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ASIA PACIFIC UNIVERSITY OF TECHNOLOGY & INNOVATION
SCHOOL OF ENGINEERING

ENGINEERS INSIGHT

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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.

In this volume

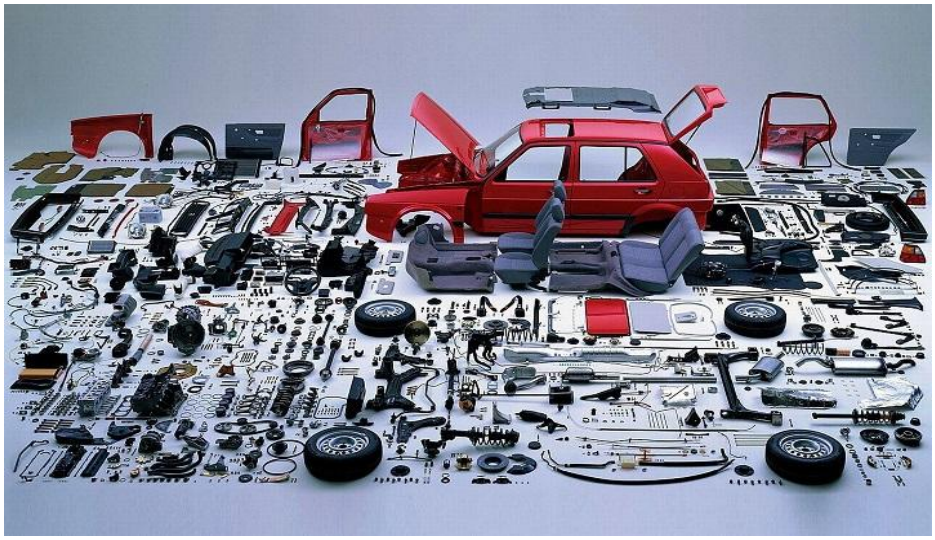
Lead Editor
Shankar Duraikannan

Editorial Team
Prof Dr Ir Vinesh Thiruchelvam

Contributors
Dr.Thang Ka Fei
Dr. Lai Nai Shyan
Dr. Raed Abdulla
Mr.Ajmal Hussain Shah
Ms. Hamid Md Qasem Rasheda
Ms.Shamini A/P Patpanavan
Ms.Vickneswari A/P Durairajah
Audrey Linda Fernando

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

ENGINEERING TECHNOLOGIES FOR THE AUTOMOTIVE INDUSTRY



Automotive Engineering (Shenzhen Powerstar Technology Limited)

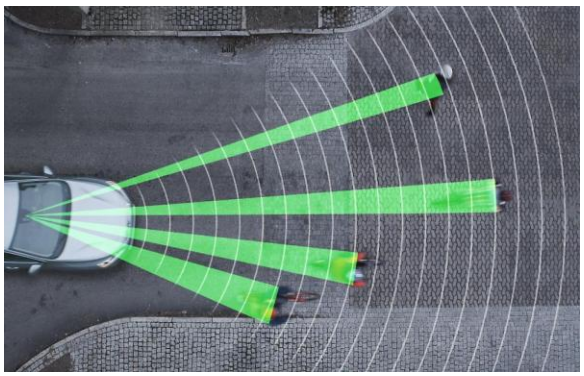
Innovative technologies for the consumer industry are moving at a fast-pace. Take Google Glass and the Smart Watch as examples, they are wearable devices designed to connect users to the net and hence augment users with a wealth of information anytime, anywhere. When it comes to the automotive industry, the use of technologies are limited to push-start systems, reverse sensors and automatic rain-sensing wipers! Well, not anymore as a whole host of new technologies based on *engineering* systems have been introduced to the public with the aim of enhancing safety and providing convenience to the drivers and passengers alike. The keyword highlighted here is *engineering*, as without the research and development efforts, or ingenuity of engineers, these technologies would not be realized at such a fast pace. Let's us start by reviewing several new engineering technologies in the automotive industry and explore the relevance of these technologies to the modules students are currently studying:-

Pedestrian Detection and Anti-Collision

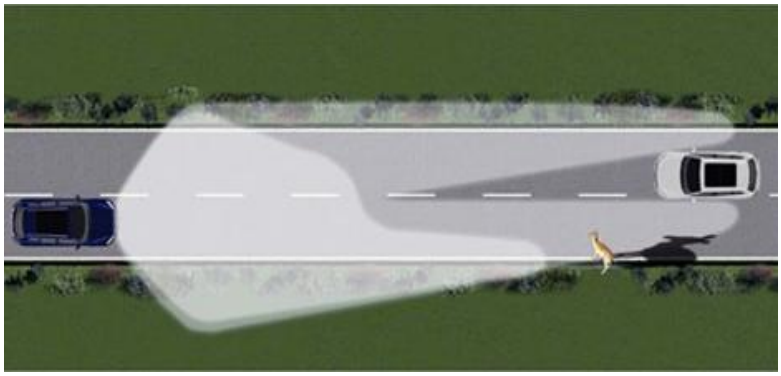
Manufacturers such as Volvo, BMW and Mercedes have introduced imaging systems that can recognize pedestrians, cyclists and other objects that may pose safety concerns for the drivers, particularly at night, and alert the drivers via augmented-reality (AR) means. The augmented information, usually in the form of warnings and highlighted objects, will be projected onto the windscreen and/or displayed on the dashboard screen. These technologies involve engineering concepts such as digital signal and image processing, as well as sensors and actuators if further alert is required as in the form of steering/pedal vibration.

Automatic Headlight Control

Several luxury car manufacturers are now offering systems that automatically illuminate and dim the high-beam of the car headlight to the approaching traffic to improve driver safety. In addition, manufacturers such as Mercedes have deployed a new lighting technology in S-Class model that adaptively changes the beam of the headlight to maximize the area of illumination. Again, these systems engage digital image processing technologies via mounted cameras that monitor and process the real-time information acquired.



Volvo's Anti-collision System (www.fourteenisland.com)



Volkswagen Dynamic Light (www.volkswagen.com)

Around-View

The Around-View system can assist drivers to park or to move out their vehicles more easily by having a 360-degree view of the vehicle's surroundings, available through a virtual bird's-eye view from above the vehicle or at the left-right and back of the vehicles. The Around-View system helps the driver to visually confirm the vehicle's position relative to the lines around parking spaces and adjacent objects, allowing the driver to maneuver into or out of car parks with great ease and safety. Examples of manufacturers offering such systems are Lexus, Nissan, Infinity and BMW.

Connected Infotainment Systems

With advent of high-speed data and with powerful processors, consumers can now access to useful information via tablets and smart-phones. They would want to have the same access in their vehicles as well and this is exactly what Apple and Google are aiming at with the availability of the Apple CarPlay and Google Android Auto systems, in addition to other existing proprietary embedded OSs. These are the systems that mimic an iPhone and Android smartphone's functionality that in turn allows users to access maps, music, videos and messaging, among many others. In addition, with GPS and connectivity to the internet, autonomous-driving may then be experienced with each connected vehicle broadcasting its actual location and via intelligent traffic management that aims at analyzing traffic patterns, avoid bottlenecks and identify potential dangers.

Around View Monitor System (www.autoorb.com)

Weblink to Sync Smart Phones with Car (www.telematics. info

In conclusion, we are now at an exciting age of time in which new automotive technologies are being introduced constantly which aim at easing drivers' convenience and improving safety. If a student has recently graduated, this is an exciting time to work as an engineer and to be part of the driving-force behind. Finally, if one is still studying for an engineering Degree, one can sharpen skills via group-based complex-engineering problem (CEP) projects as well as final-year projects. Eventually a student may be developing proto-types that serve as new automotive system of the future.

