a stainless steel container produced. Boronizing processes were performed in a tube furnace at 850ºC, 950°C and 1050ºC for 2, 4 and 6 hours. The boronized high carbon steel specimens were characterized by using optical microscopy, X-ray diffraction (XRD) analysis and Vickers hardness testing. The results show that boride layer thicknesses formed on the boronized high carbon steels were ranged from 12 to 110 µm depending on the process temperature and treatment time. The hardness of borides formed on the samples changes between 1234.667 and 2192.333 $HV_{0.1}$ depends on the treatment time and temperature.

Keyword: *Boronizing, High Carbon Steel, Boride Layer.*

1. Introduction

For many years, surface treatment is an important heat treatment in metallurgy. Boronizing and related thermochmical heat treatment has become widely accepted as selective surface treatments where atoms are transferred to the surface of the steel at elevated temperature.

Boronizing is a thermochemical diffusion surface treatment in which boron atoms are diffused into the surface of the workpiece to form hard borides with the base material [1]. It can be applied to a wide range of steels including carbon, low alloy, tool and stainless steel, and also some super alloys as boron atoms can diffuse easily into the surface of metallic material due to their relatively small size and very mobile nature. The formation of the metal boride will provide the excellent surface properties in terms of high hardness, corrosion resistance, high temperature oxidation resistance up to 850C, and the length of service life up to 3-10 times [2]. In industry, boronizing has long been used to improve the surface properties of dies e.g. injection moulding dies, hot forming dies, extrusion dies and also in tools because of boride have high hardness, good wear resistance, and good corrosion and also oxidation resistance.

Boronizing on high carbon steel is commonly used nowadays to protect the surfaces of tool components and also dies. With this technique, it can improve components life up to several times. Many of industries have preferred this kind of technique on high carbon steel-based components such as pins, bots, punches, clamping, valve components and fittings because no voids are produced at diffusion zone (more stronger), can be uniformly applied to irregular shapes and also cost effective for large or small parts. To control the boronizing processes in automatic installations, knowledge of kinetic parameters is important. It is very important to establish the variables that affect the boronizing kinetics process to control automated procedures and obtain desirable properties. In this study, the influence of kinetic parameters such as temperature and time in boronizing process on high carbon steel was observed.

2. Experimental Procedure

In this study, high carbon steel plate with chemical compositions is shown in the table was used as the boronizing substrate.

Table 2.1: Chemical composition of the as-received steel

	Chemical composition (%, by weight)							
Material	C	Cr	Mn	Ni	Si	Mo	W	P
HCS	1.26	8.184	0.594	0.148	1.376	2.498	0.072	0.046

Firstly, the as-received High Carbon Steel plate was cut into 12 specimens with dimension of 10 mm length, 10 mm width and 5 mm height. After that, the specimens were ground from 120 up to 600 grit emery papers to get desired surface finish. Silica gels were used to avoid the specimens from corrodes after grinding process. So after grinding, the specimens were quickly stored in a container that contains silica gels. The specimens were then placed into a container produced and embedded with boronizing agent. The boronizing agent that was used in this study are Ekabor 2. The thickness of the boronizing agent around the specimen was set to 15 mm [3]. After that, the specimens along with the boronizing agent were sealed in a container produced. Then, the container was placed into a furnace for boronizing process. Boronizing process is carried out by holding the specimen in an argon atmosphere. Argon gas was supplied into the tube furnace to avoid oxygen from affecting the boronizing process. Boronizing process was done at temperature of 850°C, 950ºC and 1050°C for 3 holding times which are 2 hours, 4 hours, and 6 hours. After boronizing process was completed, the container was cooled in room temperature and then the specimens were removed. After that, the specimens were characterized by using X-Ray Diffraction (XRD), Optical Microscope and Vickers Micro Hardness.

3. Result and Discussion

3.1 Microstructure of Boride Layer

Optical microscope examination on the microstructures of the boride layer that was formed during boronizing at various temperatures and times are shown in Figures 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8 and 3.9 below.

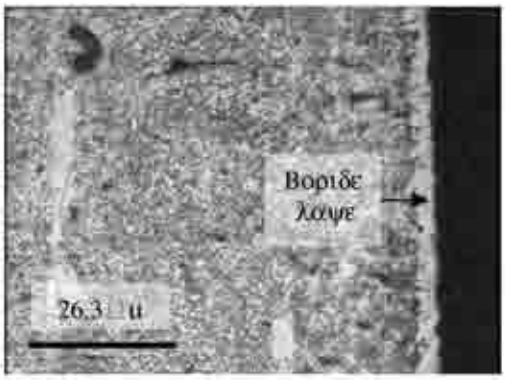


Figure 3.1: Boronized high carbon steel at 850°C for 2 hr (500X)

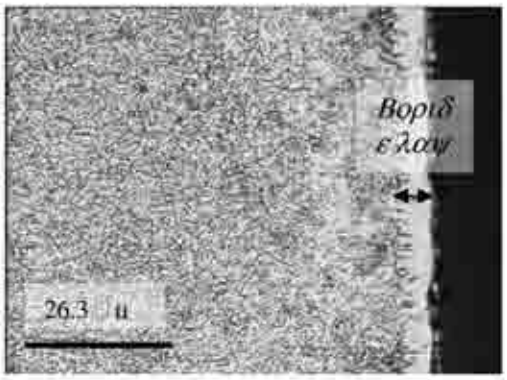


Figure 3.2: Boronized high carbon steel at 850°C for 4 hr (500X)

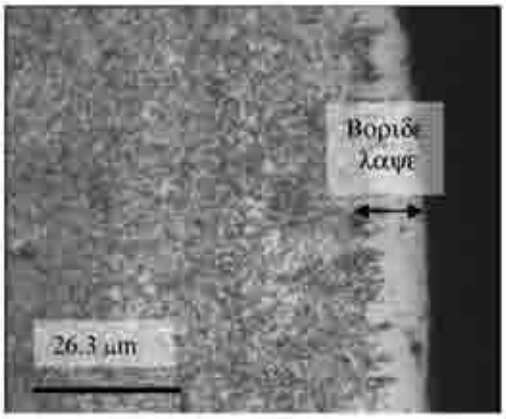


Figure 3.3: Boronized high carbon steel at 850°C for 6 hr (500X)

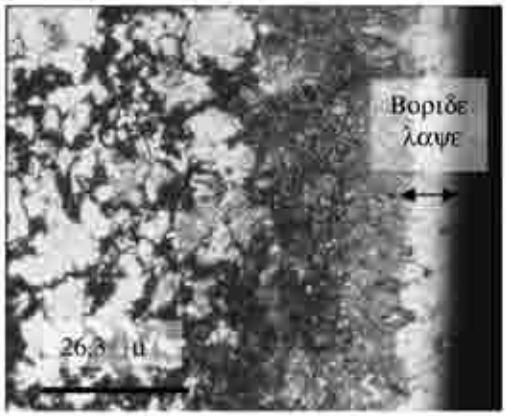


Figure 3.4: Boronized high carbon steel at 950°C for 2 hr (500X)

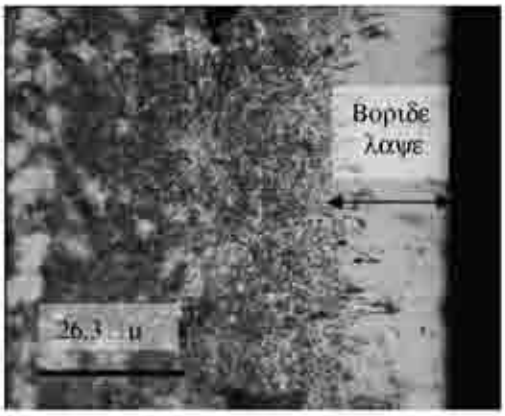


Figure 3.5: Boronized high carbon steel at 950°C for 4 hr (500X)

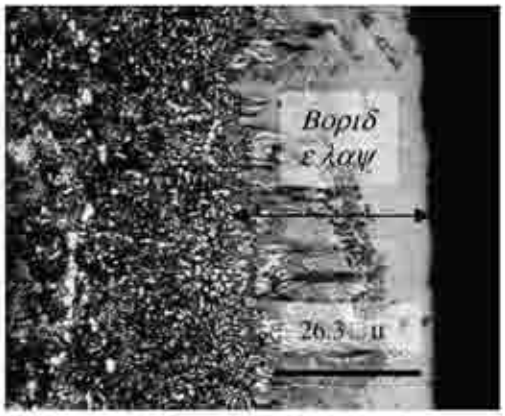


Figure 3.6: Boronized high carbon steel at 950°C for 6 hr (500X)

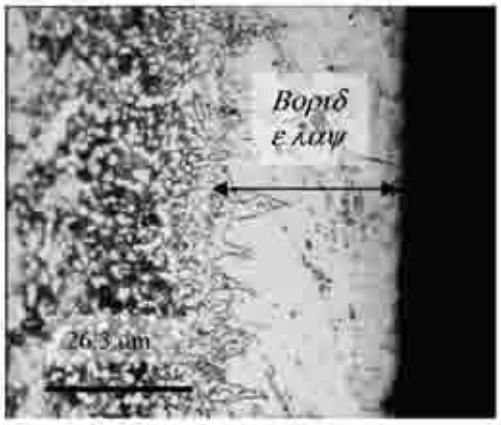


Figure 3.7: Boronized high carbon steel at 1050°C for 2 hr (500X)

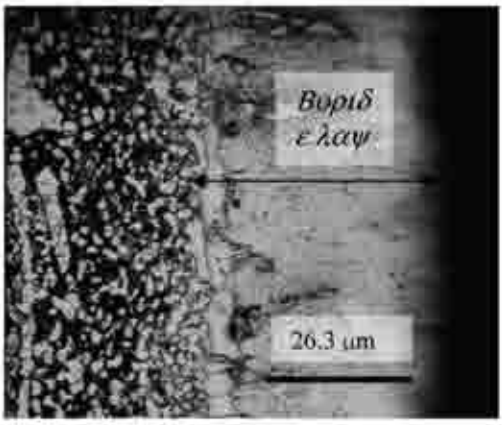


Figure 3.8: Boronized high carbon steel at 1050°C for 4 hr (500X)

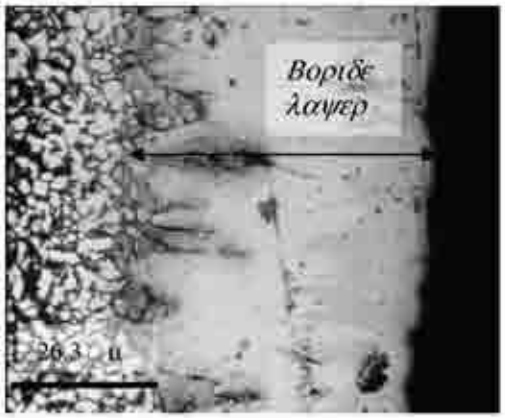


Figure 3.9: Boronized high carbon steel at 1050°C for 6 hr (500X)

As a result of optical microscope investigation on boronized high carbon steel specimens, it is indicated that all the boride layers that were formed on the surface of the high carbon steel specimens have a tooth-shape structure and these structures were homogeneously distributed over the surface of the high carbon steel specimens. From these microstructures of boride layer, the thickness of boride layers for various temperatures and time were calculated and the values were summarized at Table 3.1 below.

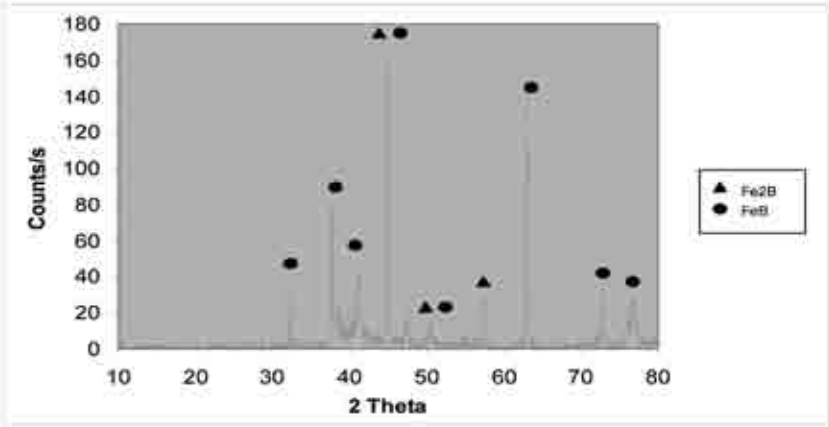
Table 3.1: The thickness of the boride layer at different boronizing temperature and time

Temperature, T (K)	Time, t (hr)	Boride layer, d (µm ± 1µm)
850°C (1123K)	2	12
	4	14
	6	22
950ºC (1223K)	2	24
	4	36
	6	54
1050°C (1323K)	2	63
	4	97
	6	110

From Table 3.1, it is shown that the thickness of boride layer on boronized high carbon steel specimens were ranged from (12 μm ± 1 μm) to (110 μm ± 1 μm). From the results shows, it is indicated that the thickness of boride layer was increased with increasing process temperature and treatment time. This is because boron atoms that were introduced into the surface of the high carbon steel substrate were through diffusion process. Since it is a diffusion process, the parameters that are playing a major role in diffusion process are treatment temperature and path of diffusion process. Higher temperature will gives higher energy than low temperature. Thus, boronizing at high temperature will give high energy to the boron atoms to diffuse into the substrate surface. With a certain time of period, boron atoms can diffuse deeper to the steel substrate to form hard boride layer.

3.2 X-Ray Diffraction (XRD)

The present of borides (FeB + Fe_2B) formed on the surface of steel substrate was confirmed by x-ray diffraction analysis (XRD) [4] shown in Figure 3.10 below.



3.3 Vickers Microhardness Test

The Vickers micro hardness (HV) values of boronized high carbon steel at 850ºC, 950°C and 1050°C for 2, 4 and 6 hr were summarized in Table 3.2 below. The hardness of the boronized high carbon steel was measured by using a digital micro hardness tester fitted with a Vickers indenter under loads of 100 g.

Table 3.2: Vickers micro hardness values of boronized high carbon steel for different times and temperatures

Temperature, T (K)	Time, t (s)	Hardness Vickers Number ($VHN_{0.1}$)			
		D_1	D_2	D_3	$D_{average}$(±15)
As-received HCS	-	211	215	208	211
850°C (1123K)	2hr	1220	1245	1239	1235
	4hr	1524	1527	1517	1523
	6hr	1588	1595	1650	1611
950ºC (1223K)	2hr	1669	1675	1635	1660
	4h	1700	1763	1723	1729
	6hr	1859	1822	1875	1852
1050°C (1323K)	2hr	1993	1955	1925	1958
	4hr	2115	2138	2079	2111
	6hr	2187	2200	2190	2192

The maximum microhardness values in boronized high carbon steel reached (2192 ± 15) HV when boronized at 1050ºC for 6hr while the minimum value is (1235 ± 15) HV when boronized at 850°C for 2hr. The micro hardness value of high carbon steel substrate was also measured as (211 ± 15) HV. Thus, surface hardness values were increased 9–10 times by the boronizing process.

The case depth microhardness of the boronized high carbon steel was measured by using a digital micro hardness tester fitted with a Vickers indenter under loads of 100 g. The variation of hardness of boronized high carbon steel for different temperatures and times from surface into matrix were summarized in Table 3.3, 3.4 and 3.5 below.

Table 3.3: Case depth microhardness of boronized high carbon steel at 850°C for 2, 4 and 6 hr

Distance, µm	Vickers Microhardness Number ($VHN_{0.1}$)		
	2 Hour	4 Hour	6 Hour
5	1214	1580	1599
10	1012	1480	1550
15	548	990	1498
20	376	667	1441
25	243	250	269

Table 3.4: Case depth microhardness of boronized high carbon steel at 950°C for 2, 4 and 6 hr

Distance, µm	Vickers Microhardness Number ($VHN_{0.1}$)		
	2 Hour	4 Hour	6 Hour
15	1649	1713	1824
30	1630	1700	1800
45	534	731.1	1790
60	451	512.7	731.1
75	300	312	324

Table 3.5: Case depth microhardness of boronized high carbon steel at 1050°C for 2, 4 and 6 hr

Distance, µm	Vickers Microhardness Number ($VHN_{0.1}$)		
	2 Hour	4 Hour	6 Hour
25	1900	2100	2180
50	1875	2030	2175
75	760	1975	2074
100	543	870	1998
125	350	368	387

From the Table 3.3, 3.4 and 3.5 above, we can see that the hardness values of boronized high carbon steel from the surface into the substrate of the high carbon steel were gradually decreased. The hardness value of boride layer for case depth hardness is likely same with surface hardness measurement. There are no obvious changes of the hardness value at the boride layer but after the boride layer, the hardness values were decreased suddenly. This is because the presence of hard FeB and Fe_2B phases in boride layer, which give much higher hardness than that of the high carbon steel substrate.

4. Conclusion

In this study, boronizing process was successfully conducted on high carbon steel plate. The data obtained were compared with varies boronizing temperature and time conducted. The results are summurized as follows:

4.1 The Optical Microscope cross section examinations on the boride layers that are formed on boronized high carbon steels substrate have a tooth-shaped structure and this structure is homogeneously distributed over the surface. The thickness of the boride layer is range from 11.842 to 109.211µm and these boride layer thickness are depends on treatment time and temperature. The longer boronizing time and higher temperature results in the thicker boride layer.

4.2 The presence of FeB and Fe_2B phases in the boronized high carbon steel were confirmed by XRD analysis.

4.3 The hardness of borides formed on boronized steels were varied from 1234.667 up to 2192.333 $HV_{0.1}$. These hardness values depend on the treatment time and temperature. As temperature and treatment time increases, the specimens become harder.

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KATEGORI TEKNOLOGI KEJURUTERAAN ELEKTRIKAL/ ELEKTRONIK/ TELEKOMUNIKASI

E1 - Computational Intelligence Method For Optimal Rotary Design System

Kantan A/L P.Saminathan
Pusat Latihan Teknologi Tinggi (ADTEC)Batu Pahat
kantan@adtecbp.gov.my

Abstract

The purpose of this research is to design fuzzy logic feedback controller to position the output of a rotational system with one flexible joint. The system produces oscillations that need to be dampening. Therefore LQR and FLC are used to solve mentioned problem. The experiment hardware consists of one SRV02 plant in the high gear ratio configuration and one Rotflex joint. The Rotflex joint consists of an encoder whose output shaft is attached to a long link. In order to control four system variables, the multivariable fuzzy controller is designed by using coefficients of a Linear Quadratic Regulator (LQR) controller. Fuzzy logic controllers were compared with LQR controller through simulation and experiment and the results showed that fuzzy controller performed better than LQR controller.

Keywords: *Compared, Controller. Simulation, dampening, rules*

1. Introduction

The classical control development and analysis is the ability to construct accurate mathematical models, such as transfer functions and state space representations, of complex dynamic systems. Many of the classical approaches for compensator design and stability analysis are rendered ineffective without a suitable model of a physical plant. Identifying system parameters, utilizing simplifying assumptions, and judging the validity of the resulting simulation results are very difficult topics to convey solely in a lecture format. Typically, algorithms textbook procedures cannot serve as alternatives for the engineering intuition garnered through hands-on laboratory experience. One of the most crucial steps in teaching the flow of the modeling procedure to undergraduate engineering students is the "validation" of their developed model. In order to fully validate the system model, an experimental test must be performed on the target plant with all pertinent data collected and stored for comparison to the corresponding simulation results. Without such feedback it is extremely difficult to comprehend the impact of modeling assumptions, to observe measurement errors, or to locate possible modeling mistakes. Due to this need, a hardware interface system must be utilized that can interact with the physical plant and sensors such that the experimental test can be realized. In each component of the project, we utilized the WinCon real-time interface to actuate the robotic link and to collect measurements from the numerous sensors embedded on the physical plant.

2. Literature Review

2.1 Literature Overview

The aim is to replace an existing PID controller with a fuzzy controller, using initial guesses as to the fuzzy membership functions and rules to tune the fuzzy controller for optimum performance and to compare the performance of three control regimes i.e. without controller, ON-OFF controller, LQR and FLC.

A single input / single output process is considered. The FLC has two control inputs: the current error and the change of error. The control action is the change in the manipulated variable. The tuning of the two scaling factors for the two control inputs is done automatically by a fuzzy set of Meta rules. The performance measures for tuning are the overshoot, rise time and the amplitude of oscillation of the transient response of the process. The rules for tuning are of the form:

IF performance measure IS X, THEN scaling factor IS Y,

where *performance* measure is one of three above mentioned performance measures. *X* is a fuzzy set describing the performance measures and *Y* is a fuzzy set describing the scaling factor correction.

By changing the scaling factor of each controller input, the weight given to the input of the controller is changed. For example, if the system response is slower than desired, the effect of the error on the system must be increased. Hence, the error scaling factor is increased. Similarly, if the overshoot or amplitude of oscillation is higher, the effect of the change of error on the controller should be bigger. Hence, the appropriate scaling factor is increased.

The proposed algorithm was developed and the performance of the four control regimes (without controller, ON-OFF controller, LQR and FLC) was examined. To assess the robustness of the controller, it was compared with the PID controller when both had 3% zero-mean noises added to the temperature sensor. The tuning was accomplished in 13 steps with the scaling factors initialized to unity. Without some form of adaptive tuning, both controllers come out of critical damping once the process parameters are changed. However, the fuzzy controller is more robust under such changes.

2.2 Fuzzy Controller Design

From experience it is difficult to design fuzzy controller for more than two system variables based on the system operator knowledge. In multivariable control schemes, Mamdani fuzzy controller based on the LQR controller design can be used[1]. Two components of the LQR controller are the optimal gains F and the summation block, Fig. 1.

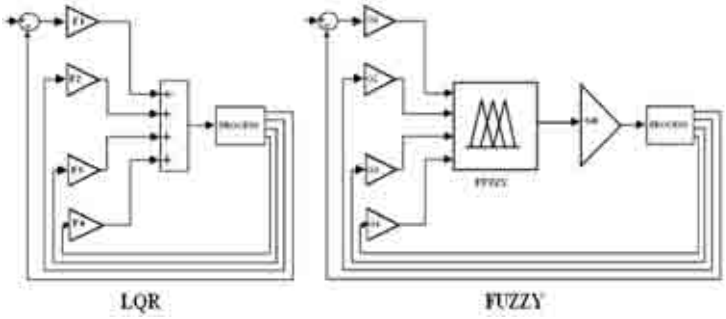

Fig.1: General form of the control system with the LQR and fuzzy controller

Fuzzy controller has four components: rule-base, interface mechanism, fuzzification interface and defuzzification interface, Fig. 2.

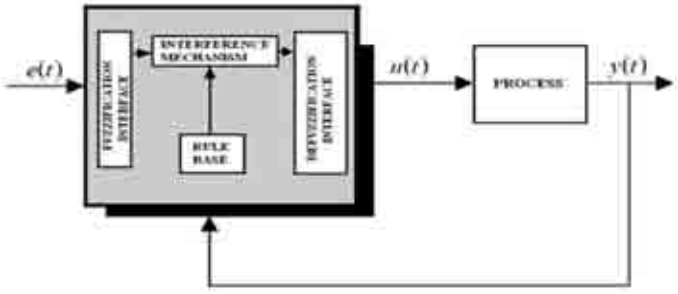

Fig. 2: Control system with fuzzy controller

2.3 Sugeno-Type and Then Rules :

Sugeno-type systems can be used to model any inference system in which the output membership functions are either linear or constant. This fuzzy inference system was introduced in 1985 and also is called Takagi-Sugeno-Kang. Sugeno output membership functions (z, in the following equation) are either linear or constant. A typical rule in a Sugeno fuzzy model has the following form: *If Input 1* = x *and Input 2* = y, *then Output is* z = ax + by + c. For a zero-order Sugeno model, the output level *z* is a constant *(a=b =0)*. Fuzzy sets and fuzzy operators are the subjects and verbs of fuzzy logic. Usually the knowledge involved in fuzzy reasoning is expressed as rules in the form:

If x is A Then y is B

where x and y are fuzzy variables and A and B are fuzzy values. The if-part of the rule "*x* is *A*" is called the *antecedent* or premise, while the then-part of the rule "*y* is *B*" is called the *consequent* or conclusion. Statements in the antecedent (or consequent) parts of the rules may well involve fuzzy logical connectives such as 'AND' and 'OR'. In the if-then rule, the word "is" gets used in two entirely different ways depending on whether it appears in the antecedent or the consequent part.

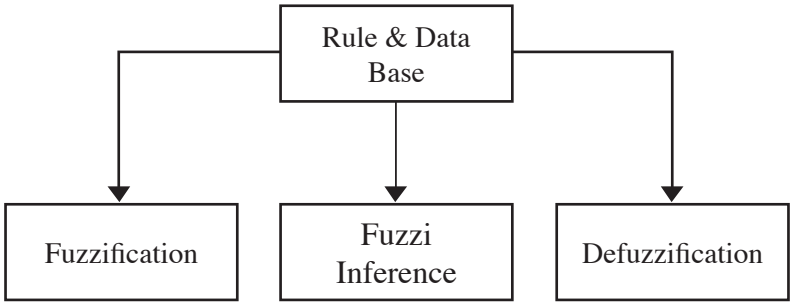

Fig 3: General Fuzzy Logic Controller

3.0 Simulated Results

The simulations have been carried out using the interface with WinCon real-time SIMULINK for Quanser Inc. operating under Windows 2000 model of the Rotary Flexible Joint System implemented in Matlab functions. The proposed controller has been implemented using Fuzzy Logic Toolbox and Simulink in the Matlab environment. A procedure similar to that used to test the Fuzzy Logic Controller is used to test the Without (PD) Controller, ON-OFF Controller and LQR Controller. For the ease of comparison, the same operator signal is used. The purpose to design a state-feedback controller is to place the tip of the arm (+ α) at a given command. The controller must also meet the following criteria:

- There should be a maximum of **5%** overshoot.
- The Arm deflection should never exceed **10°**. ($-10° < \alpha < 10°$).

The following project will be divided into two parts. There will first be a design and simulation section that will entail a number of iterations and simulations of the controller. Part II of the laboratory will consist of implementing the final controller on the physical plant (SRV02-Flexible Joint), as well as comparing the performance of the full-state feedback controller as opposed to a controller with feedback only from the servo-motor. This section will also entail some frequency analysis on both closed-loop models so an understanding of natural frequencies and resonance will also be required. System performances with the PD (without) controller, ON-OFF controller, LQR and Fuzzy controllers are compared in the simulation as following:

3.1 Comparison for the Simulated Result

System performances with the without controller, ON-OFF controller, LQR controller and fuzzy logic controllers are compared in the simulation. Simulated results for arm angle (simulated theta) and arm deflection angle (simulated alpha) are presented in the figure 4 and figure 5.

Performance of Position Control (Simulation Section)

Controller	Performance			
	Rise Time (s)	% Overshoot	Alpha Range (Arm Deflection)	Theta Value (Arm Angle)
Without Controller	0.3920	1.3398	– 20.59°< α < 20.59°	44 °
ON-OFF Controller	0.1640	1.3502	– 19.46°< α < 20.64° (OFF) - 13.57°< α < 14.37° (ON)	44 °
LQR Controller	0.1950	-0.0151	-12.87°< α < -12.87°	45 °
Fuzzy Logic Controller	0.3160	1.3434	-3.518 °< α < 3.293°	44 °

Table 1: Performance of Position Control (Simulation Section)

Table 1 shows the simulation response and performance of position control respectively for the rotary flexible joint system. The all controllers servomotor's load angle (t), at figure 4, reaches the maximum about 45° during the acceleration phase and minimum is about -45° during the deceleration phase. It shows that the LQR controller for the 2DOF which is namely PID controller has faster reactor which is their rise time is 0.1950 sec while the fuzzy logic controller was a bit 0.3160 sec. We note that the LQR controller is faster than the fuzzy controller in the sense that the rotary arm reaches the end position in a shorter time compared with that needed by the fuzzy controller. However, the LQR controller, the deflection arm angle resulting from the rotary arm acceleration is about 13 °, which is larger than that obtained with the fuzzy logic controller, about 3.2 °. During the deceleration phase, the deflection arm angle reaches less than -13 ° in the case of the LQR controller compared with about -3.5 ° in the case of the fuzzy logic controller at figure 5.

3.2 Comparison for the Measured Result

System performances with the without controller, ON-OFF controller, LQR controller and fuzzy logic controllers are compared in the measured. Measured results for arm angle (measured theta) and arm deflection angle (measured alpha) are presented in the figure 6 and figure 7.

Controller	Performance			
	Rise Time (s)	% Overshoot	Alpha Range (Arm Deflection)	Theta Value (Arm Angle)
Without Controller	0.6150	-5.2979	-9.844 °< α < 9.316°	40 °
ON-OFF Controller	0.2130	-4.8585	-10.37 °< α < 10.55° (OFF) - 7.48°< α < 7.61° (ON)	40 °
LQR Controller	0.6540	-8.8132	–7.207°< α < 7.207°	37 °
Fuzzy Logic Controller	0.3200	-1.1230	-3.193 °< α < 3.418°	44 °

Table 2: Performance of Position Control (Experimental Section)

Table 2 shows the experimental response and performance of position control respectively for the rotary flexible joint system. The fuzzy controlled servomotor's load angle (t), at figure 68.25, reaches the maximum about 43.87° during the acceleration phase and minimum is about -41.57° during the deceleration phase. But for LQR controller, it reaches only about 40°.

The table 2 shows that the fuzzy logic controller for rotary flexible join system has faster react on which is their rise time is 0.3200 sec while the LQR controller was a bit 0.6540. We note that the fuzzy controller is faster than the LQR controller and without controller in the sense that the rotary arm reaches the end position in a shorter time in the experimental.

However, the LQR controller, the range of deflection arm angle resulting from the rotary is about -7.207°< α < 7.207° , which is larger than that obtained with the fuzzy logic controller, about -3.193 °< α < 3.418° at figure 7. Figure 6 show that the FLC either Fuzzy Logic performed better than LQR controller. The Fuzzy controller results are almost identical with LQR controller arm deflection. Fuzzy Logic Controller gives the minimal arm deflection among all the controllers.

4. Conclusion And Recommendation

4.1 Conclusion

Fuzzy logic controller was designed and tested in the Quanser's Rotary Flexible Joint Robotic Arm system. Four types of controllers method were tested namely PD (without) controller, ON-OFF controller, LQR controller and Fuzzy Logic controller. It is found that LQR controller had longer mathematical calculation in real time system as compared to Fuzzy Logic controller . Fuzzy Logic controller system was also successfully designed and tested for Rotary Flexible Joint System. Subsequently all the controllers were compared with the LQR controller through simulation and experiment. The results showed that Fuzzy Logic controller performed better than the other controllers. It was also found, Fuzzy Logic controller should be turned so that performances for servo load angle becomes better and arm deflection (vibration) become less.

The implemented Fuzzy Logic controller was very suitable to control linear techniques or non-linear techniques. It is also suitable for the optimization of various parameters to improve the efficiency. No extra cost was needed for the maintenance of the Rotary Flexible Joint System by applying the Fuzzy Logic controller.

4.2 Future Recommendations

This project involved optimizing a fuzzy model from a basic model. There is much scope for further development of the project.

- Use different shaped MFs

This project only uses triangular membership functions for the input and output inference mechanisms. It is possible that, for individual problems, Gaussian or bell shaped membership function types will prove more effective than limiting the type of membership function to triangular alone.

- Allow MFs more freedom

In this algorithm, the corners and apexes of each membership function are only allowed a small degree of freedom. Perhaps there is a means of setting the bounds of these parameters, which increases the search space for the genetic algorithm.

4.3 Objective and Scopes of project achievement

The objectives of the project were achieved. It is found that the FLC can perform better than LQR controller.

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ANNEX

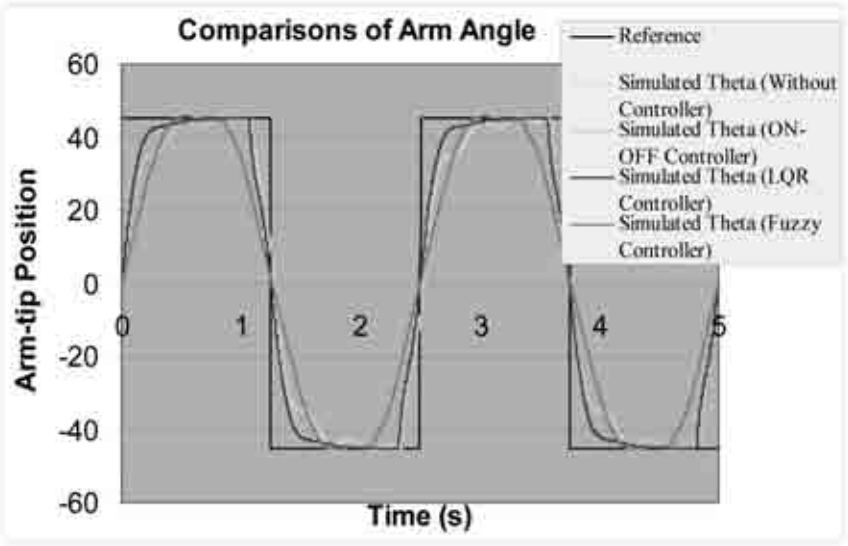


Figure 4: Simulated plot results for servo load angle.

Figure 5: Simulated plot results for arm deflection angle.

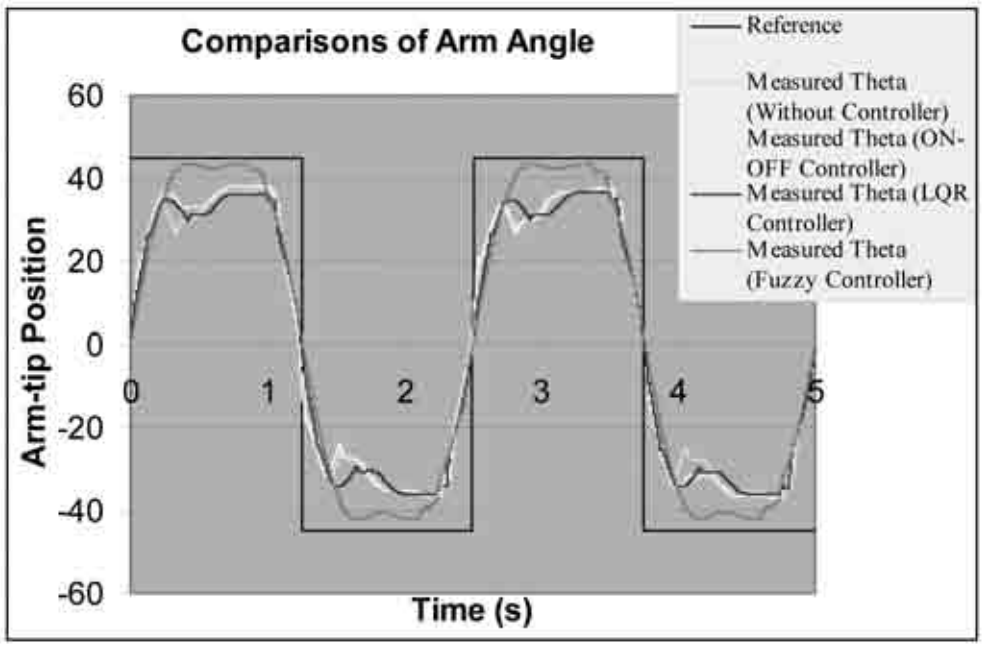


Figure 6: Experimental plot results for servo load angle.

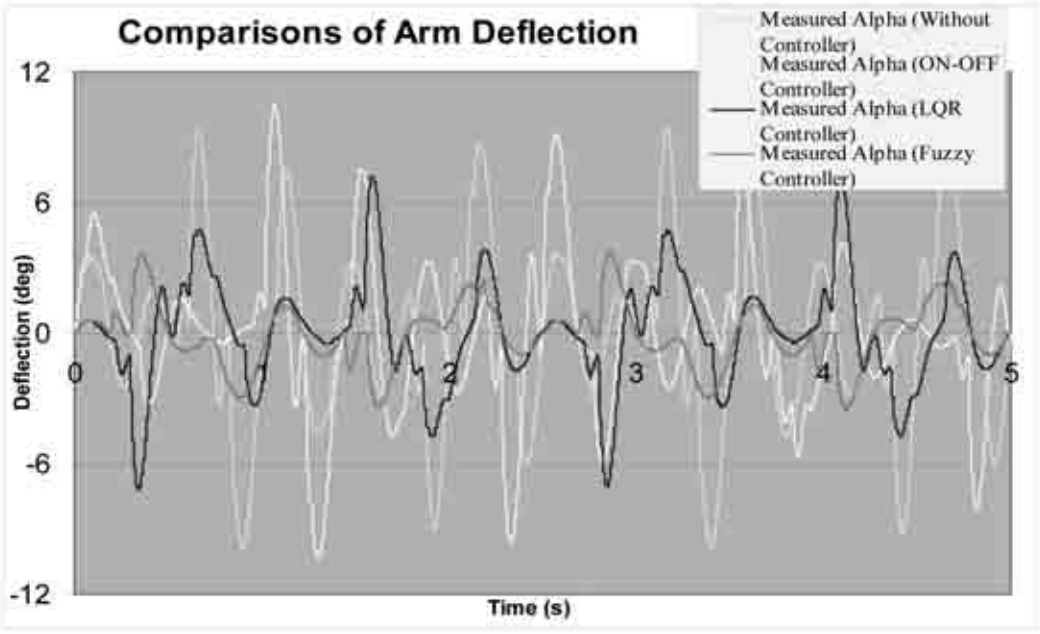


Figure 7: Experimental plot results for arm deflection angle.

E2 - Relay, Electo-Pneumatic PLC Training Kit (R.E.P Training Kit)

Nantha Kumara A/L Periasamy; Hasmadi bin Hamzah; Khairul Anur B. Adenan Bashah; Ida Liliana bt. Musa; Mazliza bt. Muhamad Puad
Institut Latihan Perindustrian Kangar

Abstrak

Relay, Elektro-Pneumatik dan Pengawal Logic Bolehaturcara (PLC) merupakan peralatan yang digunakan dalam sistem pengawalan. Pada zaman sekarang penggunaannya banyak digunakan dalam industri perkilangan. ***Geganti (relay)*** *adalah satu suis elektrik yang dikawal oleh litar elektrik yang lain untuk operasi buka dan tutup. Dalam keadaan sebenar, suis ini dikawal oleh satu elektromagnet untuk beroperasi. Mengikut NEMA (National Electrical Manufacture Association US)* ***Pengawal logik Bolehaturcara*** *(PLC) ditakrifkan suatu peralatan elektronik yang beroperasi secara digital di mana ianya menggunakan ingatan boleh-aturcara untuk menyimpan arahan di storan dalaman bagi melaksanakan fungsi-fungsi tertentu seperti logik, penjujukan, pemasaan, pembilang dan arimatik dengan cara mengawal menerusi modul/keluaran digital atau analog untuk berbagai jenis mesin atau proses.* ***Sistem pneumatik*** *memerlukan injap kawalan untuk mengarah dan mengaturkan aliran bendalir dari pemampat atau pam ke pelbagai peranti beban. Daripada hal ini kami telah mencipta satu modul yang boleh membantu kaedah pembelajaran berkaitan dengan Relay , Electro-Pneumatic dan Programmable Logic Controller. Ia boleh membantu pelajar memahami penggunaan Relay , PLC dan Elektropneumatik dengan lebih mudah dari segi sistem pengoperasiannya dan spesifikasinya. Konsep yang kami cuba ketengahkan di sini ialah kaedah pembelajaran yang ringkas serta senang untuk difahami kerana ketiga-tiga komponen telah digabungkan di dalam satu panel. Dengan adanya projek sebegini , para pelajar dapat mempraktikkan segala teori yang telah dipelajari dengan menggunakan projek R.E.P training kit. Secara tidak langsung ianya lebih mudah dikendalikan oleh mereka yang kurang berpengalaman tentang Relay , Elektro-pneumatik dan PLC. Dengan adanya peralatan ini , proses pembelajaran menjadi lebih ringkas dan berkualiti bertepatan dengan konsep pembelajaran masa kini yang serba canggih.*

1. Pengenalan

Pada masa kini, kaedah pembelajaran banyak dipelbagaikan agar apa yang akan disampaikan mendapat kepuasan atau pun kefahaman yang sempurna. Seperti yang kami cadangkan dalam projek ini, kaedah pembelajaran mudah yang berkonsepkan penggunaan PLC, Relay dan Elektropneumatik serta peralatan mekanikal yang lain seperti silinder, injap dan sebagainya.

Selain itu pembelajaran berkaitan PLC, Relay dan Elektropneumatik adalah secara berasingan. Ini menyebabkan pelajar sukar memahami kaitan di antara ketiga-tiga komponen ini. Oleh itu kami telah menghasilkan satu alat yang menggabungkan ketiga-tiganya di dalam satu panel.

2. Kaedah

2.1 Pengawal Logik Bolehaturcara

PLC *(Programmable Logic Control)* atau Pengawal Logik Bolehaturcara merupakan sesuatu peralatan yang dicipta untuk mengantikan penggunaan relay yang banyak ke dalam satu pengawalan. PLC berfungsi dengan melihat masukan kepada keluaran samaada ‘on’ atau ‘off’ berpandukan kepada aturcara yang diberi.

PLC mula diperkenalkan pada tahun 1960an oleh Bedford Associated yang pada mulanya dikenali sebagai 'Modular Digital Controller' (MODICON). Pengawal Logik Bolehaturcara (PLC) adalah sejenis kawalan yang digunakan untuk mengawal sesuatu proses di dalam satu sistem automasi. Ia merupakan satu peranti pengawal logik yang mula dicipta pada tahun 1968 oleh sekumpulan jurutera dari General Motor Corporation USA bila syarikat tersebut memerlukan alternatif baru bagi menggantikan sistem kawalan geganti (relay) yang kompleks. Perkembangan selanjutnya menghasilkan sistem yang boleh membuat sambungan digunakan untuk fungsi mudah *signal binary*. Signal-signal disambung mengikut arahan dalam aturcara kawalan. PLC yang kini mampu mengawal pelbagai tugas.

2.1 Geganti

Apabila elektrik disalirkan ke konduktor, ia akan menghasilkan medan magnet di dalam gegelung. Kekuatan medan magnet tadi akan menarik bilah kaki daripada normally close ke normally open. Ketika suis dilepaskan, ia akan memotong aliran elektrik dan menyebabkan bilah tadi kekedudukan asal. Ini disebabkan oleh bilah spring yang menolak kembali bilah tadi.

Cara yang mudah bagi memahami proses ini adalah dengan melihat cara kerja magnet biasa dimana ia akan menarik semua bahan berasaskan besi. Berbeza pula dengan elektromagnetik, apabila elektrik dialirkan ke gegelung maka akan terhasil magnet dan apabila alir elektrik diputuskan magnet tadi akan hilang. Walaubagaimanapun, bagi proses mengawal pelbagai beban terdapat satu komponen yang mengunakan sistem elektromagnetik ialah relay.

Relay boleh digunakan secara menyeluruh bagi mengawal arus yang tinggi dan mampu mengawal pelbagai suis. Gegelung relay menghasilkan medan magnet bagi menggerakkan kaki ke normally open dan close serta mampu melakukan seratus kali ganda beban.

2.3 Elektropneumatik

Salah satu komponen yang akan digunakan dalam projek kami adalah elektropneumatik. Elektropneumatik adalah gabungan diantara elektrik dan sistem pneumatik. Antara contoh komponen elektropneumatik ialah injap kawalan arah. Solonoid akan dipasangkan pada injap tersebut dan akan menjadi pemandu bagi mengawal arah pergerakkan injap.

Kebanyakkan industri Automasi menggunakan system elektropneumatik dalam proses pemasangan dan pembungkusan. Kaedah menggunakan sistem ini adalah lebih mudah dan cepat serta ianya boleh dikawal sepenuhnya.

3. Proses Merekabentuk

Untuk merekabentuk *R.E.P. Training Kit*, kami telah menggunakan lukisan terbantu komputer iaitu AutoCAD. Ia bertujuan bagi merangka dan merekabentuk keseluruhan bahagian serta mengatur kedudukan komponen yang sesuai supaya tidak timbul masalah apabila ia beroperasi kelak.

Penggunaan AutoCAD melibatkan lukisan berbentuk tiga dimensi. Daripada lukisan, ukuran bagi setiap bahagian dan rupabentuk bagi setiap pandangan bahan kerja dapat di lihat.

Setelah aktiviti merekabentuk ini selesai, kami dapat mengenalpasti jenis-jenis kerja pemesinan dan pengukuran yang perlu dilakukan. Selain itu kami juga dapat mengetahui bahan mentah serta peralatan yang akan digunakan untuk projek *R.E.P. Training Kit* ini.

Kami telah memilih beberapa buah *hardware* bagi mendapatkan bahan mentah dan kelengkapan yang berkaitan dengan projek ini. Kami mengambil masa selama sebulan dalam mendapatkan maklumat tentang keseluruhan bahan mentah yang sesuai untuk projek ini.

Rekabentuk kejuruteraan pada asasnya melibatkan pelbagai teknologi menyerupai satu aktiviti penyelesaian masalah yang kompleks. Ia adalah sebahagian daripada prinsip seni yang menggunakan konsep-konsep saintifik sebagai asasnya. Rekabentuk juga merupakan proses yang rasional dalam membuat keputusan iaitu dengan menimbangkan setiap masalah yang timbul, mencari penyelesaian yang terbaik dan bersesuaian dengan skop yang dikehendaki. Dalam merekabentuk ini, masalah dapat dilihat dari pelbagai aspek dan penyelesaian dibuat dalam pelbagai cara. Antaranya adalah dengan menggunakan analisis matematik, pengalaman sedia ada, penyelidikan dan ujikaji.

Proses rekabentuk adalah satu proses yang berulang-ulang dan begitu kompleks. Ini bermakna proses rekabentuk merupakan kerja-kerja yang perlu dilakukan bagi menghasilkan sesuatu projek baru atau pengubahsuaian ke atas projek sedia ada.

3.1 Peringkat Pertama – Proses Pemotongan

Kerja-kerja pemotongan bakelit dilakukan dengan menggunakan jigsaw mengikut ukuran yang telah ditetapkan. Pada permulaan, bakelit hendaklah ditanda terlebih menggunakan penanda untuk membuat garisan. Proses ketiga ialah proses squaring iaitu suatu proses kemasan di mana benda kerja tadi akan dimesin dengan teliti mengikut saiz yang telah ditetapkan. Proses pemotongan yang sama dilakukan pada acrylic untuk tapak projek. Kerja-kerja perlu dilakukan secara berhati-hati supaya tidak berlaku sebarang kemalangan kerana proses pemotongan dilakukan menggunakan alatan yang tajam.

Proses yang berikutnya adalah proses *drilling*. Sebelum memulakan proses, mata alat hendaklah dilaraskan dengan menggunakan *edge-finder* untuk menetapkan sudut yang tepat supaya tidak berlaku sebarang kerosakkan semasa menjalankan proses. Setelah mendapat sudut pada koordinat 0,0, mata alat boleh dipasang mengikut saiz yang perlu iaitu 10mm.

Setelah selesai proses drilling, bahagian-bahagian tersebut dipasang dengan mengunakan skru agar projek tahan dan kukuh.

3.2 Peringkat Kedua – Proses Pemesinan

Peringkat kedua merupakan proses penebukan pada permukaan utama projek dan bekalan kuasa. Lubang-lubang akan ditebuk untuk menempatkan komponen-komponen yang digunakan dalam projek ini. Proses ini dilakukan dengan menggunakan mesin CNC (FANUC ROBODRILL).

3.3 Peringkat Ketiga – Penghasilan Kotak Suis Tambahan

Pada peringkat ini, proses penghasilan kotak tambahan dilakukan. Kotak tambahan ini berfungsi untuk menempatkan suis-suis tambahan yang akan digunakan sekiranya perlu. Proses ini dilakukan dengan menggunakan Mesin Comweb.

3.4 Peringkat Keempat – Proses Menghasilkan PCB SUB-BOARDS

Protel 99 SE adalah perisian yang digunakan untuk melukis skematik diagram dan litar PCB.

3.5 Peringkat Kelima – Pemasangan Komponen dan Pendawaian

Merupakan peringkat di mana semua komponen dipasang pada permukaan utama projek. Proses pendawaian dibuat selepas kerja-kerja pemasangan komponen ini siap dibuat.

4. Peralatan Yang Digunakan

Bil	Komponen	Fungsi
1	Pengawal Logik Bolehaturcara (PLC)	Mengawal operasi sesuatu litar dan menggantikan penggunaan relay yang banyak dalam sesuatu litar
2	Geganti (Relay)	Untuk mengawal pelbagai beban dan berfungsi untuk pelbagai suis
3	Butang Tekan	Digunakan sebagai suis untuk memulakan operasi
4	Bekalan Kuasa	Digunakan untuk membekalkan tenaga elektrik pada sistem PLC dan Relay
5	Selinder Dua Tindakan	Aksesori tambahan untuk bantuan pemahaman dalam penggunaan Elektropneumatik
6	Pemasa (Timer)	Pengaturcara masa
7	Penggera (Buzzer)	Peralatan tambahan yang digunakan untuk pemahaman
8	Injap 5/2 way double solenoid	Mengawal arah udara mampat
9	Banana Plug	Sebagai soket untuk membuat sambungan elektrik
10	Motor	Untuk menggerakkan conveyor
11	Wayar	Mengalirkan arus pada peralatan elektrik seperti motor, LED dan PLC
12	Acrylic	Bahan untuk menempatkan semua peralatan yang digunakan untuk REP Training Kit

5. Keputusan Dan Analisis

Berikut adalah borang soal selidik yang diedarkan untuk dibuat analisis :

Soal Selidik Literasi Maklumat
Keperluan REP Traning Kit (Relay, Elektro-Pneumatik, PLC) dalam proses pembelajaran di institusi pengajian.

Anda diminta memberi pandangan ikhlas mengenai kemudahan menggunakan REP Training Kit dalam salah satu kaedah pembelajaran di institusi pengajian. Semua pandangan dan jawapan yang anda berikan adalah sulit dan tiada kaitan dengan kedudukan anda di tempat anda belajar/anda mengajar. Segala pandangan dari anda akan kami gunakan dalam penyelidikan projek ini.
Sila isikan butir-butir maklumat dibawah sebelum menjawab soalan soal selidik.

1. No. Martriks :-..... Kursus : -.....

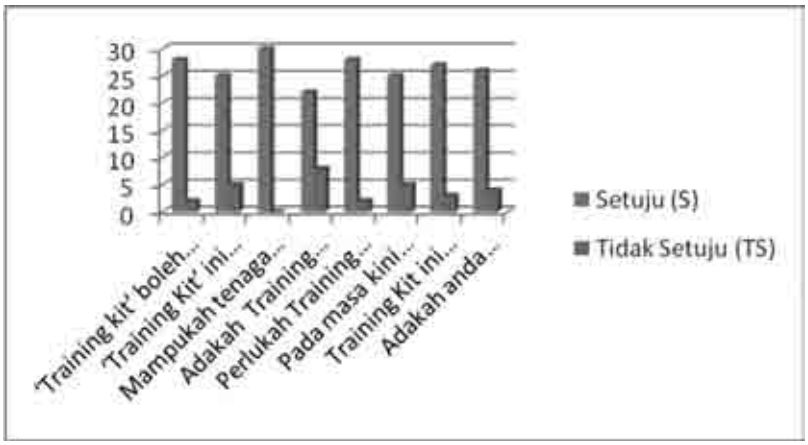
ARAHAN:-

Anda hanya perlu tandakan (√) pada ruangan Setuju (S) atau tidak setuju (TS) berdasarkan pandangan / pengalaman anda. Borang soal-selidik ini telah diedarkan kepada 30 orang pengajar dan pelajar .

Bil	Perkara	Setuju (S)	Tidak Setuju (TS)
1.	'Training kit' boleh membantu dalam proses pembelajaran.		
2.	'Training Kit' ini lebih padat dan ringkas (Relay,Elektro-Pneumatik,PLC).		
3.	Mampukah tenaga pengajar memberi tunjuk ajar dengan mudah menggunakan Training Kit.		
4.	Adakah Training Kit mampu menarik minat pelajar dari segi pembelajaran?		
5.	Perlukah Training Kit ini disediakan disetiap institiut pengajian tinggi?		
6.	Pada masa kini kaedah pembelajaran PLC, Relay dan Elektro-Pneumatik sukar difahami pelajar		
7.	Training Kit ini memenuhi kehendak matapelajaran berkaitan (Relay,Elektro-Pneumatik,PLC).		
8.	Adakah anda bersetuju dengan cadangan kami untuk menghasilkan R.E.P Training Kit?		

Keputusan soal-selidik.

Bil	Perkara	Setuju (S)	Tidak Setuju (TS)
1.	'Training kit' boleh membantu dalam proses pembelajaran.	28	2
2.	'Training Kit' ini lebih padat dan ringkas (Relay,Elektro-Pneumatik,PLC).	25	5
3.	Mampukah tenaga pengajar memberi tunjuk ajar dengan mudah menggunakan Training Kit.	30	0
4.	Adakah Training Kit mampu menarik minat pelajar dari segi pembelajaran?	22	8
5.	Perlukah Training Kit ini disediakan disetiap institiut pengajian tinggi?	28	2
6.	Pada masa kini kaedah pembelajaran PLC, Relay dan Elektro-Pneumatik sukar difahami pelajar	25	5
7.	Training Kit ini memenuhi kehendak matapelajaran berkaitan (Relay,Elektro-Pneumatik,PLC).	27	3
8.	Adakah anda bersetuju dengan cadangan kami untuk menghasilkan R.E.P Training Kit?	26	4



Perbandingan Diantara Kaedah Lama Dan Kaedah Baru

Relay

Programmable Logic Control (PLC)

Electropneumatic Trainer

Relay, Electropneumatic, PLC

Trainer

R.E.P. Training Kit merupakan alat bantu belajar yang dilengkapi dengan PLC, Geganti (Relay) dan juga Elektropneumatik. Gabungan ketiga-tiga alat ini direka dalam bentuk yang mudah untuk difahami terutamanya dari segi pendawaian litar. Kaedah pembelajaran ini tidak terhad dan boleh dipelbagaikan lagi contohnya, mempelbagaikan program bagi menarik minat semua orang yang ingin mendalami ilmu yang berkaitan dengan PLC, Relay dan Elektropneumatik.

6. Kesimpulan

Sekiranya dilihat dari segi rekabentuk dan fungsi, alat ini mempunyai potensi untuk dikomersialkan pada masa hadapan. Ini kerana kaedah pembelajaran akan menjadi lebih mudah dengan adanya alat ini. Golongan utama yang kami sasarkan untuk menggunakan alat ini ialah para pelajar di institut pengajian seperti universiti dan juga politeknik yang mempelajari tentang PLC, relay dan juga elektropneumatik. Alat ini memudahkan para tenaga pengajar memberi penerangan kepada pelajar. Selain itu, alat ini juga boleh dikomersialkan di kilang-kilang untuk digunakan semasa mengadakan latihan kepada pekerja.

Akhir sekali, dapatlah dikatakan bahawa ‘R.E.P. Training Kit’ yang dihasilkan ini adalah suatu ciptaan yang ideal di mana ianya boleh berfungsi dengan baik, menjimatkan ruang, kos yang agak rendah, alatganti yang mudah didapati serta mencapai objektif yang ditetapkan.

7. Rujukan

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E3 - Analysis On Soft Handover Parameters For UMTS Network

Rhoma Erma Bin Zaini
Institut Latihan Perindustrian Ipoh
rhomaerma@gmail.com / rhomaerma@ilpipoh.gov.my

Abstract

This project aimed to analyze the soft handover (SHO) adding and dropping threshold and time to trigger values. The analysis was focused on downlink direction, usually this direction of data transmission requires higher data rates than the transmission in uplink direction. Field test were conducted in real Universal Mobile Telecommunication System (UMTS) network, assist by one of Malaysia's local 3G network service provider at PETRONAS Twin Tower surroundings. The soft handover performance also being analyze through statistical report obtained from network provider. From simulations, results indicate that soft handover provides downlink transmission power gain, which can be seen as improvement of the UMTS network performance. New SHO parameter being proposed to network provider and the statistical report being analyze again in order to validate the simulation.

Keyword: soft handover, UMTS, 3G.

1. Introduction

Soft handover is different from the traditional hard handover process. With hard handover, a definite decision is made on whether to handover or not and the mobile only communicates with one Node B at a time. With soft handover, a conditional decision is made on whether to handover or not. Depending on the changes in pilot signal strength from the two or more Node Bs involved, a hard decision will eventually be made to communicate with only one. This normally happens after it is clear that the signal coming from one Node B is considerably stronger than those come from the others. In the interim period of soft handover, the mobile communicates simultaneously with all the Node Bs in the active set. The difference between hard and soft handover is like the difference between a swimming relay and track-and-field relay events. Hard handover happens on a time point; while, soft handover lasts for a period of time.

2. Soft Handover Algorithm

The Wideband-Code Division Multiple Access (WCDMA) soft handover algorithm as described in the 3GPP TR 25.922 specifications differs slightly from the IS-95A algorithm as used in cdmaOne, the standard for North American cellular systems also based on CDMA[1, 2]. Based on the Ec/No measurements of the set of cells monitored, the mobile station decides which of three basic actions to perform; it is possible to add, remove or replace a Node B in the active cell. These tasks are respectively called Radio Link Addition and Radio Link Removal, while the latter is Combined Radio Link Addition and Removal[3, 4].

3. Methodology

3.1. OPNET Simulation

During this project numbers of measurements series were build and run in order to obtain the desired results. To draw the conclusions about the effect of the distance to the Node B and the soft handover threshold on the soft handover probability, SIMMODEL1 was developed. Simple network model as used in the "SIM-series" may produce result in a reasonable amount of time but they should provide reliable information applicable to real network situations and reflect characteristics recognizable in real life systems. The following iterative process has been used to obtain the end-results regarding OPNET simulation:

3.1.1 Define goals:

The scope of this project is to study the overall impact of soft handovers on the system performance. During the early stages of this research it has been decided that mainly two aspects of soft handovers are to be examined: the SHO time to trigger and SHO threshold value.

3.1.2 Build model:

The models built, the core network was either abstracted or aggregated as a compound object as the exact knowledge of the mechanisms affected in this part of the network are not considered relevant in the scope of this project. While the modeling and simulating work carried out, OPNET Modeler 14.0 was used. The modeling has been restricted to the network layer of OPNET. Early in the modeling process the decision has been made to use the process and node models included in the UMTS specialized library without modifying proto-C source code in the process editor or designing new node models using the node editor. This enables fast configuration of network models in the network editor using the included models of Node B's, RNC's and mobile workstations based on Release 99 of the 3GPP specifications. To model mobile users the UMTS model was used in combination with the Wireless module of OPNET. This additional module enables assigning three-dimensional trajectories to mobile objects and includes terrain effects in the network editor. This first feature being especially useful for simulating the non-static models built for this project.

3.1.3 Simulate:

The simulations are discrete event, continuous time simulations and are run in OPNET. The runtime varied from 10seconds to some minutes for the simple models used in the "SIM series".

3.1.4 Analyze results:

The results on the SHO time to trigger, SHO threshold and SHO probabilities are presented in Section 4.

3.2. Simulation model (SIMMODEL1)

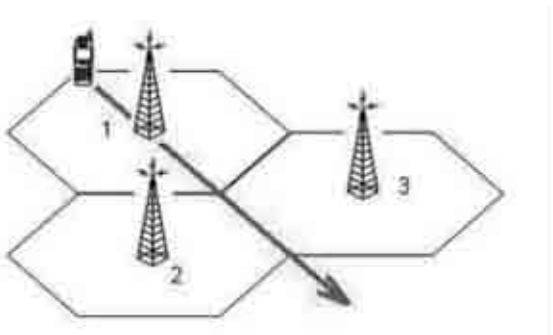

Figure 3.1: Simulation model – triangular three cell scenario with trajectory.

For the simulation, the numbers of sequences have been run using the parameters below:

UE speed	50 km/h
Soft handover threshold	1 … 12
Add time to trigger	40ms, 100ms, 160ms
Drop time to trigger	240ms, 640ms, 1280ms
Cell radius	1000m
Node B spacing	1500m
Traffic type	Conversational ; bit rate 12.2 kbps
Path loss model	Vehicular ; Okumura-Hata

3.3. Network Performance

The main role of analyzing the SHO parameter is to seek the best setting of SHO threshold and SHO time to trigger value in order to improve the performance of the network. In this project, the selected RNC's performance statistic is obtained from 3G network provider to analyze the current performance. The selected RNC is Kepong RNC which covers the Klang Valley area. From the RNC performance statistic, specific area and serving cell is select whereby the statistic reflect some degradation of SHO success rate.

3.4. Drive Test

A few sessions of drive test is organized with assist by a team from 3G network provider. From the drive test, the data such as Received Signal Code Power (RSCP) and Energy per chip over Interference spectral density (Ec/No) from real 3G network being obtained. Also a specific scrambling code used by the serving cell can be identified the soft handover events. In this project, the drive test is conduct at the PETRONAS Twin Tower surrounding. Figure 3.2 shows the drive test area.

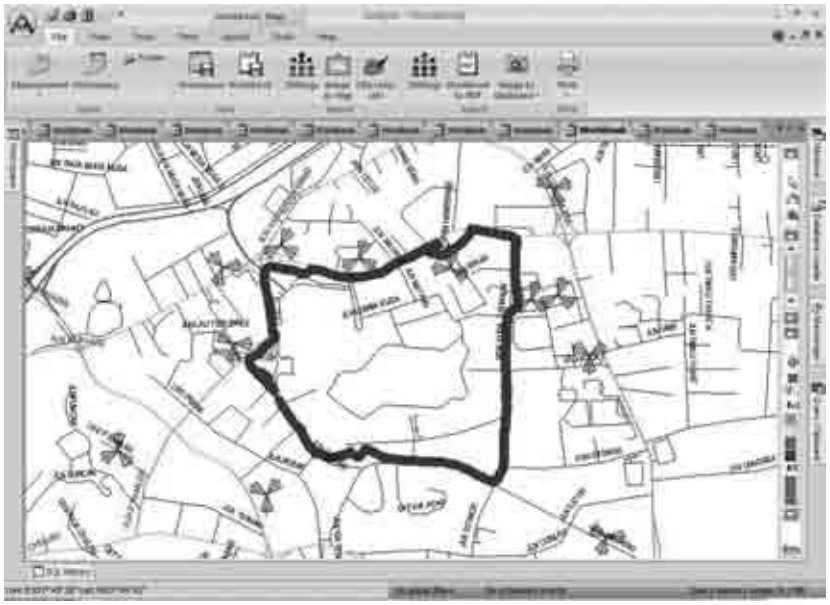

Figure 3.2: Drive test area

3.4.1. NEMO Outdoor

NEMO Outdoor is used during the drive test to collect the air interface measurement especially the handover event. During the drive test, a normal call is establish in certain area or route to measure the actual network behavior. Drive test is done to capture the handover measurement that happens on RRC layer, that consist of all the protocols on Uu interface, Node B power carrier characteristics and so on.

3.4.2. NEMO Analyze

NEMO Analyze is used to present the overview the log file of drive test. It also can be used for rapid analysis for multiple log files run simultaneously. In this project, NEMO Analyze is used as a tool to plot the drive test log files so that an analysis can be done on the selected area.

4. Measurement and Result

4.1. Network Performance Analysis

Data about network performance obtained from 3G network service provider and the statistical data being analyzed. The soft handover success rate is measured on daily basis. **Figure 4.1** shows the soft handover success rate trend for BTS installed at Wisma Selangor Dredging building which used scrambling code XYZ (SC-XYZ). This data is recorded from reporting suite at the RNC and exported to Microsoft Excel to plot a graph. The data is collected from mid of August 2009 to mid of September 2009.

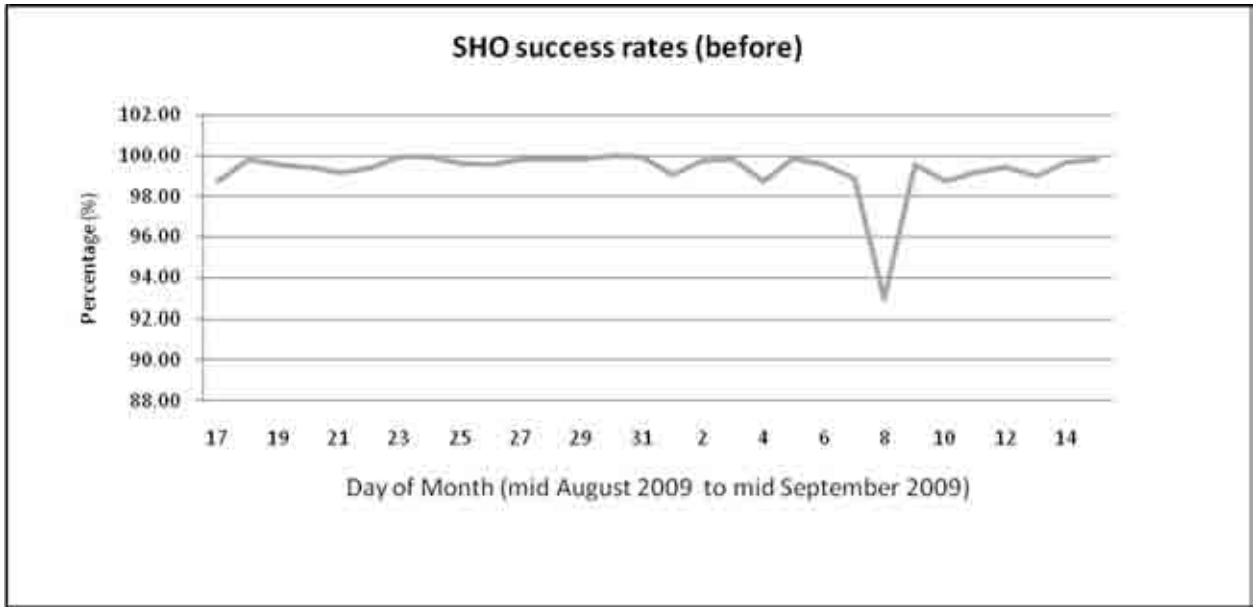

Figure 4.1: SHO success rate (before)

4.2. Description of test network and measurements parameters

The field test was conducted in real 3G network environment having an obstacle such high buildings, medium buildings, trees and rough surfaces which enable the wave to reflect and diffract[7]. The field test measurements were accomplished using UTRA FDD frequencies. The default parameter that have been used by the 3G network service provider list as in the **Table 4.1**:

Parameter setting	
Addition Window	4 dB
Addition Time	100 ms
Addition Reporting Interval	0.5 s
Drop Window	6 dB
Drop Time	640 ms
Replacement Window	2 dB
Replacement Time	320 ms
Replacement Reporting Interval	0.5 ms
Maximum Active Set Number	3

Table 4.1: Parameter setting at 3G network provider

4.3. Drive test measurement

The NEMO Outdoor was used to capture and store the RSCP, Ec/No and soft handover events. This software was installed on a laptop computer. Mobile phone (UE) was connected laptop computer. The GPS unit also was connected to the laptop computer to capture the latitude and longitude of the moving mobile phone. The mobile equipment as well laptop computer was placed inside a car and the GPS unit was placed on top of the car. The mobile phone was place approximately 1 m. The car was moved along the route shown in Chapter 4 as **Figure 4.2**, on which the measurements were performed. The speed of the car was approximately 40 km/h. **Figure 4.2** and **4.3** show the pattern of captured RSCP and Ec/No during the drive test at PETRONAS Twin Tower surround.

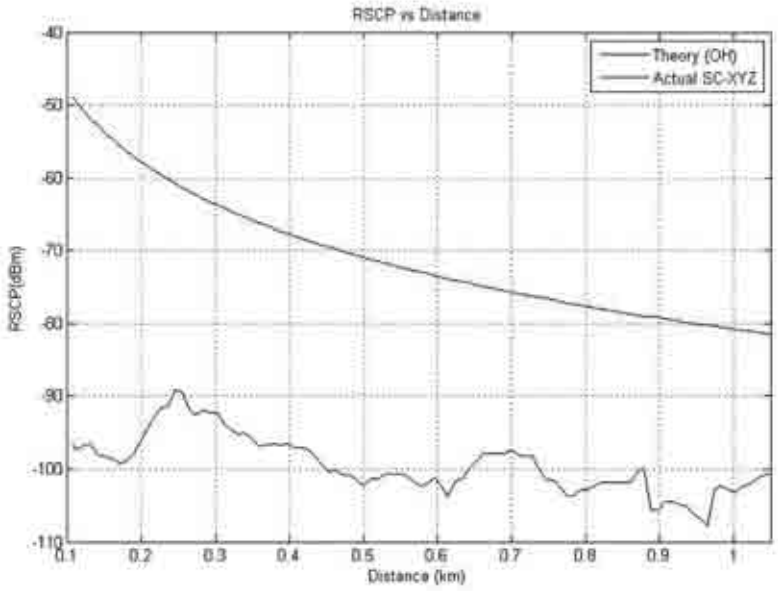

Figure 4.2: RSCP captured at PETRONAS Twin Tower surround

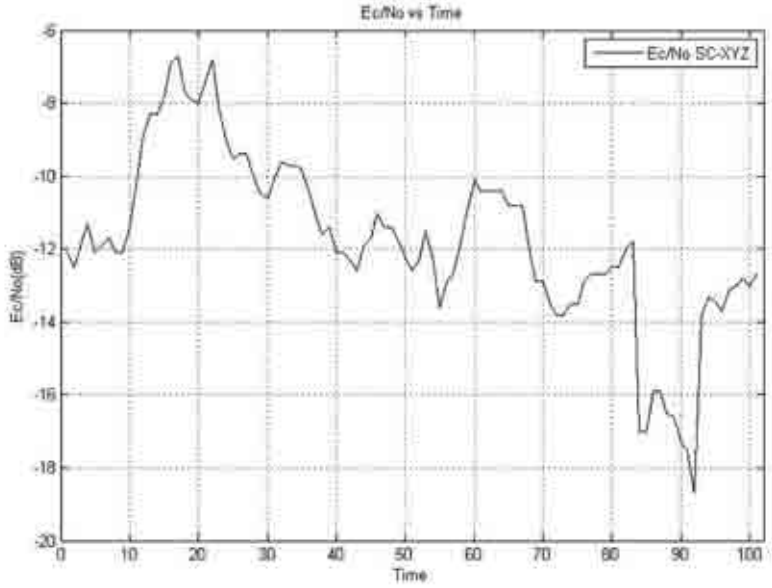

Figure 4.3: Ec/No captured at PETRONAS Twin Tower surround

4.4. Setup of measurements parameters for OPNET simulation

The aim of this project was to present the optimum SHO parameters for UMTS network. In framework of this thesis, accomplished simulations data present the SHO gain expressed as downlink transmission power for different SHO windows. For obtaining this gain, various sets of adding and dropping threshold with different sets of their time to trigger values were chosen and results analyzed. The smallest SHO adding and dropping thresholds were, consecutively 0 dB and 1 dB, and the highest ones were 6 dB and 9 dB. The shortest time to trigger values for adding and dropping the signal to and from active set were, consecutively 100 ms and 240 ms, and longest were 160 ms and 1280 ms. The SHO adding threshold 0 dB and dropping threshold 1 dB with the time to trigger values 100 ms and 240 ms was considered as “hard handover”.

4.5. Results on OPNET simulation

The systems setting at the 3G network provider as listed at **Table 4.1** are used in OPNET simulation. The other parameters used in OPNET simulation are shown in **Table 4.2**. The rows contain the list of adding and dropping thresholds. Adding thresholds are in the left side of the brackets and the dropping thresholds are in the right side of the brackets. Each row is marked with the number from 1 to 12. The columns contain the time to trigger values of adding and dropping thresholds. The value on left and the value on the right value are, consecutively adding and dropping time to trigger values. The columns are numbered from 1 to 5. Numbers of rows and columns are later used in the simulations analysis. The simulations were run for the different threshold and time to trigger value, the performance of downlink transmission power are present in **Table 4.3**, also the soft handover probability are listed in **Table 4.4**.

Sim No.	SHO Threshold [add drop]	Time to trigger [add drop]				
		[40 640]	[100 640]	[160 640]	[160 1280]	[100 240]
1	[0 1]	(1,1)	(1,2)	(1,3)	(1,4)	(1,5)
2	[1 2]	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)
3	[1 4]	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)
4	[2 4]	(4,1)	(4,2)	(4,3)	(4,4)	(4,5)
5	[1 5]	(5,1)	(5,2)	(5,3)	(5,4)	(5,5)
6	[2 5]	(6,1)	(6,2)	(6,3)	(6,4)	(6,5)
7	[3 4]	(7,1)	(7,2)	(7,3)	(7,4)	(7,5)
8	[3 5]	(8,1)	(8,2)	(8,3)	(8,4)	(8,5)
9	[3 6]	(9,1)	(9,2)	(9,3)	(9,4)	(9,5)
10	[4 6]	(10,1)	(10,2)	(10,3)	(10,4)	(10,5)
11	[6 6]	(11,1)	(11,2)	(11,3)	(11,4)	(11,5)
12	[6 9]	(12,1)	(12,2)	(12,3)	(12,4)	(12,5)

Table 4.2: List of soft handover used in OPNET simulation

Sim. No.	SHO Threshold [add drop]	Time to trigger [add drop]				
		[40 640]	[100 640]	[160 640]	[160 1280]	[100 240]
1	[0 1]	28.54	29.11	30.92	28.42	31.09
2	[1 2]	28.31	28.67	30.15	27.32	30.87
3	[1 4]	27.31	27.65	29.17	27.53	30.32
4	[2 4]	27.12	27.52	28.32	26.42	30.87
5	[1 5]	26.43	26.53	28.23	26.23	30.11
6	[2 5]	25.87	25.34	27.32	25.83	29.44
7	[3 4]	28.47	29.55	30.32	25.21	30.31
8	[3 5]	27.65	29.21	29.32	24.79	29.73
9	[3 6]	27.54	28.56	28.64	24.22	29.60
10	[4 6]	26.43	27.93	28.20	23.58	28.99
11	[6 6]	24.65	25.93	26.21	23.32	27.40
12	[6 9]	23.22	24.94	25.18	22.69	26.56

Table 4.3: Downlink transmission power (dBm)

Sim No	SHO Threshold [add drop]	Time to trigger [add drop]				
		[40 640]	[100 640]	[160 640]	[160 1280]	[100 240]
1	[0 1]	21	20	19	23	16
2	[1 2]	21	20	20	24	17
3	[1 4]	22	21	20	25	17
4	[2 4]	23	22	21	26	18
5	[1 5]	25	25	23	27	20
6	[2 5]	27	26	24	27	21
7	[3 4]	29	26	25	30	22
8	[3 5]	30	28	27	32	24
9	[3 6]	31	30	28	33	25
10	[4 6]	35	33	32	36	28
11	[6 6]	38	36	35	39	31
12	[6 9]	48	48	47	51	43

Table 4.4: Soft handover probabilities (%)

4.6. Soft handover gain for various setups for time to trigger values

For each SHO parameter, the downlink transmission power's data was collect from the simulation. The higher was the adding and dropping thresholds, and the longer time to trigger values of SHO, the higher was the SHO probability. These simulation results present that the larger is the SHO probability, the lower is the downlink transmission power. The SHO with parameter set (12,4) provides the lowest downlink transmission power. In this case, where time to trigger values are very long, 160 ms for adding and 1280 for dropping threshold, UE enters and leaves the SHO area slowly, without rapid SHO decisions that could cause large signal variations. The last column in Table 4.3 is the worst case and the column before last one is the best case situation during the simulation in context of downlink transmission power. Accomplished simulation data can be also presented as in **Figure 4.4** and 4.**5**.

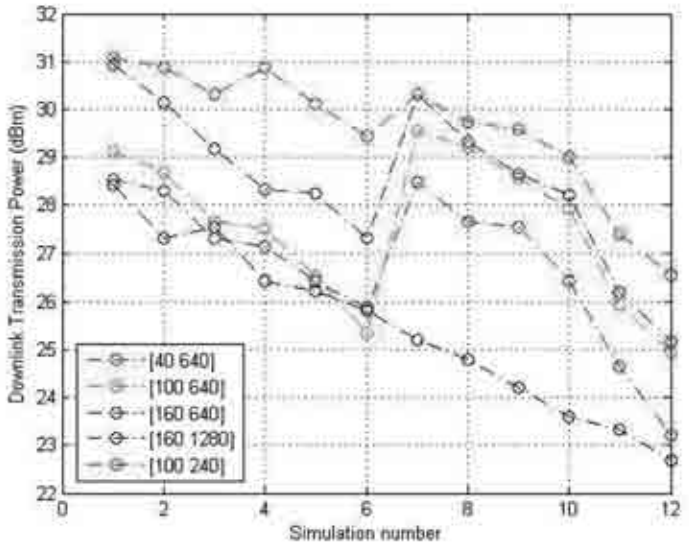

Figure 4.4: Downlink transmission power for five different set of SHO time to trigger values.

Figures 4.4 show the comparison of transmission powers between different time to trigger set of values for particular SHO windows. From these simulations shows that the gain is transmission power can be achieved using various time to trigger values. The highest SHO gain, approximately 5.1 dB, is obtained for the adding 3 dB and dropping 4 dB thresholds, if the time to trigger values are changed from [100 240] to [160 1280]. If the adding and dropping time to trigger value is too short, the "ping-pong effect" occurs often and the signal from the base stations hops rapidly because of propagation characteristic[3].

Downlink transmission powers are compared also for a certain set of time to trigger values with different adding and dropping thresholds. From these simulations, soft handover gain can be noted at the level almost 4.5 dB. The gain is calculated between transmitted power for adding and dropping 0 dB and 1 dB, and power transmitted for 6 dB and 9 dB adding and dropping thresholds. For all sets of time to trigger values, it can be seen that soft handover gain is significant and reaches almost 6 dB. The highest transmitted power is at the level of 31 dBm and the lowest one is over 23 dBm.

4.7. SHO probability

As the simulation data show, the highest power gain is provided for the situations, when mobile is the longest time in SHO, meaning that the SHO probability should be the highest. This is for the following measurements (12,1), (12,2), (12,3), (12,4), (12,5). Different SHO thresholds have the highest impact on SHO probabilities. While changing the time to trigger values, just result slight changes to the SHO probabilities and transmission powers

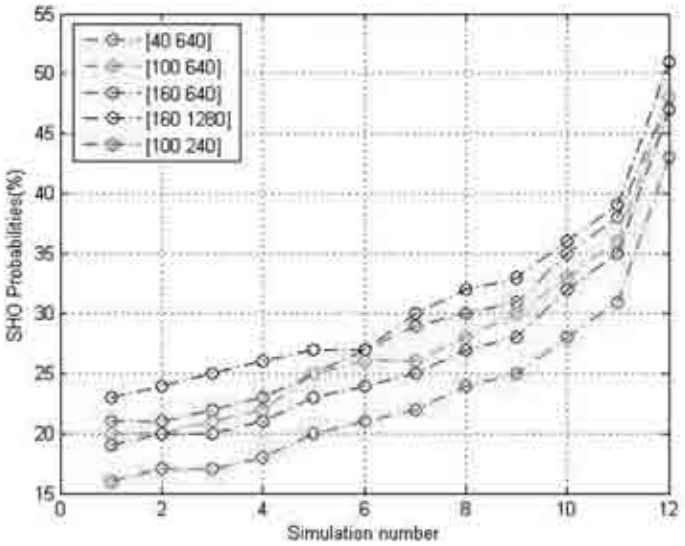

Figure 4.5: Soft handover probabilities for five different set of SHO time to trigger values.

Short time to trigger values resulted also in the high amount of drop calls, which were affecting smooth transmission[8, 9]. The drop calls can be also avoided by use of larger time to trigger values[9]. Moreover, the time to trigger values up to 640 ms is very short and there was no significant SHO gain, if these values were used. The conclusions of SHO optimum parameters for the radio network planning are clear. The SHO thresholds providing the large SHO area should be used as well as longer time to trigger values[10]. With these conditions, in this project, the new SHO parameter setting is proposed to the 3G network provider. The new SHO parameter setting for 3G network as shown in the **Table 4.5**.

Parameter setting before changes		Proposed new parameter setting	
Addition Window	4 dB	Addition Window	6 dB
Addition Time	100 ms	Addition Time	160 ms
Addition Reporting Interval	0.5 s	Addition Reporting Interval	0.5 s
Drop Window	6 dB	Drop Window	6 dB
Drop Time	640 ms	Drop Time	1280 ms
Replacement Window	2 dB	Replacement Window	2 dB
Replacement Time	320 ms	Replacement Time	320 ms
Replacement Reporting Interval	0.5 ms	Replacement Reporting Interval	0.5 ms
CPICH Ec/No filter coefficient	600	CPICH Ec/No filter coefficient	600
Active Set weighting coefficient	0	Active Set weighting coefficient	0
Maximum Active Set Number	3	Maximum Active Set Number	3

Table 4.5: Proposed SHO parameter for 3G network service provider

4.8 Result applying new SHO parameter

After new SHO parameter being applied by 3G network service provider at their RNC, again the network performance report is obtained and being analyzed specifically on BTS Wisma Selangor Dredging with scrambling code XYZ (SC-XYZ) to validate the new SHO parameter. The data is collected from mid of September 2009 to mid of October 2009. **Figure 4.6** show the soft handover success rate was return to normal trending which it is reflect reading 98% and above.

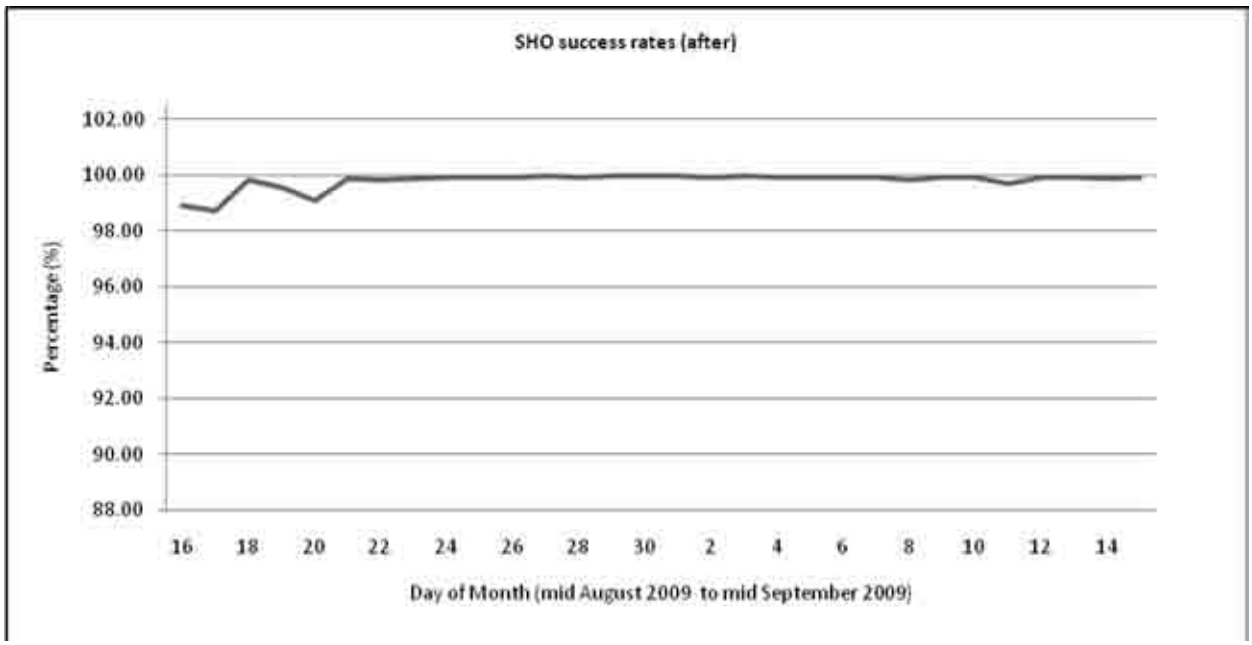

Figure 4.6 : SHO success rate (after)

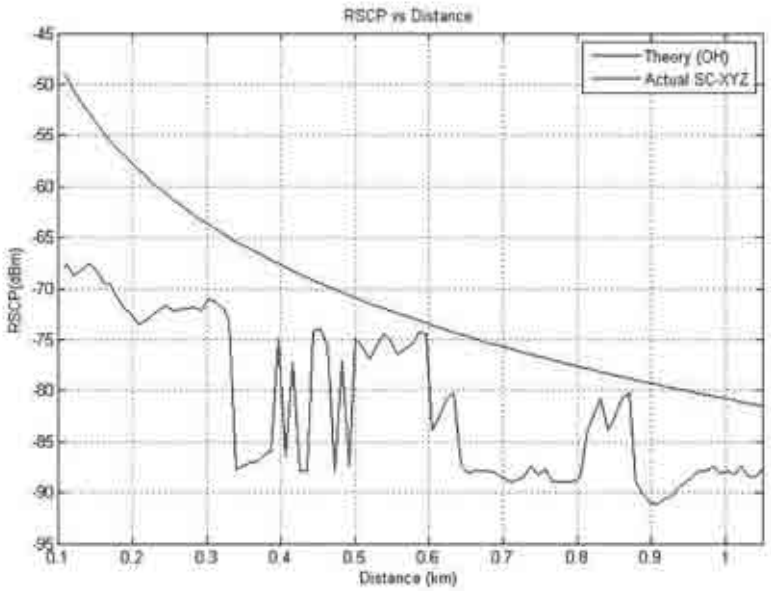

Figure 4.7: RSCP captured at PETRONAS Twin Tower surround

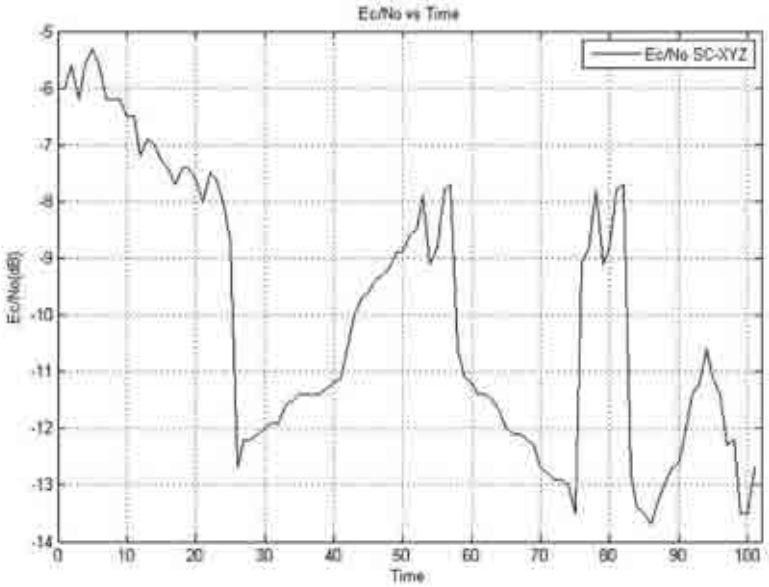

Figure 4.8: Ec/No captured at PETRONAS Twin Tower surround

5. Conclusions

In radio network planning it is important to estimate correctly the capacity and plan the coverage for given area. Optimum parameters, responsible for functionality of the network, are needed to satisfy above criteria. The purpose of this project was to explore experimentally the effect of soft handover on improvement of the soft handover parameter in order to improve the transmission power in downlink direction in UMTS network so that the capacity of the network also being improved. . Soft handover gain achieved in the simulation result which was varying from 3 dB to 5.5 dB, depending on the soft handover window sizes changed by soft handover adding and dropping thresholds and their adding and dropping time to trigger values. These simulations also indicate that soft handover provides downlink transmission power gain, which can be seen as improvement of the UMTS network performance.

