A · P · U
ASIA PACIFIC UNIVERSITY
OF TECHNOLOGY & INNOVATION
SCHOOL OF ENGINEERING

ENGINEERS INSIGHT

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Contents

'Engineers Insight' is a quarterly issue by the School of Engineering for the reading pleasure of the staff and students allowing for knowledge sharing and capturing of events for the benefit of engineering education

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E-Waste Handling

As the evolution of technology continues to see advancements that not only enable for life to be simpler and faster but it also has created concerns in parallel. One of the fundamentals issues which has been raised over the last decade is the problem of e-waste. This phenomenon of e-waste has not only bugged landfills or waste handling companies in terms of collection and disposal but it also has a precious value that makes e-waste not actually waste per say but in reality almost like gold being thrown into the dump.

Typical Holding Warehouse for E-Waste

E-waste can be anything electronic based such as PCs or Laptops to home appliances such as a Refrigerator or a Microwave. IT Equipment belonging to organizations are removed at the end of life or based on new upgrades in accordance with the regulations which have been put in place. This is very normal in many developed countries. Where possible equipment is re-used, recycled or disposed of with minimum impact on the environment. There are basically 10 categories for e-waste;

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools
7. Toys, leisure and sports equipment
8. Medical devices
9. Monitoring and control instruments
10. Automatic dispensers

The standard disposal plan which is normally applied for e-waste is as follows;

- If the equipment is in good working order and is a model currently in use, the data is wiped and systems rebuilt for re-issue.

- If the equipment is not in good working order and is a model currently in use, a repair is attempted and then rebuilt for re-use.
- Equipments which are not repairable or not models currently in use are disposed of through a specialist external supplier. The items are catalogued and picked up by the supplier's own staff in unmarked vans.
- All data is wiped or components holding data are physically destroyed beyond any recovery of information contained thereon.
- If units can be resold on the open market they are offered for re-use.
- Units which are no longer saleable are broken down into components and offered to the spares market.
- Components which cannot be re-used as spares are sent for reclamation of materials.
- Waste materials after reclamation are disposed of with the minimum environmental impact possible.
- Companies are usually registered for disposal of waste and the above disposal process is covered within waste regulations.
- The external supplier provides transfer notes and keeps records of all waste transfer to final disposal companies.

Where machines are used in secure areas and hold restricted or classified information, data is wiped prior to removal from the site using a certified Data Cleaner. Should the machine not be capable of running this software, due to fault, then the media is physically destroyed, beyond any recovery of information contained thereon, on site.

Typical E-Waste Processing Plant

E-waste also contains hazardous materials which makes the handling of it a little more difficult at times. Some of the sample of hazardous materials involved are as below;

- Uninterruptable power supplies - lead-acid batteries
- Cathode ray tubes (televisions, computer monitors)
- Fluorescent tubes, backlights to laptop screens, thin-film transistors
- Electrical/electronic equipment containing polychlorinated biphenyl (PCB)
- Fridges and freezers, due to chlorofluorocarbon (CFC), an ozone depleting substance
- Mercury: found in fluorescent tubes (numerous applications), tilt switches (mechanical doorbells, thermostat), and flat screen monitors. Health effects include sensory impairment, dermatitis, memory loss, and muscle weakness.
- Sulphur: found in lead-acid batteries. Health effects include liver damage, kidney damage, heart damage, eye and throat irritation. When released in to the environment, it can create sulphuric acid.

The process of recycling and sorting of e-waste is quite tedious. Electronic waste processing usually first involves dismantling the equipment into various parts (metal frames, power supplies, circuit boards, plastics), often by hand, but increasingly by automated shredding equipment. In an alternative bulk system, a hopper conveys material for shredding into an unsophisticated mechanical separator, with screening and granulating machines to separate constituent metal and plastic fractions, which are sold to smelters or plastics recyclers. Magnets, eddy currents, and screens are employed to separate glass, plastic, ferrous and nonferrous metals, which can then be further separated at a smelter. Copper, gold, palladium, silver and tin are valuable metals sold to smelters for recycling. Hazardous smoke and gases are captured, contained and treated to mitigate environmental threat. These methods allow for safe reclamation of all valuable computer construction materials. With higher usage of electronic products nowadays there will definitely be a large demand to look to into more efficient and eco-friendly methods to deal with e-waste. Therefore e-waste grows in parallel with the evolution of technology.