Dr. Thang Ka Fei

BUILDING A SUSTAINABLE FUTURE IN CONSTRUCTION

Construction is the creation of something that is different from the materials that went into it (Free Dictionary) or it can be defined as clearing, dredging, excavating and grading of land associated with buildings, structures, bridges, etc. (Business Directory). The concept of sustainability embraces the preservation of the environment as well as critical development-related issues such as the efficient use of resources, continuous social progress, stable economic growth and the eradication of power. Sustainable construction involves practising sustainable activities from the inception of a project till the demolition of the project itself. A construction project life cycle is composed of five major processes; inception, design, construction, operation and demolition. Each project incorporates elements of economic efficiency, environmental performance and social responsibility and a balance has to be found between all these elements. Social sustainability is to improve the quality of human life, to implement skills training and capacity enhancement of the disadvantaged, to seek fair or equitable distribution of construction social costs, and to seek intergenerational equity. The economic sustainability is to ensure financial affordability to the intended beneficiaries, to promote employment creation; to enhance competitiveness, to choose environmentally responsible suppliers and contractors, and to maintain capacity to meet the needs of future generations. The biophysical sustainability is to extract fossil fuels and minerals at rates which are not faster than their slow redeposit into the Earth's crust. This can be achieved by reducing the use of 4 generic resources (namely, energy, water, materials, and land); by maximising resource reuse and/or recycling; using renewable resources in preference to non-renewable resources to minimise air, land and water pollution and to maintain and to restore the Earth's vitality and ecology. Li Yi-Shen *et al* (2007) in his paper titled 'A checklist for assessing sustainability performance of construction projects' listed major attributes affecting project sustainability performance in a consistent and holistic way across the project life cycle from the inception to demolition stage. The following are some of the attributes:

Economic sustainability factors

Inception stage

- Evaluation of local, regional, national and global market supply and demand of current similar products/ projects and in the future
- A project should serve the local economy and take advantage of the infrastructure in the local economy to generate economic benefits
- Analysis should not be focused on stage or sectional profits but the total profit from operating a construction project across its life cycle

Project Design Stage

- Consider the total cost involved in project life cycle, including site formation, construction, operation, maintenance cost and demolition cost
- Consideration has to be given to economy, durability and availability of material selection

Project Construction Stage

- Fees paid to professionals and consultants such as engineers, environmental, ecological and geological.
- Costs for all types of materials such as concrete, lime, steel, timber, bamboo, and brick
- Costs for consuming various types of energy such as electricity, oil, gas, coal and water resources
- Various types of measures for protecting the site safety

Project Operation Stage

- Develop a balance sheet to continuously check with the project cost and time Salaries for managerial staff, workers, professionals, and engineers
- General expenses of daily water, electricity, gas, and consumables
- Resource investment for market analysis, advertising, and promotion
- Training employees for improving the quality of human resources
- Consideration being given to benefit economically to the local society

Project Demolition Stage

- Human resources provided for planning, managing and operating project demolition (Labour cost)
- Costs for waste loading and unloading, transportation, charges for disposals
- Compensation made for the damaged environment to the local residents, land, water, and ecosystems
- The value of the land after demolition for re-development
- Valuable residues, such as steel, brick, timber, glass, equipment for reuse and recycle

Social sustainability factors

Inception stage

- Considering that the land selection for project site should protect cropland and natural resources.
- Avoiding negative impacts from project development on any cultural heritage
- Project implementation should be able to provide local employment opportunities
- The project improves local infrastructure capacity, such as drainage, sewage, power, road, and communication, transportation, dining, recreation, shopping, education, financing, and medical

Project Design Stage

- Considerations are given in designing process for emergencies such as fire, earthquake, flood, radiation, and eco-environmental accidents, operation, maintenance cost and demolition cost

Project Construction Stage

- Provisions of working opportunities from implementing the project to the local labour market, including construction workers, professionals, and engineers
- Provision of warning boards and signal systems, safety measures and facilities for the public
- Provisions of better drainage, sewage, road, communication, heating, and electrical systems

Project Operation Stage

- Costs for employing workers, managers, and professionals
- Benefits of improving living standards of the local communities
- Provision of spaces and facilities beneficial to the development of local communities

Project Demolition Stage

- Provision of land upon the completion of project demolition to enable the implementation of new projects according to the demands of local community and public awareness
- Job opportunity - Provision of jobs during project demolition for site work, transportation and disposal
- Presence of safety risks to workers and the public during project demolition from explosion, dismantling, toxic materials, and radioactive materials

Environmental sustainability factors

Inception stage

- Examining potential ecological risks and benefits associated with the proposed project
- Examining potential air pollution from the proposed project and its impact on the local climate
- Examining potential water pollution from the proposed project, including both surface and ground water.
- Examining potential noise pollution during both project construction and operation stages
- Examining waste generation at both project construction and operation

Project Design Stage

- Knowledge of energy savings and environmental issues
- Effective communications among designers, clients, environmental professionals, and relevant governmental staff to ensure all environmental requirements are incorporated into the design process
- Incorporation of all environmental considerations into project design for construction, operation, demolition, recycling, and disposal
- Use of modular and standardised components to enhance build ability and to reduce waste generation

Project Construction Stage

- Utilising land effectively and the measures taken to avoid land pollution
- Protection of living environment for both human beings and animals
- Generation of CO_2, CO, SO_2, NO_2, and NO
- Noise and vibration induced from project operation
- Release of chemical waste and organic pollutants to water ways
- Waste produced from project operation
- Effects on people's living environment and the balance on eco-systems
- Saving energy and resources consumption including electricity and water

- Ensuring on-site health and safety by reducing the number of accidents, providing on-site supervision, and providing training programs to employees
- Using typical renewable materials such as bamboo, cork, fast-growing poplar, and wheat straw cabinetry, which are reproducible
- Reducing the release of chlorofluorocarbons and hydro-chlorofluorocarbons thus protecting the ozone layer
- Reuse of building components, rubble, earth, concrete, steel and timber
- Consideration being given to the reduction of earthwork and excavation, formwork, reinforcement, concreting and waste treatment during structural operation
- Controlling environmental impacts from walling, roofing, insulation, component installation, plumbing and drainage, painting, landscaping, and waste treatment
- Emphasis on site hygiene, and the provision of health care and safety
- Environmental management task force, resource coordination, supervision and cooperation culture
- Resource inputs for implementing environmental management, including labour, plant, materials and finance
- Establishment of environment management system, application of environmental management standards such as ISO 14000, project manuals, programs, progress control reports
- Environmental experts, environmental management facilities, energy and resource saving technology, pollution reduction technology, and waste reduction technology
- Environmental protection law and regulations on construction activities

Project Operation Stage

- Release of chemical wastes through dumping and in landfills and waterways
- Generation of various chemicals such as CO_2, CO, SO_2, NO_2, and NO
- Noise and vibration induced from project operation
- Negative impacts from project operations to flora, fauna, and ecosystems
- Energy consumption on electrical, lighting and other energy appliances
- Water usage for production of hygiene, cooling, and heating
- Use of both renewable and non-renewable raw materials

Project Demolition Stage

- Adequate demolition plan on hazard materials and waste reduction or recyclables
- Supervision and control on the demolition activities to protect the environment
- Adoption of technologies to alleviate the disturbance on eco-environment systems and neighbourhood, and to maximise waste reusing and recycling
- Classification of demolition wastes for enabling effective treatment and disposal
- Special treatment given to toxic materials, heavy metals, radioactive chemicals released from demolition
- Recycling and reclaiming of useful materials such as steel, brick, glass, timber, and some equipment

The Global Reporting Initiative (GRI) was introduced in 2000 with the aim to create an accountability mechanism to ensure companies were following the CERES (coalition for Environmentally Responsible Economies) Principles for responsible environmental conduct. GRI is a leading organization in the sustainability field that has developed a comprehensive Sustainability Reporting Framework. This framework consists of metrics and methods for measuring and reporting sustainability related impacts and performance by a company or an organization's everyday activities. By having a sustainability report, an organization can demonstrate the link between its strategy and its commitment to a sustainable global economy. Figure 1 shows the number of GRI reports in Malaysia which clearly shows the number of organizations that are seriously embarking on sustainability is increasing. Construction companies in Malaysia that have embraced GRI includes CSC Steel Holdings and YTL.

