RICES 2019

RESEARCH INNOVATION COMMERCIALISATION & ENTREPRENEURSHIP SHOWCASE

ENGINEERING

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The publisher hereby records its gratitude to individuals who have helped in one way or another to make this book project a reality.

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FOREWORD

VICE PRESIDENT RESEARCH AND INNOVATION

The e-Research, Innovation, Commercialization, Entrepreneurship Showcase (eRICES) publication is one of the numerous publications, including journals that MMU Press takes pride in. I am truly pleased that Assoc Prof Dr Madhubala, the first Director of MMU University Press, and her team have embarked on the initiative to publish the inaugural eRICES 2019.

The eRICES 2019 will be the first compilation of MMU's researchers and entrepreneurs' fascinating insights on research ventures and idea creation for commercialising research output as well entrepreneurship.

RICES is an excellent platform for MMU to interact with internal and external stakeholders. These interactions enable researchers to realise potentials for collaborations, IP exploitations, commercialisation and further research. It allows for industrial related viable research and feasible output. This eRICES publication extends the present interactions even further, allowing for post-event interactions to materialise beyond the existing valued stakeholders.

RICES 2019 is evidence of the excellent effort RICES organisers and MMU University Press. Their commitment and dedication have paid out with another hallmark achievement reflecting my Research and Innovation (R&I) Division to synergise the development of Research-Innovation-Commercialisation-Entrepreneurship (R-I-C-) nexus in all research activities. I look forward to RICES 2020 exhibition and its publication.

Thank you

Prof Ir. Dr. Hairul Azhar bin Abdul Rashid
Vice President Research & Innovation
Multimedia University

MULTIMEDIA UNIVERSITY PRESS

I take pride in setting up among others, the Effective Teaching Methodology Unit, the Learning Institute for Empowerment, the Faculty of Applied Communication and the latest, the MMU University Press in MMU. This would not have been possible if not for the support of Prof Hairul Azhar Abdul Rashid, Vice President (Research & Innovation), the 2018 steering committee and the current Press Board Members.
A BIG THANK YOU to the team.

Within a year in 2019, some of the steering committee members took upon themselves the task in setting up international journals: Asian Journal of Law and Policy (AJLP), International Journal on Robotics, Automation and Sciences (IJORAS), Journal of Engineering Technology and Applied Physics (JETAP), Issues and Perspectives in Business and Social Sciences (IPBSS), International Journal of Management, Finance and Accounting (IJOMFA), International Journal of Creative Multimedia (IJCM) and Journal of Science and Social Science (JSSS). These are MMU's first seven international journals since it's inception in 1997. It is heart-warming to see some journals have had their very first publications in the same year.

This year in 2020, MMU Press embarks on publishing other forms of publications and eRICES is among the first. These four eRices Publications showcase research, ICT, multimedia, entrepreneurship and social innovation projects. They showcase researchers' innovative and creative ideas, expertise and their use of technology to provide solutions to address, among others, social, health and wellbeing, economic, educational, environmental and industrial challenges as well as propagate technological developments.

THANK YOU to the Chief Editors, the Reviewers and the Editorial / Design Team.

Assoc Prof Dr Madhubala A/P Bava Harji
Director MMU University Press
Multimedia University

Research, Innovation, Commercialization, Entrepreneurship Showcase (RICES)

Assalamualaikum warahmatullahi wabarakatuh and very good day!

Research, Innovation, Commercialization, Entrepreneurship Showcase (RICES) is an annual event organized by MMU that showcases research projects, innovations, commercialisations and entrepreneurship. Driving Digital Innovation is the tagline selected this year to highlight the importance of having the right tools, technologies and strategies for a digitally transformed organization, community and nation. This year we organised it on 7 November 2019. A total of 167 research projects, 25 start-ups, spin offs and ventures, 26 research centres and 7 research institutes participated in the showcase.

Apart from the exhibitions, we had pitching sessions as well as talks by representatives from the industry.

Both local and international judges who evaluated the showcases had used the judging criteria which is similar to criteria that are set for international exhibitions, such as International Conference and Exposition on Inventions by Institutions of Higher Learning (PECIPTA) and International Invention, Innovation & Technology Exhibition (ITEX).

I would like to take this opportunity to thank the organising committee and everyone who had directly or indirectly attributed to the success of RICES 2019.

Ts. Dr. Junaidi Abdullah
Director of RICES 2019
Deputy Director, Research Management Centre
Multimedia University

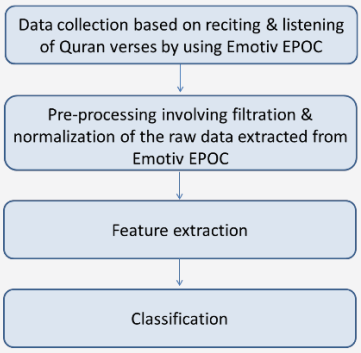

ENGINEERING

A Study on Brain Activity during Quran Listening and Recitation

Introduction

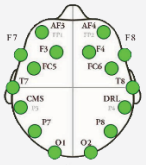
Brainwaves are produced by synchronised electrical pulses from masses of neurons communicating with each other. In this research, we analyse the waves produced by the brain when listening and reciting Quran. Brainwaves are detected using sensors placed on the scalp which called EEG. The EEG signal is extracted from the brain using Emotiv EPOC. The EEG device contains 14 electrodes along with two references electrodes. They are divided into bandwidths to describe their functions. The experiment consists of two parts; reading and listening. Participants will be requested to read and listen to several surahs that are pre-determined. The EEG signal will be retrieved while experimenting the participants.

System Flowchart



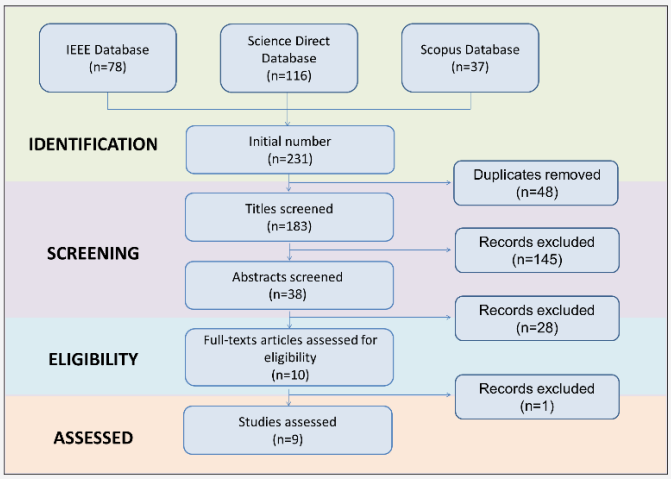
Equipment

EMOTIV EPOC+ 14 Channel Mobile EEG



Electrode arrangement

Systematic Literature Review



Research Gap

1. Most of the researchers, did not conduct the performance test on large dataset. Therefore, we proposed to use a larger number of testing subjects so that the results would represent a more concrete scientific evidence.
2. Due to limited research in this area, we aim to carry the study in a way that the experiment will have an absolute and undisputable end results in order to draw a conclusion as to whether Quran recitation can be one of trusted emotion therapy.

Software

EMOTIV 3D Brain Activity Map – Standard Edition

The head model is a true 3D surface which can be zoomed and rotated to view activity at any angle. The application displays a real-time map of our mental activity in four significant brainwave frequency bands. Adjustable gain allows us to see detailed information and relative strengths between different brain regions. Adjustable buffer size allows us to see instant responses or average activity over longer periods. It also includes custom band definition, record and play back sessions, 3D surface models for each band. 3D Brain Activity Map allows us to save and replay sessions and insert up to four different kinds of markers in the data stream to highlight particular events during the session.

Life Made Easier™ TM Group

Team members: Ms. Nur Asyiqin binti Amir Hamzah, Dr. Ervina Efzan binti Mhd Noor, Ms. Nur Hasanah binti Ali & Ms. Noor Ziela binti Abd Rahman | FET MMU
Research assistants: Mohamad Razwan bin Abdul Malek & Muhamad Razlan bin Kamaruzaman | FET MMU

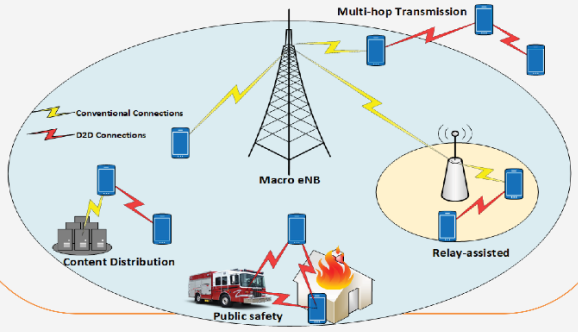
Funds: FRDGS

Algorithm and Scheme for Efficient Spectrum Utilisation of 4G/5G D2D Communication

Mardeni R. (Project Leader), Abdulraqeb A., Fareha N., M.Y. Alias, Zubaida Y, K. Anuar, J.J. Tiang
Centre for Wireless Technology, Faculty of Engineering, Multimedia University
Y. J. Jack (Webe Digital), A. Abas (TMRND)

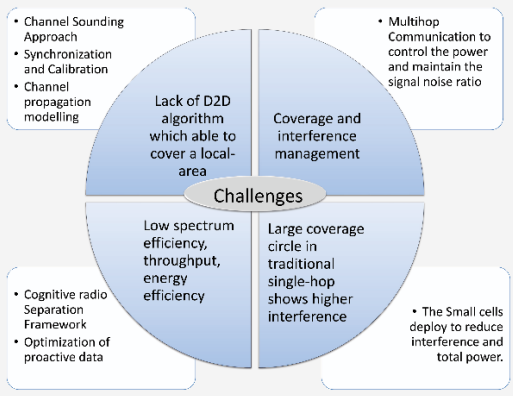
INTRODUCTION

Device-to-Device (D2D) communication has promised a new era of fifth generation (5G) technology by enhancing the performance of devices, allowing direct transmission between users in close proximity. The preliminary studies done have proven that this concept will improve spectrum reuse, coverage of the cell, throughput, reduce end-to-end latency and energy consumption. Furthermore, this technology introduces new peer to peer services as well as location-based applications. Thus, D2D will be one of the technologies that will be implemented in the next generation of 5G cellular networks. D2D will also facilitate the interoperability between critical public safety networks and commercial networks based on long term evaluation (LTE). However, there are various challenges such as an interference management and energy efficiency between the D2D users.

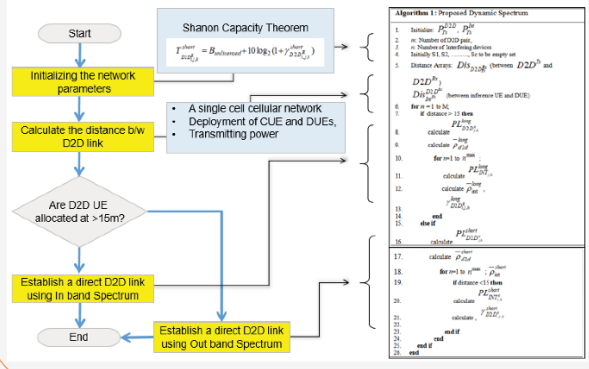


RESEARCH OBJECTIVES

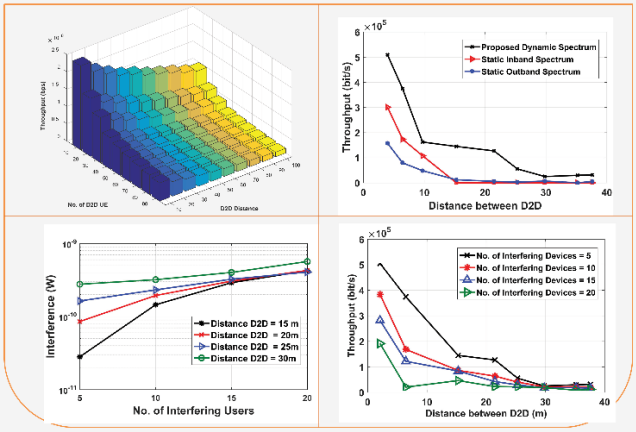
a) To analyse D2D communications capacity and interference between D2D links.
b) To develop D2D communications algorithm and scheme to offer wireless peer-to-peer services and improve spectrum utilisation.
c) To evaluate and validate the performance of the proposed D2D optimum algorithm.



PROPOSED ALGORITHM



RESULTS



ACKNOWLEDGMENT

- Telekom Malaysia, TM R&D with project ID: MMUE/170014.
- Fundamental Research Grant Scheme (MMUE/170017), Ministry of Higher Education, Malaysia.

RESEARCH OUTCOMES

JOURNAL

Mardeni R., A. Alhammadi, M.Y.Alias, K.Anuar, T.J.Jiat, Y.J.Jack, A.Abas, *Underlay/Overlay Cognitive Radio D2D Networks Using USRP and GNU Radio*, International Journal of Engineering and Technology (IJAE), ISSN : 2227-524X, (Scopus).

Mardeni R., A. Alhammadi, M.Y.Alias, K.Anuar, T.J.Jiat, Y.J.Jack, A.Abas, *An Algorithm of Novel Auto-tuning Handover in 4G/5G HetNets Communication*, International Journal of Engineering and Technology (IJAE), ISSN : 2227-524X, (Scopus).

Abdulraqeb Alhammadi, Mardeni Roslee, Mohamad Yusoff Alias, Ibraheem Shayea, Saddam Alraih, *Dynamic Handover Control Parameter for LTE-A/5G*, Automatic Control and Computer Sciences, ISSN 0146-4116, (Scopus)

A. Alhammadi, Mardeni R., M.Y.Alias, K.Anuar, K. S. Sandhawa, Y.J.Jack, [2019], A.Abas, *An Intelligent Spectrum Handoff Scheme Based on Multiple Attributes Decision Making for LTE-A Network*, International Journal of Electrical and Computer Engineering (IJECE), 2019, ISSN: 2088-8708, (Scopus).

A. Abdulraqeb, R. Mardeni, A. M. Yusof, S. Ibraheem, A. Saddam "Self-optimization of handover control parameters for mobility management in 4G/5G heinets" Automatic control and computer sciences, (ISI/Scopus).

CONFERENCE PAPER

Mardeni R., A. Alhammadi, M.Y.Alias, K.Anuar, T.J.Jiat, Y.J.Jack, A.Abas, *Underlay/Overlay Cognitive Radio D2D Networks Using USRP and GNU Radio*, 4th International Symposium on Technology Management and Emerging Technologies (ISTMET 2015), Dec 18 - 20, 2018, Langkawi Island, Malaysia. P20181044, Scopus.