6. Future Recommendation

Due to time constraint, this project only includes soft handover parameter study. For future study, it is highly suggest that the scope of study could be wider to include inter-system handover. As it was mentioned, in WCDMA network the improvement of the network performance can be seen as coverage and capacity extension. An attractive and simple way to improve the downlink performance is to use larger soft handover areas. This causes lower transmission powers in downlink direction providing more capacity to the network, but also larger overhead is introduced caused reducing the network performance[11]. Therefore, further study is required to analyze, how much downlink transmission power can improve the capacity network. While doing this project, the field test was conducted with one of 3G network service provider in Malaysia, so for future, the others of the 3G network service provider can be choose so that the end result can be compare among them.

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E4 - Development of an Electronic Arabic Dictionary

Siti Noormaya binti Bilmas; Muhammad Nasir Ibrahim; Mariani Idraos
Pusat Latihan Teknologi Tinggi (ADTEC) Batu Pahat.
snoormaya@yahoo.com; mnasir@fke.utm.my; mariani@fpree.utm.my

Abstract

Currently, the arrangement of common Arabic dictionary is based on the first letter of the words according to the Arabic alphabet sequence. For this 'Electronic Arabic Dictionary' it is developing based on the arrangement of Hans Wehr Dictionary edited by J. M. Cowan. Since publish in 1964, this dictionary is the only one that have been arranged according to the Arabic root word. So far, there is no electronic version for this dictionary format. Therefore, the objective of this project is to develop the software format for Hans Wehr dictionary and as the first step is to design the database structure based on the root word arrangement concept. The content of this electronic dictionary is fully based on the Hans Wehr dictionary content. Beside provide the meaning for each word, this dictionary also give information about the root word derivation form, derivation words and its usage example.

Keywords: *database structure, Arabic root word, electronic dictionary.*

1. Introduction

Compared to the paper dictionary, electronic dictionary turn out to be favourite as consulting tools for most users, especially for student [7]. It is efficiently used in learning of foreign language such as Arabic language [9]. Recently, there are many electronic Arabic dictionary are being developed to be on line or off line usage. But all these dictionaries have a similarity at the aspect of the data arrangement. All the words are arranged according to its first character of the word.

This paper discusses new arrangement for this electronic Arabic dictionary. The arrangement that proposed is an adaptation from a dictionary that written by Hans Wehr originated from Germany around 1964. This dictionary is arranged the Arabic words according to its root word. So, far this is the only dictionary that used this kind of system arrangement. This arrangement is a kind of unique that gives the advantage on more information given along the meaning and the user will more understand how to use the word for the correct grammar. This kind of system is still not produced in software format. As far as this project concern is to develop a database structure that based on this system. Root word base system.

2. Hans Wehr Dictionary

The main reference for this project is Hans Wehr Dictionary. This dictionary presents the vocabulary and phraseology of modern written Arabic. The word arrangement is according to its root words. Under a given root the sequence of entries is as follows as Figure 1. In the presentation of the entries in the dictionary, homonymous roots are given separately in only a few especially clear instances [1].

I	***fa'ala***
II	***fa"ala***
III	*fā'ala*
IV	*'af 'ala*
V	*tafa"ala*
VI	***tafā 'ala***
VII	***infa'ala***
VIII	***ifta'ala***
IX	*if 'alla*
X	*istaf 'ala*
XII	*if 'aw'ala*

Table 1: List of "Forms"

As for the Arabic verb morphology it will includes expansion of the root. Some expansions are lexical derivations which are result a "new words". But others are variation of the verb's conjugation. Western scholars have assigned Roman numerals to the various patterns of derivation, which are called "forms". Also, the root is designated "Form I". A particular form does not have a consistent meaning across verbs, although, it has a "usual" meaning. In addition, no verb root has all the derivations. The forms numbered beyond Roman numeral X are rare and obsolescent, for which reason many elementary grammars omit them. The list of this form can be seen through Table 1. The **boldfaced** transliteration indicates a word that would actually exist in an Arabic lexicon for this particular root (ف - ع - ل) (f - ' - l - right-to-left) [1].

The middle vocal in "form I" active voice can be *a, i or u*, depending on the root applied in "form I". The exact vocalization depends on the word form. Forms XI (*if 'ālla*), XIII (*if 'awwala*), XIV (*if 'anlala*), and XV (*if 'anlā*) are very rare. Common uses of those stems include [1]:

- fa''ala is often used to make an intransitive verb transitive. Eg: *karuma* is "be noble" but *karrama* is "make (someone) to be noble", or, more idiomatically, to "honour".
- *infa'ala* gives a passive meaning. Eg: *kasara* "break" and *inkasara* "be broken".
- *if 'alla* is used only to render stative verbs meaning "to be or become X" where X is a colour or physical defect, eg: *ihmarra "turn red, blush" or itrašša "go deaf".*

Then for the derivation, it derives from the root word. The meaning of the derivation word has much similar meaning to the root word meaning.

3. Database Design

There are four main parts of this database. There are the root word meaning, the root word form and its meaning, the example that show how to use the root word and the list of derivation words.

As for the database structure design purposes, Microsoft Access is used. The process is simplified as in the flowchart shown in Figure 2. For the table structure design, the first step is to create the table [8].

For this database, there are four table are created. First table is the list for root word, second table is listed the form, third tables list the examples and the fourth table list the derivation words. This is the step for dividing the information into tables. For each table the data have been divided into several fields. For field name that assign to each table area as the Table 2.

The ID field is used to keep track the number of data that have been stored. For the DATA NO, this is the field for unique number that have been created based on the reference list. The format is shown as Table 3.

كـتـب

Kataba u (katb, كـتـبـة *kitba,* كـتـابـة *kitāba)* To write, pen, write down, put down in writing, note down, inscribe, enter, record, book, register (ه s.t.h.); to compose, draw up, indite, draft (ه s.t.h); to bequeath, make over by will (ل ه s.t.h. to s.o); to prescribe (عل ه s.t.h. to s.o); to foreordain, destines (ل or عل ه s.t.h. to s.o.; of God); pass. *kutiba* to be fated, be foreordained, be destined (ل to s.o.) | كـتـب عل نـفـسـه ا ن to be firmly resolved to..., make it one's duty to ..., كـتـب عنه to write from s.o.'s dictation; كـتـب كـتـابـه *(kitābahū)* to draw up the Marriage contract for s.o., marry s.o. (عل to) II to make (ه s.o.) write (ه s.t.h.); to form or deploy in squadrons (ه troops) III to keep up a correspondence, exchange letters, correspond (ه with s.o.) IV to dictate (ه ه to s.o. s.t.h.), make (ه s.o.) write (ه s.t.h.) VI to write to each other, exchange letters, keep up a correspondence VII to subscribe VIII to write (ه s.t.h.); to copy (ه s.t.h.), make a copy (ه of s.t.h.); to enter one's name; to subscribe (ل for); to contribute, subscribe (ل ب money to); to be entered, be recorded, be registered X to ask (ه s.o.) to write (ه s.t.h.); to dictate (ه ه to s.o. s.t.h.), make (ه s.o.) write (ه s.t.h.); to have a copy made (ه by s.o.)

كـتـاب *kitāb* pl. كـتـب *kutub* piece of writing, record, paper; letter, note, message; document, deed; contract (esp. marriage contract); book; الـكـتـاب the Koran; the Bible | اهل الـكـتـاب *ahl al-k.* the people of the Book, the adherents of a revealed religion, the kitabis, i.e., Christians and Jews; الـزواج كـتـاب k. *azzawāj* marriage contract; الـطلاق كـتـاب k. *aṭ-ṭalāq* bill of divorce; تـعـلـيـمـى كـتـاب (ta'limi) textbook; كـتـاب الاعـتـمـاد credentials (dipl.); د ا ر الـكـتـب library

كـتـبـى *kutubi* pl. –ya bookseller, bookdealer

Root word
Form
Derivation word
Word pronunciation
**others are the meaning*

Figure 1: Hans Wehr dictionary entry [1]

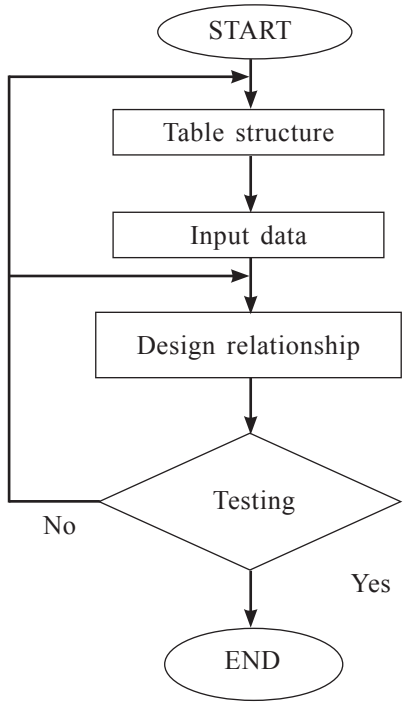

Figure 2: Database design methodology

TABLE 1				
ID	DATA NO	ROOT WORD	PRONOUNCE	MEANING

TABLE 2			
ID	DATA NO	FORM	MEANING

TABLE 3			
ID	DATA NO	EXAMPLE	MEANING

TABLE 4				
ID	DATA NO	DERIVATION	PRONOUNCE	MEANING

Table 2: List of Table Field

2	0	0	0	0	0	5	6
Character sequence number based on the first letter of the root word. The order is according to the 28 Arabic character		Root word sequence number based on the entries arrangement in the dictionary for each section of the 28 Arabic character					

Table 3: Data No Format

Data Number: 22000063	
Root word	كتب
Arabic character sequence	ك - 22
Entry number in the dictionary	000063

Table 4: DATA NO creation

The first two bit is for the character sequence that has been assigned according to the 28 Arabic characters. It is start with the alphabet ( ) , the sequence is 1 and end with alphabet (ي) the sequence number is 28. Then for the next 6 bits is assigned according to the entries arrangement in the Hans Wehr Dictionary for each character sequence. This six (6) bit is reserved for the number counting to maximum value of 999 999 or entry. For the example how the DATA NO is created can be seen in Table 4. Then for the data entry, the data example is as the Figure 1.

The next field is ROOT WORD, PRONOUNCE, MEANING, FORM, EXAMPLE and DERIVATION. After the tables have been established, the process of entering data to the tables. The tables which have been filled by the data sample can be seen as the Table 5 to Table 8.

root word				
ID	DATA NO	ROOT WORD	PRONOUNCE	MEANING
10	05000057	جدل	jadala	u i (jadl)to twist tight, tighten, strech (ه a rope); to braid, plait (ه s.th. The hair, etc.)
11	06000026	حتم	hatama	i (hatm) - to decree, make necessary, prescribe {على ه s.th. for s.o.}, make (ه s.th.) a duty, a necessity {على ه s.th. for s.o.}to impose, enjoin {على ه s.th. for s.o.}; to decide, determine definitely (ب s.th.)

Table 5: Root Word Table

Form			
ID	DATA NO	FORM	MEANING
1	02000056	II	to adjudge, adjudicate, award
2	02000056	VII	to be cut off; to be finished, be done; to be deci
3	02000111	V	to fritter away one's fortune, be overgenerous; t

Table 6: Form Table

EXAMPLE			
ID	DATA NO	EXAMPLE	MEANING
1	02000056	انبت قد وبينهم بينه الامر	it's all over between him and them, they are through with each other
2	02000111	جهده بذل	to take pains;
3	02000111	مساعدة كل بذل	to grant every assistance;

Table 7: Example Table

DERIVATION				
ID	DATA NO	DERIVATION WORD	PRONOUNCE	MEANING
1	01000002	اب	ab	August (month; Syr., Leb., Jord., Ir.)
2	01000030	ابوة	ubuwa	fatherhood, paternity

Table 8: Derivation Table

4. Unicode

For the data entry it consist two types of characters which are Roman and Arabic. The computer which use Windows XP and above, the character recognition function is embedded. For the Roman character the computer used ASCII code, where as for the Arabic character, Unicode is being used.

Unicode is an industry standard character. This standard character set actually a unique number that created to be deal with computer. The main objective of Unicode is to provide a unique number for every character, no matter what the platform, no matter what the program and no matter what the language [5]. Arabic Unicode Standard currently is version 5.0. For standard character of Arabic language it is lies in range of 0600 – 06FF [3]. Then, for the supplement character for Arabic language is in range of FB50 – FDFF [4]. The Unicode is arranged in matrix form. For example for the letter (ك) the Unicode is 0643.

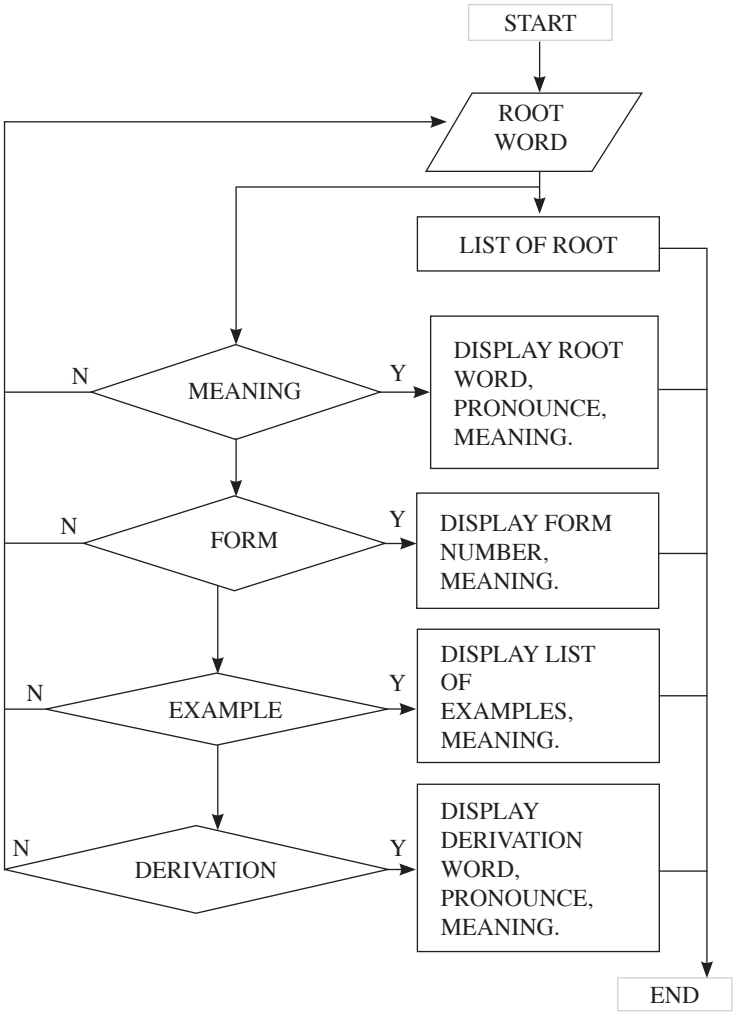

Figure 3: Database structure output

5. Result and Discussion

As the process of creating and entering data is finished, next step is to do the relationship among the tables. The relationship is done according to its primary key for each table[8]. In this database structure, the primary key is the DATA NO. The DATA NO for every table are linked together so that the information in the tables is related to each other.

The main idea of this database is to find the information by its root word. Therefore, the query designs also according the specification. The database structure is translated into flowchart as shown in Figure 3. This flowchart shows that information can be access by the root word input.

For testing purposes, an interface is created (Figure 4). There two ways of searching the data. If the user is not familiar with the root word, the user can choose to list out all the root words and the search according to the list (Figure 5) . For the user that know the root word, can directly type the root word to access the meaning. The dialog box will appear for user to enter the input using Arabic character (Figure 6). For the other information such as list of form, examples and derivation word of each root word can also be accessed. Figure 7 to Figure 10 is the example of display for the information in the database.

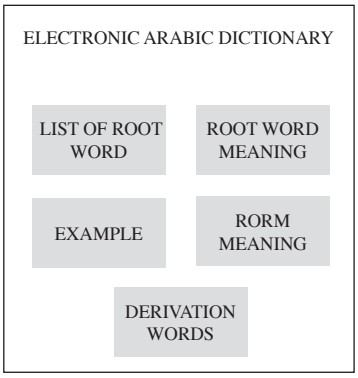

Figure 4: Main interface display

Figure 5: List of root words display

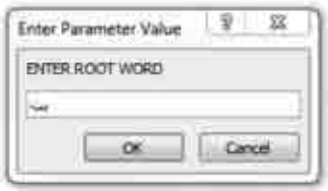

Figure 6: The dialog box for the input

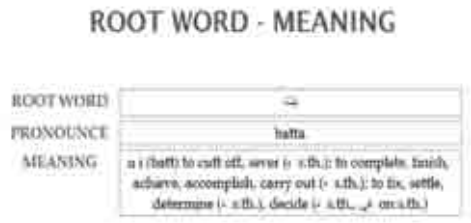

Figure 7: The meaning of the root word display

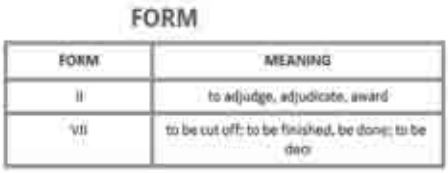

Figure 8: The list of form display

Figure 9: The derivation display

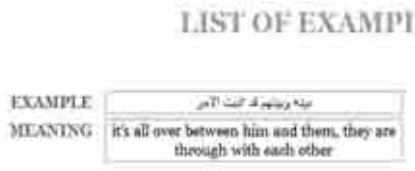

Figure 10: The list of example display

6. Conclusion

In spite of religious and academic, now proved Arabic language is becoming commercial in Malaysia[6]. Therefore, the development of electronic module as a tool of reference really needed as a way to improve the information sharing[10].

For that reason, Hans Wehr electronic dictionary database is developed as a new approach to the arrangement of the Arabic dictionary. This database is design to be used for the future development of electronic dictionary, whether for the on-line or off-line usage.

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E5 - Electrical Capacitance Tomography For Imaging A Mixture Of Water And Oil

Fazlul Rahman Mohd Yunus
Institut Latihan Perindustrian Ledang

Abstract

Electrical Capacitance Tomography (ECT) is a non-intrusive technique for obtaining information about the distribution of the contents of closed pipes by measuring variations by means of evaluating dielectric permittivity of the materials inside the pipe. ECT offers some advantages over other tomography modalities, such as no radiation, rapid response, low cost, being non-intrusive and non invasive, and the ability to withstand high pressure and high temperature. A 12-electrode ECT sensor system with LabVIEW software programming has been developed. This system can be used to investigate volume ratio of water and oil mixture particularly in horizontal-stratified distribution inside a flowing model. Measurement data from hardware system can be acquired directly to computer through of existing data acquisition system (DAS) card to provide the cross sectional image of water and oil mixture. The Linear Back Projection (LBP) used in this project was the first of the first algorithm used for the ECT system but yet still very commonly employed

Keywords: *AC capacitance circuit, electrical capacitance tomography, data acquisition system.*

1. Introduction

The word *'tomography'* is derived from the Greek words *'tomos'* meaning 'to slice' and *'graph'* meaning 'image'. The Oxford English Dictionary defines tomography as 'radiography' in which an image of a predetermined plane of the body or other object is obtained by rotating the detector and the source of radiation in such a way that points outside the plane gives blurred image.

Tomographic technology involves the acquisition of measurement signals from sensors located on the periphery of an object, such as vessel or pipeline [1]. This gives information on the nature and distribution of components within the sensing area. Most of the tomographic techniques are concerned with abstracting information to form a cross sectional images. This can be done by placing sets of array sensors (mainly electrodes) around the pipes to be imaged. The sensing field interrogates a projection of a suitable radiation across the materials of interests, which is assumed to be a circular cross section [2].

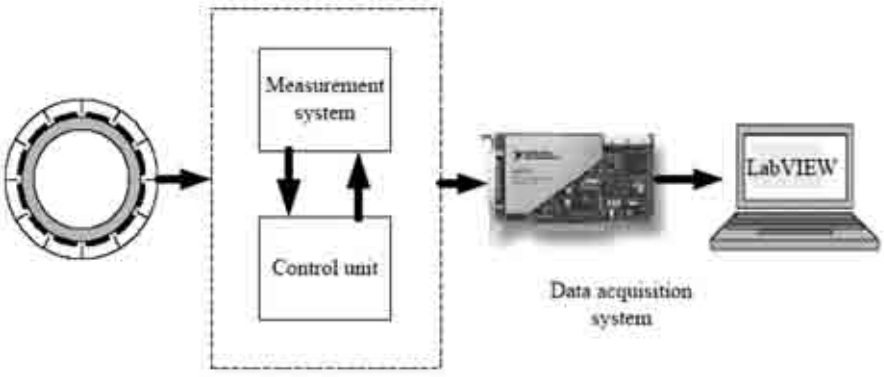


Figure 1: Electrical capacitance tomography (ECT) diagram

Tomographic system involves the acquisition of measurement signals from sensors located on the periphery of an object, such as process vessel and pipeline. This reveals information on the nature and distribution of components within the sensing zone [2]. Electrical capacitance tomography (ECT) is a non-contact and *soft-field* technique for determination of the dielectric permittivity distribution in the interior of components from external capacitance measurements. The earliest ECT application used sensors on the outside of the pipelines sections to image the interior flow process.

The idea is to install a number of sensors around the pipe or vessel to be imaged. The sensor output signals depend on the position of the component boundaries within the sensing zones. A computer is used to reconstruct a tomographic image of the cross-section being observed by the sensors. This reveals information on the nature and distribution of components within the sensing zone.

2. Components Of Electrical Capacitance Tomography

The ECT system comprises of capacitance sensor, capacitance measuring unit, and computer control. The sensor is comprised of an array of twelve (12) electrodes wound around the periphery of the pipe or the vessel to be imaged. The measuring unit conditions the signal captured by the sensors and transmits the signals to the control computer. The control computer processes the acquired information and constructs permittivity distribution images corresponding to the cross section viewed by the sensor. The control computer employs the Linear Back Projection Algorithm (LBPA) for generating permittivity images. The images are displayed on a 1,024 square pixel grid using a suitable graduated color scale o indicate the variation of permittivity. The imaged are analyzed to compute the parameters related to the process for example, spatial distribution, flow rate, and volume ratio of the materials inside the pipes [1].

The ECT system shown in Figure 2 is the block diagram of the ECT system used to acquire permittivity distribution images of contents of the pipe during a process.

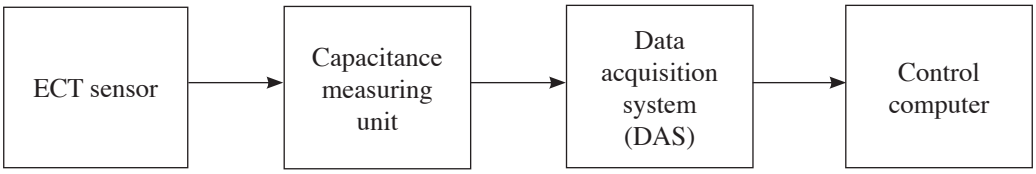


Figure 2: Block diagram of electrical capacitance tomography system (ECT)

The system consists of the followings:

(i.) Capacitance sensor which comprises of an array of electrodes attached to periphery of the pipe or vessel which is to be imaged.
(ii.) Capacitance measuring unit to acquire and process the signals obtained from the capacitance sensor.
(iii.) Data acquisition system (DAS) is to acquire and digitize the analog signal to digital signal to control computer.
(iv.) Control computer to reconstruct and display the permittivity distribution image using the obtained measurement data, and to monitor as well as to control the process taking place inside the pipe.

3. Sensor Hardware Design

ECT sensor is the heart of the ECT system. The design of ECT sensors is closely linked to the capabilities of the capacitance measuring unit to be used with the sensor. An ideal capacitance measuring system will have very low noise level, a wide dynamic measurement range and high immunity stray capacitance to earth and be able to carry measurement at high speed [3]. Sensors used for ECT systems are designed according to the cross-section of the vessel to be imaged and position of the electrodes. The

electrodes can be mounted on the outside or on the inside of the vessel of interest. The selection of placing the electrodes depends on the material used to manufacture the pipe. If the pipe is made of conducting material, internal electrodes are used. If the pipe is made from insulating material, external electrodes are used.

Sensors with external electrodes are non-intrusive, and easy to design. These sensors are not subjected to high temperature, high pressure and turbulences of the materials inside the pipe. Therefore, the sensors will not interfering, and get contaminated by the process itself. However, external sensors can exhibit considerable non-linearity in their response to dielectric materials introduced inside the sensor. This effect is caused by the presence of the sensor wall, which introduces an additional series coupling capacitance into the measurement of the inter-electrode capacitance [2].

The selection of the number of electrodes around the circumference of the sensor is a tradeoff between axial and radial resolution, sensitivity and image capture rate [2]. ECT systems can be used with sensors having 6, 8, 12 and 16 electrodes. The measurement sensitivity depends on the surface area of the sensor electrodes as the electrodes normally occupy most of the circumference. If the number of electrodes is increased, the radial resolution will be improved, while a reduction in length of electrodes will give better axial resolution [3].

In the research project, twelve (12) external electrodes are selected as more electrodes result in better image reconstruction. The arrangement of 12 electrode ECT system is illustrated in Figure 3. However as the electrode size reduces, the SNR of the system decreases. When the smallest of the measured capacitance (for opposite electrodes), reaches the lowest value can be measured reliably by the capacitance measurement circuit, the image resolution can be improved by increasing the axial length of the electrodes.

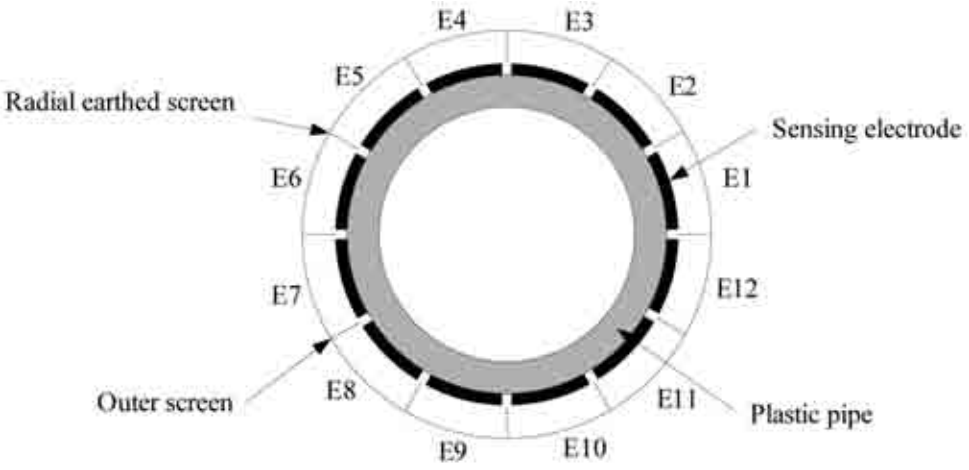


Figure 3: Electrical capacitance tomography sensor.

4. Image Reconstructed

The main objective of tomography is to provide cross-sectional images inside pipe investigated. The sample of image reconstructed is shown in figure 4 and 5.

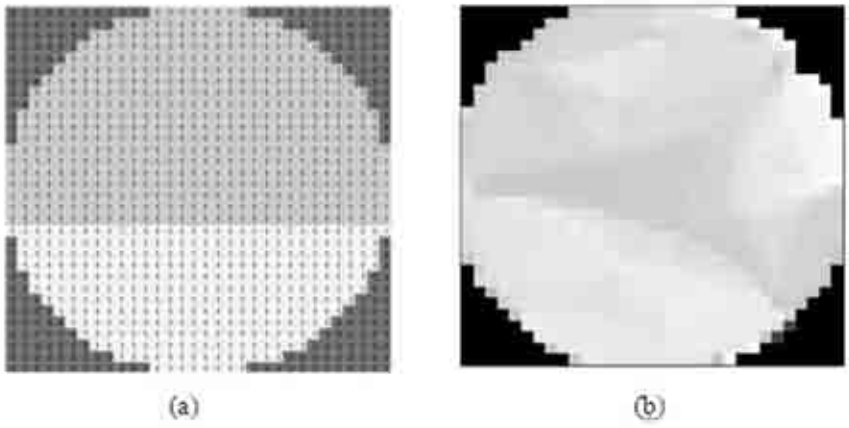


Figure 4: Reconstruction image of 40% water (a) Actual 2D image (b) 2D LBP image

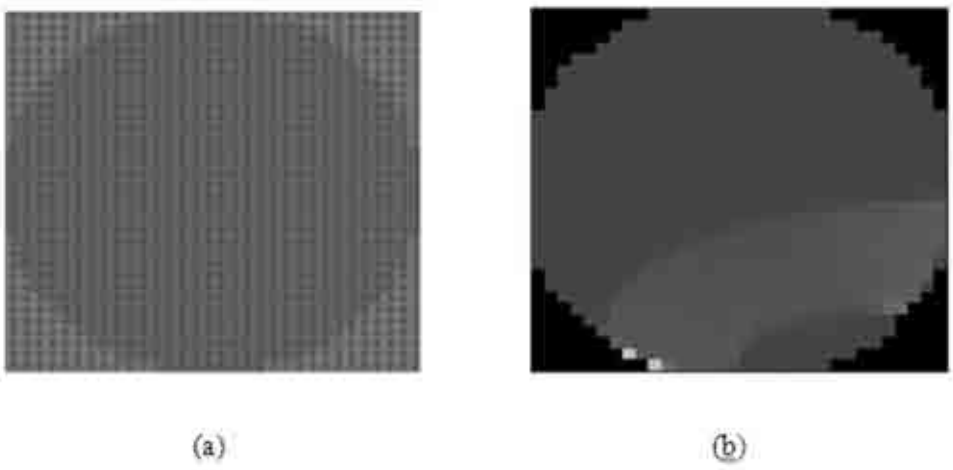


Figure 5: Reconstruction image of 100% water (a) Actual 2D image (b) 2D LBP image

5. Conclusion

The ECT systems can be used for studying the chemical process inside a pipe and helps in viewing the contents, which is not visible. Various information for example spatial distribution and volume ratio can be obtained by examining the permittivity distribution images. Real time ECT process monitoring plays important function in vast areas of industry and scientific research concerning liquid flow properties. It is proved that the operation efficiency of such process is closely related to measurements accuracies and control of hydrodynamic parameters such as flow regime and rate. Most developed tomography system had not been able to be implemented into industrial process due to the high cost and flexibility than other equipment available in today's market. Therefore, it is essential to develop a tomography system which is cost effective, flexible and robust to the industrial demands.

6. References

[1] Prof.L.R. Subramaniam and Sharath Subash Donthi. *Capacitance Based Tomography for Industrial Applications* , M.Tech Credit Seminar Report, Electronic System Group, EE Dept.IIT, Bombay. 2004

[2] Williams R.A and M.S Beck (1995). Process Tomography – *Principles, Techniques and Application*. United Kingdom: Butterworth Heinemann Ltd. 1995

[3] Process Tomography Limied.*Engineering Design Rules for ECT Sensors-Issue 4.* United Kingdom , PTL App.Note AN3. 2001

E6 - Automatic Toilet Light Controller

Raja Mohammed bin Raja Daud, Siti Noormaizura binti Sarkam, Alwary Suhaimy bin Johari, Hajar Aswad @ Zulkifli bin Mohamad, Fakhrul Dahri bin Basir,
Alwary Suhaimi bin Johari

Institut Latihan Perindustrian Nibong Tebal

Abstract

Now days there are many ways and many companies approaching to Go Green. Big company like Proton goes for producing Hybrid car for better environment in our life. Penang government instructed on shopping complexes for not providing plastic bag to customer which is cannot be disposed in short period and many other supportive teams contributes on earth's healthy. Electrical energy is one of the most important requirements in our living live today. On 28 March 2009 we celebrated Earth Hour which organized by WWF to turning off our electricity for one hour and it was supported by all people in the world. This Earth Hour is to raise awareness towards the need to take action on climate change. But electrical energy mostly wasted by users and one of the examples is the light in the toilet area. Toilet lamps switched on most of the times even there are no people inside the toilet. For building like education institution such as ILP Nibong Tebal, toilets receive visitors and use by many peoples especially student but not all the time the toilet was used by people. So it is targeted as the area with most wastes of electrical energy. Most of the times the lamps of the toilets remain switch on for 8 hours per day while not all the day long was people inside the toilet. This consumed much power and electrical bill that need to pay per month and it is around RM100,000. In term of supporting Earth Hour, the main objective of this project is to design and develop an automatic circuit to switch the lamp when there are only people in the toilet. By this automatic lamp switching control innovation project, the usage time of the lamp can reduce into optimum level and will reduce power usage which will support on Go Green thus beneficially reduce an electrical bill.

1. Introduction

Careless and undisciplined is human being which will contribute to the main factor of an electrical waste. Peoples do not bother about toilet lamps because they think there will be a person in charge to close all the lamps or they afraid that there are another person still using the toilet. This resulting to the wastage of electrical powers because the toilets still in bright even nobody inside the toilet.

Electrical bill may reduce if we can control this situation and using electrical power at optimum condition. Because of this problem, the Director of ILP Nibong Tebal had asked the Electrical Department to solve this issue by creating any device that can switch on and off the light automatically only when people entering the toilet. Total number of toilets in ILP Nibong Tebal for this project is around 24 toilets, where 4 toilets at Electrical Department , 2 toilets at Networking Department , 4 toilets at Multimedia Department and 14 toilets at Printing Department. This entire toilet was used during classes are always on from 8.00am to 5.30pm.

1.1. Project background

As this project needs to detect human existence, non-contact sensor needs to be use. The sensor should be able to detect the existence and the direction of the people. PIR (Passive Infrared Sensors) is the best sensors that can be use in this project because it matches with our needs. PIR is an electronic device which measures infrared light radiating from objects in its field of view. PIR are often used in the construction of PIR-based motion detector. It also can be use for direction detection. Normally this PIR operates by motion that had been detected and will trigger the lamp to switch on depend on the timer setting. In this project, we will change from the timer based control to people existing control whereby this PIR will detect in-out direction of visitor. Counter method will be used as the controller, whereby if people go inside the toilet, counter will plus one and when people leaving the toilet the counter will minus one. By using this project,

the lighting in toilets area can be automatically control which will eliminates human error on controlling toilet lamps. This will help to reduce the total hour of the light to turn on and will reduce the electrical energy and reduce electrical bills.

1.2. Innovation area location

Figure 1.1 shows the floor outlines of the toilets, where each floor has 2 toilets whereby one for men and one for and women. From the floor outlines, each toilet are using 4 double florescent lamps, where each lamp using 40W electrical powers. Below is the calculation for total power usage on each toilet.

- Quantity of Double 40W Florescent Lamp = 4
- Total number of lights per toilet = 8
- Total power consumptions per toilet = 8 X 40W = 320 Watt.

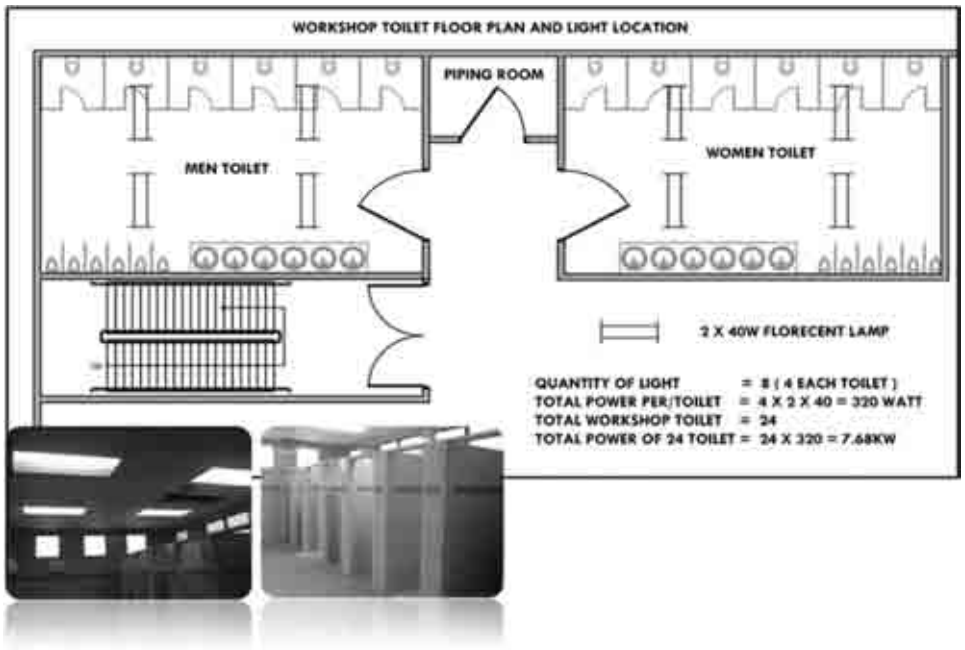


Figure 1.1: Toilet floor outline and total lamp for each toilet

1.3. Energy usage data

Estimation of total power consumption can be compared from total hour usage per day with using this automatic device and not using this device. In this estimation, current hour usage per day is estimated as 8 hours and by using automatic device total hours per day is estimate as 3 hours. Total usage per month will be calculates for 20 working days. By this we can get the total power consumptions each toilet per month and the total bill need to be pay for each month.

The calculation are using TNB web bill calculator, where the tariff for is Commercial C1:0.25, 0.27, 0.34 [1]. For the calculation between current demand and after using an automatic device, please refer Attachment : Table 1.

From table 1.1, we can see the different of total bill need to pay for every month, where it can save around RM 20,199.02 each month. From the data we can conclude that by reducing the electrical energy usage using an automatic switching device, we can save the cost to pay on electrical bills and supporting Earth Hour.

2. Project operation

The basic operation and function of the circuit is to switch on the toilet lamp automatically when visitor enter the toilet, then switch off the lamp when visitor leave the toilet. If two or more person entering the toilet the device will using counter to count the number of person entering the toilet. When the person leaves the toilet, the counter will deduct the counts until the value reach '0'. The light will remains on if the counts are not '0', where it represent there are still a person inside the toilet.

2.1. Project block diagram

The circuit was divided into 4 sections, where first section is the sensing circuit, second section is the control circuit, the third section is the output circuit and fourth section is the power supply circuit. Figure 2.1 below shows the basic block diagrams of the project and Table 2 shows the output for each stage of the circuit.

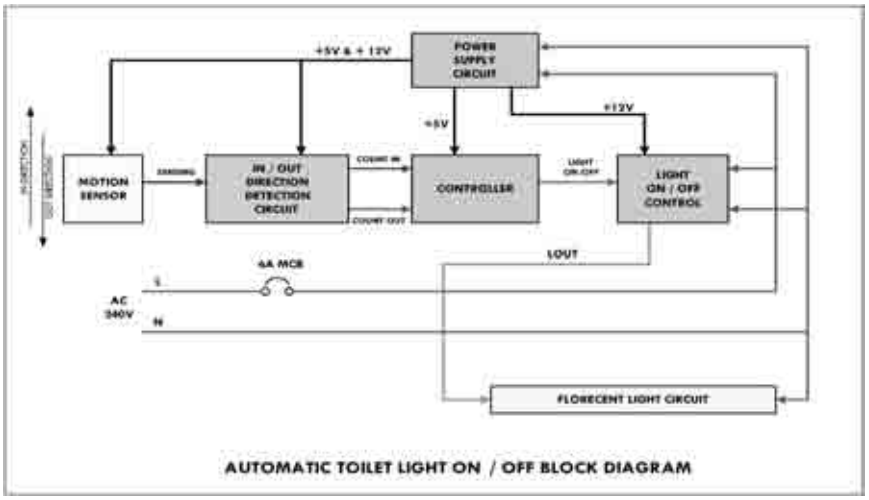


Figure 2.1: Automatic toilet light control block diagram.

Table 2: Output signals for each stage of the block

Circuit output and logic table						
Direction	**Sensing**	**Count IN**	**Count OUT**	**Light ON/OFF**	**LOUT**	**Light**
IN	***+5V***	***+5V***	***0V***	***+5V***	***240V AC***	**ON**
OUT	***-5V***	***0V***	***+5V***	***0V***	***0V***	**OFF**

2.2 Sensing and direction detection circuit

The sensing and identification function is to detect the person either enter or leaving the toilet. In this section, identification circuit needs to differentiate the direction of entering or leaving of the visitors to control the controller to plus or minus the counter. Most suitable sensor is PIR sensor because it would be able to detect direction of motion**.**

2.3. Controller

Controller circuit is the counter which receives feedbacks from sensing circuit and calculates to plus counter or minus counter. This circuit will make decision either to switch 'on' or 'off' the toilet lamp. The output of this circuit will control the lamp switch.

2.4. Lamp switch controller

This circuit is an isolation area between low voltage and AC240V high voltage. This circuit consists of FET transistors which switching on and off the Solid State Relay. The main function of this circuit is switching on and off the high voltage current and can be control using low voltage current flow trough the FET.

2.5. Power supply

Most circuit using DC voltage power supply and it was supported by the Power Supply Circuit. This project will use linear power supply bay using fixed regulator IC7812 for supply +12V, IC7809 for supply +9V, and IC7805 for supply +5V.

3. Hardware

The design consists of a few components and below are the main components that being use in the project.

a) PIR (Passive Infrared Sensors) Murata IRA-E700 – Motion and Direction Detection.
b) IC LM324 Quad Op-Amp – Signal Amplifier and Comparator.
c) IC CD4538 Dual Precision Monostable – Direction Output Control Signal.
d) IC 40193 4 Bit Counter – Main Controller and Counter.
e) FET IRF540 N-Chanel MOSFET – Relay Control Switch.
f) SOLID STATE RELAY 240V 20A – Main Light On/Off Control Relay.

3.1. PIR (Passive Infra Red) Sensor

Human body generates infra red signal that can be detected by this PIR sensor, in that term this sensor is suitable to use as human detection either motion or direction. In this project, MURATA IRA-E700 SERIES PIR will be use. It is a Dual Type Pyroelectric Infrared Sensor which means it has two sensing elements connected in a voltage bucking configuration as shown in figure 3.1.

Figure 3.1: PIR sensor

PIR sensors have multiple variables that affect the sensors input and output. PIR sensor itself has two slots in it. Each slot is made of a special material that is sensitive to IR. When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. Human body have its radiation approximately wavelength of 9.4μm [3]. Figure 3.2 (Refer Attachments) shows when a warm body likes human or animal passes by the sensor, it detected by first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the first half zone and entering second intercepts half sensing area, the reverse happens, whereby the sensor generates a negative differential change. The changed of the pulses are what are detected by this PIR sensor.

3.2 Fresnel Lens

Lens is use as a projector for light or wave to increase the focusing point or improve the wavelength. In this project, Fresnel lens will be use to improve the detection of PIR sensor. Figure 3.3 shows the plastic Fresnel lens that will be use in this project and figure 3.4 (Refer Attachments:Figure 3.3 and 3.4) is the cross section diagram of the Fresnel lens. The lens element is round with a diameter of 1 inch and has a flange that is 1.5 inches square.

The Fresnel lens is made of an infrared transmitting material that has an IR transmission range of 8 to 14 μm that is most sensitive to human body radiation [2]. It is designed to have its grooves facing the IR sensing element so that a smooth surface is presented to the subject side of the lens which is usually the outside of an enclosure that houses the sensor as shown in figure 3.5 (Refer Attachments:Figure 3.5). The flange of the lens is used for mounting the lens in a suitable frame or enclosure. Mounting can best and most easily be done with strips of Scotch tape. Silicone rubber adhesive can also be used to form a more waterproof seal.

The Fresnel lens has a focal length of 0.65 inches from the lens to the sensing element [3]. Figure 3.6 shows the lens dimensions and lens detection angles (Refer Attachments: Figure 3.6).

3.3. IC LM324 - Low power quad operational amplifiers (Refer Attachments: Figure 3.7)

The LM324 series consists of four independent high gains operational amplifiers and internally frequency compensated for unity gain. It is designed specifically to operate from single supply 3V to 32V or dual supplies ±1.5V to ±16V. It is operated in very low power supply current drain (700 μA) which is independent of the magnitude of the power supply voltage [4].

3.4. IC CD4538BM – Dual precision monostable multivibrator (Refer Attachments: Figure 3.8)

The IC CD4538BM is Dual Precision Monostable Multivibrator with independent triggers and reset controls. The device is retriggerable and resettable, and the control inputs are internally latched. Two trigger inputs are provided to allow either rising or falling edge triggering. The reset input are active low and prevent triggering while active. The pulse duration and accuracy are determined by external component RX and CX that required to be connected. The device does not allow the timing capacitor to discharge through the timing pin on power-down condition. Fig 3.8 show an internal circuit of the IC and Table 3 shows the truth table of the IC operation [5] (Refer Attachments:Table 3).

3.5. IC HEF40193B – UP/DOWN 4 bit binary counter (Refer Attachments:Figure 3.9)

The HEF40193B is a 4-bit synchronous up/down binary counter. The counter has a count-up clock input (CPU), a count-down clock input (CPD), an asynchronous parallel load input (PL), four parallel data inputs (D0 to D3), an asynchronous master reset input (MR), four counter outputs (Q0 to Q3), an active LOW terminal count-up (carry) output (TCU), and an active LOW terminal count-down (borrow) output (TCD).

The counter outputs change state on the LOW-to-HIGH transition of either clock input. However, for correct counting, both clock inputs cannot be LOW simultaneously. The outputs TCU and TCD are normally HIGH. When the circuit has reached the maximum count state of ‘15’, the next HIGH-to-LOW transition of CPU will cause TCU to go LOW. TCU will stay LOW until CPU goes HIGH again. Likewise, output TCD will go LOW when the circuit is in the zero state and CPD goes LOW. When PL is LOW, the information on D0 to D3 is asynchronously loaded into the counter. A HIGH on MR resets the counter independent of all other input conditions. The counter stages are of a static toggle type flip- flop[6].

Table 4: IC 40193B truth table

MR	$\overline{PL}$	CPU	CPD	Mode
H	X	X	X	reset (asynchronous)
L	L	X	X	parallel load
L	H	↑	H	count-up
L	H	H	↑	count-down

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; ↑ = positive-going transition.

3.6. FET IRF540 (Refer Attachments : Figure 3.10)

IRF540 is n-channel FET which capable to carry maximum 1A current through source to drain. Current will flow from source to drain when the FET receive voltage at Gate pin. It is suitable as primary switch in advanced high efficiency, high-frequency isolated DC-DC converters for Telecom and Computer applications. It is also intended for any applications with low gate drive requirements [7].

3.7: Solid state relay (Refer Attachments:Figure 3.11)

This active semiconductor device have same concept of the coil relay whereby it use photo coupler to actuate a switch rather than use moving copper contact which electromagnetic controls. Photo coupler receives power from the input and transmits lights on shines across an open space. On the load side of this space, a part of the device senses the presence of the light, and triggers a solid state switch that either opens or closes the circuit under control.

Often, solid state relays are used where the circuit under control must be protected from the introduction of electrical noises. Advantages of Solid State Relays include low EMI/RFI, long life, no moving parts, no contact bounce, and fast response. Using solid state relay will prevent problems such as metal degradation between contacts, contact welding, wear, or a rapid increase in the contact resistance which exists in mechanical relay [8].

4. Schematic diagram

4.1. Sensing and direction detection circuit (Refer Attachments : Figure 4.1)

The PIR are the main sensor to detect motion and direction, the signal of the PIR are depend on the direction of people entering (+5v) or leaving (-5v) the toilet. This signal is feed to IC1A and IC1B that operates as amplifier, having gain 100 times each stages and total gain about 10,000 times. IC1C and IC1D will be use as direction comparator, where it will compare the input signal from amplifier, either people leaving or entering the toilet. This entire ops amp already builds in one IC LM324. Potentiometer R10 is a sensitivity adjustment to vary the detection range.

After the amplification process, the output will goes to IC CD4538BM to keep a delay for the direction triggered before sending to controller. The first single shot to receive a trigger input from IC1C or IC1D will turn its output on to indicate the direction of detection and will also inhibit the other single shot so that it cannot be triggered while the first single shot is on. Potentiometer R15 adjusts the amount of time that an output remains on after motion is detected. Lastly an output from pin 10 of IC2 will indicates the direction people entering by giving +5V to Q1 then to *Out*+. Then an output from pin 6 of IC2 will indicate the direction people leaving the toilet by giving +5V to Q2 then to *Out*-. Terminal *Out* + and *Out*– will be feed to counter or controller circuit.

4.2. Controller circuit

The main function of controller or counter circuit is to make a decision to switch on or off the light by depending on the direction detected by sensing and direction circuit. When the controller read the direction of visitor are entering the toilet by receiving +5V signal at pin *Count In* , it will command to turn on the light by give +5V (High) at its output and remain high.

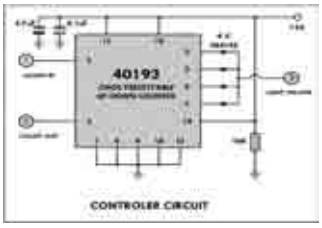


Figure 4.2: Controller schematic diagram

The controller is counter circuits whereby it will count the number of people enter or out from the toilet. When it gets high signal at pin Count In the Counter will plus with one, and when receive another triggering at pin Count In the Counter will add another one, this make the Counter value become 2.

When the controller receives +5V at pin Count Out, it will subtract the Counter value with one. The output of controller still remains high until Counter = 0 which will switch off the light. Table 5 shows the logic operation of the controller with the light on/off status (Refer Attachments:Table 5).

4.3 Light control ON/OFF circuit

This section is the light control circuit. This circuit only to receive command from control circuit either to 'ON' or 'OFF' the light. On this circuit the main device that are using is either ***AC Relay*** or the ***Solid-state Relay***. Output pin from Controller will connected to a FET transistor IRF540. When port output from Controller are '0' the FET are in open condition, when the output from Controller goes high or '1' the FET will turn 'on' and let current flow from supply trough the solid state relay. When the relay turn on it will let the AC 240V supply to the lamp. Figure 4.3 shows the block diagram of the light controller circuit.

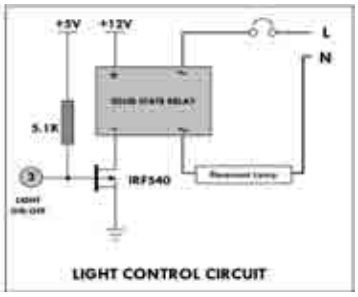


Figure 4.3: Light Control Schematic Circuit.

5. Project methodology and implementation

The approach to complete the project divided into few stages, where the first stage is identify and find the main component like sensor, microcontroller, counter and the relay. After that the circuit was simulate part by part and section to identify the basic operation. This simulation is using free java type simulation software

that calls Circuit Simulator. After simulation had been done the circuit assembled parts by parts depend on the section had explained before and test is done by each section to collect the data for output signal. The last stage of the circuit is assembled together and test for its function (Refer Attachments: Figure 5.1).

6. Project task and schedule

This project implementation done for two semesters, where semester 1 2010 was implemented follow schedule 1 and semester 2 2010 was implemented follow schedule 2. Each scheduled for 17 weeks and below is the details of implementation schedule 1 and schedule 2. (Refer attachment : 6.1 Table 6, 6.2 Table 7)

7. Project expectation

The circuit is expected will have 90% success and 10% error due to the interference and noise of the sensor during detection. The type of PIR sensor also might the main issue due to either it can give difference signal depend on direction. The main critical area on development of this project is on direction and sensing circuit where the PIR with 2 elements is non commercialize in Malaysia. The others circuits are expected to work 100% functionality.

The prototype of this project will implement in the men's toilet at electrical department in ILP Nibong Tebal and expected to be used by all toilets in this institution. We also expect to produce user-friendly control box that can be used by all peoples and wireman.

8. Conclusions

This project only concentrates on the toilet lights but it is not possible to be use in other application for example in corridors or stairs. If we can control the usage of the power automatically, we can contributes to Earth Hour campaign and also reduce an electrical bill in this institution. If this project success, it will helps in reducing power usage approximately 850KW per month and cost beneficial approximately RM 20,000 per month just by controlling all toilets lamp in ILP Nibong Tebal.

If we can further produce user-friendly Automatic toilet light controller control box, we also contributes to Earth Hour campaign which beneficial to world's healthy and helps consumer reducing their electricity usage.

9. Reference:

[1] http://www.tnb.com.my/residential/billing/bill-calculator.html
[2] http://www.fresneltech.com/materials.html
[3] http://www.glolab.com/pirparts/pirmanual.PDF
[4] http://www.national.com/mpf/LM/LM324.html#Overview
[5] http://www.datasheetcatalog.org/datasheet/nationalsemiconductor/DS006000.PDF
[6] http://www.nxp.com/documents/data_sheet/HEF40193B.pdf
[7] http://www.datasheetcatalog.org/datasheet/stmicroelectronics/9387.pdf
[8] http://en.wikipedia.org/wiki/File:SolidStateRelay-Diagram.svg

Attachments

Tables:

Table 1: Calculation table of energy usage data.

No.	Items of calculation	Current use	With automatic device
1.	Estimate hour use per day	8 Hours	3 Hours
2.	Estimate number of days/month	20 Days	20 Days
3.	Energy usage/toilet	320W	320W
4.	Energy usage/day	8 hours X 320 = 2.56KW	3 hours X 320 = 960W
5.	Energy usage/month	2.56KW X 20 = 51.20KW	960W X 20 = 19.2KW
6.	Cost/toilet/month	RM 1,274.68	RM 497.68
7.	Energy usage/ILP/month	1,228.8KW	384KW
8.	Cost/ILP/month	RM 29,759.08	RM 9,560.06

Table 3: IC CD4538BM Truth Table

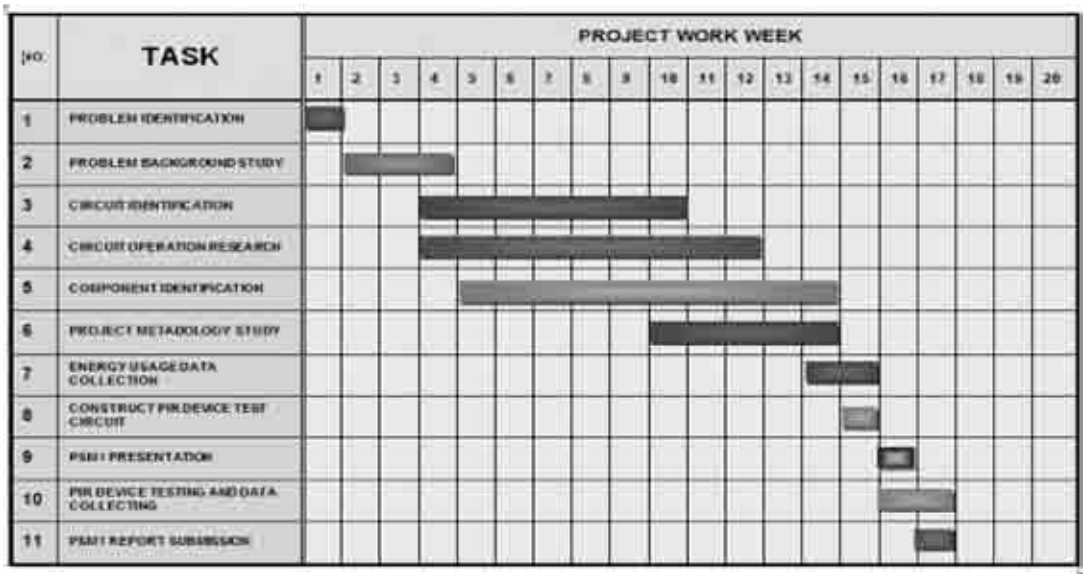
Truth Table

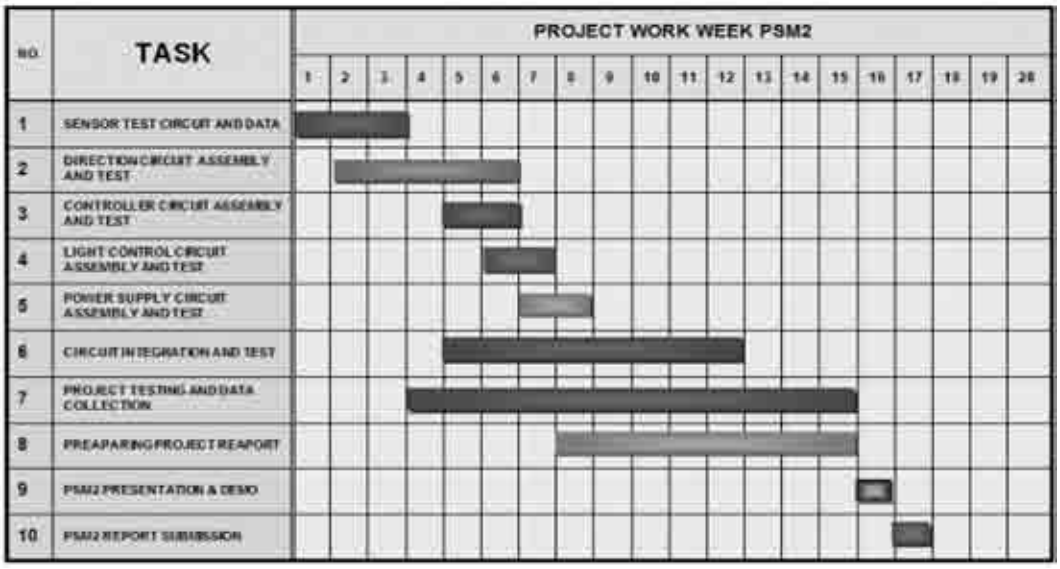
Inputs			Outputs	
Clear	A	B	Q	$\bar{Q}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↓	⎍	⎎
H	↑	H	⎍	⎎

H = High Level
L = Low Level
↑ = Transition from Low to High
↓ = Transition from High to Low
⎍ = One High Level Pulse
⎎ = One Low Level Pulse
X = Irrelevant

Table 5: Controller Logic Operation

No.	Visitor direction	Count IN	Count OUT	Counter	Light ON/OFF
1.	No people in toilet	+5V	0V	0	Turn OFF
2.	Enter toilet	+5V	0V	0+1 = 1	Turn ON
3.	Enter toilet	+5V	0V	1+1 = 2	Turn ON
4.	Leave toilet	0V	+5V	2 -1 = 1	Turn ON
5.	Leave toilet	0V	+5V	1 -1 = 0	Turn OFF


NO.
TASK
PROJECT WORK WEEK
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
1 PROBLEM IDENTIFICATION
2 PROBLEM BACKGROUND STUDY
3 CIRCUIT IDENTIFICATION
4 CIRCUIT OPERATION RESEARCH
5 COMPONENT IDENTIFICATION
6 PROJECT METADOLOGY STUDY
7 ENERGY USAGE DATA COLLECTION
8 CONSTRUCT PIR DEVICE TEST CIRCUIT
9 PSM I PRESENTATION
10 PIR DEVICE TESTING AND DATA COLLECTING
11 PSM I REPORT SUBMISSION


NO.
TASK
PROJECT WORK WEEK PSM2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
1 SENSOR TEST CIRCUIT AND DATA
2 DIRECTION CIRCUIT ASSEMBLY AND TEST
3 CONTROLLER CIRCUIT ASSEMBLY AND TEST
4 LIGHT CONTROL CIRCUIT ASSEMBLY AND TEST
5 POWER SUPPLY CIRCUIT ASSEMBLY AND TEST
6 CIRCUIT INTEGRATION AND TEST
7 PROJECT TESTING AND DATA COLLECTION
8 PREAPARING PROJECT REAPORT
9 PSM2 PRESENTATION & DEMO
10 PSM2 REPORT SUBMISSION

Figures:

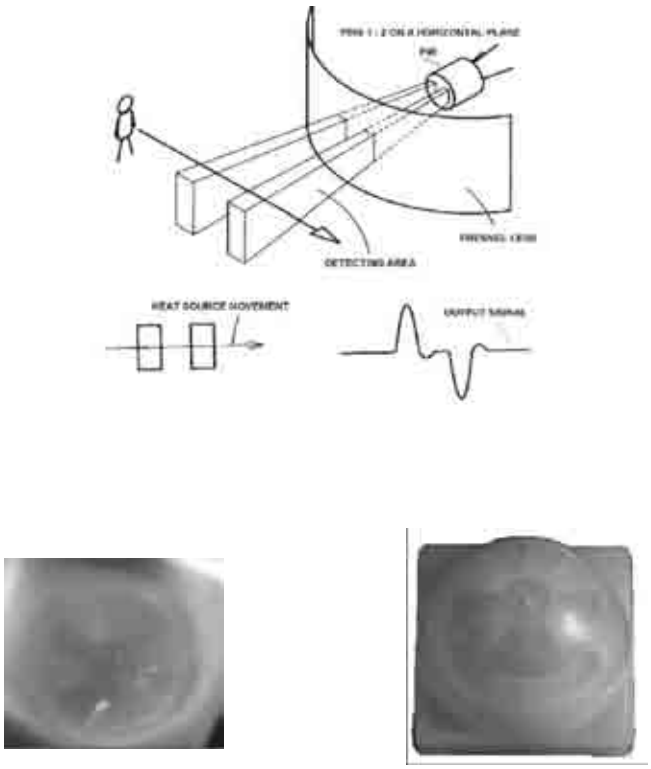


Figure 3.3: Fresnel lens

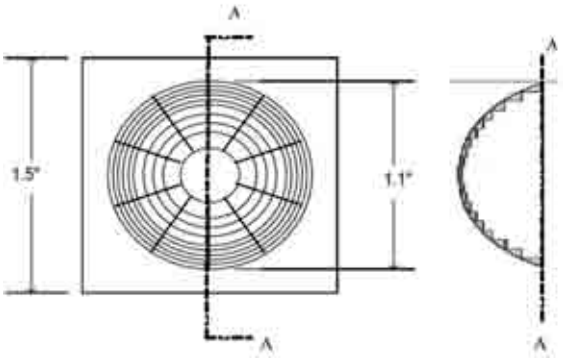


Figure 3.4: Cross section of Fresnel lens

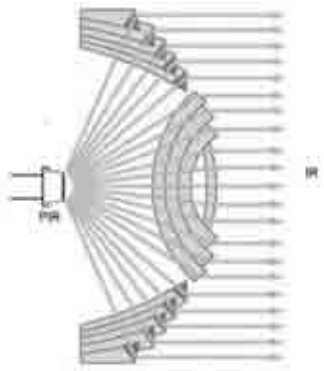


Figure 3.5: Groves face of lens facing to PIR Sensor

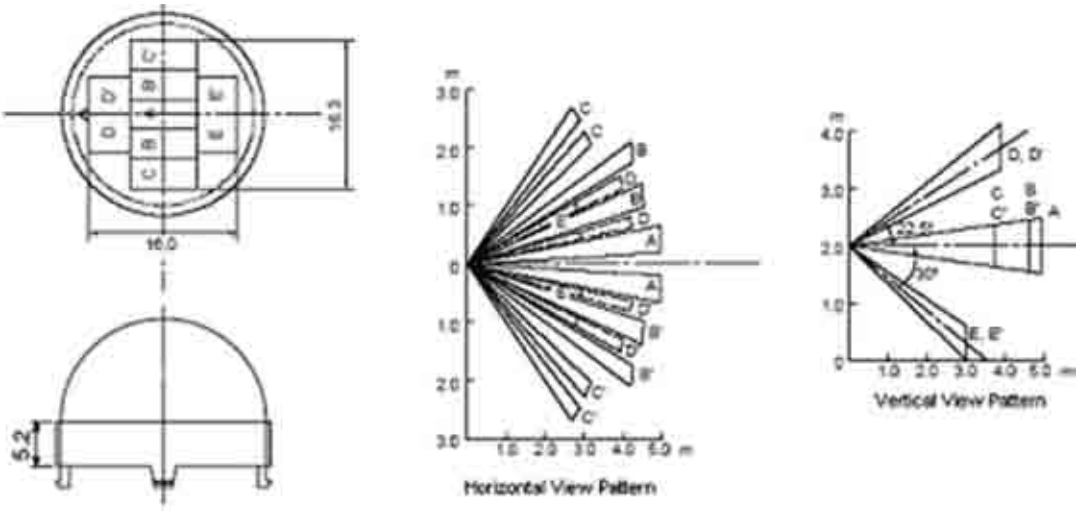


Figure 3.6: Fresnel lens detection angle and lens dimension.

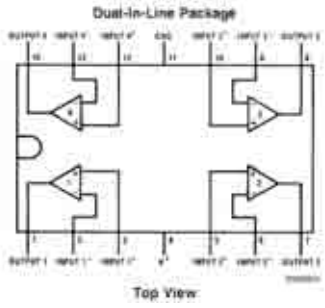


Figure 3.7: LM324 pin configuration and internal circuit.

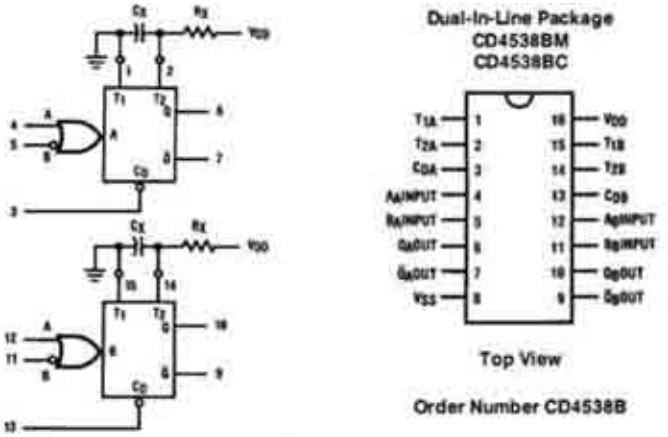


Figure 3.8: Internal Circuit Diagram and Pin Configuration

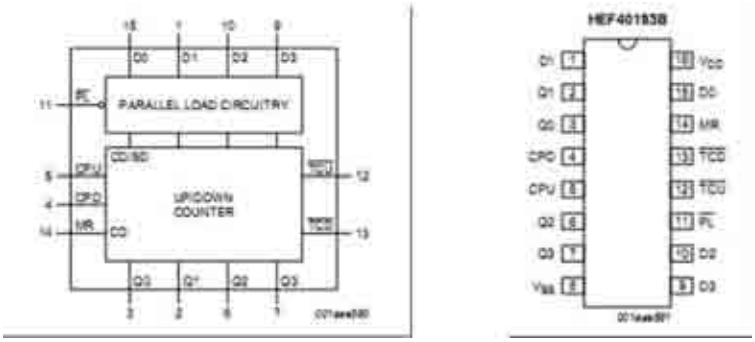


Figure 3.9: IC 40193B internal circuits and pin configuration

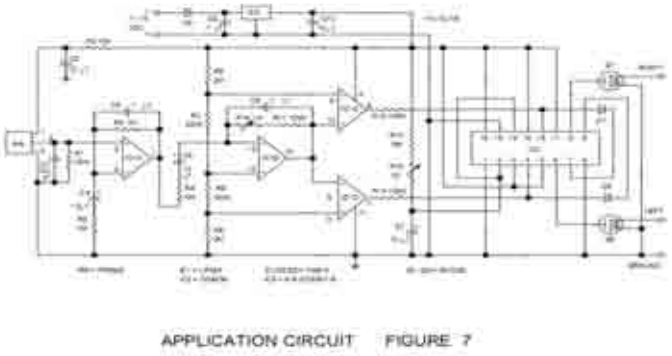


Figure 4.1: Sensing and Direction Detection Schematic Circuit

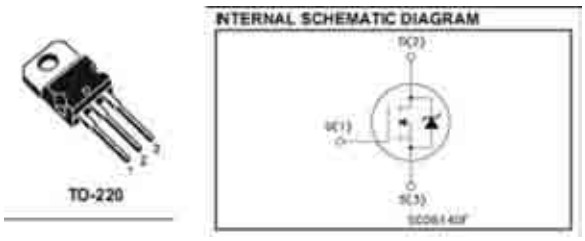


Figure 3.10: N-CHANEL FET IRF540 Internal Schematic and Package.

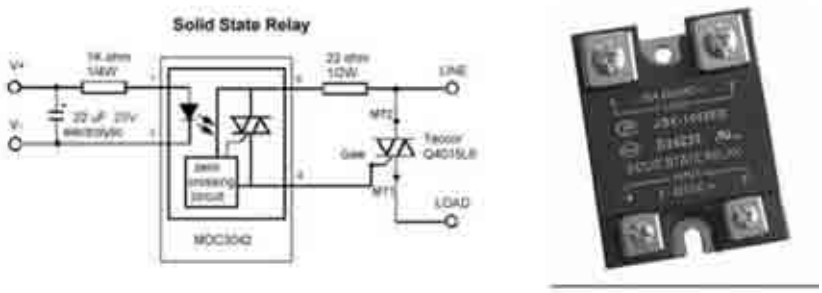


Fig 3.11: Solid State Relay Configuration and Internal Circuit

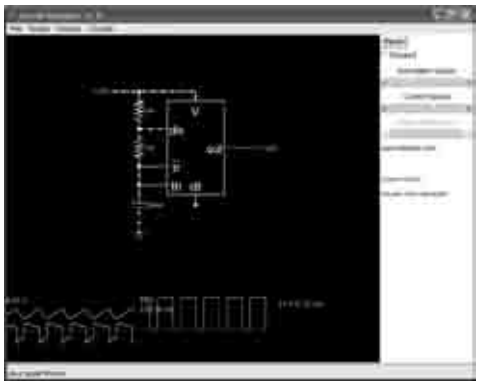


Figure 5.1: Circuit Simulator Program

E7 - Automatic Storage And Retrieval System (ASRS)

Zambri Bin Abdul Halim; Kesavan A/L Radhakrishnan; Ahmad Taufiq Bin Shamsudin; Muhammad Shaffek Bin Yahya; Mohammad fathimarwan Bin Muslimin; Mohd Iqqiuddin Bin Nadzaharuddin
Department of Mechatronic Engineering Technology,Japan Malaysia Technical Institute (JMTI)
E-mail: zambri_a@yahoo.com

Abstract

Miniature storage and retrieval system is fully automated system that consists with push buttons and 14 diffuse sensors react as an input, meanwhile power window motor, cylinder and pneumatic valve as an output. The function is to store and retrieve the work pieces from the rack and the system is easily re-programmed according to the task given where programmable logic control (PLC) working as main controller to the system. The mechanism of the system can easily be dismantled out to perform servicing activity. Troubleshooting box consist with several switches where troubleshooting activities can be implemented by instructor during teaching process. This project is suitable as training equipment for the training needs of mechatronics and reasonable prices.

Keywords:*. Easily re-programmed, Programmable logic control (PLC), Sensors, Troubleshooting box, teaching process*

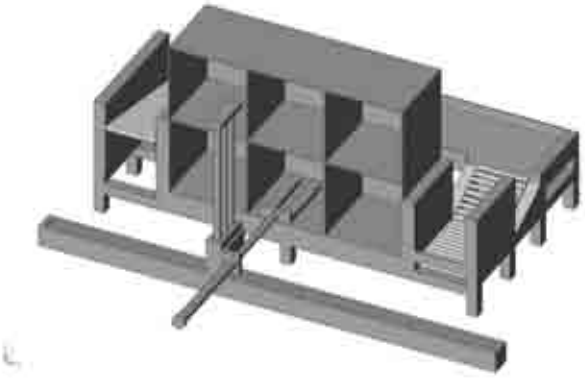
1. Introduction

ASRS Systems are devices designed for automated storage and retrieval of parts and items in manufacturing, distribution, retail, wholesale and institutions. They focus on bringing “goods to the man” rather than manual walking and searching. Space savings, increased productivity/reduced labor, increased accuracy and reduced inventory levels are some of the primary benefits. Ideal for lean manufacturing, sustainability, six sigma, Kahnban, JIT and other value added methodologies and processes. Titanium has been perceived as a material that is difficult to machine. Due to titanium’s growing acceptance in many industries, along with the experience gained by progressive fabricators, a broad base of titanium machining knowledge now exists. However, the parameter settings on WEDM of titanium alloy are still lacking. The available technological data which is based on manufactures for in house experimentation is helpful but insufficient.

2. Automatic Storage and Retrieval System (ASRS)

This prototype application of the principle of electro-pneumatic and the use of PLC. Electro-pneumatic components used are Dual Rodless Cylinder, Rodless Cylinder, Double Acting Cylinder, 5 / 3 Way Double solenoid valve and 5 / 3 Way Double solenoid valve. Type of PLC used is CS1G and programs written for the PLC using CX-Programmer software.

Products taken from the room "LOADING" by palletizing transferring body that would put the product on the hook move the cylinder axis which includes the axes X, Y, and Z. Products will be stored in a room the size of 120mm (length) x 145mm (width). Each room has a diffuse sensor which is used as a detector to the presence of the product. Products can be stored in any location that is on the shelf by simply pressing a push button representing each room. To remove the product from the storage room, push button for the retrieval of the push button 4 is pressed and the signal will be sent to direct retrieval axes for the production process.



Here, the "roller conveyor" will serve as the "transfer module" that will move items to the conveyor belt.

3. Faulty box as a fault simulator

Faulty box is used as the fault simulator and it is very suitable to be used as teaching materials. 10 different switches are used to the level of understanding will be evaluated from various aspects such as sensors, pneumatics, electrical systems and programming. When one of the switches was switched off, that particular components will be malfunction. By using programme console, the student will do troubleshoot the problem as task was given.

4. Conclusion

The miniature ASRS consist simple mechanism, PLC and faulty box. The mechanism of the system can easily be dismantled out to perform servicing activity. Faulty box consist with several switches where troubleshooting activities can be implemented by instructor during teaching process. Thus, this miniature ASRS is suitable as training equipment for the training needs of mechatronics and reasonable prices.

5. Recommendation

A few areas need to study and extensive discussion was encountered and recommended to be further study are as follows:

A few elements such as hydraulic system should be installed for better understanding of mechatronic elements needed.

A few stations with different characteristic should be fabricated so the learning process can be expanded.

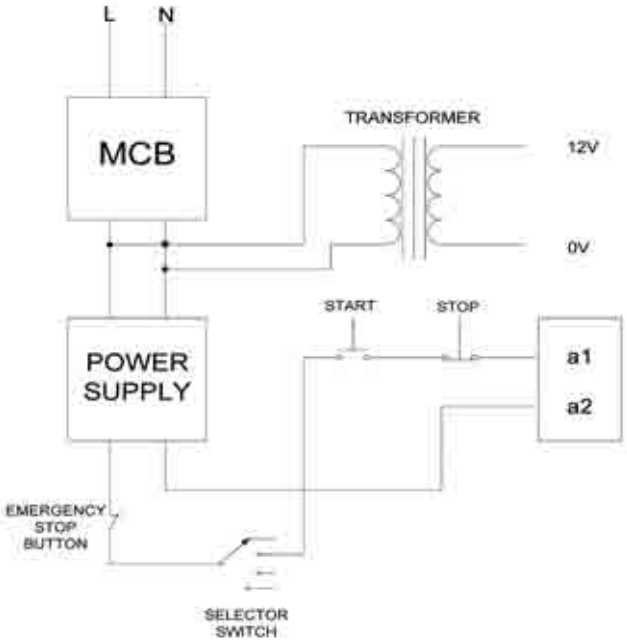
REFERENCES

[1] Norliana Mohd Abas, Md Fuad , electrical engineering technology 35 (12) (1995) 1693–1701

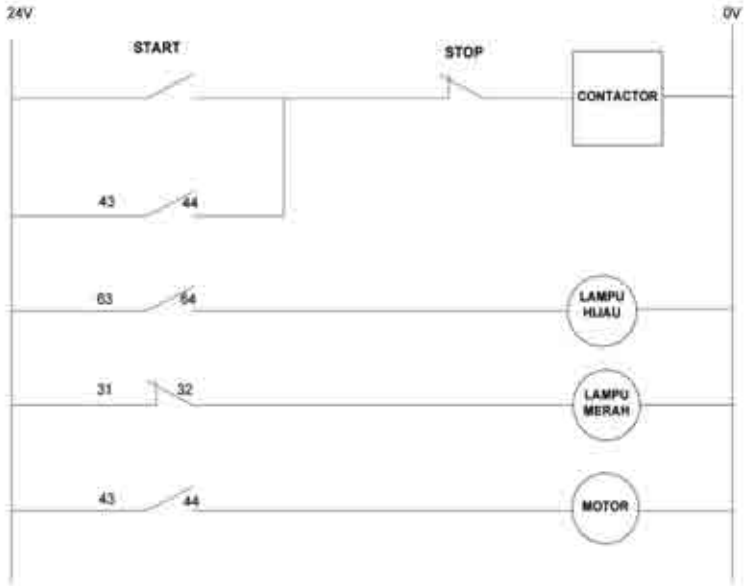
[2] J.T. Huang, Y.S. Liao, W.J. Hsue, programmable logical controller. 87 (1–3) (1999) 69–81.

Attachments

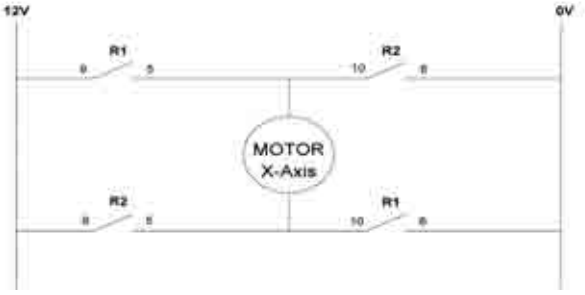
LITAR BEKALAN KUASA



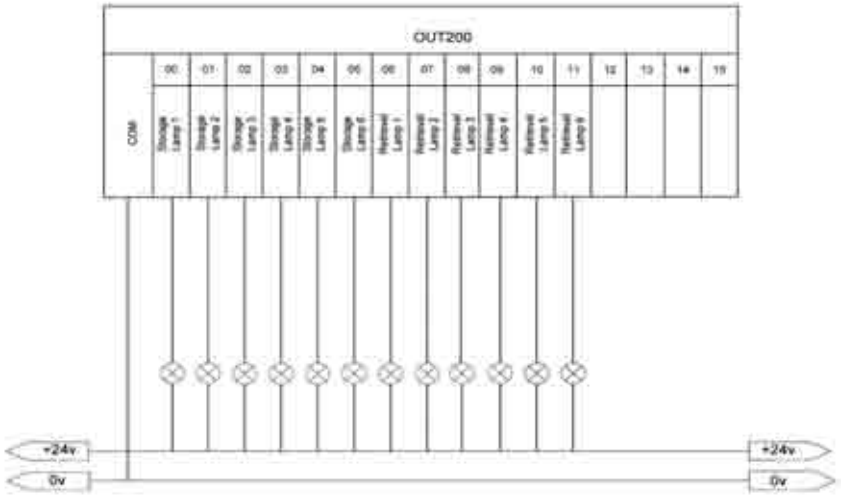
LITAR AC MOTOR



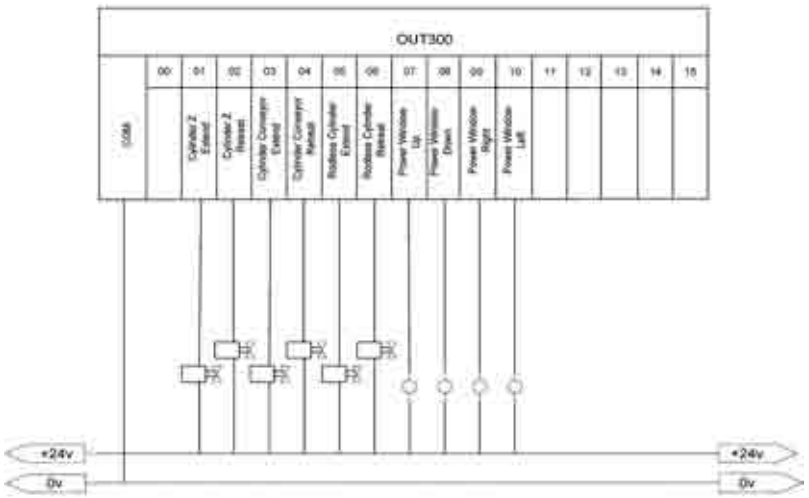
LITAR DC MOTOR



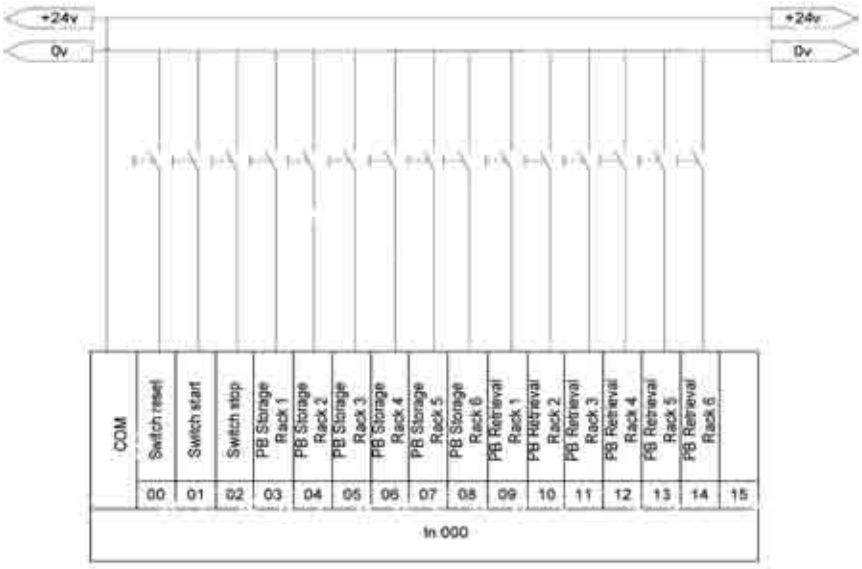
OUTPUT CONNECTION CIRCUIT



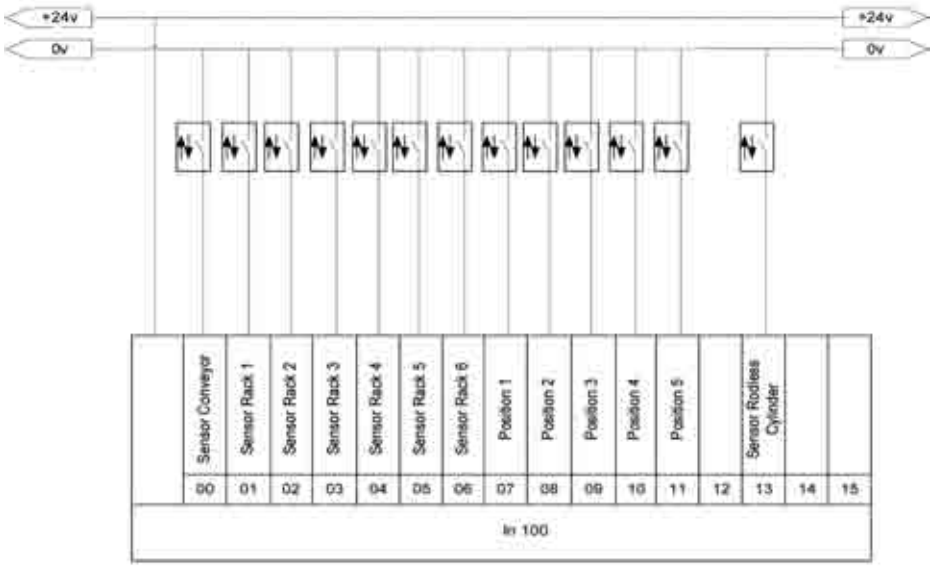
OUTPUT CONNECTION CIRCUIT



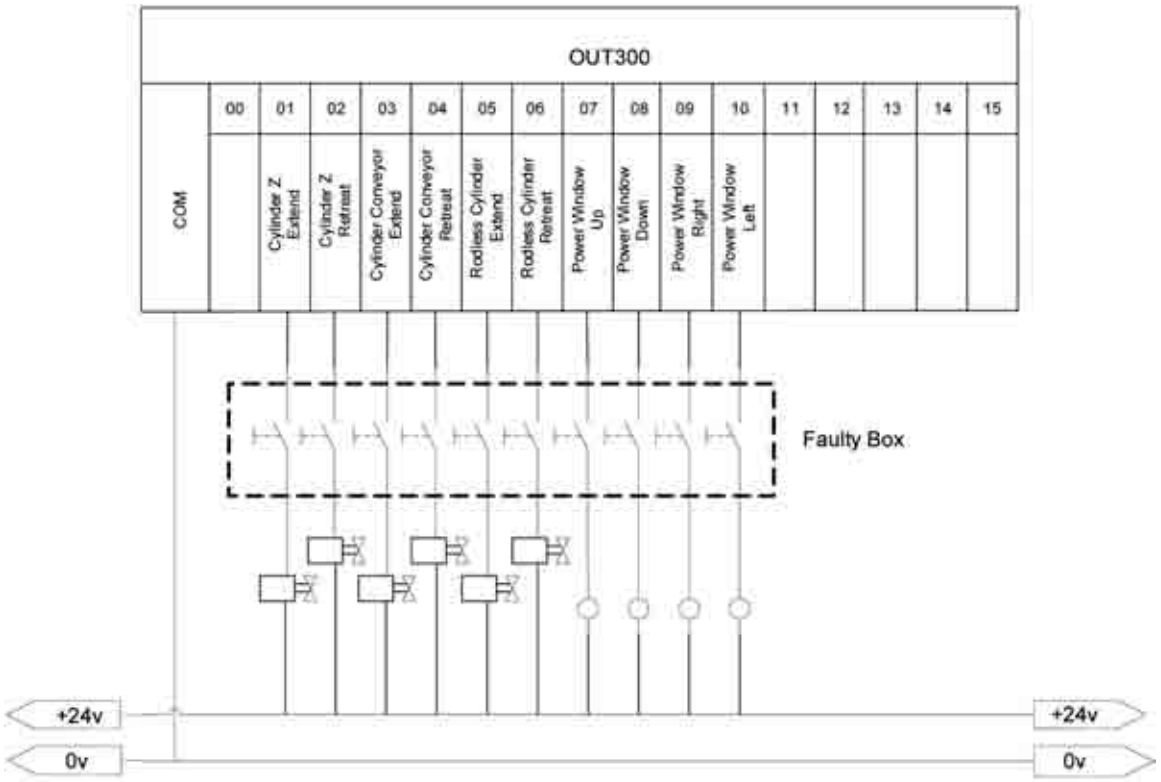
INPUT CONNECTION CIRCUIT



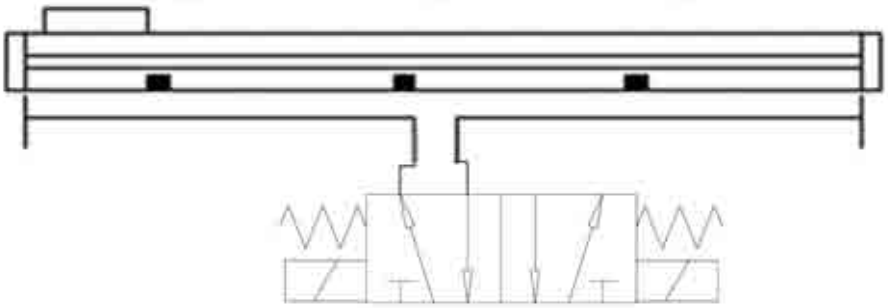
INPUT CONNECTION CIRCUIT



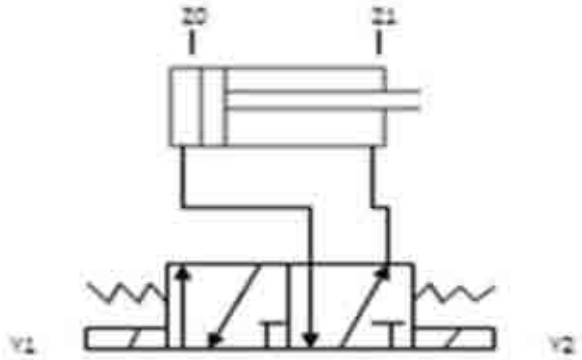
FAULTY BOX CONNECTION CIRCUIT



Rod less cylinder



Double acting cylinder



E8 - Hardware Implementation Of A Low Cost Power Electronic Inverter Using Integrated Power Module (IRAMS) For 200W 3-Phase Brushless DC Motor

S.Saaidon[1], Md. S. M. Salleh[2], NR. Yusoff[3], A. Yunus[4], Sh. Khasim[5].
Institut Latihan Perindustrian Kepala Batas
sarizan@ilpkbpp.gov.my, mohd_sukimi@ilpkbpp.gov.my, suhana@ilpkbpp.gov.my, azri_yunus@ilpkbpp.gov.my, shamimi@ilpkbpp.gov.my

Abstract

This research focuses on the design, development and implementation of hardware for sensor-based operation of integrated three-phase electronic power inverter to drive 200W 3-Phase Brushless DC Motor. The proposed solution adopted a PIC16F767 microcontroller developed by Microchip Inc. This microcontroller has the advantages such as low-cost implementation, the minimum hardware requirements, factors, small and compact size, and protection from faults such as currents, temperature, and the failure of the module.