By understanding and abiding by all attributes pertaining to sustainability in each stage of a project, a construction project could be turned into a fully sustainable project (The London 2012 Olympic and Paralympic Games in Olympic Park was built with sustainability in mind from procurement to operation of sites). This is possible only when all parties involved in the construction life cycle which includes architects/ designers, purchasers and suppliers, subcontractors, consultants and all other stakeholders involved are prepared and trained/ educated on the effect of sustainable practices to the environment and the economy of a country.

Shamini Patpanavan @ Pathmanathan

The Institution of Engineers, Malaysia

SEMINARS & WORKSHOPS

Are You Ready To Be An Engineer & The Reason I Became An Engineer

Graduation is the first step of one's career and therefore it's significant to choose a career that gives plenty of enjoyment and satisfaction over the next 40 to 50 years of one's working life. Engineering stands at the top of the list that provides the satisfaction from day one of any engineer's career. Never a dull moment, benefits to the society, exploring the world, professional environment, challenging work, prestige, technology and scientific discovery, financial security, variety of career opportunities and greater understanding of work may be the ten among 'N' reasons an engineer answers when questioned on the reason why he chose to become an engineer. On October 13, 2014 the thought provoking talk on "Are You Ready To Be An Engineer & The Reason I Became An Engineer" was presented by Mr. K. M. Chua and Mr. Kelvin Tan from MATA. The invited talk was presented as the part of Inotech 2014 and the MATA-APU MoU Signing Ceremony. 82 students and 10 staff attended the talk.

SEMINARS & WORKSHOPS

Satellite Television

Advances in satellite technology have given rise to healthy satellite services that provides various services to broadcasters, Internet Service Providers(ISPs), governments and the military. Satellite television is a system of supplying television programming using broadcast signals relayed from communication satellites. The signals are received via an outdoor parabolic reflector antenna usually referred to as a satellite dish and a low-noise block down converter (LNB). A satellite receiver then decodes the desired television programme for viewing on a television set. Receivers can be external set-top boxes, or a built-in television tuner. On October 17, 2014 a talk on “Satellite Television” was conducted by Ir. Zulkeflee Bin. With all his experience in satellite television, the guest speaker kept his session alive with demonstration and exhibition of the actual transceiver used in satellite television. 84 students and 5 staff of school of engineering attended the session

SEMINARS & WORKSHOPS

Engineering Studies – An Investment in Your Future

Engineering education is teaching knowledge and principles related to the professional practice of engineering. It includes the initial education for becoming an engineer and any advanced education and specializations that follow. Engineering education is typically accompanied by additional examinations and supervised training requirements toward a professional engineering license. On October 28, 2014 a talk on "Engineering Education - An Investment in Your Future" was delivered by Professor Dave Cheshire of Staffordshire University. The guest speaker highlighted the significance of engineering education as a road map towards achieving professional engineering status. Sixty two students and four (4) staff attended the talk.

SEMINARS & WORKSHOPS

ICACCT – 2014 Pre-Conference Tutorial at APIIT, India

Modelling is a representation of construction and working of any system which is simpler than the system it represents. A model should be a close approximation of the real system and also should be simple to understand. The important part of modelling is validation of the model. Simulation is a model validation technique. Usually a model intended for a simulation study is a mathematical model developed via a simulation tool. On November 26, 2014 a preconference tutorial on 'System Modeling and Simulation' was conducted by Mr. Shankar Duraikannan, at APIIT Panipat, India in association with the IEEE Student Chapter of the Institution as part of 8th International Conference on Advanced Computing and Communication Technologies. 30 participants of the conference attended this workshop.

The Institution of Engineers, Malaysia

INDUSTRIAL VISITS

Cypark Integrated Renewable Energy Park

Cypark is the leading Integrated Renewable Energy power producer in Malaysia. The company established the country's first Integrated Renewable Energy Park (IREP) in Pajam, Negeri Sembilan which rests on 64 acres of safely closed non sanitary landfill. On October 7, 2014, the industrial visit to the power plant gave an opportunity to 30 students accompanied by 2 staff to witness the rehabilitation of the 64 acres waste land and understand how a solar farm is constructed.

The Institution of Engineers, Malaysia

INDUSTRIAL VISITS

Tan Chong Motor Holdings Sdn Bhd

Tan Chong Motor Holdings Berhad (TCMH) was incorporated in Malaysia on 14 October 1972. From its humble beginning as the distributor of small motor vehicles back in the 1950s, TCMH Group (the Group) has grown into 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. On top of that, the Group is the franchise holder and exclusive distributor of Nissan passenger and light commercial vehicles as well as Renault vehicles in Malaysia; supported by more than 80 after-sales service centres. The two assembly plants in Segambut (Kuala Lumpur) and Serendah (Selangor) have very close capacities in which both plants together can deliver 100,000 units a year. On October 9, 2014, 35 students accompanied by 5 academic staff visited the assembly plant in Segambut. The participants were briefed on safety procedures and were taken around every section of the assembly plant. The students had an opportunity to interact with the employees of the plant who answered to the queries raised by the students at the interaction section on completion of the plant tour.

INDUSTRIAL VISITS

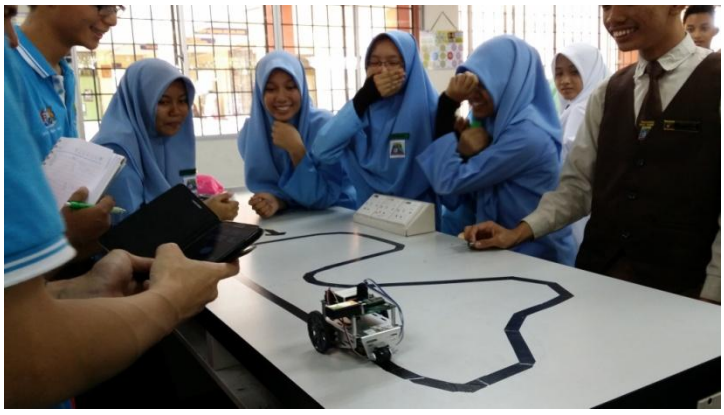
Astro All Asia Broadcast Center

Astro Malaysia Holdings Berhad is a leading integrated consumer media entertainment group in Malaysia and Southeast Asia with operations in 4 key areas of business, namely Pay-TV, Radio, Publications and Digital Media. Astro offers 170 TV channels, including 37 HD channels,. Astro is the country's first non-subscription based satellite TV, offering 22 TV and 20 radio channels. On October 21, 2014, 30 students accompanied by 2 academic staff visited Astro. The students were given an detailed demonstration of every stage of satellite TV and radio broadcasting. The students were excited to see live actors and stars performing at the studios.