Mardeni R., A. Alhammadi, M.Y.Alias, K.Anuar, T.J.Jiat, Y.J.Jack, A.Abas, *An Algorithm of Novel Auto-tuning Handover in 4G/5G HetNets Communication*, 4th International Symposium on Technology Management and Emerging Technologies (ISTMET 2018), Dec 18 - 20, 2018, Langkawi Island, Malaysia. P20180048, Scopus.

Abdulraqeb Alhammadi, Mardeni Roslee1, Mohamad Yusoff Alias, Ibraheem Shayea, Saddam Alraih, *Dynamic Handover Control Parameter for LTE-A/5G Mobile Communications*, Advances in Wireless and Optical Communications 2018, 15-16 Nov 2018, Riga, Latvia, Scopus.

Advanced Handover Self Optimization Approach for 4G/5G HetNets Using Weighted Fuzzy Logic Control, 2019 15th International Conference on Telecommunications (Conf TEL), Graz, Austria, 3 5 July 2019.

Mohamed Abohzy, Mardeni Roslee, Azzulraqeb Alhammadi and Ghaith Anuar, Experimental Implementation of Underlay/Overlay CR-D2D Networks Using USRP, IEEE International RF and Microwave Conference (RFM) 2018, Penang, 17 Avril 2018.

INTELLECTUAL PROPERTY

Copyright ISOI, Underlay/Overlay Cognitive Radio 4G/5G D2D Communication Using USRP and GNU Radio, 6/3/18.

AWARD:

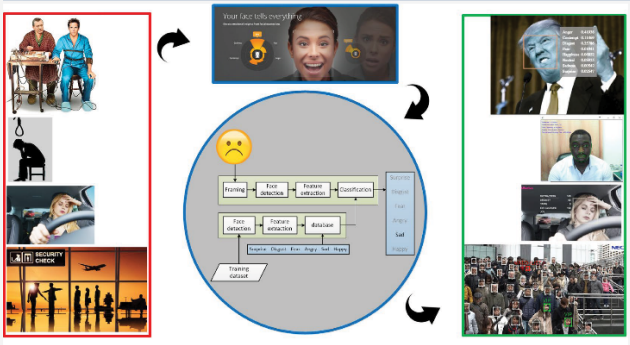
1. Silver Medal, Category B, Project Leader, Algorithm and Scheme for Efficient Spectrum Utilization of 4G/5G D2D Communication, Research Innovation Commercialization & Entrepreneurship Showcase (RICES 2018), Nov11, 2018, Multimedia University, Cyberjaya

Ambience: Emotionally-Aware Human-Expressive Virtual Assistant for Affective Ambience

Project Leader: Dr. Chee Pun Ooi

Members: Dr. Vishnu Monn, Prof. Raphael CW Phan, Dr. Koksheik Wong, Dr. Tan Wooi Haw, Mr. Adamu Muhd Buhari

PROBLEM STATEMENT

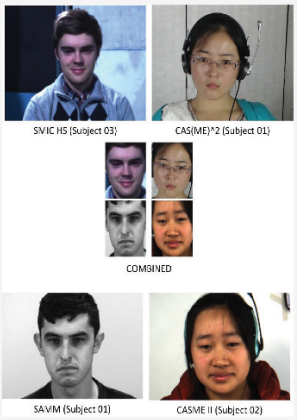


❑ Challenges

- ✓ Attaining ***fast*** and ***reliable*** performance
- ✓ To make Human Computer Interaction (HCI) more ***natural*** and ***user friendly***
- ✓ Automatic analysis of facial expression of emotions, face recognition and depression detection

PROPOSED SOLUTION

Spontaneous Datasets



Full-face Feature Extraction

Algorithm 1: Full face features with facial landmark points

Data: $\mathcal{L}_n$, where $n \rightarrow x|y \in \{1, 2, 3, ..., N\}, N = 68$

Result: $\mathcal{F}_k$, where $k \in \left\{1, 2, 3, ..., \sum_{n=1}^{N-1} 2 \cdot n\right\}$

```
for i ← 1 to N by 1 do
    for j ← 1 to i by 1 do
        F_k ← sqrt((L_{x,i} − L_{x,j})^2 + (L_{y,i} − L_{y,j})^2);
        F_{k+1} ← (L_{y,i} − L_{y,j}) / (L_{x,i} − L_{x,j});
        k ← k + 1;
```

FACS-based Feature Extraction

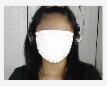
Algorithm 2: Selected region features with facial landmark points

Data: $\mathcal{L}_n$, where $n \rightarrow x|y \in \{1, 2, 3, ..., N\}, N = 68$

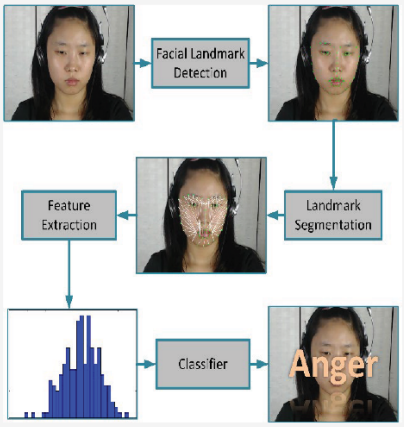
Result: $\mathcal{F}_k$, where $k \in \left\{1, 2, 3, ..., \sum_{n=1}^{N_S} 2\left(N_{AU_c} \cdot N_{S_C}\right)\right\}$

```
for i ← 1 to N_S by 1 do
    for j ← 1 to N_{AU_i} by 1 do
        for t ← to N_S by 1 do
            F_k ← sqrt((L_{x_i,l_2} − L_{x_i,l_1})^2 + (L_{y_i,l_2} − L_{y_i,l_1})^2);
            F_{k+1} ← (L_{y_i,l_2} − L_{y_i,l_1}) / (L_{x_i,l_2} − L_{y_i,l_1});
            k ← k + 1;
```

Extracted features



Extracted features



EXPERIMENTAL RESULTS

Papers	Features	Classifier	Accuracy (%)				
			SMIC	CASMEII	CAS(ME)^2	SAMM	COMBINED
Liong et al., 2014	OS weighted LBP-TOP	SVM	53.66	42.00	-	-	-
Le Ngo et al., 2014	STM	Adaboost	43.78	44.34	-	-	-
Huang et al., 2015	STLBP-IP	SVM	57.93	59.51	-	-	-
Huang et al., 2016	STCLQP	SVM	64.02	58.39	-	-	-
Liong and Wong, 2017	Bi-WOOF + Phase	SVM	68.29	62.55	-	-	-
Xu et al., 2017	Facial Dynamics Map	SVM	54.88	45.93	-	-	-
Liong et al., 2018	Hierarchical STLBP-IP	KGSL	54.00	46.00	-	-	-
Proposed Algo. I	Full-face features	SVM	47.24	57.97	63.30	49.11	59.90
Proposed Algo. II	FACS-based features	SVM	**50.81**	**67.61**	**77.71**	**64.32**	**79.50**

Speed: up to ~500 fps with 640x480 (Xeon Processor E5-2650)

PUBLICATIONS

1. AM Buhari, VM Baskaran, RCW Phan, K Wong, CP Ooi, HW Tan, Real-time micro-expression recognition system with facial landmark points. *Journal of Visual Communication and Image Representation (In preparation)*

Life Made Easier™ TM Group

MULTIMEDIA UNIVERSITY

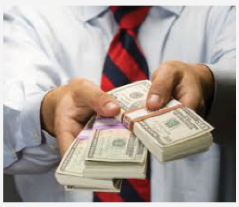
Automated Detection of Visual and Speech Content for Film Censorship using Deep Learning

Project Leader: Assoc. Prof. Ir. Dr. Hezerul Abdul Karim
Project Member: Mohd Haris Lye Abdullah, Assoc. Prof. Dr. Mohammad Faizal Ahmad Fauzi, Dr. Sarina Mansor, Dr. John See
Research Scholar: Nouar AlDahoul, Abdulaziz Saleh Ba Wazir

Faculty of Engineering (FOE)

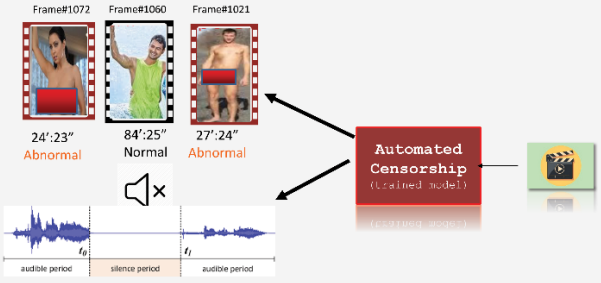
Problem Statement

- All local and foreign films should obtain **suitability approval** before distribution or public viewing (Ministry of Home Affairs – Security Collective Responsibility).
- The process of screening visual content for censorship purposes involves recruiting a **large amount of manpower 24/7**, and thus imposes a huge censorship cost per month.
- All the recruited personnel should participate in **extensive training** to ensure the fulfilment of filtering standards which leads to increment in censorship cost.
- **Manual** visual and speech content detection is **inaccurate** due to **fatigues of manpower** and **weakness of human visual system in long-term screening**.
- Identifying inappropriate visual and speech contents suffers from **low speed** detection specially in long movies because of speed limits of human visual system.



Solution Description

This Solution uses deep learning algorithms of Convolutional Neural Network (CNN) to detect unwanted visual contents (e.g., nude and sexual scenes). Moreover, our solution utilizes Recurrent Neural Network (RNN) to detect speeches fall within foul language category. The system specifically detects the location of inappropriate frames within a video and processes them.

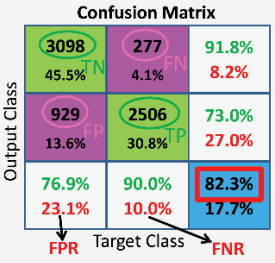


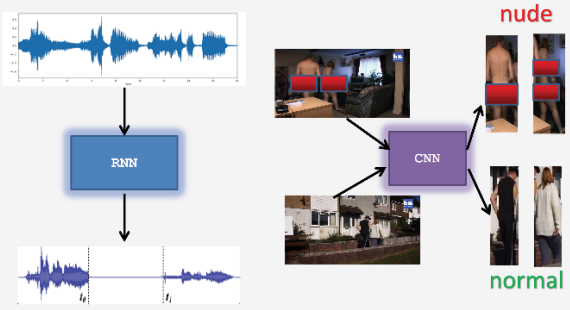
Featured Results

Foul Language Detection

Accuracy	96.11%
Precision	93.68%
Recall	98.89%
F-score	96.22%
Detection Time	54.3 ms

Nudity Detection





Commercialisation Potential

- Robust automatic censorship for broadcasting companies and video providers in video screening such as UniFi and Astro compared to the manual one.
- Current manual censorship systems are error-prone and time consuming.
- Our proposed system can help the recruited personnel to detect such inappropriate contents accurately in a short time.

Special Highlights

- Collaboration between MMU and TM and the research is fully-funded by TM R&D, Malaysia.
- Fast and accurate detection (Detection speed of 5 fps, accuracy 82.3%)
- System flexibility to be trained with other categories of unwanted contents (e.g, another language).
- Presentation: 4 conference presentations
- Publications: 2 conferences, 2 journals

List of Publications
1. Rasoul Banaeeyan, Hezerul Abdul Karim, Mohd Haris Lye Abdullah, Mohammad Faizal Ahmad Fauzi, Sarina Mansor, John See Su Yang, "Automated Nudity Recognition using Very Deep Residual Learning Network", International Conference on Advanced Science, Engineering and Technology (MECON) 2018, March 20-21, 2019, MMU Cyberjaya.
2. Rasoul Banaeeyan, Hezerul Abdul Karim, Mohd Haris Lye Abdullah, Mohammad Faizal Ahmad Fauzi, Sarina Mansor, John See Su Yang, "Acoustic Pornography Recognition Using Fused Pitch and Mel-Frequency Cepstrum Coefficients", International Conference on Advanced Science, Engineering and Technology (MECON) 2018, March 20-21, 2019, MMU Cyberjaya.
3. Nouar AlDahoul, Hezerul Abdul Karim, Mohamad Faizal Ahmad Fauzi, Mohd Haris Lye Abdullah, Sarina Mansor, John See, "Local Receptive Field-Extreme Learning Machine based Adult Content Detection", IEEE International Conference on Signal and Image Processing Applications (IEEE ICSIPA), September 17-19, 2019, Malaysia, Kuala Lumpur.
4. Abdulaziz Saleh Ba Wazir, Hezerul Abdul Karim, Mohd Haris Lye Abdullah, Sarina Mansor, "Acoustic Pornography Recognition Using Recurrent Neural Network", IEEE International Conference on Signal and Image Processing Applications (IEEE ICSIPA), September 17-19, 2019, Malaysia, Kuala Lumpur.

Life Made Easier™ TM Group

Blended Learning with E-Learning Tool and Interactive Class Approach

Faculty Faculty of Engineering and Technology

Project Leader Mr. Chong Peng Lean

Team Members Mr. Tan Chun Fui

Description

The I-Vision Learning Board is an educational and teleconferencing support equipment designed for instructor to capture face-to-face visually-stimulating e-learning/training videos while interacting with owns illuminated handwritten notes and digital content portrayed on the board during recording. It consists of a special glass board embedded with illumination circuitry and projection entity.

Key Features

1. Specially-designed glass board:
To enable the presenter to write on the transparent glass and maintain eye contact as well as body language with the audience. The glass is custom-made to enable projection of slides, graphic, and video to facilitate idea delivery.

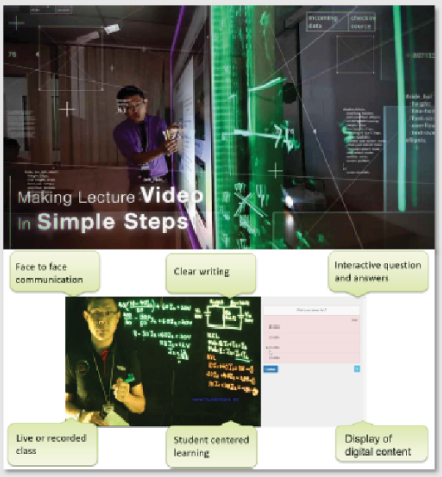
2. Illumination circuitry:
To enable the writing on the glass board to be illuminated and its colors to be controlled.

3. Support structure:
To enable the board to be portable, user-friendly and provide a firm support frame.

4. Recording equipment:
It comes with a setup consisting of a video recorder, microphone, black back-drop, computer and a projector for video recording.