The novel inverter scheme used in this research is called an integrated power module (IRAMS10UP60B) produced by International Rectifier. By using this integrated power module, the traditional six discrete transistors and gate driver can be replaced using one integrated device. Hence reduces the circuit complexity and times during designed and fabricated the printed circuit boards. The speed reference is obtained by varying the duty cycle of the PWM signals through an opened-loop system.

The no-load experimental results show that the 20% of duty cycle, , the motor speed is approximately to 1352rpm with a terminal voltage of 6.34V and at the 60% of duty cycle, the motor speed is approximately to 1472 rpm with a terminal voltage of 12.84V. Meanwhile at the 100% of duty cycle the maximum speed is 2302rpm and the terminal voltage is able to reach 14.50V. Therefore the speed control is proportional to the voltage terminal, thus these results consistent with the analytical theory of principle operation of brushless DC motor.

Keywords: *Microcontroller, Power Electronic Converter, 3-Phase Brushless DC Motor (BLDC), Integrated Power Module (IRAMS10UP60B), Pulse Width Modulation (PWM).*

1. Introduction

This project focuses on the sensor-based operation capability of integrated three-phase electronic inverter using PIC16F767 as the microcontroller for the controller module and integrated power module IRAMS10UP60B to identify the switching of the power transistors IGBTs that function as an inverter.

The innovation of this project lies on using an integrated power module that improves the traditionally approach by used six discrete transistors and gate drives with simply using a single chip device, hence shrinking the compactly the components circuit development.

The design, development and hardware implementation of this sensor-based operation capability of integrated three-phase electronic inverter is predicted to drive and control the three-phase brushless DC motor direction and speed satisfactorily.

Brushless Direct Current Motors (BLDC) are rapidly gaining popularity. They are broadly used in many fields such as Automotive, Medical, Aerospace, Home Appliances, Consumer, Industrial Automation Equipment and Instrumentation, because of their simple construction, reliable operation, high efficiency and low maintenance.

As the name implies, thw brushless DC motors do not use brushes for commutation, as an alternative they are electronically commutated. Brushless DC motors are more reliable than standard DC (mechanically commutated) motors.

A Brushless DC motors have many advantages over brushed DC motors. These advantages for instance are high efficiency, long operating life, better speed versus torque characteristics, high dynamic response, noiseless operation and higher speed ranges. However, there are several reason to use the of a brushless DC motor over a brushed DC motor such as:

(i) The absence of the mechanical commutator allows higher speeds

(ii) Brush performance limits the transient response in the DC motor

(iii) With the DC motor we have to add the voltage drop in the brushes among motor losses

(iv) Brush restrictions on reactance voltage of the armature constraints the length of core reducing the speed response and increasing the inertia for a specific torque

(v) The source of heating in the brushless DC motors is in the stator, while in the DC motor it is in the rotor, therefore it is easier to dissipate heat in brushless DC motors

(vi) Reduced audible and electromagnetic noise.

A brushed DC motors start rotating when supply voltage is applied. On the contrary, the brushless DC motor requires power electronics for commutation. Unlike brushed DC motor, mechanically commutated, the brushless DC motor is commutated electronically by power electronic inverter.

Inverter is one type of power electronics converter. In brushless DC motors operation, inverter is used to permit electronic commutation that the brushless DC motor requires. It changes DC signal to AC signal that is needed by the brushless DC motor. There are many topologies of inverter which may be used to provide single-phase supply, three-phase supply and several types of power electronic inverter are listed below [1]:

(i) Converter/Rectifier: Convert AC voltage/current into DC voltage/current

(ii) Inverter: Converts DC voltage/current into AC voltage/current

(iii) Chopper/Switch mode Power Supply: Steps up/down voltage/current level

The power module used in this project is called integrated power modules. This module is combines and optimizes a protection circuit and drive matching Insulated Gate Bipolar Transistors (IGBT). The system reliability is improved by the short circuit protection, temperature monitoring and the integrated under-voltage lock-out protection. The high speed embedded High Voltage Gate Driver (HVIC) presents IGBT gate driving capabilities without using opto-coupler devices which is reduces the overall dimension of the inverter system design.

The bipolar approach as discussed in [2] is used to utilize 3 PWM control signals on three high side IGBTs, which regulate the rotational speed of the motor, together with three more normal on and off signals on the three low side IGBTs that are embedded in the IRAMS integrated power module, hence enabling the operation of a three phase brushless DC motor.

Microcontroller is popularly deployed to control the systemic conversion of voltage from DC to AC in inverter circuit. Generally microcontroller is programmed to generate pulse width modulating (PWM) signal, and these signals are fed into the integrated power module. The reason to use an integrated power module due to its provides very compact and high performance of Alternating Current (AC) motor drives that primarily targeting for low-power inverter-driven application.

The ability of microcontroller to produce the desired pulse width modulation (PWM) signal is very crucial [3]. Apart from generating PWM and control signals, fault control features are important as well. The over current, over voltage and over temperature protection are able to be optimized by using microcontroller. The combination of the controller module and the integrated power module expected to drive the brushless DC motors in forward rotation, reverse rotation and speed control.

2. Operation of BLDC Motor

A brushless DC motor is fed by a conventional three-phase voltage source inverter, and its configuration is shown in Figure 1. The switching devices are IGBT type and labeled as Q1, Q2, Q3, Q4, Q5 and Q6. The conducting interval for each phase is 120° by electrical angle. Therefore, only two phases is conducting current at any time, leaving the third phase floating. This cause opens a window to sense the BEMF in the floating winding. Six IGBTs switches are powered respectively by the PWM signals output from microcontroller, through which the direct current is inverted to alternating current for driving the brushless DC motor. There are six combinations of the stator excitation in one cycle and each combination lasts for a phase period 60° electrical. Therefore there are six zero crossing points in one cycle. The commutation signal of the floating phase is obtained by lagging the BEMF zero-crossing point 30° electrical. When Q1 and Q2 are turning on, current goes through the phase A from Q1 firstly, then through the phase C, and finally back to source by through Q2. Based on the floating phase BEMF detection, the system obtains the rotor position and controls the inverter to drive the brushless DC motor [5].

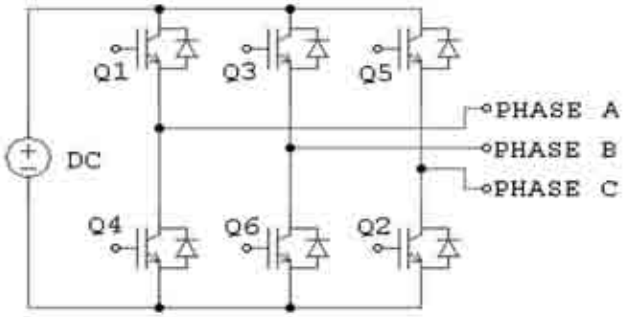


Figure 1. Main circuit configurations for three-phase inverter

The energizing of the stator windings must be done according to a correct sequence via electronic commutation. The determination of the correct energizing sequence is achieved by translating the input from 3 Hall position sensors [6],[7]. For these 3 position sensors, each of the sensor will sense the rotor magnetic poles and produce whether a high (logic 1) or low (logic 0) signals to indicate North (N) or South (S) position. The important aspect is that the controller must be able to interpret the Hall sensor inputs and energize the stator windings respectively [8].

Figure 2 illustrates the relationships between Hall sensor outputs and phase voltage energizing sequence. This is usually referred to as motor's truth table as it determines which phases need to be energized for each Hall sensors transition.

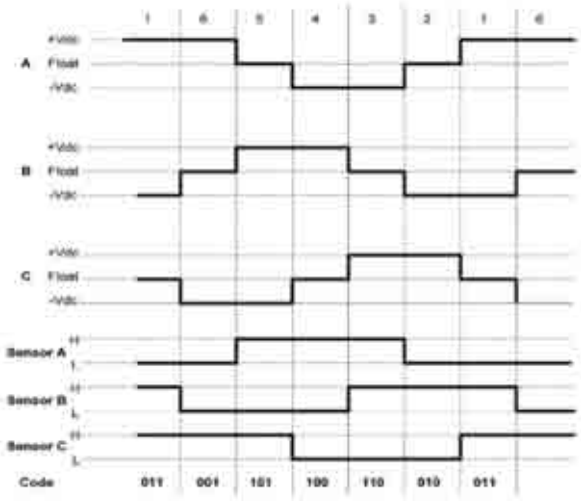


Figure 2. Hall sensor outputs and stator phase voltage relationships.

3. Control Strategy

The three-phase full bridge inverter as illustrated in Figure 1 is used as the inverter scheme for the BLDC motor. The magnitude of the output voltages can be varied by incorporating pulse with modulation (PWM) signal into the circuitry to adjust the switching frequency (turn-on time and turn-off time) of individual power semiconductor switches.

The inverter module consists of six insulated gate bipolar transistors (IGBT). This inverter is also referred to as three one-leg inverter. The switches are labeled as Q1, Q2, Q3, Q4, Q5, Q6, while each leg is phase shifted by 120° from one another. This gives rise to a 3-phase output voltage. There are two types of control methods which is 180° conduction and the other one is 120° conduction. The 180° conduction method has better utilization of the switches and normally a preferred method. However, in this research, the 120° conduction method will be implemented**.**

Special care must be taken in the switching operation. The two switches within one-leg cannot be turned on simultaneously, as this will result in a phenomenon called "shoot through". If both switches turned on at the same time, the corresponding leg will be short circuited. This particular scenario must be avoided to prevent damages to the inverter.

This problem is very prominent for the 180° conduction methods due to three transistors are turned on at any instant of time. This is also the reason why 180° conduction method is not preferred in this research. Instead, for the 120° conduction method, this problem is less likely to occur because only two transistors are turned on at any instant of time. This is the reason why 120° conduction method is the preferred method for this research. Also, BLDC motor runs perfectly with 120° conduction method due to the trapezoidal nature of the motor.

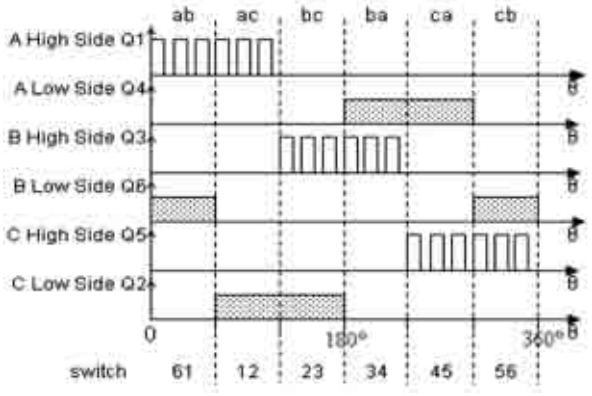


Figure 3. Gating signal for 120° conduction

Ideally, the output voltage of an inverter should be sinusoidal, but in practice, this is very difficult to achieve. Normally the output voltage is non-sinusoidal and contains harmonics property. However, by incorporating appropriate PWM switching techniques, the output voltage can be obtained close to sinusoidal, while the harmonics can be appropriately reduced [9].

4. Experiment And Results

As shown in Figure 4 there is necessary equipment, before conducting and setup the experiment on this research project. It includes a laboratory power supply, the 24V 3-phase BLDC motor and the speed controller board. Meanwhile, the measurement equipments are the digital multimeter, power analyzer, oscilloscope and hand-held tachometer.

Figure 4. The brushless DC motor experimental equipment

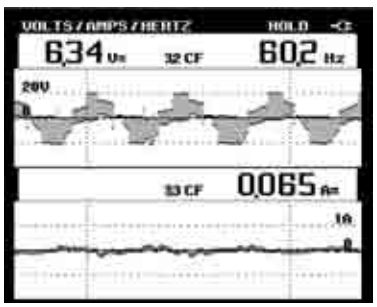
The Laboratory DC Power Supply is used to become two independent power supplies to the two voltage regulators. A supply of +20V is supplied to these voltage regulators LM7805CT and LM7815CT. The VR LM7805CT will produced +5V for the control module PIC16F767, while the +15V output is supplied from LM7815CT to power-up the integrated power module IRAMS10UB60P. Meanwhile, other supply of +24VDC bus line is utilized for the integrated power module IRAMS10UB60P that required by the brushless DC motors.

The speed of the brushless DC motor is measured directly at the rotor shaft, via a hand-held tachometer. The speed reading from this tachometer can be compared against the line-to-line voltage frequency. These two values should correlates because both can be used to determine the speed of the rotor.

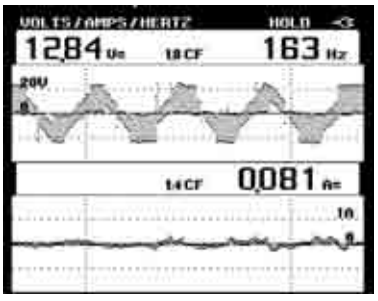
The BLDC motor line-to-line voltage is measured across any two of the three motor input terminals. While the current probe is attached to any one out of the three input terminals. The measurements are performed by using Fluke Power Analyzer that is capable of measuring and displaying graphically the line voltage and current waveforms.

This experimental setup was performed using an opened- loop speed control. It means that the speed control of the motor is achieved by using an external duty cycle control in order to set the reference speed and not by the speed feedback mechanism that normally associated with the closed-loop control system.

Figure 5(a) and (b) show the steady state performance of the terminal voltage (motor line voltage) and current waveforms of the brushless DC motor at several distinguished PWM duty cycle values. From these results, it can be seen that the PWM scheme generated and IRAMS power module integration can indeed be used as a drive for the 3-phase BLDC motor.



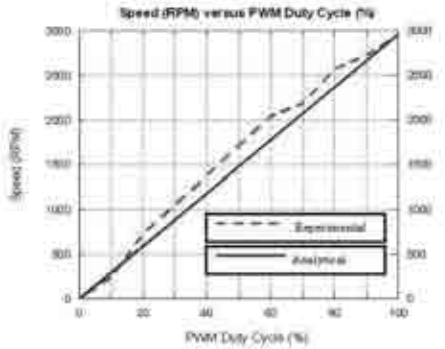
a) Terminal Voltage and Current Waveforms at 20% duty cycle



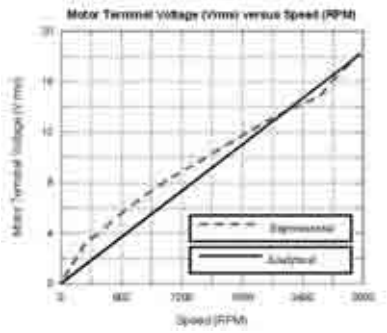
b) Terminal Voltage and Current Waveforms at 60% duty cycle.

Figure 5. Steady state performance of the terminal voltage (motor line voltage) and current waveforms with-respect-to PWM duty cycle

This experiment is arranged so that the relationships between PWM duty cycle versus motor speed and motor terminal voltage versus motor speed can be appropriately illustrated. From the analytical it is known that the PWM duty cycle is proportional to motor speed, and thus the supplied voltage is also proportional to motor speed [10]. Figures 6 (a) and (b) demonstrated the relationships of the experimental results in graphical forms.



a) Graph of motor speed versus PWM duty cycle.



b) Graph of motor terminal voltage versus motor speed.

Figure 6. Graphical relationship among PWM duty cycle, terminal voltage and motor speed

Based on the experimental observation, the brushless DC motor needs about 10% PWM duty cycle in order to start its rotational motion. As the PWM duty cycle increases, the terminal voltage would also increases proportionally. This gives rise to the current drawn by the motor coils. As a result, the motor rotational speed would become increase accordingly.

5. Discussion

In this experiment, the 10 kHz PWM frequency is good for switching the six IGBTs in the IRAMS power module. It is observed as well that the level of acoustic noise at 10kHz is acceptable and does not disturbing despite a little humming. While deciding for the optimize PWM frequency, often some trade-off need to be considered between switching losses and motor efficiency. High switching frequency could be good for the motor but at the same time increases the switching losses and vice-versa. Nevertheless, in this research, the 10kHz PWM frequency opted is able to drive the brushless DC motor satisfactorily.

Another influencing factor to the non-sinusoidal behavior could probably be due to the effect of distortions like harmonic contents, noise, switching losses, and the BLDC motor characteristics itself [11], [12]. The solution for eliminating harmonics would be by employing different PWM schemes like Multiple PWM and Sinusoidal PWM. Other than that, some filter could be implemented, such as the resistor-capacitor (RC) low pass filter to eliminate unwanted noises.

From the graphs shown in Figure 6, the PWM duty cycle and motor speed has an almost linear relationship, thus the terminal voltage and the motor speed has an almost linear relationship too. This result is important in order to make a claim that the proposed low cost power electronic inverter for brushless DC motor drive system conforms to the brushless DC motor theoretical principle.

6. Conclusion

In conclusion, the low cost power electronic converter for 3-phase brushless DC motor drive system has been proposed in this research. The proposed solution adopted the opened-loop speed control strategy

that is capable of controlling the 3-phase brushless DC motor satisfactorily. The developed prototype has several advantages like the following:

(i) Low cost system implementation

(ii) Minimum hardware requirement

(iii) Small and compact PCB size

(iv) Fail-safe operation by built in fault conditions detection

(v) Ability to operates up to 200W BLDC motor

The speed control is achieved by using an external potentiometer in order to provide variable PWM duty cycle for speed reference. Other important control features like run and stop control, and direction selection (clock-wise and counter clock-wise) have also been successfully incorporated in the prototype. The fool-proof fault conditions detection are also tested, verified and integrated to offer ease-of-mind feeling for potential users.

Though the aim and objectives are met, and this research resulted in a successful prototype, some potential improvements might still be worth looking at because this is not a universal solution. Further research on the software and hardware might eventually leads to a more robust design of the power electronic converter for 3-phase brushless DC motor drive system.

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E9 - Simulation Of A Mini-Wind Energy System For Commercial Building Application

A. Yunus[1], Md. S. M. Salleh[2], NR. Yusoff[3], S.Saaidon[4], Sh. Khasim[5].
Institut Latihan Perindustrian Kepala Batas
E-mail: azri_yunus@ilpkbpp.gov.my, sarizan@ilpkbpp.gov.my, mohd_sukimi@ilpkbpp.gov.my, suhana@ilpkbpp.gov.my, shamimi@ilpkbpp.gov.my

Abstract

Wind Energy System is one of the power energy that can be renewed and it is the popular clean energy nowadays as the already exists replacement source. Based on our Prime Minister's suggestion to promote the new energy that can be renewed, it is suggested by my supervisor of this project which is 'Simulation of a Mini Wind-Energy System For Commercial Building Application'. This project is software simulation that uses MATLAB software which can design, test and simulate of the wind power simulation. The result could be displayed easily as simulation and analyzed the result and parameter efficiency and effectively. In addition, this project can be furthered in helping to produce hardware for the actual system. The project will be focusing on the air power system for commercial building usage whereby the power is beyond 100Kw. The result is found to achieve the objective with the success of carrying out the simulation with required power estimated. All the parameters and production signals could be written perfectly and analyzed which it is acquired during simulation process being carried out.

1. Introduction

1.1 Background

Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetation. We use this wind flow, or motion energy, for many purposes: sailing, flying a kite, and even generating electricity.

The terms wind energy or wind power was describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity. This type of renewable resources or renewable energy for generation has negligible fuel costs and relatively low maintenance costs and in economic terms, wind power has a low marginal cost and a high proportion of capital cost.

The modern wind power industry began in 1979 with the serial production of wind turbines by Danish manufacturers Kuriant, Vestas, Nordtank, and Bonus. These early turbines were small by today's standards, with capacities of 20 to 30 kW each. Since then, they have increased greatly in size, while wind turbine production has expanded many countries all over the world.

1.2 Problem Statement

The conventional use of fossil fuels for power generation is fast losing popularity as environmental considerations become a priority. In addition, the depletion of fossil fuels worldwide and the volatility of the oil price have led to the search for alternative energy sources. Renewable energy resources, such as wind and solar energy, are clean, inexhaustible forms of energy ideal for sustainable development. The recent increase in research and technology development in this field has improved the affordability and availability of renewable energy options.

Renewable energy systems make use of more than one energy resource such as the wind system. The attraction of a wind energy system is the complementary nature of these energy sources, thus allowing the wind energy system to harvest more energy than a standalone unit. In South Africa, wind energy systems are being investigated for remote area power generation applications. The initial cost of a wind energy system is higher than a fossil fuel driven generator, but returns will be found in the low operating and maintenance costs.

The wind energy system can be used to electrically supply power to commercial building and can be compete against current energy source therefore the efficiency of the system should be increased. This is made possible by the use of power electronics, and an appropriate control strategy. By the integration of these components, the system is able to harvest the optimal amount of available energy. The wind energy system has therefore been realized to be a cost effective and efficient means of generating power for rural.

1.3 Project Objective

The objectives of this project are;

i. To study and to investigate wind energy systems.
ii. To design a power converter to be integrated with a wind turbine.
iii. To control the system in order to meet the requirement of a commercial building.

1.4 Project Scope

In order to achieve the objective of the project, there are several scope had been outlined. The scope of this project includes using MATLAB SOFTWARE (2009 Release) to design and simulated wind energy system by:

i. Literature reviews on the wind energy systems and collecting information on the latest wind energy technologies and type of power conditioning converters.
ii. Simulation of the proposed wind energy system with appropriate source/load control.
iii. Analysis will be made on the designed wind turbine system.

2. Simulation Of The System

Simulation of the system allows for the design of the hardware and software to be critically evaluated without constructing the system. Necessary changes can therefore be made to the system without incurring additional costs. The system has been simulated using *Simulink*, a simulation software package provided by *MATLAB 2009a*.

Figure 1: MATLAB Software R2009

2.1 Wind Turbine Block

Wind turbine block can be used in the simulink library and can be modified by changing the parameters configuration. There are two block parameters need to be setting. The wind turbine and the induction generator (WTIG) are shown below. The stator winding is connected directly to the grid and the rotor is driven by the wind turbine. The power captured by the wind turbine is converted into electrical power by the induction generator and is transmitted to the grid by the stator winding. The pitch angle is controlled in order to limit the generator output power to its nominal value for high wind speeds. In order to generate power the induction generator speed must be slightly above the synchronous speed. But the speed variation is typically so small that the WTIG is considered to be a fixed-speed wind generator. The reactive power absorbed by the induction generator is provided by the grid or by some devices like capacitor banks, SVC, STATCOM or synchronous condenser.

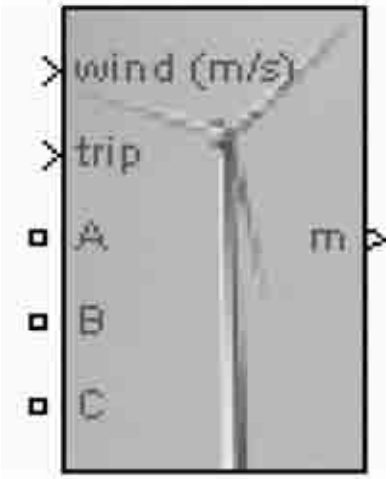


Figure 2: Wind Turbine and induction generator block

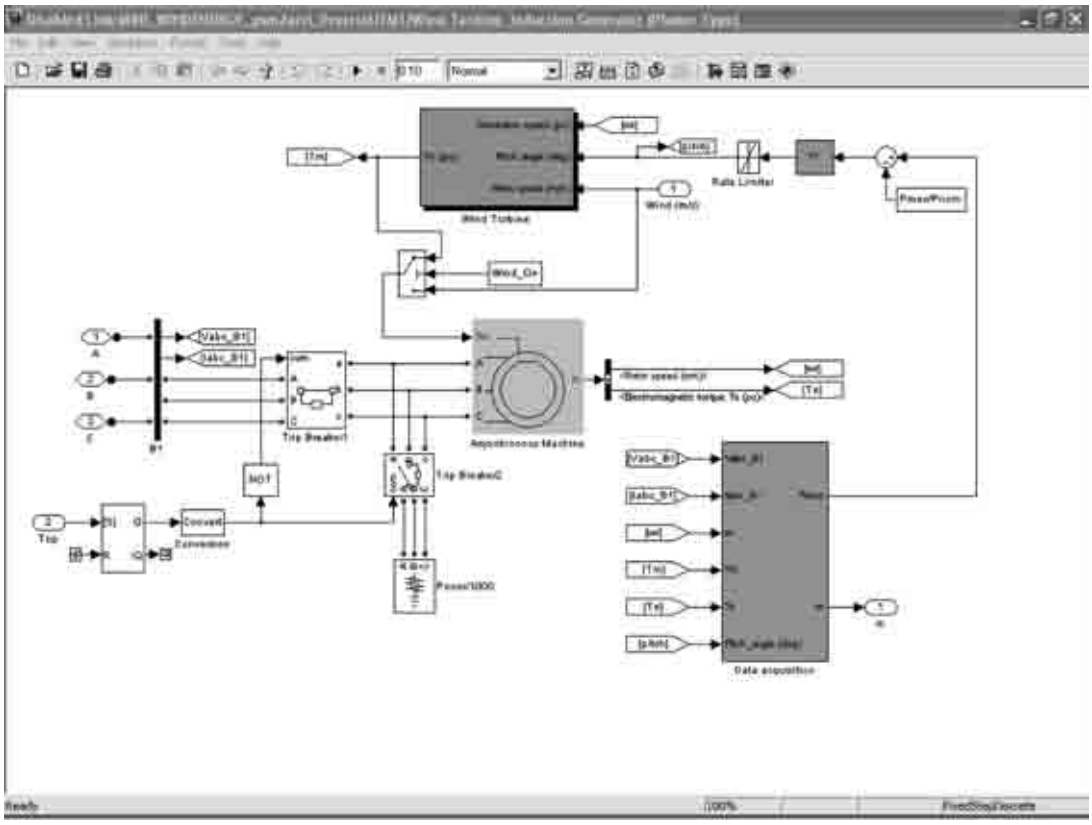


Figure 3: Look under mask for wind turbine induction generator block.

Simulink output vector containing 8 wind turbine induction generator (WTIG) internal signals. These signals can be individually accessed by using the Bus Selector block.

2.2.1 Power converter

This project used power converter the two Universal Bridge blocks in an ac/dc/ac converter consisting of a rectifier feeding an IGBT inverter through a DC link. The inverter is pulse-width modulated (PWM) to produce a three-phase 50 Hz sinusoidal voltage to the load. In this project the inverter chopping frequency is 2000 Hz. The IGBT inverter is controlled with a PI regulator in order to maintain a 1 pu voltage (415 Vrms, 50 Hz) at the load terminals.

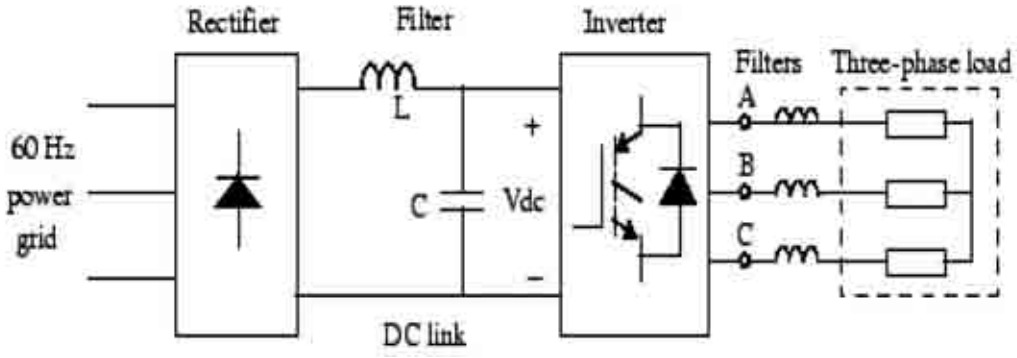
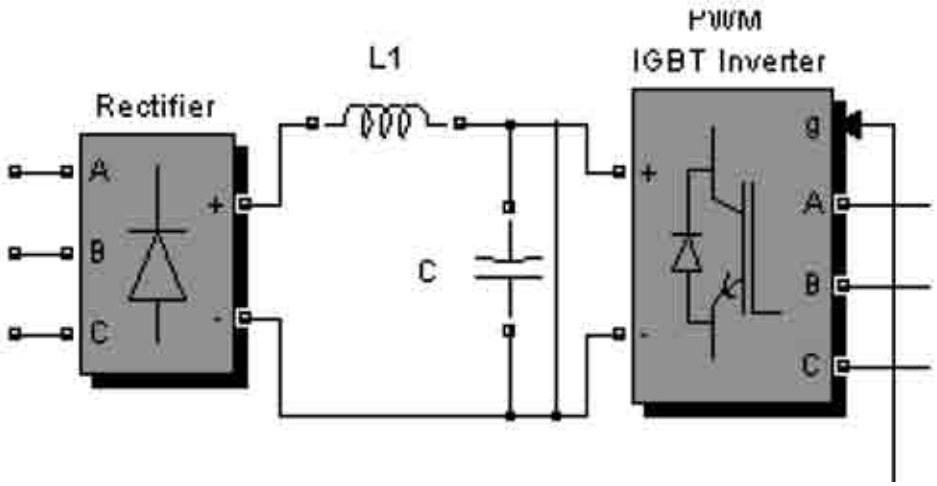


Figure 8: AC-DC-AC PWM Converter

Figure 9: AC-DC-AC PWM Converter Block



The Universal Bridge block implements a universal three-phase power converter that consists of up to six power switches connected in a bridge configuration. The type of power switch and converter configuration is selectable from the dialog box. The Universal Bridge block allows simulation of converters using both naturally commutated (line-commutated) power electronic devices (diodes or thyristors) and forced-commutated devices (GTO, IGBT, MOSFET). The Universal Bridge block is the basic block for building two-level voltage-sourced converters (VSC). The device numbering is different if the power electronic devices are naturally commutated or forced-commutated. For a naturally commutated three-phase converter (diode and thyristor), numbering follows the natural order of commutation.

3. Result And Discussion

3.1 Introduction

Simulation of the system allows for the design software to be critically evaluated without constructing the system. Necessary changes can therefore be made to the system without incurring additional costs. The system has been simulated using *Simulink*, a simulation software package provided by *MATLAB*.

This energy system simulation shows the results for 5 conditions where the output voltage depends to the wind speed and it stay constant during the changing in wind speed. The output voltage measured by the changing of RLC Load (in Watt). We also can measure the load current value during the changing of RLC load.

3.2 Project Results

All project simulation result can be display and monitor by scope measurement. Figure 4 shows the project simulation using a MATLAB Software. The turbine block connects directly to the rectifier (full bridge diode). The power bridge illustrates the use of two Universal Bridge blocks in an ac/dc/ac converter consisting of a rectifier feeding an IGBT inverter through a DC link. The inverter is pulse-width modulated (PWM) to produce a three-phase 50 Hz sinusoidal voltage to the load. In this project simulation the inverter chopping frequency is 2000 Hz.

The turbine generator produces a 3 phase, 415V, 50 Hz voltage at full capacity 100 KVA. This voltage feeds a 50 Hz, 0 to 100 KW load through an AC-DC-AC converter. The 415V, 50 Hz voltage obtained at rectified by a six pulse diode bridge. The filtered DC voltage is applied to an IGBT two-level inverter generating 50 Hz. The IGBT inverter uses Pulse Width Modulation (PWM) at a 2 kHz carrier frequency. The circuit is discretized at a sample time of 2 us.

The load voltage is regulated at 1 perunit (415 V rms) by a PI voltage regulator. The first output of the voltage regulator is a vector containing the three modulating signals used by the PMW Generator to generate the 6 IGBT pulses. The second output returns the modulation index.

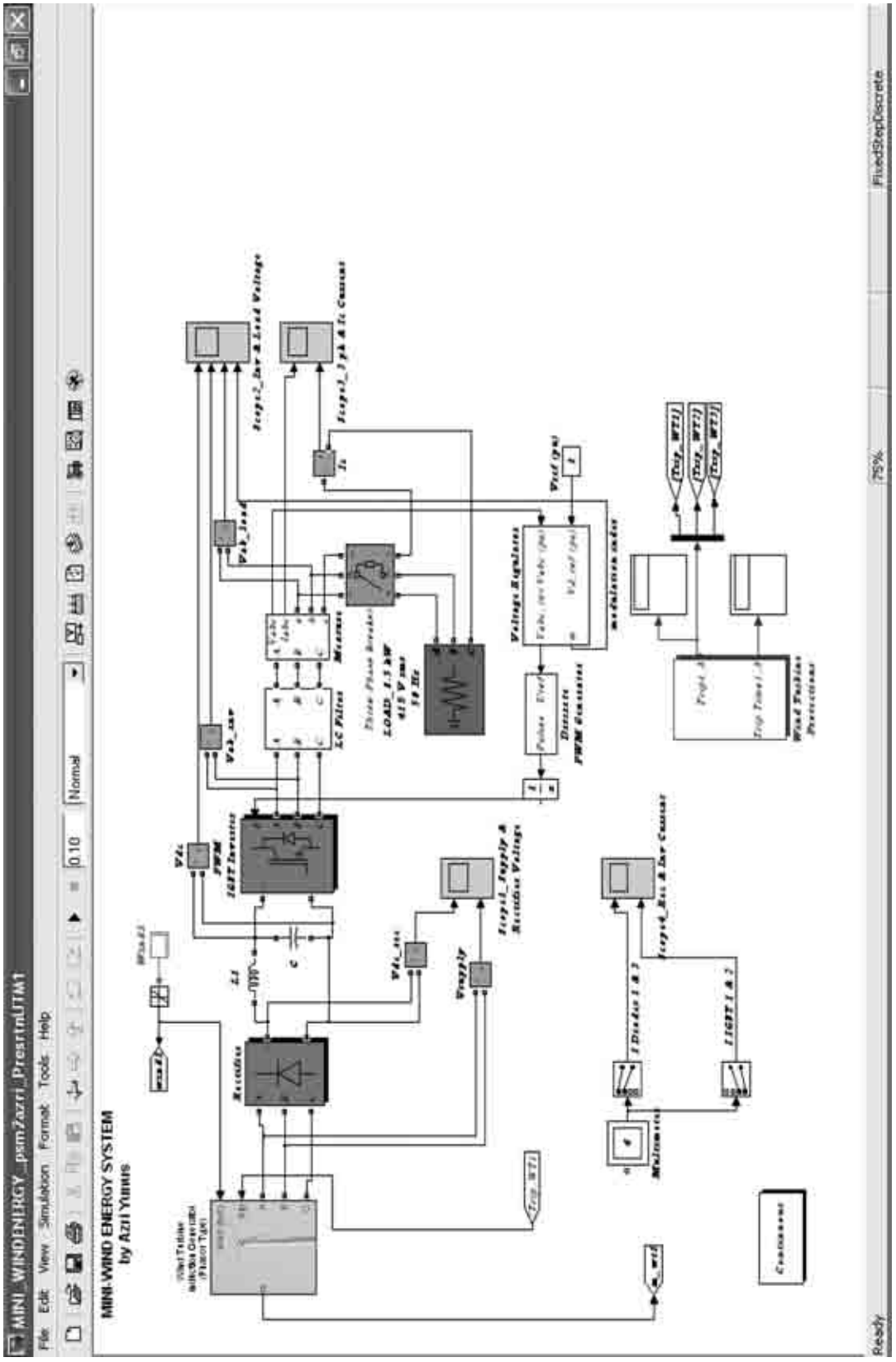


Figure 4: Wind Energy system simulation using simulink MATLAB

4. Conclusion And Recommendation

4.1.1 Conclusion

Wind energy system is one of the renewable energy sources that can be commercialized for reduces dependence on fossil fuels and reduce air emissions. At the same time reduces the global warming effected. Wind energy systems also are reliable, clean and have high potential for future energy market with average marginal cost one cent per kilowatt-hour. The wind energy system can be used for small, medium or grid system with wind farms system for higher usage of electricity. The wind energy system can be used for both system single phase and three phase system depend to the wind speed and size of wind turbine.

Using MATLAB simulation software, this project shows that wind energy meets the intent of the National Energy Policy that is, a renewable source of electricity that reduces dependence on usual energy sources and at the same time reduces air emissions. Using MATLAB simulation software, we can observe the output characteristic of wind energy model by the input or output (load) parameters. We found that by changing the load capacity, the output voltage still constant with peak voltage value 590 Volt (415 Vrms). We also found that the load current varies with load changing and the DC output voltage change depend on the value of input voltage from turbine generator and capacity of load.

Using MATLAB simulation software, we also can design and observe the power converter characteristic by using IGBT device. The observation of characteristic of power converter was done with different value of load capacity and we found that the parameter value must select truly for good and stability output.

Using MATLAB simulation software, we also can control the system in order to meet the requirement of load capacity especially for commercial building application. This simulation was successful with simulation of load capacity for maximum 100 Kilowatt and the three phase output voltage 415 Volt was produced constantly.

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E10 - Design and Development of an Industrial Cartesian Robot for Engraving and Milling Application

Ong Joo Hun
Pusat Latihan Teknologi Tinggi (ADTEC) Kulim
ongjh188@yahoo.com.my

Abstrak

Kertas ini ditulis untuk menerangkan proses rekabentuk dan pembangunan satu Cartesian Robot untuk kegunaan dalam industri terutamanya untuk applikasi ukiran kayu dan mengisar logam. Rekabentuk dan pembangunan projek akan melibatkan dua bahagian penting iaitu bahagian pertama yang melibatkan rekabentuk, perkakasan, pendawaian dan pengujian elemen manakala bahagian kedua pula meliputi bidang perisian yang mengawal pergerakan paksi robot. Rekabentuk perkakasan bolehlah dikategorikan kepada dua, iaitu rekabentuk elektrikal dan rekabentuk mekanikal. Rekabentuk elektrikal merangkumi pendawaian komponen-komponen kawalan seperti kawalan stepper/servo motor, masukan dan keluaran, sumber bekalan kuasa dan peranti keselamatan. Rekabentuk mekanikal pula meliputi lukisan mekanikal dengan perisian AutoCAD dan fabrikasi bahagian-bahagian robot berkenaan. Rekabentuk perisian pula melibatkan pemprograman untuk memacu lengan robot kepada kedudukan yang dikehendaki dengan tepat. Ia juga melibatkan penggunaan modul-modul masukan dan keluaran, carta-carta aliran program, dan pengaturcaraan perisian jenis Graphical User Interface (GUI) untuk tujuan pemantauan sistem. Secara asasnya, programmable automation controller (PAC) jenama CTC 2600XM telah digunakan sebagai pengawal utama robot ini. Ia merupakan pengawal yang menggunakan bahasa statement list untuk mengawal stepper / servo motor bagi 3 paksi robot dan segala peranti masukan dan keluaran. Projek ini melibatkan sistem pacuan dan transmisi mekanikal serta sistem penderiaan demi menjadikan sistem robotik ini mempunyai kebolehulangan dan ketepatan yang tinggi supaya dapat menghasilkan produk yang berkualiti.

Keywords: *Cartesian Robot, Rekabentuk Elektrikal, Rekabentuk Mekanikal, Rekabentuk Perisian*

1. Pengenalan

Cartesian robot ini direkabentuk dan dibangunkan untuk menyelesaikan proses pengukiran (*engraving*) dan pengisaran (*milling*) logam di rumah atau bengkel yang menggunakan bekalan kuasa elektrik 240VAC. Cartesian robot ini bersifat mudah alih dan dapat mengurangkan kos pengeluaran dan masa berbanding dengan mesin CNC yang mahal dari segi kos pembeliannya serta terjaminnya kualiti produk yang dihasilkan. Inovasi ini bertujuan untuk menyahut cabaran ke-enam Wawasan 2020 iaitu mewujudkan masyarakat saintifik dan progresif, masyarakat yang mempunyai daya perubahan tinggi dan berpandangan ke depan, yang bukan sahaja menjadi pengguna teknologi tetapi juga penyumbang kepada tamadun saintifik dan teknologi masa depan. Ini juga selaras dengan kehendak nilai asas pelengkap pertama Lapan Tonggak Perdana Pentadbiran iaitu membudayakan kreativiti dan inovasi di kalangan pendidik IPT supaya melahirkan modal insan yang berkualiti, berkemahiran tinggi, berdaya tahan dan berdaya saing bagi menjayakan transformasi Model Baru Ekonomi dan seterusnya melonjakkan ekonomi Malaysia menjadi negara maju menjelang tahun 2020.

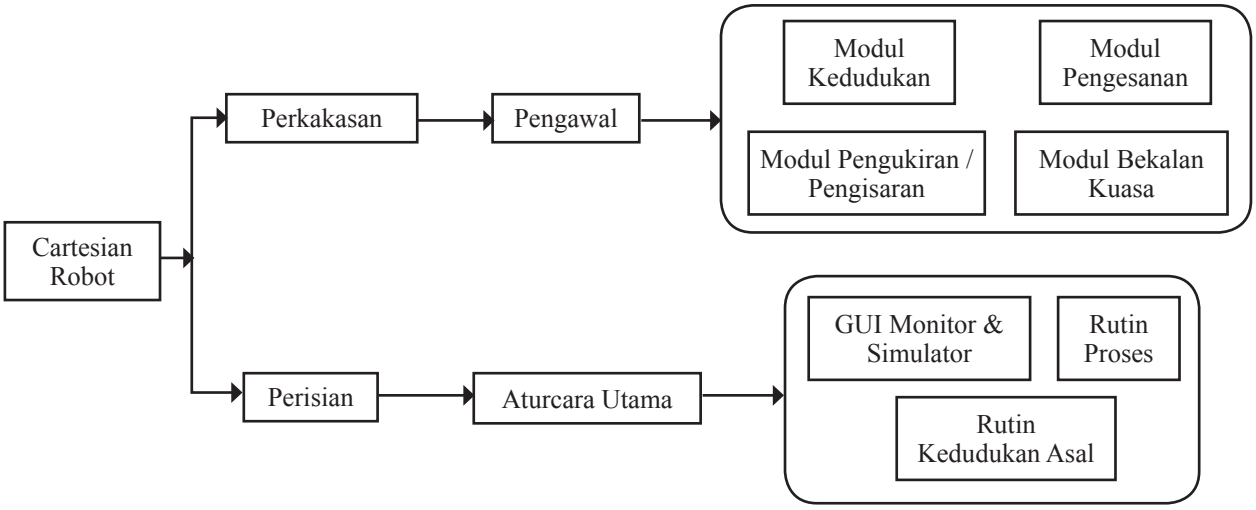
Robot merupakan komponen automasi untuk melaksanakan kerja-kerja yang berat, sukar dan berulangan melalui suruhan yang dimasukkan. Robot boleh diaturcara semula dan biasanya memiliki beberapa darjah kebebasan (Degree of Freedom) dan berkeupayaan berkomunikasi dengan peranti-peranti automasi yang lain. Oleh itu, robot memainkan peranan yang penting dalam Sistem Pembuatan Fleksible (FMS) dan Sistem Pembuatan Berintegrasi Komponen (CIM).

Robot perindustrian mempunyai pelbagai jenis tatarajah berdasarkan bentuk geometri dan sampul kerjanya seperti tatarajah cartesian, selinder, polar, revolute, SCARA, lengan bandul dan lengan berbilang

sendi. Untuk industri automasi, cartesian robot telah digunakan secara meluas dan kegunaannya merangkumi pempaletan, penyimpanan dan pengembalian produk secara automatik, pengeloloan bahan dan pemasangan automatik.

Tatarajah Cartesian robot dipilih untuk proses mengukir dan mengisar kerana lebih ekonomik berbanding dengan tatarajah robot yang lain. Sampul kerjanya yang besar dan tidak terhad oleh capaian lengan robot memang sesuai untuk digunakan dalam applikasi industri.

Kertas ini membincangkan proses pembangunan robot ini yang merangkumi rekabentuk perkakasan dan proses ujian seiringan dengan pembangunan perisian. Bahagian perkakasan dibahagikan kepada 4 modul utama iaitu modul kedudukan, modul bekalan kuasa, modul pengesanan dan modul pengukiran produk. Bahagian perisian pula bertanggungjawab untuk menggerakkan pengolah robot kepada kedudukan yang dikehendaki dan pada masa yang sama, ia mengawal peranti masukan dan keluaran sistem. Program yang direka mempunyai pelbagai fungsi seperti rutin kedudukan asal dan rutin proses. Robot ini berupaya menghubungkan segala peranti, modul dan sistem kawalan seperti penggunaan stepper motor, sistem elektro-pneumatik, peranti pengesan (magnetik, optikal & suis mekanikal) dan geganti. Selain itu, robot ini juga mempunyai ciri-ciri keselamatan terhadap dirinya dan juga operator. (Rajah 1 dan Rajah 2)

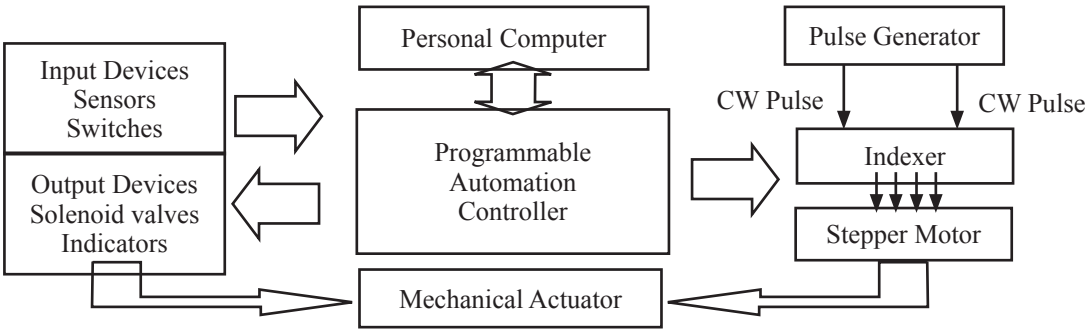


Rajah 1. Gambarajah blok struktur projek

2. Pernyataan Masalah

Kita dikehendaki merekacipta satu cartesian robot yang dapat menyelesaikan proses pengukiran (*engraving*) dan pengisaran (*milling*) logam di rumah / bengkel yang menggunakan bekalan kuasa 240VAC. Cartesian robot yang dicipta mesti bersifat mudah alih dan dapat mengurangkan kos pengeluaran dan masa berbanding dengan mesin CNC yang mahal dari segi kos pembeliannya. Cartesian robot yang direka mesti berupaya untuk memperoleh kedudukan yang tepat dan bersesuaian untuk melakukan applikasi industri masa kini. Kedudukan robot ini boleh diaturcara semula melalui perisian seperti aturcara jenis statement list dan mengandungi sistem pemantauan jenis GUI untuk kawalan keseluruhan robot.

Proses untuk membangunkan sistem robotik ini adalah rekabentuk sistem mekaninal, sistem elektrikal, bahagian mekanikal seperti jig & fixture, Programmable automation controller dan GUI programming, integrasi perkakasan dan perisian, dan proses terakhir seperti troubleshooting, modifikasi sub-sistem yang bermasalah, pengujian dan pentauliahan sistem.



Rajah 2. Blok diagram sistem robotik

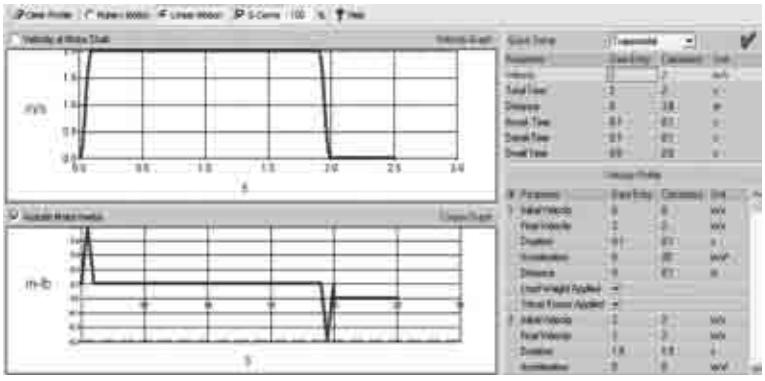
3. Rekabentuk Sistem Mekanikal

Rekabentuk sistem mekanikal pada cartesian robot merangkumi rekaan ketiga-tiga paksi gerakan lengan robot iaitu paksi X, Y dan Z. Lengan robot ini direka untuk mengukir atau mengisar logam dengan mengikut corak yang dikehendaki. Pemilihan komponen-komponen yang sesuai amat penting dalam pembinaan ketiga-tiga paksi robot. Pemilihan pengesan hujung seperti alat pengukir industri juga penting supaya dapat menghasilkan produk ukiran atau kisaran yang berkualiti. Rekabentuk dan pembinaan ditumpukan pada modul kedudukan (*positioning*) yang menggunakan kaedah leadscrew driven system oleh pacuan stepper motor.

Projek ini menggunakan 3 buah stepper motor iaitu 2 buah stepper motor 5 phase dan 1 buah stepper motor 2 fasa. Motor 5 fasa dipilih untuk paksi Y dan Z demi mendapatkan kejituan dan ketepatan yang diingini. Ketahanan dan keupayaan untuk paksi XYZ dapat diukur dengan menggunakan perisian motor sizing. (Rajah 3, Rajah 4 dan Rajah 5).

Rajah 3. Pacuan leadscrew untuk paksi XYZ

Rajah 4. Pemilihan stepper motor

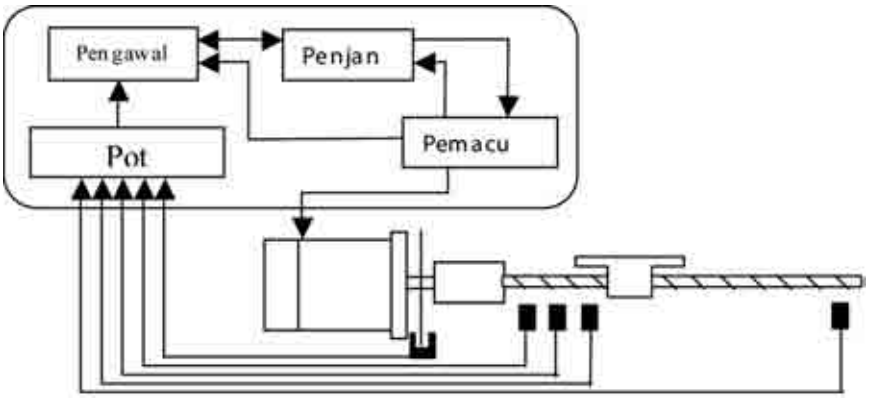


Rajah 5. Velocity profile untuk stepper motor

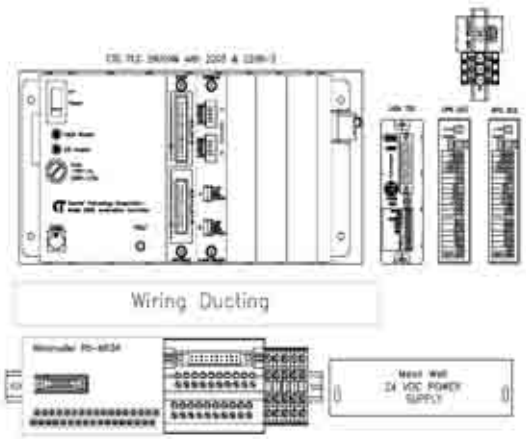
4. Rekabentuk Sistem Elektrikal

Rekabentuk sistem elektrikal pada robot ini akan merangkumi penggunaan modul bekalan kuasa, modul pengesanan dan segala pendawaian komponen-komponen elektrik dengan pengawal CTC (Control Technology Corporation). Sistem elektrikal robot mesti mengandungi litar pelindungan arus dan voltan beban lampau. Selain itu, untuk mengapplikasikan robot ini dalam proses mengukir dan mengisar, maka program QuickStep digunakan untuk mengaturcara setiap pergerakan paksi robot untuk menghasilkan produk yang berkualiti.

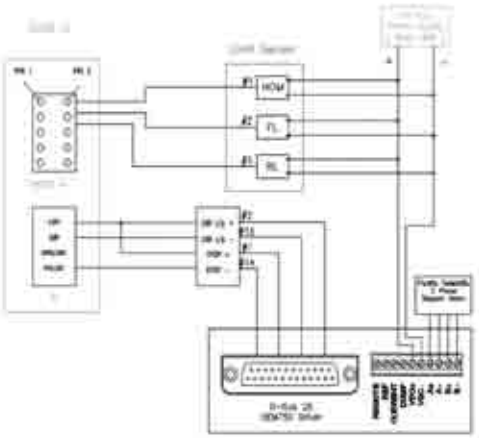
Pergerakan tiga paksi sistem robotik ini adalah dikawal oleh stepper motor dengan melalui aturcara QuickStep. Stepper motor beroperasi dengan berprinsipkan tarikan dan tolakan daya magnetik. Stepper menukarkan denyutan digital kepada putaran aci mekanikal untuk menggerakkan skru dulu (leadscrew) dan beban. Pergerakan stepper motor adalah berkadar terus kepada bilangan masukan denyutan dan kelajuannya bergantung pada frekuensi denyutan yang dihantar. Apabila stepper motor digunakan dalam kawalan kedudukan (positioning), aci motor mesti balik ke kedudukan asalan dan operasi untuk membalikkan aci motor ke kedudukan ini dipanggil mengesan kedudukan asalan. Tiga suis had diperlukan dalam pergerakan paksi untuk mengesan dan elak daripada lebihan gerakan yang boleh merosakkan sistem (Rajah 6, Rajah 7 dan Rajah 8).



Rajah 6. Leadscrew dan suis had (limit switch)



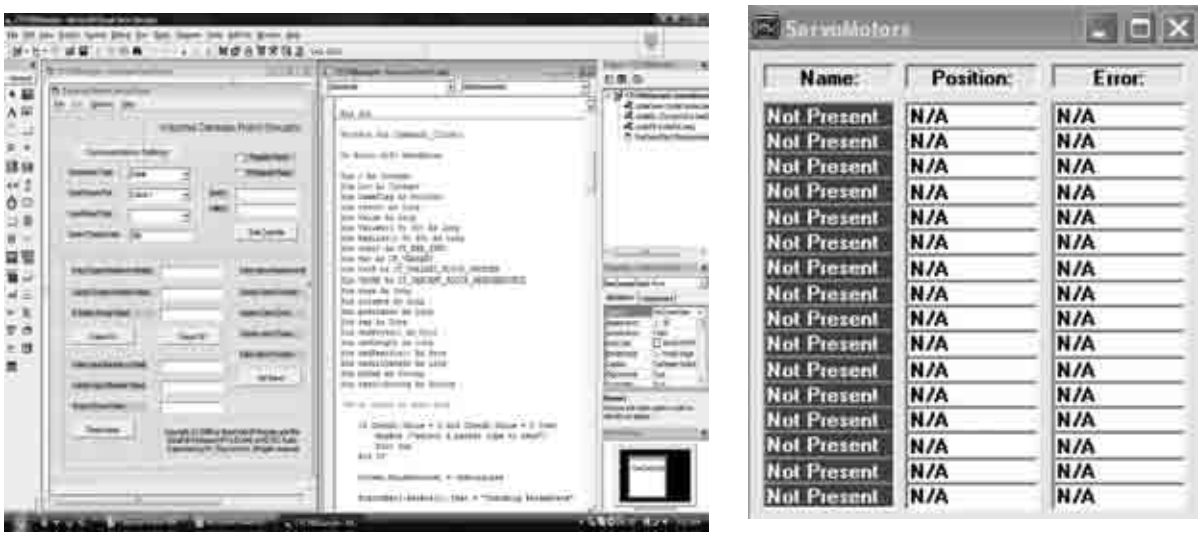
Rajah 7. Sistem kawalan elektrikal robot



Rajah 8. Litar skematik stepper motor driver

5. Rekabentuk Perisian Graphical User Interface

Simulator berbentuk Graphical User Interface (GUI) yang dibangunkan dengan MS Visual Basic 6.0 telah digunakan untuk mengawal operasi keseluruhan sistem. GUI ini digunakan untuk gambaran secara grafik demi memudahkan pengguna berinteraksi dengan mesin yang dikawal di mana pengguna boleh memantau pergerakan setiap paksi robot dan masukan serta keluaran setiap peranti dalam sistem.

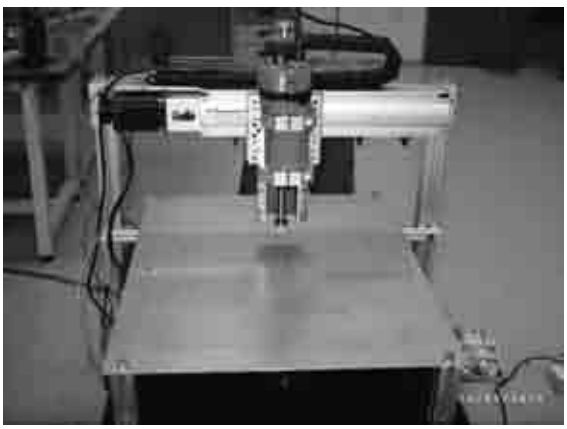


Rajah 9. Graphical User Interface (GUI) untuk sistem robotik

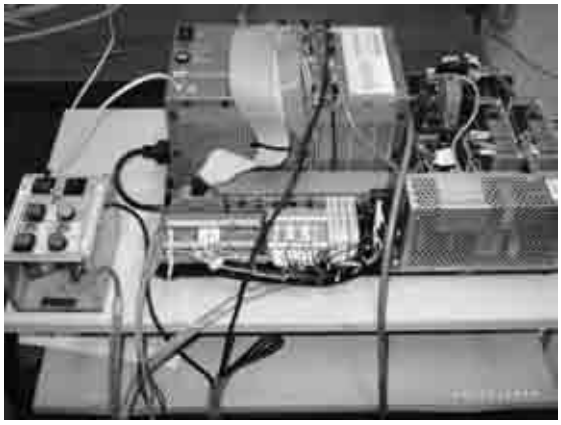
6. Keputusan

Rajah 10 dan Rajah 11 menunjukkan cartesian robot yang telah siap dibina dan litar pendawaian bagi komponen-komponen yang terdiri daripada sumber bekalan kuasa, pengawal, geganti, pengesan dan blok terminal untuk penyambungan wayar. Robot ini telah diuji prestasinya dengan menggunakan dynamic monitoring antara pengawal CTC dengan computer melalui laluan kabel RS232C.

GUI yang direka telah digunakan untuk menguji program status, controller configuration, numeric registers, flags, servo status, digital inputs atau outputs sebelum operasi sebenar dan semasa operasi robot. Dengan menggunakan GUI ini, troubleshooting dan diagnostics telah digunakan untuk menguji pendawaian setiap komponen ke atas robot. Kita boleh "force" (key in) nilai baru ke dalam numeric registers untuk mengawal critical time delays, kelajuan dan kedudukan stepper / servo motor sebelum atau semasa robot beroperasi. Pelarasan dynamic real-time ini telah membenarkan kita mengesan perubahan dengan cepat. Ini menjimatkan masa kita dalam menghasilkan program yang baik atau pelarasan pada mesin demi meningkatkan produktiviti.



Rajah 10. Industrial cartesian robot



Rajah 11. Litar pendawaian komponen elektrik

7. Kesimpulan

Sistem cartesian robot yang direkabentuk telah berjaya direka dan diuji prestasinya untuk applikasi mengukir dan mengisar logam. Sistem ini berupaya mengendalikan proses mengukir dan mengisar logam secara automatik berdasarkan program yang telah dibuat. Robot ini berupaya untuk mendapatkan kedudukan yang tepat dan mempunyai kebolehulangan yang baik. Ia boleh diaturcara semula dan boleh digunakan untuk sebarang applikasi yang melibatkan tiga paksi pergerakan linear dengan cara melakukan sedikit perubahan pada aturcara dan jenis pencengkam berdasarkan kehendak applikasi. Sistem robotik ini dilindungi sepenuhnya oleh elemen-elemen pengesanan yang disambungkan pada kerangka robot ini. Robot ini tidak akan melepasi had maksimum sampul kerjanya dan ia akan berhenti dengan serta merta selepas had ini. Robot ini akan berhenti daripada beroperasi jika terdapat halangan yang memasuki ruang kerja robot. Ini merupakan satu bentuk keselamatan bagi robot dan pengguna. Selain itu, robot ini juga dilindungi daripada arus dan voltan beban lampau dengan bantuan pemutus litar dan fius.

8. Rujukan

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E11 - Portable Chiller Trainer

Roslan Zulkifli
Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam
roslan@adtecsa.gov.my

Abstrak

Dalam menilai dunia yang serba canggih serta berteknologi tinggi masa kini, penggunaan sistem penyejukbekuan dan penyamanan udara tidak kurang pentingnya dalam merentasi kecanggihan teknologi dunia masa kini. Keadaan ini jelas menunjukkan bahawa penggunaan sistem penyejukbekuan dan penyamanan udara amat penting dalam pembangunan industri di Negara kita pada masa kini dari masa ke semasa perkembangan dalam bidang ini sedikit sebanyak memberi satu kesan baru dengan percambahan penghasilan produk yang berkaitan dengan bidang ini. Di atas kesedaran inilah, usaha dalam menghasilkan projek ini dapat memberi manfaat kepada semua dalam melaksanakan pengajaran yang lebih berkesan dan sistematik. Dengan terhasilnya Air Cooled Chiller, satu projek dapat membantu proses pengajaran dan pembelajaran tentang sebuah unit penyaman udara yang menggunakan angin sebagai bahan pendingin kedua. Disamping itu juga projek ini dapat membantu pihak ADTEC untuk digunakan sebagai peralatan dan kemudahan serta menjimatkan kos pengeluaran.

1. Pengenalan

Dalam bidang penyejukbekuan dan penyamanan udara, penggunaan sistem *air cooled chiller* adalah begitu popular bagi sesebuah kawasan atau bagunan yang besar. Dengan itu kami telah diberi ilham oleh Allah s.w.t bagi mengurangkan kos pemasangan yang hanya boleh diletakkan pada satu tempat kepada satu unit yang mudah alih iaitu *portable air cooled chiller*.

Portable air cooled chiller(PACC) merupakan sebuah projek yang bukan sahaja menjimatkan kos malah dapat dijadikan alat bantuan mengajar untuk **Modul Testing and Comissioning** bagi **Tahap 4**. PACC juga memenuhi **Terminal Performance Objective** (TPO) pembelajaran iaitu Conduct System Inspection,Testing and Comissioning and Performnace Test.

2. Objektif Projek

Terdapat beberapa objektif kajian yang ingin dicapai dalam kajian ini. Objektif tersebut adalah seperti berikut:-

1. ADTEC Shah Alam hanya mempunyai sebuah sistem *chiller jenis water cooled* berkapasiti 15 Ton dan tidak boleh diallihkan ke lokasi yang lain.(Rajah 1)
2. Diaplikasikan untuk tujuan pembelajaran dan kegunaan bila adanya majlis ditempat terbuka atau dewan yang tidak mempunyai alat hawa dingin yang boleh digunakan secara terus untuk menyamankan dan memberi keselesaan.
3. *Portable air cooled chiller* yang sedia ada dipasaran tidak sesuai untuk kegunaan latihan kerana ianya tidak direkabentuk untuk tujuan unit trainer disamping itu juga harga yang mahal.
4. Tidak terdapat *Portable air cooled chiller* yang bersesuain untuk latihan amali di pasaran.Rajah 2
5. Menarik perhatian para pengguna/pelajar khususnya, pada unit penyamanan udara yang berkeupayaan tinggi.Sebagai alat bantu mengajar dan pembelajaran.

6. Menjimatkan kos pembelian alatan oleh pihak JTM khususnya ADTEC Shah Alam.

7. Projek ini boleh dikomersialkan dipasaran kerana ianya mudah dikendalikan, mesra alam dan menjimatkan dari segi kos pemasangan dan boleh diguanakan pada bil-bila masa diperlukan.

Rajah 1: Water cooled chiller15 ton (Yang sedia ada dibengkel)

Rajah 2: Portable air cooled chiller(yang ada dipasaran)

Rajah 3: Portable air cooled chiller yang dihasilkan

3. Pendekatan

3.1 *Portable air cooled chiller* unit dipasang mengikut tahap keupayaan sebenar sistem *air cooled chiller* digunakan di bagunan-bagunan mahupun industri-industri yang memerlukan keupayan penyejukan yang tinggi.

3.2 Sistem ini beroperasi dengan menggunakan gas bahan pendingin R22 sebagai bahan penyejukan pertama untuk menyejukan air (water) didalam gelong penyejat (chiller) secara terus. Air yang telah disejukan sehingga 4°C akan dipam oleh sebuah pam air untuk dialirkan ke alat pengembus udara (AHU/FCU) dan udara sejuk disebarkan keruang atau kawasan yang dinyamanakan .

3.3 Unit peleuwap diletakan diluar hanya air sejuk dipam melalui paip mudah lentur (flexible) untuk menghubungkan unit penyejat/pengembus udara dibahagian dalam bangunan/ruang yang didinginkan

METHODOLOGI

Diagram Operasi dan Konsep Latihan yang digunakan pada *Portable air cooled chiller trainer*

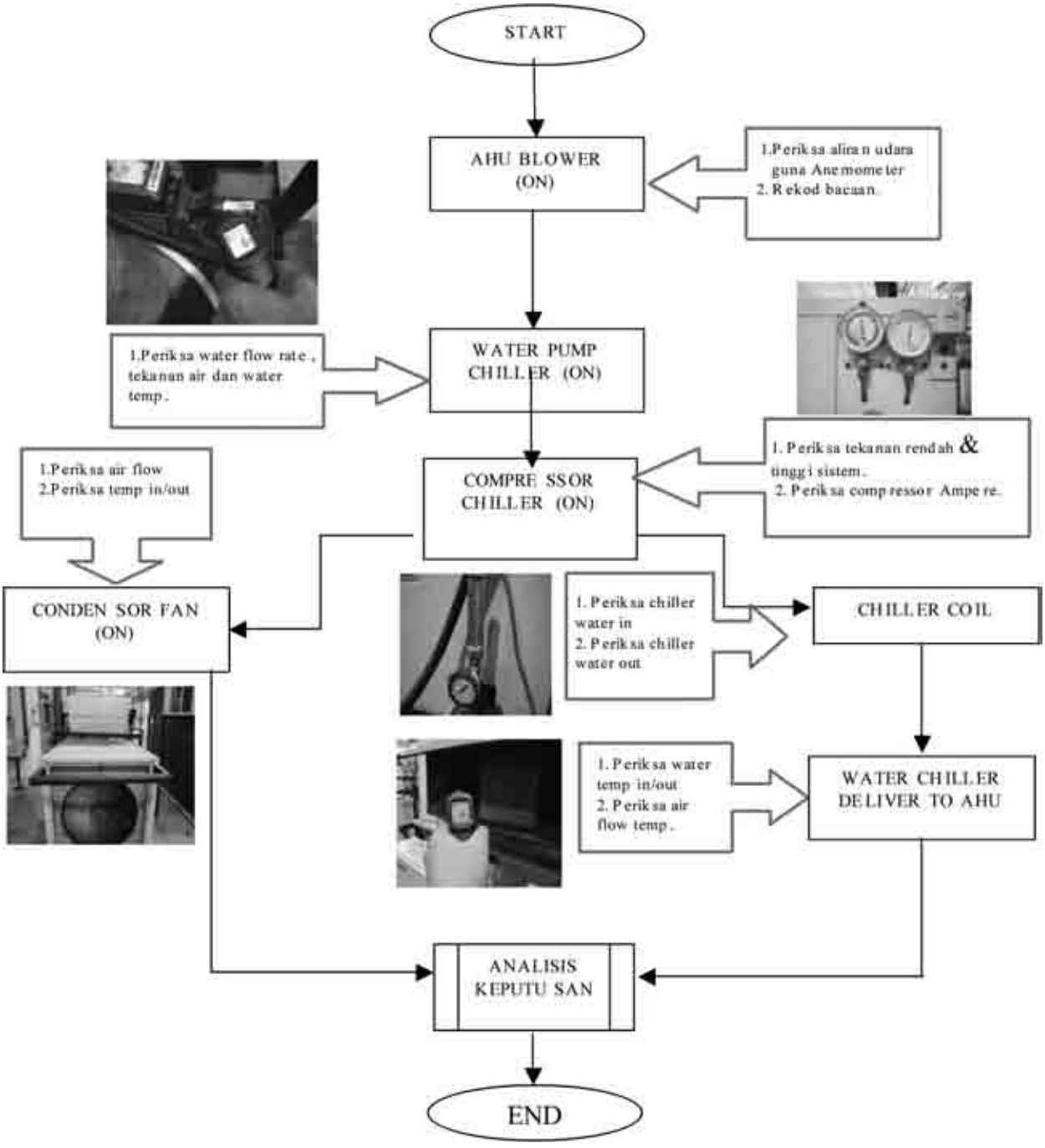
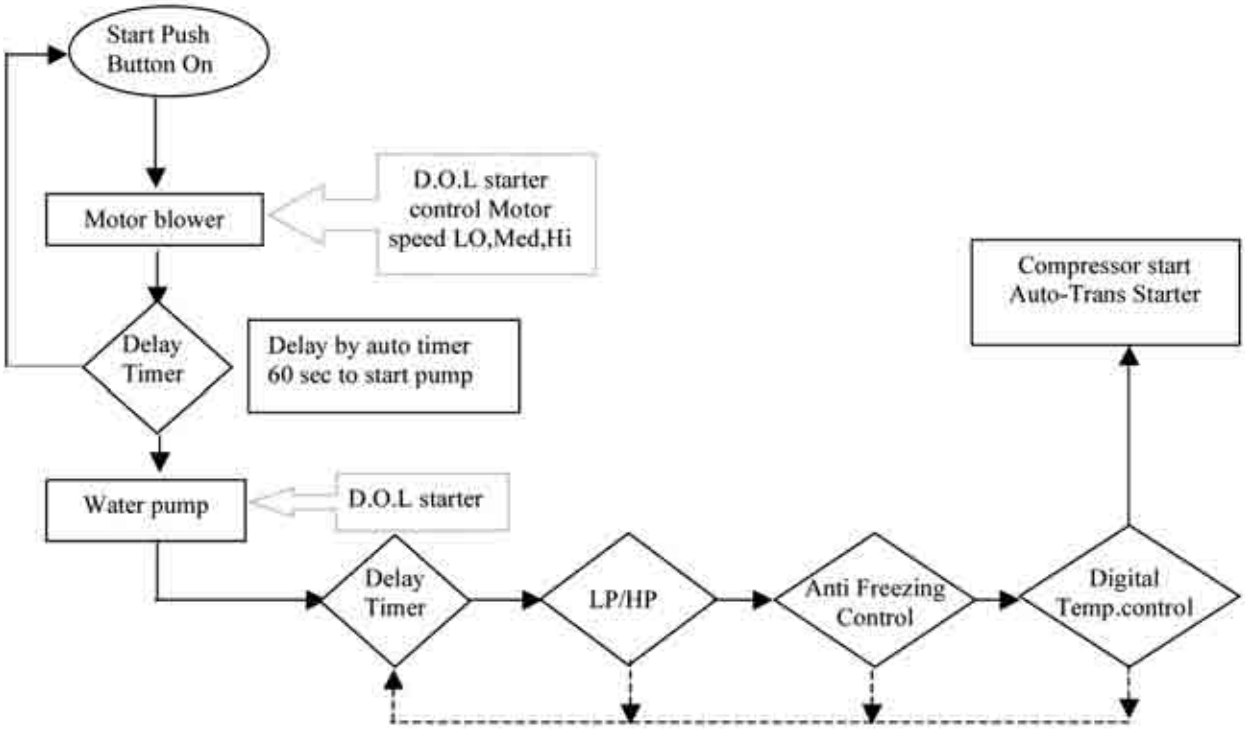
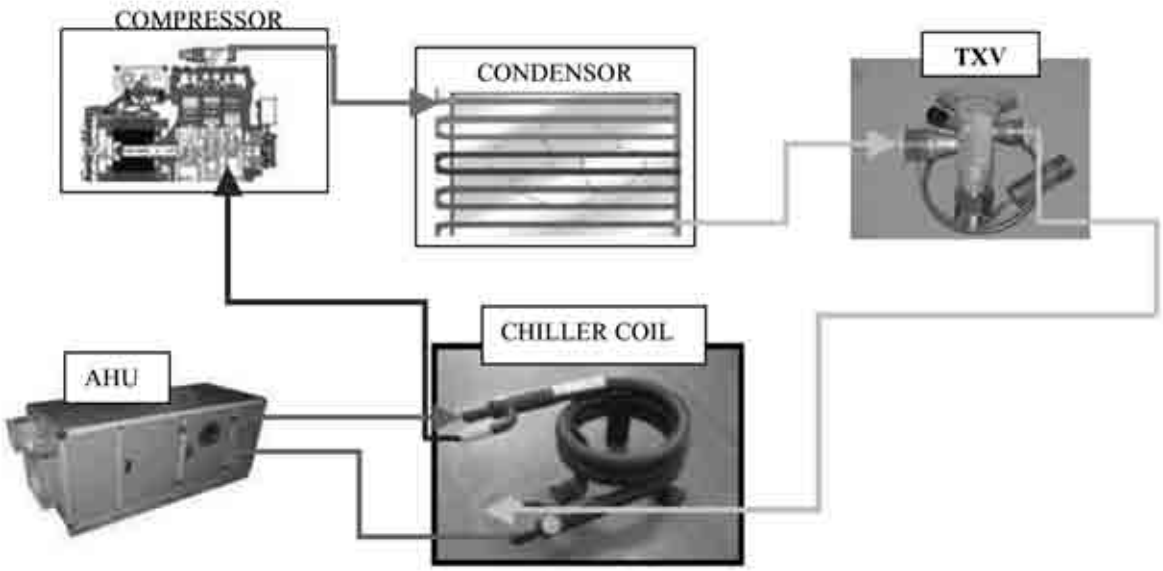


Diagram Operasi dan Konsep Elektrikal yang digunakan pada *Portable air cooled chiller trainer*



Komponen Utama Mekanikal *Portable air cooled chiller trainer*



Spesifikasi Minima Projek	
Kapasiti penyejukan : 100,000 Btu/hr	Compressor : ScrollKapasiti compressor : 10 hp
Pam air : ¼ hp	Kapasiti kipas penyejat : ½ hp
Sistem elektrik : 3 fasa/415 volt/ 50hz (Auto-trans starter)	Comp Ampere : 25 ampere

4. Kelebihan

4.1 Boleh digunakan dimana sahaja dalam bengkel untuk tujuan latihan

4.2 Kupayaan chiller adalah kapasiti sebenar

4.3 Sesuai untuk latihan buka/pasang tanpa melepaskan gas CFC/HCFC

4.4 Pemantuan penggunaan dengan ciri-ciri asas keselamatan sistem elektrik dan mekanikal

4.5 Mudah dikendalikan

4.6 Menjimatkan masa latihan /penerangan semasa proses pengajaran

4.7 Penjimatan kos elektrik dan kos pembelian peralatan latihan

5. Hasil Ujian Kendalian Sistem

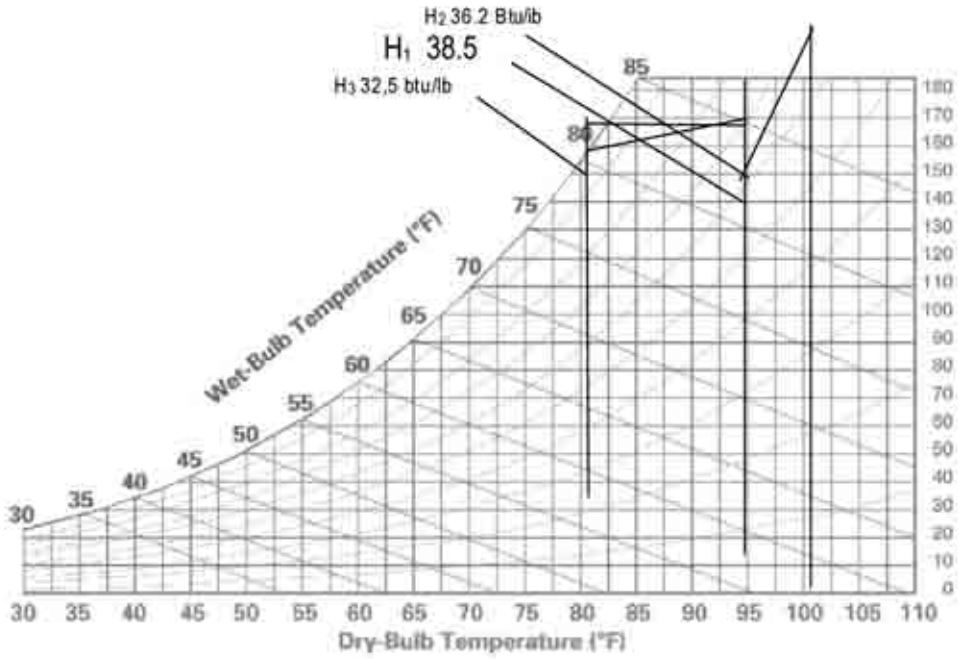
5.1 Ujian keatas sistem telah dilakukan selama 8 jam tanpa henti, hasil ujian diambil pada waktu puncak beban (peak-load) jam 2.30 /3.30 petang seperti jadual dibawah ;

No	Perkara di uji	Data Diperolehi
1	Ambient Temperature	DB 33 °C WB : 29 °C
2	AHU Supply Air (Air off) temperature	DB 23 °C WB : 20.5°C
3	Return Air (Air on) temperature (room temp.)	DB 30 °C WB: 24°C
4	Water leaving temperature (Chiller)	10.3 °C
5	Water entering temperature (Chiller)	24.6°C
6	Different temperature (W/L and W/E)	14°C
7	Air flow AHU	199 ft/min
8	Condenser temperature Inlet air Outlet air	 DB : 32°C WB : 26°C DB : 38°C WB : 28.9°C
9	Air Flow condenser fan	220 ft/min
10	High pressure gauge Low pressure gauge	260 psig 64 psig
11	Compressore ampere	13 amp

Analisa Kesekapan sistem (System Performance analisyis)

1. Berdasarkan data ujian yang diperolehi analisa kecekapan sistem menggunakan graph psychometric seperti dibawah ;

Ambient Temperature	DB 33 °C /91°F WB : 29 °C / 84.2 °F
AHU Supply Air (Air off) temperature	DB 23. °C / 73.4 °F WB : 20.4°C / 68.9 °F
Return Air (Air on) temperature (room temp.)	DB 30 °C / 86 °F WB: 24°C / 75.2 °F



Sensible heat cooling (Eh_2-Eh_3) = 36.2 -32.5 = 3.7 Btu/Ib d.a
Latent heat cooling (Eh_1-Eh2) = 38.5 – 36.2 = 2.3 Btu/Ib d.a
Volume (supply air) = 13.7 cu.ft/lb
Total Cooling Capacity (TCC)
TCC (Btu/Hr) = 4.5 x CFM x (standard air flow) x (EH_1-LH_3)
= 4.5 x 605 x (14.1 cu.ft/lb) x (38.5 – 32.5)
13.073 cu.ft.lb

= **161,812 BTU/hr = 1.4 Ton/hr**

6. Kesimpulan

Secara keseluruhannya dengan menggunakan unit *portable chiller* ini beberapa ujian telah dilakukan samada didalam bilik atau diruang terbuka, sistem dapat berfungsi dengan selamat dan baik, suhu udara yang dinyamankan dapat mengekalkan udara dingin dibahagian keluar unit kendalian kipas (AHU) dan ianya boleh dimanafaatkan sebagai unit yang memberi keselesaan untuk digunakan dan sebagai unit latihan memdapatkan udara nyaman dan mesra alam.

7. Rujukan

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E12 - Security Alert System

Mohd Sani B. Saian
Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam

Abstrak

Di era yang canggih dan moden kini, arus perkembanagan teknologi juga semakin pesat dan maju menuju kepada matlamat utama wawasan 2020. Pelbagai produk baru kini dapat dihasilkan dengan bentuk yang lebih unik, kreatif dan inovatif sejajar dengan matlamat kerajaan yang ingin melahirkan pelajar yang berkemahiran kursusnya dalam bidang industri sekarang. Dengan adanya idea-idea yang bernas daripada belia kini, maka kreativiti yang dihasilkan dapat digunakan bersesuain dengan era dunia globalisasi. Daripada itu maka saya telah mencipta ***"Security Alert System"*** *dimana matlamatnya adalah untuk menjaga keselamatan. Dan yang penting dapat menjaga keselamatan pada barang yang berharga.*

Keyword*: Keselamatan*

1. Pengenalan

Menjelang zaman era kegemilangan, pelbagai teknologi yang serba canggih dan moden telah berkembang bak cendawan tumbuh selepas hujan. Perkembangan ini telah menjadi sebahagian keperluan dalam kehidupan seharian kita. Seperti yang kita ketahui, negara kita Malaysia adalah salah sebuah negara termaju di persada dunia selaras dengan pembangunan yang telah kita capai menuju wawasan 2020. Pelbagai usaha telah di buat untuk mencapai matlamat ini.Projek ini di reka bagi memudahkan lagi para pekerja dalam pengurusan khususnya dalam keselamatan barang. Ia adalah salah satu elemen sistem yang cekap. Dengan adanya projek ini, dapat membantu sedikit sebanyak dalam menjaga keselamatan bagi barang-barang yang berharga dan bernilai. Projek ini menggunakan program PIC ***(Programmable Intergrated Circuit)*** yang digunakan sebagai otak kepada sistem kawalan kerana ianya telah diprogramkan supaya mengawal keseluruhan operasi input dan output.

2. Objektif Projek

Projek ***"Security Alert System "*** di reka khas untuk memudahkan pekerja menjaga keselamatan barang-barang yang terdapat di stor atau makmal di mana kawasan sistem robot ini adalah barang yang bernilai. Objektif utama projek ini seperti berikut ;-

i. Menjaga keselamatan di kawasan yang penting.
ii. Mengelakkan berlakunya kecurian dan kerosakan
iii. Menjimatkan ruang kerja
iv. Sistem yang cekap dan selamat
v. Mempelajari teknik programming
vi. Mempelajari teknik membuat litar

3. Methodologi Projek

3.1 Perkakasan

Dalam penyediaan projek ini, perkara yang paling penting ialah menitik beratkan penggunaan bahan dan peralatan kerana ia akan menentukan bagaimana terhasilnya projek nanti. Berikut adalah bahan dan peralatan yang telah digunakan sepanjang projek ini.

1. DC Geared Motor Dan Aluminium
   i) Digunakan bagi menggerakkan pintu motor
   ii) Pergerakkan boleh dikendali dengan FORWARD atau REVERSE
   iii) Aluminium digunakan untuk membuat rangka

2. Buzzer dan Lampu
   Digunakan untuk memberi isyarat sekiranya berlaku kecurian atau kerosakan pada sistem.

3. Transistor
   Fungsi transistor ialah menggandakan arus, sebagai contoh ia boleh digunakan untuk menggandakan arus keluaran yang kecil untuk menghidupkan lampu, relay atau sebagai peranti berarus tinggi..

4. Enhanced 10A Motor Driver
   i) Litar ini diguna untuk mengawal pergerakkan motor forward ataupun reverse, kelajuan motor dan lain-lain lagi.
   ii) Ia direka dengan Dimension: 6cm x 4.5cm

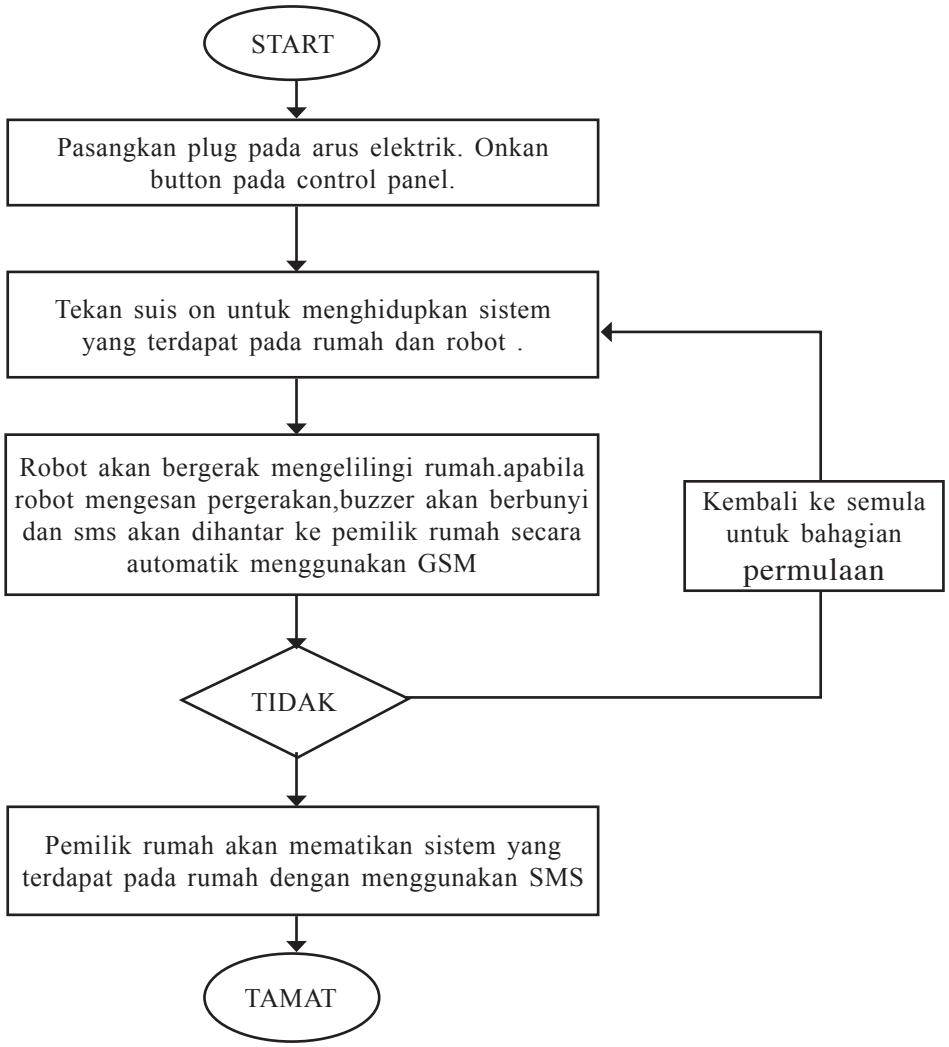
5. Infrared Sensor & GSM Module

3.2 Operasi Kerja

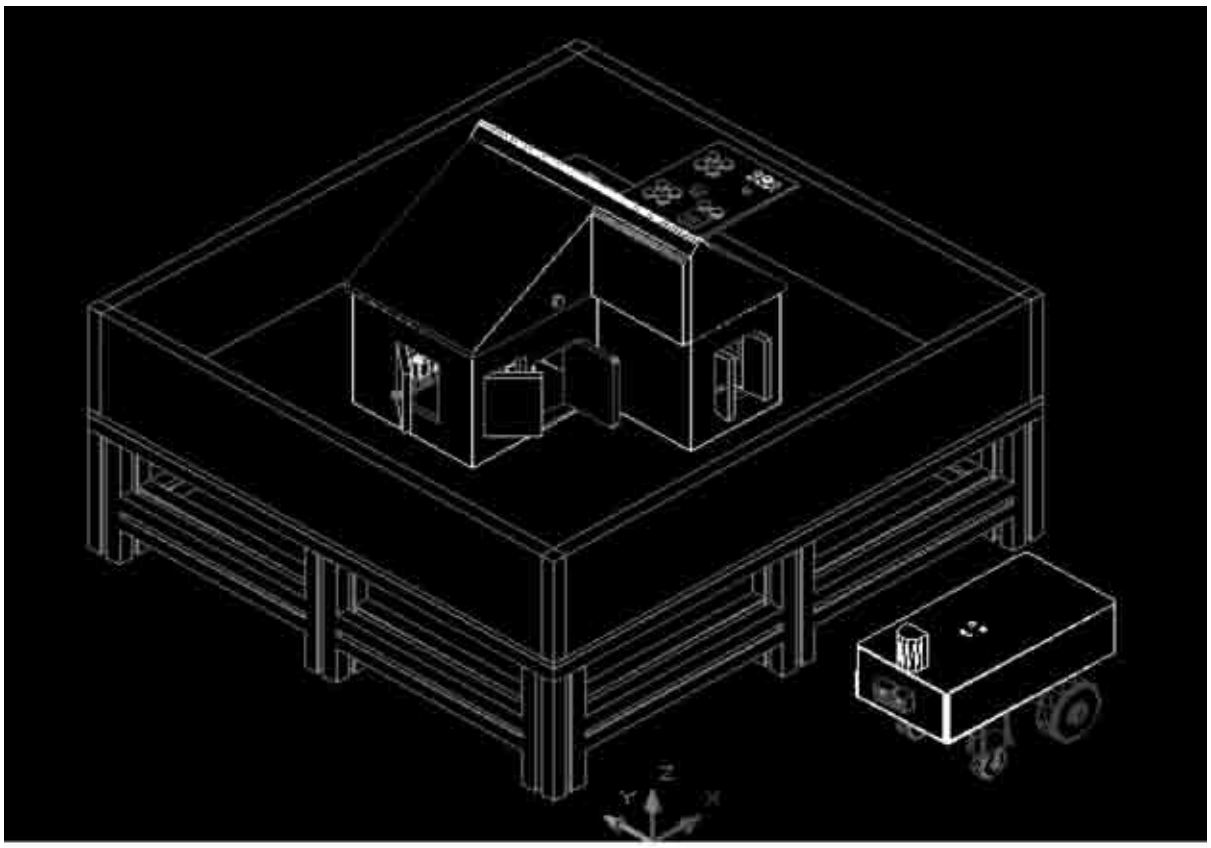
Projek ini menggunakan program PIC ***(Programmable Intergrated Circuit).*** Ia digunakan sebagai jantung kerana ianya telah diprogramkan supaya mengawal keseluruhan operasi input dan output. Dimana robot digunakan sebagai alat pengesan yang akan mengelilingi rumah.Selepas robot mengesan sebarang pergerakan, buzzer yang terdapat pada badan robot dan buzzer yang dipasang pada rumah akan berbunyi secara serentak. Sistem GSM yang terdapat pada rumah akan menghantar signal kepada pemilik rumah dengan menghantar SMS

Pemilik rumah akan menerima SMS yang dihantar oleh sistem GSM yang terdapat pada rumah tersebut dimana sistem ini mampu menghantar dan menerima SMS daripada pemilik.Pemilik rumah juga mampu mematikan sistem yang terdapat pada rumah dengan menggunakan SMS yang dihantar kepada sistem GSM yang terdapat pada rumah.