INDUSTRIAL VISITS - STEM

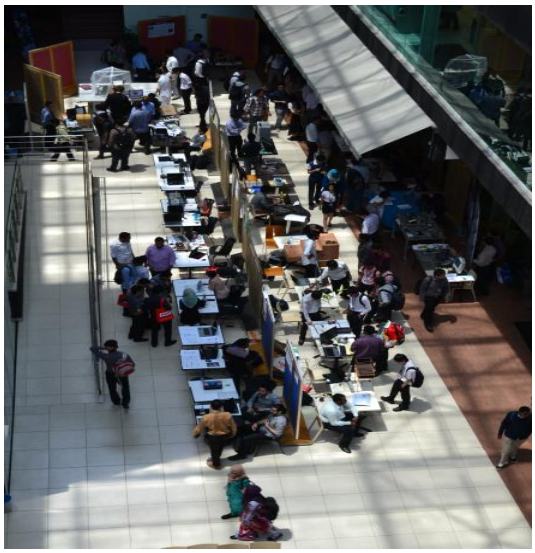
SMK Jalan Reko, Kajang

On the 27th of September 2014, the IEM-APU Student Section (IASS) together with Dr Vinesh and Mr Suresh conducted an engineering awareness programme and robotics workshop at SMK Jalan Reko for 30 students who were in Form 3. The students were happy to have an insight into the working world of an engineer and the importance of Science, Technology, Engineering and Mathematics (STEM) in a developing nation. The students were then taught how to build mini robots which also included basic programming. The session ended with a line following competition in which 4 groups took part. The Head of Science, Mr Chow and afternoon Section Head, Puan Zaiton were very grateful to the APU students and academicians for spending time over a Saturday to conduct this workshop.



SOE COMPETITIONS

INOTECH 2014



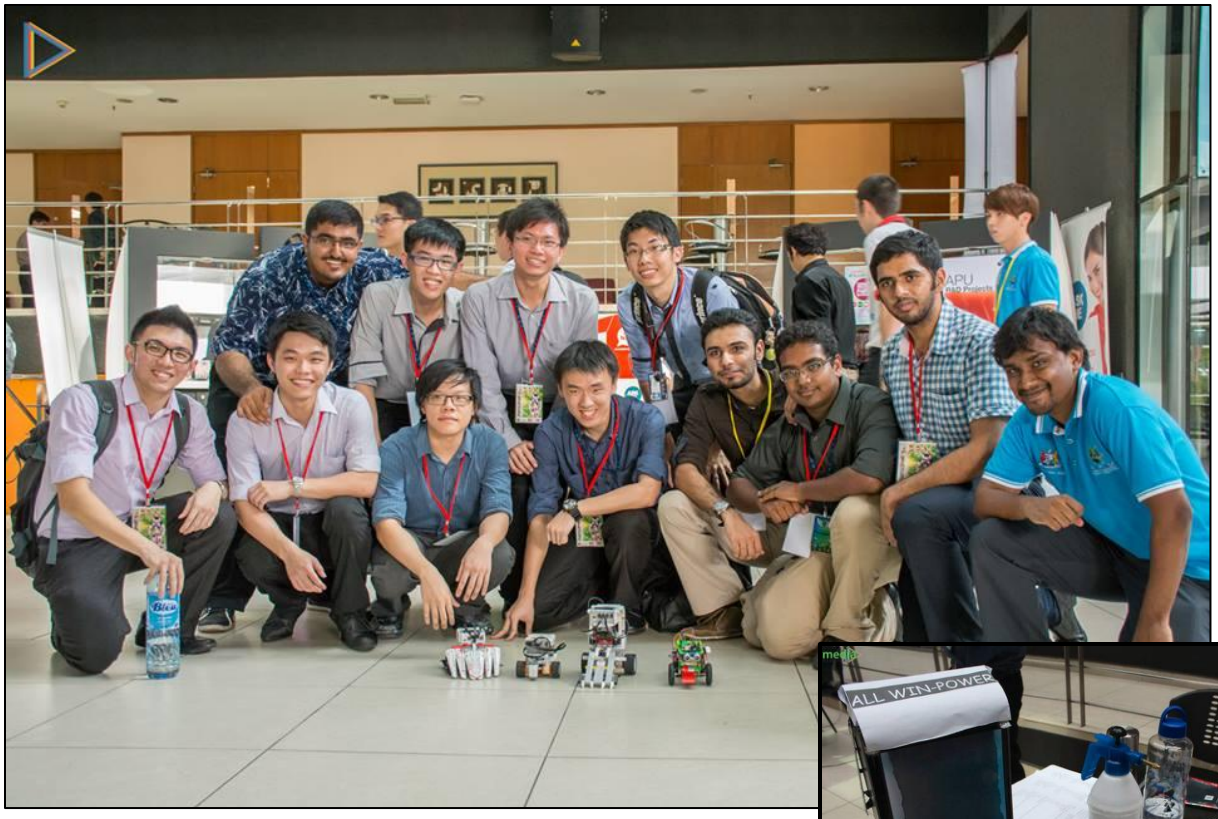
"InoTech 2014" is the annual design competition organized for innovative young engineering and computing students to exhibit their talents in their relevant study fields. The purpose of this activity was to equip students with the skills of thinking critically and constructively, speaking persuasively, listening attentively while exploring their ability to solve technical problems. The event was conducted at the university campus on the 13th October 2014 and was jointly organized with the Institute of Engineers, Malaysia (IEM). IEM annually funds and supports a design competition within local universities and for 2014 we were fortunate to have their support for APU's Inotech 2014. IEM's contributions were also to make available judges for the competition, promote the event within the IEM circle via its publications/magazines/bulletins and also to endorse APU as a partner promoting Science, Technology, Engineering and Mathematics (STEM) education in Malaysia. Inotech 2014 also played host to the MoU signing between APU and the Malaysian Automation Tecnology Association (MATA). A total of 36 students participated in the event showcasing very impressive creations which wowed our guest judges which led to them having a tough time deciding on the winners. The first prize winner was Ahmed Mohamed Osman for his project 'Intelligent Mobile Phone Based Parking Reservation System'. In second place, Alex Looi Tink Huey for his project 'Systematic Approach to the Utilisation of Palm Oil Mill Fluent For Renewable Biogal Power Plant Aided by Software Computation' and in third place, Vaasan Rao for the project 'Self Navigating Mobile Robot Using Raspberry Controller.

IEM-APU STUDENT SECTION

IASS

IEM-APU Student Section (IASS) is specifically been established for the APU students to serve the student members of the Institution of Engineers, Malaysia (IEM) in APU. The engineering club is a connecting bridge between IEM-APU Student Section and IEM, Malaysia. In other words, IEM-APU Student Section is considered as a medium to interact with the engineering world through the help of IEM. The main ambition of IASS is to support young and would-be engineers in building a fulfilling career in the engineering world. This is accomplished through the organizing of various social and professional activities to cultivate and assist the students in advancing their professional status.

During the academic year 2013-2014, two main competitions were organized by IASS and conducted within the campus of APU: InoTech 2013 and APROC (Asia Pacific Robotic Competition). Both events aimed to exhibit the students' talents on their engineering fields by relating to the latest technologies. InoTech 2013 was a platform to introduce general innovative projects from different engineering fields, whereas APROC focused on the robotics field under four categories: maze solving fire-fighting robot, line following robot, sumo wrestling robot, and robot racing.