5. EdPuzzle software (blended learning freeware online):
To embed the e-learning video made with interactive questions and answers throughout the video to assess the students' learning achievement.

6. Skype software (communication freeware online):
To enable recording of own lecture and deliver it live to other online audiences for distance learning.

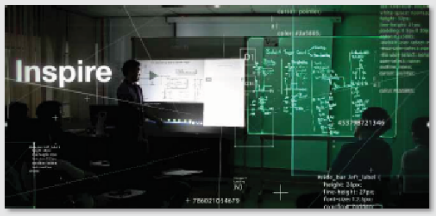


Commercialization Potential

1. Education sector:
The I-Vision Learning Board can be commercialised as an educational support equipment to record student-centered e-learning videos which support blended learning, e-learning, distance learning and Mass Open Online Courses (MOOCs) in universities and schools. Instructors will be able to deliver a video which emphasises face-to-face communication for content delivery and delivering a one to one self-tutoring experience. The students will be able to learn at own pace, time and venue base on the e-learning video produced.

2. Teleconferencing sector:
The I-Vision Learning Board can also be commercialised as support equipment for online teleconferencing product in online meetings. Users can see each other face-to-face while illustrating descriptions on the board and communicating. When equipped with Skype, it can deliver a one-to-one teleconferencing experience.

Special Highlighted



1. Awarded the Gold Award from I-Teach Symposium and Workshop 2017 competition.
2. Awarded the Silver Award from ITEX 2018.
3. Awarded the Silver Award from MTE 2018.
4. Awarded a Bronze Award from PECIPTA 2017.
5. Copyright approved on 6 October 2017. Copyright protection number: LY2017005393.
6. The patent filed on 8 November 2018. Application number: PI 2018704185.
7. Interested industry collaborator: Global Digital Network Sdn Bhd.
8. The product is pilot tested and implemented in the Center for Diploma Program, Multimedia University Melaka.

CHARACTERIZATION OF DUAL-MATERIAL HETERO-DOUBLE GATE TFET IN SUB-MICRON REGION

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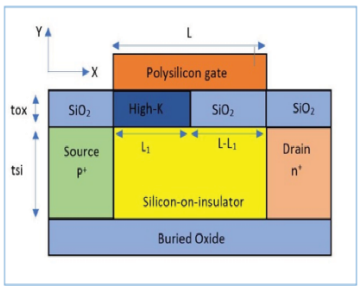
SYNOPSIS:

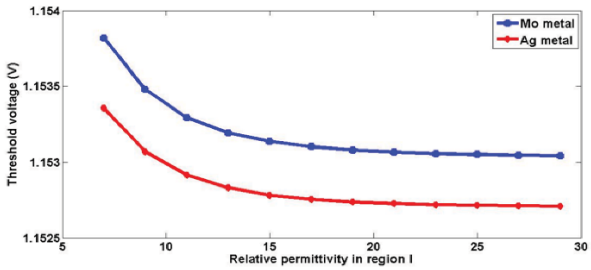
As conventional MOSFETs are scaled to the sub-nanometer region, the close proximity between source and drain reduces the control of gate over channel which leads to several problems, such as high subthreshold swing (SS), high leakage current, and other short channel effects (SCEs) like threshold voltage roll-off and increased substrate bias effect. Tunneling field-effect-transistors (TFETs) are considered one of the attractive device to replace conventional MOSFETs in the sub-nanometer region due to its lower subthreshold slope (*SS*) than 60 mV/decade at room-temperature. Despite the better SS, there are two main drawbacks with TFETs, low ON-state current which degrades the operating speed and results in large ambipolar current. Choi et al [***"Demonstration of hetero-gate-dielectric tunneling field-effect transistors (HG TFETs)", Nano Converg., vol. 3, no. 1, pp. 1-15, Jun. 2016***] have proposed hetero-dielectric gate (HDG) TFET to overcome these two shortcomings by using high-κ material at source and SiO_2 at the drain side. The main drawback of this technique is that the high-κ dielectric near the source increases the coupling between the gate and source which reduces the energy band of source region and results in leakage current. The DMG technique is to enhance the performance of the device but alone it is not enough to rectify the problems associated with TFET, therefore, we have presented a dual metal triple-gate-dielectric (DM_TGD) TFET to suppress the ambipolar behaviour and improve the performance. We have placed the lateral combination of dielectrics TiO_2 and Al_2O_3 partially near the source and SiO_2 at the drain side.

RESULT AND DISCUSSIONS:

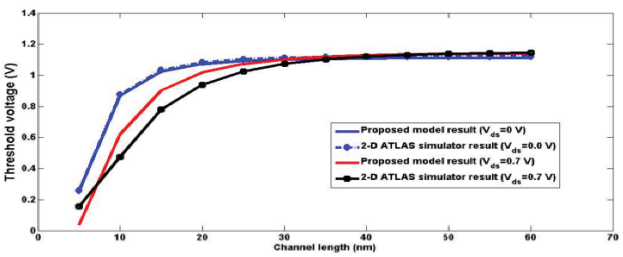


Region I: high-k region near source to control the tunnelling current with relative permittivity of kr_1 and thickness tox_1=3 nm

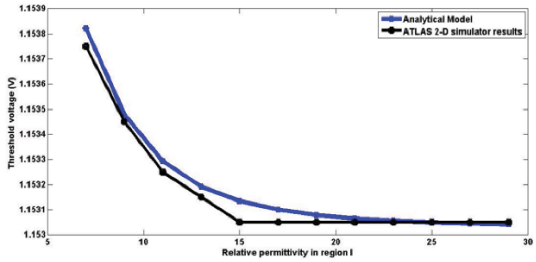
Region II: low-k near drain (relative permittivity of kr_2) to minimize the ambipolar current, with thickness tox_2=3 nm



Threshold voltage variation with relative permittivity in region I for two gate metals



Comparison of threshold voltage with proposed and 2-D ATLAS simulator



Comparison of threshold voltage with proposed model and 2-D ATLAS simulator results

Threshold Voltage comparison with references results

Φ_{m1} (eV)	Φ_{m2} (eV)	Threshold voltage (V)	
		Proposed	Ref [13]
4.0	4.0	0.349	0.34
4.4	4.4	1.10	0.74

(Upasana, R. Narang, M. Gupta, M. Saxena, "Simulation study for dual material gate hetero-dielectric TFET: Static performance analysis for analog applications", *Proc. Annu. IEEE India Conf. (INDICON)*, pp. 1-6, 2013)

CONCLUSION:

The proposed model shows a good agreement with the 2-D ATLAS simulator results. As gate voltage increases, the tunneling width reduces which lowers the threshold voltage. Threshold voltage of the device also reduces as the dielectric constant of the tunnel space region increases and the length of high-k region increases.

Comparison of Microarray Breast Cancer Classification using Support Vector Machine and Logistic Regression with LASSO and Boruta Feature Selection

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Abstract

Breast cancer is the most frequent cancer diagnosis amongst women worldwide. Despite the advancement of medical diagnostic and prognostic in early detection and better treatment, there is still a deficiency of a better-reliable system or good markers in predicting and diagnosis of breast cancer. The breast cancer classification is significantly important in the early stage of diagnostic test. Preliminary research on the usage of machine learning classifier and feature selection method for breast cancer classification is conducted here. Two feature selection methods namely Boruta and LASSO and SVM and LR classifier are studied here. A breast cancer dataset from GEO web is adopted in this study. The findings show that LASSO with LR gives the best accuracy using this dataset.

Introduction

The increase in the number of patients diagnosed with cancer shows a high rate of observation with high mortality and morbidity in developed and developing countries[1]. It is estimated that more than 2 million patients were newly diagnosed with cancer and almost 627,000 breast cancer mortalities were reported [2].

Among the cancer cases, breast cancer is the second leading cause of cancer death[1]. In fact, according to the Malaysian Cancer Registry Report 2007 to 2011 it is the most prevalent cancer among Malaysian female [3] as shown in Figure 1.

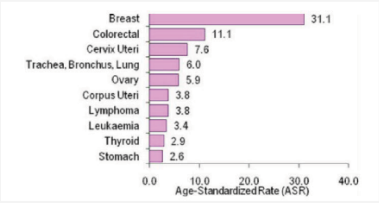
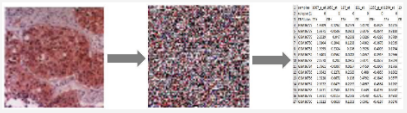


Figure 1. Ten most frequent cancers in Malaysian females 2007-2011 [3]

Breast cancer survival rate is greatly influenced by the stage of cancer during diagnosis. Lack of early detection program and insufficient treatments contributed to high death among breast cancer patients. Hence, early cancer diagnosis and treatment is needed to reduce the risk of cancerous and abnormal tissue from spreading to other organs.

This work focus on our preliminary findings on application of Support Vector Machine and Logistic Regression in classification of breast cancer microarray data. To tackle the dimensionality issue, two feature selection methods are considered, LASSO and Boruta. Breast cancer microarray data that is developed by Human GENOME project consist of a large number of gene features profiles with small samples size. Normally features sample size can be reached up to thousand whereas samples sample size normally less than hundred. The finding shows that LR with LASSO has the best performance.



(a) (b) (c)

Figure. 2. Physical sample from DNA human body(a) Gene expression (in image expression) using high density DNA technology(b) to microarray gene expression profiles in dataset form (c)

Research Methodology

A human recurrence breast cancer microarray dataset is retrieved from Gene Expression Omnibus (GEO) database for this study. The data is labelled as estrogen receptor active (ER+) or estrogen receptor inactive (ER-) or in other words either the gene features are belonging to normal or abnormal cells.

Table 1. Representation of breast cancer microarray dataset GSE2034(Recurrence Dataset)

	ER+	ER-	Sample	Gene	Class
GSE2034	180	106	286	22283	Binary

The dataset is fed to feature selection first to select and identified the most informative data before the sample are classified. Practically, feature selection will be done after pre-processing. However, for our preliminary result, we make used of raw data that retrieved from the GEO web and we determine the target value. So, preferably all the variable is conducted in numbers and will be split into two separate file namely features and target. Next, the data will be divided into training and test sets. Normally we divided into 20% test and 80% training. Finally, the results are observed and recorded.

Results and Discussion

The effectiveness of classification result without the help of feature selection or with feature selection algorithm is observed.

For criteria (1), using LR classifier, 72.22% accuracy is achieved which is much better than SVM classifier in which only obtained 59.72% accuracy. However, for criteria (2), when feature selection is implemented together with the classification algorithm, Boruta feature selection shows improvement of classification result to 69.44% and 73.61% for Boruta+SVM and Boruta+LR respectively. Between SVM and LR, Boruta gives significant improvement to SVM. Combination of LASSO+LR shows a very significant improvement of almost 37% from using only LR algorithm. Unfortunately, there is no effect when LASSO is used with SVM as the result is similar with using only SVM classifier.

Table 2. Comparison result of Microarray data based on criteria mentioned in (1) and (2).

Criteria	SVM	LR
Without Feature Selection (FS)	59.72%	72.22%
Boruta	69.44%	73.61%
LASSO	59.72%	98.61%

Conclusion

Application of SVM and LR together with Boruta and LASSO feature selection techniques on the microarray breast cancer classification process is explained in this work. There is no improvement observed when using LASSO in SVM. However, using Boruta feature selection, the classification accuracy increased by almost 10% when Boruta is used prior to classification using SVM. Whereas, the combination of LASSO+LR show substantial result when the accuracy achieved shoot to almost 99% better than the classification with LR without any feature selection. However, Boruta+LR only increase by lesser than 2% from classification result of LR. Future work will include more dataset and focus on the tuning of parameters in the classifier and feature selection algorithm.

Acknowledgement

This research is funded by the Fisabilillah R&D Grant Scheme (MMUE/180060)

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[1] GLOBOCAN, "Estimated Cancer Incidence, Mortality and Prevalence Worldwide in 2012," *Section of Cancer Surveillance*. pp. 1–7, 2012.

[2] F. Bray, J. Ferlay, I. Soerjomataram, R. L. Siegel, L. A. Torre, and A. Jemal, "Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries," *CA. Cancer J. Clin.*, 2018.

[3] Ministry of Health Malaysia, "Early Detection of Common Cancers And Referral Pathways: Module for Health Care Providers," *MOH, Module 2017*, 2017. [Online]. Available:http://www.moh.gov.my/resources/index/Penerbitan/Rujukan/NCD/Early_Detection_Of_Common_Cancers_And_Referal_Pathways_Module_For_Health_Care_Providers.pdf. [Accessed: 16-Nov-2018].

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Demonstration of an All-Optical-Based Hybrid Visible Light Communication Backbone and Hotspot for Wireless Data Broadcasting

Introduction

- Utilize visible light emanated from LEDs (i.e., 400-800 THz) as the data transmission medium.
- Faster, cheaper, greener, cleaner, broader bandwidth and safer optical version of Wi-Fi.
- Incorporates LEDs (transmitter), photodetector (receiver), and microcontroller (signal processing).

Technology Challenges

- Lacking in terms of actual implementation of VLC or hybrid FSO/VLC system.
- Ambient light interference is inevitable.
- Require a clear line of sight (LOS) path for signal transmission.
- A proper "lights off" mode is needed.

Objectives

- To adopt the VLC technology as a viable high-speed and low-cost optical data transmission of the ICT infrastructure.
- To develop a complete demonstration platform for an all-optical-based VLC backbone and mobile hotspot network.

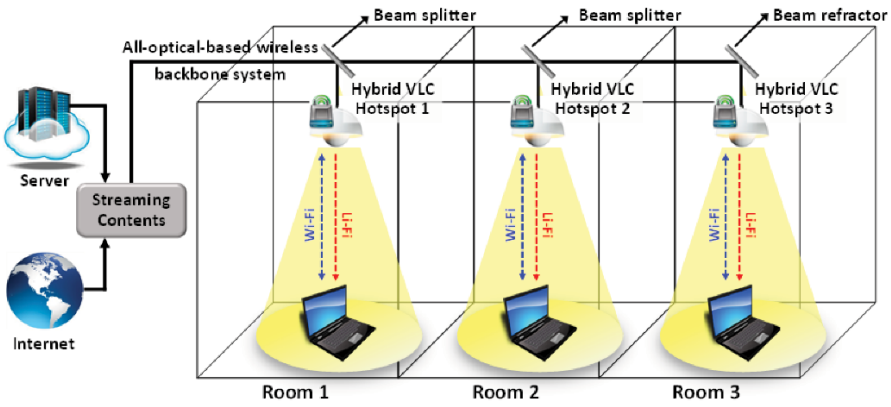

Fig 1. Concept of our proposed hybrid VLC hotspot network with an all-optical based backbone system for indoor deployment.