CARTA ALIRAN PROSES



GAMBARAJAH / LUKISAN PROJEK



3.3 Pengujian Dan Penambahbaikan

Pengujian dan penambahbaikan merupakan langkah terakhir sebelum projek diperkenalkan atau di gunakan.

Pengujian yang dilakukan telah dianalisa antaranya menepati spesifikasi, menepati kehendak,kebolehfungsian dan masalah.Pengujian terhadap projek yang dilakukan bagi mengesan kelemahan serta dapat memperbaiki kelemahan yang ada dengan melakukan penambahbaikan. Ini dilakukan bagi mendapat projek yang mengikut spesifikasi, menepati kehendak, dan kebolehfungsian yang sempurna.

Di sini kami telah mengesan beberapa kelemahan yang terdapat pada prototaip kami, antaranya motor DC untuk menggerakkan pintu bagi forward dan reverse.

1. Pengujian Pemasangan

Setelah kesemua bahagian komponen siap dibentuk atau dihasilkan, maka proses pemasangan akan dijalankan mengikut kedudukan pada setiap bahagian.

Proses pengujian ini dilakukan ke atas rangka yang telah dipasang kerana bahagian ini amat penting dalam penghasilan prototaip ini. Rangka diuji dengan memeriksa setiap penyambungan berada dalam keadaan yang sempurna.

2. Pengujian Percubaan

Setelah projek ini siap dipasang pada bahagian yang sepatutnya, maka proses pengujian terhadap projek harus dilakukan bagi memastikan projek berfungsi seperti yang dirancang dari peringkat awal perancangan. Ini bagi mengetahui keberkesanan atau kemampuan beroperasi pada tahap yang maksimum.

3. Langkah Keselamatan

i. Sebelum melakukan pengujian, pastikan unit berada dalam keadaan baik dan tiada sebarang perkara yang boleh mendatangkan kemalangan semasa menjalankan kerja.
ii. Semasa membuat pengujian elektrikal, penumpuan haruslah diberikan sepenuhnya kerana kelalaian boleh menyebabkan kemalangan.
iii. Jauhkan peralatan elektrik daripada bahan pengalir seperti air
iv. Gunakan pena ujian (Test Pen) bagi memastikan sama ada terdapat pengaliran arus elektrik atau tidak.
v. Tutup semula belakan elektrik semasa pengujian untuk ujian keterusan, penebat dan pengebumian switch board.
vi. Pastikan semua kabel dalam keadaan ketat dan tidak menyentuh kabel lain bagi mengelakkan berlakunya litar pintas.
vii. Tidak bergurau senda semasa melakukan kerja bagi mengelakkan kejadian yang tidak diingini.
viii. Kemas peralatan dan kawasan setelah kerja siap dilakukan supaya tempat kerja kelihatan bersih dan teratur.

4. Keputusan Dan Perbincangan

Setelah menyiapkan Projek ini dengan jayanya, beberapa ujian pada projek ini telah dilakukan. Antara ujian yang telah dibuat adalah melakukan pengujian keupayaan ***" Security Alert System".*** Ini kerana di dalam projek yang ini, sistem yang digunakan adalah gabungan empat elemen sahaja. Ujian ini dibuat bertujuan untuk memastikan ***"Security Alert System"*** tersebut berada dalam keadaan baik dan tidak mengalami sebarang masalah.

Melalui pengujian ini, kami akan mengetahui kemampuan projek ini yang sebenarnya dan juga dapat mengesan sebarang masalah pada projek yang telah kami buat. Proses pengujian sebegini perlulah diberi perhatian dan keutamaan yang lebih supaya dapat mengelakkan sebarang keselahan yang berlaku untuk jangka masa yang pendek atau jangka masa yang panjang didalam proses pengujian tersebut.

1. Masalah Yang Dihadapi

- Belaku kerosakan pada komponen
- Kekurangan bahan dan peralatan untuk menyiapkan projek
- Berlaku percanggahan idea antara ahli kumpulan

2. Cadangan Penambahbaikan

Dengan terhasilnya projek ini, sedikit sebanyak dapat membantu pelajar mengetahui kegunaan***" Security Alert System "*** untuk kegunaan pada masa kini. Oleh yang demikian kami berharap ia dapat manjadi satu tarikan untuk pelajar-pelajar mengembangkan lagi sistem yang berkaitan dengan Security Alert System.

Cadangan kami untuk masa yang akan datang adalah menambah bahagian-bahagian atau model unit yang lain sebagai ***" Security Alert System "*** yang utama untuk di buat pengujian oleh pelajar-pelajar yang akan datang seperti:

- Membuat penambahbaikan pada sistem automatik
- Menggunakan motor yang lebih berkuasa tinggi pada magnet untuk projek yang lebih besar.

- Mereka litar-litar yang lebih baik
- Menggunakan bateri yang berarus tinggi

5. Kesimpulan

Kesimpulan yang dapat dibuat daripada projek ini iaitu ***"Security Alert System"*** adalah mengenai penjagaan dan keselamatan pada barangan yang berharga. Para pelajar yang telah mempunyai kemahiran menjalankan projek tersebut dengan lancar dan lebih berkesan di mana ia merangkumi penyediaan litar dengan kemas dan teliti, pemasangan pendawaian, penggunaan peralatan bagi menjalankan projek dan sebagainya.

Selain itu juga, masalah-masalah yang timbul semasa melaksanakan projek ini ialah membolehkan pelajar membiasakan diri dalam situasi sebenar di alam pekerjaan kelak. Ini termasuk juga dengan proses penyediaan laporan dimana ia menerangakan mengenai perjalanan sesuatu projek tersebut serta cara mengendalikannya. Kerjasama di antara ahli kumpulan serta hasil tunjuk ajar dan bimbingan Penyelia Projek dapat memupuk daya saing antara satu sama lain.

Kemajuan teknologi terkini semakin meningkat, pembaharuan dan rekaan terbaru setiap saat akan berubah. Disebabkan peredaran zaman, kami telah mencipta satu projek yang dapat mengurangkan berlakunya kehilangan dan kerosakan barang dalam sektor perindustrian.

6. Rujukan

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E13 - Smart Lamp Control System

En.Ungku Shahrul bin Ungku Mat
Pusat Latihan Teknologi Tinggi(ADTEC) Shah Alam

Abstract

Penggunaan pengawal lalulintas dengan memegang bendera hijau dan merah ketika kerja penyelenggaraan di jalanraya dilakukan masih lagi dipraktikkan oleh kontraktor-kontraktor yang melaksanakan kerja tersebut. Sistem ini kelihatan tidak begitu efisyen malah membahayakan nyawa pengawal lalulintas itu sendiri. Diatas kesedaran inilah maka Smart Lamp Control System dicipta bagi tujuan menggantikan fungsi pengawal lalulintas berkenaan. Ianya adalah bercirikan masa depan dengan mengambil konsep penggunaan lampu isyarat beserta papan tanda amaran keselamatan yang boleh digunakan untuk mengawal lalulintas semasa kerja-kerja penyelenggaraan di jalanraya sedang dilakukan. Pengawalan lalulintas menggunakan sistem ini dapat menjimatkan tenaga kerja, mengelakkan kemalangan yang mungkin berlaku terhadap pengawal lalulintas yang bertugas serta mengawal aliran trafik kenderaan supaya lebih lancar dan sistematik. Reka bentuknya yang boleh dilipat dan mudah alih dapat memudahkan penggunaannya dimana sahaja ia diperlukan. Selain itu kendalian produk ini adalah bercirikan keselamatan yang efisyen disamping penggunaan yang mudah dan cepat. Litar kendalian yang dibangunkan adalah berasaskan litar kawalan automatik yang menggunakan pengesan jarak dan pemasa yang boleh ditentukan oleh pengguna. Produk ini juga boleh dijadikan sebagai peralatan latihan untuk pelajar lebih memahami fungsi dan operasi Programmable Logic Controller(PLC) yang mereka pelajari di Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam.

Keywords : *lalulintas, mengawal, rekabentuk, mudah alih, automatik*

1. Pengenalan

Pada masa kini, kerja-kerja naiktaraf dan menyelenggara jalan sedang giat dijalankan diseluruh negara untuk meningkatkan keselesaan pengguna jalanraya. Aktiviti penyelenggaraan di jalanraya yang sedang beroperasi seringkali mengganggu kelancaran aliran trafik dan juga mengundang bahaya kepada pekerja mahupun pengguna jalanraya yang lain. Penyelesaian dan pencarian kepada kaedah yang lebih inovatif dan efektif adalah perlu untuk meningkat tahap keselamatan dan melancarkan aliran trafik semasa kerja penyelenggaraan.

Lampu isyarat adalah suatu alat pemberi isyarat yang di tempatkan di persimpangan jalan, lintasan pejalan kaki atau lokasi-lokasi lain yang berfungsi untuk mengawal aliran trafik. Sistem pengaturan lampu isyarat elektrik pertama digunakan di Salt Lake City, Utah pada tahun 1912. Bermula di sinilah sistem lampu isyarat tiga warna diperkenalkan sebagai pengendali untuk mengawal lalu-lintas. Namun begitu, penggunaan lampu isyarat ketika kerja-kerja senggaraan jalanraya masih belum diaplikasikan di negara ini. Penggunaan tenaga kerja manual dengan menggunakan pengawal lalu lintas yang memegang bendera hijau dan merah kelihatan agak konvensional dan tidak praktikal.

Atas usaha dan inisiatif inilah maka lahirlah idea yang cuba diketengahkan ini yang dinamakan *Smart Lamp Control System*. Fungsinya seakan-akan sama dengan lampu isyarat sebenar. Namun kegunaannya lebih spesifik untuk kegunaan mengawal lalu-lintas semasa kerja pembaikan atau penyelenggaraan jalan. Rekabentuknya dicipta khusus, unik, moden dan fleksibel. Penghasilan rekabentuk produk ini disesuaikan dengan papan tanda amaran iaitu "AWAS KERJA-KERJA SEDANG DIJALANKAN DI HADAPAN". Asas kefungsian terdiri daripada dua litar kawalan iaitu kendalian manual dan auto. Litar kawalan manual direka bertujuan apabila lalulintas terlampau sesak. Apabila dilaraskan dalam keadaan manual nyalaan lampu tersebut mengikut masa yang telah ditetapkan. Sekiranya keadaan lalu lintas tidak sesak, sistem kendalian boleh dilaraskan kepada kendalian auto. Kendalian auto menggunakan sistem pengesan gerakan yang berfungsi

untuk menyalakan lampu hijau atau merah sekiranya pengesan gerakan (*motion sensor)* mengesan kenderaan dihadapannya. Produk ini menggunakan bekalan 240V daripada genset dan ia sangat mudah dibawa kemana-mana kerana terdapat roda di kedua-dua belah kaki serta boleh dilipat untuk mengecilkan saiznya.

2. Objektif

Beberapa objektif telah disenaraikan sebagai garis panduan untuk menangani permasalahan yang timbul, antaranya ialah:-

- Memudahkan kawalan aliran trafik semasa kerja-kerja senggaraan di bahu jalan.
- Menjimatkan kos tenaga kerja yang digunakan untuk mengawal lalu lintas tersebut.
- Mengelakkan kemalangan daripada berlaku semasa kawalan trafik sedang berjalan.
- Boleh digunakan sebagai alat bantuan mengajar dan pembelajaran. Ianya juga bertujuan bagi memudahkan pengajar menerangkan cara-cara kendalian dan sistem ini beroperasi.

3. Kaedah

Dalam kesungguhan untuk melaksanakan dan mengenengahkan projek ini, beberapa aspek perlu diberi penekanan melalui kajian literatur. Antaranya termasuklah aspek merekabentuk produk, memperolehi sumber yang merangkumi bahan dan peralatan serta kefungsian bagi setiap komponen. Projek ini perlulah menepati ciri-ciri berikut iaitu rekabentuk yang unik, moden dan fleksibel. Selain itu, dilengkapi dengan ciri-ciri keselamatan yang baik di samping menepati keperluan bagi menangani masalah. Dalam pembinaan jalanraya, papan tanda keselamatan adalah perkara utama. Ianya perlu disediakan mengikut jarak dengan perkataan yang sesuai, jelas dan mempunyai pantulan cahaya. Warna papan tanda pembinaan sementara yang standard iaitu tulisan dan garisan sempadan berwarna hitam berlatarbelakangkan oren. Papan tanda sementara perlulah didirikan dan penyokong mudah alih yang sesuai bagi kedudukan sementara. Semua pemasangan hendaklah mengambilkira hentaman dan mengurangkan risiko kepada pengguna jalanraya dengan merujuk kepada Arahan Teknik (Jalan) 2C/85.

Melihat kepada penggunaan produk ini yang akan diletakkan di luar dan terdedah kepada cuaca yang tidak menentu, penghasilan produk ini perlu mengambilkira pembuatan struktur yang kukuh bagi menempatkan komponen produk dan pemilihan bahan yang sesuai bagi menjamin ketahanannya. Rekabentuk produk terbahagi kepada dua bahagian iaitu bahagian mekanikal dan bahagian elektrikal. Bahagian mekanikal adalah bahagian yang agak rumit kerana kerja-kerja ini melibatkan proses pemotongan, melarik, mengimpal, mencanai, menggerudi dan mengikir besi bagi mendapatkan ukuran yang tepat. Ini penting untuk menghasilkan produk yang bermutu dan berkualiti tinggi.

Bahagian elektrikal pula memerlukan kajian metodologi yang mendalam bagi melahirkan sistem aplikasi kawalan trafik yang efisyen dan mesra pengguna. Proses ini memerlukan pengetahuan dan penelitian kerja yang sangat tinggi khususnya dalam membuat litar kawalan kerana kesilapan yang kecil boleh merosakkan komponen dan keseluruhan sistem tersebut. Produk ini mengaplikasikan sistem kawalan menggunakan *contactor* (sesentuh) dan *motion sensor* (pengesan gerakan). *Contactor* merupakan peranti elektromagnet yang murah dan mudah didapati. Ia bertindak sebagai suis yang berkonsepkan elektromagnet dan berkendalian secara automatik apabila diberikan bekalan manakala *motion sensor* beroperasi apabila litar kawalan dilaraskan pada kendalian auto yang bersifat lebih mesra pengguna ketika aliran trafik tidak sibuk. Berikut disertakan litar skematik untuk sistem aplikasi kawalan trafik (sila rujuk lampiran 1). Selain itu, *timer* (pemasa) juga digunakan untuk mengawal kemasukan bekalan ke sesentuh untuk kawalan masa operasi.

Keselamatan produk berkuasa elektrik perlu dititikberatkan. Justeru itu, peralatan perlindungan perlu dipasang pada produk ini. Antara peranti pelindungan yang digunakan ialah *MCB*, *push button* dan *emergency stop.* Litar kawalan perlu disertakan dengan peranti pelindungan bagi menjamin keselamatan penggunanya.

Pendawaian dibuat mengikut litar yang telah ditetapkan. Pada setiap tamatan kabel dilabelkan dengan betul bagi mengelakkan berlakunya sebarang kesilapan manakala setiap sambungan dibuat dengan ketat agar kelihatan kemas. Prototaip produk dan kendalian boleh dilihat dengan merujuk lampiran 2-3.

4. Keputusan Dan Analisis

Setelah prototaip produk berjaya dihasilkan, proses pengujian peringkat akhir perlu dilaksanakan. Ini bertujuan bagi memastikan litar kawalan berfungsi dengan baik dan pengesanan kerosakan atau kelemahan produk dapat diatasi. Kerosakan pada produk dikatakan berlaku apabila ia tidak mampu melaksanakan fungsinya seperti yang dikehendaki. Kerosakan boleh berlaku disebabkan beberapa perkara iaitu pemilihan komponen yang tidak tepat, susunatur dan pemasangan yang tidak sempurna serta pendawaian yang salah. Kaedah yang digunakan untuk pengujian ialah dengan menggunakan kaedah berikut (carta alir proses pengujian boleh merujuk lampiran 4-5)

Setelah ujian dijalankan didapati semua sambungan dan komponen-komponen yang digunakan berfungsi dengan baik. Kesimpulannya *SMART LAMP CONTROL SYSTEM* adalah rekaan yang selamat digunakan dan berfungsi dengan baik dan mampu mengatasi masalah aliran trafik semasa kerja senggaraan jalan dilaksanakan. Dengan terhasilnya prototaip akhir produk ini terbuktilah bahawa kemahiran dan pengetahuan dalam sistem kawalan elektrik dapat digunakan sepenuhnya.

Produk ini juga boleh dijadikan sebagai model latihan untuk pengajar menerangkan prinsip asas operasi sebuah lampu isyarat isyarat dengan menggunakan *contactor, timer* dan *motion sensor.* Ini seterusnya akan membantu pelajar memahami asas fungsi dan operasi *Programmable Logic Controller(PLC)* yang mereka pelajari di Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam.

5. Kesimpulan

Cabaran yang paling getir dalam perlaksanaan sesuatu produk adalah dalam proses percambahan minda untuk mencipta produk *first hand* yang bersifat unik, kreatif dan inovatif. Ini penting bagi memenuhi gagasan kerajaan yang mementingkan idea inovasi di kalangan masyarakat dan budaya kerja. Namun setelah terhasilnya produk *SMART LAMP CONTROL SYSTEM* ini, kami berasa amat berbaloi kerana usaha kecil ini dapat memberi sumbangan kepada satu lagi idea inovasi negara dengan kos yang murah dan sistem penyelenggaraan yang lebih mudah. Kami berharap agar produk ini dapat diperhebatkan lagi dengan penggunaan alatan atau komponen yang lebih baik seperti *wireless system* yang berfungsi sebagai pengganti penggunaan kabel yang menyambungkan dua panel tersebut. Selain itu, penggunaan bateri bekalan DC bagi memudahkan bekalan dicas ataupun apabila kerja-kerja di tempat yang sukar mendapat bekalan.

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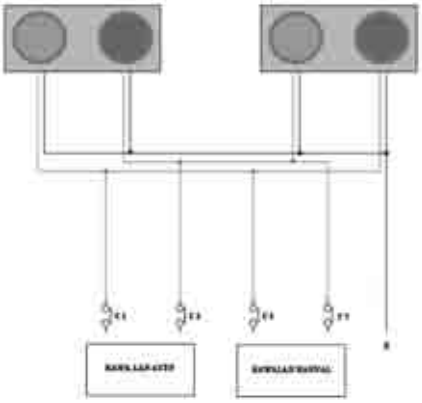
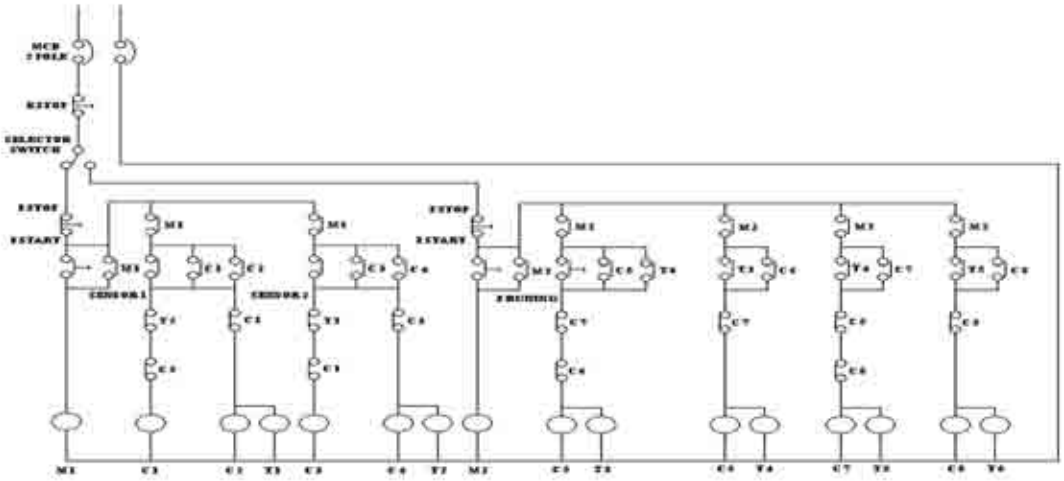
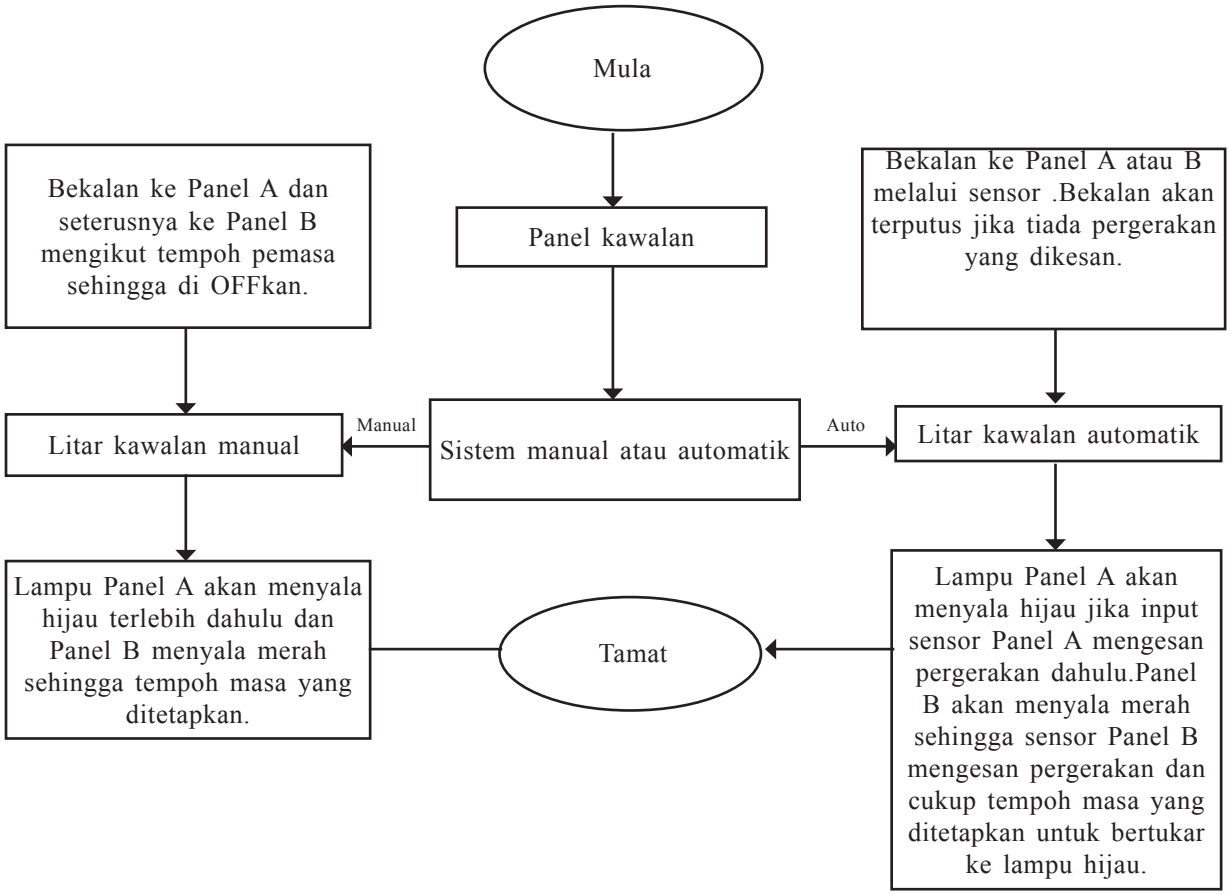
Lampiran 1





Lampiran 2

CARTA FLOW DIAGRAM

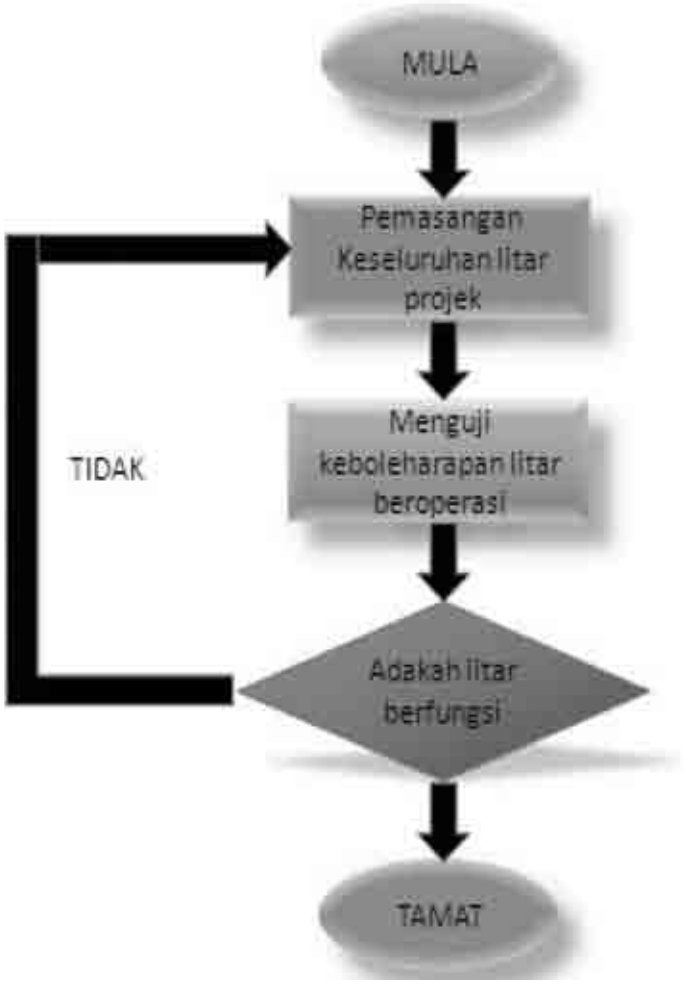


Lampiran 3

AWAS
KERJA-KERJA SEDANG
DIJALANKAN DI HADAPAN

AWAS
KERJA-KERJA SEDANG
DIJALANKAN DI HADAPAN

Lampiran 4


MULA
Pemasangan Keseluruhan litar projek
Menguji keboleharapan litar beroperasi
TIDAK
Adakah litar berfungsi
TAMAT

Lampiran 5

KENDALIAN AUTOMATIK

SENSOR 1	PANEL A			PANEL B	
	RED	GREEN	SENSOR 2	RED	GREEN
DETECT	/	X	NOT DETECT	X	/
20 SAAT	X	/	20 SAAT	/	X
NOT DETECT	X	/	DETECT	/	X
20 SAAT	/	X	20 SAAT	X	/

KENDALIAN MANUAL

TIMER(S)	PANEL A		PANEL B	
	RED	GREEN	RED	GREEN
10	X	/	/	X
0	/	X	X	/
10	/	X	X	/
0	X	/	/	X
10	X	/	/	X

E14 - Sistem Paparan Tanpa Wayar Penggunaan Makmal Menggunakan Saluran Radio Frekuensi (RF)

Mohd Riznan Ali, Nurdiyana Pairan, Nor Mazline Mustar dan Marina Sukor
Pusat Latihan Teknologi Tinggi (ADTEC) Batu Pahat, Johor
marina@adtecbp.gov.my

Abstrak

Satu sistem penghantaran data ke paparan LCD melalui modul transmitter dan receiver dapat dilaksanakan dengan bantuan pemprograman PIC. Untuk melaksanakan projek ini, beberapa litar elekritronik digunakan supaya penghantaran isyarat dapat dilakukan melalui transmitter, receiver ke LCD Display dengan hanya menekan suis yang digunakan sebagai input. Penggunaan sistem ini diaplikasikan diantara bilik makmal dan bilik pengajar bagi memantau penggunaan sesuatu makmal oleh pelajar atau pengajar selain dari penggunaan jadual makmal yang disediakan secara manual. Modul transmitter dan receiver dikawal oleh PIC bagi pengoperasian kedua-dua modul tersebut. RF transmitter menghantar isyarat dari suis yang diletakkan didalam makmal manakala RF receiver memaparkan penggunaan bilik makmal pada paparan LCD secara tanpa wayar dengan jarak lingkungan 200 meter. Projek ini dibangunkan untuk menghasilkan sistem paparan tanpa wayar dengan kos yang lebih efektif berbanding dengan sistem yang sedia ada serta menyelesaikan masalah pertindihan penggunaan makmal oleh pelajar atau pengajar di institut latihan.

Keywords : LCD, tanpa wayar, transmitter module, receiver module, RF

1.0 Pengenalan

Penghantaran isyarat melalui gabungan litar elektronik, modul transmitter dan receiver diaturcarakan dengan *Peripheral Interface Controller* PIC16F873. Penggunaan sistem ini menggunakan proses pengendalian mengikut jarak yang dikehendaki didalam lingkungan 200 meter. Setiap maklumat akan dipaparkan melalui paparan LCD selaku *output* kepada sistem yang diletakkan didalam pejabat/ bilik pengajar dengan hanya menekan suis yang diletakkan di tepi pintu setiap bilik kuliah atau makmal sebagai suis *input.*

2.0 Objektif Projek

Sistem paparan tanpa wayar ini memberi kemudahan kepada pengguna dengan memberi maklumat mengenai penggunaan bilik kuliah atau makmal. Dengan adanya sistem ini, pengguna dapat membaca pada paparan untuk mengetahui bilik kuliah atau makmal yang sedang digunakan atau tidak digunakan. Sistem ini juga dapat memastikan jadual penggunaan bilik makmal adalah mengikut ketetapan jadual yang disediakan secara manual. Sistem ini juga mengurangkan masalah pertindihan waktu penggunaan makmal yang ingin digunakan oleh pengajar atau pelajar pada sepanjang semester. Sistem paparan ini dikendalikan dengan mudah melalui penggunaan modul Tx dan Rx. Setiap maklumat akan dipaparkan melalui paparan LCD didalam bilik pengajar/pejabat bagi tujuan pemantauan.

3.0 Teori Berkaitan

Peripheral Interface Controller (PIC) atau micropengawal merupakan satu sistem kawalan yang diaturcarakan di dalam satu IC dengan kos yang rendah. Para pereka dan peminat teknologi elektronik berupaya untuk meluaskan hasil ciptaan mereka dengan pelbagai aplikasi melalui IC ini. PIC 16F873

mempunyai ciri-ciri RISC (*Reduced Instruction Set*) dengan 28 pin mikropengawal berkelajuan maksimum 20MHz. PIC 16F873 mempunyai storan program sebanyak 4K dengan 192 bytes RAM dan 128 bytes Data EEPROM storan boleh diaplikasikan untuk projek bersaiz sederhana. PIC 16F873 juga mengandungi tiga *timer*, dua 8bit dan satu 16 bit *timer*, 22 i/o pin, lima masukan analog ke digital, dua PWM modul, 12C (*Inter Integrted Circuit*) dan SPI (*Serial Peripheral Interface*) modul. PIC ini juga bertujuan untuk mengawal suatu proses kerja mengikut kehendak pengguna.

Di dalam projek ini, isyarat daripada suis akan ditukarkan dari isyarat analog ke digital menggunakan penukar A/D yang sediaada didalam mikropengawal PIC16F873. Isyarat digital tersebut seterusnya akan diproses dalam PIC mengikut aturcara yang ditetapkan serta dapat melaksanakan proses yang dikehendaki seperti yang telah di aturcarakan.

Penghantaran menggunakan Radio Frekuensi (RF) digunakan secara meluas dalam sistem komunikasi. Dengan penambahan keupayaan yang lebih berkesan, kos yang rendah, penggunaan sistem komunikasi tanpa wayar menjadi lebih banyak penggunaannya. Secara umumnya pemancar dan penerima untuk radio frekuensi digunakan untuk menghantar dan menerima isyarat yang telah dimodulatkan melalui antenna. Bagi projek ini, modul *transmitter* dan *receiver* juga mengandungi bahagian decoder dan encoder yang membenarkan laluan isyarat analog ke digital melaluinya.

Radio Frekuensi di pilih kerana kos penggunaannya yang rendah berbanding dengan teknologi isyarat tanpa wayar yang lain seperti ZigBee dengan frekuensi yang berbeza. Selain itu gangguan pada isyarat RF adalah rendah semasa tempoh pengoperasiannya kerana julat frekuensinya yang besar [1].

Rajah 1: Rajah sistem paparan tanpa wayar.

Rajah 1 di atas adalah gambarajah sistem paparan tanpa wayar bagi sistem yang dibangunkan terdiri daripada suis, modul *receiver* dan *transmitter, LCD Display* dan PIC16F873.

4.0 Model Sistem Paparan Tanpa Wayar

Bagi melaksanakan projek ini, model sistem telah direka dan ditetapkan seperti Jadual 1 dibawah. Spesifikasi sistem paparan tanpa wayar ini mengandungi tiga bahagian terdiri daripada bahagian komponen asas, perisian dan aplikasi.

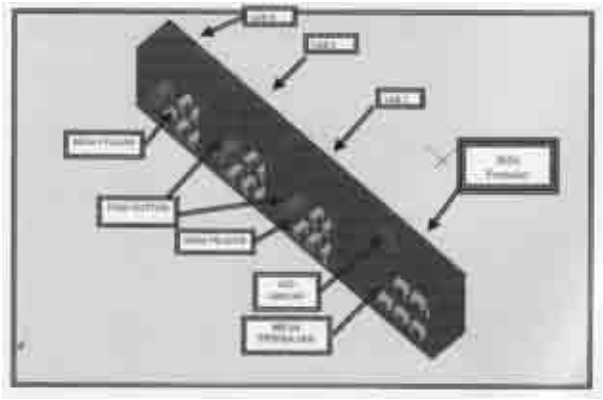
Jadual 1 : Model sistem paparan tanpa wayar

Perkara	Kuantiti	Perkara	Kuantiti	Perkara	Kuantiti
Komponen Asas		***Perisian***		***Aplikasi***	
Bekalan Kuasa	1 unit	Microcode Studio	1 unit	Makmal	3 unit
PIC 16F873	1 unit			Bilik Pengajar/ Tempat pemantauan	1 unit
RF Module Transmitter	1 unit				
RF Module Receiver	1 unit				
LCD	1 unit				

Perisian Microcode Studio yang digunakan adalah pembangunan keseluruhan bagi menulis *source code*. Pembangunan keseluruhan memudahkan pembangunan *firmware* dengan memperkenalkan ruang kerja yang mudah kepada pengguna. Ia membantu mengurus fail *source code* dan menekankan komen, kata kunci dan sebagainya.

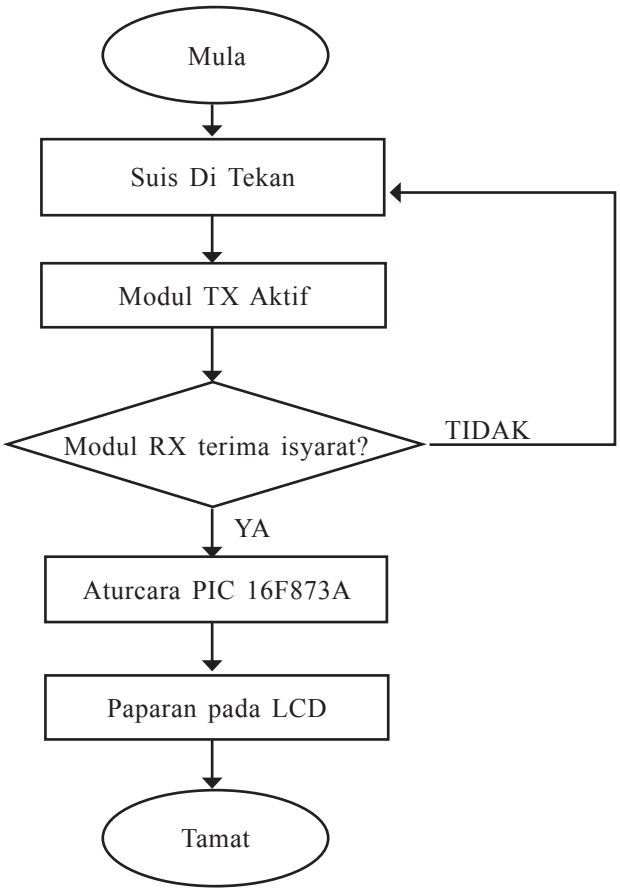
Model bagi projek ini adalah dengan meletakkan 3 unit makmal yang akan dikawal penggunaanya oleh PIC16F873 serta dipaparkan pada LCD sebagai keluarannya. Keluaran bagi sistem ini iaitu LCD akan diletakkan dalam Bilik Pengajar Bahagian bagi tujuan pemantauan.

5.0 Methodologi

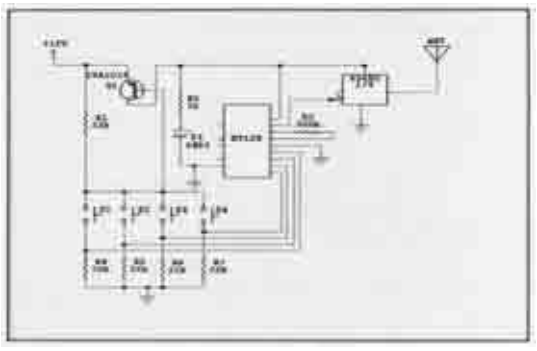


Rajah 3: Lakaran 3D sistem paparan tanpa wayar

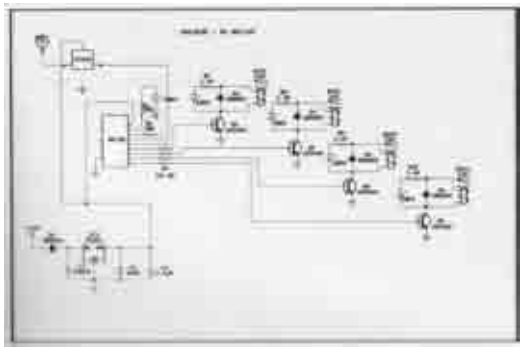
Rajah 2 : Carta alir pengoperasian sistem



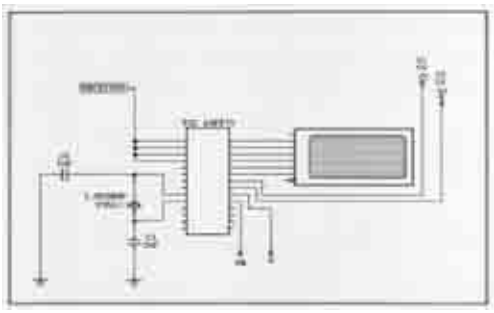
Rajah 2 di atas menunjukkan pengoperasian modul *transmitter* dan *receiver*. Suis akan menghantarkan isyarat kepada modul *transmitter*. Apabila modul *transmitter* diaktifkan, ia akan berkomunikasi dengan modul *receiver*. Akhir sekali maklumat akan disalurkan pada paparan LCD. Sekira telah tamat penggunaan bilik makmal litar akan diresetkan semula. Rajah 3 pula menunujukkan lakaran 3D untuk sistem ini.



Rajah 4: Litar skematik Transmitter



Rajah 5 : Litar skematik Receiver



Rajah 6 : Litar skematik PIC16F873

Litar *transmitter* seperti Rajah 4 atau dikenali litar penghantaran isyarat berfungsi memancarkan isyarat dalam bentuk frekuensi kepada litar *receiver* (penerimaan isyarat). Kedua litar ini berfungsi sebagai litar kawalan jauh yang dapat menghantar frekuensi mengikut jarak yang ditetapkan. Litar *transmitter* dan litar *receiver* seperti Rajah 5 adalah litar yang saling bergantung antara satu sama lain. Kedua litar ini merupakan litar pengoperasian. Rajah 6 menunjukkan litar kendalian PIC16F873dan litar ini membekalkan bekalan kuasa 5V serta menghasilkan keluaran penghantaran isyarat pada LCD. Pengawalan litar untuk sistem ini diaturcarakan dalam PIC16F873.

6.0 Keputusan

Jadual 2 di bawah menunjukkan keputusan hasil dari pemasangan litar serta pengatucaraan yang diprogramkan dalam PIC16F873. Semua LCD memaparkan keluaran seperti yang dikehendaki. Kesemua isyarat dapat dihantar secara tanpa wayar mengikut jarak yang telah ditetapkan.

Jadual 2: Keputusan projek

Bil	Bahagian	Jarak	Paparan LCD/ Bilik Pengajar (*Receiver*)
1	Makmal 1 (*Tranmit* Suis1)	70 m	"Makmal 1 sedang digunakan. Terima Kasih."
2	Makmal 2 (*Transmit* Suis 2)	100m	"Makmal 2 sedang digunakan. Terima Kasih"
3	Makmal 3(*Transmit* Suis 3)	150m	"Makmal 3 sedang digunakan. Terima Kasih"

Daripada jadual diatas didapati setiap suis yang berada didalam makmal dapat melaksanakan operasi masing-masing melalui penghantaran isyarat pada modul receiver. PIC 16F873 diaktifkan dan maklumat penggunaan makmal di paparkan pada paparan LCD.

7.0 Kesimpulan

Tujuan utama projek ini adalah untuk memantau penggunaan makmal di institut latihan oleh pengajar atau pelajar secara lebih sistematik selain dari maklumat penggunaan makmal yang diperolehi melalui jadual yang disediakan secara manual. Dengan terhasilnya sistem ini dapat memudahkan urusan pekerjaan yang melibatkan penggunaan bilik makmal secara lebih cepat dan tepat. Sistem ini menggunakan kos yang rendah iaitu sekitar RM 230.00 di samping penggunaan sistem pendawaian yang ringkas dan kemas. Dengan adanya sistem seumpama ini, masalah pertindihan penggunaan makmal oleh pelajar atau pengajar dapat dielakkan.

8.0 Rujukan

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E15 - Design and Fabrication Study of Si Microprobe for MEMS Out-of-Plane Cantilever Probe Card

Nor Illiani Ramzi; Badariah Bais; Burhanuddin Yeop Majlis
Advance Technology Training Centre (ADTEC) Taiping, Perak.
illiani_ramzi@yahoo.com

Abstract

Current trend in integrated circuit manufacturing which has seen double number of transistors in every 2 to 3 years has resulted in a drastic rise of input/output pads count in a single die and consequently a significant decrease of its size and spacing. In addition, pad damages caused by scrubbing effect has started crucially affecting the wafer level probing. Here, we proposed a solution to overcome these problems by applying Micro-Electromechanical Systems (MEMS) technology for probe card which consist of out-of-plane predeformed cantilevers with Si microprobes arrays. We have developed a microfabrication process which includes exploitation of HNA wet etching isotropic profile to form the microprobe tips and sputtering of Ti-Ni layers which have different internal stress to produce out-of-plane predeformation of cantilever. The sharp and protruding tip of these microprobes not only meet the need of smaller contact tips for finer pad pitches, but also minimize the scrubbing effect.

Keywords: MEMS, microprobe, microfabrication and wafer level probing.

1. Introduction

Inspection on individual dies at wafer level, often referred as wafer probing, was first introduced to confirm that fabricated chips are functional. Emergence of Known Good Die (KGD) concept where dies are being sold instead of packaged parts, however, has placed a crucial importance for wafer level probing as the wafer foundry needs to be assured that these dies are delivered with the best quality possible [1]. Despite the newly found importance, its existing technology is currently facing its limitation since the number of transistors on integrated circuit has been doubled every 2 to 3 years for the past 30 years and has cause a drastic rise in the number of input/output (I/O) pads in a single die [2]. Compounding to the problem, the emerging trend of shrinking complex devices into a single piece of chip in the semiconductor industry nowadays has resulted in a significant decrease of I/O pads size and pitch [3]. In addition, scrubbing effect which was not a serious problem until the I/O pads got smaller has started crucially affecting the wire bond adhesion [4]. Scrubbing occurs in conventional wafer probing as the probe card tip makes contact with the pads of device under test (DUT) by mechanically breaking down the interfacial surface oxide on the I/O pads and often lead to pad damage in the same general area that wire bond is made for final packaging.

Since the existing probe card technology can no longer adapt to these new challenges in wafer probing, new probing approach that not only will minimize the scrubbing effect but also meet the requirement for fine-pitched I/O pads were in high demand. Micro-ElectroMechanical System (MEMS) probe card has been widely use because they are compatible with silicon batch processing and capable of being miniaturized into several micrometers. Membrane probe card was first proposed to replace conventional epoxy ring probe card. However, this type of probe card still has a few limitations as tension received by some tips might cause other tips not to contact the contact pad. Furthermore, contact resistance of membrane probe card is also higher than the conventional probe card due to its disability to scrub contact pads [5]. Here, we proposed a new type of MEMS microprobe structure consisting of out-of-plane pre-deformed cantilever beams and Si microprobes arrays. The advantage of out-of-plane pre-deformed cantilever beam is that it can be used to provide certain amount of overdrive to compensate large contact force which is essential for obtaining good electrical contact. In this paper, the proposed design of an out-of-plane cantilever microprobe is presented.

2. Concept and Design

Key element in designing MEMS microprobe is contact material properties such as hardness, yield strength and wear resistance. Tungsten and Nickel are most commonly used for probe tips due to its resistance to wear and failure caused by fatigue stress. However, tungsten is not suitable for this device as it has high contact resistance. On the other hand, Nickel has been widely used as a good choice of tip material because of its excellent mechanical properties and lower contact resistance which made it suitable for this purpose. Nickel is also known to have large strain limit which is to enhance cantilever stiffness. Pre-deformation of Si cantilever can be made by controlling the internal stress of successively deposited layers of 2 different materials. To achieve outward pre-deformation, material with higher expansion should be deposited before lower expansion material. Therefore, combination of Titanium and Nickel layers are chosen as the most suitable coating materials of Si microprobe for this design.

2.1. Contact Force

MEMS probe card needs to apply a certain level of contact force in order to obtain low contact resistance probing with DUT where the contact resistance should not exceed 0.5 Ω. Holm's Theory as in Equation 1 was utilized in specifying the required amount of contact force to be applied to achieve low resistance contact.

$$R_c = \frac{\rho_1 + \rho_2}{4}\sqrt{\frac{\pi H}{F}} + \frac{\sigma_p H}{F} \qquad \text{(Eq. 1)}$$

H is the hardness of materials while ρ_1 and ρ_2 are electrical conductivities of probe tip and contact pad materials. Using ρ_2 = 2.7 x 10^{-8} Ωm as reference value of aluminum (Al) contact pad, contact resistance for various materials were calculated at different level of contact force and depicted in Table 2. It can be seen that low contact resistance can only be achieved when contact force larger than 30 mN is applied.

Table 2. Contact Resistance for Different Materials

Probe Tip Material	Contact Resistance (Ω)			
	F = 10 mN	F = 30 mN	F = 50 mN	F = 100 mN
Nickel	0.62	0.21	0.13	0.06
Titanium	0.67	0.23	0.15	0.08
Chromium	0.63	0.218	0.134	0.07

2.2. Overdrive

Contact force to be applied to individual pads were reduced from 12 g force (gf) to 1 gf to overcome the increasing total contact force on DUT caused by increasing number of contact pads. To compensate these reduced forces, a certain amount of overdrive must be applied to achieve sufficient ohmic contact between probe tips and contact pads. Overdrive is the vertical distance which probe tip travelled starting from the point of initial contact with contact pads. Using Equation 2 below, microprobe cantilever can be designed to give desired level of overdrive/deflection during probing by specifying a certain amount of contact force. By considering 30 mN of applied contact force, length of probe cantilever were calculated for different level of overdrive. The calculated results were shown in Fig. 1.

$$F = \frac{Et^3 w}{4l^3} d_{max} \qquad \text{(Eq. 2)}$$

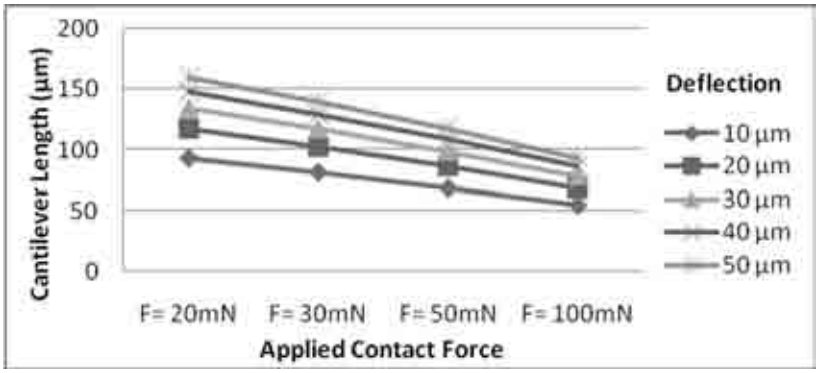

Figure 1. Calculation of Cantilever Length at different level of deflection/overdrive

2.3. Microprobe Design

Base on results in Fig. 1, the microprobe structure is designed with a length of 100 µm, a width of 50 µm and a thickness of 10 µm in order to have a 30 µm deflection when a contact force of 50 mN is applied. The microprobe contact properties were optimized by implementing high aspect ratio protruding tip feature and reducing its diameter. As a good 'rule of thumb', the probe tips diameters were designed to not exceed one half of the pad size and were specified to be not more than 10 µm. Pitch between each microprobes were specified to 30 µm to adapt to latest trend of IC technology while the height of each probes were designed to be in the range of 20 µm to 30 µm to prevent short circuit caused by particles. Overall parameters of the designed microprobes are tabulated in Table 1.

Table 1. Microprobe Design Parameters

Design Parameters	Specification
Tip diameter	< 10 µm
Microprobes height	20 – 30 µm
Pitch	30 µm
Contact force	50 mN
Contact resistance	< 0.5 Ω

3. Fabrication Process

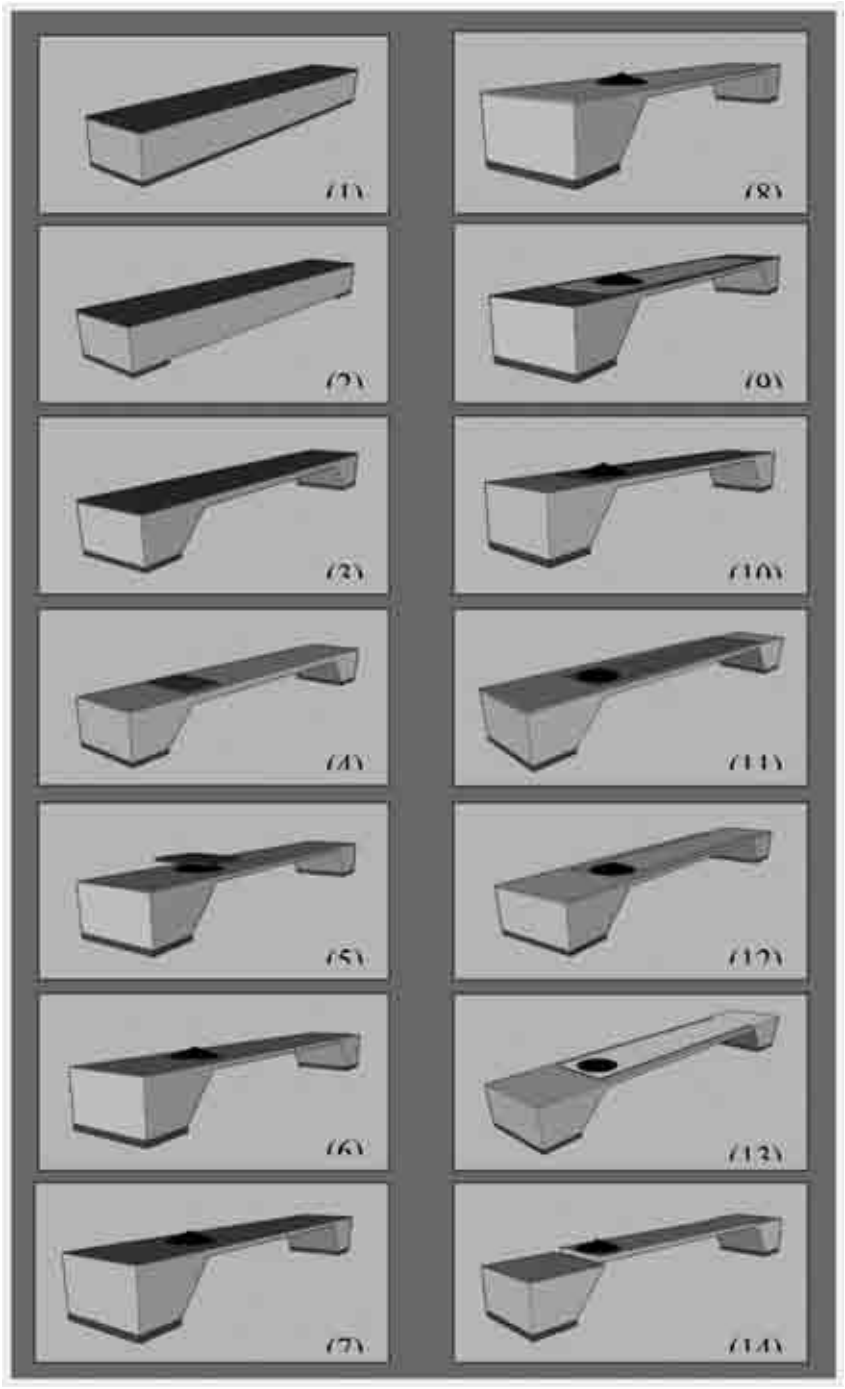

Figure 2. Process Flow of Microprobe Fabrication

Fig. 2 shows the proposed fabrication process flow for the design. 675 µm thick p-type silicon wafer with <100> orientation will be used as substrate (1). Both sides of wafer surface are already coated with silicon nitride (Si_3N_4) layers by Low Pressure Chemical Vapor Deposition (LPCVD). First, cantilever thickness of the microprobe will be defined through anisotropic wet etching of the silicon wafer from the backside. For this purpose, the backside Si_3N_4 layer is patterned by using Deep Reactive Ion Etching (DRIE) to act as mask during the wet etch (2). A 22% potassium hydroxide (KOH) etchant solution is prepared by diluting 28.2g of electronic grade KOH pellets in 100 ml DI water. The solution is heated in a glass beaker until it reaches the etch temperature at 80 ºC. Then, etching process of the silicon wafer backside takes place

while the front side is kept unexposed (3). Next, formation of microprobe tip will be done by exploiting the isotropic profile of HNA wet etching. 50 µm x 50 µm Si_3N_4 square which will be used as masks during the etching were formed by photolithography and DRIE process consecutively (4). HNA etchant solution for isotropic wet etching is prepared by mixing 2 parts of Hydrochloric Acid (HF), 7 parts of Nitric Acid (HNO_3) and 1 part of Acetic Acid (CH_3COOH). Etching is done by setting the etchant temperature to 80 °C and then dipping the wafer into the etchant for 110 seconds (5). The Si_3N_4 mask is then removed through Buffer Oxide Etching (6). Later, the wafer is deposited with Ti adhesion layer and followed by Ni thin film through DC magnetron sputtering (7). The subsequent step will be patterning of the Ti/Ni films which are etched by using diluted Aqua Regia etchant (10). Prior to this step, Al thin layer is first evaporated onto the Ni film (8) and then patterned as mask through photolithography and wet etching (9) by using Al etchant solution (H_3PO_4:HNO_3:H_2O). The last stage of this fabrication flow will be cantilever patterning which is done through lift-off technique. In this stage, photolithography of cantilever pattern is first performed (11), followed by Al evaporation onto the photoresist (12) which finally will be stripped-off by rinsing in acetone (13). Lastly, the microprobe is released through DRIE process (14).

4. Results and Discussion

Calculated results shown in Fig. 1 give impression that the longer the length of cantilever, the larger is the deformation/deflection magnitude. Thus, the length of the cantilever should be designed according to the desired deflection. Also, a study of agitation effect on HNA etch profile at different speed shows that etching with agitation at 370 rpm speed resulted in the highest aspect ratio of microprobe tip.

5. Conclusion

Through this study, a new design of microprobe that not only will meet the need of smaller contact tips for finer pad pitches, but also will minimize the scrubbing effect is established.

6. References

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E16 - Development of an Ion Sensitive Field Effect Transistor Process for Research and Teaching

Chin Seng Fatt
Advanced Technology Training Centre (ADTEC) Taiping, Perak
csfatt.msc@gmail.com

Abstract

The fabrication of an Ion Sensitive Field Effect Transistor (ISFET) in an educational laboratory course is challenging because the process is complicated and time consuming. A simple methodology using cost effective technique has been developed which is suitable for undergraduate laboratories and research in process and sensor technology that allows the fabrication of ISFET similar to the fabrication in a semiconductor foundry. This allows undergraduates to learn about sensor technology in addition to the fabrication technology for ISFET.

Keywords: ISFET, microfabrication, sensor technology

1. Introduction

The ISFET is essentially a type of transistor known as the Ion Sensitive Field Effect Transistor that has the structure of a conventional metal oxide transistor or MOSFET except without the metal layer on top of the gate and uses silicon nitride as the ion sensitive layer [1, 6, 8]. The ISFET is fabricated using standard integrated circuit (IC) technology similar to a MOSFET. The implementation of the fabrication of ISFET in an educational laboratory course can be complicated and time consuming. A simple methodology has been developed that allows undergraduates to learn about the fabrication technology of ISFET with ease [2]. The developed methodology uses safe-friendly materials and cost effective facility that can be applied to in-house fabrication laboratories [2].

2. Methodology

2.1. ISFET Layout

The layout of the ISFET is similar to that of a MOSFET with source, drain, gate and contacts. The layout is designed using computer aided design software (CAD) and printed on transparency as masks. The masks will be used to define the structure of the ISFET during fabrication [3].

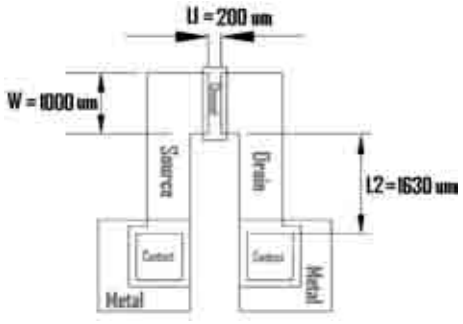

Figure 1: ISFET layout with dimension.

The typical layout of ISFET was designed as in Figure 1 above. The length of channel (sensing membrane) U, of the ISFET is designed to ensure a good contact with the solution. The long source and drain extension is to avoid any metal contacts with the solution at the gate [3].

2.2. Fabrication Flow

Since ISFET is based on a MOSFET, the fabrication flow between the both devices is similar [4, 5]. At the beginning, after cleaning the wafer substrate, a thick layer of field oxide is formed through wet oxidation. The first mask pattern is transferred to onto the wafer through photolithography steps to define the source and drain. The photolithography steps will be repeated until all patterns on the individual mask have been transferred to the wafer. After exposure and developing the photoresist, the underlying field oxide is then etched using buffered oxide etch (BOE) to create the source and drain. Like MOSFET, the source drain of the ISFET is doped with either phosphorus or boron to create n-type or p-type device. Doping process is done by spin-on technique and thermal diffusion.

All fabrication steps follow closely the conventional process of a metal gate MOSFET right until to the formation of gate oxide [4, 5]. For ISFET, the gate oxide is formed by dry oxidation after second mask patterning. A thin layer of chemically sensitive material usually silicon nitride is then deposited on top of the gate oxide. After nitride deposition, the process continues with the contact formation using third mask pattern. The ISFET structure is said to be completed once the metal contacts are formed at the contacts via metallization. As ISFET do not have a metal gate, the metallization is performed at the source and drain contacts. Figure 2 summarize the process flow described.

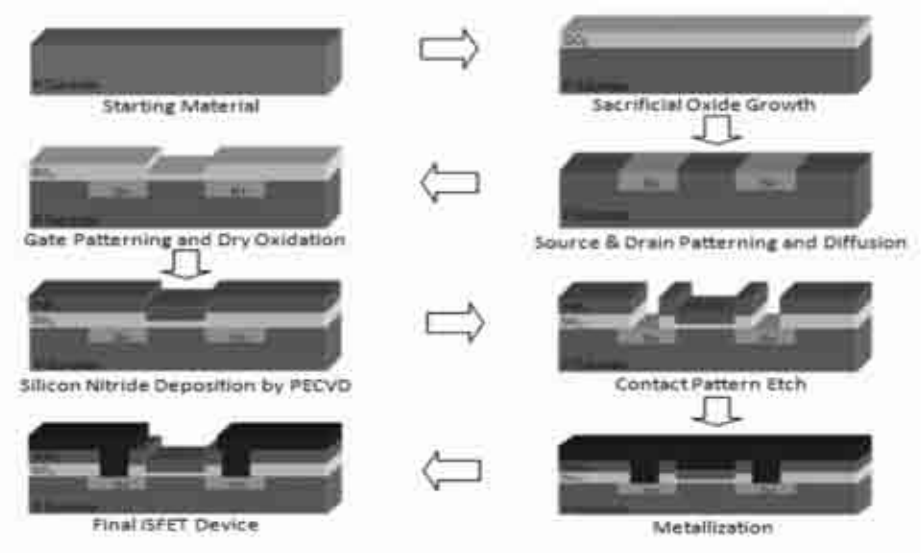

Figure 2: n channel ISFET Fabrication flow.

3. Fabrication Modules and Consumables

The fabrication of ISFET uses low cost facility and in-house consumables as summarized in Table 1. The consumables are silicon wafer, photoresist, phosphorus liquid dopant, boron liquid dopant, acetone, developer, de-ionized water (DI), BOE, aluminium source and aluminium etch solution. All these are used during photolithography and chemical etching processes [7].

The equipments used in the fabrication of ISFET are dry and wet oxidation furnaces, p-type and n-type diffusion furnaces, wet etching module, photolithography module and a physical vapour deposition (PVD) module. The oxidation furnaces are used to grow field oxide and gate oxide while the diffusion

furnaces diffuse the dopants deep into source and drain region. Chemical etching or removal of material are performed at the wet etch module. Metallization of source and drain contacts are done inside a PVD module using aluminium as the source. Other equipments including spin coater, hot plate and the mask aligner are used for photolithography [7].

Table 1: List of Fabrication Modules and Consumables according to Process

Process	Modules	Consumables
Dry Oxidation	Dry Oxidation Furnace	Oxygen Gas Nitrogen Gas
Wet Oxidation	Wet Oxidation Furnace	Oxygen Gas Nitrogen Gas Water
Spin on dopant and Diffusion	Wafer spinner module p-type and n-type Diffusion Furnace	Phosphorus liquid dopant Boron liquid dopant Oxygen Gas Nitrogen Gas
Photolithography	Mask aligner and exposure module Hot plate Wafer spinner	Masks Photoresist
Etching	Wet etch module	Buffered oxide etch solution Aluminum etch solution Developer Acetone De-ionized water
Metallization	Physical vapour deposition	Aluminum source
Nitride deposition	Plasma enhanced chemical vapour deposition	Silane gas Nitrogen gas

4. Laboratory Implementation

The fabrication process can be implemented in one semester undergraduate course. The fabrication can be divided into lecture and laboratory sessions. In the lecture session, the undergraduates will learn the theoretical aspects of the fabrication. In the lab phase session, the undergraduates will run a complete ISFET fabrication. The undergraduates will be exposed to all aspects of the fabrication technology by performing operation to standards as many different process steps as possible.

5. Conclusion

The developed methodology for the fabrication process of ISFET is simple, shorter processing time, uses inexpensive and safe-friendly facility. The fabrication requires no additional or post processing step as all the materials used are standard IC materials including the ion sensitive layer. The ISFET layout is designed

using CAD software and the design is transferred on to transparency as mask. The mask is used to define the pattern of the ISFET during fabrication. This methodology is straightforward and allows rapid prototyping of ISFET. This simple developed process provide undergraduates an opportunity to learn and understand the technology used in the making of ISFET and at the same time introduce the students to silicon fabrication technology.

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E17 - Pengoptimuman Reka Bentuk Fabrikasi Transistor Kuasa VDMOSFET Menggunakan Kaedah Taguchi

Jamal bin Jurait
Pusat Latihan Teknologi Tinggi (ADTEC) Taiping, Perak
Email: jamal@adtecprk.gov.my

Abstrak

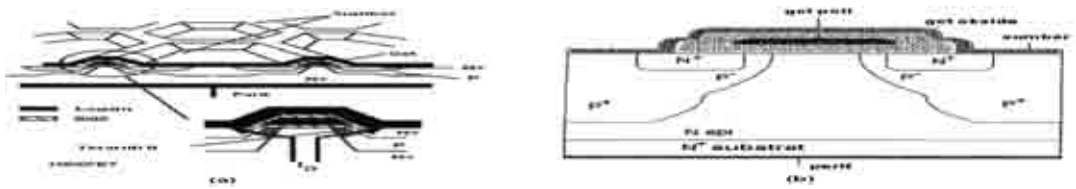
Empat faktor dikenalpasti mempengaruhi voltan runtuh dan rintangan dalaman peranti kuasa VDMOSFET iaitu faktor kelebaran parit, kedalaman parit, ketebalan epitaksi serta keberintangan epitaksi. Setiap faktor mempunyai tiga peringkat terbaik yang memberikan gabungan berbeza mengikut jajaran L9 Kaedah Taguchi. Simulasi fabrikasi peranti kuasa VDMOSFET mengikut jajaran L9 dilakukan dengan menggunakan modul ATHENA manakala simulasi kajian pencirian elektrik dijalankan dengan menggunakan modul ATLAS daripada perisian SILVACO. Analisis nisbah S/N dijalankan untuk memilih faktor dan peringkat yang optimum. Hasil daripada analisis nisbah S/N mendapati keempat-empat faktor memberikan pengaruh yang signifikan terhadap voltan runtuh dan rintangan hidup. Saiz kelebaran dan kedalaman parit masing-masing sebanyak 2.88 µm dan 0.32 µm berserta ketebalan dan keberintangan epitaksi masing-masing sebanyak 7.0 µm dan 1×10^{15} Ωm memberikan nilai voltan runtuh yang optimum. Saiz kelebaran dan kedalaman parit sebanyak 2.85 µm dan 0.34 µm berserta ketebalan dan keberintangan epitaksi sebanyak 6.0 µm dan 1×10^{13} Ωm memberikan rintangan hidup yang optimum.

***Kata kunci** : VDMOSFET, Kaedah Taguchi, Silvaco*

1. Struktur VDMOSFET

Transistor kuasa VDMOSFET (*Vertical Double Diffused Metal-Oxide-Semiconductor Field-Effect Transistor*) adalah pensuisan pada frekuensi yang tinggi dimana mempunyai rekabentuk yang dapat menahan peringkat aliran arus sementara besar untuk mengawal voltan runtuh [1]. Pelbagai aplikasi telah digunakan dengan lebih ketara pada voltan bawah 100 V [2]. Rajah 1 (a) menunjukkan struktur dalaman VDMOSFET di mana sambungan sumber dan parit dengan kawasan dopan yang tinggi, sementara Rajah 1 (b) adalah keratan rentas transistor kuasa VDMOSFET dengan tindihan kawasan get/p^+ agak besar dan profil dopan sisi pada saluran adalah lancar. Kawasan dalaman jenis-p^- biasanya berlitar pintas terhadap kawasan jenis-p^+ dan sumber jenis-n^+[3].

Rajah 1. (a) Struktur Dalaman VDMOSFET; (b) Keratan Rentas VDMOSFET Saluran-N (Salame, 2001; Mileusnic, 1999)[2]



2. Ciri Elektrik Transistor Kuasa Mosfet

Operasi asas bagi struktur salur-n beroperasi untuk voltan positif pada parit bermula apabila elektrod get dibumikan ke sumber, Pencirian elektrik untuk peranti kuasa VDMOSFET amat penting iaitu voltan ambang *(threshold voltage,* V_{TH}), voltan runtuh pada parit (*breakdown voltage,* BV) dan rintangan hidup (*on-resistance,* R_{ON}).

2.1 Voltan Ambang

Untuk operasi bagi aplikasi kuasa, MOSFET berada dalam keadaan tutup *(turn off)* apabila voltan get adalah 0 V dan seterusnya untuk operasi buka *(turn on*), ia bergantung kepada pembentukan lapisan konduktif pada permukaan semikonduktor apabila diberi voltan positif, V_g. Ketika V_g ditingkatkan elektron mula bergerak ke antara muka oksida dan membentuk lapisan cas bagi laluan salur untuk arus. Ini adalah keadaan yang dikenali voltan ambang, V_{TH} (Baliga, 2008) [3].

$$V_{TH} = \frac{\sqrt{4\varepsilon_s kTN_A \ln(N_A/ni)}}{\left(\varepsilon_{ox}/t_{ox}\right)} + \frac{2kT}{q}\ln\left(\frac{N_A}{n_i}\right) \quad (2.1)$$

2.2 Voltan Runtuh

Voltan runtuh, BV adalah voltan yang mengalami keruntuhan dan peranti mengalirkan arus ketika get dalam keadaan pincangan songsang (Barkhordarian, 2004)[4]. BV berlaku bila diod badan-hanyut *(body-drift)* pincangan songsang mengalami kejatuhan dan berlakunya pengaliran antara sumber dan parit melalui proses pendaraban runtuhan *(avalanche)* ketika elektrod get dan sumber dibumikan dan persamaan BV (Baliga, 2008) adalah seperti berikut :

$$BV = 5.34 \times 10^{13} N_A^{-3/4} \quad (2.2)$$

2.3 Rintangan Hidup

Jumlah rintangan antara terminal sumber dan parit semasa keadaan hidup dikenali sebagai rintangan hidup, R_{ON} (Oh, 2000)[5]. Ia digunakan sebagai parameter penting untuk menentukan pemeringkatan nilai arus maksimum dan sebaran kuasa di dalam peranti ketika pengaliran arus. Nilai R_{ON} diukur pada kecerunan ciri keluaran pada kawasan linear untuk voltan parit rendah. Rintangan salur dan rintangan pada kawasan hanyut adalah penyumbang utama kepada nilai R_{ON}. Rintangan pada kawasan hanyut, R_{epi} dikira menggunakan formula dengan arus tetap disebarkan pada sudut 45° (Hong et al. 2004) [6].

3. Metodologi

Melalui kaedah reka bentuk Taguchi, empat faktor akan dikaji ialah kesan kelebaran parit, kedalaman parit, ketebalan epitaksi dan keberintangan epitaksi yang bertujuan untuk melihat nilai voltan ambang (V_{TH}), voltan runtuh (BV) serta rintangan hidup (R_{ON}). Keempat-empat faktor tersebut telah divariasikan seperti Jadual 1. Nilai bagi variasi ini dipilih berdasarkan kepada keputusan mengikut nilai voltan ambang bagi transistor kuasa VDMOSFET adalah 2 hingga 3 V (Baliga, 2008)[3].

Jadual 1. Variasi 4 Faktor

Variasi	Kelebaran Parit (μm)	Kedalaman Parit(μm)	Ketebalan Epitaksi (μm)	Keberintangan Epitaksi (Ωm)
1	2.8	0.32	6	1×10^{16}
2	2.9	0.33	6.5	1×10^{15}
3	3.0	0.34	7	1×10^{13}

Kaedah Taguchi telah mencadangkan analisis menggunakan nisbah S/N (Signal-to-Noise ratio) dengan menggunakan nisbah S/N, ia membolehkan nilai yang diperolehi untuk mengetahui kesan set nilai tersebut [8]. Dua ciri kualiti yang digunakan dalam mengoptimumkan reka bentuk ialah nisbah S/N dalam mengukur tahap prestasi faktor hingar (Gologlu et al. 2008) seperti yang ditunjukkan dalam persamaan 3.1 dan 3.2 [7].

Kecil untuk yang terbaik $$S/N = -10\log\left(\frac{1}{n}\sum y^2\right) \quad \textbf{(3.1)}$$

Besar untuk yang terbaik $$S/N = -10\log\left(\frac{1}{n}\sum\frac{1}{y^2}\right) \quad (3.2)$$

dimana *y* adalah data cerapan daripada eksperimen dan *n* adalah nombor eksperimen. Jadual 2 memaparkan jajaran L_9 yang mempunyai sembilan set ujikaji berpandukan empat faktor yang setiap satunya mempunyai 3 peringkat.

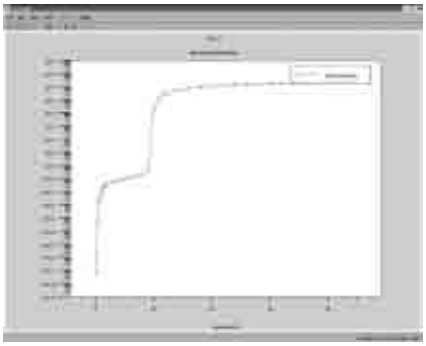
Jadual 2. Variasi 4 Faktor 3 Peringkat untuk jajaran L_9

Set	Kelebaran Parit (µm)	Kedalaman Parit(µm)	Ketebalan Epitaksi (µm)	Keberintangan Epitaksi (Ωm)
1	2.8	0.32	6	1×10^{16}
2	2.8	0.33	6.5	1×10^{15}
3	2.8	0.34	7	1×10^{13}
4	2.9	0.32	6.5	1×10^{13}
5	2.9	0.33	7	1×10^{16}
6	2.9	0.34	6	1×10^{15}
7	3	0.32	7	1×10^{15}
8	3	0.33	6	1×10^{13}
9	3	0.34	6.5	1×10^{16}

4.0 Keputusan Dan Analisis

4.1 Keputusan Nilai Voltan Ambang, Voltan Runtuh dan Rintangan Hidup

Melalui reka bentuk VDMOSFET yang telah diubahsuai, fabrikasi peranti dengan ketebalan 6 µm dan keberintangan epitaksi sebanyak 1.0×10^{16} Ωm telah memberikan nilai voltan runtuh pada 55.981 V. Ciri set pertama ini juga mempunyai kelebaran parit 2.8 µm dan kedalaman 0.32 µm. Nilai voltan ambang hasil simulasi diperolehi dari graf I_d-V_d seperti dalam Rajah 4, iaitu nilai BV untuk set pertama peranti adalah 55.981 V.



Rajah 4. Hasil simulasi voltan runtuh, BV bagi set pertama peranti

Nilai R_{ON} bagi salur n-MOSFET boleh diperolehi melalui nilai BV seperti yang ditunjukkan dalam persamaan 4.1 (Baliga, 2008)[4].

$$R_{ON} = \frac{WD}{q\mu nNd} = 5.93\times 10^{-9} (BV)^{2.5} \quad (4.1)$$

Nilai keseluruhan V_{TH}, BV dan R_{ON} bagi kelapan-lapan ujikaji berikutnya dipaparkan dalam Jadual 3.

Jadual 3. Keputusan keseluruhan eksperimen bagi nilai voltan ambang (V_{TH}), voltan runtuh (BV) dan rintangan hidup (R_{ON})

Set	V_{TH} (V)	BV (V)	R_{ON} (Ωcm^2) ($\times 10^{-4}$)
1	2.379	55.981	1.390
2	2.431	68.063	2.266
3	2.081	71.547	2.568
4	2.256	66.938	2.174
5	2.438	65.496	2.059
6	2.574	62.874	1.859
7	2.840	74.092	2.802
8	2.662	62.141	1.805
9	2.864	60	1.654

4.2 Analisis kesan faktor terhadap Voltan Runtuh (BV) dan Rintangan Hidup (R_{ON})

Setiap faktor yang diuji akan memberikan nilai/peringkat yang paling optimum melalui analisis nisbah S/N. Jadual 4 menunjukkan nilai nisbah S/N untuk voltan runtuh, BV dan rintangan hidup, R_{ON}.

Jadual 4. Nisbah S/N untuk voltan runtuh, BV dan rintangan hidup, R_{ON}.

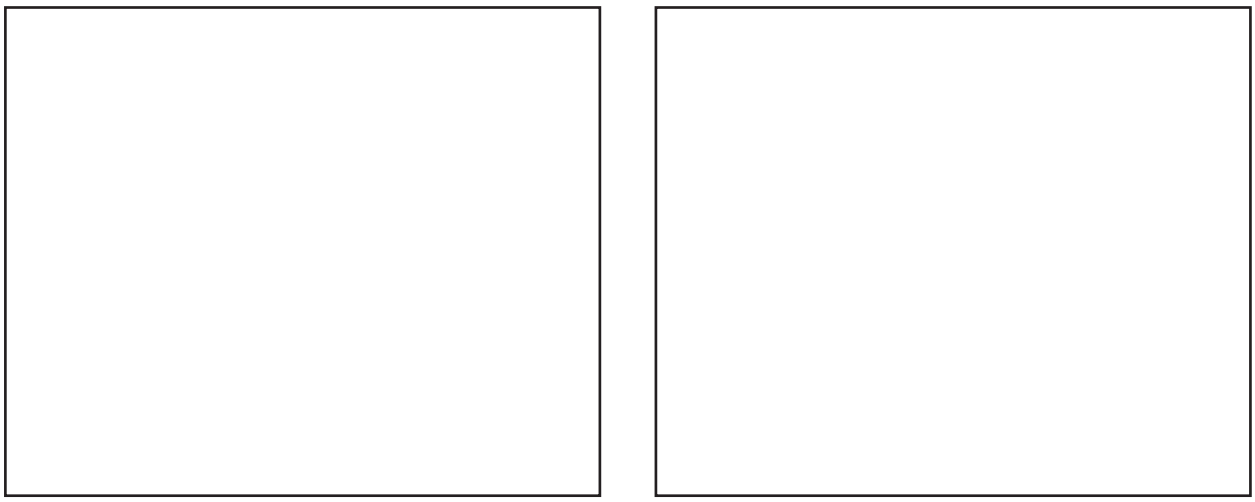
Set	Kelebaran Parit (μm)	Kedalaman Parit(μm)	Ketebalan Epitaksi (μm)	Keberintangan Epitaksi (Ωm)	Nilai S/N BV	Nilai S/N R_{ON}
1	2.85	0.32	6	1×10^{16}	44.503	77.137
2	2.85	0.33	6.5	1×10^{15}	46.201	72.894
3	2.85	0.34	7	1×10^{13}	46.634	71.809
4	2.88	0.32	6.5	1×10^{13}	46.056	73.256
5	2.88	0.33	7	1×10^{16}	45.867	73.728
6	2.88	0.34	6	1×10^{15}	45.512	74.616
7	3.0	0.32	7	1×10^{15}	46.938	71.051
8	3.0	0.33	6	1×10^{13}	45.410	74.870
9	3.0	0.34	6.5	1×10^{16}	45.105	75.631

Analisis nisbah S/N dalam kaedah Taguchi ini dapat dinilai melalui gambaran secara graf bagi mengenalpasti peringkat yang paling optimum untuk sesuatu faktor. Jadual 5 menunjukkan empat faktor dan peringkat-peringkat parameter yang digunakan bagi analisis nilai purata S/N [8].

Jadual 5. Empat faktor dan peringkat parameter bagi analisis nilai purata S/N

Faktor	Parameter	Peringkat	Nilai
A	Kelebaran parit	A_0	2.85 µm
		A_1	2.88 µm
		A_2	3.0 µm
B	Kedalaman parit	B_0	0.32 µm
		B_1	0.33 µm
		B_2	0.34 µm
C	Ketebalan epitaksi	C_0	6.0 µm
		C_1	6.5 µm
		C_2	7.0 µm
D	Keberintangan epitaksi	D_0	1×10^{13} Ωm
		D_1	1×10^{15} Ωm
		D_2	1×10^{16} Ωm

Rajah 5 (a), graf S/N yang memaparkan kesemua faktor yang terlibat dalam voltan runtuh, BV. Saiz kelebaran dan kedalaman parit yang paling optimum dalam memberikan voltan runtuh yang tinggi. Rajah 5 (b) menunjukkan graf S/N yang memaparkan kesemua faktor yang terlibat dalam untuk rintangan-buka R_{ON}. Faktor-faktor dan peringkat yang digunakan untuk analisis rintangan hidup ini adalah sama dengan voltan runtuh.



(a) (b)

Rajah 5. (a) Graf purata S/N untuk voltan runtuh; (b) Graf purata S/N untuk rintangan hidup

5. Kesimpulan

Kaedah reka bentuk Taguchi digunakan untuk menghasilkan reka bentuk ujikaji yang lebih sistematik. Kaedah Taguchi terbukti menjimatkan masa mereka bentuk dan hasilnya adalah baik mengikut kehendak dan objektif projek. Ini memudahkan dengan hanya 9 eksperimen perlu dijalankan berbanding dengan 81 eksperimen yang mungkin dihasilkan dari empat faktor untuk tiga peringkat. Pengoptimuman reka bentuk peranti VDMOSFET menggunakan kaedah Taguchi telah menunjukkan keempat-empat faktor iaitu kelebaran parit, kedalaman parit, keberintangan hasil dopan dan ketebalan epitaksi mempengaruhi respon terhadap voltan ambang (V_{TH}), voltan runtuh (BV) dan rintangan hidup (R_{ON}). Peranti optimum yang memberikan voltan runtuh (BV) yang tinggi adalah dengan saiz kelebaran parit sebanyak 2.88 µm dan kedalaman parit sebanyak 0.32 µm berserta ketebalan epitaksi sebanyak 7.0 µm dan diikuti dengan keberintangan epitaksi sebanyak 1×10^{15} Ωm. Manakala peranti optimum yang memberikan rintangan hidup (R_{ON}) yang rendah adalah dengan saiz kelebaran parit sebanyak 2.85 µm dan kedalaman parit sebanyak 0.34 µm berserta ketebalan epitaksi sebanyak 6.0 µm dan diikuti dengan keberintangan epitaksi sebanyak 1×10^{13} Ωm.

6. Rujukan

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E18 - Data Acquisition For Agriculture Monitoring System

Semai Azura binti Seman; Sisu Arman bin Amir; Dayang Salwan binti Abang Abd Rahman
Institut Latihan Perindustrian Kota Kinabalu (ILPKK)
Email : pengarah@ilpkk.gov.my

Abstract

Telemetry is a technology that allows the remote measurement and reporting of information of interest to the system designer or operator. Telemetry typically refers to wireless communications such as using a radio frequency system to implement the data link but can also refer to the data transfer over other media such as a telephone, computer network or via an optical link. Realizing the importance to monitor plant without going to the plantation, a low cost Data Acquisition For Agriculture Monitoring System has been built by using telemetry system. This monitoring system can capture a data from plantation and deliver the data to the control room. This transmission system uses Amplitude Shift Keying (ASK) modulation techniques. ASK is a form of modulation that represents digital data as variations in the amplitude of a carrier wave. In this research, the main focus is light and temperature value. The lighting and temperature will be captured using this telemetry system. The outcome of this project will lead a better monitoring system in agriculture.

Keywords*: Telemetry, Data Acquisition, Agriculture*

1. Introduction

Telemetry is a technology that allows the remote measurement and reporting of information of interest to the system designer or operator. The word is derived from Greek roots *tele* is remote, and *metron* is measure. Telemetry typically refers to wireless communications such as using a radio frequency system to implement the data link but can also refer to data transfer over other media, such as a telephone or computer network or via an optical link . In this project wireless telemetry have been choose. Wireless telemetry is more complex than wire telemetry, as it requires a final radio frequency (RF) stage. Despite its complexity, it is widely used because it can transmit information over longer distances. Thus, it used in those applications in which the measurement area is not normally accessible. It can also transmit at higher speeds and have enough capacity to transmit several channels of information if necessary [1].

This architecture produces a telemetry system having the following characteristics of the standard telecommunications definition of telemetry:

i The use of telecommunication for automatically indicating or recording measurements at a distance from the measuring instrument.
ii The transmission of non voice signals for the purpose of automatically indicating or recording measurements at a distance from the measuring instrument.

1.1 Problem Statement

In conventional method in agriculture, when gardener want to monitor plant they have go to the plantation. Realizing the importance to monitor plant without go to the plantation, a low cost "Data Acquition For Agriculture Monitoring System" has been built by using telemetry system. This monitoring system can collect a data from plantation and deliver the data to the control room without wasting a lot of time to go to plantation. In this project orchid had been choosen because its have sensivity in humidity, light and temperature. However in this project, the main focus is light (percentage) and temperature (degrees celcius) value. Light is a key factor in growing healthy orchids. Direct sunlight may cause plants to '*burn*', and

too little light (90°C) will prevent plants from flowering. The temperature has three sensitivities, which are warm, intermediate and cool. However the ideal temperature for day is between 15.56° C to 32.2° C while the ideal temperature for night is between 10° C to 21.1° C [2].

Two types of sensor had been used, which is temperature and lighting sensor. Temperature sensor (LM35DZ) that had been used measuring between 0°C to +100°C. For lighting sensitivity the Light Dependent Resistor (LDR) has been use. After receiving a data an analog form from sensors, the data is converted to a digital form before the data is transmitted to a receiver. The RF transmitter has input supply between 2.5V to 12V. The RF transmitter has a small dimension and use amplitude shift keying (ASK) modulation at 315 Mhz. Transmitter that transmit a data using wireless must be compatible with receiver. For this project, the most important thing is know the entire main component to ensure this project can be proceeds as planning.

1.2 Objectives of the Project

The objectives of this project:

i. To implement transmitter system in monitoring system.

ii. To integrated transmitter and receiver by using wireless technology.