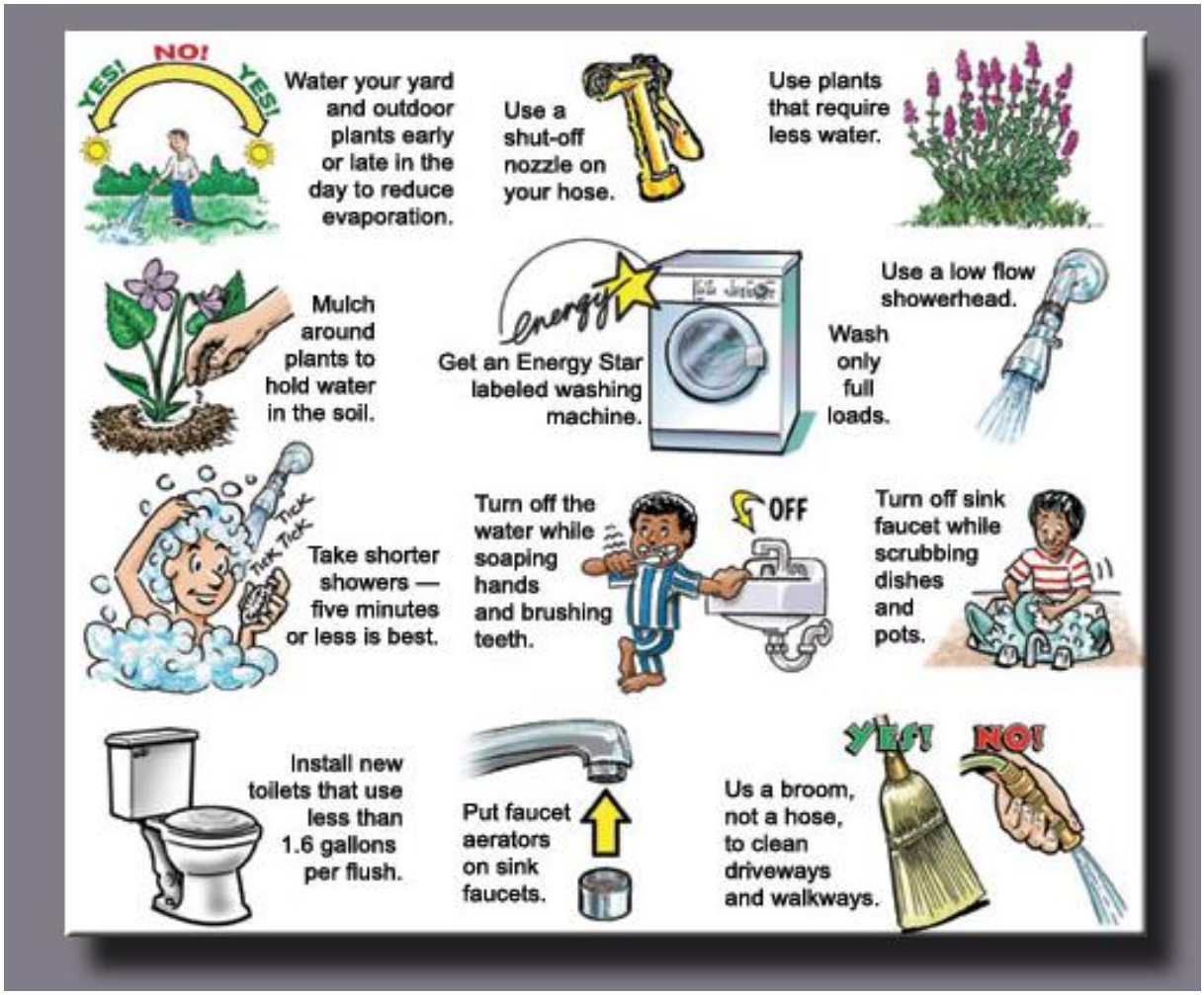
Assoc Prof Ir Dr Vinesh Thiruchelvam

Energy Conservation

"Go Green" is a widely used term that can mean something different to everyone. The word “Go green” can be explained as simply taking steps to "conserve energy, reduce pollution and save money." Go green can be achieved through simple steps and does not have to mean skipping showers, selling your car and never setting foot in a grocery store.

Conserve Energy

Conserving energy is one of the most basic concepts involved in going green. Simple strategies such as turning off the lights when not in use and turning the water off while brushing your teeth can go a long way. There are several energy-efficient products available varying from light bulbs to large appliances that can help conserve energy as well. Although these products may be a bit more expensive initially, they can save energy and money in the long run. One of the most effective ways to save energy is to improve operations and maintenance. In many buildings it is possible to save ten to thirty percent of the energy usage by changes of operation and maintenance methods.



Energy Conservation Methods

The intensity of energy conservation can be improved by the following tips:

House:

- Use bathroom and kitchen exhaust fans only when needed.
- Oil the motor and fan bearings according to the manufacturer’s instructions. this will extend the life of all equipments.

Water Supply:

- Set the temperature control on your water heater to the recommended temperature by the manufacturer. The higher the temperature of the water setting in the tank for you to use, the higher the heat loss.
- Locate your water heater as close as possible to the point of greatest hot water use. Hot water remaining in a supply pipe after you turn off the tap eventually cools and gets wasted. The longer the supply pipe the more heat lost.

- Use the smallest practical diameter for hot water supply pipes to minimize heat loss and to reduce the volume of trapped water.
- Repair leaky faucets /taps promptly. A steady drip can waste litres of water per month.
- Encourage family members to take shorter showers instead of tub baths. The average person uses about half as much hot water in a shower as in a tub.
- Turn off running water when shaving or brushing your teeth and fill a dishpan with rinse water instead of letting the faucet run while you do dishes by hand.

Cooling:

- Insulate your home to keep moderate temperature in room.
- Select air conditioning equipment on the basis of its Energy Efficiency Ratio (EER). You can calculate the EER for a window units or central systems by dividing the cooling capacity, expressed in kW or BTUH, by the electric power input, expressed in watts. Generally an EER of 13 or more is excellent, 11 or 12 are good, 10 is just adequate. Avoid equipment with an EER below 10.
- Locate window air conditioners on the north side of your house. Direct sunlight on your unit makes it work harder.
- Check air conditioner filters at least once a month and clean or replace them as needed.

Lighting:

- Check the wattages of the incandescent light bulbs in your house. In many cases, you can substitute lower wattage bulbs and get lighter for the same amount of energy. Look for the lumens of bulb instead of watts. Lumens indicate the brightness of the bulb. Watts only tell you the amount of power consumed by the bulb during working condition.
- Urge everyone to turn off lights when leaving the room. Having wall switches in convenient places help everyone to remember.
- Select lighting fixtures on the basis of their efficiency. Fluorescent lamps produce about four times as much light per watt as incandescent bulbs.
- Install photoelectric controls and timers to turn off outdoor lights during the day.
- Clean lighting fixtures regularly, dust on lams, reflectors and bulbs impairs lighting efficiency.
- Choose light colors for walls, ceilings, floors and furniture. Light colors reflect light. Dark colors absorb light and required higher bulb wattages.

Cooking:

- Always use pots and pans with absolutely flat bottoms on your range. To cook efficiently, heat must transfer directly from the surface element to the pan. Warped bottoms leave an air gap, which provides an escape route for heat.
- Select pots and pans that are tight size to completely cover the surface element. When any part of the surface element is exposed, you are wasting heat and energy.
- Develop the habit of lids on cooking. Tight –fittings lids help keep heat in a pan, permitting you to use lower temperature settings and shorter cooking times.
- Make more use of your pressure cooker. It cuts cooking time to one-third that of conventional methods.

General:

- Clean or replace air filters on exhaust fans, humidifiers, and other electric appliances. Clogged filters impair performance and cause units to run longer.
- Turn off the television when nobody's watching.
- Turn off the iron a few minutes before you finish ironing and complete the rest of your clothes with the heat remaining in the iron.
- Turn off the iron when the telephone or doorbell interrupts your work.

Finally:

Everyone will have a big question in their mind on how much energy can be saved by following the advice given? The following is a list of several measures with their estimated energy savings:

Conservation Methods vs Utility Bill Savings

S. No:	Energy conservation opportunities	Estimated Energy Savings
1	Maintain air-conditioning units by annual checkups and adjustments.	15% of cooling cost
2	Maximize use of daylight	50 – 60% of lighting cost
3	Improve lighting maintenance	10% of lighting cost.
4	Turn of unnecessary lights	17% of lighting cost.
5	Reduce lighting	15-28% of lighting in existing buildings 25-50% of lighting in new buildings.
6	Use insulating glass	10-13% of cooling costs.
7	Insulate hot water pipes and storage tanks.	15% of water heating costs.
8	Provide adequate insulation for wall and roof	20% cooling cost.