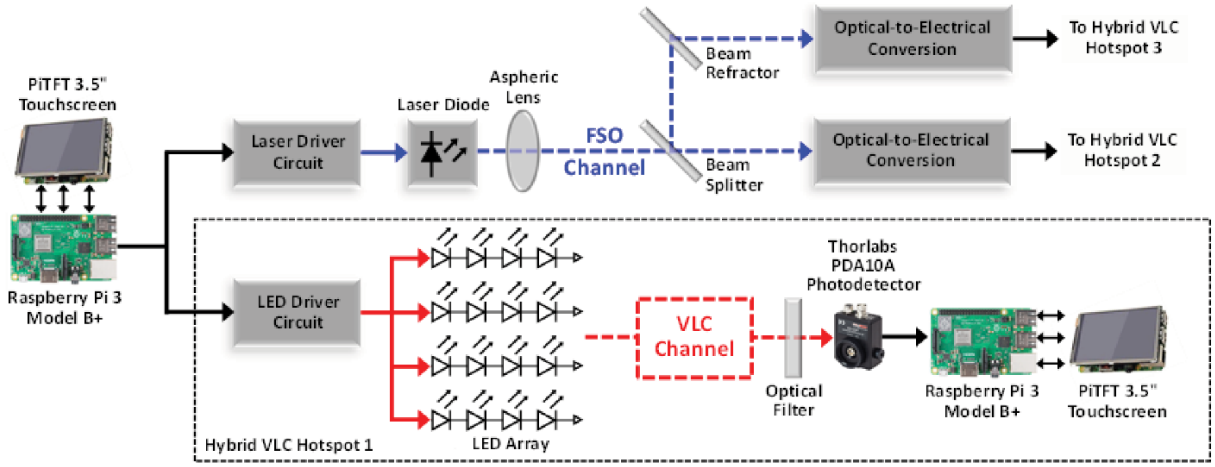

Fig 2. Concept of our proposed hybrid VLC hotspot network with an all-optical based backbone system for indoor deployment.

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Demonstration of an All-Optical-Based Hybrid Visible Light Communication Backbone and Hotspot for Wireless Data Broadcasting

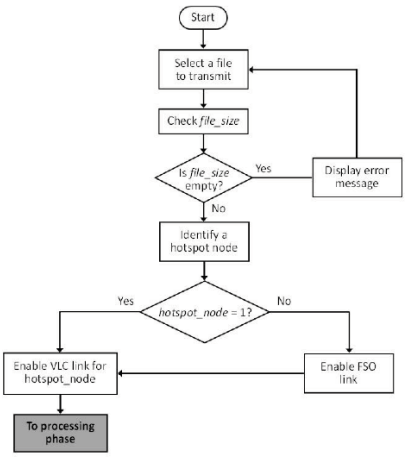

Fig 3. Flowchart for handling the integration between the FSO and VLC links.

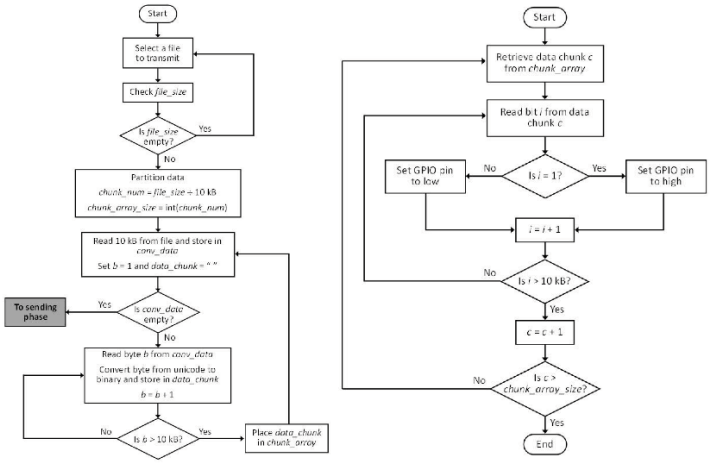

Fig 4. Flowchart depicting the transmitter's data processing mechanism, which consists of (a) the processing phase and (b) the sending phase.

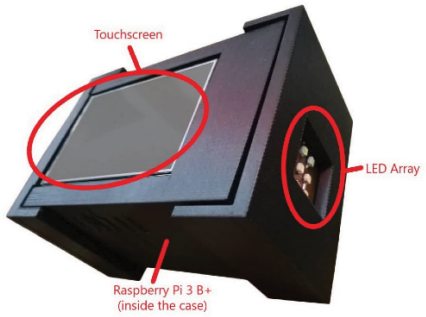

Fig 5. VLC transmitter prototype with integrated touchscreen.

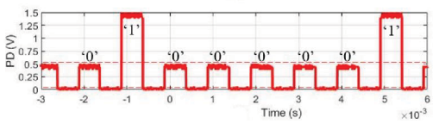

Fig 6. Waveforms corresponding to the transmission of "A."

Research Output

- A preliminary study has been carried out to estimate a cost savings of RM 488,400 with the proposed hybrid VLC solution in a sample of 222 hotel rooms.
- A hybrid VLC/FSO prototype has been designed and constructed.
- User interface of the proposed hybrid system has been developed.
- An indexed journal has been accepted.

Novel Imapct

- Cost-effective high-speed wireless backbone system.
- New architecture of the hybrid VLC and wireless backbone solution for potential indoor hotspot implementations.
- Potential commercialization for ubiquitous and seamless high-speed indoor wireless data broadcasting.

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Design, Fabrication and Proof Testing of Earth Electrode Performance with Various Configurations

OBJECTIVES

- To design & fabricate various earth electrodes

1. Design spike rod to enhance electric field intensity
2. Design smaller size to reduce time and cost installation
3. Fabricate different materials to analyse the effect under high impulse

- To investigate the performance of earth electrodes in different soil resistivity.

1. Two sites will be tested: one with poor soil, another is good soil.
2. Adding a layer of gravel sand to investigate the ionization under soil properties.

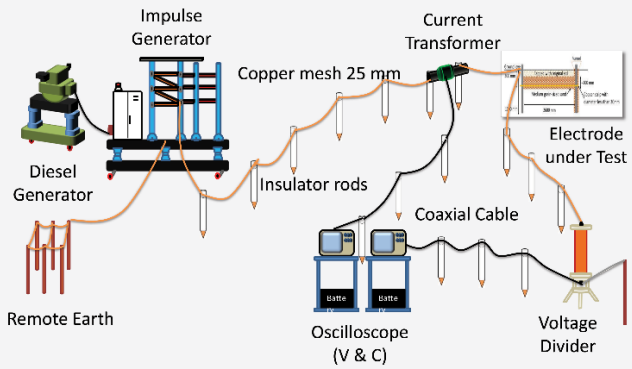
- To investigate the performance of earth electrodes under high impulse conditions.

1. Analyse in terms of time for current to discharge to zero, difference in RDC and Rimpulse as well as ionisation effect.

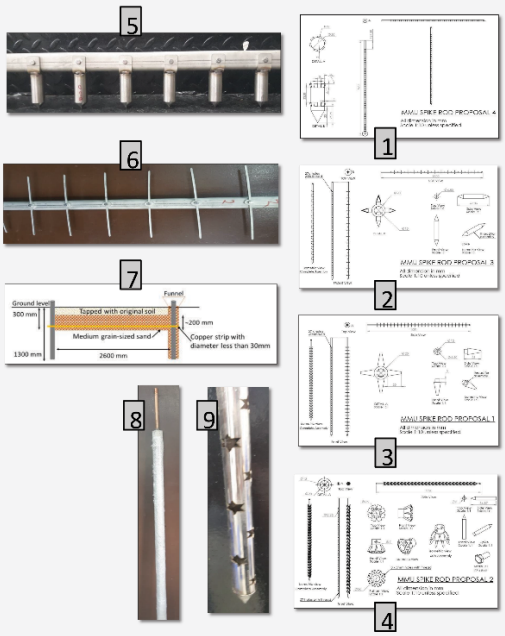
INTRODUCTION

- Earthing systems are needed to effectively discharge any fault currents to the ground. Practically, lower RDC needs larger grounding system.
- However, the cost and time to install is higher. A larger grounding system also influenced the inductive effect caused the time for current to discharge a bit slower.
- Two parameters need to be considered to improve the grounding system under high impulse current: soil properties and earth electrode.
- It has been known from previous studies that soil properties would change under high impulse conditions, due to soil ionization process.
- During ionisation process, streamers are formed, reducing the earth resistance value.
- A remarkable study has done by Ali et al where it shown that rod with spike increase the electric field and reduce resistance value.
- Therefore, this research aims to consider a few designs of earth electrodes to enhance the ionisation process hence reducing the earth resistance value.

TEST SETUP



ELECTRODE DESIGN



PRELIMINARY RESULT

Table 1: Soil resistivity profile

	HV Lab	Sg. Merab
Upper resistivity, (Ωm)	111.40	1464.40
Lower resistivity, (Ωm)	454.24	443.37
Thickness, h (m)	5.16	8.32

Table 2: Resistance difference

Sand Test Conf.	RDC (Ω)	Rimpulse (Ω)	% diff.
A	63.71	41.23	35.28
B	49.32	34.03	31.00
C	94.24	46.69	50.46

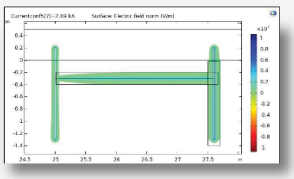


Figure 1: Electric field region in sand test

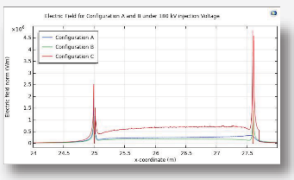


Figure 2: Electric Field distribution along the sand area

- Soil resistivity profile for HV Lab and Sg. Merab has been measured using Wenner method and interpreted using RESAP module in Current Distribution, Electromagnetics Fields, Grounding and Soil Structure Analysis CDEGS) as in Table 1.
- Three configurations has been tested under Sand Test to see the effect of gravel sand with diameter of 10 mm. Conf A represents one rod connected with copper strip, conf B represents two rods connected with copper strip, Conf C represents as electrode design (7).
- Figure 1 shows that a region where electric field larger than critical electric field at 400 kv/m for Conf C and it confirmed with Figure 2 where Conf C has higher electric field compared to Conf A and B.

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Development and Performance Analysis on Antennas for 5G Communication Technologies

Abstract

Several fifth generation (5G) single element antennas for terminal devices with and without metamaterial loading have been presented which revealed the fact that metamaterial has a considerable impact on antenna parameters. In addition, a sub-6 GHz multi-layer massive mMIMO base station antenna loaded with metamaterial for 5G applications is presented. This research has invented 360° octa shaped mMIMO antenna with overall 256 elements. Each broadside has 32 elements and capable to steer in a wide beam angle with high gain up to 19.5 dBi at 3.5 GHz operating frequency. The antenna is suitable to be combined with RF switch controller and implemented for very precise localization system, a smart antenna system and radar in the future.

System Configuration

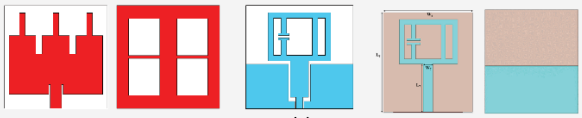

Figure 1: 5G receiving antennas for terminal devices a) Antenna-1 top layer, b) Antenna-1 bottom layer, c) Antenna-2, d) Antenna-3 top layer, e) Antenna-3 bottom layer

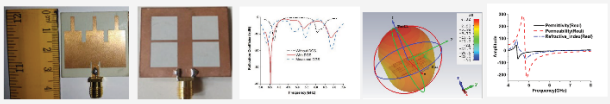

Figure 2: (a, b) Fabricated prototype for antenna-1, (c) S11 of antenna -1, (d) 3d radiation pattern of antenna-1, (e) Effective parameters of meta-material unit cell of Antenna-3

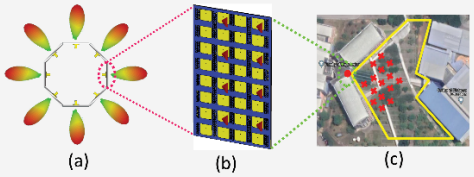

Figure 3: Octa mMIMO Antenna design a) Radiation pattern, b) 32 elements c) MMU implemented area

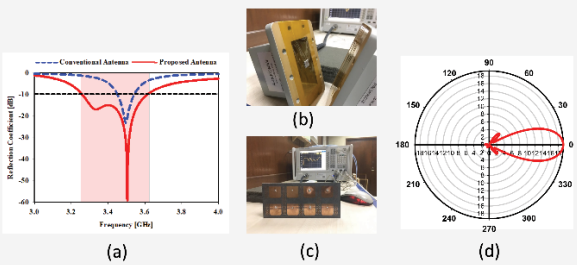

Figure 4: a) Subarray Reflection Coefficient, b) Fabricated ENG metamaterial, c) Fabricated 2*4 Subarray antenna d) Radiation pattern.

Problem Statement

5G antennas are one of the most promising and best technologies which can substantially increase the overall network speed and capacity by reducing the co-channel ISI interference as well as the fading effect compared with the current 4G antennas and by increasing bandwidth and gain. At the same time for terminal devices the antenna should be compact enough to meet requirements of IoT devices. A challenge of Mid-Band 5G single element antennas integrated in terminal devices is to be designed with a compact size using low loss materials. On the other hand, conventional 4G/5G MIMO antennas required more power to cover nearly 360° with an additional mechanical parts, lower gain and undesired multipath interference. Therefore, the demand to design massive mMIMO antenna for next generation network (5G) which is capable to provide high quality of service (QoS) and excellent coverage with lower mutual coupling using new technique is highly required.

Novelties

- 5G Multilayer mMIMO antenna with a controlled beam direction at azimuth angle.
- High gain, wide bandwidth and less mutual coupling on metamaterial antenna.

Advantages

- Potentially covering 360° with lower mutual coupling less than -32 dB.
- High Gain and its capability for scanning at specific/desired angles.
- Compact size, High bandwidth.

Commercial Potential

- 5G base station terminal, 5G portable modems, 5G routers, IoT devices and other terminal devices.
- On emergency localization estimation technique.