IEM-APU STUDENT SECTION

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IASS

Seminars and workshops were significant part in sculpting the students' knowledge and experiences as well. The speakers were from APU engineering department and our invited speakers from the engineering field. Several workshops were conducted within the university campus such as: CNC Machining, Microcontroller Interfacing and Programming, Linear Circuit Analysis Using MATLAB and Simulink, LabVIEW for Everyone, Development of Engineering Software Application with MATLAB and 3D Design Using Creo. Different seminars were organized to enlighten the students in the engineering world, like: Design Flow Process in Engineering by DreamEDGE, Introductory talk on Go Green in the City Competition by Schneider Electric, Utilization of Solar Energy by CERTO Solutions, GENETRON Test and Measurement Roadshow, ABB Robotics, Astana Digital on Darwin Robot, Nao Robot by HuRoBs and more.

Industrial visits organized by IASS made a remarkable impact on the engineering students and staff as they were exposed to the real engineering industry. Main industrial visits were: Yakult Factory, MEASAT Satellite System, National Instruments, PROTON Manufacturing Plant, SIRIM Sdn Bhd, TAMCO Switchgear, Cypark Integrated Renewable Energy Park, TOP GLOVE and JIMAH Power Plant.

SOE COLLABORATIONS

MATA

On the 13th of October 2014, the Malaysian Automation Technology Association (MATA) signed an MoU with APU to initiate its support in engineering education by promoting design projects to be undertaken by APU engineering students. The MoU was signed by MATA President, Mr Tiong Khe-Hock and APU's Deputy Vice Chancellor, Prof Ron Edwards. The ceremony was in conjuction as well with APU's Inotech 2014 in which industrial guest talks were given by MATA senior members and MATA alliances exhibited their engineering technology. These were from companies such as Watts Eurodrive, Omron Malaysia, IME, Beckhoff Automation and SMC Pneumatics. To date MATA has already fed seven FYP titles which are currently being undertaken by APU's engineering students.

SOE CONFERENCES

2014 International Research Symposium on Engineering and Technology

The 2014 International Research Symposium on Engineering and Technology was held on November 7 – 9, 2014 at Park Royal, Kuala Lumpur Malaysia. Mr. Niranjan Hari, our renown Mathematics academician attended the symposium and presented his paper on 'Stratified Flow For MHD Mixed Convection Stagnation Point Toward A Vertical Plate In A Porous Medium With Radiation'.

8th International Conference on Computing and Communication Technologies

The 8th International Conference ICACCT–2014, technically sponsored by IETE and co-sponsored by Computer Society Chapter, IEEE Delhi section was conducted on 15th of November at APIIT India. SoE academician Mr. Shankar Duraikannan conducted a pre conference tutorial on 'System Modeling and Simulation' and presented a paper on ' Simulation and Analysis of DVB-S2 with RS Coding in Comparison with BCH Coding'.

A Conceptual Study of Long Range Active RFID System for Reliable Data Communication

Dr. Raed Mohammed Taher Abdulla

Abstract

Radio Frequency Identification (RFID) system has shown remarkable progress, especially in identifying, locating, or tracking objects. Some of the existing challenges include improving position estimation beyond RFID coverage. Following a brief introduction, an analysis of the new requirements of the indoor location system-based RFID and a system prototype is presented. To this end, this research proposed a combination of ZigBee-based RFID

Introduction

Radio Frequency Identification (RFID) is an automatic identification method that uses radio frequencies between RFID readers and tags. The RFID system consists of the RFID tags (a microchip with a coiled antenna), the RFID readers, and the computer network [1, 2].

Related Work

Real-time analysis of data streams is supported by the integration of the RFID technology and WSNs. A variety of topics on design and the implementation of the RFID system are addressed in various studies. Most likely, the requirement of an active RFID system is the most important theme among the studies. WSN, similarly to RFID, is a very low-cost and low-power technology employed in a number of possible techniques; each one of them considered by different transmission bandwidth and communication ranges [27].

ZigBee-Enabled Active RFID System

Active tags can be automatically located and tracked based on the particular need of a user. With the ability to operate under harsh conditions for years at a time without human interference, these sophisticated wireless devices can communicate data at a long range [11]. The mesh, cluster tree, and star network configuration are shown in Figure 1.

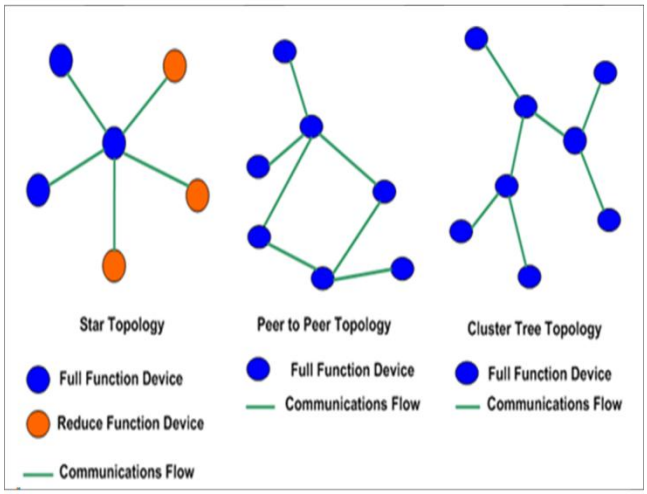

Figure 1: ZigBee network topologies

System – Level Design

Figure 3 shows the structure of the nodes demonstrated in this work. The basic functionality of the novel, active RFID system is described as follows. As long as active tag nodes have no packets to send or receive, they can command their radio to adopt the deep sleep mode. During this period, the microcontroller unit of the RFID reader is also set to the power down mode. The nodes of the active RFID reader seek to send a packet to trigger the tags of an active RFID.

Sensor-Transceiver Module Design

Several sensor modules were incorporated by the active RFID system. The design of the modules allowed for flexibility based on the particular needs of the system. One Maxstream ZigBee XBee series 2 [26] wireless chip was included in each sensor module. Each sensor module operated in the range of 2.4 GHz and used the 802.15.4 protocol.

Design Consideration

Figure 4 shows the appropriate implementation of the complete RFID system.

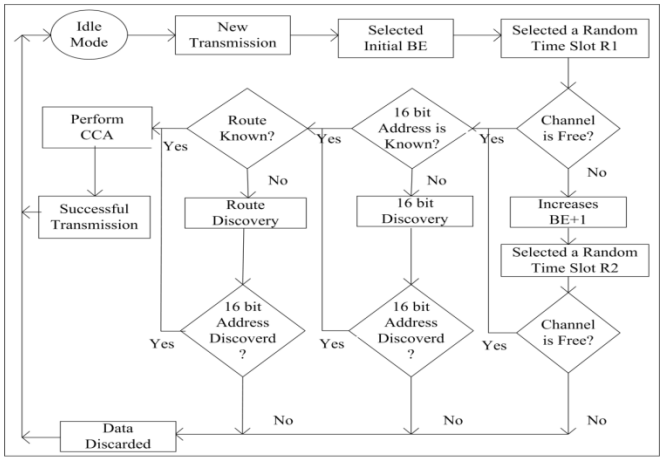

Figure 4: CCA for RFID nodes

Hardware Design of the RFID System

The hardware components of the 2.4 GHz active RFID system used in this work have two principal components: a reader, which is referred to as an interrogator, and a tag, which is referred to as an RFID tag applied to an object for tracking.