Mr. Arun Seeralan B

Seminars & Workshops

3D Design using Creo Software

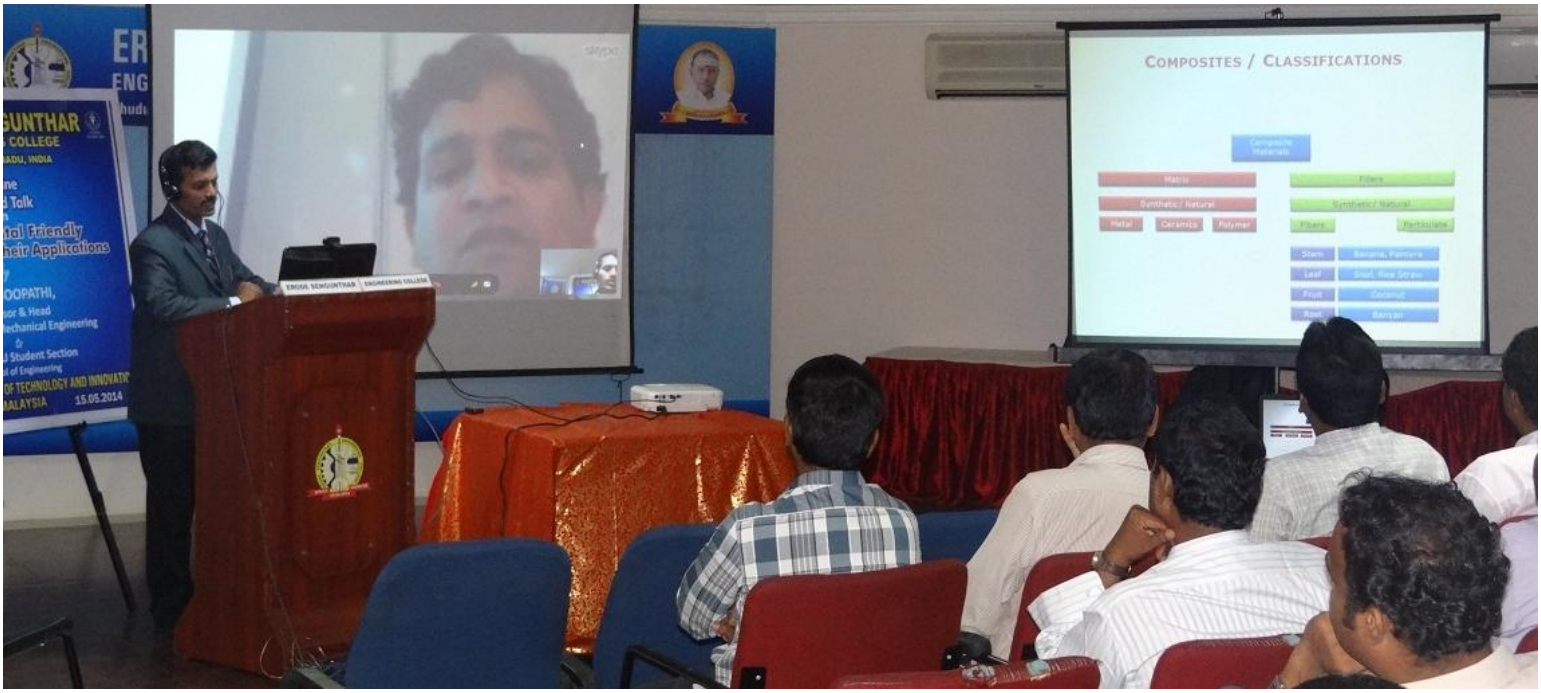
Mr Arun Conducting the Creo Application Workshop

3D modeling is at the forefront of product innovation and design. Using the right 3D CAD modeling software enables engineers to create, modify and optimize 3D designs quickly and in a flexible manner. Creo as a 3D modeling software enables the user to create faster and easier design cycles, enables the user to adapt to unpredictable design changes and to works seamlessly between multiple source of CAD data. A one day workshop 3D Design Using Creo was conducted by Mr. Arun Seeralan on Saturday, April 19, 2014. 22 students of SoE participated in the workshop. The participants had a hands on experience on 3d modeling using Creo.

SoE Students Who Attended the Creo Software Application Workshop

Seminars & Workshops

Environmental Friendly Composite and Their Applications



Prof Dr Boopathy Giving His Lecture on Composite Materials

The interest in eco-friendly or "green" composite materials is growing. Natural fibers, extracted from plants, are gaining attention as polymer-matrix composite (PMC) reinforcements due to their comparative advantages over synthetic fibers.. Natural fibers are relatively low in cost, are renewable and biodegradable. Their production systems are associated with low equipment wear and are very much energy efficient. A online technical talk on “Environmental Friendly Composites and Their Applications” was held on Thursday, May 15, 2014. The talk was first of its kind with an online telecast of the talk done by Prof. Dr. L. Boopathy from Erode Sengunthar Engineering College in Tamil Nadu, India to our staff and students at APU. Prof Boopathy gave an overview of the advantages and drawbacks of applying natural fibers, some of them relatively unknown, as reinforcements of PMCs. The mechanical behavior of composites incorporated with selected fibers was discussed in terms of the effect of surface micro-morphology and the fiber/matrix interaction. The online talk that was telecasted via skype at APU was attended by 90 students and 6 staff .

Attendees at the Broadcasted Seminar from India

Seminars & Workshops

Giving Back to Schools - Basics of Robotics Using Boe-Bot

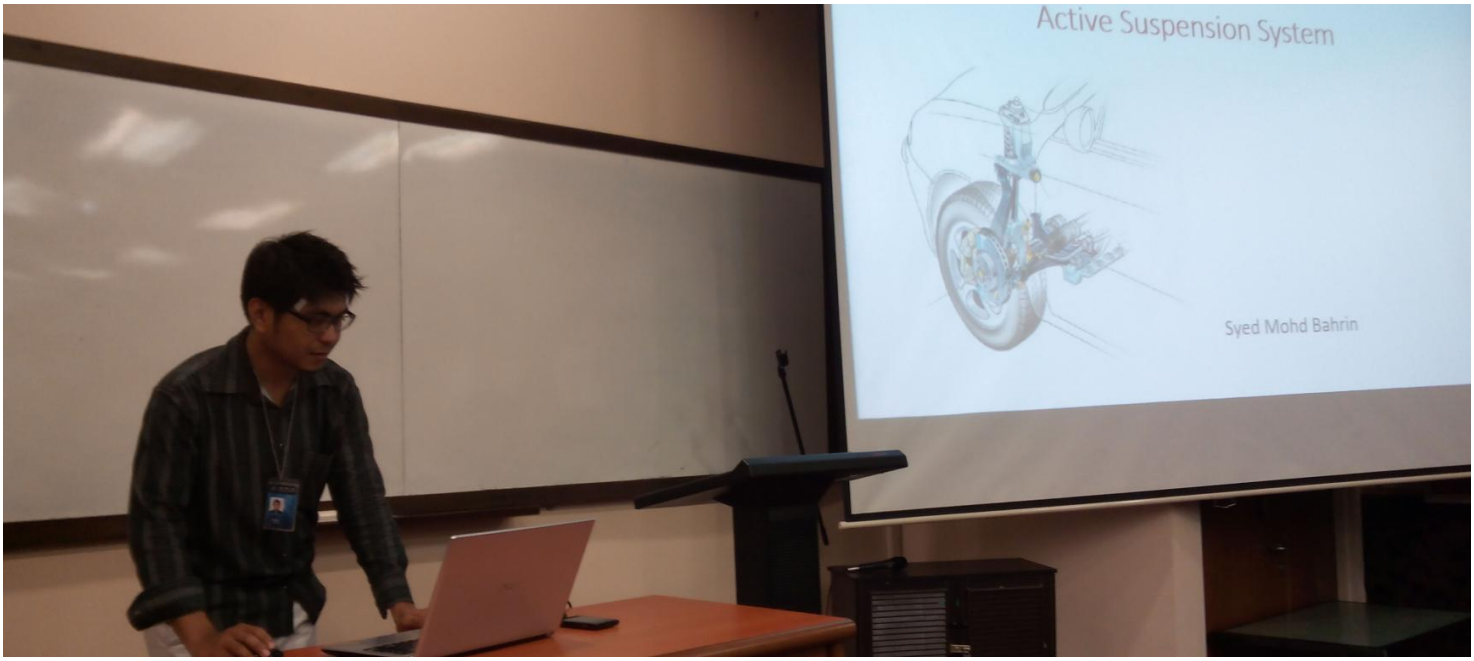
IASS Committee Members Rajaram and Andrew Teh in Action

On Saturday May 17, 2014, IEM-APU Student Section (IASS) together with the Institute of Engineers Malaysia (IEM) volunteered at SMK Bandar Baru Sg Long by conducting a workshop on 'The values of becoming an engineer', 'Who is IEM?' and 'Hands on Building of a Simple Robot'. A total of 4 APU-SoE students were involved in teaching the Form 1 girls the art of robotics. The students were Rajaram, Andrew Teh, Lik Wei and Priyesh. The students had a great learning experience to the point they could actually assemble and wire up a mini robot. Furthermore, SoE lecturers Suresh Gobee and Vicky Durairajah gave a briefing on the fundamentals of robotics which was a highlight as most of the students were already members of the school's Robotics Club. As a tribute to IEM, Dr Vinesh gave an awareness of the importance of Science, Technology, Engineering and Mathematics (STEM) as a forefront to the country's development and described the importance of the role an engineer plays in a developing country like Malaysia. It was a successful event with the school's Head of Science teacher Puan Siti requesting of a repeat event come this November for her Form 4 students.