1.3 Scope of the Project

Every project have a certain limit.There are scope of this project which is sofware part and electrical part.

i. Software part

In software part, to create a program to collect the data Microsoft Visual C++ 6.0 has been use. PIC16F873A microcontroller that has 28 pins is used. The temperature and lighting data will be collected for every 5 seconds. This is a difficult part to know the function each pin and how to create the program.

ii Electrical part

In electrical part, RF module which is controlled by PIC16F873A is used to collect data. Two sensors are used to collect data which is temperature and lighting sensor. LM35DZ chip is used as a temperature sensor because it is able to use with single power supplies, or with plus and minus supplies. It also able to measure form 0°C to +100°C and it fulfills a condition to measure the temperature of orchid. Light Dependent Resistor (LDR) has been used as a lighting sensor because it has high sensitivity to light. LDR is an electronic component whose resistance decreases with increasing incident light intensity.

2. Literature Review

2.1 Transmitter Wireless (RF Transmitter)

This low cost RF transmitter can be used to transmit signal up to 100 meters. The antenna design, working environment and supply voltage will seriously impact the effective distance. It is good for short distance, battery power device development. It has benefits of such as [3]:

i Wide input supply (2.5V until 12V).
ii Easy to integrate (Data, Vcc and Gnd).
iii Device in deep sleep mode when data pin is grounded.
iv Very small dimension.

Table 2.1: Specification RF Transmitter

Operating Voltage	2.5V until 12V
Operating Current	4mA or 5V, 15mA or 9V
Quiescent Current	10μA
Operating Temperature	-10°C until 60°C
Modulation	ASK
Max. Data Rate	9.6K
Data Input	TTL
RF Power	20mW or 5V

2.2 RF Receiver (315MHz)

This low cost RF Receiver can be used to receive RF signal from any 315MHz transmitter. Super regeneration design ensure sensitive to weak signal. It has benefits such as:-

i. Low power consumption (4mA)
ii. Easy to integrate (Vcc, GND and Data)
iii. Super regeneration design
iv. Very small dimension

Table 2.2: Specification RF Transmitter

Operating Voltage	4.5V to 5.5V
Operating Current	4mA or 5V
Operating Temperature	-10°C until 60°C
Sensivity	-105dBm
Max. Data Rate	4.8K
Data Output	TTL

2.3 Sensor

2.3.1 Temperature sensor (LM35DZ)

In this project, temperature sensor (LM35DZ) has been used. The LM35DZ is a precision temperature sensor. It is guaranteed accurate to ±¼°C at 25°C. At different temperatures it is less accurate, but it is never more than 2°C inaccurate and it probably is not this inaccurate anyway it is just the manufacturer's maximum limits that may apply. Typically is stays accurate to within ±¾°C over its temperature range so this is a good general purpose [4].

2.3.2 Lighting sensor (LDR)

The light dependent resistor or famously known as a LDR is made using the semiconductor Cadmium Sulphide. The device is used in control circuits to turn lights on and in photographic exposure meters. The resistance of the LDR decreases as the intensity of the light falling on it increases. Incident photons drive electrons from the valiancy band into the conduction band.

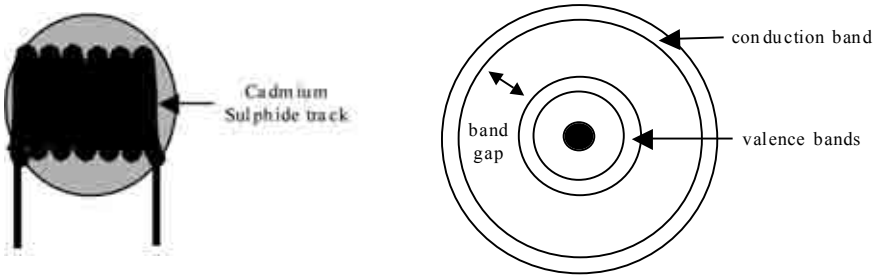


Figure 2.1: Structure of a Light Dependent Resistor, showing Cadmium Sulphide track and an atom to illustrate electrons in the valence and conduction bands Generally LDRs are used for smoke detection, automatic lighting, counting and alarm systems.[5]

2.4 Microcontroller (PIC16F873A)

Microcontroller is the most part in this circuit. Microcontroller is like an engine for this project. In this project, it uses PIC16F873 which have 28 pins. PIC16F873A devices are have three pin for I/O ports, fourteen pin for interrupts and five pin A/D input channels. Figure 2.1 shows the pin diagram for PIC16F873A. Figure 2.2 shows the specification of differential each PIC16F873A.[6]

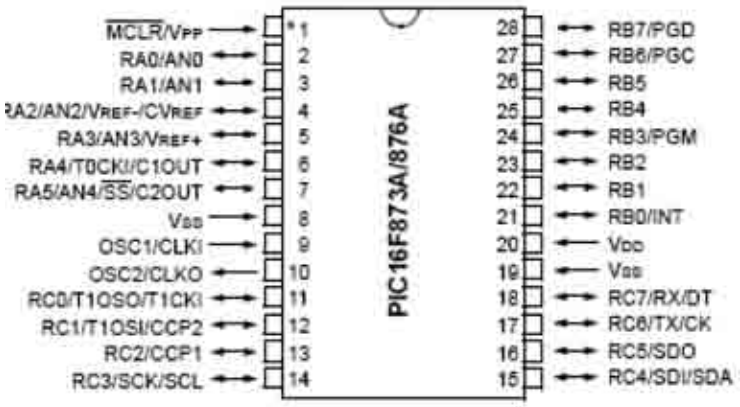


Figure 2.2 : Pin diagram of PIC 16F873A

Key Features	PIC16F873A	PIC16F874A	PIC16F876A	PIC16F877A
Operating Frequency	DC – 20 MHz	DC – 20 MHz	DC – 20 MHz	DC – 20 MHz
Resets (and Delays)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)
Flash Program Memory (14-bit words)	4K	4K	8K	8K
Data Memory (bytes)	192	192	368	368
EEPROM Data Memory (bytes)	128	128	256	256
Interrupts	14	15	14	15
I/O Ports	Ports A, B, C	Ports A, B, C, D, E	Ports A, B, C	Ports A, B, C, D, E
Timers	3	3	3	3
Capture/Compare/PWM modules	2	2	2	2
Serial Communications	MSSP, USART	MSSP, USART	MSSP, USART	MSSP, USART
Parallel Communications	—	PSP	—	PSP
10-bit Analog-to-Digital Module	5 input channels	8 input channels	5 input channels	8 input channels
Analog Comparators	2	2	2	2
Instruction Set	35 Instructions	35 Instructions	35 Instructions	35 Instructions
Packages	28-pin PDIP 28-pin SOIC 28-pin SSOP 28-pin QFN	40-pin PDIP 44-pin PLCC 44-pin TQFP 44-pin QFN	28-pin PDIP 28-pin SOIC 28-pin SSOP 28-pin QFN	40-pin PDIP 44-pin PLCC 44-pin TQFP 44-pin QFN

Table 2.2 : Specification of Differential each PIC 16F873A

2.4 Orchid

In this project orchid had been choosen because its have sensivity in humidity, light and temperature. However in this project, the main focus is light and temperature value. Light is a key factor in growing healthy orchids. Direct sunlight may cause plants to '*burn*', and too little light (90^{o}C) will prevent plants from flowering. The temperature has three sensitivities, which are warm, intermediate and cool. However the ideal temperature for day is between 15.56^{o} C to 32.2^{o} C while the ideal temperature for night is between 10^{o} C to 21.1^{o} C. [7].The detail classification can see in Table 2.1

Table 2.4 : The Classification Temperature

3 TEMPERATURE CATEGORIES		
	Day	**Night**
Warm	26.67^{o}C to 32.2^{o}C	18.3^{o}C to 21.1^{o}C
Intermediate	21.1^{o}C to 26.7^{o}C	12.78^{o}C to 18.3^{o}C
Cool	15.56^{o}C to 21.1^{o}C	10^{o}C to 12.78^{o}C

3. Methodology

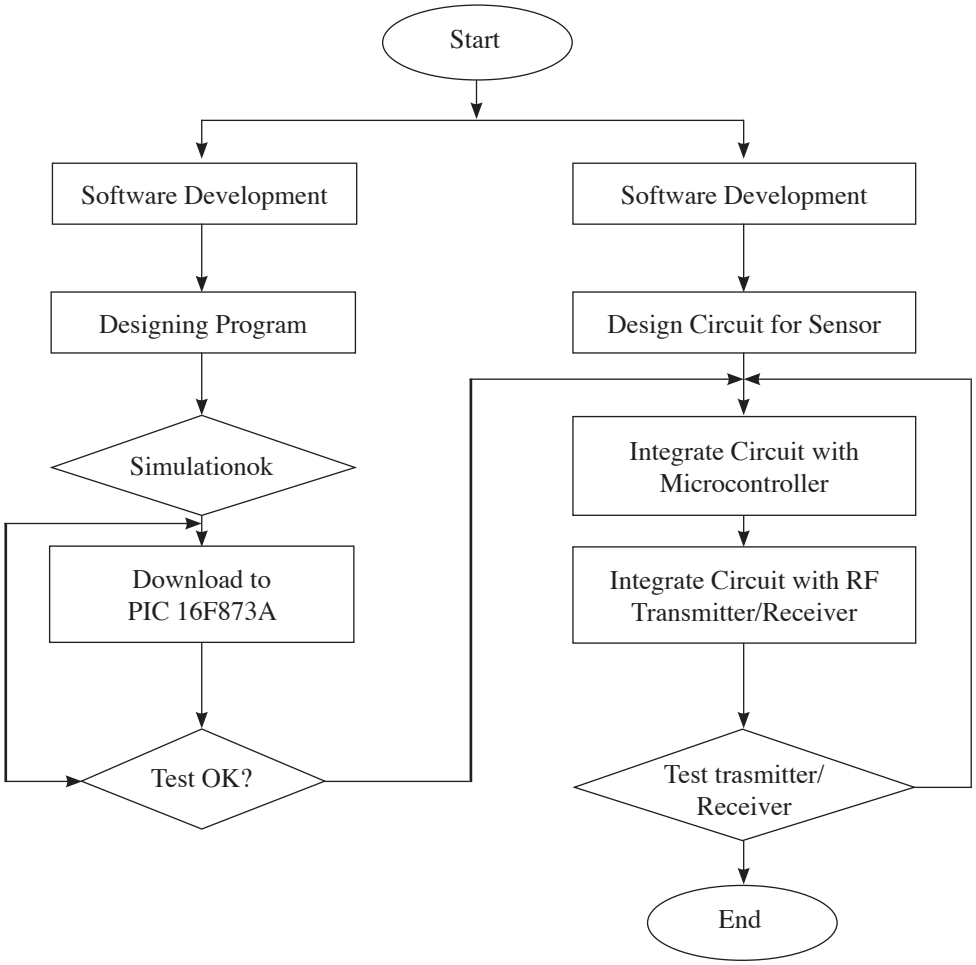


Figure 3.1: Flow Chart for Project Development Methodology

3.1 Hardware Development

In this project, the main important steps are designing and constructing a transmitter monitoring system. The circuit must be tested on prototyping board (PCB). Refer to **Appendix A** of the circuit. Once it has works effectively, the circuit will transfer on printed circuit board (PCB). Refer to **Appendix B.**

3.2 Software Development

PIC16F873A has chosen to control the overall system. The microcontroller will received a signal from temperature (LM35DZ) and lighting (LDR) sensor. In this project, C++ language has been used as an interface programming. Refer to **Appendix C**. MPLAB IDE is a software program that runs on a PC to develop applications for microchip microcontroller. Simulators are built into MPLAB IDE and a program can be tested without any additional hardware. The simulator is used to test how the code will be operated. When programmed is successfully, the programmed will be tested and download it into PIC16F873A. After the application has been successfully it needs to be tested on its own. A device can be programmed with the in-circuit debugger or a device programmer. MPLAB IDE can be set to the programmer function, and the PIC16F873A can be “burned”.

4. Result And Data Analysis

4.1 Analysis on Hardware

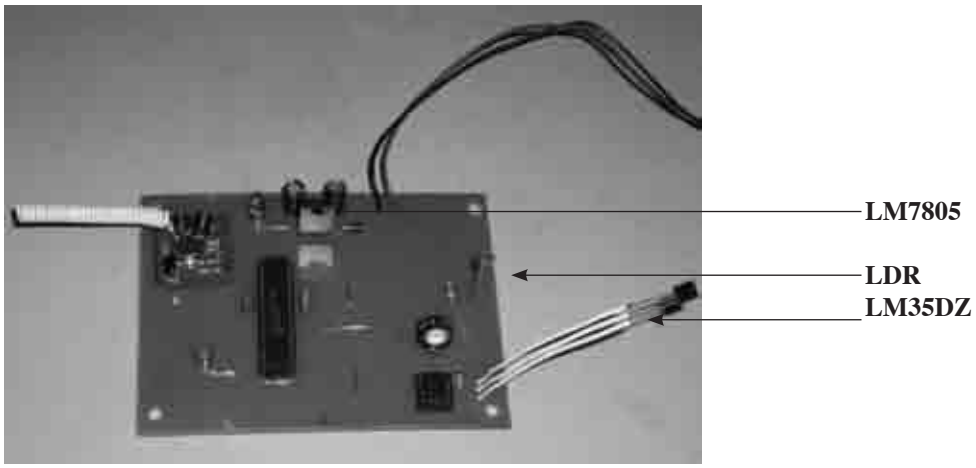


Figure 4.1 : Transmitter monitoring system

4.1.1 Power Supply

The suitable voltage ranges for this project are between 7V to 15V. if the voltage at power source is too high than the ranges will occur the voltage regulator (LM7805) becomes hot and damages. So the typical voltage that can be given is around 12v. Voltage regulator will regulate the given voltage to 5V (Vcc) to supply power to PIC16F873A. The purpose of using diode (D1) is for circuit protection in case the polarity of the power source is incorrect. Capacitor C1 and C2 are used to stabilize the voltage input and output of voltage regulator. Capacitor C2 is also used to reduce the instability of PIC and LED as power indicator. Figure 4.1 below shows the circuit of power supply.

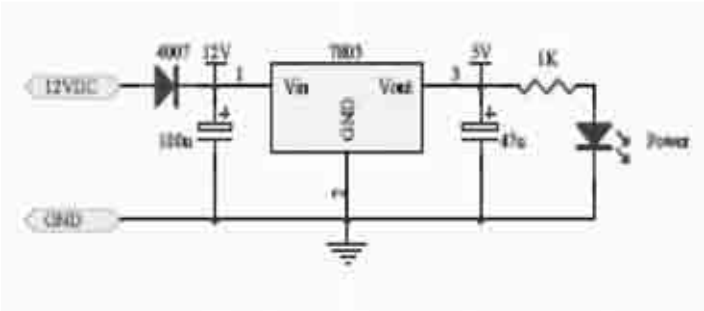


Figure 4.2: Power supply circuit

To ensure the power supplied is 5V, it can be measured using multimeter and oscilloscope which shows in Figure 4.3 and 4.4.

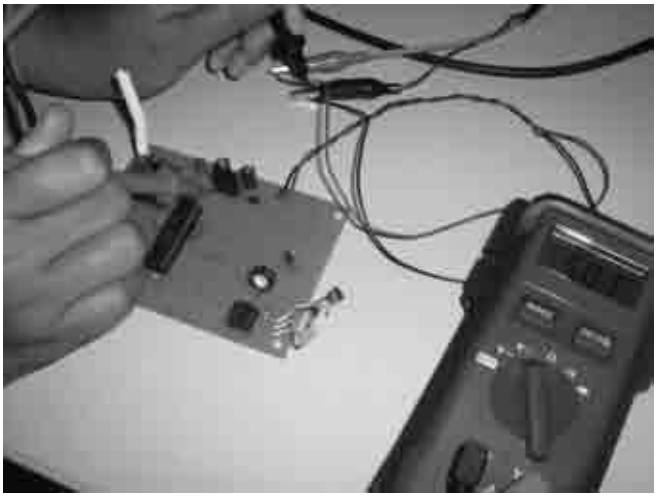


Figure 4.3 : Measured voltage using Digital Multimeter

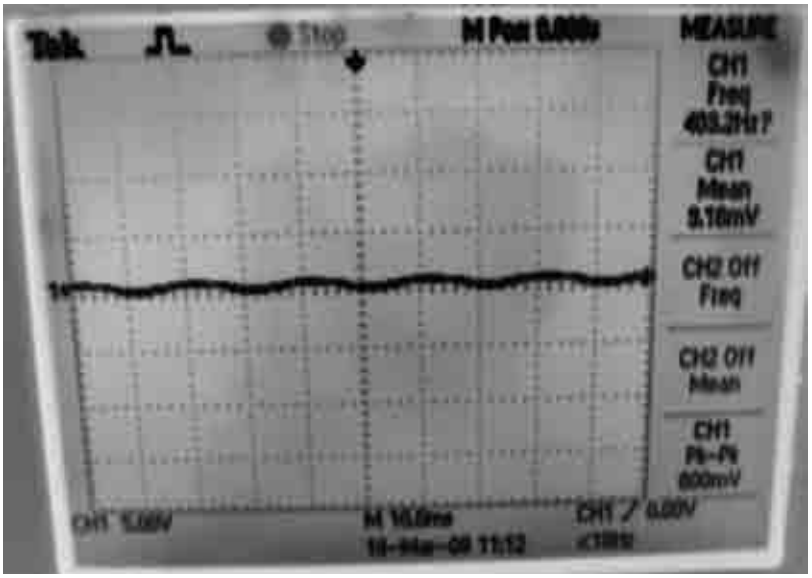


Figure 4.4 : Output voltage from transmitter monitoring circuit using Oscilloscope

4.1.2 Light Dependent Resistor (LDR)

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. The light dependent resistor consists of a length of material (cadmium sulphide) which resistance changes according to the light level. Therefore the brighter the light, the lower the resistance. Analysis of LDR in Table 1.1 below shows that brighter light will influent the voltage.

Table 4.1: Brightness versus Voltage

Brightness (In degree)	Voltage
0	4.0 V
45	3.4 V
60	3.3 V
90	2.9 V
125	1.9 V

From Table 1.1, the brightness is measured in degree. When the brightness is decreased, the voltage will increase.

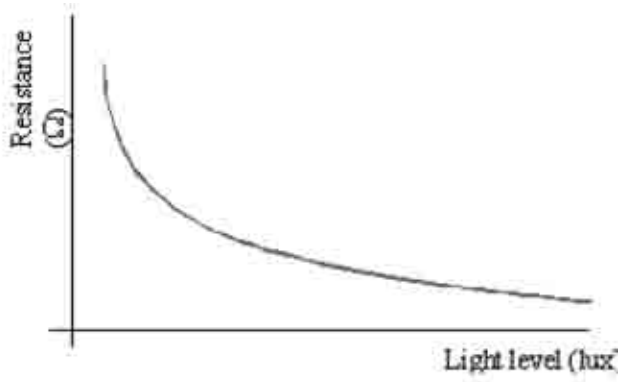


Figure 4.5 : Light level versus Resistance

4.1.3 Temperature Sensor (LM35DZ)

The LM35DZ puts out a voltage proportional to temperature. LM35DZ measuring temperature between 0 and 100°C by producing an output voltage 10mV times the temperature in degrees Celsius. LM35DZ analysis is shows in Table 4.2.

Table 4.2 : LM35DZ analysis in different condition

Condition	Voltage (V)	Degree Celsius (°C)
Room temperature	0.2 V	20°C
Medium hot	0.3 V	30°C
Hot	0.5 V	50°C
Very Hot	0.8 V	80°C

Note:
1°C = 10mV

From observation of Figure 4.6 shows when temperature increased, the voltage will decrease.

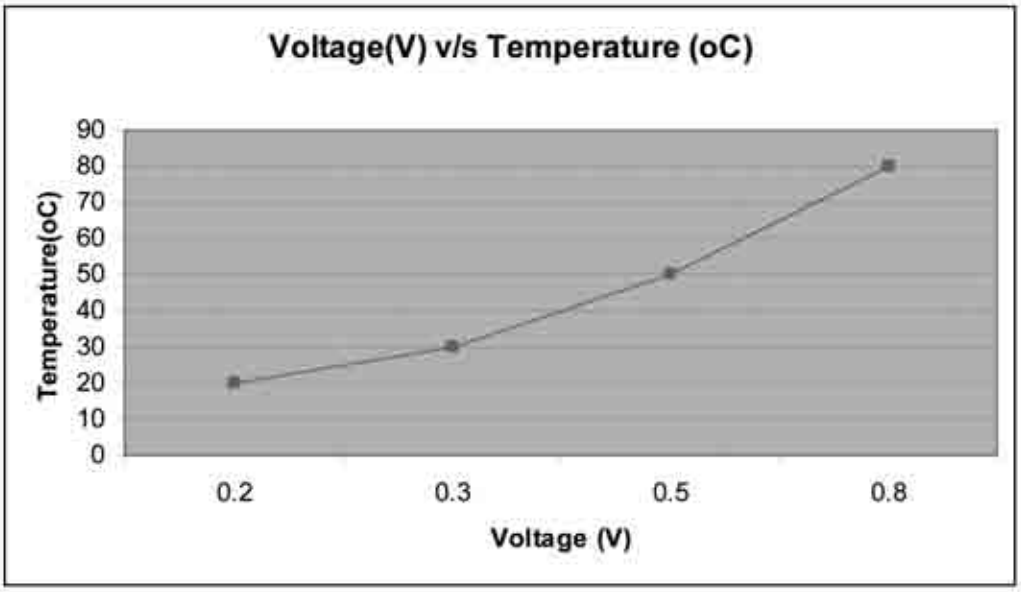


Figure 4.6 Voltage (V) versus Temperature (°C)

4.1.4 RF Transmitter (315Mhz)

To ensure the data transmit is 313 MHz, spectrum analyzer has been used. Figure 4.7 below shows the waveform of RF transmitter.

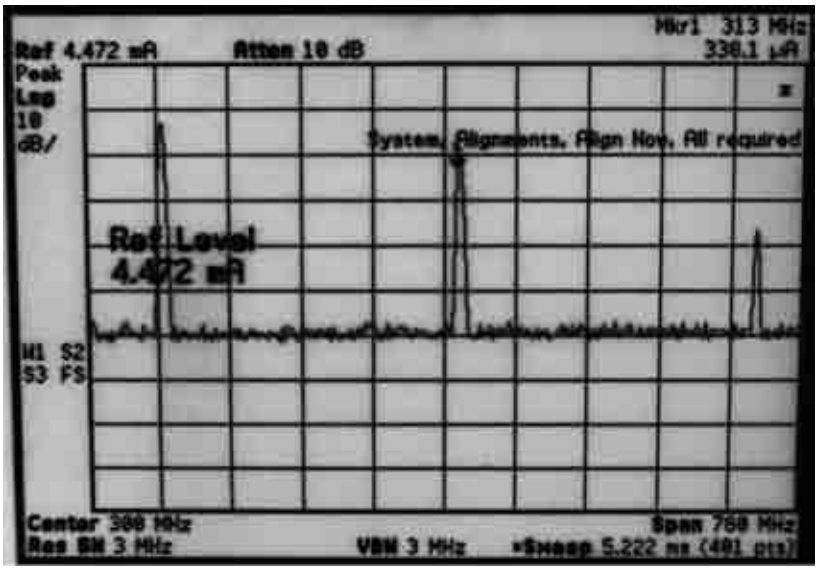


Figure 4.7: RF transmitter using Spectrum Analyzer (1st marker)

As a comparison, a second wave from second marker has a different frequency around 633 Mhz as in Figure 4.8. The second wave was higher than first wave because of harmonic distortion has occurred.

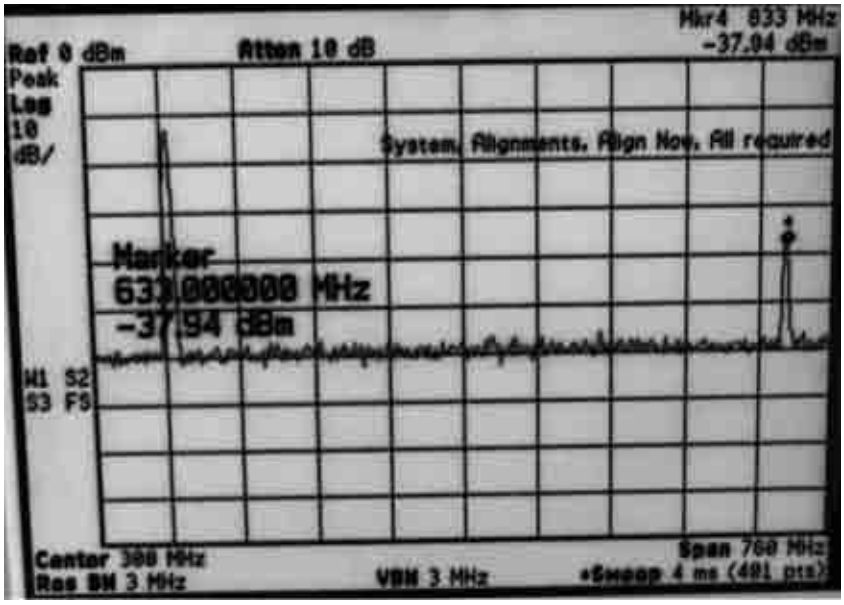


Figure 4.8 : RF transmitter using Spectrum Analyzer (2nd marker)

4.1.5 Transmitter Circuit Using Oscilloscope

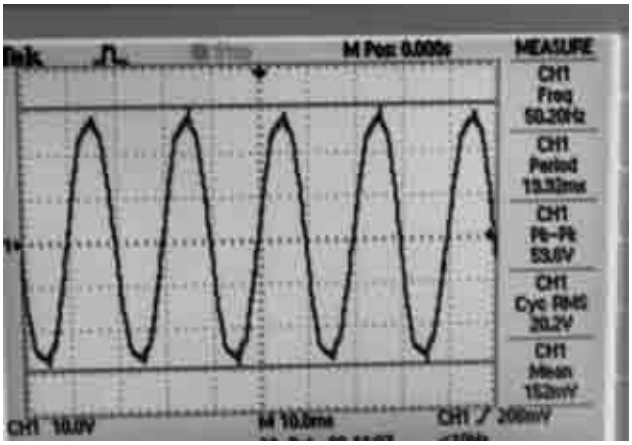


Figure 4.9 : Pin 3 (PIC 16F873A) waveform from LDR

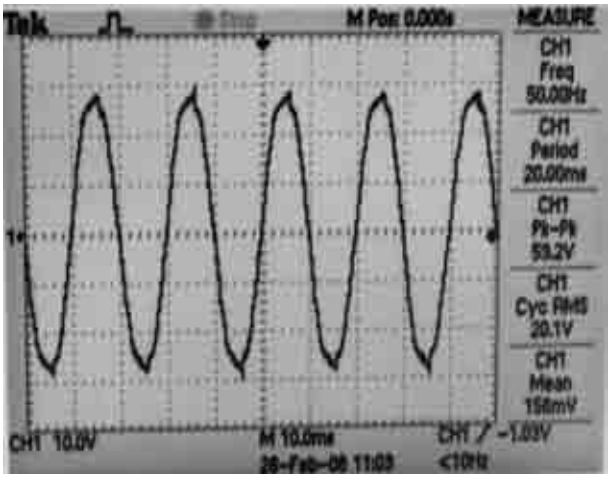
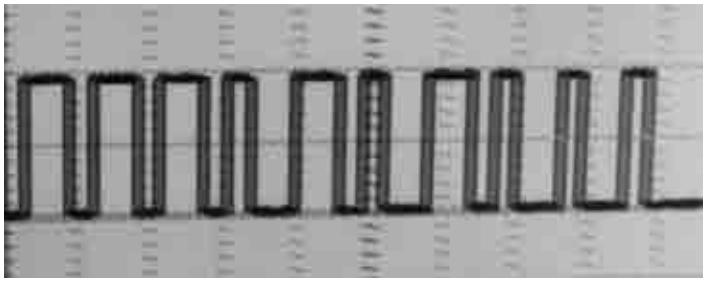


Figure 4.10 : Pin 2 (PIC16F873A) waveform from LM35DZ



Frequency	109.7 Hz
Period Time	9.120 ms
Pk-pk	5.2 V
Rms	29.3 V

Figure 4.11 : Output waveform from Pin 17 (PIC16F873A) when transmitted a data

From observation, the carrier is ON when the digital input binary is '1' and the carrier is OFF when the digital input is '0'. Therefore, binary ASK modulation is also known as ON-OFF keying.

4.1.6 Monitor Display (Laptop)

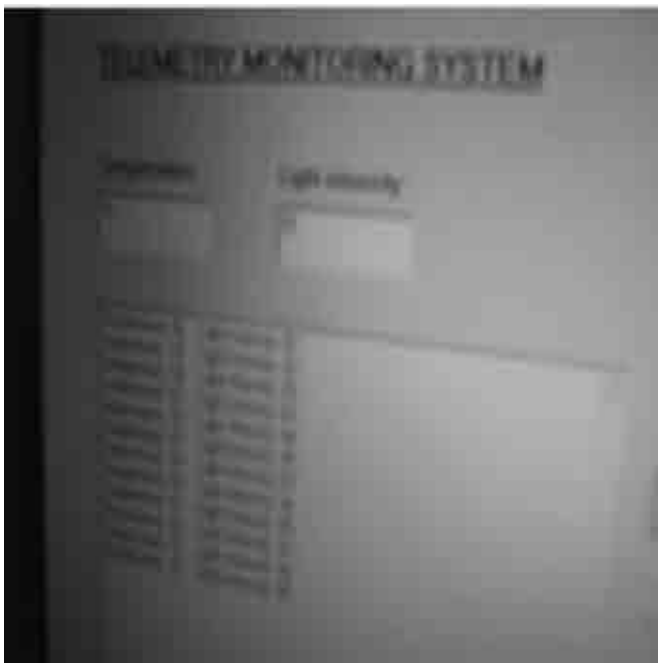


Figure 4.12 : Visual Basic display the result

From observation, data will display every 5 second. Time for displaying depends to program that created.

5. Conclusion & Recommendation

5.0 Conclusion

As a conclusion, this project has achieved the objectives. Data can be collected from temperature and lighting sensor and transmit the data to receiver at frequency 315 MHz. However, the idea of this project still can be to improve to provide a better solution in agriculture. The project is quite complicated because it is involved many applications in order to set up the whole device. The major challenge is in the software interfacing part because it is the main part to interface transmitter and receiver. At the end of this project, 'Data Acquition For Agriculture monitoring System' had been successfully built.

5.1 Recommendation

Based on the performance and achievement of the system built there were more features and recommendation could be added to the existing ones. The success of this project will be a good starting point towards better hardware and software development that will happen in future. The following list some of the changes that should be made to produce and better project:

i Measuring three sensitive orchid's temperatures which are humidity and lighting.
ii A LCD display can be added, so the transmitted date could be monitor.
iii Besides display rainfall to the personal computer, this project also can display the data to the mobile phone.
iv A better circuit using PCB multilayer should be replaced the simple circuit that be used in this project. Using the multilayer PCB, the circuit will becomes more stable because the grounding system can be separate with the signal plane.

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Control Power Point Presentation using Mobile Phone

Khadijah Staari
Electronic&Electrical Department, Telecommunication Division
ADTEC Melaka
khadijahstaari@gmail.com

Abstract

This paper is elaborate on how to control power point presentation by using mobile phone. The medium for connectivity between power point presentation and mobile phone is unwired which is using Bluetooth technology. The motivation from this paper is the combination of old technology by imatation from new technology. Nowadays, most of the presenter will using wireless projector and making presentations from anywhere in the room without having to hassle with cables. However, not all presenters have the opportunity to buy this technology as the price of wireless projector is quiet expensive. Although, the technology smartphone has the ability to control the power point presentation from the screen smartphone as the phone has application Quick Office but in this paper the mobile phone that is used does not has Quick Office application but work as a computer mouse. Therefore, this paper will elaborate more how to combine mobile phone technology and Bluetooth technology to imitate the wireless projector technology with best value of money. The experiment is using mobile phone Nokia 3120 as this mobile phone provides compatible price compare to other mobile phone, while the model Bluetooth adapter is DBT-122 from D-link brand.

Keyword: *wireless presenter*

1. Introduction

Wireless presenter is software that developed for working with Nokia mobile phone and provides access to Windows files on Personal Computer, PC by using wireless technology Bluetooth. In this paper will concentrate on how to control presentation slide using mobile phone. This application is a medium between transmitter and receiver that is the mobile phone and PC, Figure 1. The mobile phone is functions as remote control to control the power point presentation with the help of wireless technology Bluetooth.

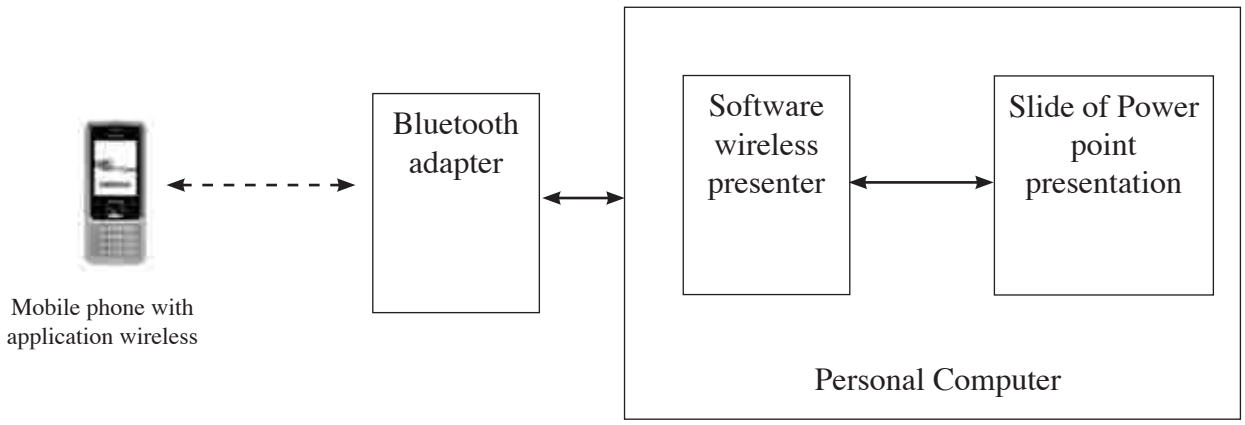

Figure 1

2. Hardware and Software Requirements

There are two requirements to achieve the objective of this application, which are hardware and software tools. For hardware requirements, the tools are Bluetooth dongle or build-in Bluetooth in your laptop or Personal Computer (PC) and Mobile phone Nokia 3120, which is function as remote controller. Meanwhile, the software requirements must using Operating System from Microsoft XP SP2, installer of Wireless Presenter for Personal Computer, which is can download from website, installer of Wireless Presenter for Nokia mobile phone also can download from Nokia's website and the main application is Microsoft Office (version 2003) for opening the Power Point presentation.

3. Step by step Setup

There are eight main steps in this paper. The first step is to turn ON the Bluetooth device in laptop or Personal Computer through Nokia Connection Manager, Figure 2. In this step user should enable the Bluetooth driver for Microsoft only, Figure 3. By enabling, the driver of Bluetooth for Microsoft only will avoid the issue of driver conflict in operating system.

Figure 2

Figure 3

Second step is purpose for adding new device which is the mobile phone that must connected with laptop or personal computer, without this step the mobile phone cannot work as remote controller, Figure 4 and Figure 5.

Figure 4

Figure 5

After selecting which device that want to connected to personal computer, there will appear a wizard for user to choose the passkey or do not use the passkey for establishing the unwired connection between mobile phone and personal computer, as shown in Figure 6. In this experiment, the Windows will choose the passkey for establishing the connection, Figure 7. Therefore, the same passkey also must be use in mobile phone.

Figure 6

Figure 7

After enter the passkey that generate by Windows into mobile phone Bluetooth, the finish wizard will appear at PC screen include with the number of serial port that assign to the mobile phone for outgoing and incoming data, Figure 8. The number of serial port is very important when to troubleshoot the connection between Bluetooth devices if the connection cannot establish.

Figure 8

Meanwhile, in wizard Bluetooth devices will appear the device that connected to PC, which is the mobile phone Nokia 3120, Figure 9. If user clicks to the tab COM port, he can check the incoming port that use for communication, Figure 10.

Figure 9

Figure 10

After completing the process for connecting the Bluetooth device, now is the process for setup the connection between Power Point presentation and mobile phone via software Wireless Presenter. After install the software Nokia Wireless presenter in Personal Computer, select the incoming serial port of Bluetooth device based on the same port that used in Figure 10, Figure 11. Meanwhile, the application of wireless presenter in mobile phone is used for selecting the device, which is the Bluetooth of Personal computer.

Figure 11

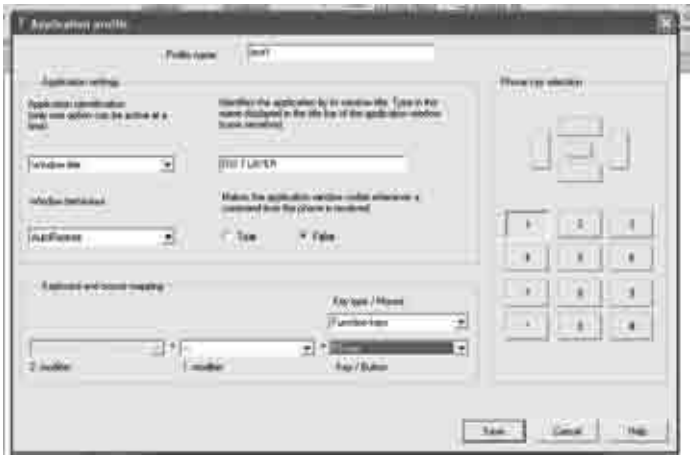

Figure 12

There are a few basic configurations that must assign between PC and mobile phone for establish the the connection, which is the profile name that user want to appear in screen of both PC and mobile phone. Then the selection of window title in application identification and the most important is the name of Power Point slide that want to control. For selecting the key pad of mobile phone that user want to use as controller, the phone key selection is used with the section keyboard and mouse mapping. In this part, the user can select the function of each button in mobile phone that he want uses as controller the slide presentation, Figure 12.

4. Conclusion

Through this paper writer hopes that the user can apply this knowledge and technology in all institute to boost the performance of lectures. Besides, the cost are reasonable and easy for setup the hardware and software.

References

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E20 - SMS Water Tank Alert System

Syamsul Halim Wahab; Fairuzana Kamso; M. Z. M. Nasir
Pusat Latihan Teknologi Tinggi (ADTEC) Melaka

Abstract

SMS Water Tank Alert merupakan projek yang direkabentuk khas oleh ADTEC Melaka untuk mengatasi masalah bekalan air yang sentiasa terputus di institut. Secara ringkasnya, pam bagi tangki air institut dikendalikan secara manual di mana jurueknik penyelenggaraan perlu memanjat tangga tangki untuk melihat paras air. Bagi mengatasi masalah tersebut, satu mekanisme pemberitahuan perlu dibangunkan untuk membeari amaran awal mengenai paras air yang telah mencapai tahap kritikal. Hasil kajian yang dijalankan, mekanisme pemberitahun yang sesuai adalah menggunakan sistem pesanan ringkas (SMS). Melalui sistem ini, dua penderia terapung diletakkan di dalam tangki, di mana ia akan menetapkan dua paras air yang berbeza. Dua paras tersebut akan memberitahu tahap air hampir mencapai keadaan kritikal dan telah mencapai keadaan kritikal. Apabila penderia diaktifkan, satu isyarat akan diberikan kepada pengawal. Kemudian pengawal akan memberi arahan kepada telefon selular supaya menghantar pesanan ringkas kepada jurueknik penyelenggaraan mengenai paras air tangki hampir atau telah mencapai tahap kritikal.

Keyword *: Sistem Pesanan Ringkas (SMS), Mekanisme Pemberitahuan, Penderia Terapung, Pengawal*

1. Pengenalan

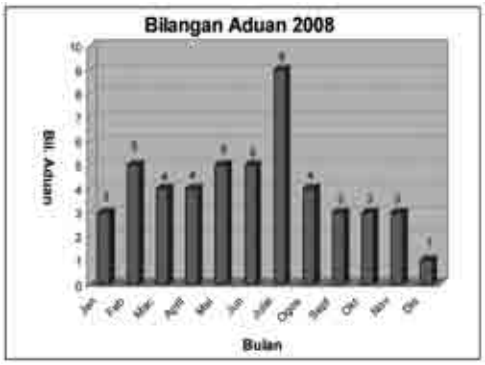
SMS Water Tank Alert merupakan projek yang menggabungkan kejuruteraan elektrikal, elektronik dan telekomunikasi untuk menyelesaikan masalah berdasarkan keadaan sebenar. Menggunakan PIC sebagai pegawal, sistem ini dibangunkan untuk menyediakan satu mekanisma pemberitahuan.

Sistem ini dapat memudahkan pihak Pusat Latihan Teknologi Tinggi (ADTEC) Melaka bagi menentukan kedudukan air dalam tangki utama melalui penghantaran Sistem Pesanan Ringkas (SMS) kepada pekerja pam supaya membekalkan air sekiranya kedudukan air di paras rendah atau kritikal.

2. Permasalahan

2.1 Latarbelakang masalah

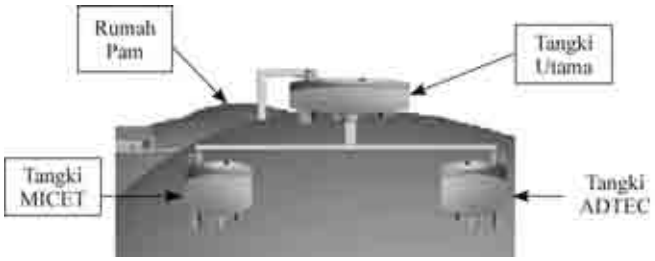
Sehingga tahun 2008 terdapat banyak aduan mengenai terputusnya bekalan air yang dialami oleh pelajar dan kakitangan institut ADTEC Melaka. Masalah tersebut semakin ketara ketika berlakunya acara rasmi dan memberi kesan terhadap aktiviti yang dijalankan. Rajah 1[1] adalah statistik aduan mengenai masalah bekalan air. Kajian telah dijalankan bagi mengenalpasti punca dan langah bagi mengatasi masalah tersebut



Rajah 1. Statistik bilangan aduan masalah bekalan air pada tahun 2008

2.2 Sistem bekalan air ADTEC Melaka

Struktur geografi muka bumi ADTEC Melaka adalah kawasan berbukit, Oleh kerana faktor ini tangki air ADTEC Melaka bergantung kepada tangki utama yang dimiliki dan dikendalikan oleh syarikat kontraktor utama untuk membekal air. Ia mempunyai kapasiti 500,000 gelen air dan membekalkan air kepada dua institut iaitu ADTEC Melaka dan Universiti Kuala Lumpur (MICET).



Rajah 2. Saluran air dari tangki utama.

Air disalurkan ke tangki utama melalui pengepaman dari rumah pam. Tangki utama tidak mempunyai alat untuk mengesan paras air. Ini menyebabkan proses pemantauan paras air dan pengepaman air dilakukan secara manual oleh pekerja kontraktor utama. Pekerja tersebut akan mengepam air selama dua jam setiap hari dari rumah pam yang berada 79 meter dari tangki utama. Kemudian air dari tangki utama akan disalurkan kepada tangki ADTEC Melaka dan tangki MICET secara tindakan graviti.

Rajah 3. Saluran air ke ADTEC Melaka

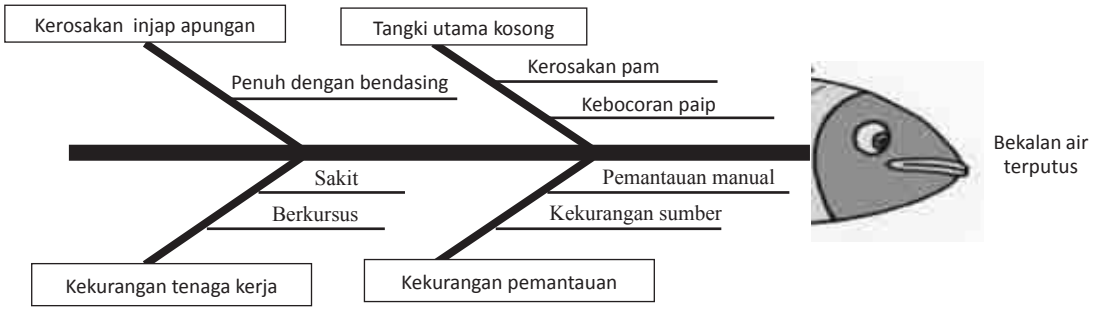
Tangki ADTEC berukuran 6.7 meter tinggi dan mempunyai diameter 3.6 meter. Ia boleh sehingga menampung 180,000 gelen air. Air dari tangki ini akan disalurkan kepada keseluruhan bangunan institut.

Rajah 4. Tangki ADTEC dan tangki utama

Kapasiti air dalam tangki ADTEC mampu bertahan sehingga 4 hari bagi penggunaan harian. Jangkamasa ini akan berkurangan kepada 3 atau 2 hari, jika ada sesuatu acara rasmi yang dianjurkan oleh institut.

2.3 Punca Masalah

Hasil daripada kajian yang dijalankan, didapati tiadanya mekanisme atau sistem pemantauan secara automatik pada tangki utama dan tangki ADTEC. Sekiranya terdapat aduan mengenai bekalan air terputus, juruteknik penyelenggaraan akan memeriksa paras air dengan menaiki tangga. Jika paras air rendah, beliau akan menghubungi pekerja kontraktor utama supaya mengepam air pada tangki utama. Jelas di sini bahawa faktor manusia banyak memainkan peranan. Antara beberapa faktor lain adalah seperti berikut.



Rajah 5. Faktor-faktor bekalan air terputus

3. Pembangunan Sistem

Hasil daripada maklumat mengenai punca masalah bekalan air yang sering dialami oleh institut ADTEC Melaka, dapat disimpulkan bahawa, satu mekanisma pemberitahuan harus dibangunkan untuk mengetahui paras air di dalam tangki. Mekanisma ini juga akan memberi amaran awal kepada juruteknik penyelenggaraan yang bertanggungjawab mengenai kedudukan air di paras rendah. Sistem telekomunikasi selular dikenalpasti sebagai mekanisma paling praktikal kerana faktor jarak tidak memainkan peranan. Dengan menggunakan Sistem Pesanan Ringkas (SMS), maklumat mengenai paras air tangki akan terus dihantar ke telefon selular juruteknik penyelenggaraan. Sistem yang dibangunkan ini dinamakan *SMS Water Tank Alert*.

3.1 Konsep asas sistem

Tiga komponen utama di dalam sistem ini adalah pengawal, penderia dan peranti yang menghantar SMS. Pengawal yang digunakan adalah *Peripheral Interface Controller* (PIC) yang dipasang pada litar kawalan dan diprogramkan. Penderia terapung digunakan untuk mengesan paras air dan disambungkan kepada litar kawalan sebagai input. Output litar kawalan pula adalah telefon selular yang membolehkan penghantaran SMS dilakukan.

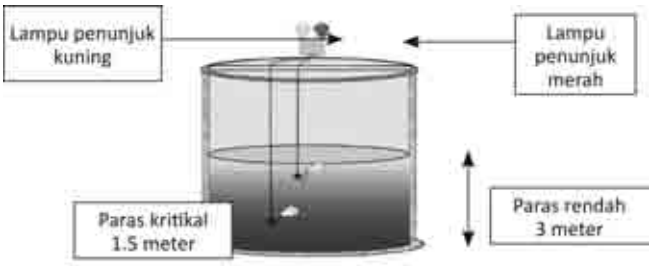
Penderia terapung PIC Telefon selular

Rajah 6. Konsep sistem

Apabila penderia terapung mengesan paras air yang ditetapkan, ia akan menghantar isyarat kepada litar kawalan yang dipasang PIC. Litar kawalan seterusnya akan memberi arahan kepada telefon selular untuk menghantar SMS kepada nombor yang telah ditetapkan padanya.

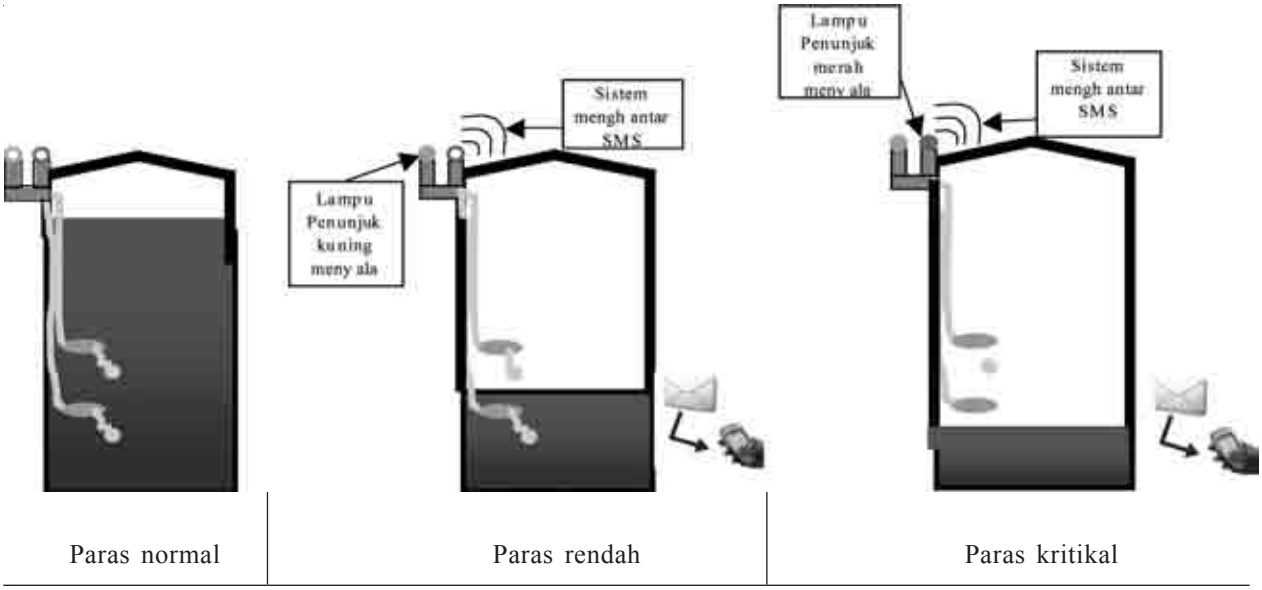
3.2 Mekanisma sistem

Bagi mengelakkan gangguan bekalan air, kandungan air tangki ADTEC tidak boleh dibiarkan kosong kerana pengepaman air ke tangki utama dan penyaluran air ke tangki ADTEC akan mengambil masa. Setelah mengambil kira faktor tersebut, sistem ini akan dipasang dua penderia terapung yang ditetapkan kepada paras rendah pada 3 meter dan paras kritikal pada 1.5 meter dari dasar tangki[2].



Rajah 7. Paras penderia terapung

Sesuatu sistem yang berkesan perlu mempunyai mekanisma alternatif sebagai sokongan jika mekanisma utama gagal berfungsi. Bagi sistem *SMS Water Tank Alert*, dua buah lampu penunjuk dipasang pada atas tangki ADTEC sebagai sokongan kepada sistem SMS. Lampu penunjuk berwarna kuning akan menyala ketika paras air rendah manakala paras air di kedudukan kritikal akan menyalakan lampu merah. Selain itu satu *speaker* juga dipasang untuk memberitahu paras air telah berada pada tahap kritikal. Ini bermakna apabila penderia diaktifkan, lampu dihidupkan oleh pengawal iaitu PIC. Ini penting jika juruteknik bertanggungjawab bercuti atau berkursus.



Rajah 8. Mekanisma sistem

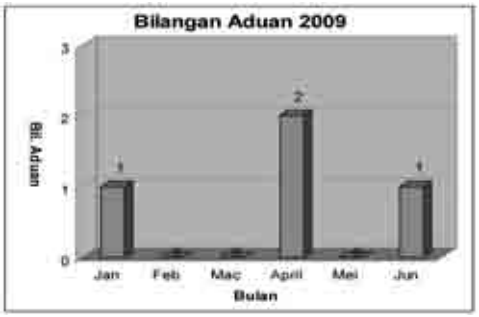
Kedua-dua penderia terapung akan dipasang pelampung dan pemberat supaya berada di keadaan paras normal. Penderia berada di dalam air dan tidak diaktifkan manakala sistem di dalam keadaan menunggu. Paras rendah menunjukkan paras air yang telah susut di bawah 3 meter dari dasar tangki. Ini akan mengakibatkan penderia terapung paras rendah akan diaktifkan. Isyarat akan dihantar ke litar kawalan, dan seterusnya PIC akan mengarahkan telefon selular untuk menghantar SMS. Kemudian mesej "*Warning!!! Water in low level*" akan dihantar. Sebagai sokongan lampu penunjuk kuning akan menyala. Apabila air susut di bawah 1.5 meter, penderia paras kritikal pula akan diaktifkan dan proses yang sama akan diulang. Mesej yang dihantar adalah "*Warning!!! Water in critical level*". Selain dari itu lampu penunjuk berwarna merah dan *speaker* akan dihidupkan[2].

3.3 Gambar sistem yang dibangunkan

Rajah 9. Sistem yang dibangunkan dan lokasi pemasangan

4. Kesan Apabila SMS Water Tank Alert Dipasang

Apabila sistem dipasang, ternyata ia memberi impak yang besar dalam menyelesaikan masalah bekalan air yang serig terputus yang dialami oleh penghuni ADTEC Melaka secara efektif. Ini boleh dibuktikan dengan bilangan aduan yang menurun seperti ditunjukkan di da1am Rajah 10[1].



Rajah 10. Statistik bilangan aduan masalah bekalan air pada tahun 2009

5. Penaiktarafan Sistem

5.1 Kelemahan *SMS Water Tank Alert*

- Penggunaan penderia terapung kurang sesuai kerana ia mudah rosak pada tekanan air yang tinggi.
- Penggunaan telefon selular kurang sesuai kerana fungsi yang kompleks pada telefon berkenaan.
- Sistem hanya boleh menghantar SMS pada seorang sahaja.
- Tiada mekanisma dua hala di mana juruteknik boleh menghantar SMS kepada sistem untuk arahan tertentu seperti mematikan *speaker*.

5.2 *SMS Water Tank Alert 2*

SMS Water Tank Alert 2 masih di dalam pembangunan di mana ia dinaiktaraf daripada *SMS Water Tank Alert*. Penderia yang digunakan pada sistem ini adalah penderia ultrasonik[3] manakala telefon selular digantikan dengan modem GSM (*Global System for Mobile Communications*).

Penderia ultrasonik PIC Modem GSM

Rajah 11. Konsep *SMS Water Tank Alert 2*

Penggunaan penderia ultrasonik akan mengatasi kelemahan penderia terapung. Ini kerana faktor tekanan air tidak memainkan peranan terhadapnya. Penggunaan modem GSM pula membolehkan penghantaran SMS dilakukan kepada lebih dari seorang. SMS juga dihantar dengan lebih pantas. Selain dari itu juruteknik boleh menghantar SMS kepada sistem untuk mematikan *speaker* dan lampu penunjuk serta menghidupkan kembali sistem.

6. Kesimpulan

Sistem ini telah digunapakai hampir 2 tahun dan membantu mengatasi masalah gangguan bekalan air di ADTEC Melaka sejak bertahun yang lalu. Ia dihasilkan oleh pelajar-pelajar Mekatronik dengan bimbingan dan penyeliaan dari pengajar. Sistem ini terbukti berkesan sebagai instrumen di dalam mengatasi masalah bekalan air secara efektif dan telah dinobatkan tempat pertama di dalam Pertandingan Kreativiti dan Inovasi peringkat JTM. Dengan pengubahsuaian dan penaiktarafan yang sepatutnya, sistem ini boleh diaplikasikan di dalam industri dan komersial.

7. Rujukan

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E21 - Performance Study Of Wireless Body Area Network (WBAN) In Medical Environment

Marina Sukor[1]
Pusat Latihan Teknologi Tinggi (ADTEC) Batu Pahat, Johor
Sharifah Ariffin[2], Norsheila Fisal[3], S.K. Syed Yusof[4], Adel Abdallah[5]
Telematic Optic Department, Universiti Teknologi Malaysia (UTM)
marina@adtecbp.gov.my

Abstract

Advanced in sensors and wireless communications devices have enabled the design of miniature, cost-effective, and smart physiological sensor nodes. One of the most approaches in developing wearable health monitoring systems is emerging of wireless body area network (WBAN). IEEE 802.15.4 provides low power, low data rate wireless standard in relation to medical sensor body area networks. In the analysis presented, the star network topology of 802.15.4 standard at 2.4 GHz was considered for a body area network configured in beacon mode. The main consideration is in total data bits received by all the nodes at the coordinator and flight times of a data packet reach its destination. We discuss what wireless technologies can be used for medical applications and how they perform in a healthcare environment. The low-rate Wireless Personnel Area Network (WPAN) is being used to evaluate its suitability in medical application.

Keywords: IEEE 802.15.4, sensors, wireless body area network, PAN coordinator, star topology

1.0 Introduction

Nowadays, most wireless technology is focusing on increasing high data throughput. A set of applications such as industrial, agricultural, vehicular, residential and medical required simple wireless connectivity, relaxed throughput, very low power, short distances and low cost. The IEEE 802.15.4 standard was specifically design to support low power with low data rate networks where latency and bit rate are not so critical. This is a response to the rapid usage growth in this area [1]. IEEE 802.15.4 would go beyond the current state of the art where a 403MHz medical implant communication services (MICS) is used for implant-to-controller, point-to-point communication without networking support [2]. The study and research are focuses in the analysis of IEEE 802.15.4 standard configured as a star network where the coordinating device which are external to the body. The performance of data transmission between nodes to Personal Area Network (PAN) coordinator is observed.

IEEE 802.15.4 working group is defined at lower layers of protocol stack, which are MAC and physical layer (PHY). IEEE 802.15.4 is a simple packet data protocol for lightweight wireless networks and it channel access is via Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) with optional time slotting. The physical layer defines three medium-dependent wireless raw data rates covering three different frequency bands. The frequency bands are 20, 40, and 250 kbit/s using the 868-868.8, 902-928 and 2400-2483.5 MHz frequency bands. In these respective frequency bands, there are one, ten and sixteen channels at these particular rates.

2.0 Background

The low rate WPAN supports two types of topologies. They can perform a star topology which is the nodes can only talk to the coordinator or in a peer-to-peer topology where network nodes able to route the data. Several peer-to-peer networks can work together to form a mesh or cluster tree topologies. In this paper, a star network topology is considered. With the star topology there are two communication methods, which are beacon mode and non-beacon mode. In beacon mode, communication is controlled by the network coordinator, which transmits beacons for device synchronization and network association control. The network coordinator defines the start and end of a super frame by transmitting a periodic beacon. The length of the beacon period and hence the duty cycle of the system can be defined by the user between certain limits as specified in the standard [3].

In non-beacon mode, a network node can send data to the coordinator, by using CSMA/CA if required. To receive the data from the coordinator the node must power up and poll the coordinator. The advantage of non-beacon mode is that the node's receiver does not have to regularly power-up to receive the beacon. The disadvantage is that the nodes must wake up to receive the beacon and the coordinator cannot communicate at anytime with the node but must wait to be invited by the node to communicate.

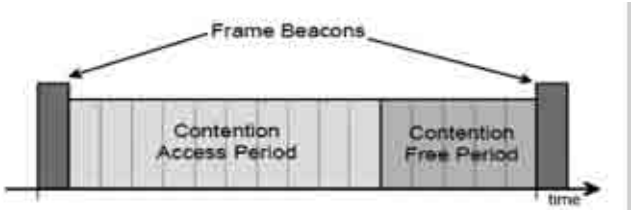


Figure 1: Superframe structure with GTSs

Figure 1 illustrates the structure of the superframe uses by IEEE 802.15.4. A superframe begins with beacon frames sent periodically by the coordinator at an interval that can ranges from 15ms to 245s. There are both active and inactive periods in the superframe. The coordinator communicates with the nodes only during the active period and enters a low power mode during the inactive period. The macBeaconOrder (BO) decides the length of the Beacon Interval (BI) and the parameter macSuperframeOrder (SO) describe the length of the active portion of the superframe. The BI and basesuperframe duration can be calculated as below:

$$BI = BSfD \times 2^{\wedge} BO \ symbols \ldots \quad (1)$$

$$BSfD = BSD \times NSf \ldots (2)$$

where;
BI = Beacon Interval
BSfD = Base Superframe Duration
BSD = Base Slot Duration = 60symbols
NSf = Number of Superframe Slots = 16

The active portion of each superframe is divided into 16 equal time slots and consists of 3 parts; the beacon, a Contention Access Period (CAP) and a Collision Free Period (CFP)[1]. Each guaranteed time slots (GTS) consists of some integer multiple of CFP slots where;

[1] The CFP is only present if GTS are allocated by the PAN coordinator to some of the devices

$$1 <= SO <= 15 \ldots (3)$$
$$1 <= BO <= 15 \ldots (4)$$

3.0 Data Transmission

There can be three different types of possible data transmission, which are transmission from a device to the coordinator, transmission from the coordinator to the device and transmission between any two devices. In a star topology only the first two transmission techniques are possible. Transmission between any two devices is not supported, where as in a peer-to peer network all the three types of transmissions are possible.

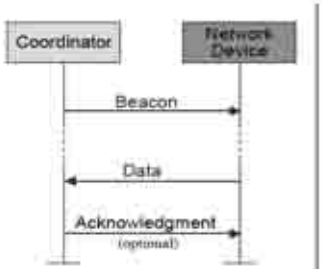


Figure 2 : Transmission between device to coordinator

The process shown in Figure 2 is transmission between devices to coordinator [3]. The operation starts when device listens for the beacon. On finding the beacon, device will synchronizes the superframe structure. This process will acknowledge the device of the beginning and end time of the CAP. Then the device will have to compete with its peers for a share of the channel. The device will transmit the data to the coordinator when it is permitted.

4.0 Medical Environment

In the experiment, the WBAN is set to have 3 number of nodes on the body with area is set to 10m x 10 m. CBR packets will be operating in this architecture. For this simulation, the medical data rate is reference to [4] and it is shown in table 2. The parameters for simulation result in figure 3, 4, 5 and 6 are summarized in the table1:

Table 1: Traffic parameters

Parameter	Value
Traffic Type	CBR
Number of Nodes*	3
Number of Coordinator	1
Mode Movement	None
Traffic Direction	Node to Coordinator
Packet Size	70 byte

*Applications to the nodes is defined in table 2

Table 2: Physical and Application parameters

Physical	Type
Radio Propagation Model	Two Way Ground
Antenna Type	Omni Antenna
Application	Value
ECG bit rates (node 1)	600 bit/d
Blood Pressure (node 2)	0.3 bit/s
Video (node 3)	8 bit/s

5.0 WPAN Performance

The network throughput is a measurement of the amount of data transmitted from the source to the destination in a unit period of time (second). The throughput of a node is measured by counting the total number of data packets successfully received at the node, and computing the number of bits received, which is divided by the total simulation runtime [5] that gives;

$$tp = Rbits/(sim_time) \quad \ldots (5)$$

where;

tp =throughput
Rbits = total data bits received
sim_time= simulation runtime

The simulation model used star network topology where routing mechanism has been disabled. This is because the standard does not support routing of data among the peers. Therefore, the maximum number of hops for any data packet before reaching the destination node can be only one [5]. The average delay is calculated by taking the average of delays for every data packet transmitted.

$$D[E] = TD/ Rpkts \quad \ldots (6)$$

where;

D[E]=Average Delay
TD= Total Delay
Rpkts = Total number of received Packets

6.0 Results and Discussions

We analyze the performance of WPAN in beacon enabled with star environment as the beacon order varies from 0 to 8. The result is shown in figure 3 where more collisions had been observed in the low beacon order compared to high beacon order.

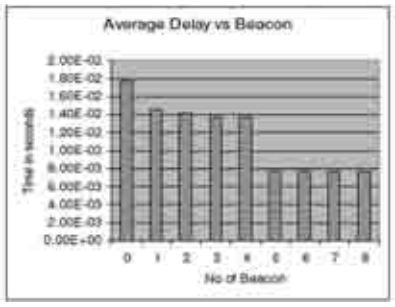


Figure 3 : Delay increases with increasing of beacon

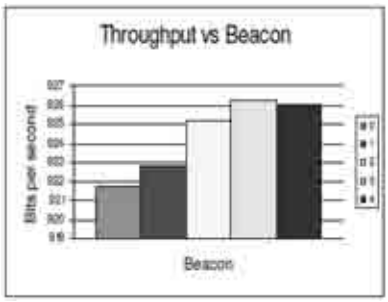


Figure 4 : Collisions reduces by increases beacon.

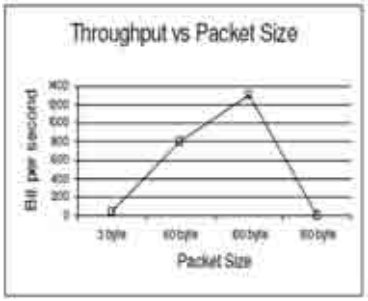
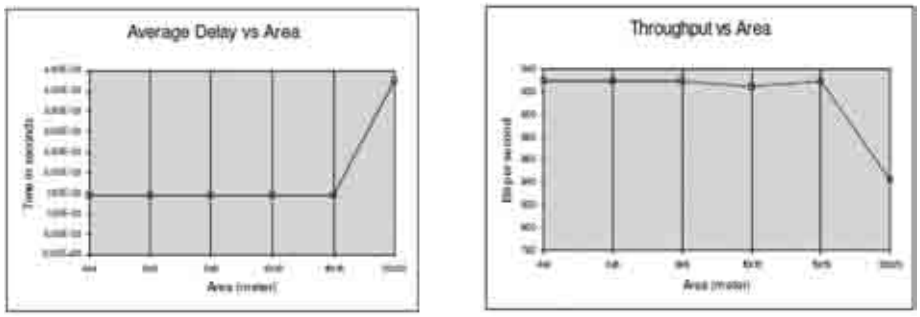


Figure 5 : Packet size assumptions

Figure 3 also shown that low beacon causes high average delay in data transmission from devices to coordinator. Therefore, more transactions are likely to be delayed until the beginning of the next frame. Because beacon is in enabled mode, transmission of a frame using slotted CSMA/CA is required to be complete before the end of the CAP. This means that slotted CSMA/CA can no longer work effectively if the beacon is small.

Next we analyze the throughput performance in WPAN with varied beacon order. The result is shown in figure 4 where CAP allows each beacon to send almost the same amount of data to a coordinator. It also shown that when the beacon is small, the amount of data received at coordinator is also small which will cause collision, while the throughput increases by the increasing the number of beacon.

The packet size is assumed to be 70 bytes for CBR traffic as shown in figure 5. By setting the packet size to 70 bytes, the throughput is almost 900 bit per second. This is because according to table2 the ECG sensor transmits 600 bits per second data rates from devices to coordinator while blood pressure transmits almost 0.3 bits per second. Therefore, assumption of packet size 70 bytes is reasonable to allow data transmits for all three devices to coordinator.



(a) (b)

Figure 6 : Throughput and delays differences across area in a) and b)

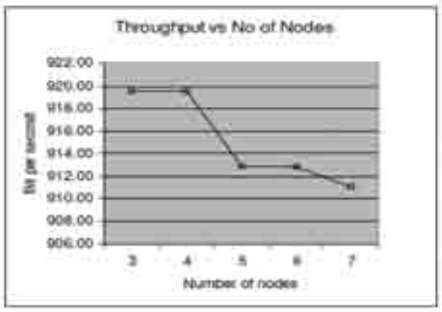


Figure 7 : Throughput compared to number of devices

The relationship between throughput and area topology (meter), average delay and area topology (meter) are also analyzed. Figure 6 a) shown that by increasing the area within coordinator and devices will cause the throughput to decline tremendously after 15 meters square. This is because there are probabilities that the MAC packets are loss due to the interference of other devices such as collisions. However, the average delay will increased when the node gets further away from the coordinator as shown in Figure 6 b). Thus, we can conclude that the suitable maximum range for medical environment is to operate within 15-meter square from the coordinator.

Figure 7 shows the affect when we add more nodes on the body area. Effectively when there are fewer frames waiting in MAC queue lead to the lower average delays as observed in the graph. It is observed that the offered loads on the WPAN will reach its maximum with just four devices. Adding another device to the network will result overload the capacity of WPAN. By increase the number of nodes to seven in 10x10 meter area will cause the throughput to drops to 0.922% due to interference of devices such as collisions.

7.0 Conclusion

Wireless Personnel Area Network (WPAN) is a new wireless short-range communication technology. WPAN targets low data rate, low power consumption and low cost wireless networking, and it offers device level wireless connectivity. This paper focused on the performance analysis of WPAN. It estimates possible working conditions of the technology for medical applications.

The results indicated that the technology can be successfully used for low data rate application with the factors that effected the performances of wireless body area network are the size of packet size, the number of beacon that being used, topology area and number of devices on the body. It has been observed that more collisions will happened at the beginning of a superframe, especially a low beacon order. The packet size is set to 70 byte to achieve desired output and the distance should be less than 15 meter square for IEEE 802.15.4 operating at a good condition in hospital room/medical environment. Increasing the number of nodes to seven in 10x10 meter area will drops the throughput to 0.922% due to interference of devices such as collisions.

This paper has presented the performance analysis of data transmission in WBAN using WPAN technology. However, there are several WPAN features that can be implement and test. For the propose future works is to compare three different data transmission methods which is direct, indirect and guaranteed time slot in wireless body area network.

6.0 References

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E22 - Design and Implementation of Nominal Characteristic Trajectory Following (NCTF) Controller for Linear Motion Servo System

Noor Hisham Jalani
Advanced Technology Training Centre (ADTEC) Batu Pahat, Johor
jnhisham@adtecbp.gov.my

Abstract

The Linear Motion Servo System consists of a cart driven by a DC motor, via a rack and pinion mechanism to ensure consistent and continuous traction. Since many controllers can be implemented in this system in order to control the position, therefore the implementation of a practical controller must be investigated. A practical controller is proposed known as a Nominal Characteristic Trajectory Following (NCTF) to control the position of the cart. This paper presents a position tracking control strategy that meets the position tracking performance. The effectiveness of the proposed NCTF controller is evaluated and compared with Proportional-Velocity (PV) controller through simulation and experiment.

Keywords: *NCTF, PV, position control, linear motion servo system.*

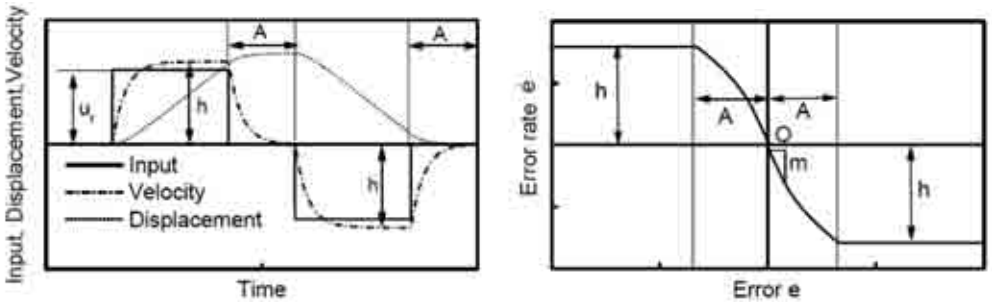
1. Introduction

Motion control system is a challenging problem in the area of control systems and very useful to demonstrate concepts in linear control such as the stabilization of unstable systems. Until now, a lot of intelligent approaches about the position control for linear motion servo system have been proposed. A two-degree-of-freedom internal model control method based on fuzzy logic has been presented, which adjusts the parameter of feedback controller on-line for the permanent magnet linear synchronous motor position servo system. The control system structure is simplified and has fast dynamic response, while parameter identification is not demanded [1]. Another researcher has also used fuzzy logic controller for position control. The results gave smaller overshoot, shorter settling time and smaller steady-state error than the PID controller [2]. The position control of a linear induction motor using adaptive fuzzy back-stepping design with integral action is proposed; the controller can track periodic step, sinusoidal and triangular inputs precisely [3]. The NCTF controller has been proposed as a practical controller for point-to-point (PTP) positioning systems [6]. Therefore, the purpose of this project is to evaluate and compare the effectiveness of the NCTF and PV controller through simulation and experiment.

2. NCTF Controller

In order to determine the NCT, a simple open-loop experiment has to be conducted. In the experiment, an actuator of an object is driven with stepwise inputs, and displacement and velocity responses of the object are measured. Figure 1 shows the stepwise inputs, and the velocity and displacement responses due to the stepwise inputs. In this study, the rated input to the actuator u_r is used as a value of the stepwise inputs.

The velocity and displacement responses are used to determine the NCT. Since the main problem of the PTP positioning system is to stop an object at a certain position, a deceleration process (curve in area *A* of figure 1(a)) is used. In figure 1(a), *h* is the maximum velocity which depends on the input step height. From the curve in the area *A* and *h* in figure 1(a), the NCT in figure 1(b) is determined.



(a) Stepwise inputs and responses (b) Nominal characteristics trajectory (NCT)

Figure 1: NCT Determination

There are three important parameters in the NCT as shown in Figure 1, the maximum error indicated by *h*, the inclination of the NCT near the origin indicated by *m* and range of deceleration motion expressed by *A* [4]. These parameters are related to the dynamics of the controlled-object. Hence, the parameters are used to design the compensator of the NCT as will be discussed in the following section.

Design the compensator based on the NCT information. Here, the following PI compensator is adopted due to its simplicity:

$$u = K_p u_p + K_i \int u_p dt \tag{1}$$

where K_p and K_i are proportional and integral gains respectively. Using the PI compensator parameters K_p and K_i and the NCT characteristic near the origin (see Figure 1(b)), the transfer function of the closed-loop positioning system controlled by the NCTF controller can be approximated as follows:

$$\frac{X(s)}{X_{ref}(s)} = G(s) = G_1(s)G_2(s) \tag{2}$$

Where,

$$G_1(s) = \frac{\alpha}{s+\alpha} \tag{3}$$

$$G_2(s) = \frac{2\xi\omega_n + \omega^2_n}{s^2 + 2\xi\omega_n + \omega^2_n} \tag{4}$$

$$K_p = \frac{2\xi\omega_n}{K\alpha} \tag{5}$$

$$K_i = \frac{\omega_n^2}{K\alpha} \tag{6}$$

Where α is the simplified is object parameters, ξ is the damping ratio and ω_n is the natural frequency. When ξ and ω_n are large enough, G(s) become nearly equal to $G_1(s)$, which represent the condition when the object motion follows the NCT as the objective of the NCTF control system. Moreover, large ξ and ω_n also make the close-loop system robust to friction or inertia variation of the object in continuous systems [5]. Finally, by using ξ and ω_n as design parameters the PI compensator parameters are designed as follows:

$$K_p = \frac{2\xi u_r}{hm} \tag{7}$$

$$K_i = \frac{\omega_n^2 u_r}{hm} \tag{8}$$

3. Design of NCTF Controller

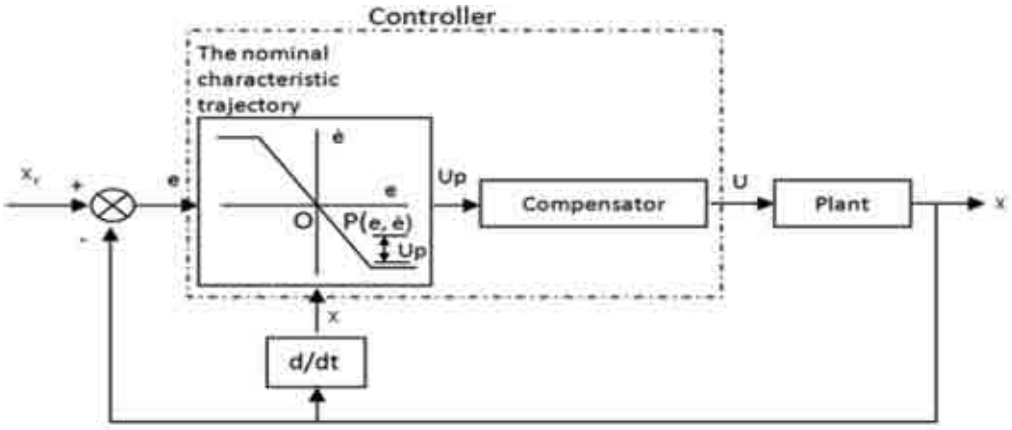
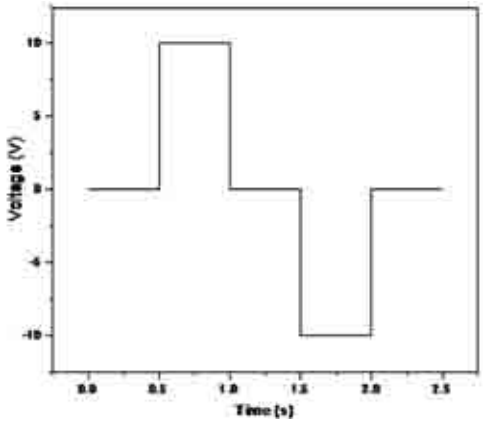
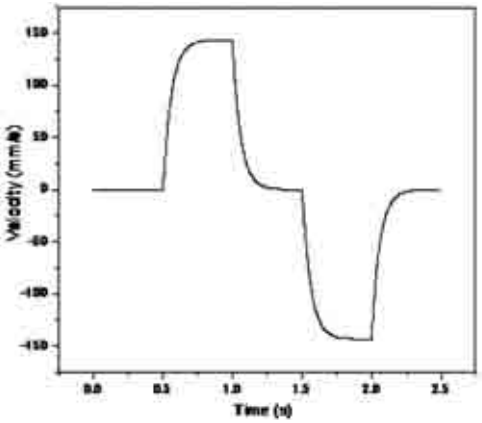


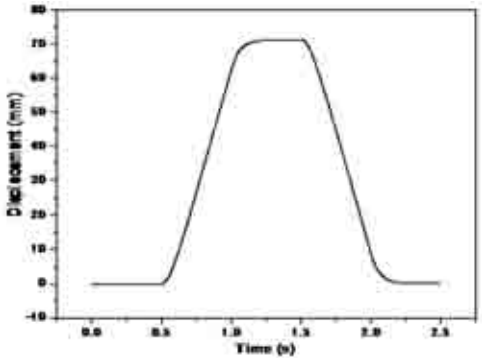
Figure 2: Proposed NCTF-Based Linear Motion Servo System



(a) Stepwise input



(b) Velocity response



(c) Displacement response

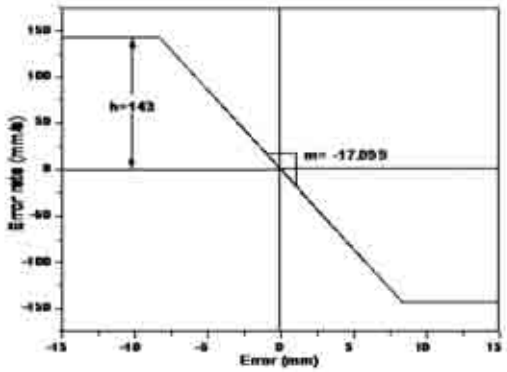


Figure 4: The Nominal Characteristic Trajectory

Figure 3: Stepwise Input and Plant Response

The stepwise input shown in Figure 3(a) is applied to the plant. The height of the stepwise input, which is 10V, is decided based on the rated input to the motor driver. The velocity and displacement responses due to the stepwise input are shown in Figures 3(b and c), respectively. Then, Figure 4 illustrates the determined NCT based on Figure 3. The NCT has a $-17.095\ s^{-1}$ inclination near the origin and a 143 mm/s maximum error rate h. The compensator parameters are designed by using h and m of the NCT. By referring to the digital implementation of the PI compensator as discussed [6], design parameters $\xi = 5000$ and $\omega_n = 1$ are selected [7]. Table1 shows the value of the compensator parameters calculated from Eq. (7) and (8).

Table1: NCTF and PV Parameter

Controllers	Parameter		
	Kp	Ki	Kv
NCTF	40.907	0.004091	-
PV	419.1239	-	11.4697

4. Implementation and Results

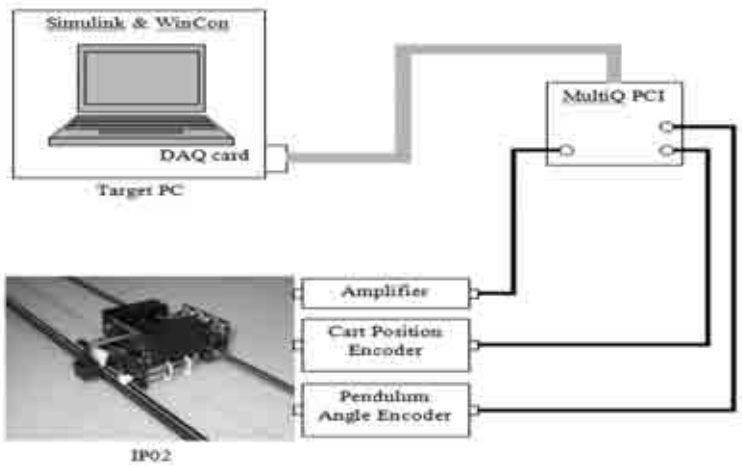


Figure 5: Linear Motion Servo System

Motion control system consists of a cart driven by a DC motor, via a rack and pinion mechanism to ensure consistent and continuous traction. The cart is also equipped with a rotary joint to which a free turning rod (or pendulum) can be attached. However, the aim of this research is only focusing on linear positioning movement. It means, the system must move from one point to another point with small overshoot and stable-state error; fast rise time and settling time. The collaboration of all these components produces the torque and force distribution within the motion control systems and controls the load to exhibit certain pre-defined behavior mechanically in a desirable manner. Real-time experiment configuration consists of computer with MATLAB, Simulink and Quanser Toolbox used as a controller, Q4 data acquisition board and Quanser IP02 Liner Motion Servo Module. The Digital-to-Analog voltage for data acquisition board is limited between -10V and 10V.

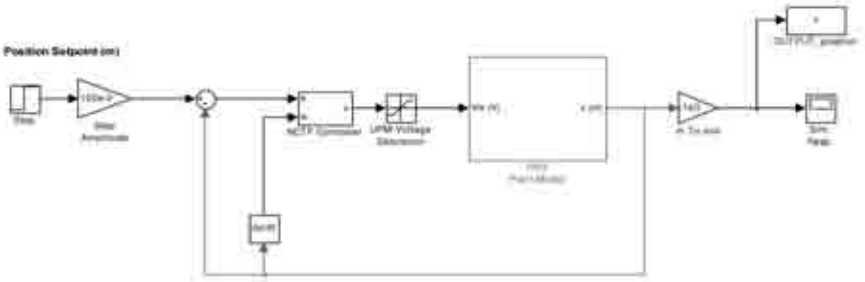
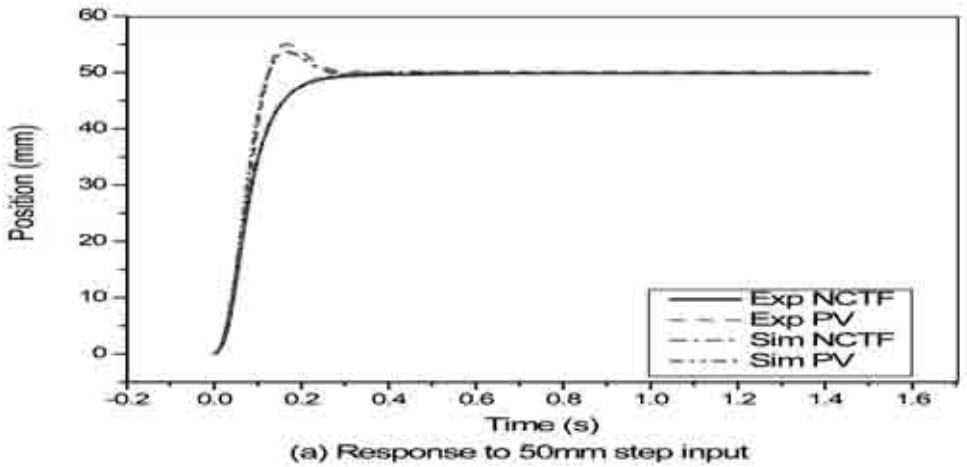


Figure 6: Simulink Diagram of NCTF Position Control

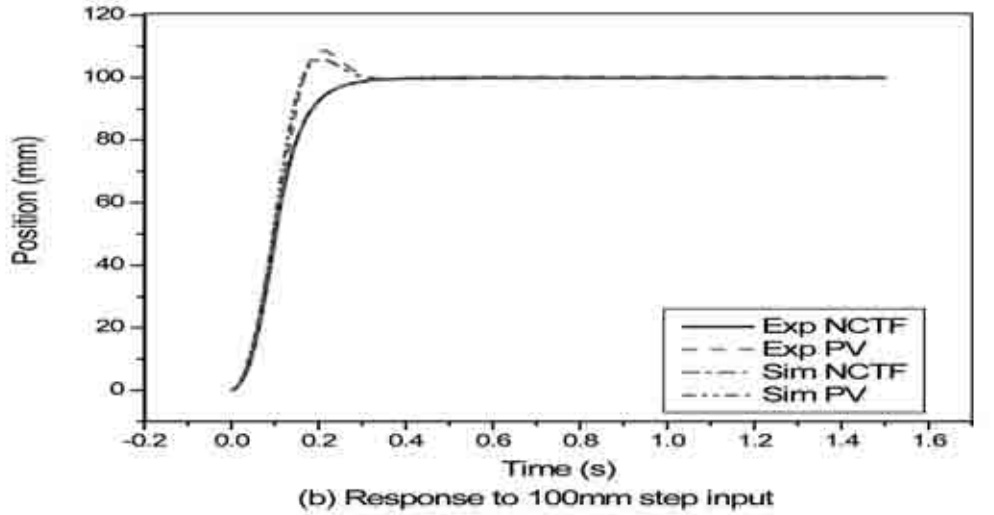
The linear motion servo system was tested by using NCTF controller and compared with PV controller. The different desired positions were chosen to evaluate the NCTF controller performance namely 50mm, 100mm and 200mm. Figure 7 shows the responses to a step input of the position control by NCTF as well as PV controller when different step input references were used. The detailed performance comparison is shown in Table 2 for position control.