Architectural Design of Active RFID Tags

The battery-operated novel active RFID tag is designed to communicate with active RFID readers in the vicinity. The design is based on the ISM band RF transmission module using the 2.4 GHz XBee series 2.

Conclusion

This study investigates the viability of the different methods that enhance and expand the use of interactive RFID technology in an indoor tracking system. To establish relevant system design principles useful for other RFID systems, designing and implementing tags and a reader system is necessary.

References

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Robotics is Revolutionising Interaction for Autistic Children

Vickneswari A/P Durairajah

Autism spectrum disorder (ASD) is a range of complex neurodevelopment disorders, characterized by social impairments, communication difficulties, and restricted, repetitive, and stereotyped patterns of behaviour. Autistic disorder, sometimes called autism. It is a life-long disorder but there is growing evidence that early intervention can make a significant difference to children's later quality of life. Usually children with ASD may be unresponsive to people or focus intently on one item to the exclusion of others for long periods of time. They may fail to respond to their names and often avoid eye contact with other people. They have difficulty interpreting what others are thinking or feeling because they can't understand social cues, such as tone of voice or facial expressions, and don't watch other people's faces for clues about appropriate behaviour.

Social robots are well suited for this kind of intervention and with the evolution of human robot interaction (HRI) expanding its wings to aid children with Autism Spectrum Disorders (ASD). HRI has expanded in the areas of socialization, communication and playful behaviour through robot-based intervention where holistic approaches are developed to contribute to the lives of children with ASD who suffers a lifelong developmental disability. These types of robots can play a central role in exercises that help ASD children improve their social, sensory and cognitive skills as well as their motor control. Therapists have programmed the robots to perform tasks that help the child practice eye contact, turn taking, imitation and so on. "Such activities include teaching a child to initiate greetings, to wait for its turn to throw the ball, to follow the robots gaze to an object of interest, and to copy the robots movements as it dances,". (www.ninds.nih.gov)

In the process, the robot becomes a friendly playmate and a mediator between the therapist and the child, difficult roles for humans to play consistently.Many researchers are involved is research with ASD children using robotic face emulators, FACE (Facial Automation for Conveying Emotions), and humanoids such as NAO and many others. The FACE robot has been used to imitate children's facial expressions as shown in figure1 instead of general arm or body movements. They observed that the children generally imitate the expressions on FACE better than on other humans, and they are working to automate this process so that a therapist will no longer have to control the imitative expressions which are lesser burden on the therapist. It is noted that children interaction increases with the aid of robots.

Figure 1: FACE robot(www.dailymail.co.uk/sciencetech/article-2172990)

However the humanoid namely NAO as shown in figure 2 and Figure 3, is highly used in this they of intervention are there several proven studies that this robot help the ASD children skills and interaction increase compared to the ASD children without the aid of the robots. This robot can communicate, mimic, dance, teach, sing, and etc. This robot have been used and tested on ASD children all over the world including Malaysia. The lead researcher in Malaysia in this area is Prof. Dr. Hanafiah Yussof COE for Humanoid Robots & Bio-sensing (HuRoBs), Fac. of Mechanical Engineering, Universiti Teknologi MARA (UiTM) Shah Alam. As stated by Shamsuddin.S et al (2012), it is proven through their pilot study of 6 months, where they divide ASD children into two groups; the first group was taught with the aid of the NAO robot and the second group in traditional manner. It was noted that the children taught with the aid of the NAO robot has 80% increase in interaction and 75% increase in eye-contact compared to the children taught in the traditional manner.

http://www.telegraph.co.uk

www.dailymail.co.uk

The above could be an eye opener and a platform to all researchers around the world to develop and investigate better ways to help ASD children develop their interaction, eye contact and learning skills. In the future, continues exposure to robots especially humanoids in a longitudinal study is hoped to be able to train these children in interaction skills that are the constructive basis in building social and communication skills amongst the children with ASD. The need of long-term studies of HRI with children with ASD is undeniable however the duration and timing of the robotic exposure is crucial as not to create 'permanent attachment' and the preference of robotic contact compared to actual humans.

BER Performance And Complexity Analysis Of Linear And Non-linear Detection Schemes For MIMO-OFDM Systems

Ajmal Hussain Shah

INTRODUCTION

Since the beginning of this century the use of multiple antennas at the transmitter and receiver sides of a wireless channel, so called multiple-input multiple-output (MIMO) technology, is deployed in many wireless applications to improve the link reliability without sacrificing bandwidth efficiency. In addition a very high data rate can be achieved by introducing OFDM along with MIMO. MIMO-OFDM style of communication, although has achieved increased data rate with good link reliability, increases the receiver complexity at the same time. An efficient detector requires good agreement between BER performance and the computational complexity. In this article the purpose is to present the BER performance analysis of non-linear detection schemes.

MIMO DETECTORS

Maximum Likelihood(ML) Detector

If the data stream is temporally uncoded, the ML receiver is solved by using the following equation.

$$Rs = \arg_s \min \|r - H_s\|^2$$

where, Rs is the estimated symbol vector. The ML achieves optimal BER performance and thus, it is known as an optimum receiver. The receiver is difficult to deploy as it searches the entire vector constellation for the transmitted signal vector, which is certainly a very difficult task. The ML receiver provides a full gain diversity and zero power losses. Theoretically Maximum Likelihood (ML) detector is a nonlinear detector but it can achieve the optimal bit-error-rate (BER) for MIMO systems. However, its complexity exponentially increases when the number of transmitting antennas increases and higher modulation orders. This makes it unrealizable in MIMO systems.

Zero Forcing (ZF) Detector

The ZF detector is a linear receiver. It separates the data streams and decodes. The channel matrix **H** is invertible and estimates the transmitted data symbol vector as

$$Rs = (H^H H)^{-1} Hs = H^* s$$

Where the symbol * represents pseudo-inverse since an inverse of **H** can only exist if the columns of **H** are independent. The diversity order of each stream is X_R - X_T + 1 which can be found by

$$Pe \le \overline{N} \left(\frac{\rho d^2_{\min}}{2X_T} \right)^{-(X_R - X_T + 1)}$$

The ZF detector decomposes the link into X_T parallel streams, each with a diversity gain and array gain proportional to X_R - X_T + 1. Hence, it is suboptimum.

Minimum Mean-squared Error (MMSE) Detector

The MMSE detector minimizes the mean-squared error between the estimated received signal symbol and the transmit symbols, and results in an optimal linear combination.

$$W_{MMSE} = R_{xy} R_y^{-1} = (H^* H + \frac{\sigma_v^2}{\sigma_-^2} I)^{-1} H$$

where Rxy is the covariance matrix of x and y.

PERFORMANCE EVALUATION PARAMETERS

Bit Error Rate (BER)

In analogue communications, the system performance is expressed by signal-to-noise ratio (SNR), whereas, bit error rate (BER) is used in assessing digital communication systems. In digital communication systems, when data is transmitted over a link, there is high probability of introducing errors due to diverse channel conditions. To assess the performance of such systems, bit error rate (BER) is used. In other words, BER assesses the transmission quality of a digital communication system. Bit error rate (BER) is defined as the ratio of received data bits over the transmitted data bits. The change in BER is mainly due to inconsistent channel conditions. In perfect channel conditions, there is no noise which leads to producing zero errors. However this does not happen in real situations. If the channel condition is good, the signal to noise ratio is high and the bit error rate will be insignificant. However, the worse channel conditions introduce a large noise, and there will be high probability of errors in receiving data. This produces a high bit error rate. Figure 1 shows the BER performance of three detectors.