IASS Members & Lecturers with SMK Bandar Baru Sg Long Teachers & Students

Seminars & Workshops

Vehicle Active Suspension System



Mr Syed Bahrin Conducting the Seminar

The active suspension and semi-active suspension are types of automotive suspensions that control the vertical movement of the wheels with an onboard system, rather than in passive suspensions where the movement is being determined entirely by the road surface. These technologies allows car manufacturers to achieve a greater degree of ride quality and car handling by keeping the tires perpendicular to the road in corners, allowing better traction and control. An onboard computer detects body movement from sensors throughout the vehicle and, using data calculated by opportune control techniques , controls the action of the active and semi-active suspensions. On Thursday, May 29, 2014, a seminar on “Vehicle Active Suspension System” was conducted by Mr. Syed Mohd Bahrin. The seminar gave a detailed demonstration of the pros and cons of active suspension systems to the automotive interest group of 8 students and 4 staff.

Lecturers & Students Who Attended The Talk by Mr Syed Bahrin

Seminars & Workshops

Energy Management

Mr Anand Sankey catching the Attention of our APU Students

Energy management includes planning and operation of energy-related production and consumption units. Objectives are resource conservation, climate protection and cost savings, while the users have permanent access to the energy they need. It is connected closely to environmental management, production management, logistics and other established business functions. An invited industrial expert talk on “Energy Management” by Mr. Anand Sankey, Director, Engineering and Maintenance, Western Michigan University was held on Friday, June 20, 2014. The interactive session was a detailed discussion on the energy management practices and procedures with the case study of practices adopted in Western Michigan University. 48 students and 10 staff who attended the session were excited with the case study of the practice of Western Michigan University in building automation and energy management.

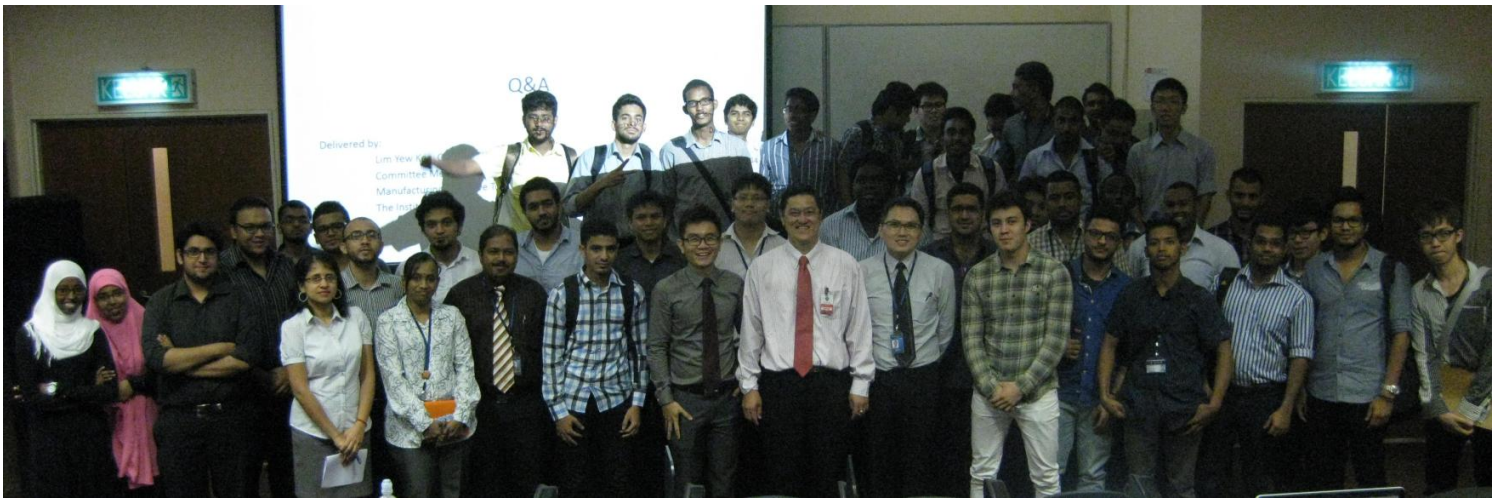
Attendees for the Industrial Talk

Seminars & Workshops

Pneumatic and Hydraulic Engineering

Mr Lim Yew Kee as is he introduced to APU

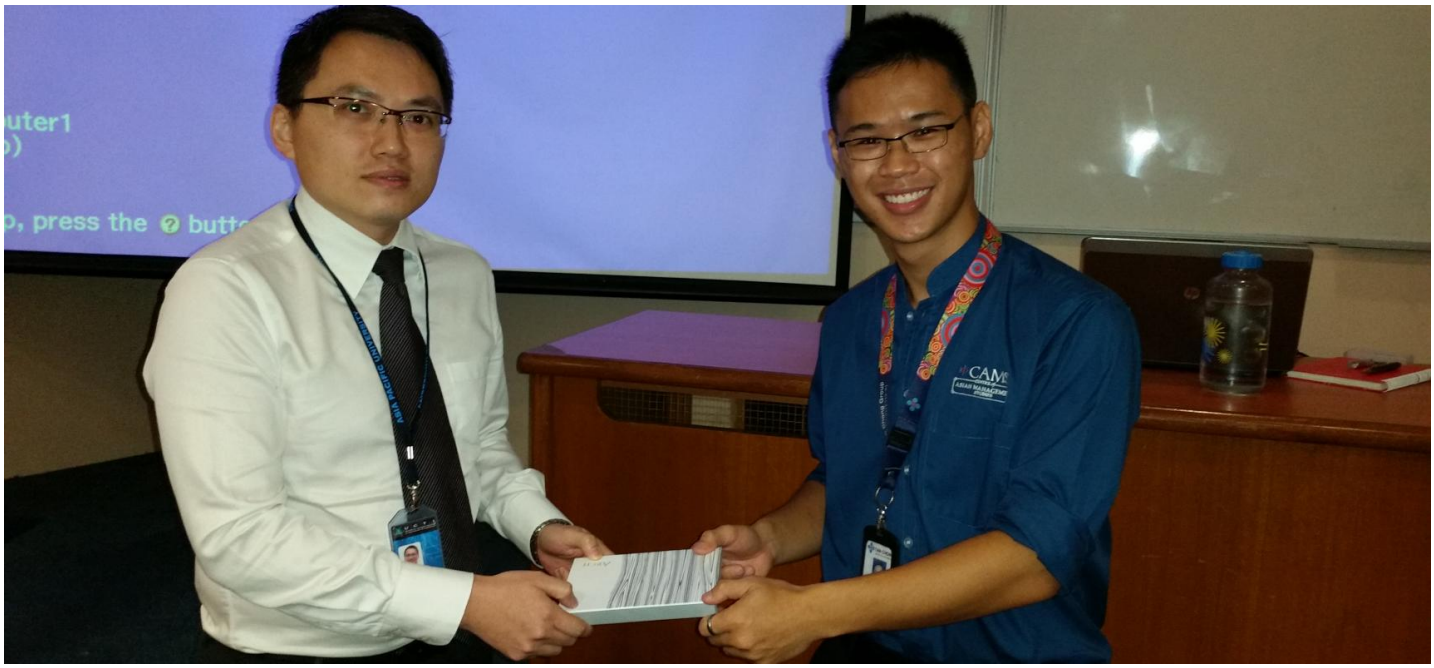
Machines of all types need power. Power allows the machines to do specific kinds of work. Two of the most efficient and compact forms of power for machines are hydraulic and pneumatic systems. Hydraulics and pneumatics can be configured into different types of power sources to lift, lower, pull, push, turn, rotate and move machines carrying tremendous loads. Tools can also be powered to break stone, join steel and cut wood. Hydraulics and pneumatics provide the energy to make work happen. A technical talk on “Pneumatic and Hydraulic Engineering” by Mr. Lim Yew Kee, CEng, MIET from the IET Malaysian chapter was held on Wednesday, June 18, 2014. The talk refreshed the knowledge of the audience on the basics and industrial applications of pneumatic and hydraulic systems. 53 students and 7 SoE staff attended the talk.