Table 2: Positioning Performances

Length (mm)	Controller	Mode of Test	Overshoot (%)	Settling Time (sec)	Steady-state Error (mm)	Rise-time (sec)
50	NCTF	Simulation	0	0.244	0	0.130
		Experiment	0.026	0.258	0	0.128
	PV	Simulation	7.323	0.235	0	0.080
		Experiment	10.194	0.242	0.044	0.076
100	NCTF	Simulation	0	0.270	0	0.144
		Experiment	0.071	0.277	0	0.145
	PV	Simulation	5.872	0.268	0	0.102
		Experiment	10.671	0.291	0.043	0.106
200	NCTF	Simulation	0	0.318	0	0.174
		Experiment	0.094	0.317	0	0.175
	PV	Simulation	5.267	0.331	0	0.144
		Experiment	11.627	0.372	0.086	0.149



(a) Response to 50mm step input



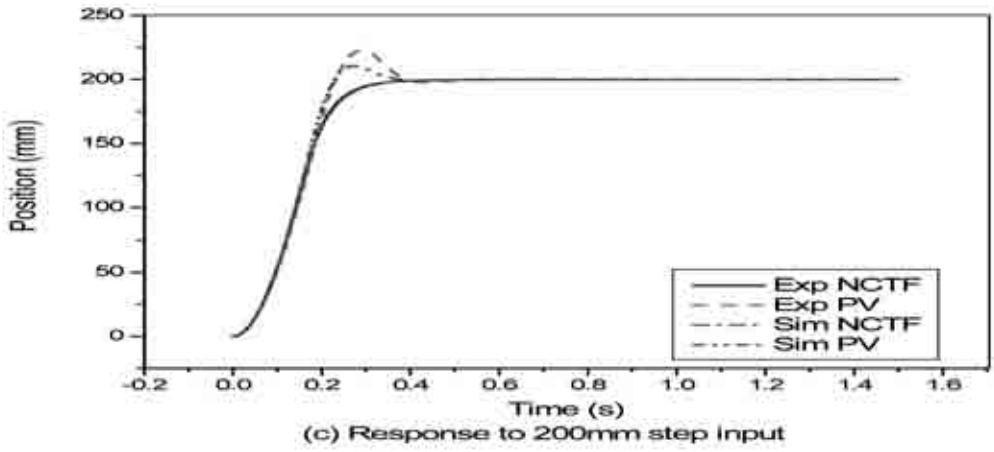


Figure 7: The Results for Position Responses

The results showed that the simulated and experimental responses of the NCTF controller are good and closed to each other compare than PV controller when a 50 mm, 100 mm and 200 mm step input references were used. However, some discrepancies exist, chiefly due to modelling errors and the diverse nonlinear elements present in the actual system. Some of the possible reasons to explain them include:

i. modelling approximations and uncertainties in model parameter values
ii. power amplifier (UPM) saturation (in voltage and/or current)
iii. DC motor dead-band effect
iv. Coulomb (dry or static) friction effect on the cart
v. stiction effect
vi. rack-pinion and gear backlash
vii. noise
viii. a cart system's track not properly leveled

The simulation and experiment results showed that the NCTF controller gave almost zero overshoot than PV controller. The simulation overshoot of PV controller gave more than 5% but less than 8%, while the experiment gave more than 10% but less than 12%. Although the PV controller gave slightly faster rise

time than NCTF controller, the settling time for both controllers is almost same. Moreover, both controllers gave zero steady-state error for simulation results, but by experiment, NCTF controller gave better results than PV controller.

5. Conclusions

The objective of this project was to design a practical positioning controller for linear motion servo system. The acquired controller for linear motion servo system must have high performance, simple structure and easy to design. The non-model based method of NCTF controller was proposed. The NCTF consists of a nominal characteristic trajectory (NCT) and PI compensator. The NCTF control system was designed based on the simple open loop experiment. The effectiveness of NCTF was evaluated and compared with existing PV controller through simulation and experiment. Both the simulation and experimental results showed that the NCTF controller is more effective for controlling position of linear motion servo system than the PV controller. The project reported here some limitations and can be further extends. Some of the recommendations for future development as follow:

i. Experimental robustness evaluation of the linear motion system.

ii. Design and implement another controller for anti-swing of pendulum.

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E23 - A Small World Network (SWN) using Mirror Identities with Cellular Automata (CA) for Influenza (H1N1) Infection Simulation

Mohd Fikri Yusof; Hiroyoshi Morikawa,PhD; Seiichiro Moro, PhD;
Fuminori Sakaguchi, PhD
Pusat Latihan Teknologi Tinggi (ADTEC) Melaka

Abstract

This paper reviews a novel model, a modified version of mirror identities with cellular automata, for simulating H1N1 desease transmission and assessing pubic health policies in a real world epidemiological environment. It incorporates characteristics of compartmental SIR model and small world networks, the latter of which is achieved through incorporation of mirror identities, thereby resulting in a bi-layered model. Results obtained from the simulations match actual data collected from the H1N1 outbreaks among students in Fukui prefectural satisfactorily, and it has been deduced that a combination of mask-wearing by the general public and reducing contact in public places is the most effective in suppressing the spread of H1N1 decease. However, the model has its limitations as it adopts a number of assumptions for purposes of simplifications. Many real-world features were also overlooked in order to keep the simulation practically manageable. Therefore, we suggest investigating further the balance between realism and simplicity so as to achieve a more optimal compromise. We are sufficiently alarmed by the outbreak of H1N1 desease, not only because it nudged the populace to the edge of panic and wreaked social and economic havoc, but also for it allowed us to observe in real time, how the modern globalized society has allowed for the epidemic to propagate at such an alarming speed. Considerable amounts of time and resources have been committed by people from various disciplines into formulating computational models, so that we can closely simulate the situation and readily combat the threat when it comes. Detailed knowledge of H1N1 transmission dynamics is the key, and it requires accurate information on how the disease transmits and how social networks operate in society.

Keywords : *Cellular Automata, Small World Network, Mirror Identity*

1. Introduction

Factors that influence the transmission dynamics of epidemics include individual diversity and social networks constructed by interpersonal relationships and simple dailycontact. For instance, interactions among individuals and contact routes both affect the outbreak of shortdistance contagious diseases such as H1N1 and severe acute respiratory syndrome (SARS). Due to the potential complexity of human interactions, researchers need a simulation model that can represent multiple social networks to analyze and control a wide range of potential transmission behaviors and epidemic characteristics.

2. Related Epidemiological Models

2.1 Compartmental SIR Model

Among physicists and epidemiologists, the most common approach to studying the spread of infectious diseases entails the use of differential equations or stochastic processing to build simulation models. Typical of the differential equations approach is the SIR compartmental model developed by Kermack and McKendrick (Fig. 1). These kinds of models can be easily processed with a set of mathematical equations and functions; a second strength is that they allow for the simplification of the factors and variables being considered. In addition to simulating the transmission dynamics of infectious diseases, these models have been used to establish numerical analytical methods and tools for calculating critical threshold values for determining disease spread potential - that is, the case reproduction number R_0 which is considered a fundamental epidemiological parameter. R_0 provides a picture of infectious disease transmission patterns and potential social problems, which allows public health agencies to develop policies and enact epidemic prevention strategies.

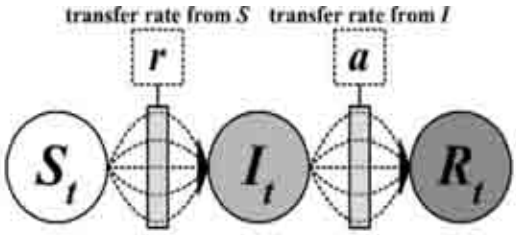


Figure 1. General transfer diagram for the Compartmental SIR model with susceptible class *S*, infective class I, and recovered class R

The SIR acronym represents three sub-populations in any society: *S*usceptible individuals who can become infected; *I*nfectious individuals who enter a refractory state following a period of infection; and*R*emoved individuals who have recovered, died, or who otherwise are incapable of transmitting the disease. A set of differential equations is used to track individual movement dynamics between sub-populations. These models are suitable for simulating infectious disease transmission dynamics, but since they categorize individuals in terms of populations, they often fail to consider social phenomena associated with human interactions. Infectious disease epidemics result from countless contacts, interactions, and transmissions, yet most SIR-like models ignore many of the spatial, heterogeneous, interactive, and local characteristics of the spreading process. This limits their utility for studying public health policies and epidemic prevention strategies. Still, some aspects of these models (especially R_0) are useful for verifying and comparing disease parameters; we therefore incorporated them into our model for purposes of improving accuracy.

2.2 Cellular Automata Models

Researchers have used cellular automata (CA) to study dynamic and/or non-equilibrium systems and to explore epidemic infection and transmission mechanisms in animals, plants and humans. Due to their ability to provide intuitive network models, cellular automata are used to identify the local clustering and social characteristics (e.g., spatiality, heterogeneity, and interactivity) considered essential for studying transmission dynamics. As shown in Figure 2, social space in cellular automata can be represented as a two-dimensional lattice, which makes it easier to describe the properties of neighborhoods. Each intersecting point in a lattice represents a heterogeneous individual and links represent their interactions.

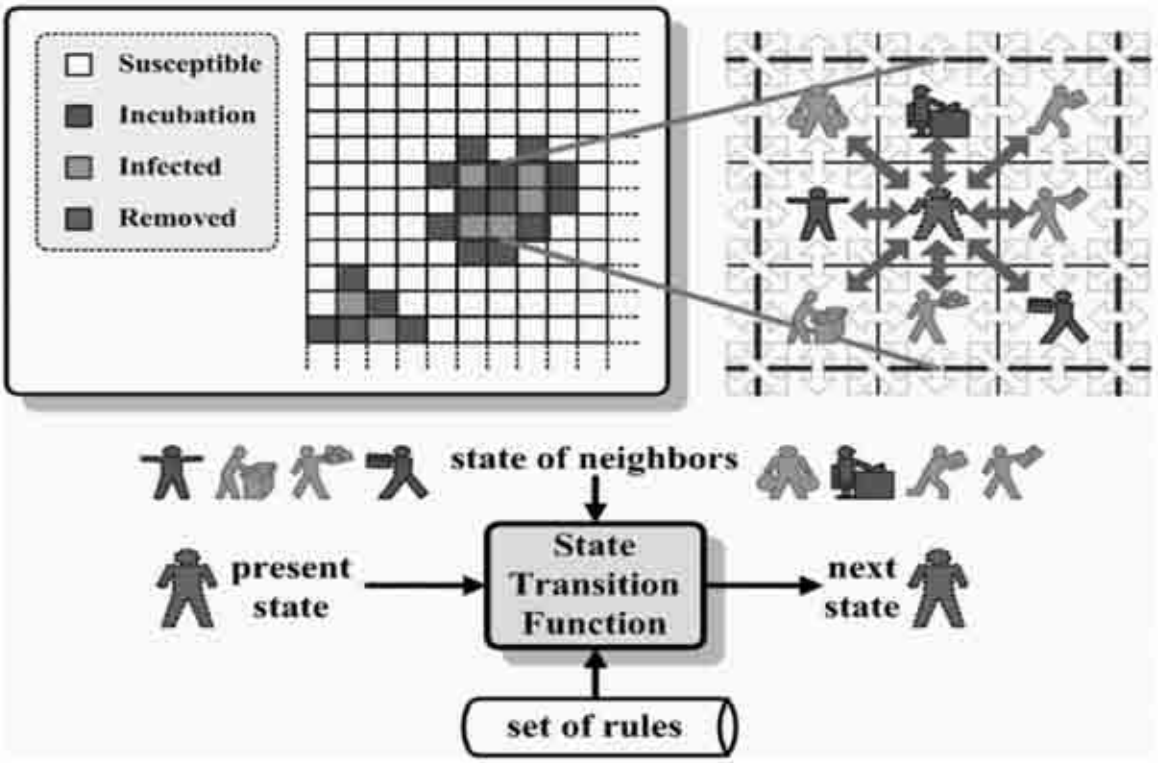


Figure 2. Cellular Automata, state transition function, and Moore neighborhood concept

Individuals possess attributes (e.g., disease progress, gender, age) that determine their current statuses. The equations demonstrate that a synchronous change occurs in the status of each lattice point at every discrete time step, based on its current status, the status of neighboring lattice points, and a set of uniformly applied transition function rules. System status is defined as the aggregate status of all lattice points. Epidemiologists use this representation and a set of specific transmission rules to apply cellular automata when studying regional infection phenomena and the spreading mechanisms of infectious diseases. Still, despite the imperative social characteristics they possess, cellular automata generally fail to exhibit a "small-world" effect. Without this characteristic, a model cannot accurately simulate real transmission dynamics nor the public health policies associated with epidemic diseases.

2.3 Small-World Social Network Model

In 1998, Watts and Strogatz used psychologist Stanley Milgram's ideas on small-world phenomena in multiple interactions among social individuals to create an abstract disordered network model. Today it is generally accepted that the topological structure of social networks that they described exerts a strong influence on the development and consequences of social issues - for example, how public opinions and social norms are formed, how wealth is distributed, how new concepts and cultural traits lead to fashionable trends, and how a single case of an infectious disease can escalate into a large-scale epidemic. Accordingly, the small-world characteristic is considered an important parameter for validating social and epidemiological simulation models.

Due to such human characteristics as clustering, low degrees of separation, multiple activity locations, and long-distance movement, actual geographic location and distance are considered secondary disease transmission factors in societies with small world properties. However, we have found that most studies that utilize a variant of Watts and Strogatz's small-world social network model to explore the transmission dynamics of infectious diseases are limited in terms of how they consider the effects of social networks. Specifically, we have noticed a lack of realistic small-world network models and simulation platforms that can be used to represent daily contact relationships for a wide range of contagious diseases; most research efforts have been limited to individual diseases with special transmission dynamics (e.g., HIV/AIDS). Our goal was to construct a small-world social network model based on daily life contacts that public health officials can use to quickly establish epidemic prevention strategies for a broad range of contagious diseases.

3. The Proposed Model

Our proposed model consists of two layers (Fig. 3). The upper layer is a multi-agent system used to simulate real-world heterogeneous cohorts. The lower layer consists of two-dimensional cellular automata (i.e., two-dimensional toric periodic lattices) used to demonstrate real-world activity spaces. The mirror identity concept connects the two layers, resulting in a small-world network model for analyzing the transmission dynamics of epidemic diseases and social issues.

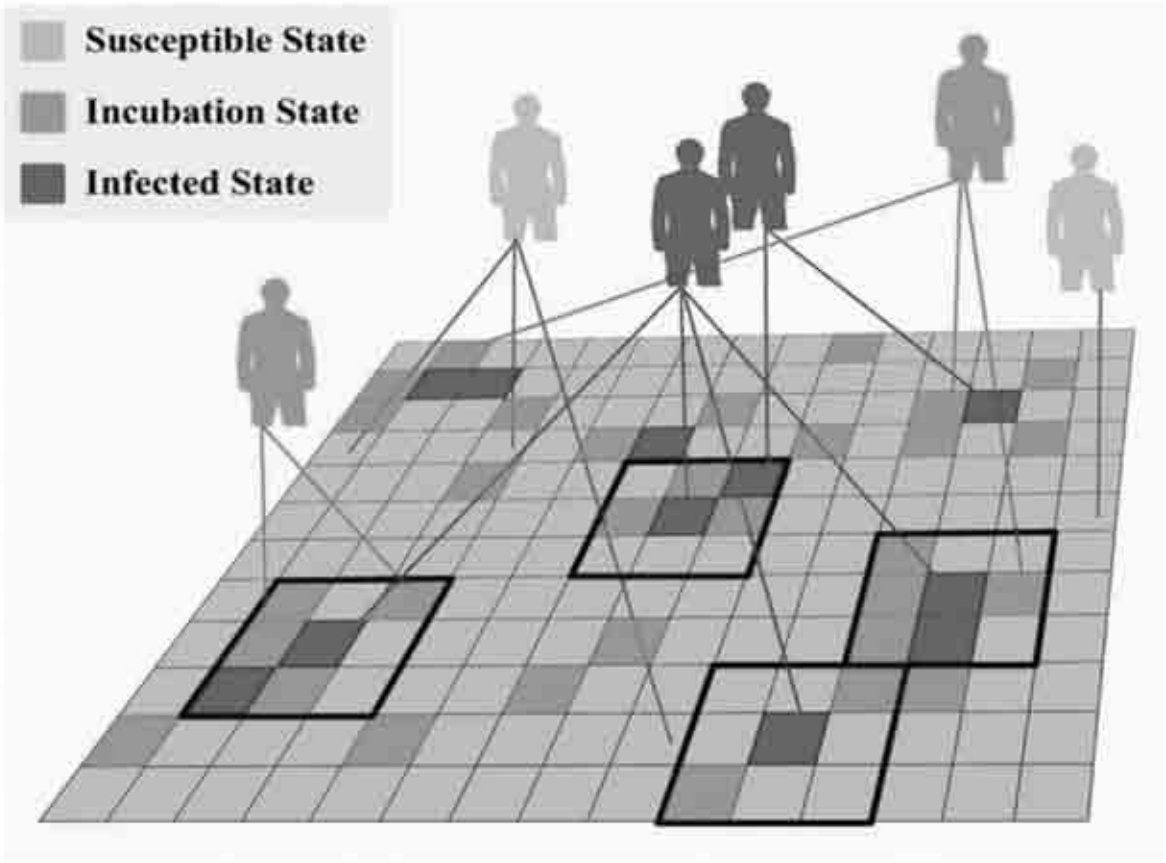


Figure 3. Cellular automata with mirror identity model (CAMIM)

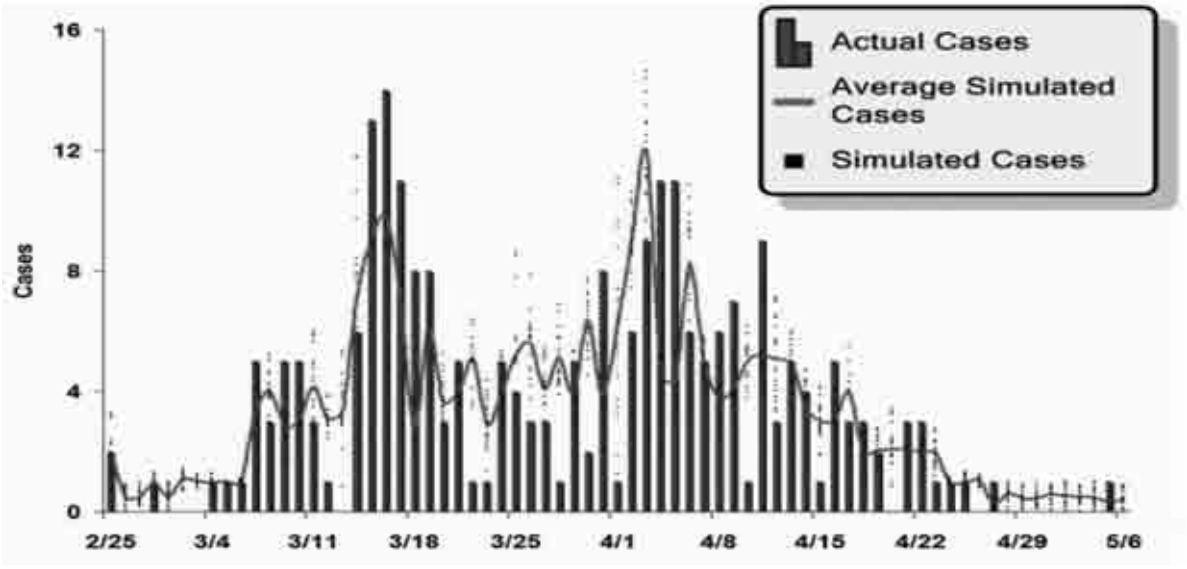
3.1 Cellular Automata with Mirror Identities Model (CASMIM)

The abstract mirror identity concept is based on human interactions and daily routines within the confines of a modern society. It specifies an individual's social attributes - for instance, long-distance movement, daily visits to fixed locations, and multiple-activity locations. In our proposed model, individuals are viewed as single agent entities of an upper-layer multi-agent system; the places that an individual visits on a regular basis are defined as mirror identities.

Each agent in the upper layer has a set of attributes describing its epidemiological progress and social mobility states. Each mirror identity, which can freely access agent attributes, has a group of private attributes that represent its current status and local data. Agents can freely access the attributes of any mirror identity they are connected to. Furthermore, agents can use their mirror identities to form clusters with other agents. In formal terms, all of an agent's mirror identities are connected through that agent; they form a star-shaped topology with the agent at the center and the mirror identities at the vertices.

4. Simulating Sars With Casmim

After initializing the model and establishing parameters according to H1N1 disease information disseminated by the Centers for Disease Control (CDC) and World Health Organization (WHO), we ran simulations of H1N1 transmission dynamics in various geographic areas and compared the effectiveness of various public health policies and disease prevention strategies.



According to the comparison of actual and simulated H1N1 cases in Fukui prefectural Japan, the simulated curve has a very close fit with data published by the city-state's health authority for the two outbreaks that occurred.

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E24 - Alat Bantu Mengajar Penguji Pelbagai Jenis Dan Jenama Pemutus Litar

Norhisan bin Sena
Institut Latihan Perindustrian Kuantan, Pahang Darulmakmur
norhisansena@yahoo.com.my

Abstrak

Dalam sistem perlindungan pemasangan elektrik terdapat pelbagai jenis dan jenama pemutus litar yang digunakan bagi tujuan melindungi nyawa manusia, melindungi bangunan dan harta benda dari kerosakan. Ciri–ciri asas sistem perlindungan mestilah bertindak pantas, mempunyai kepemilihan, kepekaan, kebolehharapan dan kesetabilan. Untuk memilih pemutus litar yang sesuai dalam sesuatu pemasangan elektrik amat sukar kerana sekarang ini telah terdapat pelbagai jenis dan jenama yang berada di pasaran seperti RENO, MAXGUARD, EPS dan lain-lain. Selain daripada itu ia menimbulkan masalah kepada pelajar-pelajar untuk memahami dengan lebih mudah modul sistem perlindungan. Oleh itu satu alat bantu mengajar (Training Kit) penguji pelbagai jenama pemutus litar direka dan dibuat kajian untuk menentukan pemutus litar yang paling sesuai dari segi kepekaannya. Secara keseluruhannya huraian yang boleh dibuat keatas kajian ini dapatlah dinyatakan bahawa kajian ini telah berjaya membuktikan kepekaan sesuatu pemutus litar boleh ditentukan secara praktikal dan juga teoritikal.

Katakunci*: Penguji Pelbagai Jenama Pemutus Litar*

1. Pengenalan

Oleh kerana elektrik sangat merbahaya tetapi sangat mustahak didalam kehidupan moden maka perlindungan merupakan satu aspek yang penting didalam pemasangan elektrik. Peraturan IEE telah menjelaskan tentang semua aspek keselamatan dan perlindungan dalam pemasangan elektrik. Tujuan utama perlindungan pada pemasangan elektrik ialah melindungi nyawa manusia, melindungi bangunan dan harta benda dari kebakaran dan melindungi peralatan elektrik dari kerosakan dan kebakaran. Dalam kendalian normal, sistem kuasa merupakan sistem tiga fasa arus ulangalik seimbang. Apabila terjadi keadaan yang tidak diingini seperti pecah tebat, pengalir bersentuhan hingga menjadikan keadaan litar pintas, litar pintas separa, litar buka, keadaan tidak seimbang, beban berlebihan ini menyebabkan kerosakan pun terjadi. Kerosakan boleh juga terjadi oleh gangguan luar, kesilapan manusia, ketuaan alat-alat dan lain-lain. Oleh yang demikian bagi mengelakkan dan mengurangkan kerosakan kepada kepada pemasangan elektrik pemutus litar untuk voltan tinggi untuk voltan tinggi seperti Pemutus Litar Vakum, Pemutus Litar Bagas Udara, Pemutus Litar Minyak dan lain-lain. Pemutus litar untuk voltan rendah pula seperti (ACB) Air Circuit Breaker, (MCCB) Moulded Case Circuit Breaker, (MCB) Miniature Circuit Breaker, (RCCB) Residual Current Circuit Breaker dan lain. Untuk projek ini hanya pemutus litar voltan rendah (MCCB),(MCB) dan (RCCB) sahaja yang dibincangkan.

2. Objektif

Objektif projek ini adalah untuk merekacipta satu alat bantu mengajar (Training Kit) bagi tujuan penggunaan pelajar-pelajar bidang elektrik mempelajari ciri-ciri sistem perlindungan seperti bertindak pantas,kepemilihan,kepekaan dan kebolehharapan apabila berlaku sesuatu kerosakan pada litar seperti kerosakan litar pintas antara fasa dengan fasa, fasa dengan bumi dan kerosakan disebabkan arus bocor kebumi. Set ini juga boleh digunakan kepada pendawai pemasangan elektrik untuk memilih pelbagai jenis pemutus litar yang berada di pasaran yang paling sesuai kepekaannya.

3. Penyataan Masalah

Tujuan projek ini dibangunkan adalah disebabkan di institusi latihan kemahiran tidak terdapat satu simulator yang dapat menguji pemutus litar (MCB,MCCB dan RCCB). Terdapat pelajar institusi latihan kemahiran kurang memahami konsep kendalian pemutus litar dan kerosakan yang berlaku pada pemasangan. Terdapat terlalu banyak jenis dan jenama pemutus litar di pasaran menyebabkan masalah kepada pendawai membuat pemilihan. Oleh itu, satu pendekatan difikirkan supaya projek ini dapat membantu pelajar memahami dengan lebih mudah dan membantu pendawai pemasangan memilih pemutus litar yang sesuai.

4. Pembangunan Projek

Dalam menjalankan dan menyiapkan projek ini, beberapa kaedah dijalankan bagi memastikan ’Training Kit” dapat disiapkan agar objektif projek ini dapat dicapai. Pada mulanya, pencarian maklumat bagi sistem perlindungan dilakukan. Ciri-ciri pelbagai pemutus litar diperolehi melalui sumber ilmiah dan internet. Komponen-komponen dan bahan-bahan untuk menyiapkan ’Training Kit’ diperolehi dari bahan latihan di Institut Latihan Perindustrian Kuantan, Pahang dan kedai elektrik dan elektronik sekitar bandar Kuantan, Pahang. Set ini boleh diubah mengikut kerosakan yang ingin diuji seperti kerosakan litar pintas antara fasa dengan fasa, fasa dengan bumi dan kerosakan disebabkan arus bocor kebumi.

5. Keputusan Dan Ujian

Bab empat akan menghuraikan semua jangkaan hasil projek dan keputusan analisis yang diperolehi. Tujuan proses analisis ini dilakukan adalah untuk menerangkan hasil ujikaji yang dijalankan terhadap ‘Training Kit’. Kerja-kerja pengambilan data dan ujikaji hendaklah dilakukan mengikut kertas ujikaji dan Standard Operation Prosedure yang disediakan untuk ‘Training Kit’ ini. Kertas ujikaji dan Standard Operation Prosedure dilampirkan dibahagian belakang tesis ini.

5.1 Kerja pengujian dan pengambilan data-data

Rajah 5.11: Kerja-kerja melaraskan panel kawalan dijalankan

Rajah 5.12: Ameter dan Voltmeter digunakan semasa pengujian dijalankan

Rajah 5.13: Kerja-kerja pengujian dijalankan

Rajah 5.14: Kerja-kerja pengambilan data untuk beban-beban yang berbeza

6. Analisa Projek

6.1. Analisa Graf

Data-data yang diambil hasil daripada ujikaji yang dijalankan pada 'Training Kit' direkod semasa pengukuran dilakukan untuk dibandingkan dan analisa bagi membezakan pemutus litar yang paling sesuai dari segi kepekaannya. Data-data yang diperolehi dibandingkan dengan graf ciri-ciri pemutus litar mengikut spesifikasi yang telah ditetapkan oleh Peraturan IEE edisi ke 16dan MS IEC 2007.

ARUS (amp)	6A	10A	12A	20A	22A	24A
MASA (saat)	Tidak trip	22s	17s	4s	2s	Serta merta

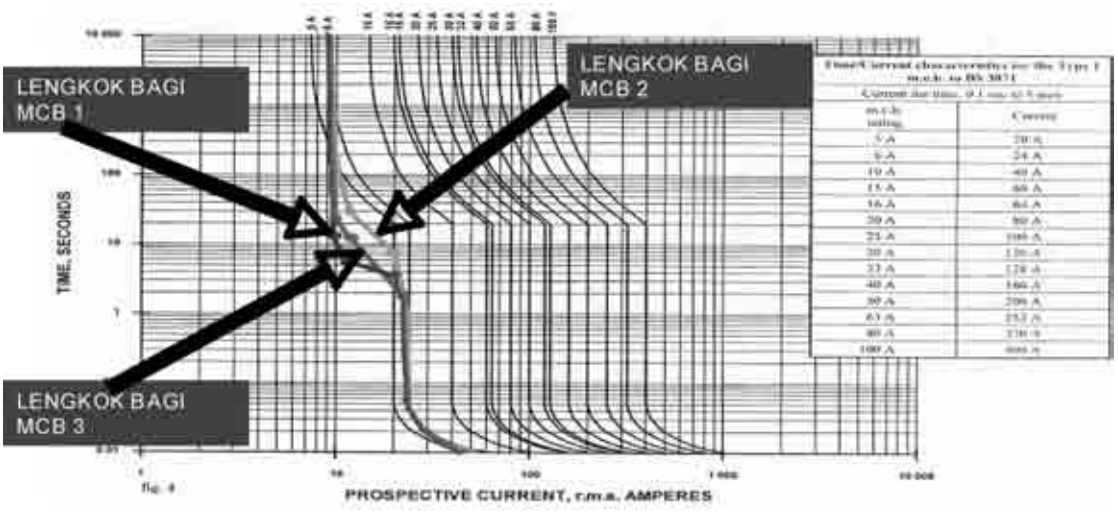
Jadual 6.11: DATA MCB 1(EPS)

ARUS (amp)	6A	10A	12A	20A	22A	24A
MASA (saat)	Tidak trip	Tidak trip	30s	9s	1s	Serta merta

Jadual 6.12: DATA MCB 2(RENO)

ARUS (amp)	6A	10A	12A	20A	22A	24A
MASA (saat)	Tidak trip	16s	7s	3s	Serta merta	Serta merta

Jadual 6.13: DATA MCB 3(MAXGUARD)



Rajah 6.14: Graf masa melawan Ciri-ciri Arus bagi perbezaan ketiga-tiga MCB Mengikut BS 3871

6.2 Analisa dan Pengiraan Nilai Arus Dan Masa bagi MCB

Pengiraan nilai arus dan masa berpandukan 'Characteristic for the type 1 mcb to BS 3871'. Analisa dibuat terhadap MCB saiz 5A hingga 63A. Nilai 'Tripping current range' digunakan untuk mengira nilai arus yang mengalir yang boleh menyebabkan MCB terpelantik.

6.21: Saiz MCB 5A
Nilai 2.7 hingga 4 ialah 'Tripping current range'
5A x 2.7 = 13.5A (berpandukan pada graf MCB akan trip pada masa 50saat)
5A x 4 = 20A (berpandukan pada graf MCB akan trip pada masa 0.1saat hingga 5saat)

6.22: Saiz MCB 6A
Nilai 2.7 hingga 4 ialah 'Tripping current range'
6A x 2.7 = 16.2A (berpandukan pada graf MCB akan trip pada masa 50saat)
6A x 4 = 24A (berpandukan pada graf MCB akan trip pada masa 0.1saat hingga 5saat)

Pengiraan yang dibuat adalah untuk MCB jenis 1 saiz 5A hingga 63A. Walaubagaimanapun 'Training Kit' yang direkebentuk hanya melakukan ujikaji untuk MCB saiz 6A sahaja, bagi membolehkan MCB terpelantik perlu menaikkan beban-beban supaya arus juga turut naik sehingga sampai nilai arus dan masa yang menyebabkan MCB terpelantik. Hasil daripada ujikaji dan pengujian yang dijalankan nilai arus dan masa adalah berbeza bagi ketiga tiga jenis MAXGUARD, EPS dan RENO. Nilai masa yang diperolehi dari ujikaji diambil dengan menggunakan jam tangan, oleh yang demikian data-data yang diperolehi kurang tepat. Bagi mendapatkan nilai masa yang tepat pengujian dengan menggunakan osiloskop adalah jalan yang terbaik, Namun memandangkan kemudahan peralatan yang terhadap pengujian menggunakan osiloskop tidak dapat dijalankan.

6.3 Analisa Dan Pengiraan Nilai Arus Yang Tidak Seimbang melalui MCCB

Pengujian yang dijalankan untuk menentukan nilai arus yang tidak seimbang yang digunakan oleh beban lampu 120W yang disambung melalui alatubah arus galangan (Zct). (Zct) digunakan untuk mengesan arus yang tidak seimbang yang melalui pemasangan tiga fasa. Ujikaji ini dilakukan dengan menggeluarkan salah satu fasa daripada Zct. Ini akan menyebabkan ELR berkendali mengikut masa dan arus yang disetkan seterusnya memberi isyarat ke 'Shut Trip' dalam MCCB menyebabkan MCCB terpelantik. Analisa daripada hasil ujikaji dan pengujian yang dijalankan mendapati nilai arus adalah sama bagi fasa yang berlainan. Data menunjukan bahawa nilai arus yang tidak seimbang adalah sama bagi membolehkan MCCB terpelantik.

7. Perbincangan, Kesimpulan Dan Cadangan.

7.1 Perbincangan

Alat bantu mengajar 'Training Kit' penguji pelbagai jenis dan jenama pemutus litar (mcb,mccb dan rccb) telah dapat dibangunkan dan diuji. Objektif projek telah tercapai keseluruhannya. 'Training Kit' sesuai digunakan untuk pelajar-pelajar kemahiran dan juga pendawai pemasangan. Walaubagaimanapun untuk menggunakan 'Training Kit' ini perlu diberi penerangan dan latihan oleh pengajar yang berkemahiran kerana ujikaji yang dijalankan melibatkan voltan dan arus yang boleh menyebabkan pengguna mendapat kejutan elektrik. Pengguna perlu mematuhi 'Standard Operation Presedure' yang diletakkan pada 'Training Kit' bagi mengelakkan sebarang kemalangan yang mungkin akan berlaku semasa menggunakan 'Training Kit' ini. Selain daripada itu pengguna mestilah menggunakan kertas ujikaji yang telah dilampirkan bersama tesis ini bagi mengikuti langkah-langkah kerja bagi menjalankan ujikaji yang ingin dilakukan.

7.2 Kesimpulan

Secara keseluruhannya huraian yang boleh dibuat keatas projek ini daripada hasil dan keputusan yang diperolehi berdasarkan keputusan daripada data-data dan analisa yang diperolehi. Dapatlah dinyatakan bahawa projek ini telah berjaya membuktikan kepekaan sesuatu pemutus litar boleh ditentukan secara praktikal dan juga teoritikal. Daripada kajian latarbelakang projek, metodologi yang digunakan maka hasilnya alat bantu mengajar(training kit) penguji pelbagai jenis dan jenama pemutus litar (mcb,mccb,rccb) 3 fasa dapatlah direkebentuk. Oleh yang demikian hasil yang diperolehi daripada projek dapat dimanfaatkan oleh pelajar untuk mempelajari sistem perlindungan pemasangan elektrik dengan lebih mendalam secara praktikal. Selain itu juga ia dapat dimanfaatkan kepada pendawai pemasangan elektrik untuk memilih pelbagai jenis pemutus litar yang berada di pasaran yang paling sesuai dari segi kos dan kepekaannya.

7.3 Cadangan

Bagi memastikan kajian yang lebih baik dapat dijalankan pada masa hadapan, terdapat beberapa cadangan penambahbaikan yang boleh dijadikan panduan agar kajian lanjutan yang lebih terperinci dapat dilakasanakan. Pertama, mencadangkan supaya semasa ujikaji dan pengujian dijalankan nilai masa yang diperolehi dari ujikaji diambil dengan menggunakan osiloskop supaya bacaan yang diperolehi adalah tepat. Kedua, mencadangkan rekebentuk mekanikal 'Training Kit' diubah kepada saiz yang kecil dan boleh dilipat bagi memudahkan lagi penggunaannya. Ketiga, mencadangkan semua tempat latihan kemahiran yang menjalankan kursus elektrikal perlu menyediakan satu alat khas seperti 'Training Kit' ini bagi menguji pelbagai pemutus litar supaya pelajar-pelajar dapat memahami konsep perlindungan secara praktikal dengan lebih mendalam. Semoga segala usaha dan kajian bagi meningkatkan ilmu pengetahuan dalam bidang elektrik terutamanya sistem perlindungan dapat dijalankan dimasa akan datang bagi membantu pelajar-pelajar kemahiran dan pendawai pemasangan elektrik.

8. Rujukan

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KATEGORI TEKNOLOGI KEJURUTERAAN KOMPUTER/TEKNOLOGI MAKLUMAT

C1 - Sistem Komputer Gugusan (Cluster PC)

Yusri bin Md Taib; Toshimori Kimura; Halimaton bt. Ishak; Zaitul Iradah bt Mahid; Emilia bt Omar
Japan Malaysia Technical Institute(JMTI)
Email: yusri@jmti.gov.my

Abstrak

Sistem Komputer Gugusan yang dibangunkan adalah sistem yang bersandarkan kepada sejumlah komputer tidak bersandar ("independent") yang digabungkan melalui penggunaan perisian dan rangkaian bagi membentuk satu sistem komputer yang bersepadu. Tumpuan kajian dan pembangunan projek adalah untuk memenuhi sesuatu aplikasi yang menuntut tahap kebolehpercayaan ("reliability") maksima. Sistem Komputer Gugusan terbukti lebih cekap berbanding Sistem Komputer Tidak Bersandar setelah diuji dengan pengaturcaraan C bagi kaedah Monte Carlo yang melalui jutaan pelelaran sehingga nilai π yang tepat diperoleh. Halaju pengiraan menjadi lebih cepat dengan nod yang digunakan adalah banyak berbanding dengan hanya menggunakan Sistem Komputer Tidak Bersandar.

Kata kunci:. sistem komputer bersepadu

1. Pengenalan

Pembangunan komputer gugusan di seluruh dunia adalah sangat memberangsangkan dengan penglibatan daripada pelbagai institusi pengajian tinggi dan kemahiran serta syarikat sehingga boleh membentuk komuniti mereka tersendiri. Berikutan dengan pembangunan sistem ini yang semakin pantas berkembang dan melihat kepada kepentingannya dalam pelbagai bidang, beberapa institusi pengajian tinggi di Malaysia sudah mula mengorak langkah untuk melakukan kajian dan pembangunan ("*Research and Development (R&D)"*) sistem ini. Berikutan itu, Institut Teknikal Jepun Malaysia (JMTi) telah menyahut cabaran untuk menjadi perintis di kalangan Institut Latihan Jabatan Tenaga Manusia (ILJTM) bagi melakukan kajian dan membangunkan sistem komputer gugusan dengan acuan tersendiri dengan penekanan kepada memenuhi keperluan institusi dan juga industri.

Dalam kajian projek ini, kaedah Monte Carlo ini telah digunakan untuk pengiraan matematik bagi mendapatkan nilai *pi* atau π. Pengiraan nilai π dilaksanakan dengan melakukan sebanyak mungkin pelelaran ("*iteration"*) iaitu sehingga jutaan percubaan sehingga nilai π yang tepat diperolehi. Pada dasarnya kaedah ini sangat lambat apabila digunakan untuk mengira nilai π kerana untuk mengira setiap angka bererti dalam nilai π tersebut, pelelaran (*"iteration"*) yang perlu dibuat adalah berulang-ulang kali bagi mendapat nilai yang tepat. Maka di sinilah keperluan menggunakan sistem komputer gugusan untuk menyelesaikan masalah ini. Bagi tujuan ini, satu program pengaturcaraan C telah dibangunkan untuk diaplikasikan pada sistem komputer gugusan yang dibina. Program pengaturcaraan tersebut juga telah ditulis untuk mengatasi masalah keseimbangan beban yang kebiasaannya dihadapi oleh nod-nod komputer gugusan apabila melaksanakan sesuatu proses kerja yang diberi.

Tujuan utama projek ini adalah untuk membangunkan suatu sistem komputer bersepadu yang boleh menyediakan kemudahan pengkomputeran yang lebih luas dan lebih berdaya kuasa daripada yang mampu sebuah komputer tunggal sediakan bagi memenuhi keperluan sesuatu aplikasi yang menuntut tahap kebolehpercayaan *("reliability")* yang tinggi. Selain daripada itu, kajian dan pembangunan projek ini juga bertujuan untuk:

a) memendekkan tempoh pemprosesan bagi sesuatu proses yang rumit.
b) memberi pilihan atau alternatif kepada penggunaan suatu sistem yang berkeupayaan seperti "*supercomputer"* yang pada dasarnya lebih mahal untuk diperolehi pada kos yang jauh lebih murah.

c) menambah keupayaan sesuatu sistem komputer pada skala yang lebih besar tanpa kekangan yang disebabkan batasan dari segi perkakasan atau perisian.

2. Komponen dan Proses Pembangunan

2.1 Komponen

Untuk pembangunan projek ini, terdapat dua komponen utama yang dibina:

a) Struktur fizikal:

Struktur ini terdiri daripada komoditi seperti dua belas (12) CPU komputer yang dijadikan sebagai nod sistem, empat (4) unit KVM *"switch"* dengan empat pangkalan yang menyanbungkan setiap nod kepada satu unit monitor, dua unit *"ethernet switch"* dengan dua puluh empat (24) pangkalan yang menyambungkan setiap nod dan pelayan, tiga (3) unit "*Unintteruptible Power Supply" (UPS)*.

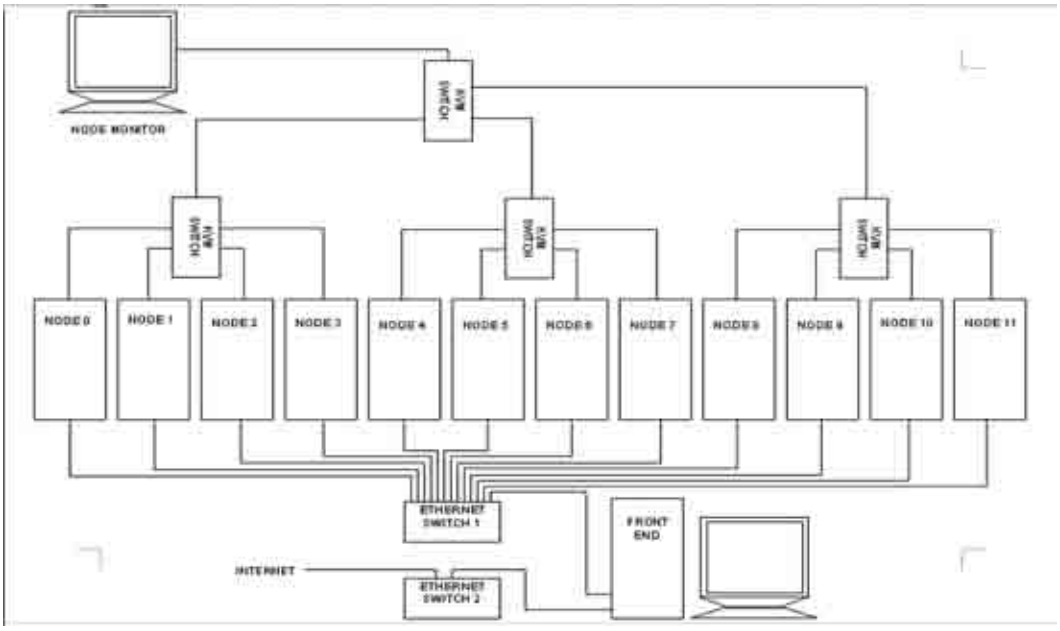
b) Struktur perisian:

Struktur ini amat penting dalam sistem komputer gugusan. Untuk pembinaan struktur ini, pelayan dan setiap nod komputer dipasang dengan perisian ROCKS Cluster. Pemasangan perisian ini menjadikannya sistem pengoperasian bagi sistem komputer gugusan ini. Ketika pemasangan perisian ini, beberapa komponen lain turut dipasang serperti Kernel Roll, Ganglia dan Area 51.

Selain daripada pemasangan perisian ROCKS Cluster, kumpulan kajian JMTi juga membina satu program pengaturcaraan C bagi aplikasi pengiraan nilai π menggunakan Kaedah Monte Carlo. Dalam pembangunan program ini, kumpulan kajian JMTi turut menumpukan kepada pengaturcaraan untuk pengagihan seimbang bagi beban pada nod sistem komputer gugusan.

2.2 Proses Pembangunan

Proses pembinaan komputer gugusan adalah mudah terutama pada pembinaan struktur fizikalnya. Hanya pembangunan program pengaturcaraan C bagi aplikasi yang ingin digunakan sahaja yang menuntut lebih penumpuan.



Gambarajah 2.1: Ilustrasi sistem komputer gugusan dibangunkan

Dalam sistem ini terdapat dua belas (12) nod komputer dan satu pelayan (*"frontend"*) yang disambungkan melalui *"ethernet switch"*. Satu monitor disambungkan kepada nod-nod komputer melalui KVM *"switch"* bagi memudahkan pemantauan setiap nod dilakukan.

3. Analisis Keputusan

3.1 Kajian

Pengujian prestasi kecekapan sistem komputer gugusan ini menumpu kepada penggunaan program pengaturcaraan C bagi lelaran (*"iteration"*) mencari nilai π berdasarkan kaedah Monte Carlo. Pengujian dilakukan dengan menjalankan program pengaturcaraan tersebut pada satu komputer tidak bersandar dan pada sistem komputer gugusan yang menggunakan empat (4) daripada dua belas (12) nod komputer. Hasil perbandingan dilakukan dengan penetapan lelaran (*"iteration"*) yang seragam bagi kedua-dua sistem.

3.1.1 Sistem Komputer Tidak Bersandar

Keputusan

i) Bilangan Titik, N = 1 000 000

```
This program estimates Pi by the Monte Carlo method.

Enter the total no of point:1000000

Starting time is : Fri Feb 06 09:20:31 2009
Ending time is   : Fri Feb 06 09:20:54 2009

The estimated value of pi is:3.140688
Press any key to continue
```

ii) Bilangan Titik, N = 10 000 000

```
This program estimates Pi by the Monte Carlo method.

Enter the total no of point:10000000

Starting time is : Fri Feb 06 09:22:04 2009
Ending time is   : Fri Feb 06 09:25:47 2009

The estimated value of pi is:3.141721
Press any key to continue_
```

iii) Bilangan Titik, N = 100 000 000

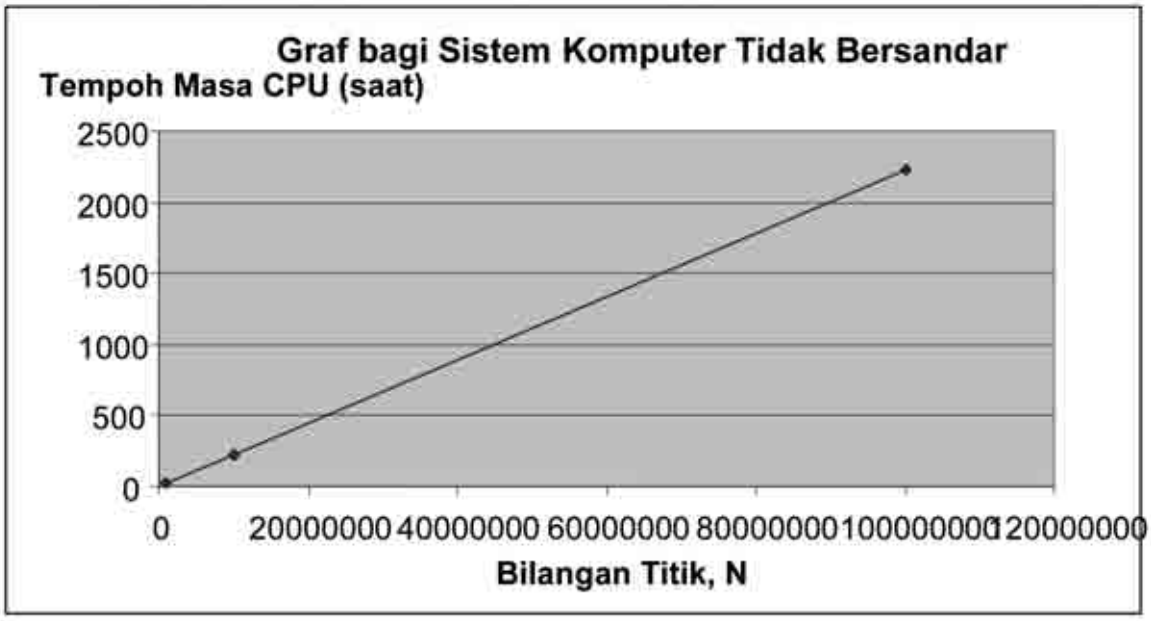
```
This program estimates Pi by the Monte Carlo method.

Enter the total no of point:100000000

Starting time is : Fri Feb 06 09:30:42 2009
Ending time is   : Fri Feb 06 10:07:56 2009

The estimated value of pi is:3.141453
Press any key to continue
```

Kesimpulan

CPU : AMD Sempron (tm) 2800++
CPU Clock Speed : 1.61 GHz
RAM : 512 MB

Jadual 3.1. Tempoh masa sistem komputer tidak bersandar

Bilangan titik, N	Tempoh Masa (saat)
1 000 000	23
10 000 000	223
100 000 000	2234



Gambarajah 3.1. Graf sistem komputer tidak bersandar

3.1.2 Sistem Komputer Gugusan

Aturcara 2 (Bilangan Titik, N = 1 000 000)

Keputusan

i) Bilangan CPU=1

```
---------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
---------------------------------------------------------------------

The total no of point:1000000

The estimated value of pi is:3.139372

Time taken                    :16.139054 seconds
```

ii) Bilangan CPU =2

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:1000000

The estimated value of pi is:3.141180

Time taken                    :8.073949 seconds
```

iii) Bilangan CPU =3

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:999999

The estimated value of pi is:3.142251

Time taken                    :5.378397 seconds
```

iv) Bilangan CPU =4

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:1000000

The estimated value of pi is:3.139780

Time taken                    :4.034610 seconds
```

Aturcara 3 (Bilangan Titik, N = 10 000 000)

Keputusan

i) Bilangan CPU=1

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:10000000

The estimated value of pi is:3.142078

Time taken                    :161.727900 seconds
```

ii) Bilangan CPU =2

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:10000000

The estimated value of pi is:3.141478

Time taken                    :80.719569 seconds
```

iii) Bilangan CPU =3

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:9999999

The estimated value of pi is:3.141820

Time taken                    :53.796162 seconds
```

iv) Bilangan CPU =4

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:10000000

The estimated value of pi is:3.141628

Time taken                    :40.432767 seconds
```

Aturcara 4 (Bilangan Titik, N = 100 000 000)

Keputusan

i) Bilangan CPU=1

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:100000000

The estimated value of pi is:3.141808

Time taken                    :1616.965292 seconds
```

ii) Bilangan CPU=2

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:100000000

The estimated value of pi is:3.141543

Time taken                    :403.536013 seconds
```

iii) Bilangan CPU=3

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:99999999

The estimated value of pi is:3.142017

Time taken                    :539.180241 seconds
```

iv) Bilangan CPU=4

```
------------------------------------------------------------------
This program esstimates Pi by Monte Carlo Method using cluster PC.
------------------------------------------------------------------

The total no of point:100000000

The estimated value of pi is:3.141895

Time taken                    :807.257810 seconds
```

3.1.3 Ringkasan Keputusan

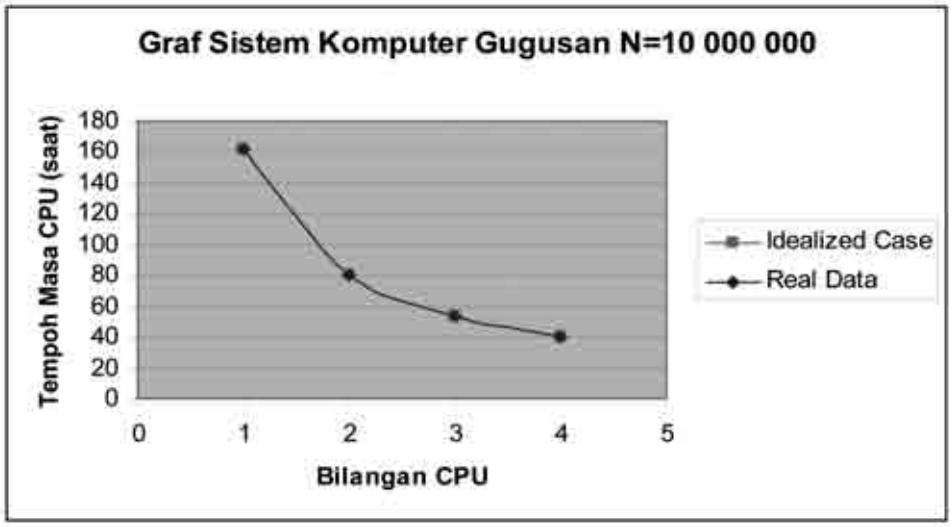
Jadual 3.2. Spesifikasi CPU

Nombor Nod	Jenis CPU	CPU Clock Speed/ GHz	RAM/ MB
0	Intel Pentium	2.533	969.276
1	Intel Pentium	2.533	969.276
2	Intel Pentium	2.533	969.276
3	Intel Pentium	2.533	969.276

Bilangan Data, N = 1 000 000

Jadual 3.3. Tempoh masa bagi data sebenar dan data hasil pengiraan bagi N = 1 000 000

	Tempoh Masa CPU (saat)			
	1 CPU	**2 CPU**	**3 CPU**	**4 CPU**
Real Data	16.139054	8.073949	5.378397	4.034610
Idealized Case	16.139054	8.069527	5.379685	4.034764

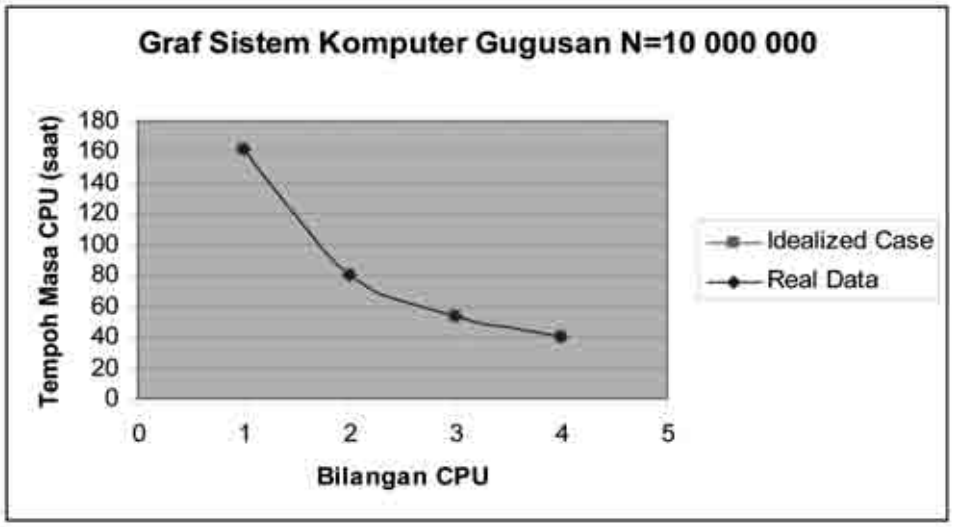


Gambarajah 3.2. Graf sistem komputer gugusan bagi N = 1 000 000

Bilangan Data, N = 10 000 000

Jadual 3.4 Tempoh masa bagi data sebenar dan data hasil pengiraan bagi N = 10 000 000

	Tempoh Masa CPU (saat)			
	1 CPU	**2 CPU**	**3 CPU**	**4 CPU**
Real Data	161.727900	80.719569	53.796162	40.432767
Idealized Case	161.727900	80.863950	53.909300	40.431975

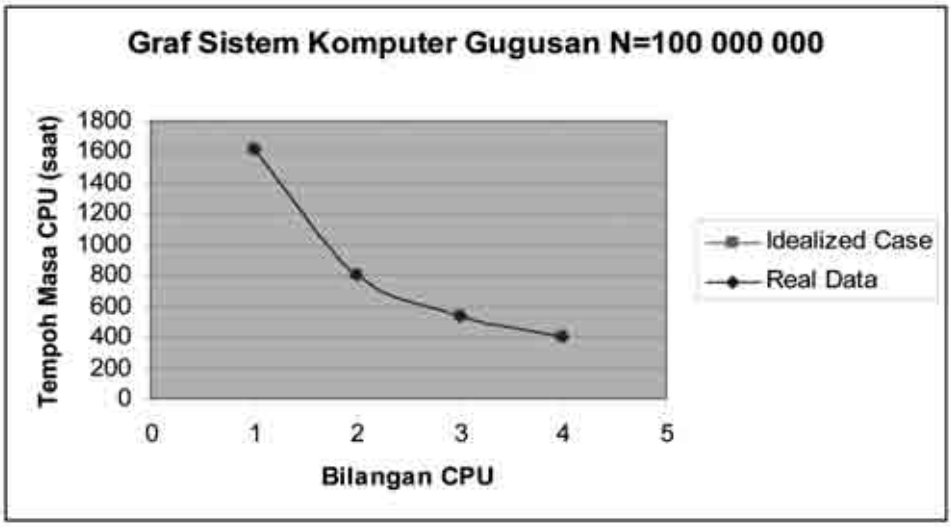


Gambarajah 3.3. Graf sistem komputer gugusan bagi N = 10 000 000

Bilangan Data, N = 100 000 000

Jadual 3.5. Tempoh Masa bagi data sebenar dan data hasil pengiraan bagi N = 100 000 000

	Tempoh Masa CPU (saat)			
	1 CPU	**2 CPU**	**3 CPU**	**4 CPU**
Real Data	1616.965292	807.257810	539.180241	403.536013
Idealized Case	1616.965292	808.482646	538.988431	404.241323



Gambarajah 3.4. Graf sistem komputer gugusan bagi N = 100 000 000

3.1.3 Perbezaan Sistem Komputer Gugusan dan Sistem Komputer Tidak Bersandar

Sistem Komputer Tidak Bersandar

Clock Speed Sistem Komputer Tidak Bersandar, CST = 1.61 GHz
Clock Speed Sistem Komputer Gugusan, CSG = 2.533 GHz

Bilangan Titik, N	**Tempoh Masa, Saat**	**N/ Saat**	**(N/Saat)*CSG/CST, N/Saat**
1 000 000	23	43478.26	68404.0

Bilangan Titik, N	**Tempoh Masa, Saat**	**N/ Saat**	**(N/Saat)*CSG/CST, N/Saat**
10 000 000	223	44843.05	70551.2

Bilangan Titik, N	**Tempoh Masa, Saat**	**N/ Saat**	**(N/Saat)*CSG/CST, N/Saat**
100 000 000	2234	44762.76	70424.9

Sistem Komputer Gugusan

Bilangan Titik, N = 1 000 000

Bilangan Nod	**Tempoh Masa, Saat**	**N/ Saat**	**Kadar Nisbah terhadap 1 PC**
1	16.139054	61961.5	0.9058
2	8.073949	123855.1	1.8106
3	5.378397	185929.0	2.7181
4	4.034610	247855.4	3.6234

Bilangan Titik, N = 10 000 000

Bilangan Node	Tempoh Masa, Saat	N/ Saat	Kadar Nisbah terhadap 1 PC
1	161.727900	61832.25	0.8764
2	80.719569	123885.7	1.7560
3	53.796162	185886.9	2.6348
4	40.432767	247324.2	3.5056

Bilangan Titik, N = 100 000 000

Bilangan Node	Tempoh Masa, Saat	N/ Saat	Kadar Nisbah terhadap 1 PC
1	1616.9	61846.7	0.8782
2	807.3	123869.7	1.7589
3	539.2	185459.9	2.6334
4	403.5	247831.5	3.5191

3.2 Perbincangan Keputusan

Sistem Komputer Gugusan lebih efektif berbanding dengan Sistem Komputer Tidak Bersandar kerana:

1) Jika dibandingkan kecekapan bagi Sistem Komputer Gugusan di dalam sistem itu sendiri, kecekapan sistem tersebut adalah berkadar langsung kepada bilangan CPU.

   Berdasarkan kepada gambarajah 3.2, 3.3 dan 3.4, apabila bilangan CPU bertambah kepada 2 atau 3 atau 4, maka tempoh masa yang diambil akan berkurangan sebanyak 1/2, 1/3 dan 1/4 daripada tempoh masa yang diambil bagi sebuah CPU.

2) Jika dibandingkan kecekapan bagi Sistem Komputer Gugusan dengan Sistem Komputer Tidk Bersandar, kecekapan Sistem Komputer Gugusan bagi 1 nod adalah 87% ~ 90% berbanding dengan Sistem Komputer Tidak Bersandar. Walaubagaimanapun, kecekapan bagi Sistem Komputer Gugusan akan meningkat, berkadar langsung dengan bilangan nod.

Gambarajah 3.6 Pembangunan sebenar sistem komputer gugusan

4. Kesimpulan

Sistem Komputer Gugusan adalah lebih efektif berbanding dengan Sistem Komputer Tidak Bersandar. Kecekapan Sistem Gugusan akan meningkat berkadar langsung dengan bilangan nod. Halaju pengiraan akan menjadi lebih cepat jika nod yang digunakan adalah banyak berbanding dengan hanya menggunakan Sistem Komputer Tidak Bersandar yang boleh mengambil masa yang lama untuk menjalankan sesuatu pengiraan yang rumit. Aturcara pengiraan PI telah diubahsuai dengan membahagikan bilangan keseluruhan pengiraan yang bergantung kepada pengiraan halaju bagi setiap nod dan mengagihkannya kepada setiap nod. Prosedur bagi penyeimbangan beban juga telah dilakukan ke atas Sistem Komputer Gugusan bagi membolehkan pengagihan jumlah pengiraan kepada setiap nod adalah bergantung kepada halaju pengiraan bagi setiap nod. Prosedur penyeimbangan beban ini bukan sahaja boleh digunakan untuk pengiraan π tetapi juga boleh digunakan untuk kebanyakan pengaturcaraan MPI terutama sekali aturcara yang menggunakan kaedah Monte Carlo.

5. Rujukan

[1] www.eveandersson.com/pi/monte-carlo-circle

[2] http://demonstrations.wolfram.com/MonteCarloEstimateForPi

[3] www.rockclusters.org/rocks

[4] http://library.thinkquest.org/C0111571/viewcode.php?cid=23

[5] math.fullerton.edu/mathews/n2003/montecarlopi/MonteCarloPiBib/Links/MonteCarloPiBib_lnk_1.html

[6] www.oscer.ou.edu/sipe_htc_sc08eduou_20080801.ppt

[7] www.deitel.com

[8] H.M Deitel, P.J Deitel, C How To Program Fourth Edition, Pearson Prentice Hall ISBN 0-13-122543-X, Page 155, 526, 560.

C2 - Integrasi Persijilan Profesional Antarabangsa Dalam Sistem Latihan Bidang Komputer di Institusi Latihan Awam dan Swasta

Shamsiah Binti Sarkawi
Pusat Latihan Teknologi Tinggi (ADTEC)
83000 Batu Pahat, Johor, Malaysia
shamsiah@adtecbp.gov.my

Abstrak

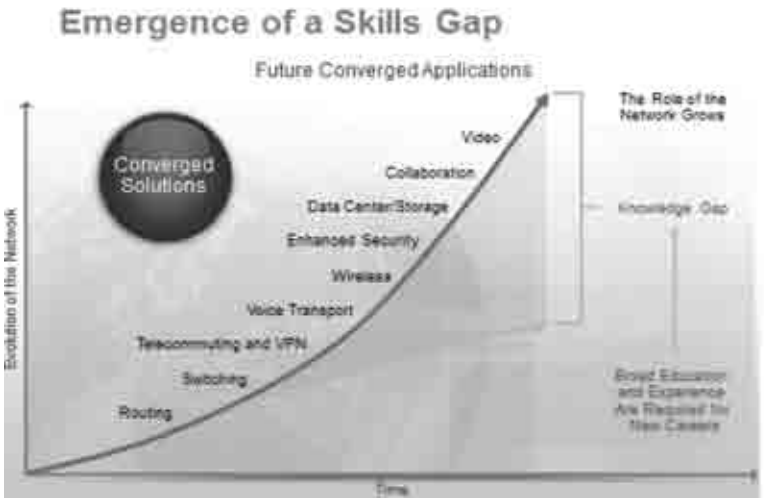
Pelbagai persijilan professional antarabangsa yang dilaksanakan di negara ini khususnya dalam bidang Komputer oleh Cisco, Microsoft, Juniper, Panduit, Redhat dan pelbagai lagi. Ia diwujudkan bagi mempersijilkan personel yang mempunyai pengetahuan dan kemahiran mengikut pengkhususan serta kurikulum yang ditetapkan. Sebahagian besar institusi latihan awam mahupun swasta telah mengintegrasikan persijilan professional antarabangsa dalam sistem latihan sama ada secara terus melaui penyelarasan kurikulum ataupun secara berasingan sebagai nilai tambah. Kupasan akan memfokuskan kaedah yang digunapai dalam mengintegrasikan persijilan antarabangsa iaitu Cisco Certification dalam sistem latihan yang dijalankan oleh institusi latihan. Integrasi ini merupakan antara langkah dalam meningkatkan tahap kebolehkerjaan graduan serta seiring dengan perkembangan teknologi semasa.

Keywords: *Networking Academy (Netacad), Local Academy (LA), Regional Academy (RA)*

1. Pengenalan

Permintaan industri terhadap persijilan professional dikalangan graduan telah meningkat secara global khususnya dalam bidang komputer. Ini berikutan jurang pengetahuan dan kemahiran yang dimiliki graduan dengan permintaan pasaran. Anggaran pada tahun 2012 sejumlah 3 juta networking professional diperlukan dengan keperluan di Asia Tenggara sahaja mencecah 190,000 orang [1] seperti gambarajah 1.1. Perkembangan teknologi yang bergerak pantas dalam bidang ICT memerlukan persediaan oleh Institusi latihan dalam memastikan graduan yang dihasilkan bersesuaian dengan keperluan pasaran. Oleh itu program persijilan professional diwujudkan oleh organisasi peneraju teknologi Komputer seperti CISCO International bagi mengatasi masalah jurang pengetahuan dan kemahiran yang wujud serta bekalan tenaga mahir bagi menampung keperluan pasaran .

Gambarajah 1.1 Anggaran Keperluan Pasaran Bagi *Networking Proffesionals* pada tahun 2012 [1]



Gambarajah 1.2 Perkembangan Teknologi dan Jurang berdasarkan kajian oleh CISCO International

2. Kaedah Implimentasi

Program persijilan profesional hanya boleh dilaksanakan oleh institusi yang telah diiktiraf iaitu didaftarkan sebagai *Academy* contohnya *Cisco Netacad* bagi Persijilan oleh Cisco.

Kriteria utama yang diperlukan bagi menjadi Cisco Netacad adalah seperti berikut [2]:

a) Mempunyai peralatan dan kelengkapan yang memenuhi kriteria minima yang ditetapkan oleh CISCO. Ini adalah merujuk kepada kurikulum program persijilan profesional yang dibangunkan oleh CISCO.
b) Mempunyai personel iaitu tenaga pensyarah yang telah dipersijilan bagi melayakkan personel tersebut mengendalikan latihan.

Langkah-langkah bagi proses permohonan adalah seperti berikut [3]:

a) Mengemukakan borang permohonan *Become An Academy* secara online
b) Penentuan RA yang menjadi penaung kepada istitusi yang memohon (selepas ini dikenali sebagai LA) oleh CISCO Malaysia.
c) Lawatan dan Verifikasi oleh *Malaysia Cisco Council* bagi tujuan kelulusan ke isnstitusi yang memohon.
d) LA akan menerima maklumbalas daripada RA setelah diluluskan.

Perlaksanaan Modul Pengajaran Program Persijilan Profesional berbeza-beza mengikut pendekatan LA yang berkenaan. Antara pendekatannya iaitu mengintegrasikan kurikulum latihan sedia ada dengan kurikulum program persijilan profesional. Contohnya program persijilan profesional CCNA meliputi 4 modul utama iaitu *Networking Fundamentals, Routing Protocols & Concepts, LAN Switching & Wireless* dan *Accessing the WAN [4]*. Modul tersebut dipecahkan mengikut semester iaitu *Networking Fundamentals* pada semester pertama, *Routing Protocols & Concepts* pada semester kedua dan seterusnya. Pendekatan ini hanya sesuai bagi kurikulum yang mempunyai pengkhususan yang hampir sama. Bagi kursus yang berbeza pendekatan kedua digunapai iaitu program persijilan profesional ditawarkan sebagai pilihan program tambahan secara berasingan kepada pelajar berminat sebagai tambah nilai.

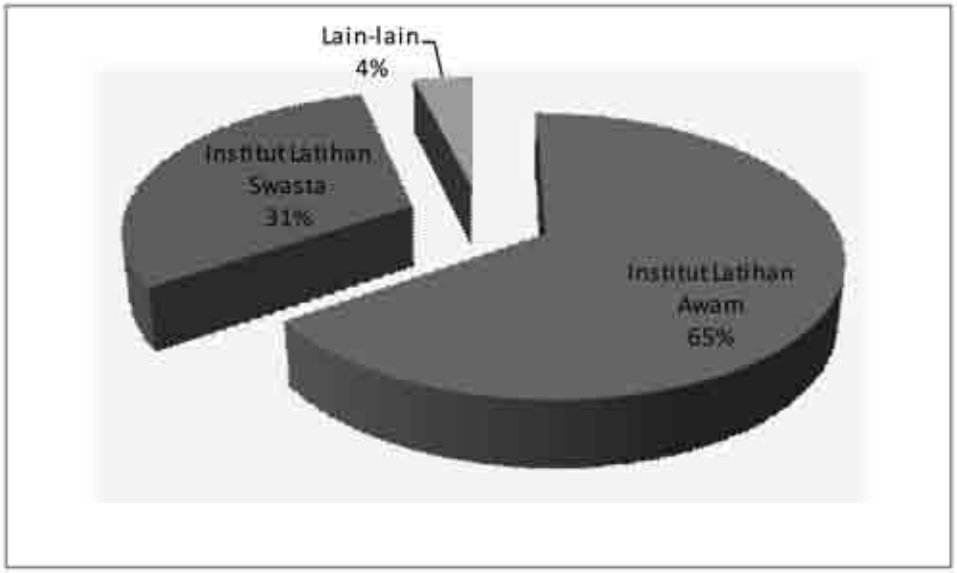
3. Keputusan dan Analisa

Sehingga 15 Februari 2011 keseluruhannya sejumlah 52 institusi latihan awam dan swasta di negara ini telah menjadi RA dan LA yang membolehkan institusi tersebut mengendalikan program persijilan professional seperti CCENT, CCNA dan CCNP [5] seperti dijadual 3.1.

Jadual 3.1 Bilangan Cisco Local Academy

Kategori Institusi	Institut Latihan Awam	Institut Latihan Swasta	Lain-lain	Jumlah
Bilangan Cisco Local Academy	34	16	2	52

Pengkelasan LA dipecahkan kepada Institusi Latihan Awam, Institusi Latihan Swasta dan lain-lain merujuk data di jadual 3.1 adalah seperti berikut.



Carta 3.1 Pecahan Cisco Networking Academy di Malaysia Februari 2011

Berdasarkan carta di atas, didapati Institusi Latihan Awam mencakupi peratusan terbesar iaitu sebanyak 67 peratus (34 buah institusi). Manakala Institusi Latihan Swasta sejumlah 31 peratus (16 buah institusi) dan lain-lain sejumlah 4 peratus (2 buah organisasi). Penglibatan yang lebih rendah oleh Institusi Latihan Swasta adalah berikutan kos pembangunan infrastuktur serta personel yang mempunyai persijilan bagi memenuhi kriteria seperti yang telah dibincangkan sebelum ini adalah tinggi.

4. Perbincangan

Penglibatan Institut Latihan Awam dan swasta membuktikan program profesional memberi banyak kelebihan dan manafaat kepada pelajar antaranya Kurikulum bagi program persijilan profesional adalah seragam secara global dan diiktiraf diseluruh dunia. Ini memberi peluang mobiliti kepada graduan untuk berada dalam syarikat tempatan mahupun syarikat antarabangsa.

Selain itu, pengiktirafan persijilan profesional yang kukuh serta diterima diperingkat antarabangsa meningkatkan kebolehkerjaan graduan. Ia juga secara tidak langsung meningkatkan imej Institusi melalui pengendalian program bertaraf antarabangsa.

Dari aspek kurikulum iainya dipantau dan dikemaskini oleh organisasi yang mengeluarkan persijilan selaras dengan teknologi semasa. Bahan pengajaran juga disediakan dan diseragamkan bagi semua academy dan boleh dicbuat capaian secara online. Ini memberikan proses pembelajaran yang lebih interaktif.

Ia juga memberikan penjimatan kos kepada pelajar untuk mengikuti program persijilan profesional kerana telah digabungkan dalam sistem latihan sedia ada. Selain itu, penjimatan kos perolehan peralatan tambahan kerana harga diskaun diberikan kepada institusi yang mempunyai *Academy ID*.

Disebalik pelbagai manafaat yang diperolehi melalui integrasi persijilan profesional, terdapat kekangan yang perlu diatasi antaranya untuk menjadi Cisco academy memerlukan kos permulaan yang tinggi bagi memenuhi kriteria yang ditetapkan. Kos yang dimaksudkan adalah bagi penyediaan peralatan agak tinggi serta latihan kepada tenaga pensyarah.

5. Kesimpulan

Integrasi persijilan profesional dengan sistem latihan di Institusi pengajian awam dan swasta memberikan banyak manafaat dan kelebihan kepada pelajar. Pendekatan integrasi yang flexible serta kaedah perlaksanaan yang seragam memudahkan institusi mengendalikan program persijilan profesional. Penyesuaian melalui integrasi persijilan profesional adalah disarankan bagi memastikan graduan yang dihasilkan releven dengan keperluan pasaran semasa yang berkembang pesat.

6. Rujukan

[1] IDC Skill Gap Research and Bain 2007. Global Job Market Analysis

[2] Academy Requirement. http://www.cisco.com/web/learning/netacad/get_involved/ Become AnAcademy.html

[3] Become An Academy Form. http://prospect.netacad.net/cnacs/pub-doc/new_acad_ prospect. shtml

[4] CCNA Modul Contain. http://www.cisco.com/web/learning/netacad/course_catalog/CCNA exploration. html

[5] Academy Locator : Malaysia. http://cisco.netacad.net/cnams/locators/LocatorMain.jsp. Carian pada 15 Februari 2011

C3 - Virtual ADTECSA Map

Safinatunnajah Ahmadi
Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam
najah@adtecsa.gov.my

Abstrak

Dengan adanya teknologi masa kini, peta berbentuk tiga dimensi dapat diwujudkan dengan bantuan perisian-perisian dan perkakasan yang betul. Keperluan semasa terhadap visualisasi dan navigasi secara tiga-dimensi (3D) di dalam pelbagai bidang tumbuh dan berkembang dengan pantas dan cepat. Sejumlah besar set data tepat 3D (contohnya model bandar) telah menjadi penting dan perlu dihasilkan dalam masa yang singkat di pasaran. Virtual Reality (VR) adalah teknologi yang membolehkan sesuatu dirasakan benar dalam persekitaran maya. Projek Vitual ADTECSA Map ini dibangunkan dengan menggunakan Easypano Tourweaver sebagai platform perisian; penggunaan fungsi dan kawalan yang lebih versatile serta mudah difahami dan digunakan oleh pengguna. Ia dihasilkan dalam bentuk gabungan gambar serta animasi dan mampu menghasilkan satu perisian interaktif yang asli dan dapat memberikan pengalaman sebenar kepada pengguna untuk menjelajah dan menerokai kawasan persekitaran Pusat Latihan Teknologi Tinggi (ADTEC) Shah Alam melalui persekitaran realiti maya.

Keyword*: realiti maya, 3D, peta, navigasi, visualisasi.*

1. Pengenalan

Dari zaman dahulu lagi, kegunaan peta dijadikan sebagai visual untuk sesebuah kawasan atau tempat; sebuah gambaran simbolik yang memberi tumpuan terhadap hubungan di antara elemen-elemen ruang seperti objek-objek, kawasan-kawasan dan tema-tema. Banyak peta berbentuk statik dua dimensi, dan ada yang tepat dan tidak begitu tepat secara geometri terhadap ruang tiga dimensi. Dengan adanya teknologi masa kini, peta berbentuk tiga dimensi dapat diwujudkan dengan bantuan perisian-perisian dan perkakasan yang betul. Projek "VIRTUAL ADTECSA MAP " merupakan projek naiktaraf dari projek lepas yang dibuat oleh pelajar Teknologi Komputer (Sistem) 2/2008. Projek ini adalah untuk memudahkan para pengguna untuk melihat sekeliling kawasan sekitar di ADTEC Shah Alam secara 360° dan boleh bergerak dari satu titik kawasan ke satu titik kawasan di sekitar kawasan ADTEC Shah Alam dengan berada di depan komputer sahaja. Antaramuka aplikasi ini direkabentuk dengan menggunakan perisian "EASYPANO TOURWEAVER". Projek ini adalah berbentuk flash (.exe) dan boleh dibuka dalam bentuk html atau website. Seterusnya, aplikasi ini boleh dimutnaik ke laman web rasmi ADTEC Shah Alam untuk menggantikan peta statik sedia ada sebagai rujukan dan panduan pengguna di laman web tersebut.

2. Objektif Projek

Objektif khusus bagi projek ini adalah:

i. Memudahkan pengguna melihat secara terperinci kawasan sekitar ADTEC Shah Alam.
ii. Memperbaharui sistem manual ke sistem yang lebih bersistematik & mesra pengguna.
iii. Menaiktaraf peta ADTEC Shah Alam yang sedia ada.

3. Latar Belakang Projek

Sebelum ini,ADTEC Shah Alam hanya mempunyai pelan lokasi ke ADTEC Shah Alam dan masih belum mempunyai peta kawasan ADTEC Shah Alam yang berdasarkan flash. Virtual ADTECSA Map ini bukan sahaja menunjukkan kawasan ADTEC Shah Alam, malah memberitahu setiap kawasan yang terperinci

yang terdapat dalam ADTEC Shah Alam di dalam bentuk gambar panorama. Contoh kedudukan pejabat pentadbiran, dewan kuliah serta bengkel dan lain – lain.

Sebelum tercetus idea untuk membangunkan projek ini pelbagai masalah yang dihadapi termasuklah membuat projek Virtual ADTECSA Map. Aplikasi ini dibangunkan setelah kajian dan perbandingan aplikasi yang dijalankan dari suatu sudut, terdapat pelbagai kekurangan yang boleh dijadikan kelebihan kepada Virtual ADTECSA Map. Selain itu, penggunaan masa yang berlebihan semasa mencari rekaan paparan yang sesuai untuk digunakan dalam pembangunan projek ini juga merupakan permasalahan yang kami hadapi. Memandangkan kesukaran yang dihadapi seperti bahan rujukan yang terhad serta pencarian secara 'on-line' juga agak perlahan, projek ini mengambil jangka masa yang panjang dalam menyiapkan sesuatu fungsi yang ingin dibangunkan. Untuk jangka masa yang terhad hanya beberapa fungsi atau penambahbaikan dapat kami bangunkan dalam projek ini.

Antaramuka aplikasi yang mesra pengguna memudahkan pengguna memudahkan pengguna menggunakan aplikasi ini tanpa sebarang masalah. Selain itu, perisian Paint Shop Pro 8 dan Adobe Photoshop CS3 juga digunakan untuk menyunting objek dalam projek ini. Dengan itu, objek akan kelihatan lebih menarik. Aplikasi ini juga melibatkan rakaman video kawasan sekeliling ADTEC Shah Alam. Pengguna boleh melihat kawasan yang diingini dengan terperinci.Disamping itu aplikasi ini boleh digunakan dalam jangka masa yang panjang. Aplikasi ini juga mempercepatkan proses untuk melihat kawasan selililing ADTEC Shah Alam. Perisian ini berguna terutama kepada pelajar baru dan juga pelawat untuk mengetahui dengan terperinci setiap bahagian atau kawasan di dalam ADTEC Shah Alam. Dengan adanya peta maya yang berunsurkan interaktif ini pengguna dapat melihat kawasan yang diingini di sekitar ADTEC Shah Alam dengan lebih mudah dan pantas.

4. Kajian Kes

Van Driel (1989) mengakui bahawa kelebihan dari 3D terletak pada cara kita melihat maklumat tersebut. Dianggarkan bahawa 50 peratus neuron otak terlibat dalam visual. Lebih-lebih lagi, dipercayai bahawa paparan 3D merangsang lebih banyak neuron; ia melibatkan jumlah yang lebih besar dari otak dalam proses penyelesaian masalah. Sebagai contoh, dengan peta 2D, otak perlu membina sebuah model konseptual sebelum analisis apapun dapat dilakukan. Mengingati kartografi beberapa kawasan peta yang kompleks ini boleh menjadi tugas yang sukar bahkan untuk minda yang paling tangkas.[1]

Walaubagaimanapun, paparan 3D mensimulasikan kenyataan spatial, sehingga membolehkan pengunjung untuk lebih cepat mengenal dan memahami perubahan elevasi dan tekstur dengan lebih baik. Konsep ini berlaku untuk navigasi 3D juga. Ketika pengguna melalui sebuah laluan ke destinasi yang tidak diketahui, sistem ini yang dapat memvisualisasikan peta yang lebih baik ; membuat pengguna memahami lebih baik dan membantu dia untuk menyusuri laluan ke destinasi dengan lebih cekap.[2]

Pada masa ini, sistem navigasi yang paling cenderung untuk memaparkan peta dengan menukar perspektif peta itu (agar terlihat seperti sebuah adegan 3D), dengan persembahan peta yang bagus tanpa bantuan apa pun seperti mercu tanda pada peta. Sistem navigasi 3D lain pula harus mampu menunjukkan objek 3D sekitarnya di sepanjang jalan ke destinasi. Objek-objek 3D yang juga dikenali sebagai mercu tanda visual. Mercu tanda visual lebih cenderung bentuk yang sama sebagai objek dunia nyata dengan butiran umum. Pastinya, navigasi melalui dataset 3D akan lebih betul dan tepat. Aplikasi analisis rangkaian seperti 3D dapat diterapkan di sini, dan kerana itu, pengguna boleh memiliki penyelesaian alternatif untuk jarak minimum untuk setiap laluan ke destinasi .[3]

Misalnya, dalam menerokai kawasan sekitar ADTEC Shah Alam, seseorang dapat mengetahui kedudukan di mana dia berada, kemudian memilih ke mana destinasi berikutnya dengan mudah. Sewaktu mengemudi sepanjang laluan yang dipilih, maklumat lengkap (atribut) untuk objek 3D sekitarnya juga dapat dilihat dan ini memberikan lebih kemudahan kepada pengguna untuk menerokai kawasan sekitar ADTEC Shah Alam.

Projek ini membantu dan memudahkan pengguna luar atau pelajar mengenali ADTECSA dengan lebih dekat secara lebih interaktif; ia memberi kemudahan kepada pengguna denngan menunjukkan peta kawasan sekitar ADTEC Shah Alam secara maya. Aplikasi ini mudah dibangunkan ; dengan gabungan flash (.exe) dan video untuk mendapatkan paparan yang menarik. Seterusnya, ia boleh dimuat naik ke laman web rasmi ADTEC Shah Alam bagai menggantikan peta 2D sediaada sebagai rujukan kepada pengguna dan pengunjung laman web tersebut.

5. Metadologi

5.1 Spesifikasi Minima Projek

Komputer : 2G Ram, Duo Core Processor, Minima 2G *free space* Hardisk
Perisian: Java & ActiveX installed, Adobe Macromedia Flash 9 Player.

5.2 Perisian

Antara perisian yang digunakan dalam pembangunan projek ini adalah :-

5.0.1 Easypano Tourweaver

Easypano Tourweaver merupakan perisian canggih yang mampu menghasilkan *virtual tour* yang kompleks dan interaktif. Perisian ini dihasilkan dengan teknologi yang terkini dan ia amat senang dan mudah digunakan berbanding perisian-perisian lain sepertinya. Perisian yang mesra pengguna ini mempunyai fungsi-fungsi yang unik seperti peta interaktif yang mempunyai kesan khas seperti kompas, *viewer skin* dan *walktrough* yang boleh diubah (*customized*), penggunaan URL, Hotspot, slideshows, dan juga fungsi asas seperti memasukkan gambar panorama spherical dan cylindrical, gambar static, fail audio serta video, dan juga text.

5.0.2 Easypano Panoweaver

Panoweaver 6.00 adalah merupakan perisian menyambungkan gambar (*photo stitching tool*) yang professional. Perisian ini boleh mengabungkan mana-mana jenis gambar ke gambar penuh *high quality* 360 darjah atau separa imej gambar panorama.

5.0.3 Adobe Photoshop CS3

Adobe Photoshop ialah satu produk perisian penyunting imej yang boleh digunakan untuk menyunting foto dan lukisan termasuk superimpose, membuat wallpaper dan membuat rekaan antaramuka (interface) laman web (contoh : button dan banner). Photoshop didatangkan dengan beberapa fungsi asas bagi memudahkan pengguna seperti memilih, melukis, menulis, dan menyunting imej.

5.0.4 Corel VideoStudio 12

Corel VideoStudio 12 atau juga dikenali Corel VideoStudio Pro X2 merupakan perisian yang mengabungkan *video editing*, *media authoring*, menambah kesan khas yang menarik dalam video, dan juga melakukan tugas burning DVD dan Blueray.

5.0.5 Swishmax 3

Swish Max 3 merupakan perisian mesra pengguna untuk menghasilkan Flash movies dengan cepat dan mudah. Swish Max 3 dipenuhi kesan khas yang menarik, dan animasi yang interaktif. Perisian ini dibekalkan dengan 350 jenis kesan khas multimedia yang dapat menghasilkan animasi canggih di dalam video, text, imej, *graphic* dan juga *sound*.

5.3 Perkakasan

Perkakasan merupakan peranti fizikal yang berbentuk komputer. Perkakasan yang digunakan dalam pembangunan aplikasi ini adalah seperti berikut :

1. Laptop Hewlett Packard Compaq nx6320
   - Spesifikasi sistem komputer :
     - Operating System – Mircrosoft Windows 7 Ultimate
     - CPU – Intel Mobile Core 2 Duo TS600 @ 1.83GHz
     - RAM – 2.5GB Dual-Channel DDR2 @ 333MHz
     - Graphics – Mobile 256MB Intel 945 Express Chipset Family
     - Hard Drives – 100GB Hitachi
2. Kamera Digital
   - Sony DHLR APSON 230
3. Thumbdrives
   - Kingston 4GB
4. External Hard Disk
   - Buffolo 320GB

6. Keputusan/ Perbincangan

6.1 Reka bentuk Antaramuka

Projek ini terbahagi kepada beberapa pilihan yang boleh dibuat oleh pengguna pada antaramuka seperti pilihan button lokasi yang diingini. Di button video pada remote control bolehkan melihat paparan video lokasi yang diingini. Rajah 4.1 (lampiran) merupakan gambarajah loading screen bagi Virtual ADTECSA Map.

6.2 Pengujian Aplikasi

Pengujian kepada aplikasi dilakukan untuk mendapatkan keputusan terhadap sistem bagi menentukan kesan kepada pengguna. Ini bermakna, aplikasi yang telah diuji ini menepati spesifikasi dan memenuhi kehendak pengguna. Proses pengujian yang dibuat telah berjaya tanpa sebarang masalah dan ralat.

7. Kesimpulan

Secara keseluruhannya dengan menggunakan perisian Easypano Tourweaver sebagai platform aplikasi telah memudahkan pembangunan projek ini. Virtual ADTECSA Map ini dapat memudahkan para pengguna melihat lokasi di sekitar ADTEC Shah Alam, pengguna juga boleh mengenali dan mengetahui dengan lebih terperinci kawasan yang terdapatnya.

Aplikasi ini menjadi boleh menjadi medium perantaraan yang interaktif di antara pengguna dan komputer. Aplikasi ini juga dapat membantu setiap pelajar dan orang luar untuk mencipta sesuatu produk yang berkualiti dan berdaya saing, selaras dengan perkembangan teknologi pada masa kini. Motif sebenar projek ini adalah memenuhi objektif yang mengambil kira bukan sahaja pada masa kini malah untuk pada masa akan datang. Rekabentuk antara muka adalah penting dalam sistem ini kerana ia menjadi perantara dan tarikan kepada pengguna. Rekabentuk yang datang dari idea yang kreatif dan digabungkan dengan kemahiran mampu menghasilkan satu aplikasi yang bermutu dan mampu menarik minat pengguna.

Setelah antaramuka siap dan berjaya dibangunkan, aplikasi ini perlu melalui beberapa lagi proses pengujian untuk memastikan tiada sebarang kesilapan dan ralat pada aplikasi. Sekiranya terdapat sebarang

kesilapan dan kelemahan seharusnya diperbetulkan terlebih dahulu sebelum aplikasi di implimentasi dalam persekitaran sebenar. Secara keseluruhannya aplikasi yang dibangunkan ini mampu memberi infomasi dan faedah kepada mereka yang menggunakan aplikasi ini.