Conclusion

Prototype of massive MIMO antenna using metamaterial

Publication

- Analysis of Defected ground structure on the stub loaded slot antenna for 5G communication, Sensors 19 (11), 2634 (Q1, IF: 3.031)
- A Compact Dual Band LC Resonator Loaded Metamaterial Inspired Antenna For 5G Wireless Communication, (IEEE IconSpace conference 2019).
- A compact dual negative LC resonator loaded metamaterial inspired antenna for 5G technology, (Awarded best paper in MJWRT 2019)

Prof. Dr. Md Shabiul Islam | Prof. Dr. Hin Yong Wong | Prof. Dr. Mohammad Tariqul Islam |
Dr. Samir Salem Al-Bawri | Dr. Lee Lini | Md. Mushfiqur Rahman

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MULTIMEDIA UNIVERSITY

Development of Automotive Lane Departure Warning System

Em Poh Ping, Fitrian Imaduddin, Wong Eng Kiong

PROBLEM STATEMENT

1. A road with dashed lane markings.

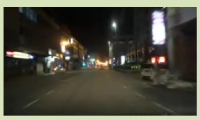
2. Lane markings with heterogeneous walkway texture.

3. Indistinct lane markings.

4. A collection of divided lanes and road barrier marking lane location.

5. Highly untidy shadows from trees blocking lane markings.

6. Intense illumination variation and lowering contrast of road markings.

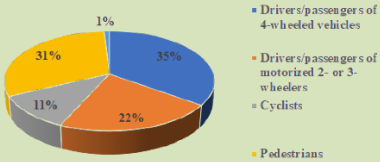


7. Night-time.

8. Heavy raining.

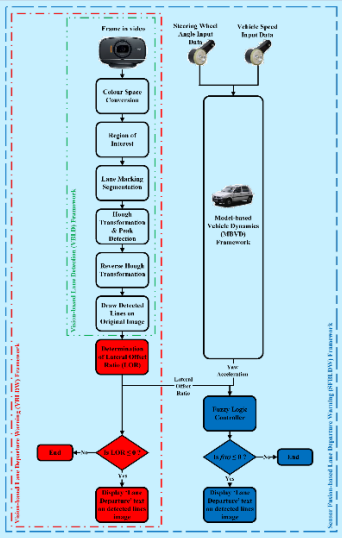
RESEARCH MOTIVATION

Distribution of Road Traffic Deaths by Type of Road User in GHO Data for Year 2013

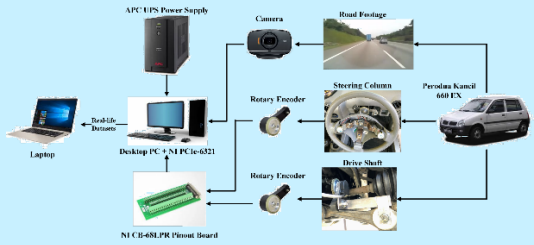


- 4-wheeled vehicles are still the main contributor to the global road fatalities compared to other road user types.
- Many related studies had shown that single vehicle lane departure crashes accounted largely in road traffic deaths that results from drifting out of the roadway into oncoming traffic, into adjacent traffic or off the roadway.

FRAMEWORK DEVELOPMENT



EXPERIMENTAL TEST BED



KEY FINDINGS AND DISCUSSION

It is reported that experimental results have shown significant improvement using sensor fusion-based framework compared to vision-based framework in lane departure detection.

99.96%
Lane departure detection rate in daytime driving environments.

98.95%
Lane departure detection rate in night-time driving environments.

Sponsored and Supported by

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DEVELOPMENT OF 3D VIRTUAL MAP CREATOR ROBOT

Min Thu Soe, Wong Wai Kit , Mahmoud Elsayed
Faculty of Engineering and Technology, Multimedia University

ABSTRACT

In many virtual map mobile robot routing applications, it is essential to obtain an accurate map for an unknown environment first, before accurately localizing the robot(s) in it.

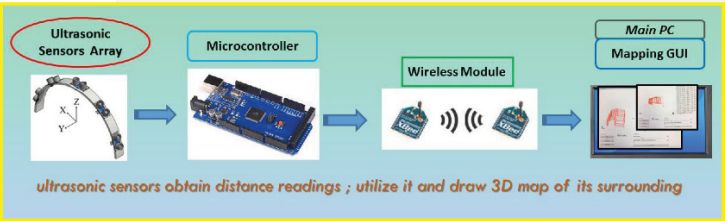
The robotic mapping problem has drawn a lot of attention in the research community. An important task in mobile robotics is to generate consistent environment maps, based on the collected sensor data. Most previous approaches also construct 2D maps only, and they only address single-robot mapping.

2D map cannot detect the obstacle size, shape and also depth of the hole on ground.

To overcome this problem, the focus shifted from 2D map towards 3D map.

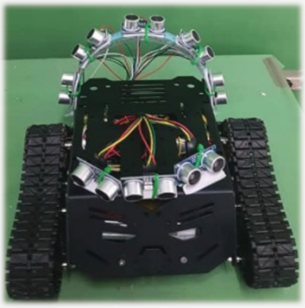
The main objective of this project is to design and fabricate the single robot with efficient 3D map plotting algorithm for virtual map formulation in robotic routing using ultrasonic sensory data as imaging sensors.

Overall



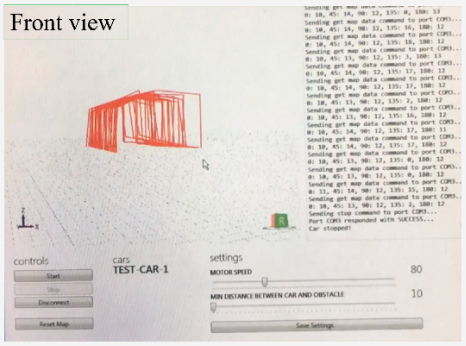
An array of ultrasonic sensors is the primary sensor of this robot used to collect mapping data and navigational purposes. The microcontroller makes decisions on where to move next or to stop based on the data returned from the ultrasonic sensors. The wireless module used for communication with the main computer.

Vehicle

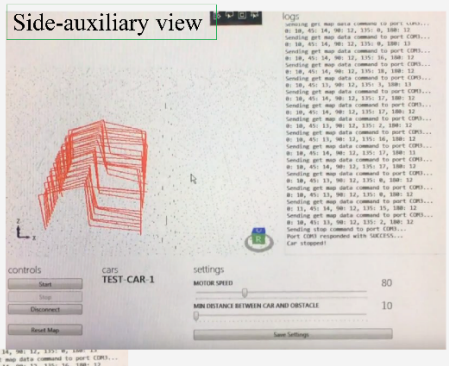


RESULT

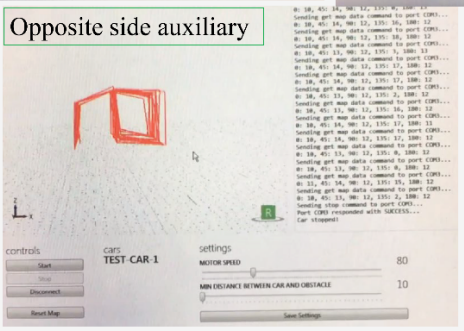
Front view



Side-auxiliary view



Opposite side auxiliary



Acknowledgement

Special thanks to Multimedia University.

This research project is sponsored by Multimedia University, Mini Fund 2018(MMUI/180176).

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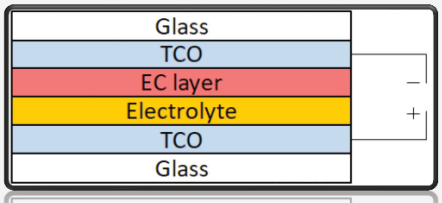
RICES 2019

Project title: **Development of Electro/Photochromic (EPC) Sensor**
Project leader: **Associate Prof. Ir. Dr. Chan Kah Yoong**
Project member: **Mr. Benedict Au, Ir. Dr. Pang Wai Leong, Mr. Lee Chu Liang, Mr. Ng Zi Neng**
Project Custodian: **Mr. Abd Hamid Mustafa**
(Service Design and Innovation, Technology and Innovation, IT&NT, Telekom Malaysia Berhad, Kuala Lumpur)
Fund provider: **TM R&D (RDTC/170939 & EPC Sensor)**
MMU EP number: **MMUE/170011**

Electrochromism

- In general, EC phenomena is due to the formation of tungsten bronze (M_xWO_3).
- WO_3 (transparent) + $xM^+ + xe^-$ <---> M_xWO_3 (blue). [M = H^+, Li^+, Na^+ or K^+]
- When a small voltage is applied at the electrode, the following occurs:
  i. M^+ ions from counter electrode move to the EC layer.
  ii. Electrons from electrode move to EC layer.
  iii. This double injection results in a dark blue film.
- When the polarity of the applied voltage changes, the film changes from dark blue to transparent.

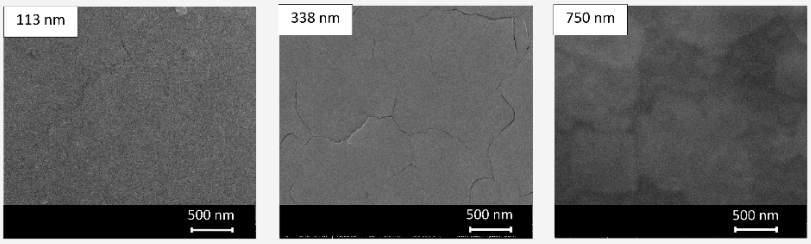
Electrochromic Device Structure



Bleached State **Coloured State**

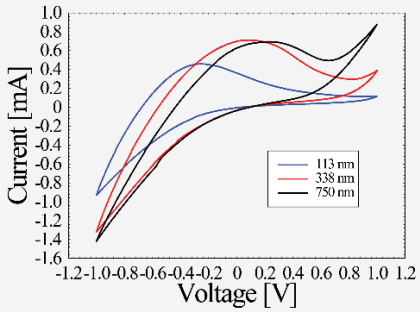
Experimental Results

Surface Morphology



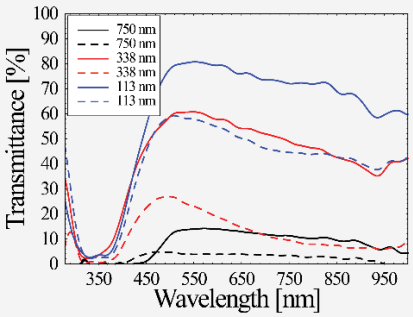
- All films macroscopically appear to have uniform and homogeneous surfaces.
- Cracks are visible as due to imposed strained during annealing process.
- Large variations with randomly orientated rectangular shape grains at greater thickness.

Cyclic Voltammetry



- In general, both anodic and cathodic current peaks increased with increasing thickness.
- This increase is an indication of the increasing active mass deposited on the substrate.
- The area under the CV curves represents the charge storage capacity which was found to increase with increasing WO_3 film thickness.

Colouring and Bleaching Transmittance



- Colouring transmittance decreased with increasing film thickness due to increase in charge capacity.
- Bleaching transmittance decreased with increasing film thickness due to existence of trapping sites.

Potential Applications

Smart Windows
Mirror Displays
Sensors

Output

International Journals

1. B. W. C. Au and K. Y. Chan, "Effect of Precursor Stirring Time on the Electrochromic Performance of Tungsten Oxide Films", *Surface Engineering*, pp. 1-6, 2019 (Scopus Q1)
2. B. W. C. Au, K. Y. Chan and D. Knipp, "Effect of Film Thickness on Electrochromic Performance of Sol-Gel Deposited Tungsten Oxide (WO_3)", *Optical Materials*, Vol. 94, pp. 387-392, 2019 (Scopus Q1)

International Conference

1. Conference presentation (Oral) in the International Conference on Sustainable Materials (ICoSM 2018), Bangkok, Thailand.
2. Conference presentation (Oral) in the International Conference on Nanomaterials: Science, Engineering and Technology (ICoNSET 2019), Penang, Malaysia.

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Flood Escape Project

Faculty	Faculty of Engineering and Technology
Project Leader	Ms. Kong Feng Yuan
Team Members	Mr. Chong Peng Lean

Description

The Flood Alert Solar Lamp has two parts: a solar lamp consisting of a solar panel, a rechargeable battery and a lamp post as well as flood alert micro-controller circuit connected to flood sensor, rain sensor, alarm and a communication module used to alert users for evacuation when flood is detected.

Application

1. To detect start & end of a flood and alert the user by alarm and SMS for early evacuation.
2. To detect start & end of rain and alert user by SMS for early warning of possible flood.
3. To illuminate the surroundings at night by utilizing green energy from photovoltaic cell.

Commercialization Potential

1. Road application:

Target application is to be applied as flood detector in the road tunnel to detect for early flood events and to provide pre-alerts to drivers and motorists before they enter the tunnel. The objective is to alert road users to change to alternative roads in order to prevent accidents and the possibility of vehicles being trapped in the flood inside the tunnel.

2. Consumer Product:

Target users are for homes, offices, commercial buildings, and underground carparks, which are often flooded during the rainy season. It is used to alert the users about the early stage of flood for immediate evacuation at home, protection of belongings and evacuation of vehicles at carparks.

Local commercialization potential is in the East Coast of Malaysia, which is often hit by monsoon floods annually. International commercialization potential is in flood stricken countries such as India, Bangladesh, China, Vietnam and Pakistan which are the top 5 countries affected by river floods (Source: World Resources Institute 2015, wri.org/floods).

3. Farming & Livestock industry

Targeted to help farmers to detect early stages of floods and alert them for immediate reaction to protect the livestock and farming goods against further losses.

4. Industry

To be installed in warehouses to detect for incoming flood and alert the user to shift goods stored to higher ground when water level detected is at a low level. This can prevent unnecessary flood damage to the goods.

Key Features

1. **Solar panel & rechargeable battery:** To be charged up during the day via photovoltaic cell and to store the energy in the battery for usage at night. To act as a sensor to sense day and night.
2. **Solar Power Management Controller:** To direct and manage the energy generated from the solar panel to the battery, circuits, sensors and lamp. To automatically switch on the lamp at night for illumination of surroundings.
3. **Flood sensor:** To detect flood water level
4. **Rain sensor:** To detect rain droplets
5. **Microcontroller:** To activate the sound alarm and send SMS accordingly to user when flood or rain sensor is triggered.
6. **Internal alarm:** Produce sound alarm to alert the user when flood is detected.