Attendees for the Industrial Talk

Seminars & Workshops

Tan Chong Motor Holdings Berhad



TCHM's Mr Johnson Chan Receiving a Souvenir from Dr Thang

TCMH Group (the Group) is today one of the largest national conglomerates involved in a myriad of business activities; from the assembly and marketing of motor vehicles and auto parts manufacturing to property development as well as trading in various heavy machineries, industrial equipment and consumer products - both locally and abroad. Tan Chong's Internship Programme provides you the opportunity to discover your strengths and apply your knowledge while acquiring real-life working experience in a fast-paced environment. Students will embark on an enriching journey where the internship is guided by mentors as they learn hands-on in the Tan Chong Group's diversified business landscape. The career talk by Mr. Johnson Chan, TCHM Group on Thursday, June 26, 2014 was an invitation and guidance for the student audience to take up their internship with TCHM. 30 students and 5 SoE staff attended the talk.

Attendees for the Career Talk by TCHM

Industrial Visits

Proton Manufacturing Plant

The Proton Shah Alam Manufacturing complex includes the original Main Plant and Multi Vehicle Factory (MVF) that contains a separate engine machining and assembly building within the complex where cylinder blocks, crankshaft and cam shafts for the CamPro engine are machined and subsequently assembled. The plant currently produces the Saga, Waja and Arena models. On Tuesday, April 8, 2014 a group of 23 students and 3 SoE staff visited Proton Manufacturing Plant at Shah Alam. The visit geared up with the protection and safety precautions. With a brief demonstration with the blue print of the manufacturing process, the participant students were then driven through every stage of the manufacturing process, namely the pressing , paint shop engine assembly and finally the drive test and quality check process.

APU SoE Students at Proton with the Academic Team

Industrial Visits

SIRIM Sdn Bhd

SoE Students Paying Attention to the SIRIM Briefing

For nearly five years, SIRIM has provided surgeons with the likes of 3D Biomodelling services. Every titanium plate produced at the Biomodelling Centre in Bukit Jalil is delicately knocked, bent and sculpted into shape by hand, allowing surgeons to plan their surgeries with greater precision than ever before. The patient's X-ray computed tomography (CT) scans gives SIRIM's Biomodelling technicians a geometrical map of the trauma site and helps them build a model of what the skull should look like, although it takes quite a bit of work to go from x-ray to the actual biomodel. Fortunately, three-dimensional imaging and rapid prototyping technologies now allow us to 'print' 3D models of patients' skulls from CT and MRI scans, so that surgeons can test titanium implants and make the most detailed revisions and corrections to them before the actual surgery takes place. On Friday, April 25, 2014 26 students accompanied by 3 SoE staff visited SIRIM, Bukit Jalil to witness the 3D modeling and printing technology.

APU Attendees for the SIRIM Visit

Industrial Visits

TAMCO Switchgear Sdn Bhd

SoE Students inside the TAMCO Factory

Tamco Switchgear (Malaysia) Sdn Bhd, is an established manufacturer of medium (air and gas-insulated switchgears of up to 40.5kV and Ring Main Units) and low voltage switchgears. On Friday, June 6, 2014, 20 students accompanied by 3 SoE staff visited TAMCO. The visit was co-organized by IEEE-PES (Power and Energy Society) under the supervision of Ir Zain Abduallah. The visit started with a brief welcome and introduction by Mr. Mazlan – Administrative Manager. The students were guided by the employees of TAMCO in small groups around the industry where they were briefed on every stage of manufacturing process for VCB Switchgears and Ring Main Units. The visit finished with a talk by Ir.Razali Budin, Senior General Manager of TAMCO which emphasized on students preparing themselves for engineering in the real world.

Ir Razali Handing a Souvenir to Dr Vinesh as Witnessed by Ir Zain

SoE Competitions

Malaysian Materials Lecture Competition 2014

School of Engineering student, Kudzai Nigel Chitewe, has created another astonishing record for APU as he bagged the Second Prize at the Malaysian Materials Lecture Competition 2014, which concluded on 14 May 2014, at the Dewan Merdeka, Putra World Trade Centre (PWTC). He was mentored by Jacqueline Lukose, Lim Siong Chung and Dr Lai Nai Shyan from SoE. Thumbs up to Kudzai, and Kudos to the mentors for guiding him towards this stellar achievement. The competition was organized by the Institute of Materials, Malaysia (IMM) in conjunction with the 9th International Materials Technology Conference & Exhibition (IMTCE) 2014. Kudzai has initially won the in-house APU Material Lecture competition on 21 February 2014, and then proceeded to achieve a finalist position in the National Semi-Finals held at UiTM Shah Alam on 3 April 2014. He was the only international student from the only private institution among the finalists. Kudzai has received a cash prize of RM2,000 and a certificate to recognize his efforts put in for the competition.

The 5 students from IMM Competition Finalist

SoE Competitions

ITEX 14
25th International Invention, Innovation and Technology Exhibition

From Left – Dr Thang, Mun Chung, Alex, Zhi Chan, Cleopatra, Syed, Mr Pang, Dr Vinesh

Two teams of students from School of Engineering (SoE) have successfully attained the Gold and Bronze awards in the recently concluded 25th International Invention, Innovation and Technology Exhibition (ITEX), which was held at the Kuala Lumpur Convention Centre (KLCC). The Gold winning team members comprises of Cleopatra Musa and Syed Abdullah. The team proposed an innovative solution titled 'Safe & Secured Motorcycle System (SSMS)' mentored by Assoc Prof Ir Dr Vinesh Thiruchelvam and Mr. Pang Jia Yew. Bronze winners Lim Zhi Chan, Alex Teoh and Ho Mun Chung came up with another innovation title 'Motorized Folding Seats for Special-Care Group' mentored by Dr Thang Ka Fei. It was indeed a great achievement and this has once again proven that our students possess qualities that are able to meet industry expectations and standards.