The figure shows that Maximum Likelihood (ML) outperforms Zero Forcing (ZF) and Minimum Mean Square (MMSE) detectors. However, despite of reduced complexity these detectors suffer from significant performance degradation.

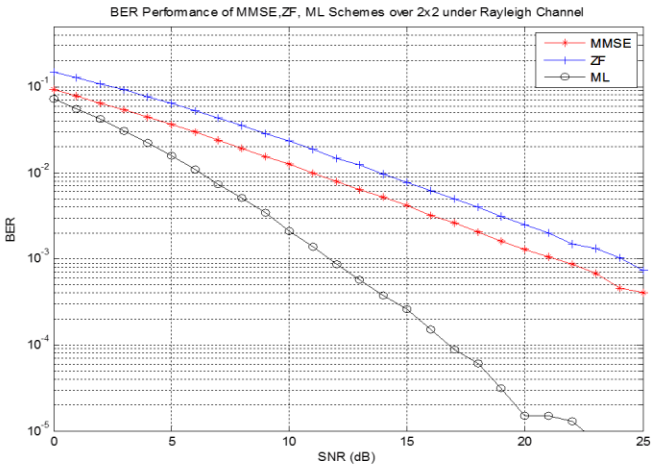

Figure 1

COMPUTATIONAL COMPLEXITY

Computational complexity can be described as the mathematical characterization of the difficulty of a mathematical problem which describes the resources required or computational steps involved to solve a problem or an algorithm. In computational complexity, it is rather important to achieve results by performing minimum number of computational steps i.e. multiplications, additions/ subtractions. There are two uses of computational complexity; one, how many steps are required to solve a problem second is classification of the complexity of a problem such as easy or hard. In detection algorithmic complexity, it is concerned about how fast or slow a particular algorithm performs. It defines as time taken by an algorithm to perform all the numerical or mathematical steps without depending on the implementation details.

TABLE I
Numbers Of Computational Operations Of The Three Detectors

Modulation MIMO-Configuration	4QAM 2x2	4QAM 4x4	4QAM 8x8
ML	2.11×10^4	4.14×10^4	378×10^4
ZF	0.014×10^4	0.18×10^4	1.20×10^4
MMSE	0.02×10^4	0.18×10^4	1.22×10^4

The computational complexities of three detectors are calculated and listed for 2x2 , 4x4 and 8x8 MIMO systems in TABLE I. From the table, the computational complexity of the ML detection is much higher than other detectors.

CONCLUSION

In this article the BER and the computational complexity has been explained and simulated for the ZF, the MMSE detection and the ML detectors. The results validate that the ML has optimal performance but has higher computational complexity.

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Design and Analysis of a Hexagonal Shape Micro Strip Patch Antenna for 5.75 GHz Applications

Hamid Mohammed Qasem Rasheda & Ajmal Hussain Shah

Introduction

Since the last decade wireless communication has seen a remarkable growth. Antenna plays a pivotal role in wireless communication. In recent years, researchers faced challenges to design a low profile, low cost, compact, lightweight and easy-fabricating antenna. Many micro strip patch antennas for WLAN applications have been proposed in the past with the advantages of being low profile with easy fabrication steps and low cost. In this article, a compact and simple hexagonal shaped micro strip patch antenna suitable for IEEE802.11a standard for wireless LAN and other applications operating at 5.75 GHz is proposed. The antenna performance has been analyzed and validated through the simulation results.

Antenna Design

In this section, the proposed antenna design including design equations is presented. The parameters of the proposed antenna are calculated at 5.75 GHz. It is worth to mention here that the correct selection of dielectric substrate is important when designing an antenna, which not only improves the radiation pattern significantly but enhances the impedance bandwidth as well. The dielectric constant and loss tangent are the most significant characteristics of a substrate. The substrate has a thickness of 1.757 mm, a tangent factor of 0.0009 and the dielectric constant of 2.2. The size of an antenna is inversely proportional to the dielectric constant. The dimensions of the proposed antenna are 45 mm^2 x 45 mm^2. The proposed antenna with a hexagonal shape is shown in Fig 1. The centre part of the hexagonal patch has an elliptical slot with a radius of 5 mm and a conducting strip thickness (*G*) of 2 mm. The micro strip feed line is 4.9 mm wide.

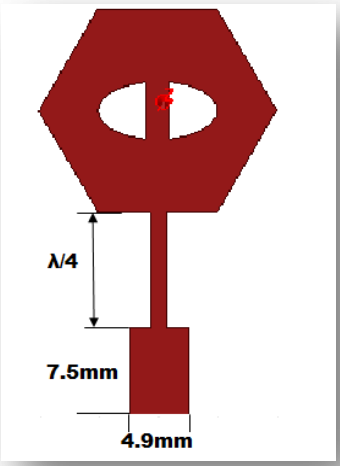

Fig 1. Geometry of the Proposed hexagonal shaped Antenna

The width and the length of the ground plane of the proposed antenna can be computed using the following expression.

$$W1 = \frac{C}{2fr} \times \sqrt{\frac{2}{\varepsilon r + 1}}$$

Where '**fr**' is the resonant frequency, '**C**' is the velocity of light and 'ε_r' is the substrate relative permittivity and is equal to 2.2 . ***W*** is the width of the proposed antenna and ***L*** is the length and ***h*** is the height of the proposed antenna.

$$W = W1 + 6h$$

$$L1 = \frac{c}{2\,F\,\sqrt{\varepsilon reff}} - 2\Delta L$$

$$L = L1 + 6h$$

Simulation Results

The antenna is designed and simulated at the resonant frequency of 5.75 GHz. Return loss is the ratio of the power fed to an antenna to the power reflected back to the feed point. Thus, the power fed to an antenna should be absorbed rather than being reflected, which certainly produces a power loss. (However, the best value of return loss must be negative infinity if the power is absorbed and must be equal to zero if the power is reflected). Fig 2 shows that the antenna has achieved a return loss of -20.27 dB. A bandwidth of 118 MHz at the resonant frequency of 5.75 GHz is evident in the figure.

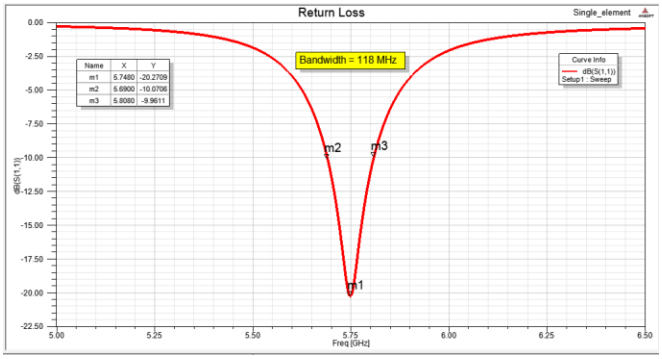

Fig 2. Return Loss

The VSWR for an antenna should be a small value and possibly be near unity. Fig 3 shows the simulated VSWR results of the proposed antenna. A VSWR of 1.73 at 7.57 GHz is evident in the figure. A 2D radiation pattern of the proposed antenna is shown in Fig 4. Notice that the null under the antenna is not as deep or seems to be gone altogether. This allows for increased signal levels to users.