8. Rujukan

[1] James Swanson , The Three Dimensional Visualization & Analysis of Geographic Data, Available: http://maps.unomaha.edu/Peterson/gis/Final_Projects/1996/Swanson/GIS_Paper.html

[2] M. Abdul Mannan and Bogdahn Juergen, 2004. Virtual Environments in Planning Affairs, in 20th ISPRS Proceedings, Istanbul, Turkey. Morley, Chris, 2002. Tool: libVRML97. Available : http://www.vermontel.net/~cmorley/vrml.htm [2010, October, 10]

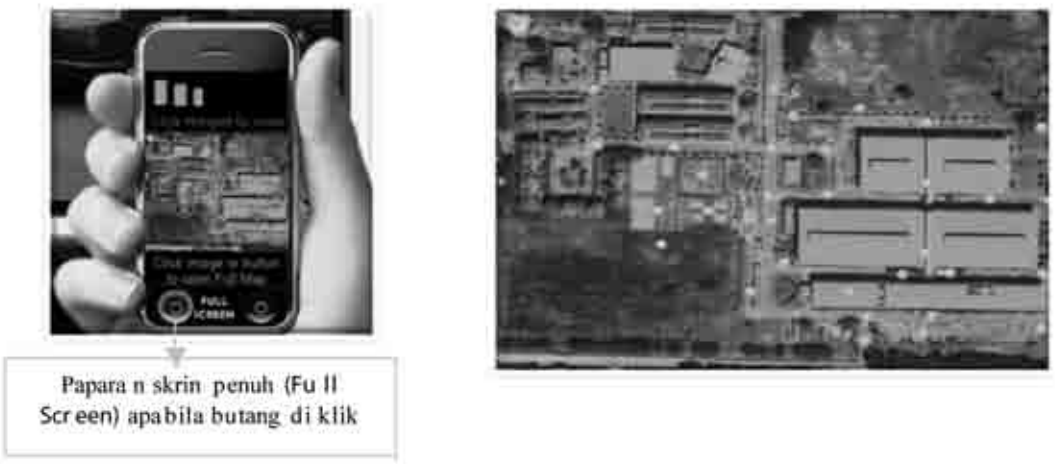
[3] Zlatanova, Siyka 2000. PhD thesis, 3D GIS for Urban Development, Thesis ICGV, GrazUT, Austria and ITC, The Netherlands, ITC Dissertation Series No. 69, Available : http://www.gdmc.nl/zlatanova/PhDthesis/ pdf/content.html [2010, October, 10]

LAMPIRAN

Rajah 4.1 : Antaramuka Utama

Rajah 4.2: Fungsi Alat Kawalan (Remote)

Rajah 4.2 adalah menerangkan setiap fungsi butang yang terdapat pada alat kawalan (Remote) sebagai kawalan bagi gambar panorama dan video.



KATEGORI TEKNOLOGI KEJURUTERAAN CETAKAN/BUKAN LOGAM/ISU-ISU PUSAT LATIHAN KEMAHIRAN

O1 - Latihan Kemahiran Tahap 6 – Teknologi Pemesinan Ketahap Ketepatan Tinggi

Mohd Yusri Bin Mohd Rahim; Zainol Bin Abd.Razak
Japan Malaysia Technical Institute
myusri@jmti.gov.my; zainol@jmti.gov.my

Abstrak

Kertas cadangan ini bertujuan untuk mewujudkan Kurikulum Latihan Kemahiran Tahap 6 dalam bidang Teknologi Kejuruteraan Pembuatan bagi pengkhususan Teknologi Pemesinan Ketahap Ketepatan Tertinggi setaraf dengan Ijazah Sarjana Muda Kejuruteraan Pembuatan (B.Eng (hons) Manufacturing Engineering). Kurikulum Latihan Kemahiran Tahap 6 ini mampu memenuhi keperluan industri-industri terutamanya dalam bidang 'Aerospace Manufacturing Component' dan juga 'Manufacturing of Medical Equipment' yang pesat membangun di Wilayah Koridor Ekonomi Utara (NCER). Elemen-elemen teras didalam kukrikulum ini adalah seperti 'Operation on High Precision Machining Technology (5 to 9 axis)', 'Reverse Engineering technology', 'Advanced CAD/CAM application', 'Operation on CMM (5 to 9 axis)', 'CNC Maintenance Technology' dan 'Management of Manufacturing System'. Latihan Kemahiran Tahap 6 ini, merupakan jambatan latihan kemahiran ke peringkat tertinggi untuk memenuhi keperluan industri tempatan serta antarabangsa seterusnya membangun ekonomi negara ke tahap yang lebih tinggi dan mampan.

Keywords: *High Precision Machining on high speed machines (5 to 9 axis); Reverse Engineering technology; Advanced CAD/CAM application; Operation on CMM (5 to 9 axis); CNC Maintenance Technology; Management of Manufacturing System.*

1. Pendahuluan

Malaysia kini sedang memasuki fasa 15 tahun yang kedua ke arah mencapai wawasan 2020 di mana manjadi hasrat Negara untuk mencapai dan menjadi Negara maju mengikut acuan sendiri, salah satu agenda kerajaan adalah untuk membangun satu sistem pendidikan berkemahiran tinggi bertaraf dunia.

Ledakan globalisasi dalam bidang teknologi telah mengubah senario di dalam mempertingkatkan kualiti latihan dan juga pembangunan kemahiran. Di bawah usaha bagi memperkasakan pembangunan dan latihan kemahiran. Pelan Induk Latihan dan pembangunan kemahiran pekerjaan Malaysia 2008 – 2020 diperkenalkan di mana salah satu pelan tindakannya adalah untuk membangun program latihan ke tahap tinggi bagi memenuhi keperluan industri dan individu.

1.1 Latar Belakang

Institut Teknikal Jepun-Malaysia (JMTI) adalah sebuah institusi pengajian tinggi kerajaan (IPTK) yang dikendalikan sepenuhnya oleh Jabatan Tenaga Manusia di bawah Kementerian Sumber Manusia.

Latihan kemahiran di JMTI mula diperkenalkan dengan kemahiran tahap 4 yang mula dijalankan di kampus sementara CIAST pada tahun 1996 dan berpindah secara tetap ke kampus utama Bukit Minyak pada tahun 2000. Latihan kemahiran tahap 5 di JMTI mula diperkenalkan pada tahun 2004 melalui 4 bidang Teknologi Kejuruteraan yang berlainan, setelah mengambil kira keperluan semasa teknologi dan juga industri.

Latihan kemahiran tahap 6 kini di cadangkan untuk dilaksanakan di JMTI setelah dilihat kepada

keperluan dan beberapa element berikut:-

i. Setelah dilihat kepada kestabilan perjalanan latihan kemahiran tahap 5 sediaada di JMTI bagi Krusus Teknologi Kejuruteraan Pembuatan dalam pengkhususan Jurutera Pembuatan CAD/CAM (H-050-5), di samping JMTI adalah pusat COE (Center of Excllence) bagi bidang Pembuatan.

ii. Perkembangan pesat dan percambahan industri dalam bidang pembuatan seperti industri *Aerospace, medical equipment, automotive, oil & gas* dan sebagainya amat memerlukan kepada tenaga mahir yang kompeten di dalam bidang pemesinan dan juga penyelengaraan mesin

iii. Melahirkan Modal Insan yang berkemahiran tinggi dan menghapuskan jurang keperluan tenaga mahir luar negara.

vi. Meningkatkan nilai JMTI khususnya dan ILJTM amnya sebagai peneraju pengeluar tenaga mahir negara ke satu peringkat yang lebih tinggi dan sebagai pelaksana unggul dalam bidang latihan kemahiran tinggi disamping sebagai pusat rujukan kepada Industri pembuatan tempatan, institutsi latihan, sekolan dan juga individu dalam mendapatkan bantuan dan juga khidmat nasihat di dalam bidang berkaitan.

v. Memertabatkan latihan kemahiran ke peringkat yang lebih tinggi dan menjadikan ianya sebagai pilihan utama pelajar kerana ianya mempunyai prospek kerja yang lebih baik disamping perlu meningkatkan komposisi pekerja berkemahiran tinggi kepada sekurang-kurangnya 37 % menjelang tahun 2015.

Cadangan Latihan kemahiran tahap 6 di dalam bidang pembuatan ini akan bertindak sebagai pemangkin serta kreteria bagi garis panduan asas kepada pembangunan silibus dan kurikulum sebenarnya nanti, setelah di lihat kepada khidmat nasihat pakar daripada beberapa buah industri berkaitan, tenaga pakar institut latihan serta penasihat teknikal JMTI.

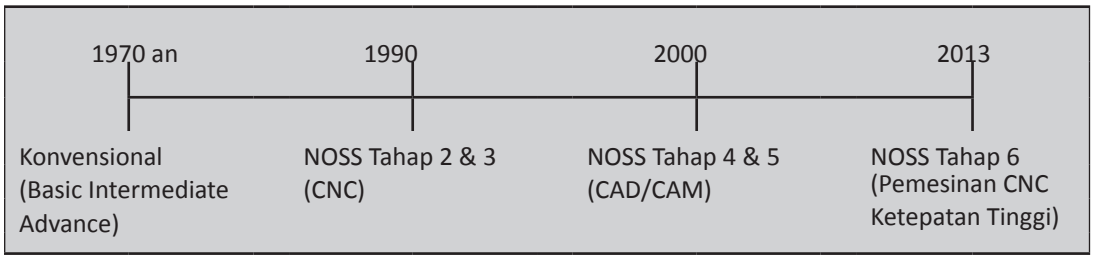
1.2 Objektif

1.2.1 Mewujud dan melaksanakan kurikulum latihan kemahiran tahap 6 dalam bidang kejuruteraan pembuatan bagi pengkhususan teknologi pemesinan ketahap ketepatan tinggi setaraf dengan ijazah sarjana muda kejuruteraan pembuatan (B.Eng (Hons) Manufacturing Engineering)

1.2.2 Menetapkan halatuju dan objektif institut Teknikal Jepun Malaysia untuk menjadikan ianya sebuah institut yang cemerlang dan unggul serta penggerak utama terhadap pembangunan teknologi termaju.

1.2.3 Menjadi pengerak meningkatkan komposisi pekerja berkemahiran tinggi kepada sekurang-kurangnya 37% menjelang tahun 2015 daripada 23 peratus sediaada.

1.3 Perkembangan Latihan Kemahiran Bidang Pemesinan Di Malaysia.



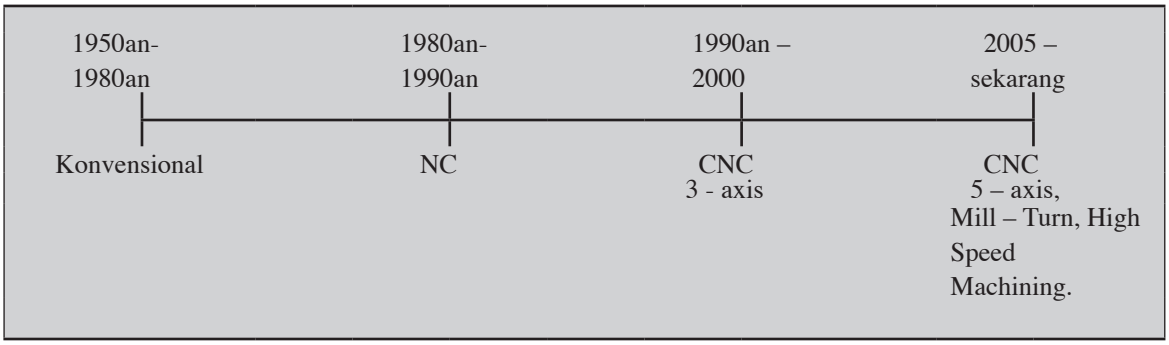
Rajah 1 : Sejarah Perkembangan Latihan Kemahiran Bidang Pemesinan di Malaysia

Latihan kemahiran telah mula berkembang di Malaysia pada sekitar era 1970 an. Pada tahun 1970an LLPPKK telah ditubuhkan bagi menyelaras program latihan kemahiran di Malaysia. Pada tahun 1990 satu jawatankuasa baru ditubuhkan iaitu Majlis Latihan Vokasional Kebangsaan (MLVK) bagi menggantikan LLPPKK, dan satu sistem baru telah diperkenalkan iaitu mengikut kurikulum NOSS. Pada tahun 1990, latihan kemahiran berpandukan NOSS tahap 2 & 3 telah bermula dalam bidang pemesinan CNC.

Pada tahun 2000, latihan kemahiran semakin berkembang dimana NOSS untuk tahap 4 & 5 telah siap dibangunkan. NOSS ini digunapakai untuk kursus bidang CAD/CAM. Tahun 2006, MLVK telah ditukarkan nama dengan Jabatan Pembangunan Kemahiran (JPK) melaui akta NASDA. Tahap tertinggi latihan kemahiran di Malaysia sehingga kini adalah pada tahap 5.

Maka melalui kertas kerja yang dibangunkan ini diharapkan akan membuka laluan kepada perkembangan latihan kemahiran di Malaysia iaitu tahap 6 dan seterusnya. Dijangka latihan kemahiran tahap 6 akan berlangsung pada sekitar 2013, apabila hasil kertas kerja ini digunapakai dan NOSS tahap 6 siap dibangunkan untuk kursus pemesinan CNC ketepatan tinggi.

1.4 Perkembangan Teknologi Pemesinan CNC



Rajah 2 : Sejarah Perkembangan Teknologi Pemesinan CNC

Perkembangan teknologi pemesinan CNC di Malaysia telah bermula pada tahun 1980an. Sebelum teknologi pemesinan CNC bermula satu kaedah yang dipanggil konvensional telah lama bertapak di industri iaitu pada tahun 1950an hingga ke tahun 1980an.

Selepas era konvensional timbul pula teknologi pemesinan NC. Pemesinan NC bermula pada tahun 1980an hingga 1990an. Kawalan berangka (NC) merujuk kepada pergerakan mesin yang dijalankan adalah mengikut perintah abstrak yang diprogramkan ke *encode* pada media simpanan.

Pada tahun 1990an hingga 2000, muncul pemesinan CNC bagi menggantikan NC. CNC merupakan penambahbaikan daripada kekurangan NC yang telah dibangunkan. Kaedah pengendalian mesin dilakukan oleh aplikasi komputer dan litar digital elektronik. Pada era ini, pemesinan CNC 3-axis mula digunakan secara meluas di industri di Malaysia.

Bermula tahun 2005 hingga sekarang satu lagi kemajuan telah dicapai dalam bidang pemesinan CNC ini. Di mana pemesinan CNC 5-axis, Mill-Turn dan High Speed Machining (Pemesinan Ketepatan Tinggi) digunakan bagi menghasilkan produk-produk yang sangat kompleks dan rumit.

2. Methodology

Dalam pembangunan kertas cadangan bagi mewujudkan kurikulum latihan kemahiran Tahap 6, satu kaji selidik telah dijalankan ke atas 30 Industri Pembuatan di kawasan perindustrian wilayah utara semenanjung Malaysia menerusi Kertas Kajiselidik(*Questionnaire*) dan perbincangan bersama pihak pengurusan syarikat

tersebut dan hasilnya adalah sepertimana berikut. Senarai pengusaha industri tersebut diperolehi daripada pengkalan data Federation of Malaysia Manufacturers (FMM), Pulau Pinang.

Dalam pembangunan kursus ini, dirumuskan beberapa aliran langkah-langkah pembangunan seperti yang ditunjukkan dalam Rajah 3 di bawah.

Rajah 3 : Langkah Pembangunan Kursus '*High Level Precision Machining'*

2.1 Keperluan Tenaga Mahir Berteknologi Tinggi.

Terdapat desakan disuarakan oleh pihak industri berhubung kekurangan tenaga berkemahiran tinggi dalam bidang pembuatan kepada pihak JMTi. Keperluan terhadap tenaga mahir berkualiti tinggi yang bukan hanya mampu menggunakan teknologi, malah mampu menguasai sesebuah teknologi dari segi penggunaan dan juga penguasaan sistem teknologi tersebut sendiri.

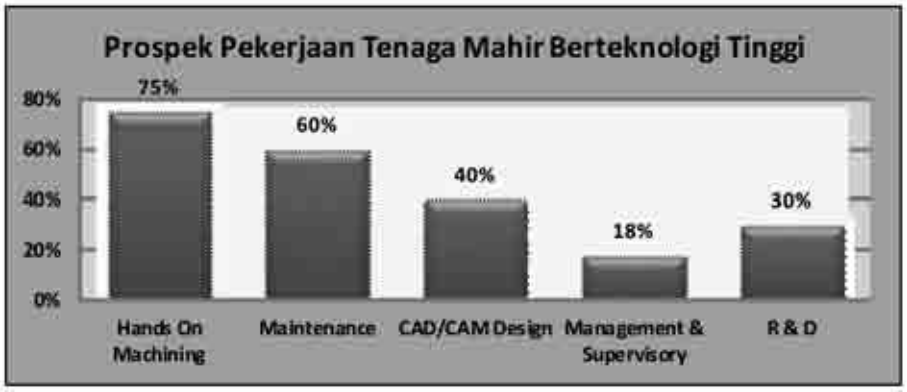
Kebergantungan terhadap tenaga mahir dari luar menyebabkan pihak industri terpaksa menanggung perbelanjaan tinggi untuk menggunakan khidmat pakar asing yang kebanyakannya datang dari negara luar. Maka pihak industri dengan ini mencadangkan supaya diwujudkan satu kursus kemahiran tinggi tempatan yang berkualiti untuk menampung keperluan tenaga mahir di premis mereka untuk mengimbangi kebergantungan terhadap tenaga mahir asing.

2.2 Analisa Keperluan Latihan

Pelbagai maklum balas yang diterima berkaitan keperluan untuk tenaga mahir berteknologi tinggi di industri. Namun dapat dirumuskan di sini, keperluan terhadap tenaga mahir berteknologi tinggi telah menjadi kritikal untuk industri yang sudah pun menggunakan sistem pembuatan berteknologi tinggi akibat kekurangan sumber tenaga kerja yang memenuhi kriteria yang diperlukan. Kualiti dan tahap latihan dalam negara seharusnya seiring dengan perkembangan teknologi yang digunakan dalam industri untuk menyokong keperluan mereka.

Maklum balas industri juga menunjukkan satu keperluan ke arah tenaga mahir yang mampu menguasai sistem mesin-mesin mereka untuk mengesan sebarang kerosakan yang menyumbang kepada masalah kualiti hasil pemesinan. Tenaga kerja mahir bidang '*maintenance*' masih terhad dan kebanyakan industri menggunakan tenaga pakar dari negara pengeluar mesin itu sendiri.

Inovasi teknologi baru menggabungkan kaedah pemesinan '*Turning*' dan '*Milling*' kepada '*Mill-Turn*'serta mesin-mesin yang berprestasi tinggi membuka dimensi baru dalam melakukan '*high level programming*'. Rajah 4. di bawah menunjukkan pekerjaan-pekerjaan yang bakal ditawarkan oleh pihak industri untuk tenaga mahir berteknologi tinggi yang diperolehi melalui kaji selidik yang dijalankan.



Rajah 4 : Prospek Kerjaya Yang Ditawarkan Oleh Industri

2.3 Pembangunan Kemahiran

Hasil kaji selidik menunjukkan terdapat beberapa kemahiran asas yang perlu ada pada tenaga mahir berteknologi tinggi. Pembangunan latihan kemahiran berteknologi tinggi melibatkan elemen-elemen pembelajaran teknologi pemesinan termaju secara teori dan amali secara lebih mendalam. Fokus pembelajaran akan lebih tertumpu kepada teknologi pemesinan terkini termasuk ;

2.3.1 Penyelenggaraan Mesin
Fokus terhadap aspek 'troubleshoot' kerosakan atau kegagalan fungsi mesin CNC, mengetahui dan memahami sistem fungsi mesin, serta menyelesaikan kegagalan fungsi mesin dan masalah kualiti produk.

2.3.2 Alatan pemesinan
Pembuatan berteknologi tinggi memerlukan penentuan proses, kaedah pemesinan dan alatan yang tepat meliputi rekabentuk jig and fixture serta prinsip rekabentuk tooling.

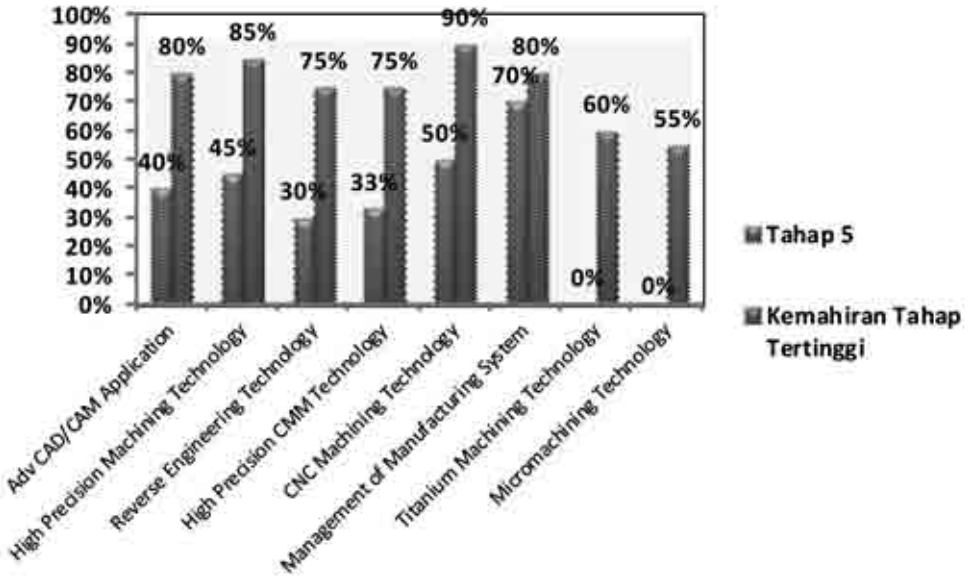
2.3.3 CAD/CAM
CAD/CAM dalam pembuatan melibatkan rekabentuk model contoh dan ia juga adalah sebahagian daripada keperluan pemesinan iaitu memprogramkan sesuatu rekabentuk ke dalam bentuk kod pemesinan CNC.

2.3.4 Metrologi dan Kawalan Kualiti Metrologi adalah aspek mendapatkan ukuran yang melibatkan ketepatan dan kemampuan mencari ukuran dimensi yang jitu. Kawalan kualiti yang meliputi aspek peningkatan kualiti produk, kemampuan sesuatu proses dijalankan dan juga melibatkan aspek statistik kawalan proses.

2.3.5 Teknologi dan Proses Pemesinan
Pendedahan kepada teknologi pemesinan logam yang terkini meliputi kombinasi pemesinan CNC Mill-Turn, pemesinan CNC dan CMM 5-9 paksi dan pemesinan CNC berkelajuan tinggi.

Berpandukan kepada sistem Latihan Kemahiran Tahap 5 dan industri pembuatan kini, sistem Latihan Kemahiran Tahap 5 lebih menjurus kepada jurutera pembuatan CAD/CAM dimana pengkhususan kepada rekabentuk sistem dan tidak kepada pengkhususan pemesinan ketahap ketepatan tinggi dimana pelatih perlu mahir keseluruhannya dalam pemesinan berteknologi tinggi dan mampu menyelenggara mesin CNC tersebut. Rajah 5 menunjukkan kemajuan keperluan penguasaan kemahiran Tahap Tertingi berbanding Tahap 5.

Rajah 5: Keperluan Tahap Penguasaan Kemahiran Teknologi Tinggi berbanding Tahap 5



2.4 Perancangan Latihan

Dari kajian dan perbincangan yang telah dijalankan berserta dengan perbualan dengan pakar-pakar industri dan juga bahagian akademik, satu kurikulum latihan kemahiran tinggi Tahap 6 bagi pengkhususan Teknologi Pemesinan ke tahap ketetapan tertinggi perlu diwujudkan di institusi dalam Malaysia terutamanya di JMTI yang setaraf dengan Ijazah Sarjana Muda Kejuruteraan Pembuatan *(B.Eng (Hons) Manufacturing Engineering)*.

2.4.1 Cadangan Kurikulum Latihan.

Kurikulum latihan berkemahiran tinggi bagi pengkhususan Teknologi Pemesinan ke tahap ketetapan tertinggi ini mestilah mencangkupi beberapa subjek teras yang utama seperti cadangan-cadangan dibawah:

2.4.1.1. *Advanced CAD/CAM system application. - Areas Covered:*
- *High level application in CAD design*
- *Designning complex function of Jig & Fixture.*
- *High level application in CAM machining (Multi-axis programming)*
- *Analysis product function.*
- *Sequence machining process in Multi-axis programming.*
- *Programming method with High precision machining on high speed machines.*

2.4.1.2. *Operation on High Precision Machining Technology - Areas Covered:*
- *Operating on 5-axis or high axis machining*
- *High level techniques to setup workpiece*
- *High level techniques to setup tools*
- *High level techniques to setup clamping devices*
- *Preparation jig & fixture on machine.*
- *Identify various reference point for establish work coordinate system*

2.4.1.3. *Operation on High precision Coordinate Measurement Machine (CMM) technology. Areas Covered:*
- *Operating on 5-axis or high axis machining CMM*
- *High level techniques to setup workpiece*
- *High level techniques to setup probing*
- *High level techniques to setup clamping devices*
- *Identify various reference point for establish work coordinate system*

2.4.1.4. *Reverse Engineering technology - Areas Covered:*
- *Reverse Engineering concept*
- *High technique of application of Probes and digitizing*
- *Data collection by CMM*
- *Data transfer by DNC to CAD/CAM system*
- *Editing and modification of drawing by CAD/CAM system*
- *generative NC data and post-processing.*
- *Data transfer to Machining by DNC.*
- *Re-machining the manufacture parts*
- *inspection techniques using CMM and surface roughness*

2.4.1.5. CNC Maintenance Technology.- Areas Covered:
- *Machine Electrical Schematics*
    - *a. Electrical Diagrams*
    - *b. Ladder Diagrams*
- *Machine Diagnostics*
    - *a. Common Diagnostic Systems*
    - *b. Binary Numbering Systems*
    - *c. Hexadecimal Numbering Systems*
- *Troubleshooting Tools*
    - *a. Digital Multimeter*
    - *b. Analog Multimeter*
- *Electrical Components*
    - *a. Switches*
    - *b. Relays & Contactors*
    - *c. Solenoid Valves*
- *Troubleshooting*
    - *a. Hydraulic Systems*
    - *b. Pneumatic Systems*
    - *c. Electrical Systems*

2.4.1.6. Management of Manufacturing system.- Areas Covered:
- *Product Data Management*
- *Digital Manufacturing*
- *Operations And Supply Chain Management*
- *Design for manufacturing*
- *Flexible competitive manufacturing systems*
- *Integrated product design and process development*
- *Decision support Systems*
- *Six sigma and lean manufacturing*

2.4.1.7. Titanium machining technology .- Areas Covered:
- *History & Extractive Metallurgy*
- *Solidification & Phase Diagrams*
- *Principles of Alloying Titanium*
- *Principles of Beta Transformation & Heat Treatment of Titanium Alloys*
- *Deformation & Recrystallization of Titanium & Titanium Alloys*
- *Mechanical Properties & Testing of Titanium Alloys*
- *Metallography of Titanium and Its Alloys*
- *Applications of Titanium*

2.4.1.8. Micromachining technology.- Areas Covered:
- *Introductions to Mechanical Micromachining*
- *Process Parameters in Mechanical Micromachining*
- *Tooling for Mechanical Micromachining*
- *Inspection in Mechanical Micromachining*
- *Interfacing with CAM Software and Understanding of NC codes*
- *Maintenance Mechanical Micro-machine-Tools*

2.4.2 Peralatan

Peralatan-peralatan yang disenaraikan dibawah ini merupakan peralatan-peralatan teras untuk mengimplikasikan program Teknologi Pemesinan ke tahap ketetapan tertinggi ini.

a. CNC Universal Milling Machine – 5-axis (c/w std. & optional accessories)
b. CNC Universal Milling Machine – 9-axis (c/w std. & optional accessories)
c. CNC Mill Turn – Multi axis (c/w std. & optional accessories)
d. CNC Turning center – 4 axis (c/w std. & optional accessories)
e. CNC Machining Center High Speed Machine – 3 axis with min. 65000rpm. (c/w std. & optional accessories)
f. CNC Micromachining (c/w std. & optional accessories)
g. Rapid Prototype Machine (c/w std. accessories)
h. CNC Coordinate Measuring Machine(c/w std. & optional accessories)
i. CNC Horizontal Profile Projector(c/w std. & optional accessories)
j. CNC Vertical Profile Projector(c/w std. & optional accessories)
k. CNC Non-Contact Video Measuring Machine(c/w std. & optional accessories)
l. High Performed computer Windows base PC with 17" digital flat panel LED screen latest version
m. High-End CAD/CAM/CAE Software latest version
n. High-End CAD Software latest version
o. DNC software latest version
p. KIT Simulator CNC Maintenance machine
q. Digital Manufacturing Solution software
r. CAPP software latest version

2.4.3 Tenaga Pengajar.

Untuk menjayakan dan mengimplikasikan dengan jayanya program berkemahiran tertinggi ini adalah tenaga pengajarnya. Tenaga pengajar merupakan aset penting dalam menjayakan program tersebut. Justeru itu, tenaga pengajar yang dilantik adalah seorang yang berkemahiran dan berpengetahuan tinggi dalam bidang ini. Bagi merealisasikan program ini dapat dijalankan dengan sempurna keperluan tenaga pengajar, khas untuk program ini dianggarkan seramai 10 orang dengan satu kumpulan pelajar tidak melebihi 30 orang pelajar setiap tahun.

Disini dicadangkan syarat-syarat kelayakan seseorang tenaga pengajar untuk menjayakan program ini:

i. Mempunyai pengalaman bekerja dalam bidang berkaitan tidak kurang dari 15 tahun.
ii. Mempunyai pengalaman mengajar aliran kemahiran dan vokasional tidak kurang dari 15 tahun.
iii. Mempunyai kelulusan akademik sekurang-kurangnya Ijazah Sarjana Muda dalam bidang Mekanikal (Pembuatan) atau setaraf dengannya.
iv. Mempunyai kelulusan akademik Ijazah Sarjana dalam bidang Mekanikal (Pembuatan) atau setaraf dengannya serta pengalaman mengajar tidak kurang dari 10 tahun.
v. Gred perjawatan dalam kerajaan sekurang-kurangnya Gred J48 keatas.
vi. Mempunyai kelulusan dari mana-mana Badan professional samaada Dalam Negara atau Luar Negara yang diiktiraf oleh FMM (Federation Manufacturing Malaysia) atau IEM (Institute Engineer's Malaysia).

Bagi tenaga pengajar yang sediada yang tidak mencapai syarat kelayakan seperti diatas, Latihan kemahiran yang tinggi untuk memahirkan pengunaan mesin yang canggih ini sangatlah diperlukan, adalah disarankan menjalani latihan di Luar Negara. Keutamaan adalah di syarikat pembuatan seperti *Aerospare manufacturing, Automative industry and Medical equipment manufacturing.*

2.4.5 Tempoh Latihan

Tempoh latihan sepenuh masa bagi kursus yang dicadangkan ini ialah satu (1) tahun. Pelajar diwajibkan menjalani latihan kemahiran di institut selama satu (1) tahun (2 semester), pelajar perlu menjalani latihan industri (industrial training) selama 6 bulan.

2.4.5 Kaedah Latihan

Kaedah latihan yang dicadangkan ini adalah berteraskan kemahiran di mana 50% ialah latihan amali dan 50% pengajaran teori.

3. Kesimpulan Dan Kelebihan Latihan Kemahiran Tahap 6.

Hasil daripada kertas kerja yang dihasilkan ini terdapat beberapa faedah yang bakal diperolehi. Dalam usaha kerajaan mengarusperdanakan latihan kemahiran teknikal dan vokasional supaya mempunyai prospek yang setaraf dengan aliran pendidikan dan fleksibal, hasil kertas kerja ini dijangka akan meningkatkan tahap kualiti latihan kemahiran ke tahap yang lebih tinggi berbanding tahap yang ada pada masa kini.

Dengan peningkatan tahap kualiti latihan kemahiran ini, maka para pengajar yang berkaliber dan cekap diperlukan dalam mengendalikan kursus pemesinan tahap tinggi. Oleh yang demikian para pengajar yang sedia ada ini akan di naiktarafkan pengajian mereka ke pengajian lebih tinggi seperti Sarjana dan Phd supaya kursus pemesinan tahap tinggi dapat dilaksanakan dengan lancar dan sempurna.

Dengan memperkenalkan kursus pemesinan tahap tinggi ini, maka institusi (JMTI) ini akan menjadi salah satu institusi yang unggul di Malaysia. Hal ini adalah kerana belum wujud pemesinan tahap tinggi iaitu tahap 6 di Malaysia pada masa kini. Institusi ini juga akan menjadi pakar rujuk pihak industri dengan apabila pemesinan tahap tinggi ini diperkenalkan.

Sejajar dengan pengiktirafan yang diberikan, institusi ini berupaya mengeluarkan tenaga mahir dan berkemahiran tinggi yang sangat diperlukan di industri pada masa kini. Hal ini akan merancakkan lagi perkembangan sektor industri di Malaysia.

Dengan sektor perindustrian yang semakin berdaya saing di Malaysia, maka syarikat-syarikat di Malaysia memerlukan pekerja-pekerja yang berkemahiran tinggi bagi memastikan syarikatnya terus berdaya saing. Justeru dengan memperkenalkan kursus pemesinan tahap tinggi ini ianya dijangka akan membantu dalam perkembangan sektor perindustrian di Malaysia.

Latihan vokasional dan teknik mempunyai peranan yang amat penting. Pendidikan aliran ini menyediakan laluan utama ke arah untuk melahirkan modal insan yang berkemahiran tinggi dan seterusnya menjadi penyumbang kepada penjanaan kekayaan baharu di Malaysia. Oleh itu, peningkatan kualiti pendidikan yang berteraskan kemahiran ini, mesti diperkasa dan mesti dijadikan agenda utama dalam memenuhi keperluan modal insan negara. Maka kursus pemesinan tahap tinggi ini berupaya membangunkan modal insan yang berkemahiran tinggi yang diperlukan di Malaysia.

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O2 - Framework for Effective Collaboration between Public Training Institute and Industries in Vocational Education and Training of Apprentices

Ramli Bin Hj. Rashidi[1)] Felix Rauner[2)], Deitmer, Ludger[3)]
and Sulaiman Bin Hj. Hassan[4]
[1)]Advance Technology Training Center (ADTEC), Dept of Manpower, Malaysia,
[2)]TVET Research Group (I:BB), University of Bremen, Germany,
[3]Institute Technology and Education (ITB), University of Bremen, Germany
[4)]University Tun Hussein Onn Malaysia (UTHM), Batu Pahat, Johore

Abstract

This study analyzes the key determinants of the effectiveness of collaboration between public and industrial training institutes. It aims is to develop potential factor and eventually a framework that can be alternative solutions to enhance cooperation between the stakeholder in the apprenticeship training. The result of the strong collaboration of the industry and the institute can develop a competent and highly skills workforce. Consequently, quality work based training in vocational education and training for the apprenticeships performance can be realized. Therefore, evaluation feedbacks on the quality of teamwork by the experts, trainers, teachers and apprentice used to development a framework for effective collaboration. This sample consists of 30 interviews, 100 survey questionnaires and four focus group discussions and workshops.

Keywords: *Goal-setting, partnerships development, management of cooperation, impact of learning and skills development and Evaluation*

1. Introduction

Active cooperation between companies and institute can have a significant impact on the vocational learning progress of apprentices or trainees [Deitmer 2010]. Therefore, transformation of learning and teaching strategic and obviously capacity for effective actions requires the establishment of stronger interaction between workplace experiences and systematic theory based learning at the institute [Heinemann/Rauner 2009; Deitmer 2010]. This arrangement is strongly linked to quality work-based training.

Accordingly, Krewerth et. al [2008] showed the importance of collaborative working as a method of increasing learners and trainers to the professional development. A closer cooperation, the Institute and the company, is essential for student to assess quality learning experience, and work-learning task [Heinemann / Maurer / Rauner 2008]

2. The key factors

The purpose of this study is to identify the key factors that have the potential to develop cooperation and the framework for effective collaboration between public training institutions and industry. With the better coordination and arrangement, partners can ensure that the work process and technology transfer in the industry can be realized and studied in depth by the apprentices.

2.1 Goal setting,

Research has first identified the goal-setting that affect the successful cooperation. According to Bergstrom [1995], Rinehart, Laszlo & Briscoe [2001], Arotake [2003], Deitmer et. al]2003] and Head [2005], suggest that goal setting binds people together and inspire them to fulfil their deepest aspiration. By

having these values, it is much easier to realign and utilize all resources to maximum effectiveness [Wood & Gray 1999, Bergstrom et. al 1995].

2.2 Partnerships development

Second were the factors that influence the development of partnerships for the implementation of apprenticeship program in VET by structuring the joint - committee. This is to align the process and implementation as to achieve strategic goal [Wood and Gray 1991, and Shelbourn et. al 2005]. By having trust and mutual respect will provides environment which not only permits but also promotes learning [Deitmer & Heinemann 2007, Deitmer and Ramli, 2007].

2.3 Management of cooperation

Third, this study has identified factors that influence the management of collaboration. Established memorandum of understanding which include an agree term of reference of share understanding, shared planning and shared - integrated instruction. It specifies the circumstances in which consultation will occur and when. It also encompasses areas of core business and policy development, role and responsipilities [Arotake 2003, Schrage 1990, Montiel-Overall 2005].

2.4 Impact of learning and competencies

Fourth determine the impact of learning and competence factors that influence the ability of successful cooperation. The learning has developed highly qualified workers with qualification, expertise, self-organized and support form of learning through work process acquisition and understanding the complex knowledge required by employees in modern organization [Rauner 2007, Spoetll 2008, Fischer, Boreham & Nyhan 2005]

2.5 Evaluating the collaborative performance and dual system in use

The fifth, evaluating performance of a collaborative partnership and the dual system used to affect cooperation. The innovative tool (ERC) applies formative evaluation where the team member hears feedback from partners. They will evaluate individually and consensually. They give feedback on what is working well and does not working well in the course of implementing the apprenticeship program [Deitmer et. al 2003]. Organization should relies on appropriate evaluation measures for better performance [Stahl, Gustavsen, Ennal & Nyhan, 2007, Helen English Association, Brian Head 2004 and Donham 1999].

2.6 Development of Framework

Finally, the sixth to develop a framework or model for effective cooperation based on the identified factors.

A strong relationship required constant communication to development of high quality vocational education between employers and training provider specifically instructors and coaches from different agencies. In this context, partnership is based on characteristic of work Rauner and Bauer [2003], Deitmer [2007, p139], Deitmer and Heinemann [2007], and Deitmer and Ramli [2007] where the main debate is over the element like (1) Communication, (2) Cooperation, (3) Trust, (4) evaluation and (5) feedback.

3. Results

The Correlation Analysis between Key Component affects effective collaboration

The factor analysis is done by using spearman's rho (r) to conform for correlation (see Figure1). All the elements have a positive correlation value between 0.609 and 0.746. These correlation values indicated that the magnitude of the correlation is significant. In general, this link shows that the expected elements of successful collaboration will be more effective with the increase of performance of all factors involved in the studies.

[Effective collaboration]

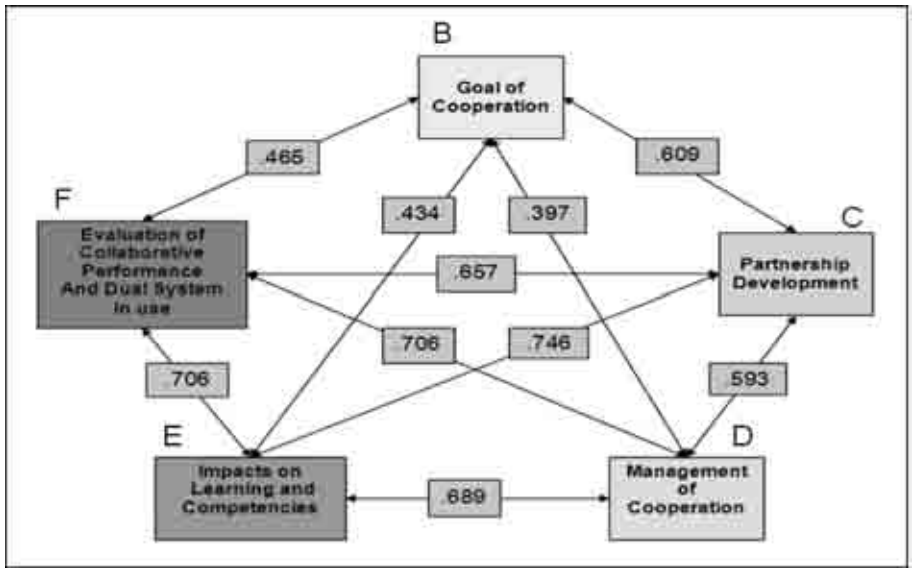

Figure 1: the Strength of the Correlation between factors contribute to effective collaboration

The values (see Figure 2) has the total amount of 100% of the effectiveness of collaboration predictor factors is mostly contributed by goal setting (28%), Partnership development (17%), Management cooperation (19%), the impact on learning and competence (23%), and evaluating of collaborative performance and dual systems in use (13%).

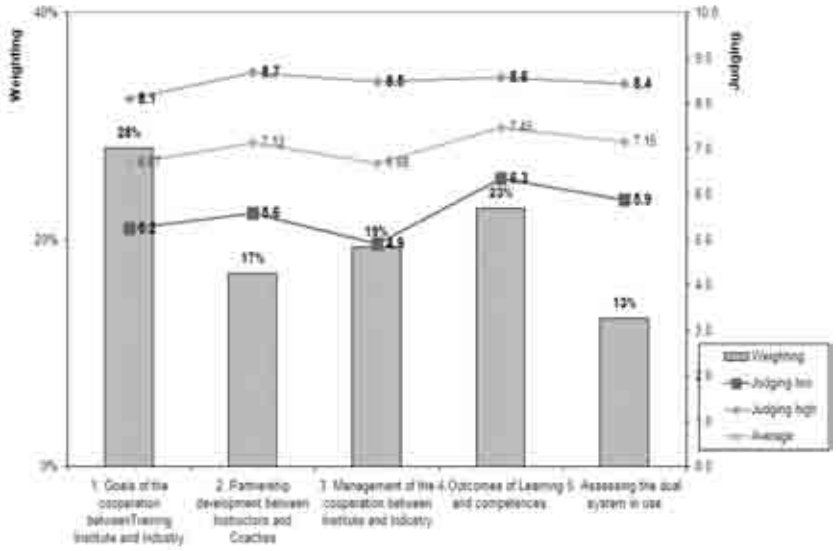

Figure 2. The Overall weighting and scoring of focus group

4. Discussion

Significant correlation between the effectiveness of collaboration with the five factors has shown that the more often they communicate about the goals, business requirements, teaching and learning activities, the more strengthen are cooperation among them. This result supports the finding by Deitmer et al [2003], Montiel-Overall [2005], Stahl [2007], and Deitmer and Ramli [2007].

It result of focus group workshop (see Figure 2) also connotes effectiveness of collaborative projects; particularly those related to the implementation apprenticeship scheme may depend on the factors above. Hence, the predictors of the effectiveness of cooperation in the implementation Dual System for apprenticeship schemes conformed to the previous study. Hence, this study provide information on the sub-factors that need to be addressed by institutions and industry in an effort to increase cooperation among themselves with respect to the effectiveness of collaboration predictors as shown in the framework (see Figure 3) that were formulated and developed. They are clear goal, trust, role and responsibilities and level communication, assessment on cooperation and feedback. They are grounded in a framework and supporting factor in an effective collaboration.

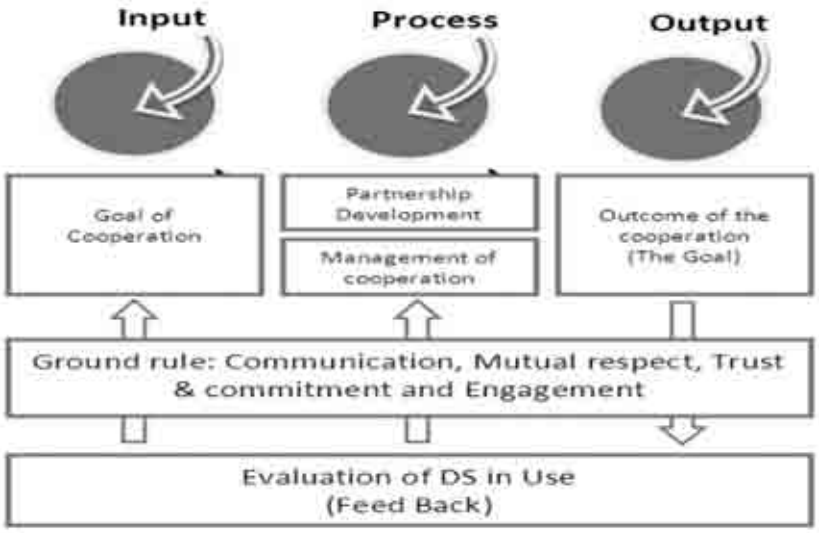

Figure 3: The Conceptual Frameworks for Effective Collaboration

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O3 - Kesan turutan Dakwat CMYK dan KCMY Untuk Percetakan "*Offset Lithography*" Pada Mesin Cetak Heidelberg SM 74-4

Muhammad Mu'izz bin Antong, Halim bin Hashim, Mahadi bin Saat,
Mohd Hamadi bin Othman, Mohd Shafrizal bin Shafii
Institut Latihan Perindustrian Arumugam Pillai Nibong Tebal

Abstrak:

Dakwat merupakan bahan asas dalam sesuatu percetakan.Dakwat memainkan peranan untuk memberi kesan terhadap cetakan dan berupaya menjadikan lebih bermaya dan berkualiti.Warna dakwat boleh menjadikan kesan sesuatu gambar lebih hamoni dan bertenaga seperti gambar yang asli. Dalam percetakan "Offset Lithography"terdapat 4 warna utama dakwat iaitu C-Cyan, M- Magenta, Y-Kuning dan K-Hitam. Warna-wwarna ini di kenali sebagai warna process kerana sifatnya yang boleh menerima dan membolehkan bercampur diantara satu dengan yang lain.Pengkelasan jenis warna dakwat (CMYK) dipilih melalui kesan himpunan warna cahaya iaitu kesan tindihan 3 warna asas cahaya –MERAH , BIRU dan HIJAU.

Didalam teknik mencetak gambar 4 warna penggunaan jenis mesin disesuaikan mengikut keperluan cetakan .Oleh yang demikian kaedah pembinaan mesin di buat dengan berbagai jenis seperti mesin cetak 1 warna, 2 warna dan 4 warna.Mesin mesin di bina secara kaedah modular unit iaitu warna-warna dakwat akan di tempat mengikut unit masing-masing.

Kaedah penggunaan dan penyusunan dakwat amat penting bagi mencapai kesan tindihan warna yang baik.Disebabkan sifat dakwat yang lembap dan menyerap kesan tindihan warna akan menyebabkan kesan sesuatu warna gambar tidak begitu bermaya dan bertenaga.Oleh yang demikian susunan warna mengikut unit cetakan pada mesin memainkan peranan dalam proses tindihan warna pada kertas atau bahan cetakan.

Bagi mesin cetak 4 warna, warna HITAM (K) seringkali di peruntukkan pada unit hadapan atau unit akhir mesin cetak, kemudian diikuti oleh susunan CMY. Kedua-dua susunan warna dakwat sebenarnya boleh diterima dalam proses cetakan, walau bagaimanapun terdapat kesan yang berlainan untuk kedua-dua susunan ini. Oleh yang demikian, ia telah memberi kami ilham untuk mengkaji kesan susunan ini pada mesin cetak Heidelberg SM 74-4.

Projek ini di bangunkan bagi mengkaji kesan dan mengenalpasti mutu cetakan hasil 2 susunan warna yang bertentangan iaitu susunan warna secara CMYK dan KCMY.Kajian ini dilakukan dengan menggunakan rekabentuk grafik,jenis dakwat dan jenis kertas yang sama yang sama dan dicetak menggunakan mesin Heidelberg Speedmaster 74-4 "sheet-fed offset".

Analisis yang dilakukan pada hasil cetakan di nilai dari segi:-

- *ketumpatan dakwat,*
- *pertindihan dakwat*
- *kesan turutan warna.*
- *Alat yang akan digunakan dalam proses analisa adalah "Spectrophotometer/ Densitometer" untuk memastikan data yang diperolehi adalah tepat.*

Kesimpulannya dari susunan penggunakan dakwat diatas, susunan secara CMYK dan KCMY menghasilkan kualiti cetakan yang berbeza.

Susunan warna dakwat secara KCMY adalah lebih praktikal kerana lebih berkualiti dari segi pertindihan warna, ketumpatan warna kecerahan warna dan kelekatan warna.

Keywords : *Offset Lithography, KCMY, CMYK, Speedmaster SM74-4.*

1.0 Pengenalan

Dalam dunia percetakan masa kini, terdapat cara percetakan tradisi dan juga percetakan secara moden iaitu digital. Walaubagaimanapun, kedua-dua cara ini masih lagi digunakan untuk menghasilkan kerja-kerja yang berkaitan dengan percetakan. Percetakan yang digunakan secara meluas di Malaysia adalah "*Offset Lithographic*". Percetakan jenis ini mampu menghasilkan kerja-kerja cetakan yang berkualiti dan juga menjimatkan. Aspek yang dititikberatkan di dalam dunia percetakan ialah masa, kos bahan mentah, kos operasi, kuantiti dan kualiti sesuatu cetakan. Kualiti cetakan adalah bergantung kepada banyak faktor antaranya penggunaan jenis kertas, kualiti dakwat, jenis dakwat, jenis mesin, susunan warna dan lain-lain.

Offset Lithographic

Proses percetakan offset lithographic mempunyai banyak variasi, iaitu heatset web-offset, coldest web offset, sheetfed, satellite offset, perfecting offset. Bagaimanapun, semua proses offset lithographic adalah sama. Offset ialah proses perpindahan dakwat dari plate percetakan kepada permukaan blanket yang mana kemudian dipindahan kepada permukaan subtrate (kertas, pvc paper dan lain-lain). Lithography pula ialah proses planographic yang mana dakwat melekat pada kawasan imej dan kawasan non imej menerima air melalui rawatan kimia.

Asal usul offset lithography

Pada masa kini offset lithography membangun dengan pesat dan berteknologi canggih. Ia bermula dengan proses stone lithography yang diperkenalkan oleh Alois Senefelder of Munich sekitar 1798. Pada batu berliang (porous stone) Senefelder melakar reka bentuk dengan bahan greas yang diserap oleh permukaan batu. Kemudian dia membasahkan keseluruhan permukaan dengan campuran gam Arabic dan air. Aplikasi gam Arabic dan air tidak bercampur dengan bahan gris dan hanya berada pada kawasan tidak berimej. Selepas permukaan batu dibasahkan barulah diletakkan pula dengan dakwat. Dakwat discampurkan daripada sabun, wax, minyak dan lampblack. Terdapat dua bahan kimia yang mempunyai peranan masing-masing, di mana dakwat dan air tidak boleh bercampur dan dakwat hanya melekat pada reka bentuk yang mempunyai gris pada batu. Dakwat dari batu dipindahkan melalui menekap helaian kertas pada permukaan batu tersebut dan menghasilkan imej pada helaian cetakan. Kekurangan proses ini ialah menggunakan masa yang lama, susah mendapatkan produk yang konsisten dan perlu menterbalikkan imej pada batu. Proses ini telah bertukar dari permukaan batu kepada permukaan metal plate dari zink dan aluminium. Bagaimanapun ini juga mempunyai kelemahan unutk mencetak pada permukaan kertas yang kasar. Pada hatun 1906, Ira A. Rubel adalah orang pertama memperkenalkan mesin offset yang mempunyai blanket getah sebagai pengantara pemindahan imej dakwat dari plate ke kertas, menghasilkan cetakan yang jelas, dan muncul offset lithography seperti yang kita tahu hari ini.

2. Objektif

Bagi susunan dakwat Cyan (C), Magenta (M) dan Kuning (Y) iaitu CMY adalah aturan yang mengikut piawaian dan juga amalan terbaik di dalam percetakan offset, manakala kedudukan hitam (K) adalah pilihan. Berpandukan situasi diatas, iaitu sama ada hitam (K) diletakkan dihadapan iaitu KCMY atau hitam (K) diletakkan dibelakang iaitu CMYK telah mendorong ke arah penghasilan kajian ini. Kajian ini adalah untuk menguji apakah kesan ke atas perbezaan susunan dakwat apabila hitam (K) di permulaan atau pengakhiran didalam percetakan offset dengan menggunakan mesin cetak 4 warna iaitu Heildelberg SM 74-4.

3. Metodologi

Dalam memastikan ujian kesan susunan dakwat kepada proses percetakan, kesesuaian ujian diperlukan. Topik yang telah dikenalpasti adalah (1) rekabentuk susunan dakwat yang disasarkan (2) mencetak hasil rekabentuk (3) verifikasi kestabilan warna menggunakan densitometer (4) analisa warna overprint untuk K awal dan K akhir (5) analisa perbezaan visual pada imej.

3.1. Rekabentuk susunan dakwat yang disasarkan

Rekabentuk susunan dakwat yang telah dihasilkan adalah untuk menguji kesan perubahan susunan warna hitam,K (dari awal ke akhir) pada percetakan offset. Rekabentuk mempunyai solid dan overprint dari

C+K, M+K, Y+K, CM+K, CY+K, MY+K, dan CMY+K dan dicetak dengan K awal dan K akhir. Oleh itu, sasaran warna didalam ujian ini yang dilihat, ujian ini juga diikuti oleh dua imej untuk penilaian kesan secara visual.

Gambarajah 1 : Rekabentuk sasaran ujian

3.2 Mencetak hasil rekabentuk

Didalam setiap cetakan, terdapat spesifikasi hasil cetakan yang berbeza bagi mesin yang berlainan. Bacaan yang biasa diperolehi untuk mesin Heidelberg Speedmaster 74 (SM74-4) iaitu mesin yang digunakan oleh kajian ini adalah : Hitam pertama-17.4, Cyan – 13.8, Magenta-14.4, Kuning-12.2, dan Hitam kelima -11.0. Hitam digantikan secara bergilir-gilir iaitu pada cetakan pertama Hitam diletakkan diawal manakala cetakan kedua, Hitam diletakkan di akhir. Ini adalah kerana mesin ini mempunyai 4 unit pencetak dimana hanya 4 warna digunakan untuk sekali cetakan.

3.3 Verifikasi kestabilan warna menggunakan densitometer

Untuk verifikasi sama ada ketumpatan warna solid diperolehi, bacaan untuk ketumpatan warna solid C, M, Y, dan K mestilah diukur. Pengukuran K dibuat dari bar hitam. Lima bacaan ketumpatan diambil dan dibahagi sama rata untuk mendapatkan bacaan yang terdekat. Dengan menganggap bacaan berada di dalam julat, ia menunjukkan jika terdapat perubahan pada ujian ia adalah kerana susunan dakwat pada mesin bukan ketumpatan dakwat.

3.4 Analisa warna *overprint* untuk K awal dan K akhir

Untuk warna overprint, sama ada K awal atau K akhir, ia diuji oleh X-Rite spectrodensitometer untuk memperolehi ketumpatan dan data bacaan (L*a*b). Perbezaan ini menunjukkan kuantitatif warna berubah kerana perubahan susunan dakwat pada unit pencetak.

3.5 Analisa perbezaan visual pada imej

Untuk lebih memahami kesan bacaan solid overprint, perbezaan visual pada imej dilakukan diantara susunan dakwat pada mesin dan operasi mesin SM74-4.

4. Keputusan dan analisa

Berikut adalah keputusan penemuan kajian beserta perbincangan berkenaan susunan warna dakwat percetakan CMYK dan KCMY. Berpandukan dari kajian yang dilakukan, kriteria atau aspek utama dalam analisis susunan warna ini adalah ketumpatan, untuk mengenalpasti konsisten dakwat, warna (bacaan L*a*b), dan perbandingan visual.

4.1. Perbandingan K awal lawan K akhir untuk SM 74-4

Ketumpatan: Jadual 1 menunjukkan nilai bacaan sebanyak 5 ukuran untuk setiap warna solid pada susunan dakwat SM74-4.

Jadual 1: Nilai ketumpatan SM74 warna solid bersama ΔD.

Verifikasi Ketumpatan SM74			
Patches	**K awal**	**K akhir**	**ΔD**
C	1.28	1.21	0.07
M	1.43	1.40	0.03
Y	1.03	1.02	0.01
MY	1.53	1.51	0.03
CY	1.54	1.51	0.06
CM	1.30	1.24	0.04
K	1.43	1.39	0.02
CMY	1.46	1.44	0.02

Perbezaan ketumpatan (ΔD) untuk ketumpatan dakwat solid K adalah minimum 0.02. Tambahan, perbezaan ketumpatan (ΔD) paling besar ialah 0.07. Berpandukan penemuan ini, cetakan ketumpatan dakwat adalah konsisten. Oleh sebab itu, jika terdapat sebarang perubahan sama ada K awal atau K akhir (pada SM 74) adalah kerana susunan dakwat pada unit pencetak dan bukanlah ketumpatan atau cetakan tidak konsisten.

Warna: Jadual 2 menunjukkan data colormetic untuk SM74 diikuti dengan bacaan ΔEab. Dengan penukaran susunan dakwat dari K awal ke K akhir memberi keputusan perbezaan warna ialah 6.6 ΔEab dengan variasi 12.1 dan 12.0 pada MY+K dan Y+K overprints. Di dalam tidak konsisten dan perubahan besar apabila K berinteraksi dengan Y berlaku kerana lemahnya pertindihan dakwat diantara K dan Y. Proses percetakan offset mencetak dakwat basah di atas dakwat basah, inilah dinamakan pertindihan dakwat, dimana peratus dakwat diambil kira. Pertindihan dakwat ini adalah satu faktor penting kerana ia akan meningkatkan bacaan L* apabila K berada di akhir susunan (warna akan menjadi cerah apabila K berada diatas kuning Y). Pengujian menunjukkan apabila K berada di awal pada SM74 menghasilkan L* yang rendah berbanding K akhir.

Jadual 2: Nilai warna metrik SM74 overprints bersama ΔEab.

SM74							
Patches	**K awal**			**K akhir**			**ΔEab**
	L	a	b	L	a	b	
C+K	15.9	-5.4	-11.0	16.3	-5.9	-8.8	2.2
M+K	13.5	14.5	1.4	14.9	13.8	-3.8	5.4
Y+K	18.4	-2.5	11.3	26.4	-2.4	20.3	12.0
MY+K	12.8	9.6	5.4	17.0	20.3	9.3	12.1
CY+K	15.0	-12.5	4.7	18.6	-18.6	8.4	7.9
CM+K	11.0	7.1	-6.8	11.6	4.1	-9.8	4.3
CMY+K	10.6	0.3	1.1	11.7	1.4	0.1	1.9

Perbandingan secara visual: Untuk perbandingan secara visual, ia dilakukan dengan membezakan dua imej pada hasil cetakan. Untuk imej yang pertama, ia mempunyai chromatic yang tinggi adalah disebabkan kekurangan warna hitam K dan mempunyai bayang. Bagi imej yang kedua, bayangnya tidak kelihatan dan hampir tiada perbezaan.

5. Kesimpulan

Secara keseluruhannya, apabila susunan dakwat telah berubah maka perbezaan berlaku pada hasil cetakan. Apabila susunan dakwat hitam K diubah diantara CMYK dan KCMY, ΔEab berubah dalam anggaran 7.0.

Apabila berlakunya persoalan tentang susunan warna hitam K, yang manakah keputusan yang tepat? Adakah ia mempunyai satu sahaja cara atau piawaian susunan dakwat untuk hitam K awal atau akhir? Oleh sebab terdapat perbezaan secara visual mengenai kedua-dua susunan ini, piawaian baru atau mengkaji piawaian sedia ada tidak diperlukan. Walaubagaimanapun, ia amat penting untuk memastikan prosedur yang dicipta konsisten untuk digunapakai. Apabila isu susunan dakwat ini dikehendaki, hendaklah dimaklumkan bahawa akan terdapat perbezaan warna dan ketumpatan dakwat dari segi hasilnya. Pemahaman tentang susunan dakwat cetakan pada unit pencetak amat penting, ia boleh memberikan hasil cetakan yang baik. Bagi percetakan offset, hitam K dipermulaan menghasilkan ketumpatan yang tinggi.

6. Prakata

Kami ingin mengucapkan ribuan terima kasih kepada Pengarah ILPAPNT kerana memberi peluang kepada kami menyiapkan kertas ini untuk program NCET yang dianjurkan oleh Jabatan Tenaga Manusia. Diharap juga penghasilan kertas ini juga meningkatkan kemahiran dan ilmu kami di bidang percetakan ini.

7.0 Rujukan:

[1] Handbook of Print Media, Technologies and Production Methods, Helmut Kipphan (Ed.)

[2] Operation manual Heidelberg SM74-4

[3] Colour Control in Lithohgraphy

O4 - Building Excellent Workforce through Effective Coaching

Affero Ismail, Noorazlina Musa
Pusat Latihan Teknologi Tinggi (ADTEC)
Batu Pahat, Johor.
E-mail: affero@adtecbp.gov.my
Norhasni Zainal Abiddin
Department of Professional Development and Continuing Education
Faculty of Educational Studies, Universiti Putra Malaysia.
E-mail: nonie@ace.upm.edu.my

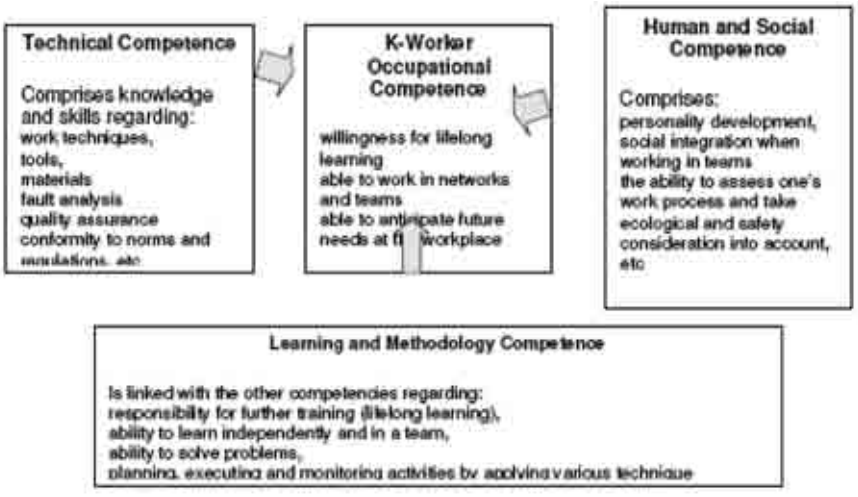
Abstract

Coaching is a part of educational training especially in Technical and Vocational Education Training (TVET) to develop people in the professions. Coaching is related to self-development, professional growth and career development of the coachee. Not only do coaches have to play role but the coaches too and all this must be placed within the specific institutional context. This article is designed to summarize existing literature on coaching in order to assist coach-coachee in enhancing the best practices for effective coaching. Thus, it focuses on model of coaching, role of coach and the nature of the coach-coachee relationship.

Keywords: *Coaching, Coach, Coachee, Practices.*

Introduction

Recently, issue of excellent workers has become vital and widely debated across the countries. It is in synchronizing with the development of K-workers. The global changes in technology and particularly in the Malaysian industries have created a dire need for skilled workforce and comprehensive training. A holistic skills training and technical training program to train K-worker should encompass not only technical competences but also human and social competences. This can be achieved through effective coaching during their training and practical in Public Skills Training Institute (ILKA) and industries as well. The coaching relationship has been described as an invaluable learning activity for beginners as well as experienced practitioners such as teachers, administrators, trainers and other professionals.



K-worker occupational competence (Source: NVTC, 2005) [53]

Many scholars have mentioned the importance of the relationship between a student and a supervisor in this context [1,2,3,4] particularly where the two work closely over a number of years. The relationship between the teacher and student plays an important role in promoting the student's objectives. However, sometimes a problem of compatibility occurs between them and therefore, Hockey [5] and Wilkin [6] suggest that they both need to know their roles in order to ensure a good relationship. Learning involves two parties, the teacher (also known as supervisor, mentor, coach) and the student (known as the trainee, mentee, mentoree, coachee, protégée). This article will discuss the supervisory approach commonly adopted towards student/trainee in order to help them achieve their objectives. In this, roles and practices of coach-coachee are described. Both parties either a coach or coachee should play their roles effectively. Hence, this article explores a review of the literature on coaching. It focuses on coaching model and the nature of the coach-coachee relationship.

Literature Review and Discussion

The Coaching Model

Coaching models help to provide a framework for a session, helping it to be a meaningful conversation with a defined outcome rather than just a chat with no clear purpose. Different models provide alternative perspectives prompting different questions to help the coachee in a variety ways. The skill of the coach is in knowing what the client needs at a particular moment so a toolkit of different models is helpful to draw upon and use as appropriate.

There are many models of coaching. Each model has their own strengths, which can be seen by looking at the coaching goals. Coaching integrates many fields of knowledge. If we look closely, most coaching approaches share things in common: (1) The establishment of a relationship built on trust, unfeigned communication and confidentiality; (2) The formulation of client-based, agreed upon goals and expectations; and (3) A deep questioning and learning dynamic in relation to your goals. There are three models that will be discussed in this section which are Schon's Three Models, The GROW Model and The Coaching Method Model.

Schon's Three Models

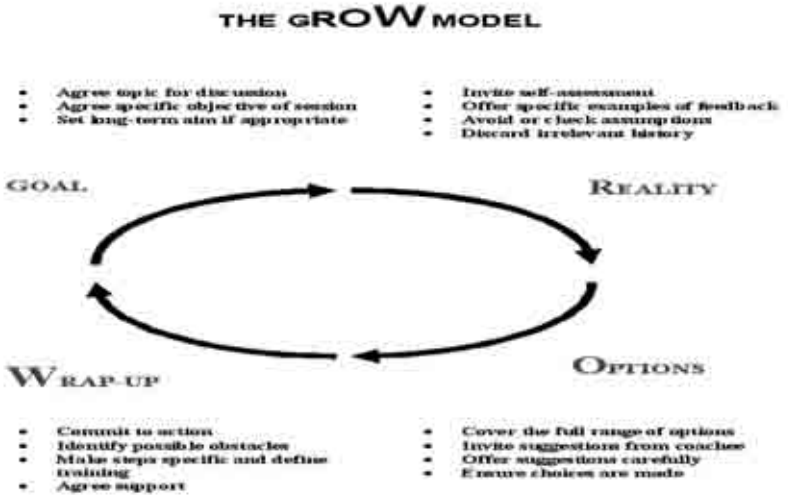
This model area as follows: (1) Joint Experimentation Model; (2) Follow Me; and (3) Hall of Mirrors. These are three ideal types and are in practice more often found together, as coach and coachee shift from one to other. In Schon [7] the coach is male and the practitioner or coachee is female. In Joint Experimentation, the coach first seeks to help a student formulate what she wants to achieve, and then via demonstration or description, they explore different ways of doing this. The coach's skill is in leading the student to search for a suitable means of achieving the desired objective. Having risked saying what she wants, she then risks experimenting in new ways. According to Schon [7], the more the coach knows about the problem, the harder it is not to tell the student how to solve it or to solve it for her. This joint experimentation can only succeed when the student can already say what she wants to produce. The experimentation is in the processes for achieving the stated ends. During these, because of the unique and unpredictable nature of each situation, the student and coach work together to learn from it, but use orthodox methods. This approach is therefore inappropriate when wholly new ways of seeing and doing are required.

In Follow Me, coach's skill consists in his capacity to improvise a complete performance and within this, to share short examples of reflection-in-action. Here, the relationship between the whole performance and its parts is crucial. The coach demonstrates a number of ways of breaking down the whole into parts and reassembling these into the whole in more understandable way. The student attempt to imitate him, and the coach and student respond each other. Here, the student's skill is to keep as many possibilities as feasible alive in her mind, temporarily suspending her own intentions while she observes the coach and tries to follow him, attempting to reproduce his operations in order to discover their meaning. She then decodes his response, testing whether the meanings she has constructed as a result are like his. By this means, she will gain some of the coach's understanding but will then utilize this ultimately in her own way [5].

In the Hall of Mirrors, the student and coach continually shift perspectives. Their interaction is at one moment a re-enacting of some aspect of the take a two-tiered view of their interaction, seeing it for itself, and as a mirror to reflect back to the student what she has brought to that interaction. The coach's skill is in showing his own confusions authentically in order to enable the student to see error or failure as learning opportunity. However, the Hall of Mirrors can only work on the basis of parallels between practice and the practicum, as for example, when the kind of enquiry established in the practicum resembles the inquiry that the student seeks to exemplify in real practice. Therefore, in all of the above models, it is important for both student and coach to assess their own learning. Thus, to do their jobs well, they become researchers, each enquiring consciously into his or her own and each other's changing understandings. However, this enquiry takes place under difficult conditions because of the complexity of the human situations of which they are part, and because they are often unaware what they already know. Their tacit knowledge as well as their confusions, their beliefs and doubts, needs to be examined. Talking to each other and working together are the main means of so doing [5].

GROW Model

The second model is GROW Model. This model involves four phases, for which GROM is an acronym (Goal, Reality, Options, What). This means that firstly the individual must set overall goals and goals for individual sessions. Secondly, he must find out the current position or reality. Thirdly, he must generate options with plans and strategies and finally he must decide what is to be done by whom, when and how [8,9]. This coaching method explains the GROW sequence in detail and introduces the concept of SMART (Specific, Measurable, Agreed on, Realistic, Timed) goals. It provides the coachee with the opportunity to practice coaching a colleague through the whole GROW sequence or with a powerful way to turn team meetings into goal-focused events. The coachee can also use members own the actions agreed, and decisions are carried through to successful completion [9]. Antonioni [10] suggests a quite similar model to the GROW model involving the following seven primary steps: (1) making observations; (2) conducting an analysis; (3) giving feedback; (4) engaging in enquiry; (5) setting goals; (6) planning action steps; and (7) recognizing improvements. Step seven recycles into step one, with both parties either focusing on the original improvement goal or setting a new one. In step two, coaches must determine how the system may contribute to the gap between an individual's desired and actual performance.



Source Leonardo Ravier (2005) [54]

The Coaching Method Model

The third model is The Coaching Method Model. Parsloe [11] suggests that there are four coaching methods, which he calls hands-on, hands-off, supporter and qualifier. Hands-on is when the coach is acting as instructor when working with inexperienced learners, whereas hands-off is best for developing higher

performance with experienced learners. The supporter method can be used when helping learners to use a flexible learning package technique and the qualifier method is suitable in helping a learner develop a specific requirement for a competence-based or professional qualification. The basic coaching process and the necessary knowledge and skills also apply to the other two main coaching roles identified, the supporter and the qualifier method. This method of learning is very inexpensive way of providing learners with a body of learning resources compared to the cost of full-time tutors and classroom-based activities. Learners can choose both the way they would like to use the learning resources and also the time and pace to suit the pressures of their environment. The qualifier method will usually apply in situations where a candidate for a competence-based or professional qualification identifies a specific performance task in which he/she needs to develop competence as part of a larger qualification program. A typical situation might be for a candidate to develop competence in preparing marketing plan, using a spreadsheet, chairing a meeting or inputting and retrieving from a database.

The Responsibility of an Effective Coach

The coach has often been compared to a teacher [12,13,14,15,16,17,18]. There are many authors who suggest that coaching is a form of facilitating learning [15,19,20,21] which is concerned with the improvement of performance and the development of skills [10,15,22,23,24,25,26]. Coach can also be seen as a trainer or counselor [12,25,27] and should be significant as a source of the guidance [12,13,25,28], development, preparation and motivation on how to improve the coachee's performance [25]. Parsloe [11] suggests that the coach's role should include, analyzing current performance, planning suitable learning, implementing the plan and evaluating performance. According to Antonioni [10], a coach should also be expert in change, spot strengths and limitations, help to crystallize visions and values, clarify and define strategy, coordinate resources to achieve goals, optimize performance, satisfaction and balance in life and stay accountable to a vision. In other words, a coach can be seen as influencing individuals' personal development and a having an ability to achieve appropriate objectives [9,29]. In the business context, a coach is part consultant and a part motivator, who career-oriented or personal, and often they are both. Unlike a therapist, a coach is more concerned with the future than with the past, with action than with introspection and with how things can happen rather than what they have done so. Unlike a traditional consultant, a coach creates solutions with the client rather than telling him or her, what to do [30]. According to Maher [28] an executive coach can provide insights into current problems and suggest a wide range of options. On the other hand, Smith [29] takes the view that such a coach should help the coachee to think things through, develop structures up on which to base action, monitor the progress in order for the coachee to succeed and keep on the right track, and help to avoid common management pitfalls.

Qualities of an Effective Coach

Discussion will now center on the qualities of the effective coach and in particular, the skills needed. It is important that a coach has 'appropriate qualifications' [10,13,15,31,32]. In the partnership, the coach uses a non-judgmental style and skill of inquiry to help individuals enhance their abilities, knowledge and skills [33]. It is common that the process of learning is achieved through a combination of doing, seeing and hearing [34]. Over-all, there is general agreement that the skills required of a an effective coach are listening skills analytical skills, interviewing skills, effective questioning techniques, observation, giving and receiving performance feedback [22,26,28,35], communicating [15,27,36], setting clear expectations, and creating a supportive environment conducive to coaching [10,29,37,38,39,40,42,43]. Therefore, in some cases, coaches need to develop strategies to help individuals learn how to accept constructive feedback in addition to developing an action plan for improvement [10,22]. For Adler [13] for example, the coach in a musical environment must be a good sight-reader and have the ability to transpose.

According to Maher [28], coaching in the performance of effective leadership can help a company, but requires three distinct types of intelligence in the coach: cognitive, emotional and behavioral. Most company executives have the first type of intelligence. Their innate cognitive intelligence has qualified them to become leaders in the first place. Emotional and behavioral intelligence are rarer and usually need to be developed. Emotional intelligence concerns the development of effective personal and interpersonal styles. Maher describes five components of emotional intelligence that are characteristic of leaders: self-awareness, self-regulation, motivation, empathy and social skills. The third type of leadership intelligence is behavioral intelligence, which concerns the specific actions required to create a vision and translate it into reality. Using

the concepts of emotional and behavioral intelligence provides context for exploring leadership issues and developing skills that would not have come up on their own. For Parsloe [11], the three important skills the coach should acquire are core skills, technical skills and personal skills. Core skills, which are common to mentoring and assessing, include listening, observing, demonstrating and responding to situations. Technical skills are related to each learner being coached using a different coaching styles to fit the performance goals of the learner. Finally, personal skills, which relate to the style and tone of the coach's behavior, include using good communication, giving support, building confidence and empathizing with learners' thoughts and ideas.

Roles of an effective coach

According to Beam [30], a good coach must: (1) have a general sense of what the supervisee wants to work on or clarify expectations; (2) evaluate the personal chemistry; and (3) set an initial timeframe and establish checkpoints along the way to measure progress and make mid course correction. Also, his professional qualifications should be checked. On the other hand, Franklin (2000) states that rather than telling employees how to solve a problem, an effective coach should be available give employees the benefit of his expertise and let those who are self-reliant figure out solutions on their own. A relationship based on thrust must be the foundation of successful coaching [26,44,45,46,47]. Effective coaches must show confidence in the individuals they are coaching, confidence in their knowledge, skills, willingness to learn and willingness to become more effective. A coach must earn the respect of those they work with by setting examples or sharing stories from their own experiences. Before suggesting ideas and sharing experiences with staff members, a coach should have a clear understanding of each individual's knowledge base as well as his or her strengths and skills by conducting observations [26].

According to Frost [15], effective coaches should be measured by looking positive performances, winning teams and successful business organizations. However, Russell [48] disagree with this statement, believing that successful coaches are not necessarily those who are the best players or winning teams, but players should be given the motivational tools to perform at extraordinary levels. Furthermore, Bowers et al. [32] and Zeigler [18] also agree that coaches who are successful are not necessarily effective coaches. There are many other factors involved. Bowers et al. [32] point out that a coach will wither know her area well or will not be ashamed to admit her weakness and learn along with her students in order to be better prepared in the future. Additionally, Franklin [35] states that, in the sports context, the role of the coach is to make maximum use of players' talents. In business, a corporate coach does much the same thing by helping employees develop and use skills in the most effective way. Therefore, the role of both the athletic and corporate coach is to create an environment where there exists challenge and the possibility of personal growth, which allows individuals to achieve their best [35,48]. Evan [49] and Johns et al. [50] propose that the best approach to coaching in sport always involves the concept of 'athlete first, winning second'. This idea of the athlete before winning is also supporter in the philosophical studies of Fry [51] and Rowland [52]+, who contend that a coach must see each athlete as an 'end in themselves' and not just 'a means to an end'.

Summary and Conclusion

There are many models of coaching that can be adapted in TVET and also in the implementing of Competency Based Training (CBT). All have their own vigor, which can be seen by looking at the coaching goals. There were three models that have been discussed in this article: Schons's Three Models, The GROW Model and The Coaching Method Model. Coaching is related to self-development, professional growth and career development of the coachees. The coach's role is to help learners to achieve their goals by acting as counselor, facilitator and advisor. Counseling is an important function in relation to the coaching because it can lead to an improved relationship between the coach and the coachee. It consists of support, feedback, providing counsel, consultation, teaching, evaluation, motivation and the monitoring of professional issues. One of the important functions of a coach is to be role model for the coachee. This view is supported by many authors who have mentioned that the coach is someone who has greater experience and helps less skilled or less experiences practitioners to achieve professional abilities. In order to react effectively, a coach must: (1) have certain goals and plans; (2) be a good communication; (3) have the knowledge and relevant skills about the candidate's area of interest; (4) be able to establish a good and professional relationship; and (5) be flexible in supervision strategies depending on the individual requirements.

In maintaining a good relationship, the coach and coachee must have certain goals or objectives. The relationship will focus on these and both parties must trust, respect, empathize and be honest with each other. An effective coach will have access to a range of teaching and learning methods, and will be able to adapt to individual supervisees and to provide clear and focused feedback to facilitate learning. A good relationship can make both parties comfortable with meeting regularly and sharing ideas or knowledge with a view to coachee development. As a student, one must be eager to learn, enhance ones self-awareness, learn from mistakes and success, develop and apply new skills and design action plans or timetables. In addition, he/she must be diligent, conscientious and hardworking, open to critics, willing to listen to others and to talk openly. Assigning experienced coaches to guide and support coachee provides valuable professional development for both parties. Coaching helps coaches face their new challenges; through reflective activities and professional conversations. Coaching allowed coaches to help others, improve themselves, receive respect, develop collegiaty from the coachees' fresh ideas and energy because the benefits of coaching is career-related and psychosocial.

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O5 - Reducing Multiple Access Interference (MAI) in DS-CDMA System

Banisrekha Mohd Nawi
Pusat Latihan Teknologi Tinggi (ADTEC) Kulim
banisrekha@gmail.com

Abstract

The performance of Direct Sequence Code Division Multiple Access (DS-CDMA) system is limited by Multiple Access Interference (MAI) instead of thermal noise. Multiple Access Interference (MAI) is a type of interference caused by multiple cellular users who are using the same frequency allocation at the same time. A Rake receiver is a scheme that counteracts the MAI problem. As the number of Rake finger increase, the bit error rate (BER) will decrease rapidly and the signal-to-noise ratio will increase. Besides that, the systems that have been done using the finite impulse response (FIR) filter and Recursive Least Square (RLS) filter to reduce the BER and increasing the E_b/N_0. When combined all those techniques, the performance of the DS-CDMA will increased. Simulations result shows that the DS-CDMA system with combined those technique mention above give the lower bit error rates. It means that the MAI have been reduced.

Keywords: DS-CDMA, MAI, Rake receiver, BER, RLS

1. Introduction

For the past few decades, wireless communication has been rising in popularity in many parts of the world. One particular area of interest is the use of the Code Division Multiple Access (CDMA) [1] in the cellular mobile communications. CDMA is a form of spread spectrum techniques [2]. Some of advantages of spread spectrum techniques are multiple-access capability, privacy within channels, interference resistance and anti jamming capability.

DS-CDMA is a method, which enables the users to share the radio frequency (FR) channel to transmit data simultaneously. The DS-CDMA transmitter multiplies each user's by distinct code waveform. The detector receives a signal composed of the sum of all users' signal, which overlap in time and frequency. In a conventional DS-CDMA system, a particular users' signal is detected by correlating the entire received signal with users' code waveform. DS-CDMA systems are generally divided into synchronous and asynchronous systems. In synchronous systems, all users are synchronized at the chip level, i.e. the delays for all users are set to zero. In asynchronous systems, the delays are different for different users. An example of asynchronous systems is Time Division Duplex (TDD) mode and Frequency Division Duplex (FDD) downlink in W-CDMA. An asynchronous system is the FDD uplink in W-CDMA. Since direct sequence waveforms have a wide bandwidth, it is subject to frequency selective multipath fading anytime that bandwidth exceeds the coherence bandwidth of the channel. A Rake receiver can be used to achieve path diversity and hence enhance the system performance.

2. Multiple Access Interference (MAI)

The detector receives a signal composed of the sum of all users' signals, which overlap in time and frequency. The multiple access interference (MAI), which refers to the interference between direct-sequence users in the system, is an impairment factor that limits its capacity and performance. MAI causes degradation in bit error rate (BER) and system performance. There has been a significant amount of research conducted on this subject since it is widely used in wireless communication systems [3] [4] [5]. There are mainly two parameters that contribute to MAI. They are:

- Cross-correlation levels (CCLs)
- "Near-far" problem.

Various efforts have been made to mitigate the effect of MAI [6]. They are as below:

1) Code waveform design
2) Forward error correction (FEC) codes

3) Sectored adaptive antennas

4) Multiuser detection

There are several example of multiuser detector such as:

- Decorrelating detector
- Minimum mean square error (MMSE) detector
- Polynomial expansion detector

5) Interference cancellation based multiuser detection
- Successive interference cancellation
- Parallel interference cancellation
- Decision feedback detectors

6) Adaptive filter
- Recursive Least Squares (RLS) filter
- Kalman filter
- Least Mean Square (LMS) filter

7) Rake receiver

3. Rake Receiver

The design of CDMA gives multi-user access and multipath rejection. The other multi-user air access technologies FDMA and TDMA cannot separate direct waves from delayed waves (i.e. multipath rejection). These delayed waveforms can cause interference; hence a multipath environment is undesirable for receiving signals but also unavoidable. In CDMA system there is propagation delay spread in the radio channel that provides multipath signal at the receiver. If multipath components are delayed in time by more than one chip duration (1/Rc), they appear like uncorrelated noise at a CDMA receiver, and equalization is not required. Thus, the Rake type correlator receiver can be used.

A Rake receiver is a radio receiver designed to counter the effects of multipath fading. It does this by using several sub-receivers each delayed slightly in order to tune into the individual multipath components. Multipath components are practically uncorrelated when their relative propagation delay exceeds one chip period. Each component is decoded independently, but at a later stage combined in order to make the most use of the different transmission characteristics of each transmission path. This could very well result in higher signal-to-noise ratio (or E_b/N_0) in a multipath environment than in a "clean" environment. Rake receivers are common in a wide variety of CDMA and W-CDMA radio devices such as mobile phones and wireless LAN equipment. The basic idea of a Rake receiver was first proposed by Price and Green and patented in 1956.

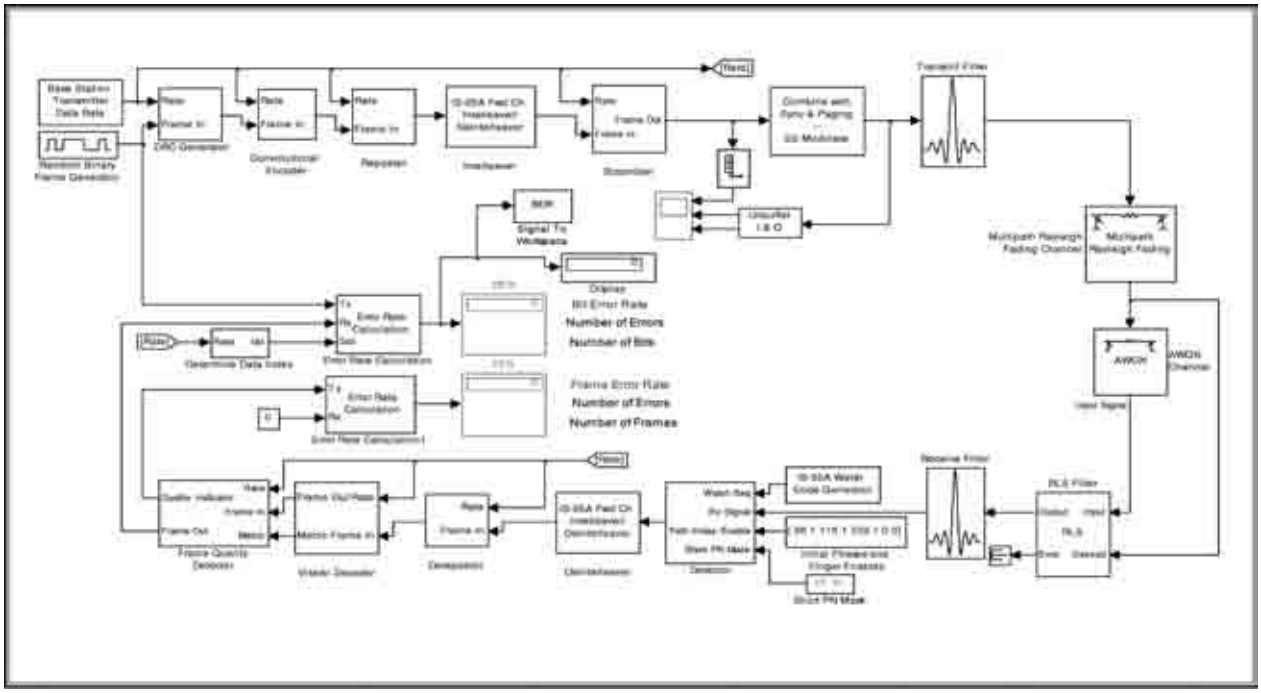

Figure 1. DS-CDMA system using MATLAB/Simulink.

4. System Model of DS-CDMA.

The block diagram of DS-CDMA system that has been modeled using MATLAB/Simulink software.

5. Result and Discussion

In this part, the result of the simulation of the DS-CDMA system that has been done using MATLAB/ Simulink is performed. All the data is precede using Excel. The data from the simulation also can be proceed using Monte Carlo. The simulation of the system is comparing the performance of the system using Rake receiver and the system using Rake receiver combined with RLS filter. The performance of the system is done by changing the parameter such as E_b/N_0, filter length, rate set, data rate and number of rake finger. The performance of the system is looking at the BER of the system. The objective is to achieve lower BER for the system.

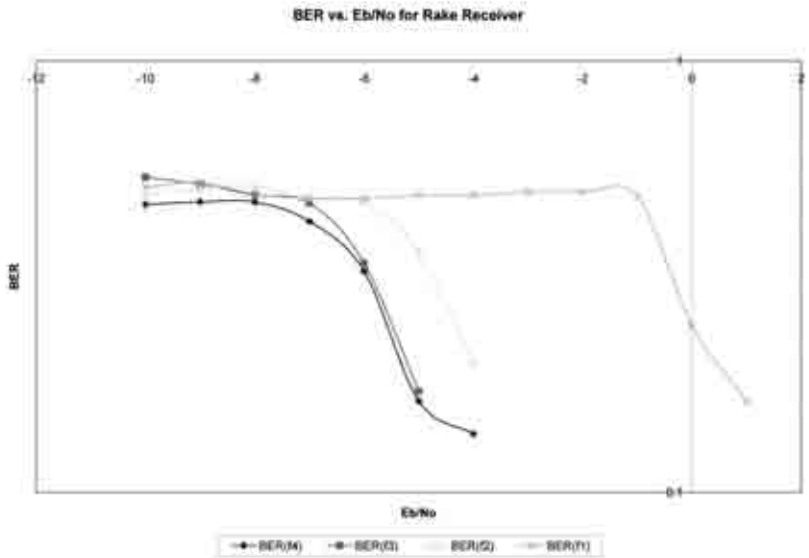

Figure 2. BER versus E_b/N_0 for Rake Receiver

Figure above illustrate the BER performance for various bit energy to noise density (Eb/N0). In this graph, it is considered with rate set I and the system is fully using the Rake receiver i.e. without using the RLS filter. The graph shows that when the BER is low, the Eb/N0 is increase. And when the Rake finger is increase, the performance of the system is improved. The improvement can be seen that the SNR is increase when the rake finger is increase. Or the BER is decrease when the finger is increase from finger one to finger four.