SoE Collaborations

ServerPak Sdn Bhd

On the 10th of April 2014, APU-SoE signed an Memorandum of Agreement with ServerPak Sdn Bhd to allow for collaboration on Final Year Projects and Internships. ServerPak was represented by Mr CJ Ong, Technical Director in the signing session. To date one student has already started on a FYP with ServerPak, Lesedi Kolobe with a title, 'To build a high level cloud computing platform that securely manages, standardizes and provides high availability to server clusters' under the supervision of Dr Thang Ka Fei.

SERVERPAK SDN BHD

General Machines, Pakistan

On the 1st of May 2014, APU-SoE signed an Memorandum of Agreement with General Machines, Lahore, Pakistan to allow for collaboration on Final Year Projects and Industrial Collaborations. GM was represented by Mr M. Ibrahim Sheikh, Managing Director in the signing session. To date this has been SoE's 2nd International industrial collaboration. One student has already started on a FYP with GM, Imran Sheikh with a title, 'Electronic Synchronization Of Horizontal Flow Packing Machine With Online Diagnosis System' under the supervision of Mr Chitturi Venkatratnam.

GM

Omron Electronics (Malaysia)

On the 13th of June 2014, APU-SoE signed an Memorandum of Agreement with Omron Electronics (Malaysia) to allow for collaboration on Final Year Projects. Omron was represented by Mr Tiong Khe Hock, Director in the signing session. The discussions that have been taken place have been very positive and the first project has been approved which once completed will be showcased at the Omron office in Petaling Jaya. Details as follows;

Smart-Platform for the following tasks:

- Pick and Place
- X-Y Table
- Heating
- Vision-inspection
- PID Control

OMRON

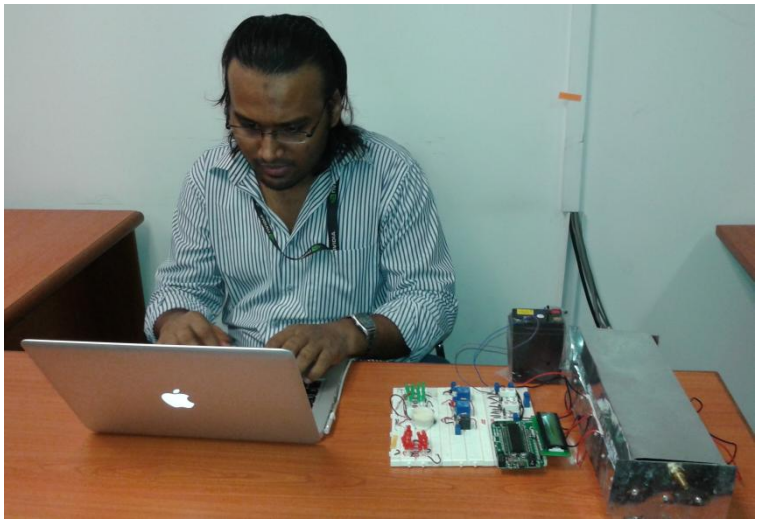
APU Earth Day Celebration

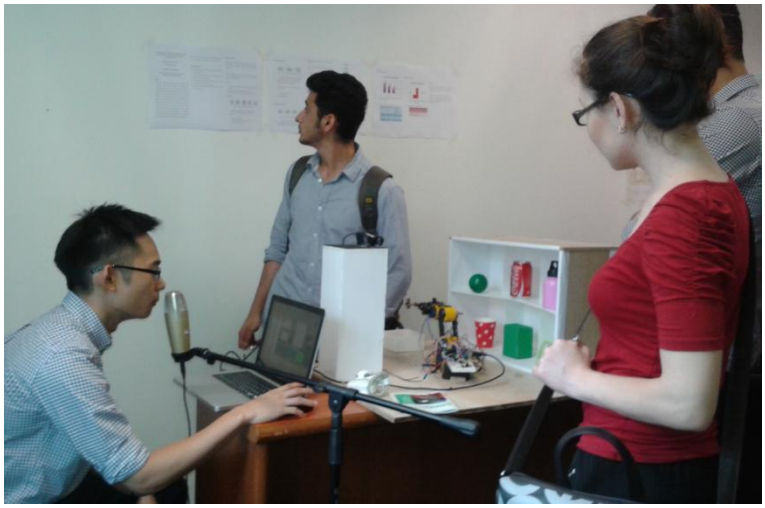
APU held its first Earth Day event on the 21st of April 2014. It was a joint effort between the Centre of Awareness for Sustainability and the Environment (CASE) and the student group – Green Environmental and Technology Club (GREAT). The Earth Day event basically a whole day session of industrial talks by experts in the field of green technologies, sustainability and representatives from the government sector. It was officially opened by Datuk Ir Ahmad Fauzi bin Hasan the CEO of Energy Commission Malaysia. In his speech he briefed on the importance of energy utilization in relation to the Vision Malaysia 2020 plan. APU's industrial partners were also invited to demostrate their green products and this was supported by KVC Electrical Sdn Bhd and Ecosensa Sdn Bhd.

SMK (P) Sri Aman was also invited and their green band peformed on stage using recycled prodcuts which banged out quite a few good numbers reflecting the latest Billboard top 100 songs. Some of the industrial experts were invited from Mr Mathias Gelber from Maleki GmBH, TNB Research Sdn Bhd's Dr Hariffon Boosroh, Prof Ir Kannan from UNIDO, M/s Sumitra from the Malaysian Red Cross, Ar Loo Kok Hoo the principle at A-Code Architects and UKM-SERI's Dr Chan Hoy Yen.

What was interesting from the talks given by the industrial experts was that a lot of studies and measures have been taken but the simple fact of human mentality on climate change and the concerns of the environment have been yet to mature. The contrast difference between the poor and the rich has a reason to do with this. Stricter government policies do help but awareness on these concerns have to be sent through before it gets too late. The student group carrying the green and environment flag in APU did well during the event. They sold recycled products and assisted in the management of the event especially for activities in the foyer. They also came up with a video montage for Earth Day and it was beautiful as expressed as well by the guests for the day.

SoE FYP Presentations Apr - Jun 2014





Students From
UC4F1307 EEE-EEIT-TE-ME

Analytical Method for Gain Analysis of A Double Balanced Gilbert Cell Mixer

Arnold G. Ruhumbika, Dr. Raed Abdulla

Abstract

A novel analytical approach for gain analysis of a double balanced Gilbert Cell Mixer is presented on this paper. An initial design of a gilbert cell mixer with differential transistor pair for the core mixer and low noise amplifier for the RF input is evaluated. The method aims on showing how the gate width and length have an effect on the mixer conversion gain, and further an evaluation of how tuning resistive loads could maximize the gain by almost +200% is demonstrated.

Introduction

Mixers play an important role in wide band communication systems, which use heterodyne system architectures at millimeter wave carrier frequencies [1]. Most of the Radio Frequency (RF) systems require mixers so as it can act as a translating device [2]. Example in receivers a mixer is used to convert the RF input frequency to an Intermediate frequency (IF) or baseband signal for easy signal processing, also a mixer is used in transmission systems to convert the frequency to a higher RF or higher IF frequency for transmission.

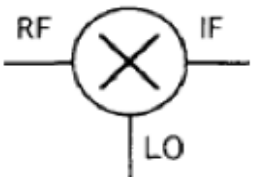


Figure 1. RF three port mixer

Proposed Design

The active Gilbert cell mixer tested is shown on figure 2. Mosfet 5-6 represents the transistor differential pair which its main purpose is switching the signal and the output is taken at v_{out} 1 and v_{out} 2, the switching at these transistors happens very fast, when Mosfet 1 & 3 are conducting the other pair is off and the process is reversed, this function multiplies (mixes) the signal coming from the transistors beneath. Mosfet 1-2 is the trans conductance (gm) stage, this should calculated theoretically through mathematical equation on how gm can affect the conversion gain.