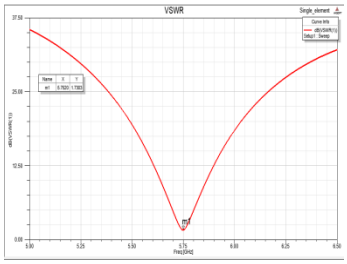

Fig 3. VSWR

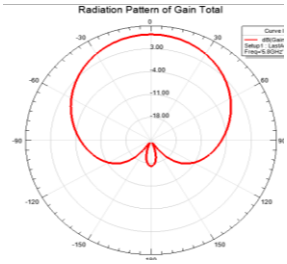

Fig 4. Radiation Pattern

Table I shows the simulated results of the proposed antenna at 5.75 GHz. The return loss of the proposed antenna is -20.27 dB which is acceptable since it is lower than -10 dB. While, the VSWR is 1.73 which is below 2. The gain and the directivity of the antenna is 7.51 dB and 7.68 dB respectively.

Table I. Performance estimate Proposed Antenna(5.75 GHz)

S. No	Parameters	Proposed Antenna
1.	Return loss (dB)	-20.27
2.	VSWR	1.73
3.	Gain (dB)	7.51
4.	Directivity (dB)	7.68
5.	Bandwidth (MHz)	118

Conclusion

In this paper, the simulated results of a hexagonal shape with an elliptical slot micro strip antenna at 5.75 GHz are presented. The results show a bandwidth of 118 MHz, a VSWR less than 2 and a return loss less than -10 dB. The antenna has gain of 7.51 dB and demonstrates a 180° omnidirectional radiation pattern. The proposed antenna is compact and simple. Hence, the antenna is suitable for IEEE802.11a standard for wireless LAN and other applications operating at 5.75 GHz.

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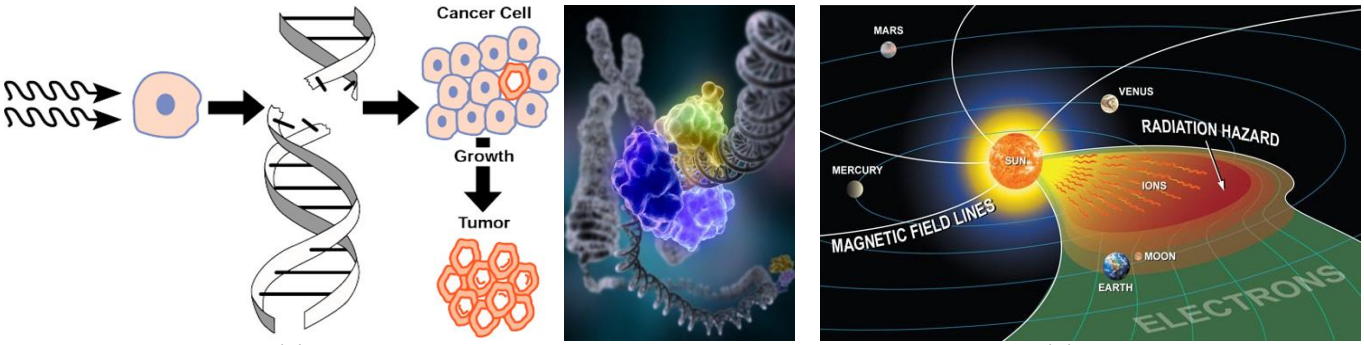
For the past few decades, the term microdosimetry has been widely used in the radiation medicine field. Microdosimetry is formally defined by Rossi and Zaider as “the systematic study and quantification of the spatial and temporal distribution of absorbed energy in irradiated matter" [1]. In other words, it is a measurement method to understand the effects of different radiation sources through an analysis of the absorption of ionising radiation at a scale comparable to the affected structures. Typically, a microdosimetry measurement requires a radiation detector, commonly known as a microdosimeter that is commensurate to the size of a biological cell.

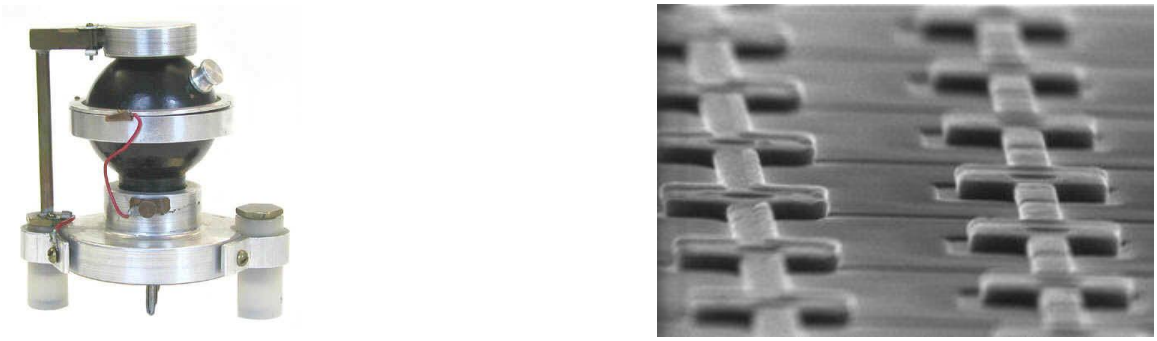
Today almost half of all cancer patients are treated with radiotherapy by using ionising radiation to control malignant cells in the body. The clinical outcome of radiotherapy depends solely on accurate delivery of the radiation to the tumour while sparing normal tissues. Therefore, detectors for in vivo real time radiation dosimetry and the understanding of radiobiological properties of the radiation are crucial for the improvement of clinical outcomes of cancer treatments. At this stage, the primary tool of experimental microdosimetry has been the low pressure tissue equivalent proportional counter (TEPC). Although it is generally considered the best detector currently available commercially, the proportional gas counter has several shortcomings. These include a relatively large physical size which limits spatial resolution and increases vulnerability to pile-up effects [1], the use of gas in the detection volume which leads to phase effects [2] and wall effect errors, and an inability to simulate an array of cells.



(a) (b)

Figure 1: (a) Development of the cancer cell due to DNA breaks produced by ionising radiation. (b) Radiations in space that can slowly destroy microelectronic components. It is necessary to have a radiation detector, (known as dosimeter) to monitor and measure the effects of these radiations upon biological cells and microelectronic circuits.

The advancement in the microdosimetric industry and rapid development of silicon nanotechnology has made silicon one of the most popular materials for producing microdosimeters. Thus, silicon based detectors have been created to solve the shortcomings of TEPC as they have many advantages due to their small size, outstanding energy resolution in nuclear spectroscopy, easy pixelation for high spatial energy resolution and ability of integration with readout electronics. In 1994, Roth and McNulty proposed the use of silicon microdosimeter arrays for the characterisation of complex radiation environments in spacecraft and airplanes [3]. The intention of this work was to study single event upset (SEU) risks in microelectronics systems and the use of the detector as a biological microdosimeter for personnel monitoring.



(a) **(b)**

Figure 2: (a) Traditional tissue equivalent proportional counter (TEPC). (b) New silicon based radiation detectors (Microdosimeter).

Since then, many medical-related experimental studies using this type of microdosimeter have been implemented and have made excellent progress. Hence, microdosimeter arrays play an important role as a radiation instrument with applications not only in radiation protection for space and microelectronics but also in radiation medicine for diagnostic and cancer treatments. These diverse applications have generated great interest in the community towards developing improved silicon microdosimeter arrays.

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SOE EVENTS

Staff Bowling & Year End Celebrations

As a close out to the year's hard work, the engineering lecturers and the support staff gathered on the 4th of December 2014 for a luncheon. This was then followed on by the bowling session in which many drains at the alley were cleaned up. Kudos the SoE team for their performances over 2014.

BE POSITIVE ALWAYS