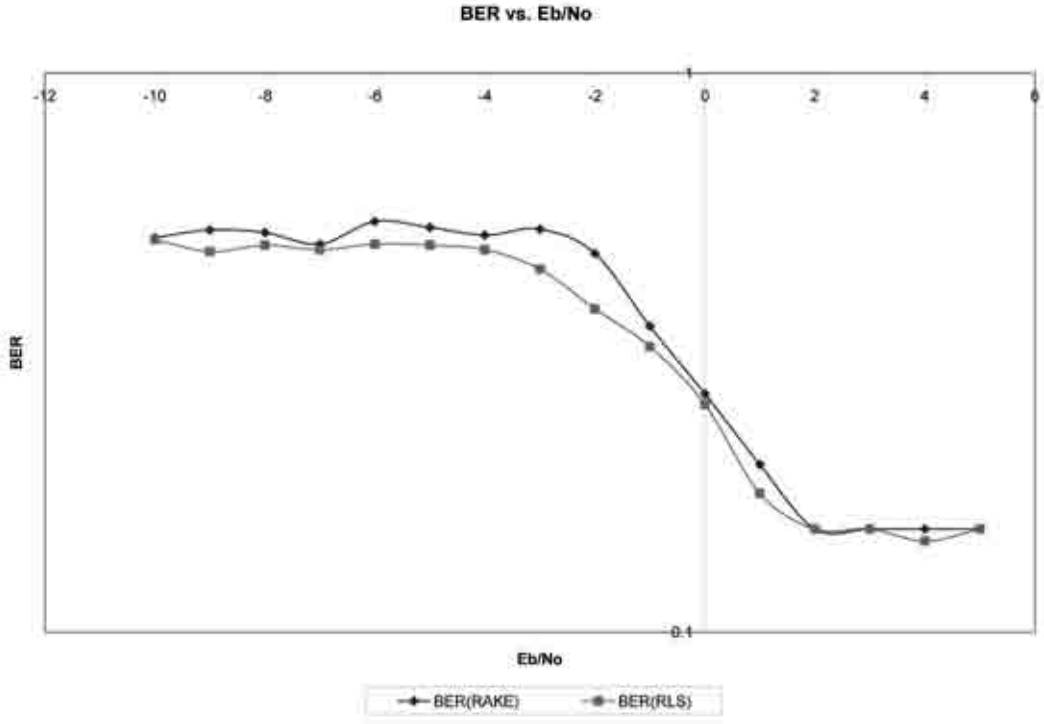

Figure 3 BER versus Eb/N0 for system with Rate Set II

The graph above show the comparison of the system with Rake receiver and the system with Rake receiver combined with RLS filter. The finger rake of the Rake receiver is set to four. This graph is to show the performance of the system when working on rate set II. The filter length of the RLS filter is 15. The performance of them is equally the same but the BER for system with RLS is lower than the system only having Rake receiver.

6. Conclusion and Future Work

After doing the simulation, the result was able to reduce the bit error rate up to 10^{-6} dB as expected. The result obtained is expected as the simulation model work. The performances of the system model perform very excellent as the signal-to-noise ratio of the system is very high for lower bit error rate. In this study was able to differentiate between the performance of the system model using only Rake receiver and the system using Rake receiver combined with RLS filter. The Rake receiver combined with RLS filter provided better performance than just Rake receiver. Actually, both of RLS filter and Rake receiver provided best performance of all the different structure. The performance can be seen by the data obtain from the simulation of the system. The results of the simulations clearly show that the Rake receiver and RLS filter provides better BER performance that a Rake receiver for almost conditions.

From the researches, multiuser detector can give better performance in order to reduce MAI in the DS-CDMA system. The Minimum Mean Square Error (MMSE) correlator is the one which is very effective in order to reduce MAI. So, in the future the MMSE correlator combined with Rake receiver can be model in DS-CDMA system to obtain great BER performance [7].

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O6 - Perancangan Dan Implementasi Model Pembelajaran LMS Untuk Meningkatkan Kualiti Pembelajaran Di ILJTM Khususnya Di ADTEC Kulim

Mohd Norhisham Maznan
Pusat Latihan Teknologi Tinggi Kulim
mohdnorhishammaznan@yahoo.com

Abstrak

Teknik pengajaran cara lama perlu dipertingkatkan oleh pelatih kemahiran di ILKA.Peningkatan teknologi ICT telah mengasimilasikan pengajaran lama ke pada cara baru yang mana memudahkan para pelatih kemahiran bukan saja menumpukan perhatian secara sepenuhnya didalam kelas atau makmal. Peningkatan kemudahan ICT seperti kemudahan web 2.0 telah memeperkenalkan satu perisian pembelajaran secara internet web based.Perisian percuma ini membolehkan pengajar dan pelajar berinteraksi antara satu sama lain dengan menggunakan kemudahan perbincangan secara online.Disamping itu juga pengajaran akan jadi lebih mudah dengan adanya kemudahan E_WIM,E_SOALAN dan Kemudahan pengajaran pelajar dan subjek didalam perisian ini.Perisian ini dinamakan seperti "Learning Management System Online" ADTEC LMS.Teknik pembelajaran ini di uji cuba di ILJTM khasnya ILKA untuk membolehkan para pelatih kemahiran untuk memantapkan lagi ilmu dari segi teori dan amali dengan kaedah pemusatan data pengajaran secara online.LMS menjadi rujukan kedua ILJTM bagi memboleh pelatih kemahiran meningkatan pengetahuan dan khususnya menjadi sumber rujukan utama untuk pelatih kemahiran.

***Kata kunci** : e-learning, pembelajaran, web, internet, moodle.*

1. Pengenalan

Trend pendidikan kemahiran semasa dan akan datang adalah berfokuskan kepada aplikasi teknologi Internet dalam carian dan akses maklumat. Teknologi Internet ini telah membuka dimensi baru dalam pendekatan pengajaran-pembelajaran kerana keupayaannya membekalkan sumber maklumat yang pelbagai menggunakan enjin pencari dan enjin direktori yang efisyen (Sonnenreich, 1998). Selari dengan perkembangan pesat teknologi Internet, konsep E- Pembelajaran telah diperkenalkan yang kemudiannya telah membuka dimensi baru dalam pendekatan pengendalian pengajaran dan pembelajaran di institusi pendidikan. Sistem Pengajaran Pembelajaran berasaskan-web merupakan program aplikasi Internet yang pesat digunakan oleh syarikat-syarikat perisian komputer dan institusi pendidikan sebagai infrastruktur kepada perlaksanaan program E-Pembelajaran. Sistem ini berkembang dengan cepat dan digunakan dengan meluas sebagai sistem maklumat dan sistem pangkalan data untuk mendidik dan mengendalikan aktiviti pengajaran dan pembelajaran dalam bidang kemahiran.

1.1 Stail Pembelajaran Dan Teknologi Maklumat

Beberapa kajian mengenai aplikasi Teknologi Maklumat dan Komunikasi (TMK) dalam pendidikan kemahiran menunjukkan perkembangan TMK dan teknologi Internet tidak memberi kesan menyeluruh kepada pendidikan kemahiran dan hanya memberi impak yang minimal kepada proses pembelajaran (Kozma, 1994). Walaupun teknologi multimedia diintegrasikan dalam pembangunan bahan pengajaran berasaskan-komputer, penggunaannya hanyalah sebagai 'penghias' kepada antara muka dan tidak berfungsi sebagai inti yang dapat membantu meningkatkan pengajaran. Persoalannya mengapakah ini boleh terjadi? Adakah pengajar tidak kreatif dalam merancang pengajaran berkonsepkan "technology-rich learning environment" ?atau pengajar tidak dapat mengaplikasikan strategi, teknik dan pendekatan pengajaran dalam bilik kuliah ke dalam bahan pengajaran berasaskan-komputer kerana pengajar tidak diberikan garis panduan yang jelas dan lengkap tentang aplikasi TMK dalam penghasilan bahan pengajaran berasaskan-komputer? Persoalan tersebut lebih menjurus kepada pembangunan bahan pengajaran yang tidak berfungsi dengan baik. Bagaimana pula dengan pelajar yang terlibat sebagai objek yang akan menentukan pencapaian pembelajaran? Adakah pengajar telah mengenalpasti tahap pembelajaran dan stail pembelajaran pelajarnya? Kajian terkini menunjukkan stail pembelajaran pelajar banyak mempengaruhi hasil pembelajaran. Mengikut Hossein Arsham (2002), untuk menjayakan pengajaran dan pembelajaran berasaskan komputer, bahan pengajaran perlulah dirancang

bagi mengwujudkan persekitaran yang membolehkan pelajar dan pendidik terlibat secara aktif dalam proses pembelajaran. Pengajaran akan membosankan jika pendidik tidak memahami stail pembelajaran yang berbeza bagi setiap individu. Mengikut Carbo (1986) dan Campbell & Campbell (1999), pelajar menjadi lebih bermotivasi, beriniasiatif dan meningkatkan tahap pembelajaran jika pengajar menyampaikan pengajaran selari dengan stail pembelajaran pelajar tersebut. Dalam pengajaran bersemuka di bilik kuliah, adalah agak sukar bagi pendidik mengesan dan memenuhi kesemua stail pembelajaran yang diamalkan oleh pelajarnya. Untuk memenuhi stail pembelajaran yang berbeza, Schweizer (1999) dan Nelson(2001) mencadangkan TMK digunakan kerana peluang pembelajaran berkesan boleh dicetuskan dengan penggunaan teknologi ini. Penggunaan TMK yang terancang akan menghasilkan pelajar yang mempunyai ciri-ciri berikut:

1. Pelajar yang lebih bertanggung jawab terhadap pembelajarannya
2. Pelajar yang boleh menentukan keperluan bahan untuk pembelajarannya
3. Pelajar bebas melakukan carian maklumat mengikut keperluan, tahap pencapaian dan pengetahuan.
4. Pelajar yang akan membina pengetahuan baru berasaskan kepada carian maklumat, komunikasi dua hala dan penemuan kendiri.

Di Malaysia, perancangan untuk memenuhi keperluan kepada memenuhi stail pembelajaran yang berbeza telah diperkenalkan melalui projek Sekolah Bestari. Prinsip pembelajaran ini menekankan kepada empat domain pembelajaran iaitu Self-Directed, Self-Access, Self-Assess dan Self-Paced.

I. Self Directed adalah pembelajaran terarah kendiri di mana pelajar akan menentukan sendiri tajuk dalam sesuatu bidang yang ingin dipelajari.

II. Self Access adalah pembelajaran akses kendiri di mana pelajar mencari dan mendapatkan maklumat mengenai tajuk yang ingin dipelajari daripada pelbagai sumber bukan pengajar. Buku rujukan, majalah, CD-ROM, internet atau secara ‘live’ digunakan untuk mendapatkan maklumat.

III. Self Assessed adalah pembelajaran kadar sendiri di mana pelajar membuat penilaian atau penaksiran sendiri mengenai tajuk yang dipelajarinya, adakah dikuasai atau tidak. Seandainya pelajar tersebut telah menguasai tajuk tersebut maka pelajar itu akan beralih ke tajuk lain.

IV. Self-Paced adalah pembelajaran langkah demi langkah mengikut kadar sendiri. Pembelajaran ini memberi ruang kepada pelajar untuk memantau progress pembelajaran diri.

Persoalannya bagaimanakah pengajar mengendalikan aktiviti pengajaran untuk mencapai matlamat pembelajaran bestari jika tiada satu sistem yang boleh mengesan dan mengenalpasti perkembangan pembelajaran pelajar. Institusi pendidikan perlu mempunyai infrastruktur dan persekitaran pembelajaran berbantukan-komputer untuk mencapai matlamat ini.

1.2 Infrastruktur Dan Infostruktur Teknologi Maklumat

Infrastruktur teknologi maklumat merujuk kepada persekitaran sokongan yang disediakan bagi membolehkan pengajaran pembelajaran berbantukan-komputer atau pembelajaran dan pembelajaran atas-talian dijalankan. Infrastruktur teknologi maklumat yang lengkap perlu bagi memastikan kejayaan perlaksanaan pengajaran dan pembelajaran berasaskan-komputer. Pengajar dan pelajar memerlukan terminal komputer yang mencukupi, sistem rangkaian yang menyeluruh dan server yang berfungsi sepanjang masa untuk menjamin pengajaran dan pembelajaran berasaskan-komputer berjalan dengan lancar. Pelajar yang menggunakan bahan pengajaran berasaskan-komputer merupakan pelajar autonomous sendirian (autonomous self- learners) adalah pengguna yang bergantung kepada kemudahan TMK untuk mengakses bahan pembelajaran. Pengajar memerlukan perisian komputer yang sesuai dan mudah bagi membantu membina bahan pengajaran elektronik.

Keberkesanan pengajaran berasaskan-web merujuk kepada kebolehan pelajar mengakses dan belajar dari bahan yang disediakan. Jika infrastruktur TMK tidak lengkap dan tidak efisyen, pengajar dan pelajar tidak dapat menjalani pengajaran dan pembelajaran dengan baik dan pelaksanaan e-pembelajaran akan gagal. Berasaskan kepada keperluan ini, Projek Sistem Jaringan ADTEC Kulim mula dilaksanakan pada tahun 2007. Projek ini melibatkan proses membekal, mengha ntar, memasang, menguji, mentauliah dan mendokumentasikan perkakasan dan perisian yang menyokong kepada sistem teknologi maklumat dan komunikasi. Infrastruktur Sistem Jaringan ADTEC Kulim termasuklah kemudahan sistem rangkaian setempat dan kemudahan talian

suwa (Bahagian Pendidikan Pengajar, 2002).Infrastruktur yang disediakan boleh meningkatkan keberkesanan dan kecekapan pembelajaran berasaskan kepada prinsip pembelajaran bestari. Kaedah pembelajaran terarah kendiri, akses kendiri dan kadar kendiri boleh digunakan dengan mengakses bahan-bahan pengajaran dan pembelajaran melalui laman web dan perisian kursus secara interaktif. Pengajaran dan pembelajaran berasaskan Internet dan Intranet perlu diperluaskan secara menyeluruh dan bersepadu di institusi perpengajaran di Malaysia bagi tujuan menyediakan pengajar-pengajar yang mahir dalam kemahiran ICT dalam E-Learning.

Menyediakan kemudahan infrastruktur TMK sahaja tidak akan memberikan impak kepada pendidikan jika pengajar tidak menggunakan kemudahan ini semasa pengajaran dan pembelajaran. Untuk memanfaatkan TMK, pengajar perlu mahir dalam merekabentuk bahan pengajaran secara elektronik menggunakan perisian tertentu dan perlu memahami jenis komunikasi yang sesuai untuk digunakan sebagai persekitaran pengajaran dan pembelajaran. Pengajar perlu merangka program pembelajaran interaktif dalam bahan pengajarannya kerana TMK menawarkan elemen interaktif menggunakan aplikasi tertentu. Secara umumnya, persekitaran interaktif ditentukan oleh pendekatan yang digunakan semasa menyampaikan bahan pengajaran kepada pelajar. Mengikut Hossein Arsham(2002), pengajaran interaktif adalah merujuk kepada pendekatan pengajaran menggunakan bahan pengajaran berasaskan- web supaya dapat mengwujudkan persekitaran yang menggalakkan penyertaan maksimum pelajar sesama pelajar dan pelajar dengan pengajar. Pendekatan yang sering digunakan termasuklah berkongsi idea secara dua hala secara serentak antara pengajar dengan pelajar menggunakan bilik sembang maya dan komunikasi sehala dengan pelajar menghantar pertanyaan tentang sesuatu perkara yang sukar difahami melalui papan buletin, ruangan forum dan mel elektronik. Pendekatan sehala merupakan peringkat interaktif yang polular digunakan dalam kebanyakan kursus berasaskan-web (Hossein Arsham, 2002). Penghasilan bahan pengajaran interaktif bergantung kepada rekabentuk antara muka yang digunakan.

Rekabentuk antara muka yang berkesan mempunyai tiga sifat iaitu:-

i) Bahan pengajaran mudah diakses
ii) Bahan pengajaran berfungsi dengan baik
iii) Bahan pengajaran dapat menjelaskan sesuatu konsep atau idea.

1.3 Sistem Pengajaran Pembelajaran

Bahan pengajaran interaktif yang disediakan oleh pengajar perlu diuruskan dengan cekap, sistematik dan berkesan bagi memaksimumkan penggunaannya dalam pembelajaran. Oleh itu, sistem yang boleh menguruskan aktiviti dan bahan pengajaran diperlukan. Sistem tersebut dikenali sebagai Sistem Pengajaran Pembelajaran atau "Learning Management System (LMS)" . Secara umumnya perisian LMS adalah kemudahan infrastruktur untuk merancang, menghantar dan menguruskan program E-Pembelajaran menggunakan format yang telah tersedia atau memilih format masa depan (Evangelisti, 2002). Mengikut American Society for Training & Development (ASTD, 2002), perisian LMS perlu mempunyai ciri-ciri berikut:

a. Sistem yang boleh menyokong pelbagai prinsip pembelajaran
b. Sistem yang dapat diintegrasikan dengan Sistem Maklumat Sumber Manusia
c. Sistem yang berperanan mentadbir aktiviti pengajaran

E-Learning Centre's (eCLIPSE, 2002) telah mengenalpasti sepuluh modul yang diperlukan dalam perisian LM S. Modul-modul tersebut adalah seperti berikut:

i. Modul Pengajaran Kursus
ii. Kemudahan animasi dan demonstrasi bahan pembelajaran atas-talian
iii. Pengujian dan Penilaian interaktif atas-talian
iv. Forum dan Diskusi
v. Perisian Perbincangan Berkumpulan (Groupware)
vi. Modul mesyuarat atas-talian (Windows NetMeeting)
vii. Kemudahan perkhidmatan komuniti atas-talian

viii. Ruangan Chat

ix. Modul bagi menjana pembelajaran secara kolaborasi

x. Modul mengesan aktiviti pembelajaran (Weblogging)

Terdapat beberapa modul LMS di atas yang telah digunakan dan diintegrasikan dalam laman web seperti modul komuniti atas-talian yang mengandungi kemudahan forum, message board dan bilik chat (World Crossing, 2002).

2. Model Sistem Pengurusan Pembelajaran ADTEC Kulim (*ADTEC Kulim Learning Management System* (*ADTEC LMS*))

2.1 Visi Dan Misi ADTEC LMS

ADTEC LMS adalah program yang dibangunkan untuk memenuhi keperluan E-Pembelajaran bagi pelajar di Institut Latihan Kemahiran. Sistem pengajaran Pembelajaran ADTEC LMS dirancang selari dengan misi, visi, matlamat, objektif dan nilai yang digariskan oleh Jabatan Tenaga Manusia iaitu menjadikan pendidikan kemahiran bertaraf dunia melalui pengintegrasian TMK dalam pengajaran dan pembelajaran secara e-pembelajaran. Pembangunan ADTEC LMS adalah untuk memenuhi visi ke arah memantapkan E-Pembelajaran dalam latihan pengajaran dengan pengintegrasian pengajaran pengetahuan kearah satu sistem pengajaran Pembelajaran yang efektif.

2.2 Pembangunan ADTEC LMS

ADTEC LMS dibangunkan oleh pensyarah di Pusat Latihan Teknologi Tinggi Kulim (ADTEC) menggunakan perisian 'Open Source'. Idea pembangunan program ADTEC LMS berasaskan kepada trend pembelajaran terkini adalah berasaskan E-Pembelajaran, keperluan kepada sistem yang boleh mengajar aktiviti pembelajaran secara elektronik dan keperluan kepada sistem yang boleh mengesan pengetahuan, kemahiran dan kompetensi pengajar pelatih dalam latihan pengajaran. ADTEC KULIM telah mengenalpasti ADTEC LMS sebagai model generik pengajaran pembelajaran berasaskan fungsi dan keupayaan ADTEC LMS sebagai aplikasi berasaskan-web yang mampu menghasilkan pembelajaran elektonik, mengesan hasil pembelajaran, integrasi dengan sistem pengajaran sumber manusia dan sumber pembelajaran, pembinaan bahan pengajaran untuk diedarkan atau diterima daripada pelajar dan kemudahan fitur pengajaran penilaian ke arah pemantapan pembelajaran bestari.

2.3 Modul ADTEC LMS

Terdapat empat modul dalam ADTEC LMS. Modul ini menyediakan kemudahan berikut:

i. Bahan kursus dimuat turun oleh pelajar bagi membolehkan prinsip pengajaran kendiri dijalankan.

ii. Kerja kursus disebarkan oleh pensyarah menggunakan pengumuman atau melalui kemudahan e-mail berdaftar.

iii. Kemudahan menghantar kerja kursus kepada pensyarah dan sistem mengesan dan mengesahkan tarikh menghantar kerja kursus.

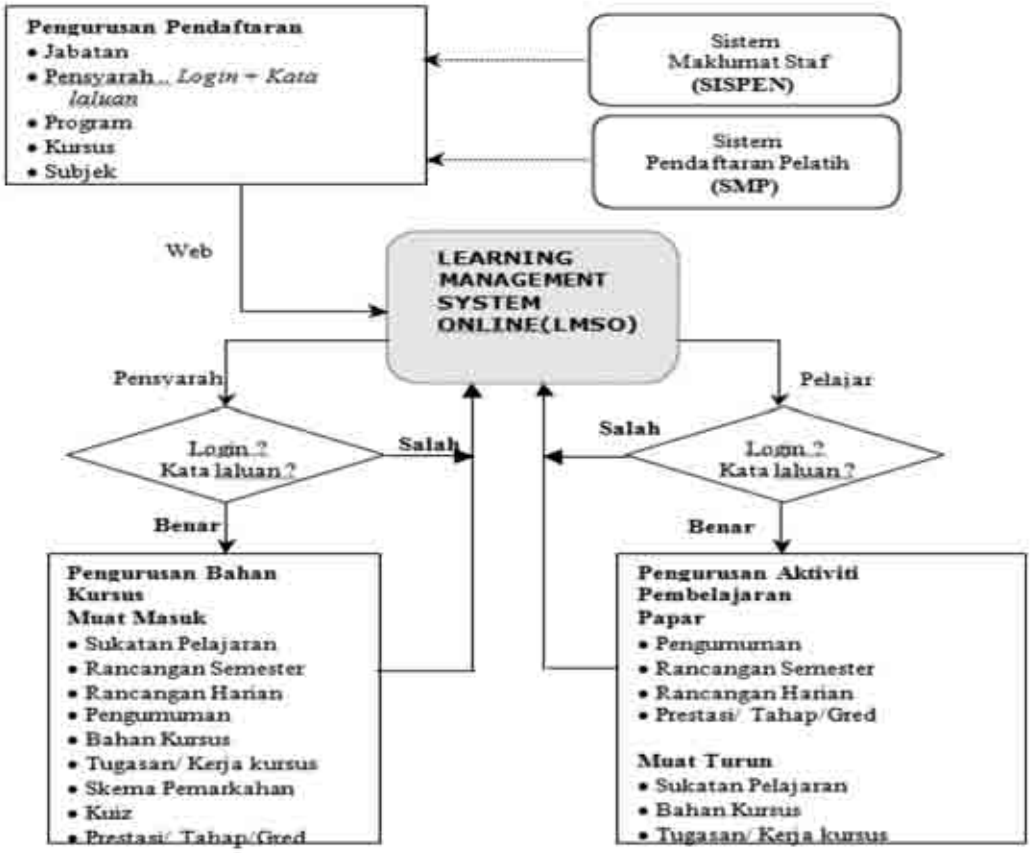
iv. Kemudahan Peperiksaan secara online.

2.4 Strategi Pelaksanaan ADTEC LMS

Pelaksanaan ADTEC LMS dalam latihan perpengajaran adalah berasaskan kepada konsep pembelajaran "Blended-Learning" (B -L). B-L adalah gabungan pembelajaran bersemuka (Face-to-Face, F2F), pembelajaran Berasaskan-Projek, pembelajaran secara praktikum dan pembelajaran berasaskan-komputer dan web. Dalam pendekatan B-L, pembelajaran tidak dilaksanakan sepenuhnya atas-talian sebaliknya program ADTEC LMS digunakan semasa pengajaran F2F.

Model LMSO Ver 1.0

Rajah 1 di bawah menunjukkan aliran data dan proses yang terdapat dalam LMSO.



Rajah 1 : Model LMSO Versi 1.0

2.5 Ujian Rintis ADTEC LMS 1.0

Konsep ADTEC LMS telah dibentangkan dalam Mesyuarat Pembangunan Latihan ADTEC Kulim dan telah menjalani tiga kali ujian rintis. Butiran lengkap tentang ujian rintis adalah seperti berikut:

2.6 Responden

Semua modul dalam *ADTEC LMS* telah diuji oleh pensyarah dari Jabatan Latihan, ADTEC KULIM. Pensyarah yang terlibat mendaftarkan pelajar bagi subjek yang ditawarkan untuk program Kursus Jabatan Elektronik ambilan Januari 2010. Sejumlah 108 orang pelajar terlibat dalam ujian rintis ini.

Program	**Kursus**	**Bilangan**	**Jumlah**
Kursus Jabatan Elektronik	Bahagian Elektronik	108	108
Jumlah			**108 orang**

Jadual 1: Pecahan Bilangan Pelajar yang terlibat dengan ujian rintis ***ADTEC LMS***

Pensyarah yang terlibat dalam ujian rintis memuat masuk bahan pengajaran , bahan penilaian dan maklumat aktiviti pengajaran mengikut sukatan yang telah ditentukan oleh Jabatan Teknologi Elektronik. Bahan pengajaran digunakan oleh responden ketika berlakunya sesi pengajaran dan pembelajaran dan selepas waktu kuliah. Pelajar memuat turun bahan pengajaran dari pelayan ***ADTEC LMS*** untuk tujuan ulangkaji di luar waktu pembelajaran resmi di ADTEC KULIM.

2.7 Spesifikasi Teknikal

Sebuah buah makmal komputer digunakan untuk ujian rintis. Setiap makmal mengandungi 25 terminal komputer rangkaian LAN dan disambungkan ke talian Internet. Perisian ADTEC LMS dan bahan pengajaran pembelajaran ADTEC LMS ditempatkan dalam server yang sama. Tujuannya supaya mudah diakses oleh pengguna dan diuruskan oleh pentadbir program. Sumber sokongan diperlukan untuk memantapkan lagi pengajaran dan pembelajaran menggunakan program ADTEC LMS. Berikut adalah spesifikasi teknikal bagi keperluan server untuk pembangunan ADTEC LMS:

- Komputer dengan Pemproses Pentium 4 Xeon
- Ingatan Utama 1GB RAM atau lebih
- Network Interface Card
- Kabel UTP Cat 5 untuk disambungkan ke sistem rangkaian ADTEC Kulim
- Sistem Operasi Microsoft Window 2003 Server
- Microsoft ODBC
- MySQL ODBC (Open source)
- Apache 1.3 (Open Source)
- PHP 5.0 (Open source)
- MySQL 3.2.3 atau lebih tinggi (Open source)
- Browser Internet Explorer 7
- macromedia Dream Weaver
- Microsoft Frontpage

Ujian rintis yang dilaksanakan di makmal pula menggunakan komputer yang sedia ada di dalam makmal yang mempunyai sambungan ke rangkaian komunikasi kampus (Intranet) dan/atau sambungan ke Internet. Setiap komputer ini dilengkapi dengan perisian Browser Internet Explorer 7.

3. Penutup

Perkembangan pesat latihan dan pendidikan atas-talian memerlukan pemantapan kepada sistem pengajaran pembelajaran. Bagi mencapai matlamat ini, ADTEC LMS akan dikemaskinikan mengikut kehendak pendidikan semasa. Untuk menjayakan pelaksanaan B-L beberapa kemudahan infrastruktur dan infostruktur perlu dipertingkatkan. Berikut adalah beberapa cadangan untuk tujuan tersebut:-

1. Menambah kuantiti bahan pembelajaran dan mempelbagaikan sumber pembelajaran di mana setiap pensyarah perlu menyediakan bahan pengajaran berbentuk elektronik dan media pengajaran berasaskan-web.
2. Pensyarah juga perlu merancang strategi pelaksanaan aktiviti pembelajaran untuk dilaksanakan dalam pengajaran F2F.
3. Menyediakan kemudahan untuk pembelajaran atas-talian dengan menyediakan makmal ICT yang boleh diakses melampaui masa resmi pengajaran dan menyediakan studio kajian dan studio simulasi berteknologi tinggi.
4. Menambah kemudahan dalam ADTEC LMS supaya boleh dikembangkan penggunaannya dalam persekitaran sistem rangkaian Intranet dan Internet, menyediakan modul yang membolehkan pelajar berkomunikasi dengan pengajar melalui e-mail, Bulletin board, Chat room dan Discussion board.
5. ADTEC LMS juga akan diintegrasikan dengan sistem penilaian berasaskan- komputer dan soal-selidik atas-talian membolehkan pelajar mengenalpasti dan menentukan keperluan pembelajaran mereka.

Isu pelaksanaan juga perlu dipertimbangkan. Di antara isu yang sering terdapat dalam pelaksanaan E-Pembelajaran adalah:

i. Bahan pengajaran tidak dapat dicapai kerana gangguan teknikal dalam makmal komputer.
ii. Keselamatan dan kerahsiaan data
iii. Penyenggaraan komputer dan sistem rangkaian
iv. Khidmat kepada pengguna

4. Rujukan

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O7 - Properties Of Compatibilized Linear Low Density Polyethylene (LLDPE)/ Organophilic Modified Montmorillonite (OMMT) Nanocomposites Prepared By Melt Intercalation

M.A.A. Taib[a], R. Mat Taib[b]

[a]Department of Advanced Materials, Advanced Technology Training Centre (ADTEC) of Taiping,Manpower Department, Ministry of Human Resources, [b]School of Materials & Mineral Resources Engineering, University Science of Malaysia.

[a]mustaffa@adtecprk.gov.my, [b]razaina@eng.usm.my

Abstract

Nanocomposites of linear low density polyethylene (LLDPE)/organophilic modified montmorillonite (OMMT) were systhesized by melt compounding using maleic anhydride grafted polyethylene (MAPE) as a compatibilizer to improve compatibility. The blends were compounded in ThermoHaake internal mixer. X-ray diffractometer is used to identify the nanocomposite structures. The XRD results suggested that the intercalated structure was formed in LLDPE/OMMT nanocomposite systems. Tensile test were performed to evaluate mechanical properties while morphological study, TGA and DSC were also carried out to characterize the nanocomposites. The nanocomposites exhibit slightly improved thermal stability and slightly enhanced the crystallization temperature, degree of crystallinity and melting temperature as compared to pure LLDPE. Increased filler loading, slightly enhance the tensile strength at 1wt. % filler loading.

Keywords: LLDPE/OMMT Nanocomposites.

1. Introduction

Polyethylene is a thermoplastic material composed of ethylene [1] which is a low energy materials and a non-polar polymers group [2,3]. Low density polyethylene (LDPE) is one type of polyethylene while linear low density polyethylene (LLDPE) is a recent development, manufactured by copolymerizing ethylene [1]. But, it is difficult to produce this low energy materials such as polyethylene interact only weakly with mineral surfaces, making the synthesis of polyolefin nanocomposites by melt compounding considerably more difficult. So, chemical modification of this resins, in particular the grafting of pendant anhydride groups [2] as a compatibilizer is added to the matrix to improve its polarity [4]. Maleic anhydride polyethylene (MAPE) is used as a compatibilizer, to achieve exfoliation [5]. A small amount additional of maleic anhydride grafted polyolefin improved the miscibility with polyolefin base [6]. The polar character of the anhydride causes affinity to the clay fillers and it can serve as a compatibilizer between the matrix and filler. The techniques that will be used to prepare nanocomposite is melt intercalation. Melt intercalation is to enable the layered silicate mixed with the polymer matrix in the molten state [7]. It is effective whenever the thermodynamics of the melted polymer/organo-clay pair allows the chains to crawl within the clay interlayer spaces, so pushing the individual sheets apart one from each other [8]. The present paper reports the structure and properties of LLDPE/organo-montmorillonite nanocomposites compatilized with MAPE by the melt intercalation method.

2. Experimental

2.1 Raw materials

LLDPE is used as a matrix material, which produced by Eastern Petrochemical Company a.k.a “Sharq Petrochemicals”. Organophilic modified montmorillonite (OMMT) is supplied by Nanocor Inc. Company with trade name of Nanomer® 1.30T. Maleic anhydride polyethylene (MAPE) is acquired from Dupont Packaging & Industrial Polymers with trade name of Fusabond® E MB226D used as a compatibilizer.

2.2 Preparation of masterbatch

OMMT nanoclay powder that has been dried in the oven at 100°C for 3 hours and MAPE compatibilizer pellet were melt-blended at 190°C by using ThermoHaake, 50 rpm of rotor speed for 10 minutes to obtain a pre-intercalated compound called masterbatch. The addition of OMMT nanoclay into internal mixer chamber were added at the 4th minute after the addition of MAPE. Ratio of OMMT to MAPE is 1:1 (20g OMMT: 20g MAPE). After compounding, the samples will be processed by two roll mill to form into sheets, then cut into a small pieces like pellet form.

2.3 Preparation of LLDPE/OMMT nanocomposites

ThermoHaake internal mixer is used to prepare the nanocomposites. The chamber temperature is 190°C. The rotor speed is 50 rpm. After compounding process, the samples will be processed into flake form by two roll mill, molded by hot press and cold press process.

2.4 Characterization

The XRD: Wide angle X-ray diffraction (WAXS), D500 diffractormeter (Siemens), CuKα radiation (0.1542 nm wavelength), Ni filter, 30kV, 30mA, scanning rate 1°/min, 2θ (1-10°).
DSC analysis is carried out using a Perkin Elmer Pyris 6 DSC. The sample was first heated from 30-200°C (1st endotherm), at 10°C/min, under nitrogen atmosphere, held for 1 minute, cooled down at 10°C/min, held for 1 minute, reheated at 10°C/min from 30-200°C (2nd endotherm).

Thermogravimetric analysis (TGA) is conducted by Perkin Elmer Pyris 6 TGA from 30°C to 600°C, at 20°C/min in nitrogen atmosphere.

Morphology of sample surfaces after tensile test is examined by scanning electron microscope, Zeiss Supra 35 VP. The sample was tested under vacuum condition by using 10kV of voltage. The sample will be coated with a thin layer of Pd-Au by using sputter coater for about 30 minutes. After that, the samples will be attached on aluminum plate using carbon tape.

The tensile test is carried by Instron machine; model No.1501, at room temperature according to the ASTM D638 of testing standard.

3. Results and Discussion.

3.1. Structure analysis of nanocomposites.

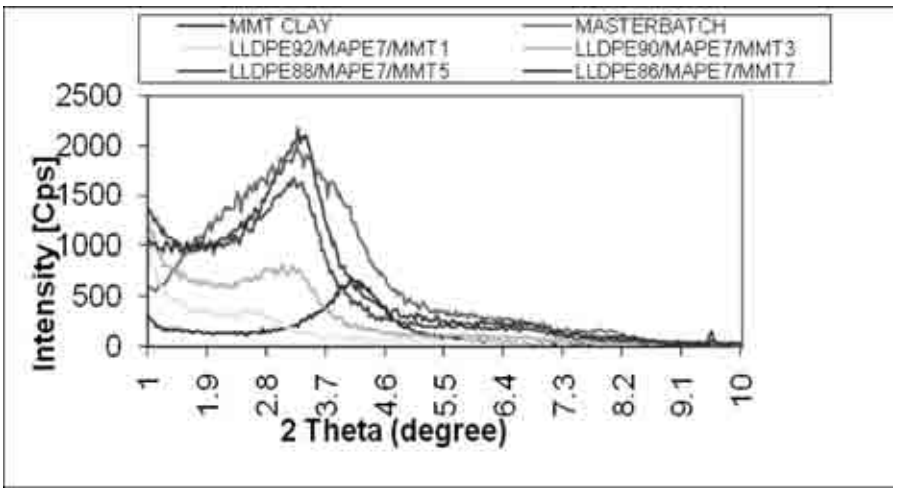


Figure 1:X-Ray diffraction patterns of OMMT, masterbatch and LLDPE/OMMT nanocomposites with various amount of organoclay.

Figure 1 shows the X-ray diffraction patterns of OMMT, masterbatch and LLDPE/OMMT nanocomposites. The X-ray pattern shows clearly that the interlayer spacing increases in size after the additional of MAPE compatibilizer and LLDPE compared to OMMT. The results of interlayer spacing are summarized in Table 1.

Table 1: Comparison of the XRD derived interlayer spacing for OMMT, masterbatch and nanocomposites system calculated according to Figure 1.

Sample	OMMT	Masterbatch	92/7/1	90/7/3	88/7/5	86/7/7
d-spacing (nm)	2.134	2.720	3.446	2.713	2.713	2.641

For nanocomposite systems, the X-ray diffraction peaks are shifted to lower angles, indicating the increase in interlayer spacing by the intercalation of polymer. The interlayer spacing increases progressively, from 2.720 nm for masterbatch system to 3.446 nm for 1wt% of filler loading and reduced in the range of 3-7% of filler loading.

The purpose of masterbatch in nanocomposites preparation is to optimize the interaction between OMMT clay and MAPE compatibilizer and to avoid material loss during compounding. On the other hand, it will produce preintercalated compound.

3.2. Crystal structure and crystallization behavior

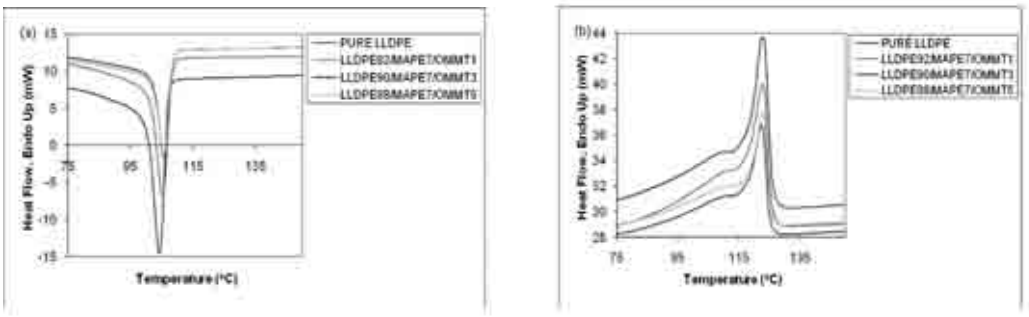


Figure 2:DSC of LLDPE and LLDPE/OMMT nanocomposites (a) curves of cooling, (b) curves of heating. Rate of cooling and heating are both 10°C/min.

Representative melting temperature (T_m) is presented in Figure 2 (a) while crystallization endotherms and degree of crystallinity are presented in Figure 2 (b) for LLDPE and LLDPE/OMMT nanocomposites. It showed that the peak of crystallization temperature of all nanocomposites was slightly higher than pure LLDPE and the T_c values are shown in Table 2. The effect of OMMT on the crystallization temperature behavior of LLDPE during heating and cooling is examined by DSC as shown in Figure 2(b) and Table 2.

Table 2: DSC results of LLDPE and LLDPE/OMMT composites.

sample	T_c (°C)	T_m (°C)	Crystallinity(%)
LLDPE	104.020	112.706	22.37
92/7/1	105.492	122.742	23.77
90/7/3	105.433	122.434	24.50
88/7/5	105.932	122.757	21.17

Table 2 shows that adding OMMT will slightly increase T_c, slightly increase the sharpness of crystallization peak, and decrease the half peak width. The nanocomposite of LLDPE/OMMT gives slightly higher crystallization temperature.

According to Table 2, the crystallization temperature and degree of crystallinity of the nanocomposites are slightly increased comparing with pure LLDPE except at 5wt. % of OMMT, it showed slightly decreased in degree of crystallinity. The degree of crystallinity at 5wt. % decreased might be cause by the selection of sample for testing is not representative.

The melting temperatures for LLDPE/OMMT nanocomposites are increased with the clay content and slightly higher than pure LLDPE.

3.3. Thermal properties

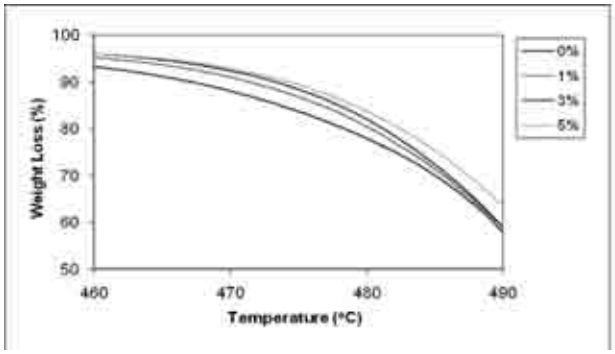


Figure 3: TGA of pure LLDPE and LLDPE/OMMT nanocomposites.

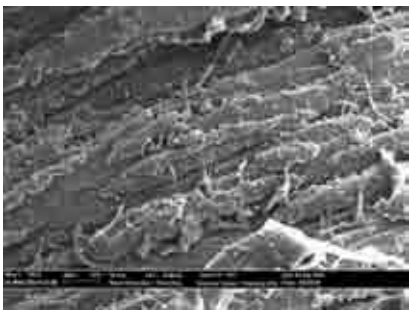
Figure 3 shows the TGA curves recorded in N_2 atmosphere for pure LLDPE and LLDPE/OMMT nanocomposites for various clay contents. The temperatures at 10% weight loss of the samples are tabulated in Table 3. From Figure 3, it indicates the LLDPE/OMMT nanocomposites show delayed decomposition compared to pure LLDPE. The thermal decomposition temperature was increased for all the nanocomposites compared to pure LLDPE.

Table 3: Thermal properties of LLDPE and LLDPE/OMMT nanocomposites.

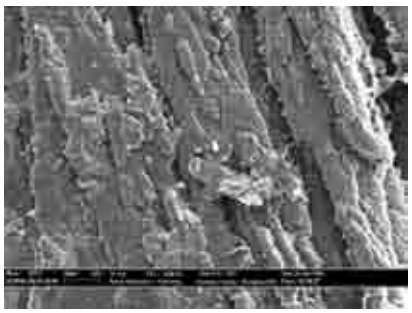
Sample	LLDPE	92/7/1	90/7/3	88/7/5
Temperature at 10% weight loss (°C)	466.96	471.04	473.10	474.19

The LLDPE/OMMT nanocomposite with 5wt. % organoclay shows the optimum thermal stability value compared to LLDPE/OMMT nanocomposite with 1wt. % and 3wt. % of organoclay in nanocomposites system.

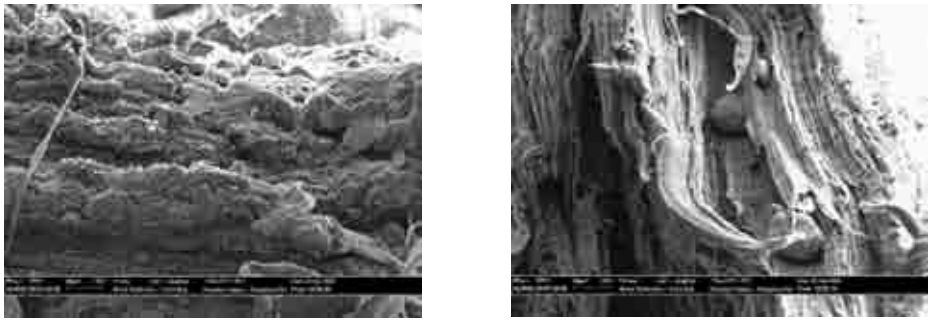
3.4. Micrographs



(a) Pure LLDPE



(b) LLDPE93/MAPE7



(c) LLDPE92/MAPE7/OMMT1 (d) LLDPE86/MAPE7/OMMT7

Figure 4: The micrograph of tensile fractured surface for (a) Pure LLDPE (b) LLDPE93/MAPE7 (c) LLDPE92/MAPE7/OMMT1 and (d) LLDPE86/MAPE7/OMMT7 at 500x magnification.

Figure 4 (a-d) shows several micrographs taken on the fractured specimen at 1wt. % and 7wt. % filler loading while pure LLDPE acts as a control specimen with magnification at 500x for each. It is clear that pure LLDPE shows smooth and ductile surface upon fracture as shown in Figure 4 (a). When viewed along the axis, the fibrillation is operative and long fibril can be found. In the case of LLDPE93/MAPE7, the fractured surface is smooth rather than pure LLDPE as shown in Figure 4 (b) and there is short fibrils appeared compared to pure LLDPE. According to Figure 4 (d), there are some small particles of the filler agglomerate can be observed from the surface. This agglomeration has leads to decrease in tensile strength and strain at break of LLDPE/OMMT nanocomposite at 7wt. % filler loading. It also revealed a significant amount of cavities were found in the compatibilized nanocomposites compared to pure LLDPE and LLDPE93/MAPE7.

At 1wt. % of filler loading as shown in Figure 4 (c), the LLDPE/OMMT nanocomposite showed a better dispersion of filler in polymer matrix, which is no or less agglomeration occur compared to LLDPE/OMMT nanocomposite at 7wt. % filler loading as shown in Figure 4 (d).

3.5. Mechanical properties

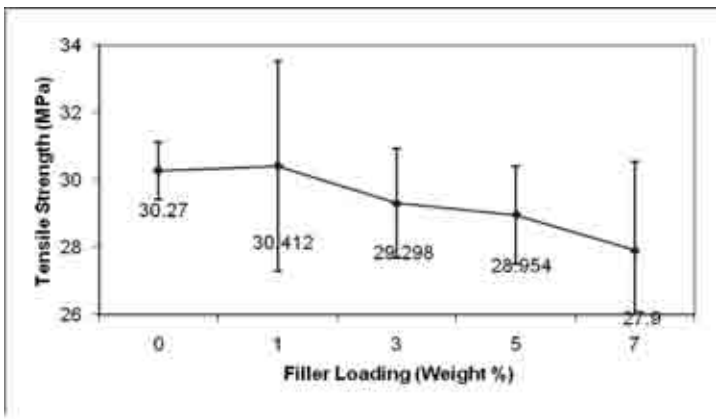


Figure 5: The tensile strength for pure LLDPE and LLDPE/OMMT nanocomposites.

The tensile strength reaches a maximum at an OMMT content of 1wt% of filler loading. The slightly increased tensile properties at low OMMT loading maybe due to the good dispersion and strong interaction of OMMT within LLDPE matrix. At higher filler loading, aggregation of the OMMT may take place and cause the decrement of tensile properties.

4. Conclusion

XRD indicate that melt blending can produce intercalating type of LLDPE/OMMT nanocomposite. The dispersion is best when OMMT content is 1%. The nanocomposite has shown slightly increased in tensile properties when the OMMT is 1%. The polymer matrix intercalated in OMMT layer and expands the d-spacing of clay which proved by X-ray diffractogram and produced intercalated structural of nanocomposites. Adding OMMT will slightly improve the thermal stability, melting temperature (T_m), crystallization temperature (T_c) and also degree of crystallinity of LLDPE. Addition of OMMT in LLDPE caused changes in fracture surface which is from ductile to brittle manner.

5. References

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O8 - Pengintegrasian Modul Sejarah Kejuruteraan Dalam Kaedah Pembelajaran Vokasional Dan Teknik

Ismawi Bin Ismail
Institut Latihan Perindustrian Labuan
ismawi@ilplabuan.gov.my

Abstract

Himpunan cerita, kejadian, lagenda dan mitos membentuk sejarah yang memberitahu masyarakat berkenaan asal-usul sesuatu perkara sehinggalah wujudnya adat resam, budaya kepercayaan dan semangat perjuangan pada masa kini. Pengubahsuaian aplikasi kejuruteraan bagi setiap ciptaan melalui inovasi dan kreativiti dapat membantu pereka/pengubahsuai melahirkan ciptaan baru atau secara terbitan (derivation). Ia amat berbeza dari teknik pengklonan teknologi kerana hasil ciptaan akan dapat dibeza dari sudut ciri keaslian (ingenuity), ketahanan, modus operasi, rekabentuk dan parameter teknologi. Namun begitu, kaedah tersebut diakui melanggar undang-undang hakcipta dan layak dihukum tetapi bukanlah rendah moral/akhlak (moral inferior) sekiranya pengetahuan teknologi dikuasai dengan cara yang mampu dijelaskan akan titik perbezaan, adaptasi dan elemen penambahbaikan, rekabentuk, kualiti dan pelbagai lagi alasan yang mesti difahami terlebih dahulu dan diaplikasikan ke atas ciptaan asal atas. Pembelajaran sejarah kejuruteraan dijangka mampu menyuburkan proses membentuk tenaga mahir menjadi teknologis berdayacipta, inovatif dan kreatif.

Keywords: *inovasi, kreativiti, undang-undang hakcipta, ciri keaslian*

1. Pengenalan

1.1 Kejayaan pekerja di peringkat nasional

Malaysia telah mengisytiharkan bahawa negara ini menggalakkan inovasi dan kreativiti sebagai modal utama (*main capital*), budaya hidup dan yang perlu dikuasai oleh saintis, pentadbir dan teknologis sebagai senjata untuk mempertingkatkan keupayaan untuk bersaing di peringkat dunia. Modal insan sedang dan akan dilatih untuk mencapai misi ini yang diharapkan dapat mempamerkan keputusannya dalam 10 ke 15 tahun yang akan datang iaitu pada tahun 2020 atau ketika Malaysia bergelar negara maju. Namun begitu, setelah sekian lama bergelar negara membangun yang hanya mengharapkan cetakan biru (*blue print*) datang dari negara maju, tenaga kerja kita selesa dengan persekitaran sedia ada dan hanya sejumlah kecil yang berdaya usaha mempertingkat teknologi yang dikuasai ketika bekerja. Itu pun setiap pembaharuan akan dikongkong (*confinement*) oleh syarikat dan dibawa balik ke negara sendiri dan dijenamakan semula sebagai pembaharuan oleh syarikat terutama syarikat asing dan multinasional. Sungguhpun demikian, pekerja te tersebut juga akan menerima imbuhan dan akan dikategorikan sebagai ” aset hidup” syarikat.

1.2 Pelan Pembangunan Modal Insan.

Di peringkat pembelajaran pula, IPTA/S dan ILKA/S merupakan tapak semaian kondusif bagi meningkatkan akademik dan kemahiran yang bakal membuahkan potensi perekacipta dan teknologis ampuh yang mampu menjana aplikasi, teknik dan seterusnya potensi rekacipta terkini. Apakah cukup sekadar menghasilkan sejumlah kecil graduan yang kemudiannya bakal menjadi perekacipta bagi menggerakkan pelan ETP negara yang memerlukan impak besar serta berpuashati dengan pencapaian 6% KDNK sehingga ke tahun 2020? Maka, wajarlah pusat pembelajaran merombakrawat intipati utama yang boleh menggalakkan lebih ramai perekacipta/teknologis berjaya dihasilkan. Kalau cintakan negara dianggap boleh disemai dengan memperkenalkan subjek sejarah sehingga ke tahap mesti lulus, aliran teknik dan vokasional juga disaran untuk berbuat demikian kerana melalui pembelajaran secara amali, seseorang pelajar dapat faham secara analitikl di manakah parameter mustahak (*key parameter*) yang boleh diubahsuai/divariasikan untuk dilakukan dan seterusnya dapat memikir penyesuaian rekabentuk yang terbaik untuk menzahirkan ke dunia realiti. Sungguhpun bakal memakan masa dari sudut tempoh latihan tetapi pemantapan ilmu pengethuan dan aplikasi teknologi dapat diserap untuk memungkinkan negara melahirkan sekumpulan saintis/teknologis yang berfikiran di luar kotak dari kebiasaan.

2. Pengembangan Sejarah Kejuruteraan

Secara umumnya, tiada dokumen rasmi yang mencatatkan keberkesanan kejuruteraan dalam komuniti atau untuk tujuan pembelajaran. Kebanyakkan saintis/teknologis melakukan ujikaji secara cuba dan jaya (*trial and error*). Hanya berbekalkan imaginasi serta semangat cuba jaya (tinkering) telah berjaya melahirkan pelbagai rekacipta dan dari situ lahir pula kekaguman yang membawa maksud tersendiri dalam nama jurutera. Pada abad ke 11, perkataan Latin yang berasal dari "*ingeniator"* adalah merujuk kepada seseorang yang memiliki *ingenium* atau *ingenius one.* Maksud ini tergunapakai bagi semua perekacipta alat tidak kira dalam apa juga disiplin yang kemudiannya merujuk pula kepada perekacipta yang menghasilkan enjin (engine) dalam konteks baru sehingga sekarang. Dunia Barat mengiktiraf Leornardo Da Vinci adalah orang yang mula mendokumenkan sejarah kejuruteraan bagi semua rekaciptanya dan saintis/teknologis sezaman dalam buku nota pada zaman Pembaharuan (*renaissance)* secara sistematik.

Usaha memperkenalkan modul sejarah dalam kurikulum latihan telah dimulakan di negara-negara maju pada lewat 90'an bagi memperbaiki dan memperoleh graduan berdaya maju dan dapat membawa pembaharuan di peringkat global.

3. Sumbangan Sejarah Kepada Kejuruteraan

Sehingga kini, adalah dikenalpasti bahawa fasa pertindanan sejarah bagi kejuruteraan dapat dibahagikan kepada 4 iaitu:

3.1 Revolusi Pra-saintifik (sebelum sehingga zaman Pembaharuan)

3.2 Revolusi industri. (Abad ke 18 hingga awal abad ke 19)

3.3 Revolusi industri kedua. (Sebelum perang dunia kedua bermula)

3.4 Revolusi teknologi maklumat. (Selepas perang dunia kedua sehingga kini)

Untuk menguasai bidang kejuruteraan lebih mantap, adalah disyorkan supaya dimulakan dari pembelajaran praktikal ketika revolusi industri yang bermula di Perancis.

4. Adaptasi Sejarah Dalam Kurikulum Latihan

Tujuan utama pembelajaran sejarah dalam konteks kurikulum latihan di IPTA/S atau ILKA/S/ TVET adalah bagi malahirkan teknologis mahir/separa mahir yang membina (*constructive technologist*). Ia disokong oleh pernyataan Ketua Jabatan Sejarah yang kemudiannya dinaikkan pangkat ke Jabatan Teknologi Elektrik, Prof. Fred A. Fish kepada President Iowa State University pada tahun 1909 yang dipetik sebagai berkata:

"It is the purpose of the department to train its students that they may become constructive engineers; that they shall not only thoroughly understand the fundamental physical principles which underlie the profession but also realize the relations that exist between engineering as a profession and engineering as a factor in our general purpose."

Selain itu, beberapa faedah signifikan lain yang dapat dihuraikan adalah seperti berikut (mengikut keutamaan):

a. Tenaga mahir bersifat glokal yang mampu mengadaptasi diri dengan persekitaran ekonomi global.
b. Mengatasi kelemahan diri dalam menghadapi arus perubahan teknologi yang dinamk dan pesat.
c. Menganggap inovasi dan kreativiti sebagai asas kukuh bagi kemajuan tahap kemajuan kerjaya kerja.
d. Merungkai permasalahan sedia ada yang tidak dapat diselesaikan pada masa lalu melalui pendekatan dan teknik terkini.

Dengan kaedah pembelajaran secara pelbagai disiplin (*multi-disciplinary*), pembelajaran sejarah kejuruteraan secara teori adalah wajib diajar supaya nilai-tambah wujud pada diri pelajar walaupun secara tetapi berbeza halnya dengan ILKA/S/TVET yang menekankan pembelajaran secara *hands–on*. Rujuk **Lampiran A.**

Inilah kelebihan yang boleh dimiliki dan diperakukan kebolehan dan kemampuan tenaga mahir Negara secara domestic ataupun antarabangsa. Sudah tentu lebih masa latihan diperlukan namun dengan memansuhkan subjek yang kurang penting atau secara pengabungan, realisasi hasil/produk rekacipta yang terubahsuai parameter teknologinya adalah sesuatu yang difikirkan perlu diteliti dan dinilai.

5. Teknologi & Al-Quran.

Surah-surah dalam AL-Quran mengandungi penjelasan saintifik yang kemudian dipermajukan oleh saintis Islam sehingga mengwujudkan teknologi kejuruteraan kompleks dan kini sedang mengalami revolusi setelah mengambil masa beratus tahun. Al-Quran yang diturunkan sekitar 1450 tahun dahulu memberi padanan dan corak sejarah ketamadunan manusia dan perjelasan secara ilmiah dalam bidang teknologi adalah seperti di **Lampiran B**.

6. Kesimpulan

Kehendak semasa yang menekankan aspek pemahaman dari akar umbi merupakan intipati sebenar bagi pelajar memahami kaedah terbaik bagi mempelopori sesuatu pembaharuan walau sekecil mana pencapaian tersebut. Ini disyorkan kepada pelajar yang mengikuti kursus bersifat jangka panjang (3 tahun atau lebih) kerana faktor masa yang mungkin sedikit terhad kepada pelajar di peringkat sijil.

Justeru itu, usaha pengajar dari segenap lapisan umur samada masih berkhidmat atau sudah bersara dapat digembleng, membentuk satu pasukan professional untuk memberi input kandungan-kandungan yang sesuai dipelajari, kalau tidak pun dibuat secara amali, dihayati secara ringkas oleh pelajar-pelajar ketika permulaan mereka menjalani kursus dalam apa juga bidang kemahiran yang bersesuaian dengan mereka.

7. Rujukan

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http://ee.eng.usm.my/v3/index.php/academics/undergraduate.html
[2] Laman Web Rasmi Universiti Tun Hussein Onn (UTHM)–
http://fkee.uthm.edu.my/v2/index.php

Lampiran B

Surah	Ayat	Bidang Kejuruteraan (Teras)
Al- Baqarah	13	Perubatan
	164	Astronomi
Ali'Imraan	5-6	Perubatan
	190-191	Astronomi
Al-A'raaf	189	Perubatan
Yunus	3-6	Astronomi
Ar Ra'd	1-4	Geologi, Astronomi, Bioteknologi
	8	Perubatan
	12-13	Metereologi
	17	Saliran, Metalurgi
Ibrahim	32-34	Maritim
Al-Hijr	16-27	Astronomi, Geologi, Perhutanan, Awam, Bioteknologi
	28-29	Bioteknologi
An Nahl	4-18	Perubatan, Veterinar, Pengangkutan, Awam, Bioteknologi, Astronomi, Maritim, Geologi
	65-70	Metereologi, Veterinar, Pertanian, Awam
Al-Hajj	5	Bioteknologi, Perubatan
	63	Pertanian
Al-Mukminuun	12-14	Perubatan
	17-22	Metereologi, Pertanian, Nutrisi, Pengangkutan
An Nuur	43-46	Metereologi, Astronomi, Bioteknologi, Pengangkutan
Al-Furqaan	2	Awam
	45-54	Awam, Astronomi, Metereologi, Maritim
Ar Ruum	20-27	Astronomi, Metereologi, Bioteknologi
	50-54	Bioteknologi, Pertanian, Makanan
As Sajdah	4-11	Astronomi, Prerubatan
Saba'	11-13	Pertahanan, Metalurgi, Awam
Faathir	9-14	Metereologi, Saliran, Perubatan, Astronomi
	27-28	Metereologi, Makanan, Geologi
Yaasin	33-43	Nutrisi, Pengairan, Astrologi, Pengangkutan
Al-Mu'min	64-68	Perubatan, Awam
Fushshilat	9-11	Astronomi, Geologi
Az Zukhruf	10-13	Geologi, Awam, Pengangkutan
Al-Jaatsiyah	4-5	Geologi, Veterinar, Astronomi
Qaaf	6-11	Geologi, Awam, Nutrisi, Pengairan
Ar Rahmaan	3-15	Perubatan, Bioteknologi, Geologi, Nutrisi
Ash Shaff	4	Pertahanan
Al Mulk	3	Aeroangkasa, Astronomi
Al- Muzammil	20	Astronomi, Perubatan
Al-Insaan	1-2	Perubatan
Al-Ghaasyiyah	17-21	Geologi, Bioteknologi

Lampiran A

Contoh Kurikulum USM

BACHELOR'S DEGREE IN ELECTRONIC ENGINEERING

LEVEL 100

		Credit	Contact Hours	
		Total Unit	Lecture	Lab/ Tutorial
Semester I				
EEE105/3	Circuit Theory 1	3	3	1
EEE123/3	Computer Programming for Engineers	3	2	2
EBB113/3	Engineering Materials	3	3	1
EMM101/3	Engineering Mechanics	3	3	1
EUM111/4	Engineering Mathematics	4	4	1
		16	15	6
SEMESTER BREAK				
Semester II				
EEE125/3	Basic Circuit Laboratory	3	0	6
EEE130/3	Digital Electronics 1	3	3	1
EEE132/3	Electronic Devices	3	3	1
EEL102/2	Engineering Practices	2	0	4
EUM112/4	Numerical Method & Engineering Statistics.	4	4	1
		15	10	13

Cadangan:
Digantikan dengan subjek Sejarah Kejuruteraan

Cadangan:
Digabungkan dengan Circuit Theory 1

Contoh Kurikulum UTHM

BACHELOR'S DEGREE IN ELECTRICAL & ELECTRONIC ENGINEERING

Course Matrix and Learning Outcomes					Learning Outcomes										
					Knowledge	Knowledge & Practical	Communication Skills	Critical Thinking & Problem Solving	Team Working Skills	Life-long Learning	Entrepreneurship Skills	Professionalism, Social, Ethics and Humanity	Leadership Skills	Design	Sustainable Development
No.	Course Code (Old)	Course Code (New)	Course	Credit	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11
Learning Domains					C	C	P	C	P	A	P	A	A	P	A
Generic Skills							CS		TS	LL	ES	EM	LS	D	SD
UNIVERSITY COURSES															
1	UMA1152	UWA10302	Islamic and Asian Civilisation	2	x		x					x			
2	UMB1011	UWB10101	English For Academic Purposes **	1	x		x			x					
3	UMB1042	UWB20302	Technical Writing	2	x		x			x					
4	UMB1122	UWB10202	Ethnic Relations	2	x				x			x			
5	UMB1052	UWB10202	Effective Communication	2	x				x	x					
6	UQ*1xx1	UQ* 1**01	Co-Curriculum I	1		x			x	x					
7	UMA1182/ UMA1142	UWA10102 UWA10202	Islamic Studies/ Moral Studies/	2	x		x					x			
8	UMC1022	BEE 31202	Creativity and Innovation	2	x				x				x		
9	UQ*1xx1	UQ* 1**01	Co-Curriculum II	1		x			x	x					
10	UMB1113	UWB10103	Nationhood and Current Development of Malaysia	3	x							x	x		
11	UM*1312	UWB10*02	Foreign Language	2	x					x		x			
Total				20	8	2	4	0	5	6	0	5	2	0	0
MATHEMATICS COURSES															
1	BDM 1913	BWM10103	Engineering Mathematics I	3	x			x		x					
2	BDM 1933	BWM10303	Engineering Mathematics II	3	x			x		x					
3	BDM 2913	BWM20403	Engineering Mathematics III	3	x			x		x					
4	BDM 3913	BWM30603	Engineering Mathematics IV	3	x			x		x					
5	BDM 2922	BWM20502	Engineering Statistics	2	x			x		x					
Total				14	6	0	0	5	0	5	0	0	0	0	0
FACULTY SUPPORT COURSES															
1	BEE 1212	BEX 10502	Computer Programming	2	x							x		x	
2	BPK 3013	BPK 20902	Entrepreneurship	2				x			x		x		
3	BPK 3013	BPK 30902	Engineering Economy	2				x			x		x		
4	BPK 4023	BEX 42503	Engineering Management	3	x		x					x			
5	BPK 4032	BEX 42702	Engineers and Society	2	x		x					x			
Total				11	3	0	2	2	0	0	2	3	2	1	0

Cadangan: Memasukkan Engineering History sebagai subjek sokongan

Cadangan: Menggabungkan Engineering Economy & Society

O9 - The Significance of English Language Learning to Industrial Training Institute Trainees

Muhammad Zulkarnain Yazed
Industrial Training Institute Labuan

Abstract

It is important for a student to have a good command in a second language before being able to use it effectively. In Malaysia and Industrial Training Institute prospect, the English language is taken as an important element. A good knowledge in the language improves the students' qualification and pose as an advantage for them. Employers nowadays demands communication skills aside from technical skills that they have already mastered. The problem is that the engineering field deals with lots of jargon. Does our teaching include teaching them to understand these terminologies? What about the teaching approach? Should the English teacher follows the English for Academic Purposes approach or the English for Specific Purposes approach? Which will benefit the students the most? This intrigues the author thus leads to the researches done in order to find the answer for this fascinating part of Teaching English as a Second Language.

Keywords : *Jargon, Teaching Approach, English for Academic Purposes, English for Specific Purposes, Teaching English as a Second Language.*

1. Introduction

The English language is a compulsory subject to be taken by the first and second semester students at Industrial Training Institute (ITI) and consist of a class a week with the duration of 1.30 hour per class. It is well known that most of the students are quite weak in the academic field which makes them choose the vocational sector. In ITI, the entire courses offered relates with the engineering field namely, Industrial Mechanics Technology, General Machining Technology, Welding Technology, Automotive Technology, Refrigeration and Air Conditioning Technology, Building Technology (wood base, concrete base and pipe and sanitary), Computer Technology (System), and lastly, Single Phase Electrical Technology. We can see clearly that the courses' scopes are quite large and the possibility of creating a specific English syllabus for each course is out of hand. But is there a way to teach these students using a single syllabus yet deliver them the input that they need in their field?

In ITI Labuan, all the courses duration is 2 semesters except for Single Phase Electrical Technology and Computer Technology (System). For the Electrical students, they are required to do their industrial training on the third semester and come back to finish their study on the fourth semester. This research are based on these particular students who already have the knowledge on the English language taught during the 2 semesters they were in the institute, and went out for their practicum and coming back for the final semester. What the author found out is that most of the students are interested in learning the language after the industrial training. The reason? Most have difficulties during their practicum in working with others that use English as their working language (note that Labuan has many international companies due to its offshore financial centre status).

What makes the author wonder is that some of these students did well in their study. They know how to use the language, they understand the underlying mechanics, and can perform well in given task. So what makes it hard for them to perform in task given during their practicum? In order to find it out, the author went to the companies that accepted them for their industrial training and did some survey. The result is quite shocking and it makes the author realize that a change is needed in the current English syllabus used at ITI.

2. English for Academic Purposes vs. English for Specific Purposes

It may sound cliché, but it has been a long debate whether we should use EAP or ESP in teaching adults that needs to learn the language in order to perform well in the working field. Looking at the current syllabus, it is divided into theory and practical. The theory mostly learn during the first semester consist of grammar lessons. In the second semester, the students are required to do public speaking, write technical

reports, conduct meetings and write a resume. In the first semester, some of the lesson are too easy for some intermediate or advance students to begin with. Therefore, it bore them. During the second semester, the lessons are quite challenging for the low proficiency students and it is quite difficult for them to catch up. But what matters the most is that both the syllabus have already been taught in school before. That means that the students already have some background knowledge on the subject. Instead of repeating the same thing again and again, why not incorporate some of the elements in the working field into the subject? That's when ESP plays it role.

ESP is an approach to language teaching which aims to meet the needs of particular learners. This means in practice that much of the work done by the teacher if ESP is to be used concerned with designing appropriate courses for various group of learners. Designing a course is fundamentally a matter of asking questions in order to provide a reasoned basis for the subsequent process of syllabus design, materials writing, classroom teaching and evaluation. We need to know:

Why does the student need to learn?

Who is going to be involved in the process?

Where is the learning to take place? What limitation does it impose?

When is the learning to take place? How much time is available?

What does the student need to learn? What aspects of language will be needed and how will they be described? What level of proficiency must be achieved? What topics areas will be need to be covered?

How will the learning be achieved? What learning theory will underlie the course? What kind of methodology will be employed? (

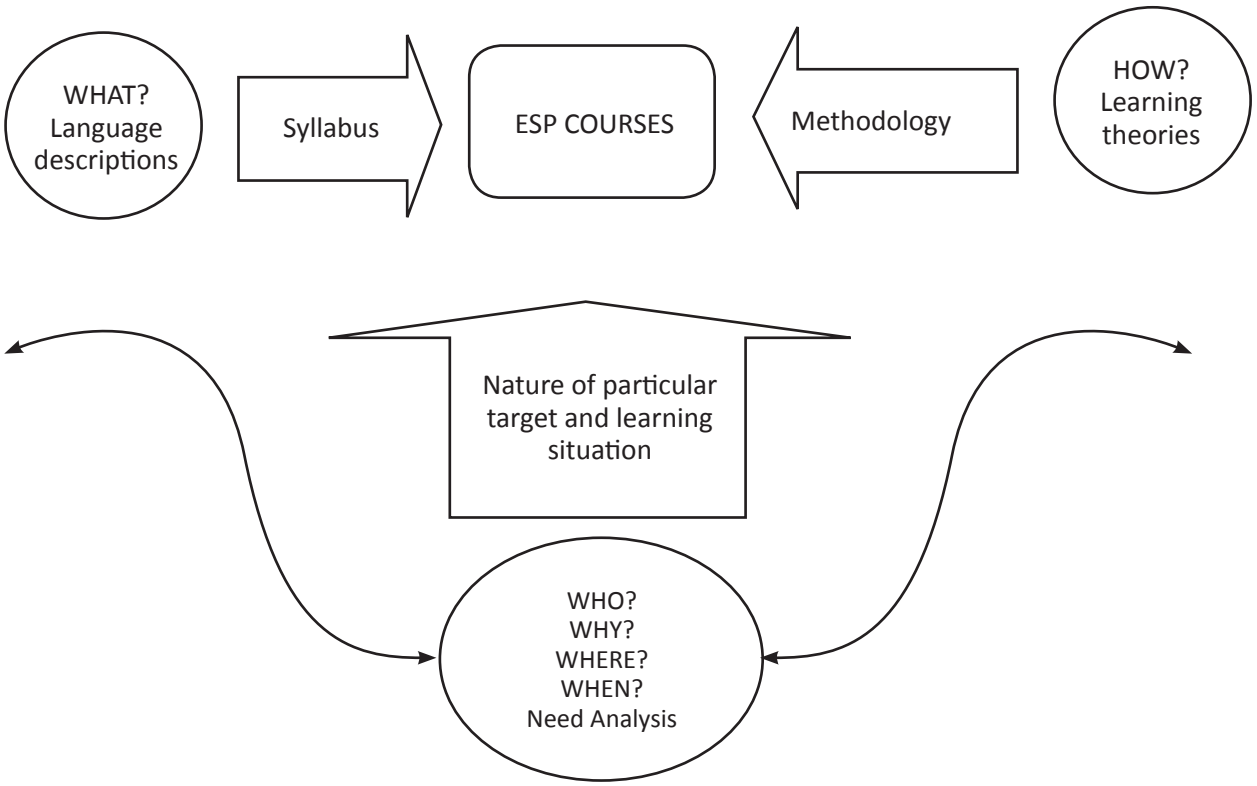

Figure 1 : Factors affecting ESP course design

3. The World of Jargon

Having said the importance of having a syllabus that caters to the needs of the industry and the students, we come to the discussion of the use of jargon. The technical jargon of every field derives their terms from a variety of languages, although these are used in English. Students, who are generally not exposed to such terms in their vernacular, perceive these terms to be difficult to learn in the beginning and this leads to some struggle in comprehending the concept fully and remembering the terms. The English language teachers need a better and intensive acquaintance with the processes for the formation of technical terms. And then they should also know how to use these processes integrated into their teaching of English.

Effective teaching of ESP depends on the effective imparting of technical jargon. We also should note that effective learning of engineering concepts depends upon the effective mastery of such jargon in English. New technologies have brought in the necessity of learning a wide range of technical vocabulary besides the coinages in the respective fields of engineering. The conscious or unconscious resistance to learning of English persists among the students for the following reasons.

3.1. The learning of technical vocabulary is not genetically triggered like the learning of mother tongue.

3.2. The jargon used in the texts of engineering and technology are quite distinct from the English text the students are exposed to in school as well as in college. The English textbooks at the school level till the students reach the higher secondary level focus on literature in the form of prose, short-story, autobiography, poetry, etc. But the English textbooks prescribed for use in ITI do not focus on literary pieces. Instead the students are exposed to the systematic strategy of using technical English. This sudden jump is rather unnerving and causes anxiety in students. This is also one of the reasons why students rarely visit the library. Nearly all the books are in English and to make things worse, filled with jargon. How are they supposed to read something that they don't understand? Therefore, an intensive vocabulary enrichment focusing in jargon is in dire need in order to help these students.

4. Feedback from Students

In order to collect the views of the students who have undergone the English course plus the industrial training, a survey had been conducted. A questionnaire with six close-ended questions with a three point scale was used for the survey. The questions were intended to elicit their responses on the usefulness of the course. The responses were collected, organized and percentage analysis was carried out. The analysis of each item is shown under:

4.1. 70% of the respondents said that the course is either VERY RELEVANT or RELEVANT.

4.2. 65% of the respondents stated that the content of the course is either HIGHLY ADEQUATE or FAIRLY ADEQUATE.

4.3. 66.33% responded that the distribution of Theory/Practical is EVEN.

4.4. 75% stated that the syllabus distribution and coverage is SATISFACTORY.

4.5. 90% stated that they like the course.

4.6. 85% of the respondents are of the view that the course helps them to develop problem-solving skills.

5. Feedback from Employers

In order to collect the data and views of the employers, the author had distributed questionnaires to the participating companies. A summary of the English subjects syllabus were attached with it. Some of the managers were eager with the research and give some suggestions and tell the author what they really need in a future employee. Using the same method as with the students, a questionnaire with six close-ended questions with a three point scale was used for the survey. The responses were collected, organized and percentage analysis was carried out. The analysis of each item is shown under:

5.1. 65.66% of the respondents said that the students English are either AVERAGE or BELOW AVERAGE.

5.2. 80% of the respondents stated that the students' communication skills are either at BEGINNER or INTERMEDIATE level.

5.3. 80% responded that the distribution of Theory/Practical is UNEVEN.

5.4. 55% stated that the syllabus distribution and coverage is SATISFACTORY.

5.5. 95% stated that they want the course to be changed.

5.6. 90% of the respondents are of the view that the course should focus more on English for Occupational Purposes.

6. Conclusion

As can be seen from the research, it is obvious that a modification need to be done to the English subject syllabus used in ITI. By incorporating ESP into the syllabus, not only will it prepare the students with the working world, but also increasing their possibility of being hired in the future. Putting in the chunk of language skills related with engineering field and taking out the not so important element from the current syllabus requires not only the English teachers, but also the engineers' cooperation. The combination of the two different level of expertise can at least ensure that the future syllabus meets the requirement of the challenging working world. Other than that, it is in the author's opinion that the time allocated for the subject should be increased. An hour and a half a week is insufficient for an adult in learning a language. A minimum of 3 hours a week is needed if we intend on improving the quality of ITI's graduates.

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O10 - TVET to Address Education for Sustainable Development

Wan Ahmad Jailani bin Wan Ngah
Centre for Instructor and Advanced Skill Training (CIAST)
jailani@ciast.gov.my

Abstract

United Nations (UN) declared The Decade of Education for Sustainable Development (DESD) from 2005 – 2014 and it is one of very important tool to achieve the objectives of Sustainable Development (SD). Malaysia's policy on sustainable development was started and clearly enunciated in the 7th Malaysia Plan (1996 - 2000) which also describes the measures taken to emphasize sustainable to enhance Malaysia's ability to develop sustainably. To ensure the policy on sustainable development is implemented in Skill Training effectively and continuously, reorientation is required to address sustainability and how everyone who involves directly or indirectly in skill training can contribute to the process. This is because moving towards the goal of sustainable development requires fundamental changes in human attitudes and behaviour and successfully making these changes is critically dependent on education and training. This paper explains the brief concept of Sustainable Development, the requirement of TVET to Address Education for Sustainable Development (ESD) and challenges toward integrating Sustainable Development in TVET.

1. Introduction

Chapter 40 of Agenda 21 of the United Nations Conference on Environment and Development (UNCED) was endorsed in order to implement the concept of sustainable development. Four main thrusts were identified for Education for Sustainable Development namely access to quality basic education, reorienting existing education, public awareness and understanding and training.

The critical role of TVET in sustainable development is long standing. For example, there commendations of the UNESCO Second International Congress on TVET (Seoul, 1999) sought a new orientation of 'TVET throughout life' in order to meet the new demands of achieving the objectives of a culture of peace, environmentally sound sustainable development, social cohesion and international citizenship of the world.' As part of the ongoing process of TVET for achieving sustainable development, the International experts meeting in Bonn (2004) formally adopted the Bonn Declaration. In 2004, TVET for Sustainable Development was considered during the UNESCO international experts meeting in "Learning for Work, Citizenship and Sustainability", hosted in Bonn, Germany. It was contended that since education is considered the key to effective development strategies, technical and vocational education and training (TVET) must be the master key that can alleviate poverty, promote peace, conserve the environment, improve the quality of life for all and help achieve sustainable development. With this, TVET has to re-orient its agenda for action so as to continually provide scientific and technical skills in relevant and responsive programs, and consequentially develop a new generation of human resources.

In many countries, there is still problem where TVET is limited to the role of being a mere supplier of skilled labour to industry and therefore, the product of TVET unable to respond effectively to the needs of the sustainable development strategies. The policy of TVET needs to be reoriented especially in TVET teacher training and curriculum towards sustainability while maintaining the principles of 6R that is Reduce, Reuse, Renew, Recycle, Repair and Rethink perspectives. Therefore TVET system needed to be aware of the concept and challenges of Sustainable Development to be applied in TVET teacher training and work place urgently.

The focus of DESD is framed within 8 key themes namely, Overcoming Poverty, Gender Equality, Health Promotion, Environment, Rural Development, Cultural Diversity, Peace & Human Security and Sustainable Urbanization. This paper will focus on the Environment Key Theme. Environmental education is widely perceived at the global level as the means to bringing about changes in attitude and behaviour towards the well being of the environment. As such, various organizations have taken initiatives in mobilizing action for the environment.

2. Concept of Sustainable Development

The concept of sustainability development is combination of three principal aspects:

a) Economy: An economically sustainable system must be able to produce goods and services on a continuing basis.

b) Environmental: An environmentally sustainable system must maintain a stable resource base, avoiding over-exploitation of renewable resource systems, and depleting non-renewable maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.

c) Social: A socially sustainable system must achieve distributional equity, adequate provision of social services including health and education, gender equity, and political accountability and participation.

Ultimately, the sustainable development will achieve quality of life through the 3 combinations of concept as show in figure 1.

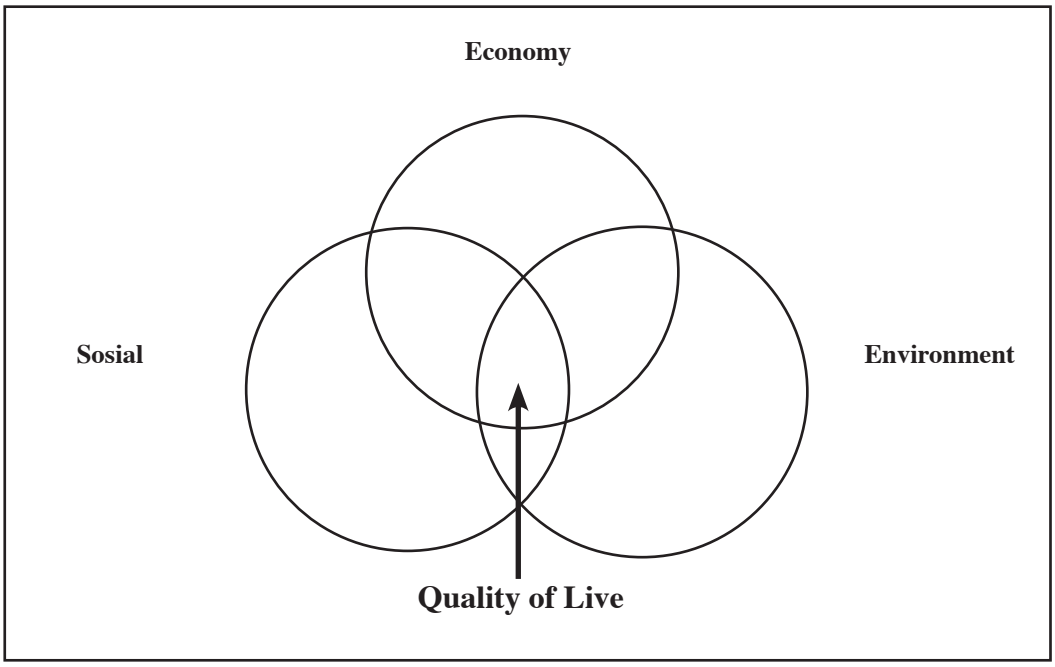

Figure 1 : The concept of sustainable Development

The International Implementation Scheme for the UN decade of education for sustainable development identifies 3 perspectives with 15 subcomponents:

a) Socio-cultural perspectives
   i. Human rights
   ii. Peace and human security
   iii. Gender equality
   iv. Cultural diversity and inter cultural understanding
   v. Health
   vi. HIV/AIDS
   vii. Governance

b) Environmental perspectives
   i. Natural resources
   ii. Climate change
   iii. Rural transformation
   iv. Sustainable urbanisation
   v. Disaster prevention and migration

c) Economic perspectives
   i. Poverty reduction
   ii. Corporate responsibility and accountability
   iii. Market economy

During the International conference in 2006 in Vietnam for TVET and ESD, Prof John Fien introduced two principles for TVET: first, TVET must promote an understanding of our ecological predicament. Second, integrated sustainable development demands that learners be tuned to the functioning of the whole global system and to the connection between the parts. Prof John Fiens also provides an even tougher version, from Karl-Henrik Robert:

a) Materials from the earth's crust must not systematically increase in the biosphere
b) Substances produced by humans must not systematically increase in nature
c) The physical basis for productivity and the diversity of nature must not be systematically diminished
d) Must be fair and efficient in meeting basic human needs

3. Principles of Education for Sustainable Development (ESD)

The concept of ESD contains following principles:

a) ESD is concerning everyone.
b) ESD is an ongoing continuously process and contributes to acceptance of change processes in society.
c) ESD is a cross-disciplinary task and has an integration function
d) ESD wants to improve living conditions of mankind
e) ESD creates individual, social and economic chances for the future
f) ESD supports global responsibility.

4. Basic Principles Of Teaching In TVET to Address Sustainable Development

The following are some basic principles of ESD pedagogy:

a) Methods for ESD in TVET should promote problem solving skills, creativity and innovative skills.
b) All techniques should be designed to suit learner characteristics, meet their needs and develop their interest and enthusiasm.
c) Methods should focus on real-life problem-solving, i.e., application of principles of science, social science and technology to solve environmental problems.
d) Problem or project-centered approach is usually more appropriate than subject or discipline approach for ESD.
e) Scientific and technological aspects of environmental issues should be supplemented with values and ethical aspects.
f) Teaching approaches should shift away from lecturing towards group-work, self study and methods which use active involvement in projects and community life.
g) Team-teaching can effectively pool talents of specialist teachers to work in an inter-disciplinary way.
h) Learners should have access to elective subjects suited to their own personal and professional needs, interests and job opportunities.

5. Issues and Challenges

The major challenge in the world today is to find ways of living and working sustainably, so that the reasonable needs and wants of people from all walks of life and in all countries can be satisfied without so over-exploiting the natural resources upon which all life depends that the ability of future generations to meet their need and wants is threatened.

Finding approaches to development that balance economic and social progress, address cultural differences, and respect ecological values and limits is the key to sustainable development. Moving towards this goal requires fundamental changes in human attitudes and behaviour in personal lives, in community activities, and in places of work. Successfully making these changes is critically dependent on education and training.

During education and training, the greater the exposure of trainees to sustainable concepts, practices and examples, the more likely it is that the desired workplace culture change will take place in the future. The challenge for TVET is to reorient and redirect its curriculum to imbue students and trainees with respect for the conservation and sustainable use of resources, social equity and appropriate development, along with competencies to practice sustainable tasks at the workplaces of today and tomorrow.

A major challenge is to raise the awareness of decision-makers, stakeholder groups (including industry) and the general public about the contradictions and consequences of productivity policies and programmes in TVET, in addition to the need to retrain displaced workers. Teachers and trainers frequently face the problem of how to integrate the issue of sustainability into the instruction they provide at college or the workplace. They play a decisive role in developing an understanding and awareness of sustainable development in initial and continuing vocational education and training.

A few issues and challenge were identified in reorienting the TVET Teacher Education to address SD as follows:

a) Understanding the Meaning and Scope of ESD in TVET

Limited awareness and understanding of ESD at all levels are still fundamental challenges resulting in a limited societal and governmental support base for ESD. This limited awareness and understanding may keep people from recognizing the presence and value of existing ESD, with activities taking place that may not carry an ESD label. Efforts need to be made to better communicate ESD more effectively so that full diversity of ESD and SD is fully understood.

b) Structuring and Placing ESD in the Curriculum

TVET system requires deep immersion in the understanding and practices of SD. The changing nature of the world of work, especially due to globalization and technological changes, demands how these changes impact upon the quality of social, economic and environmental conditions. TVET can play an instrumental role in developing a new generation of individuals who will face the challenge of achieving sustainable socio-economic development.

c) Facing the Complexity of Sustainable Development Concept

Sustainable development is a complex and evolving concept. Many scholars and practitioners have invested years in trying to define sustainable development and envisioning how to achieve it on national and local levels. Because sustainable development is hard to define and implement, it is also difficult to teach. Even more challenging is the task of totally reorienting an entire education system to achieve sustainability.

d) Sharing the Responsibility

Every sector that is touched by sustainable development (i.e., every ministry and department) can play a role in ESD and the reorienting process

e) Developing Financial and Material Resources

Reorienting education to address sustainability will require new financial resources. One of the major problems with ESD is that current education must continue while the new curriculum is being designed and developed.

f) Developing new policy to address SD

To succeed, ESD must have an authoritative impetus from national or regional governments that will drive policy development. Together, administrators, teachers, and community leaders at the local level must interpret what the policy should "look like" locally.

g) Promoting Sustainability in Popular Culture

Principles of sustainable development are not currently woven into daily life and governmental policy, the emergence of ESD could become an important "bottom-up" driver of community-based sustainable development. ESD could shape and encourage behaviours and ethics that support an informed, knowledgeable citizenry that has the political will to achieve a sustainable future.

6. Conclusion

TVET plays a key role in ensuring people can make an effective contribution to the economies, communities and environment. It is increasingly regarded as the key to improving the competitiveness of workers and helping countries achieve sustainable economic growth. All party have to work together to ensure the effectiveness and the continuity of the process and promoting sustainability to be a culture in institution and community. TVET providers must not only engage in a critical examination of productivism and its negative environmental effects, but also initiate strategies to facilitate the transition towards sustainable development. TVET policy-makers, managers and practitioners share responsibility for critiquing productivism, stimulating dialogue, raising learner and public awareness about the challenges we confront and articulating a vision and strategy for readdressing the ecological blind-spot in current constructions of TVET. It is only through the individual commitment and collective effort of the whole TVET community along such lines that progress towards an ecologically sustainable future will be achieved.

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