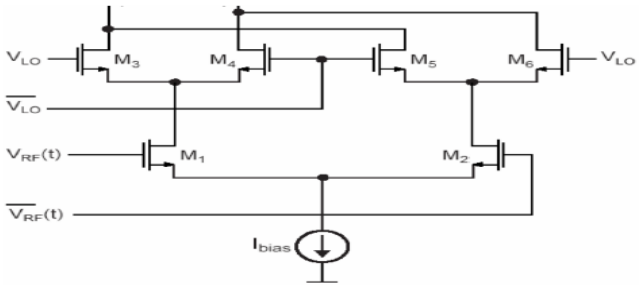


Figure 2. Gilbert Cell Topology

Mathematical Analysis

The mathematical analysis for gain derivation on a double balanced Gilbert cell mixer is represented in Figure 3.

$$I_1 - I_2 = (I_{DC} + I_1 \cos \omega_{RF} t)S(t) \quad (1)$$

$$I_4 - I_3 = (I_{DC} - I_{RF} \cos \omega_{RF} t)S(t) \quad (2)$$

$$I_{01} = I_1 + I_3 \quad (3)$$

$$I_{02} = I_2 + I_4 \quad (4)$$

$$I_{od} = I_{01} - I_{02} = (I_1 + I_3) - (I_2 + I_4) \quad (5)$$

$$= (I_1 - I_2) + (I_4 - I_3)$$

Simulation Analysis and Results

RF power (dbm)	Channel Length (um)	Channel Width ($10^{-4}m$)	Resistive Load (ohm)	RF voltage (V)	Maximum Conversion gain (dB)
-30	0.4	8	200	0016/12590	1.4
-30	0.3	9	200	0016/129062	2.133
-30	0.3	10	200	0016/12933	2.607
-30	0.3	10	360	0016/12962	4.412
-30	0.3	10	560	0016/12970	4.949

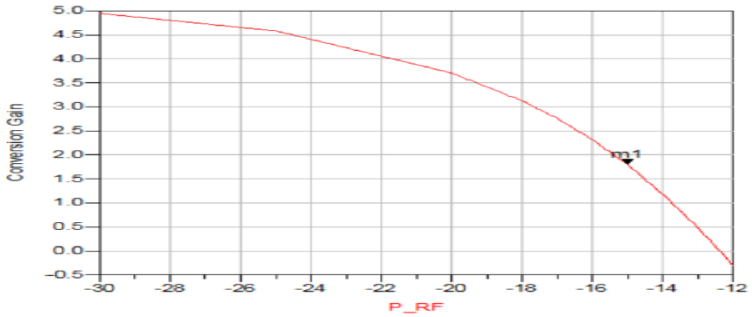


Figure 3. Conversion gain vs RF input power sample 5

Conclusion

This paper has presented two major methods of gain improvement in Gilbert cell mixers, the methods involved increasing the channel width of the MOSFET while keeping the channel length at minimum, this method has proved well by increasing the gain by 200% as seen in the results, increasing the resistive loads also has proved to have a positive results on gain, and together both methods have improved the gain by almost 300% from 1.39 dB to 4.9 dB. Increasing the bias current can do further improvement on gain however it can be limited to power requirements.

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Low Power, High Speed XOR gate for Portable Microcomputer Applications

Veeraiyah Thangasamy

Abstract: A XOR gate is designed and presented using 130nm CMOS process. The presented XOR gate has only 4T compared with the conventional XOR gate which has 12T. The designed XOR gate has a delay of 6.6 ps and power consumption of 1.37 nW. Where as the conventional design has 78 ps delay and power consumption of 2.93 uW. Thus the proposed XOR design is 11 times faster in speed and 2000 times lower in power consumption. Thus the proposed design will best suit for high speed and low power deign of ALU circuits.

I. Introduction: The demand and popularity of portable electronics is driving designers to strive for smaller silicon area, higher speeds, longer battery life, and more reliability. Power is one of the premium resources a designer tries to save when designing a system. Figure 1 shows the power consumption breakdown in a modern day high performance microcomputers [1]. The datapath consumes roughly 30% of the total power of the system. XOR gates are the extensively used component in datapaths and, therefore, careful design and analysis is of the XOR gates will contribute significant saving of power.

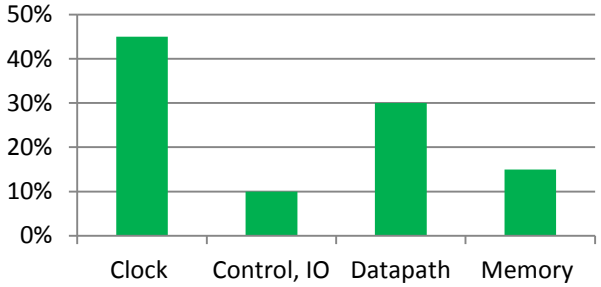


Figure 1: Power consumption breakdown in microcomputers

II. Design: The truth table of the XOR gate is shown in Table 1, and its logical expression is given in Equation (1).

Table 1: Truth table of XOR gate

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

The conventional implementation of XOR gate is shown in the Figure 2 which has 12T. The modified new XOR gate is shown in the Figure 3 which has only 4T

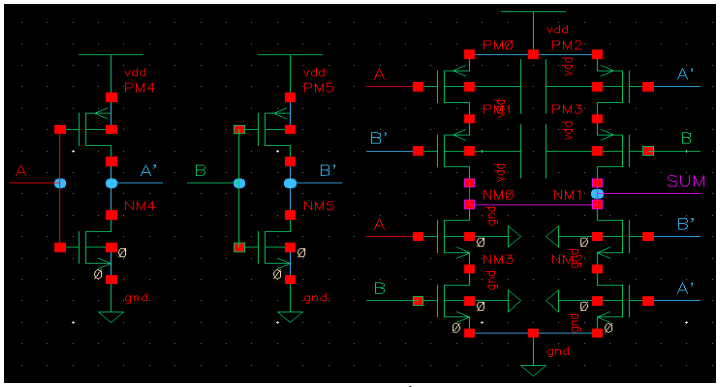


Figure 2: Conventional 12T XOR gate

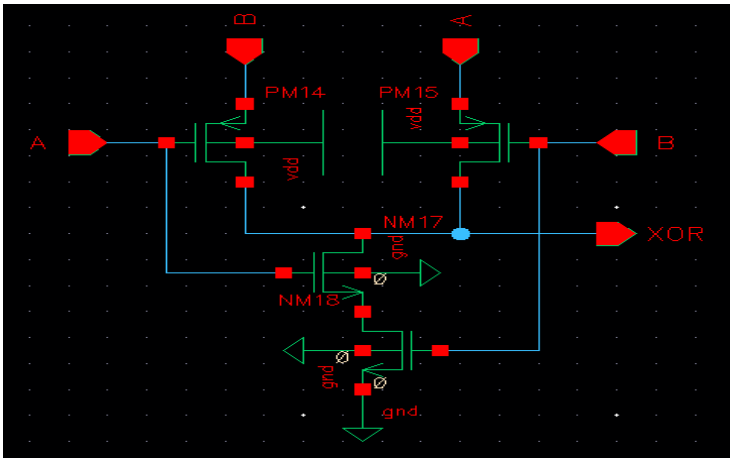


Figure 3: New 4T XOR gate

III. Simulation Results

The designed XOR gate was simulated using Cadence Spectre and the input/output waveform are shown in the Figure 4. Delay, power and PDP (power delay product) are the figure-of-merit parameters to evaluate digitals circuits. As such these parameters are determined from the simulation and are given in the Table 2. The results show that the new 4T XOR gate is 11 times faster in speed, 2000 times lesser in power consumption than the 12T XOR gate.