Special Highlighted:

1. Awarded the Gold Award from the 28th International Invention, Innovation & Technology Exhibition (ITEX 2017).
2. Awarded the Bronze Award in Malaysia Technology Expo (MTE 2018).
3. Awarded a Bronze Award from the the International Conference And Exposition On Inventions By Institutions Of Higher Learning (PECIPTA 2017).
4. Awarded the Silver Award in MMU Invention Showcase 2016.
5. Product is presented in the talk session of the 5h International Conference On Information And Communication Technology (ICoICT) 2017.
6. Awarded the MMU Startup Scheme 2016 grant.
7. Copyright protected. Approved on 9 May 2017. Voluntary notification registration number: LY2017002511.
8. Patent filed. Filing date: 12 September 2018. Application number: P1 2018703234.
9. Green Invention using renewable energy.

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FPGA implementation of OFDM Transceiver for Millimeter Wave Communication System

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❖ Abstract

Orthogonal Frequency Division Multiplexing (OFDM) is a promising modulation technique because of its ability to handle multipath frequency selective channels with a simple receiver. The objective of this project is to design and implement a baseband OFDM transmitter and receiver on FPGA hardware. The work includes designing of easily reconfigurable and adaptable modules for modulation and demodulation, synchronization, channel estimation, equalization under AWGN and multipath Rayleigh channel. A separate header file is made in FPGA that includes all the parameters that can be reconfigured without changing the rest of the design implemented. All modules are designed on FPGA using Verilog programming language and implemented on Xilinx board. Chip scope is used to provide interface between user and the hardware. Results are compared with theoretical results provided by MATLAB bit error tool.

❖ Problem Statement and Motivation

R. C. Joaquin Garcia's [2] work is focused on the FPGA suitability to support IF processing for the Std. IEEE 802.11a. The work also focusses on resource area and timing requirements for rapid prototyping and reconfigurability to be able to support different standards. S. M. Vinay Bk's [3] whole OFDM modem design has been carried out using VHDL coding. The FFT/IFFT module that has been implemented makes use of CORDIC algorithms as an alternate for multipliers. This makes better usage of FPGA resources and the performance is more due to the usage of CORDIC algorithms instead of multipliers.

❖ Methodology

1) Orthogonal frequency division multiplexing (OFDM) system

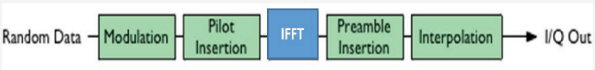


Fig.1a: OFDM Transmitter

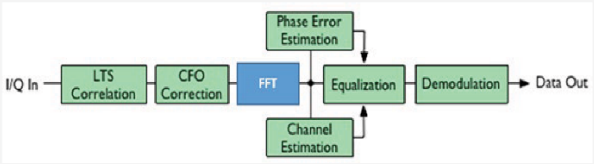


Fig. 1b: OFDM receiver

2) Filter bank multicarrier with offset quadrature amplitude modulation (FBMC/OQAM)

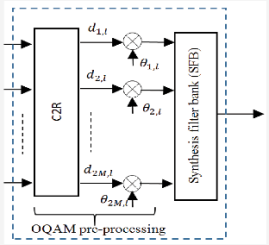


Fig. 2a: FBMC transmitter replaces IFFT in OFDM

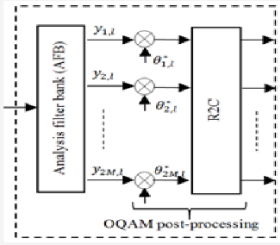


Fig. 2b: FBMC receiver replaces FFT in OFDM

❖ Experimental Setup

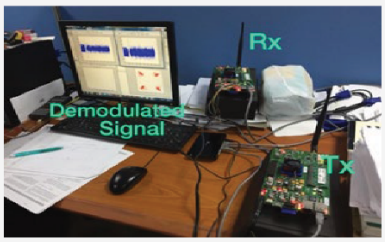
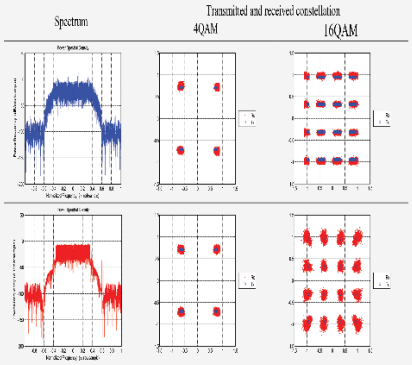


Fig. 3:Experimental Setup

❖ Results



❖ Conclusion:

In this experiment we have transmitted and received OFDM signal over wireless channel. In addition to that, we have replaced FFT and IFFT blocks with FBMC/OQAM system with modification to pilot locations to be able to receive the FBCM/OQAM successfully.

❖ References

[1] M. Nathan, "OFDM implementation details". [online]. Available: http://www.gaussianwaves.com/2011/06/introduction-toofdm-orthogonal-frequency-division-multiplexing-part-3.

[2] R. C. Joaquin Garcia, "On the design of an FPGA-Based OFDM for IEEE 802.11a," in 2nd International Conference on Electrical and Electronics Engineering (ICEEE) and XI Conference on Electrical Engineering, 2005.

[3] S. M. Vinay BK, "FPGA based Design & Implementation of Orthogonal Frequency Division Multiplexing Transceiver Module using VHDL," International Journal of Advanced Research in Engineering And Technology, Volume 4, no. Issue 6, pp. 70- 83, 2013.

[4] P. Sutton *et al.*, ``Iris_An architecture for cognitive radio networking testbeds,'' *IEEE Commun. Mag.*, vol. 48, no. 9, pp. 114-122, Sep. 2010.

[5] S. Shreejith, B. Banarjee, K. Vipin, and S. A. Fahmy, ``Dynamic cognitive radios on the Xilinx Zynq hybrid FPGA,'' in *Proc. Int. Conf. Cognit. Radio Oriented Wireless Netw.*, pp. 427-437, 2015.

Geometric Vehicle-to-Vehicle Communication for The Traffic Mobility Simulation in Malacca City

Mohammed Ahmed Salem and Azlan Bin Abd. Aziz

INTRODUCTION

Vehicle-to-vehicle (V2V) communications enable a number of applications that can make modern day transportation safer, more effective and more enjoyable. Nonetheless, the reliable and efficient design of V2V systems requires a better understanding and knowledge of the surrounding environment in which the vehicles work. In this research, we describe how to visualize vehicular communications in Malacca city in terms of received power, communication range, and neighborhood size which is defined as the number of vehicles that the ego vehicle can communicate with multi-hop communication.

SIMULATION SET UP AND METHODOLOGY

Figure 1 illustrates the flow chart of the simulation set up required to visualize the V2V communication in Malacca city.

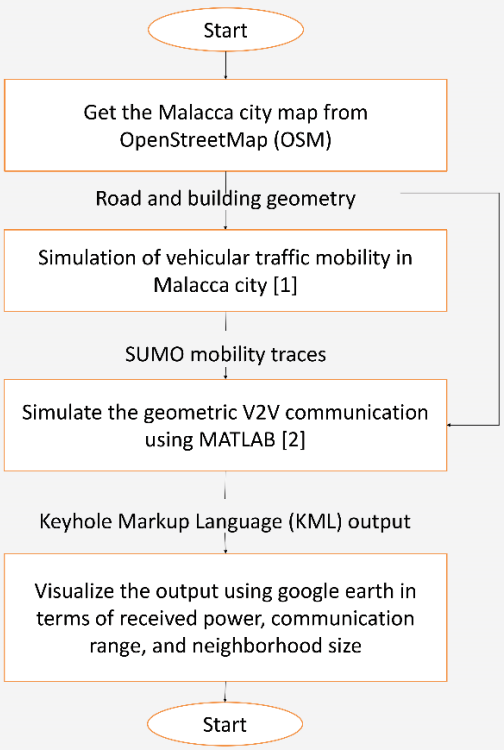


Figure 1: Flowchart of conducting the simulation.

In this research, the output of processes shown in Figure 1 are presented. The simulations are set up with 1000 vehicular and 10000 random trips.

VISUALIZING RECEIVED POWER, EFFECTIVE RANGE, AND NEIGHBORHOOD SIZE

Figure 2: Road and building geometry.

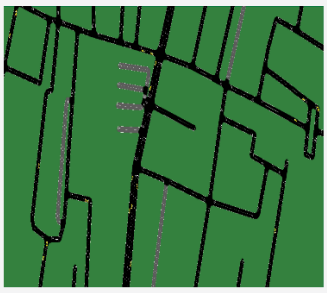


Figure 3: SUMO mobility traces.

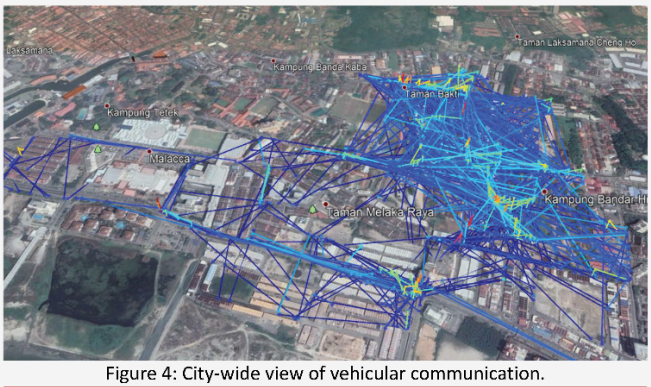


Figure 4: City-wide view of vehicular communication.

FACTORS	
STRENGTHS (+)	**WEAKNESSES (–)**
Visualize vehicular-to-vehicular (V2V) communications in terms of received power, communication range, and neighborhood size.	The obtained results are based on random simulation.

CONCLUSION

This research offers a visual account of what a vehicular communication network would look like in Malacca city. The actions of thousands of connected vehicles can be modeled and visualized by using computationally efficient algorithm. This visualization provides innovative insights into vehicular network behavior over time and space, illustrating variations in surrounding V2V communication efficiency, vehicle traffic volume, and communication parameters (e.g., received power).

REFERENCES

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[2] M. Boban, J. Barros and O. K. Tonguz, "Geometry-Based Vehicle-to-Vehicle Channel Modeling for Large-Scale Simulation," in IEEE Transactions on Vehicular Technology, vol. 63, no. 9, pp. 4146-4164, Nov. 2014..

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Project leader: Dr. Lee Chu Liang
Project member: Assoc. Prof. Ir. Dr. Chan Kah Yoong, Dr. Sin Yew Keong, Ms. Nisha Kumari, Ms. Low Pei Ling, Mr. Ng Zi Neng

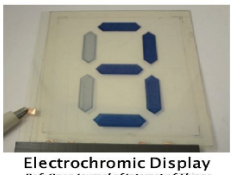
Fund provider: MMU (CAPEX 2018)
MMU IP number: MMUI/CAPEX180002

Introduction

Application of WO_3

- Potential applications of WO_3 include smart windows, displays and automotive rear-mirrors [2].

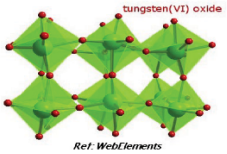
Smart Window
Ref: Glass App Source



Electrochromic Display
Ref: Open Journal of Internet of Things

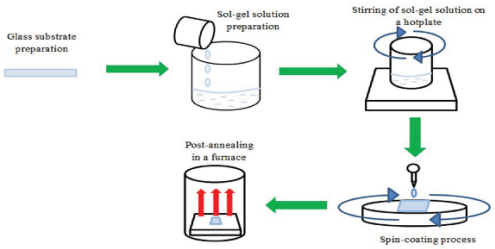
Tungsten Oxide (WO_3)

- It is an N-type transition metal oxide semiconductor.
- It has a cubic structure where it is formed by corner and edge sharing of WO_6 octahedral.
- Its cubic structure is often described as an 'empty-perovskite' where guest ions can be inserted in a large number of interstitial sites [1].
- Relatively low-cost and non-toxic.



Ref: WebElements

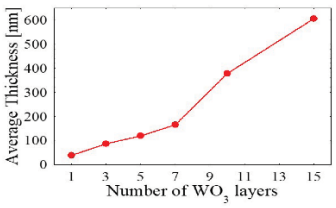
Sol-Gel Spin-Coating Method



Results and Discussions

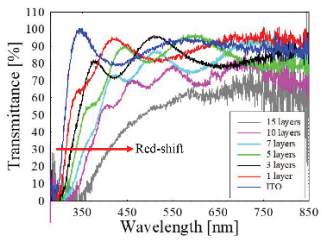
Average Films Thickness of WO_3

- Average film thickness increases with increasing number of spin-coated WO_3 layers.
- Average film thickness are 38 nm, 86 nm, 119 nm, 165 nm, 378 nm and 606 nm for 1,3,5,7,10 and 15 layers of WO_3 films, respectively.



Results and Discussions

Optical Properties of WO_3



- ITO coated glass exhibited an average transmittance of 80 % - 90 %. The steep absorption edge of ITO indicates good film crystallinity and excellent surface quality.
- WO_3 at 1, 3, 5, 7 and 10 deposited layers exhibited high transmittance of at least 70 %.
- Although the film thickness differ from each other, the transparent WO_3 films implies low concentration of oxygen vacancies [3].
- WO_3 films at 15 deposited layers exhibited a significantly lower average transmittance of 60 %.
- The low optical transmittance is due to high concentration of defects which causes light to scatter [4].
- Generally, the optical transmittance of the WO_3 films decreases with increasing film thickness in the visible range.
- This is due to increasing absorption as a result of larger cross sectional volume [5].
- It is also due to increasing scattering as a result of higher density of grain boundaries [5].
- Red-shifting of absorption edge is associated with compressive stress due to lateral grain growth caused by neighbouring grains [6].
- The observed oscillations between 350 nm and 750 nm are caused by [7,8].
  i. Difference in refractive index of the films with the substrate.
  ii. Interference of multiple reflections which originates from the films and substrate surfaces.

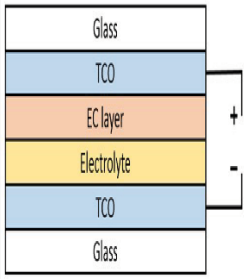
Implication

Electrochromic Device (ECD)

- WO_3 is a viable candidate as EC layer as it offers the following advantage [11]:
  i. High colouration efficiency
  ii. High reversibility
  iii. High optical modulation
- The film thickness plays an important role in the performance of ECDs, as shown by the transmittance results.
- WO_3 should be around 5 to 10 layers in ECD applications.
- Excessively thin WO_3 films are poor in quality and excessively thick WO_3 films have low optical transmittance.

Conclusion

- WO_3 films with varying thickness were fabricated on ITO coated glasses.
- WO_3 film thickness increases with increasing number of spin-coated layers.
- The optical transmittance of WO_3 films decreases with increasing film thickness.
- The optical spectrum reveals high film transmittance of at least 70 % for 1, 3, 5, 7 and 10 layers.
- The red-shifting of the absorption edge is attributed to the decrease in stress as film thickness increases.
- It is worth mentioning that the thickness of WO_3 films should not be greater than 400 nm in order to maintain high transparency (>70 %) for ECD applications.



Output

International Journal

B. Wen-Cheun Au et al, Tungsten Oxide Films Prepared by Sol-Gel Spin Coating Technique, Solid State Phenomena, Vol280, pp.71-75 (2018)

International Conference

Presentation in International Conference on Sustainable Materials ICoSm (2018),
16 April 2018, Eastin Hotel, Bangkok, Thailand

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JomSolat: A Prayer Adherence System for Muslim Children

Dr. Sarina Mansor, Dr. Ooi Chee Pun, Dr. Tan Wooi Haw,
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INTRODUCTION

- It is important for parents to teach and encourage children to form the habit of praying and develop a love for performing Solat from a young age.
- Existing solat-based apps use interactive screens, 3D animations, videos and games to facilitate young Muslim children in learning how to pray.
- No existing application or system that able to monitor and record the daily Solat of children.
- This research aims to develop a prayer adherence system using Internet-of-Things (IoT) platform, which is able to monitor, to remind and to encourage daily prayers among children.

OBJECTIVES

1. To design and construct an embedded prayer for pray adherence system.
2. To develop a web application for solat reminder, keeping track on solat progress and providing a reward system.
3. To evaluate the effectiveness of prayer adherence system in monitoring children daily prayers.

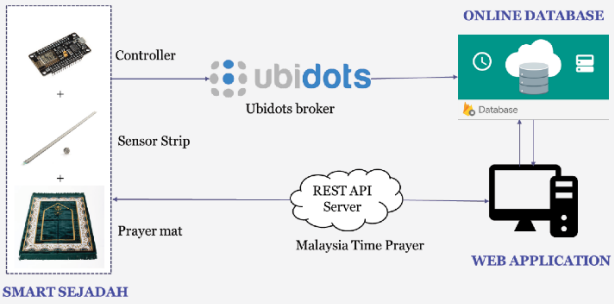
PROJECT POTENTIAL

- The project will give insight for Islamic IoT applications that could be developed in a Smart Home.
- This pray adherence system is also useful for elderly people living in a Smart Home.
- This research is parallel to the National Industry 4.0 Policy Framework that encourages IoT incorporation in daily life.

ACKNOWLEDGEMENT

This project is funded by
FISABILILLAH R&D GRANT SCHEME
(FRDGS)

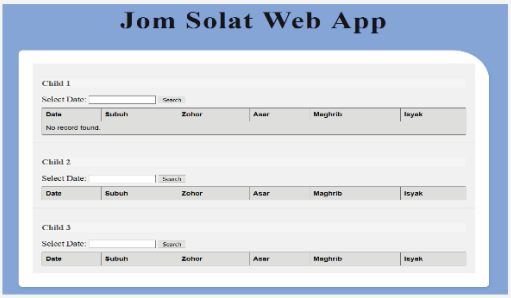
SYSTEM ARCHITECTURE



The proposed system architecture consists of two parts:

- **'Smart Sejadah'**: A prayer mat will be embedded with multi-touch sensors and controllers. The sensors will record the Solat activities and send the information to the server.
- **Web application**: A web based GUI will be developed for parents to keep track on children Solat activities based on the information stored in the server. A rewarding system will be developed to encourage children in performing Solat.

Integration of Smart Sejadah and Web Application will be developed using IoT platform.



Landslide Prediction with Wireless Sensor Network

Overview

Landslides are major geological hazards that can cause substantial economic losses and tragic loss of lives. In this study, we propose a landslide prediction model that uses sensor networks to monitor rain and ground vibration that can indicate slope stability. In addition to that, we optimise the sensor network to be able to collaboratively process sensor readings and be robust against harsh outdoor environments.

Project Members

- Ir. Dr. Goh Vik Tor – FOE, Multimedia University
- Dr. Timothy Yap Tzen Vun – FCI, Multimedia University
- Assoc. Prof. Mustaffa Kamal Shuib – University of Malaya
- Mr. Ng Jin Ren (GRA) – FOE, Multimedia University

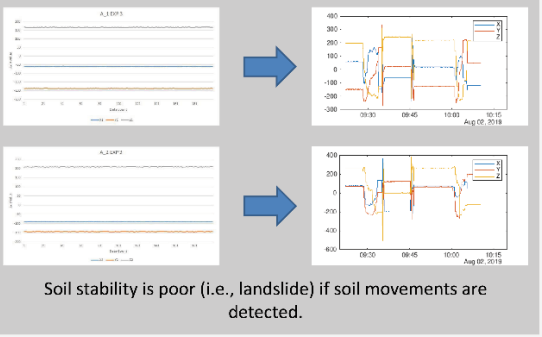
Key Features

- Cost effective – Uses off-the-shelf components.
- Robust – Uses novel networking protocols.
- Scalable – Sensor network's size can be changed.
- Portable – Consists of cloud and mobile apps.

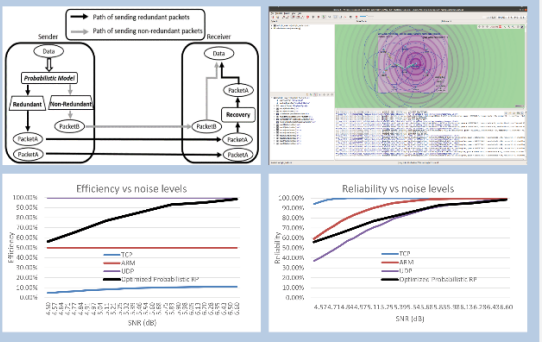
Project Description

Sensor nodes, rain gauge, and test site.

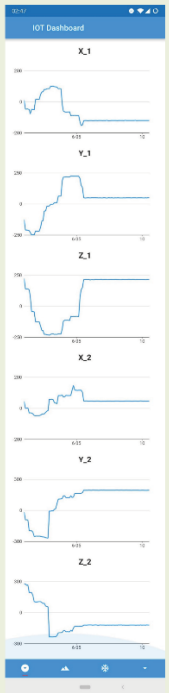
Determining the best positions to place sensor nodes.



Soil stability is poor (i.e., landslide) if soil movements are detected.



Novel redundancy-based networking protocol that increases robustness of data transmission.



Live readings from mobile app.

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Linear and Efficient Wideband RF Power Amplifier for Multi-Band Applications

Project leader: Dr. Zubaida Yusoff
Project Member: Ms Noorlindawaty (MMU Mini Fund) Assoc. Prof. Dr. Mardeni Bin Roslee (MMU GRA)
Student : Md. Golam Sadeque
Funding: MMU Mini Fund MMUI/180165 and MMU GRA (MMUI/ 180270.02)
Duration: 1 May 2018 – 30 April 2019 (MMU Mini Fund) and 15 September 2018 – 14 September 2020 (MMU GRA)

Problem statement

- ❑ A number of amplifiers are used in the base station to cover different frequency bands.
- ❑ Low efficiency and nonlinearity of the RF power amplifier (RF PA).
- ❑ RF PAs are not available in the market for the mid band frequency range of 3.3 GHz to 4.3 GHz, used for 5G applications.

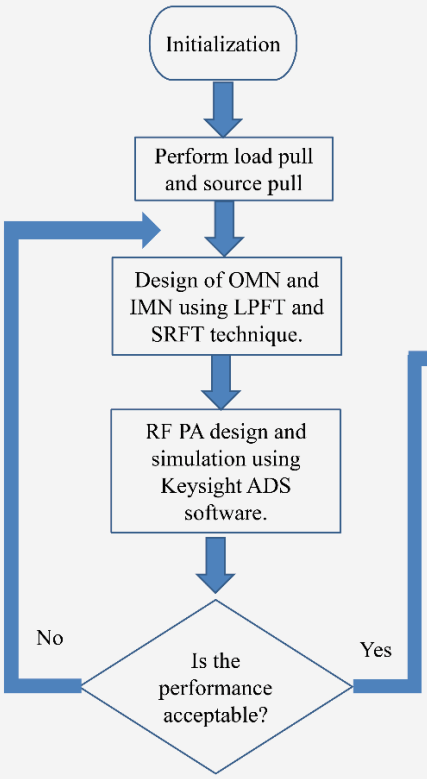
Objectives

- ➢ To design broadband Class-F RF PA (1 GHz bandwidth) with high efficiency and good linearity that will replace multiple RF PAs.
- ➢ To fabricate the RF PA using the best components in order to achieve high-performance.
- ➢ To validate the RF PA performance experimentally and compare with the simulation result.

Contribution

1. Wideband RF PA for the upcoming 5G frequency band.
2. Develop output and input matching network using LPFT and SRFT.

Methodology



5G Spectrum Allocations

Country	Low Frequency Band (GHz)
USA	3.55 - 3.7
(FCC)	3.7 - 4.2
Finland	3.4 - 3.8
France	3.46 - 3.8
Germany	3.4 - 3.8
Ireland	3.4 - 3.8
Italy	3.6 - 3.8
Russia	3.4 - 3.8
Spain	3.4 - 3.8
United Kingdom	3.4 - 3.6, 3.6 -3.8
China	3.3 - 3.6
Japan	3.6 - 4.2

Outputs

- M. G. Sadeque, Z. Yusoff, M. Roslee, and N. S. R. Hadi, "Design of a Broadband Continuous Class-F RF Power Amplifier for 5G Communication System," *IEEE Reg. Symp. Micro Nanoelectron.*, pp. 145–148, 2019.
- A. Fauzi, Z. Yusoff, and M. G. Sadeque, "Inverse Class-F RF Power Amplifier Design Using," *2019 IEEE Reg. Symp. Micro Nanoelectron.*, pp. 20–23, 2019.
- M. G. Sadeque, Z. Yusoff, and M. Roslee, "A High Efficiency Continuous Class-F Power Amplifier Design Using Simplified Real Frequency Technique," ICEECC, 2019. (Accepted)
- N.S.R. Hadi Z. Yusoff, M. G. Sadeque, S. Hashim and M. A. Chaudhury, "High Gain over an Octave Bandwidth Class F RF Power Amplifier Design Using 10W GaN HEMT," *ICEECC*, 2019. (Accepted)

Results

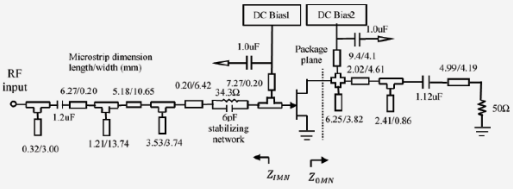


Figure. Complete circuit diagram of proposed RFPA

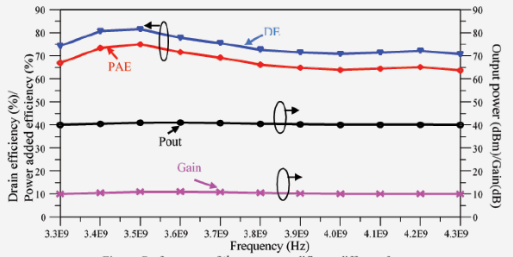


Figure. Performance of the power amplifier at different frequency.

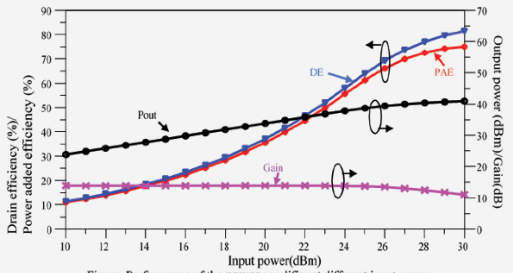


Figure. Performance of the power amplifier at different input power.

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Mobility Management Based on Self-Optimisation Approach for Next Generation Heterogeneous Networks

Abdulraqeb Alhammadi, Mardeni Roslee (Project Leader), Mohammad Yusoff Alias, Abdullah Alquhali, and Saddam Alraih

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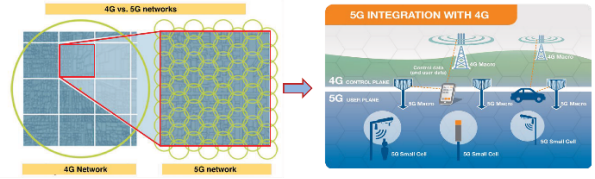
INTRODUCTION

Fifth generation (5G) networks standardisation efforts and its stringent coverage and capacity requirements are set to provide an unlimited user experience. Deploying ultra-dense small cells is an important approach in provisioning broadband data services for the 5G wireless systems. The implementation of 5G systems based on mm-wave bands provides a small area coverage. That specifically will lead to hugely increased handover (HO) probability, HO failures, HO ping pong (HOPP), radio link failure (RLF), outage probability, interruption time and throughput degradation. Thus, efficient mobility robustness optimization is required to provide seamless communication over 4G/5G HetNets.



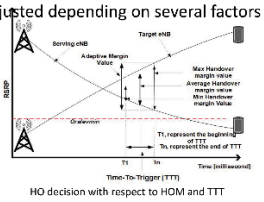
Next Generation HetNets

RESEARCH OBJECTIVES

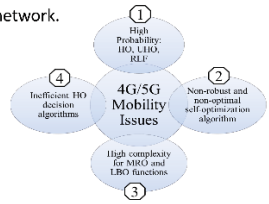
1. To develop new mobility robustness optimisation algorithms for HetNets with the deployment of 5G systems.
2. To investigate and resolve the conflict problem that occurs among the HO self-optimisation functions.
3. To design an efficient HO algorithm that makes an adaptive decision based on multiple influence factors.

MOBILITY ISSUES

Nowadays, mobility management becomes essential for providing seamless communication for various mobility levels. The concept of the HO decision depending on HO control parameters (HCPs): HO margin (HOM) and the reference signal received power (RSRP) levels with time to trigger (TTT) interval is depicted in the left figure below. The HCP can adaptively be adjusted or fixed whereby the latter means the values if the HCPs are set to fixed values for the entire interval of transmission. At the same time, the former states that HCPs values are automatically adjusted depending on several factors of the network.