Table 2: Performance Comparison.

Delay	79 ps	6.6 ps
Power	2.93 µW	1.37 nW
PDP	2.3 xJ	9 xJ

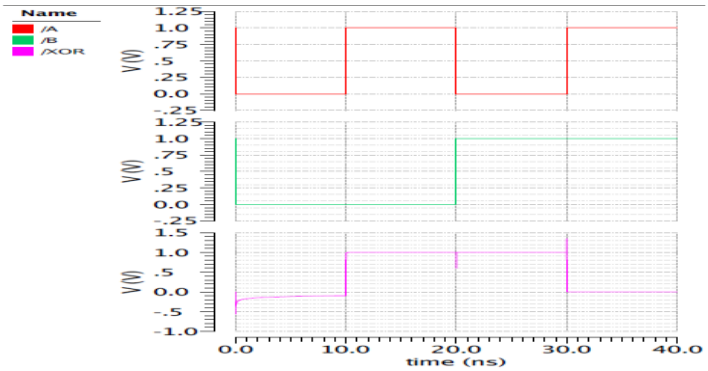


Figure 4: Waveforms of the new 4T XOR gate

IV. Conclusion

The new 4T XOR gate will find potential application in the design of high speed low power ALU circuits for any computing machines.

References:

[1] Goel, S., Kumar, A., Bayoumi, M.A., "Design of Robust, Energy-Efficient Full Adders for Deep-Submicrometer Design Using Hybrid-CMOS Logic Style", Very Large Scale Integration (VLSI) Systems, IEEE Transactions on , vol.14, no.12, pp.1309-1321, Dec. 2006

My Journey through Materials Lecture Competition 2014

Kudzai Nigel Chitewe

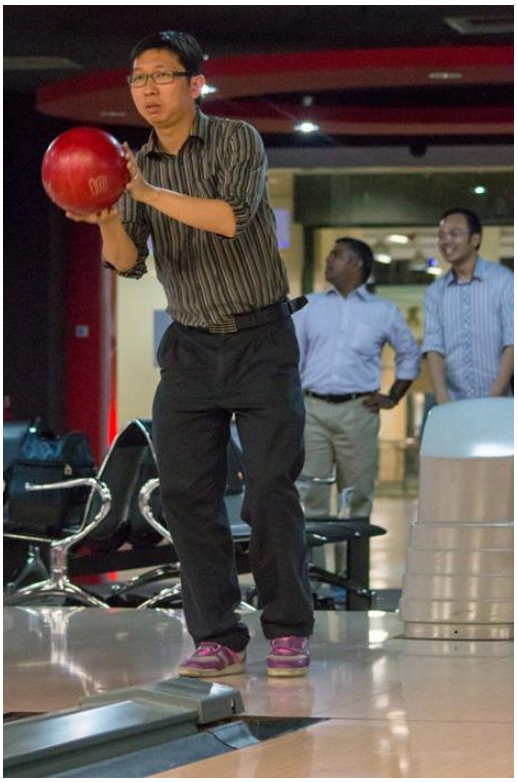
As they say, “a journey of a 1000 miles begins with a single step’’. The first in house competition ‘APU Materials Lecture Competition’ held at APU was one of the first exhilarating steps before many. The level of judging that I faced was far greater than the one I faced in the semi-finals and finals of the Materials Lecturer Competition organized under IMTCE 2014 between May 13 and 16, 2014 at KLCC, Kuala Lumpur, Malaysia. The training that followed was fierce yet necessary to make me shine brighter than most. The supervisors who were responsible for my training and my results were Ms. Jacqueline Lukose, Dr Lai Nai Shyan, Mr. Lim Siong Chung and Dr Lim Wee Han. They guided me every step of the way. They scrutinized everything to the last detail including my dress code, body language and speech pattern. I vividly remember one of the many mistakes I made was repeating the word “so” and the training was to the extent that my supervisors counted the number of times I mentioned it in my presentations .My training comprised of presenting repeatedly to various audiences until all errors and stage fright were eliminated. The semifinals came and though I was nervous but the training I had gone through came in handy and resulted in the moderator commending me at my ability to respond to questions. The finalist which I met at the competition and those that did not make it became very dear friend’ to me whom I even keep in contact on social media to date.

One week after the semifinals, I was back to the drawing board and more training followed. I took all the criticism and the hints given during the previous competition and reinvented the power point slides into something very daring. The final product was a PowerPoint slide that had marvel characters’ animations. At first I was quiet skeptical to submit such material for a national event, but the more I presented , the more I started to believe I could have not picked a better comparison. The final competition came with much complication as it came with an unforeseen setup. A technical difficulty was faced at the very opening of my presentation but as per my training I stopped, composed myself and continued to present. Having my friends and supervisors present at the event allowed me to set my eyes on familiar faces when my nerves began to kick in. When the results were announced my heart was joyous and my mind was in shock. At the end of the whole experience I have learnt more than I had ever imagined was possible in the use of PowerPoint, Presenting and Competing in a Malaysian National Competition. The way I conveyed my knowledge and portrayed it have shown me a whole new light and I would encourage any aspiring student colleagues to sign up next time around as the experience will be nothing less than priceless.

APU Bowling Session

Dr Thang

Dr Lai



Brian Lim

Talk about not getting enough of bowling when SoE's held its own bowling session last year and now here we go again. You can't get enough of it cause everyone wants to vent their frustrations by just throwing some bowls on to pins. 2 teams from SoE took part in the recent APU staff bowling tournament for 2014. It was a fun event and at times it created some tension as well in trying to uplift the performances. SoE thanks APU Management and organizers for making the tournament possible and it gave some of the staff to just relax and wind down in a social event as such.

Sardar Ali

Niranjan

Arun

SoE Conferences

7th Asian School of Renewable Energy

From the 16th to 20th of June 2014, 2 of our APU SOE students who are currently attached as interns at UKM-SERI under the supervision of Dr Chan Hoy Yen from UKM, were selected to attend the 7th Asian School of Renewable Energy at Hotel Puri Pujangga, UKM. Both Akif and Moussa Mbarouk Shaaban obtained great exposure listening to industrial expects sharing their design and project experiences in the field of wind turbines, wave energy, hybrid systems, fabrication laboratories for PV panels and capturing of hydro energy to list a few. The same workshop was also attended by SoE's Mr Syed Bahrin who was mesmerized by the technology used for PV construction.

The students at UKM-SERI have made APU and SoE proud as the feedback received has been to date very positive. SERI-UKM has 5 open positions for internships in engineering at the research centre.

Akif & Moussa at UKM

TEACHING IS ALWAYS AN HONOURABLE PROFESSION, BE PROUD TO BE IN EDUCATION

If you would like to be a part of the 'Engineers Insight' editorial team or have an article/paper published please contact: shankar@apu.edu.my