HO decision with respect to HOM and TTT



PROPOSED SOLUTION

Adjusting HCPs is a very important step for UE mobility where improper configuration of HCPs causes HO failures (HOF) that leads to service interruption. The goal of this paper is to reduce the probability of performance metrics such as RLFs and HOPP that happen during HO processes. The HO problem is formulated as follows:

$$\underset{\mathcal{T},\mathcal{M}}{\operatorname{argmin}} \quad P(\mathcal{T},\mathcal{M}) \tag{1a}$$

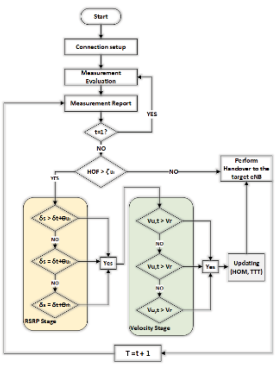
$$Subject \quad to: \quad \sum_{j=1}^{N} b_{ij} = 1, \forall_j \tag{1b}$$

$$\zeta \leq \zeta_{th} \tag{1c}$$

$$TTT_{\min} \leq \mathcal{T} \leq TTT_{\max} \tag{1d}$$

$$HOM_{\min} \leq \mathcal{M} \leq HOM_{\max} \tag{1e}$$

$$b_{ij} \in 0,1, \forall_{ij} \tag{1f}$$



PROPOSED ALGORITHM

A novel distributed ATO algorithm that automatically tunes HCPs based on UE speed and RSRP is proposed. The entity of distributed self-organising network is provided at each eNB which collects related data and periodically optimises HCPs for each UE according to its condition.

Algorithm 1 Proposed ATO Algorithm

1: Initialize systems' parameters
2: Inputs: δ_S, δ_T, $V_{n,t}$
3: Outputs: $\mathcal{M}_t$, $\mathcal{T}_t$
4: **if** Simulation time t=1 **then**
5: $HODecision \leftarrow false$
6: **else**
7: Calculate the HOF
8: **while** $HOF < \gamma > \zeta_{th}$ **do**
9: **if** $\delta_S > \delta_T + \theta_{th}$ **then**
10: Updating $\mathcal{M}$ and $\mathcal{T}$ according to (2)
11: $HODecision \leftarrow True$
12: Updating $\mathcal{M}$ and $\mathcal{T}$
13: **else if** $\delta_S < \delta_T + \theta_{th}$ **then**
14: Updating $\mathcal{M}$ and $\mathcal{T}$ according to (3)
15: $HODecision \leftarrow True$
16: Updating $\mathcal{M}$ and $\mathcal{T}$
17: **else**
18: Updating $\mathcal{M}$ and $\mathcal{T}$ according to (4)
19: $HODecision \leftarrow false$
20: Updating $\mathcal{M}$ and $\mathcal{T}$
21: **end if**
22: **end while**
23: Update HOF
24: **end if**

$$\begin{cases} \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1} + \beta, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} + \alpha & if \quad V_{n,t} < V_t \\ \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1} + \beta, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} - \alpha & if \quad V_{n,t} > V_t \\ \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1}, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} - \alpha & if \quad V_{n,t} > V_t \end{cases} \tag{2}$$

Condition 2: $\delta_S < \delta_T - \theta_{th}$

$$\begin{cases} \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1} - \beta, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} + \alpha & if \quad V_{n,t} < V_t \\ \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1} - \beta, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} - \alpha & if \quad V_{n,t} = V_t \\ \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1} - \beta, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} - \alpha & if \quad V_{n,t} > V_t \end{cases} \tag{3}$$

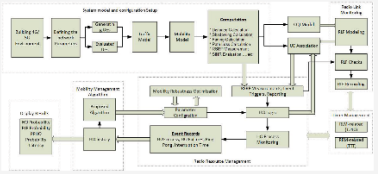
Condition 3: $\delta_S = \delta_T - \theta_{th}$

$$\begin{cases} \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1} + \beta, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} + \alpha & if \quad V_{n,t} < V_t \\ \mathcal{M}_{n,t} = \mathcal{M}_{n,t} \quad , \quad \mathcal{T}_{n,t} = \mathcal{T}_{n,t} \quad & if \quad V_{n,t} = V_t \\ \mathcal{M}_{n,t} = \mathcal{M}_{n,t-1} - \beta, \mathcal{T}_{n,t} = \mathcal{T}_{n,t-1} - \alpha & if \quad V_{n,t} > V_t \end{cases} \tag{4}$$

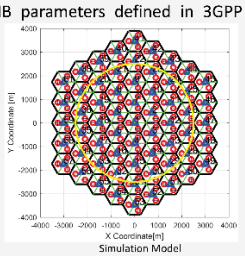
where δ_S and δ_T are the severing and target RSRP, respectively.θ_{th} denotes the threshold level which is assumed to be 2dB. $V_{n,t}$ and V_t denote the UE speed level at time t and reference speed that is assumed to be at medium range (V_t = 70 - 90 km/h), respectively. $\mathcal{M}_t$ and $\mathcal{T}_t$ are the adaptive HOM and TTT, respectively. α and $\beta$and depicts the step levels to set both the TTT and HOM, which are approximately 50 ms and 1 dB, respectively

SIMULATION ENVIRONMENT

The simulation environment utilises the developed proposed algorithms to validate their performance in the system. The performance results, in this simulation, are analysed in contrast to the performance of various algorithms for different mobility scenarios. Initially, the essential MeNB and SeNB parameters defined in 3GPP specifications are considered in this simulation.



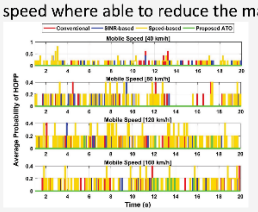
Simulation environment architecture

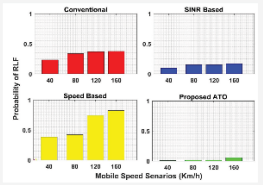


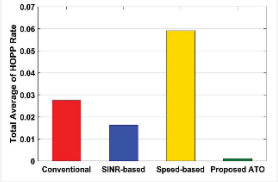
Simulation Model

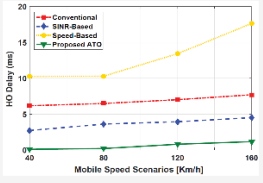
RESULTS AND DISCUSSION

The proposed algorithm was compared with different optimization algorithms: conventional, speed-based and SINR-based. From the figures below, it can be observed that the proposed algorithm provides the best performance and outperforms all the other algorithms due to able to control the HO based on SINR and speed where able to reduce the main targets such as HOPP, RLF and HO delay.









ACKNOWLEDGEMENT

- Telekom Malaysia, TM R&D with project ID: MMUE/170014.
- Fundamental Research Grant Scheme (MMUE/170017), Ministry of Higher Education, Malaysia.

CONCLUSION

As a conclusion, ATO self-optimisation HO algorithm is proposed to improve the HetNets performance. The proposed algorithm is able to adjust the values of HCPs based on UE speed and RSRP. The algorithm is able to reduces the total rate of the performance metric by more than 80% as compared with other existing algorithms. Finally, adjusting the HCPs based on UE conditions becomes a more efficient and effective technique for mobility management and is useful for future 5G wireless communication.

MULTIMEDIA UNIVERSITY

"Driving Digital Transformation"

Monte Carlo Simulation of Hole Injection Efficiency at Hetero-interface in GaN/AlGaN Thin Heterojunction Avalanche Photodiodes

P. L. Cheang, O. T. L. Wesley, A. H. You, E. K. Wong and L. L. Teo

Objective

To simulate the mean multiplication gain and excess noise factor in GaN/AlGaN avalanche photodiodes using ensemble Monte Carlo method

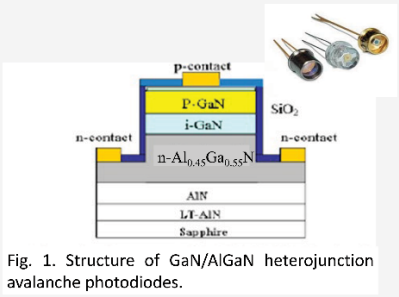


Fig. 1. Structure of GaN/AlGaN heterojunction avalanche photodiodes.

Research Methodology:

Develop an ensemble Monte Carlo model for $GaN/Al_{0.45}Ga_{0.55}N$ APD to simulate the mean multiplication gain and excess noise factor with dead-space and hetero-interface effect.

Material physical parameters of GaN and $Al_{0.45}Ga_{0.55}N$ are used to simulate the carrier transport properties and impact ionization in $GaN/Al_{0.45}Ga_{0.55}N$ APDs.

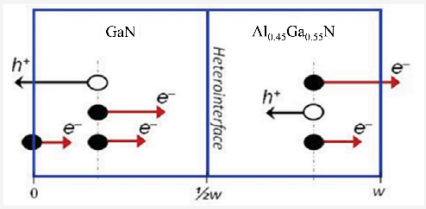


Fig. 2. Electron-initiated multiplication in $GaN/Al_{0.45}Ga_{0.55}N$ APD model.

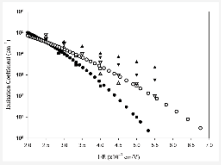


Fig. 3. Hole impact ionization coefficient (open circle symbols) is higher than that of electron (closed circle symbols) at electric field below 2 MV. Square and triangle symbols are Oguzman and Bertazzi's results.

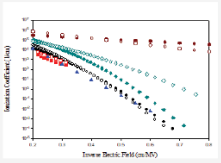
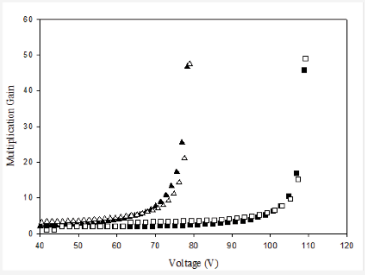


Fig. 4. Electron impact ionization coefficient, α (filled circle) and hole impact ionization coefficient, β (open circle) of $Al_{0.45}Ga_{0.55}N$ from this work are compared with those by Bellotti et al., $Al_{0.2}Ga_{0.8}N$ (square), Bulutay, $Al_xGa_{1-x}N$ (triangle) etc.



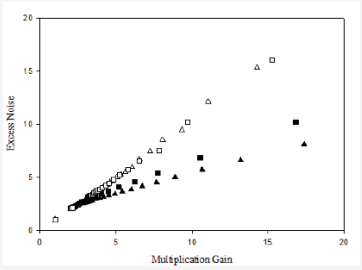


Fig. 5. (a) Electron- (filled symbol) and hole- (open symbol) initiated multiplication gain as a function of reverse-biased voltage with w = 0.1 µm (triangle) and 0.2 µm (square), and (b) Excess noise factor in $GaN/Al_{0.45}Ga_{0.55}N$ APDs.

- ✓ Mean multiplication gain of electron-initiated multiplication is higher than that of hole-initiated in 0.1 µm and 0.2 µm $GaN/Al_{0.45}Ga_{0.55}N$ APDs due to the *hole trapping* at hetero-interface junction.
- ✓ *Less feedback holes* in $GaN/Al_{0.45}Ga_{0.55}N$ APDs with electron-initiated multiplication generates low excess noise.

Conclusion

- *Excess noise factor can be reduced in thin $GaN/Al_{0.45}Ga_{0.55}N$ APDs with electron-initiated multiplication.*
- *Hole injection at hetero-interface causes the low excess noise in thin $GaN/Al_{0.45}Ga_{0.55}N$ APDs with electron-initiated multiplication.*

Acknowledgement: Ministry of Education Malaysia – FRGS/1/2017/TK04/MMU/03/5 Fund

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Network Fault Prediction Using Complex Event Processing Tool: A Real-Time Computing with Predictive Analytics

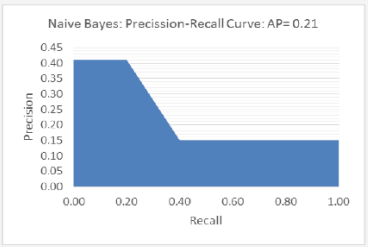
J. Emerson Raja[1], Mhd Jakir Hossen[2], Ervina Efzan Mhd Noor[3]
1, 2 and 3: FET, MMU

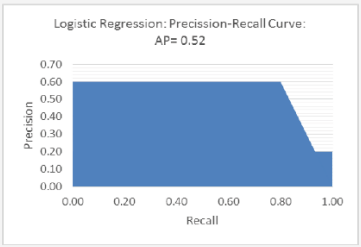
Objective: To propose a broadband network fault prediction system using the combination of Complex Event Processing (CEP) and Predictive Analytics (PA) techniques.

Methodology :

1. Analyse the benchmark data and figure out all existing event patterns.
2. Build a CEP framework with Naïve Bayes (NB) and Logistic Regression (LR) algorithms to process real-time data according to the predefined patterns.
3. Validate the framework by streaming new benchmark data.

Results:





Comparing Precession, Recall, F1 among NB and LR.

Model	Accuracy	Precision	Recall	F1
NB	86.25%	0.21	0.24	0.31
LR	89.65%	0.61	0.56	0.51

Conclusion: The prediction performance of the proposed CEP system with LR model is compared with NB model using accuracy, precision, recall and F1-score values. It is found that the proposed CEP system with LR performs better, hence it can be implemented for fault prediction in network management systems.

Acknowledgement:
Thanks to MMU for the fund RM 24660 provided.
Project SAP ID is MMUI/180175

Publication: Broadband network fault prediction using complex event processing and predictive analytics techniques. Journal of Engineering Science and Technology. [in press]

MULTIMEDIA UNIVERSITY

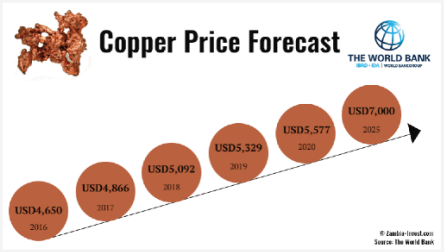
Novel Application of Hollow Electrical Earthing Electrodes in Electrical Installation Systems

Abstract

- Good earthing system is important in every electrical system. Vertically driven solid copper electrode is a widely practiced earthing method due to its simplicity and cost effectiveness. With the rising price of copper, the need for cost optimisation is imperative. In this project, hollow copper electrode will be experimented as an earthing electrode.

Problem Statement

- Material cost is an important factor in any development project. When it comes to electrical installation, the cost of copper is always a highly significant concern. One of the major section which requires copper is earthing. Hence, the challenge to be solved here is to optimize the copper cost without any significant drop in earthing system performance.



Challenge:
How can we optimise the amount of copper required for earthing system?

Research Objectives

- To investigate on the long-term variation of steady state earth resistance of hollow earthing electrode compared to solid earthing electrode

Methodology

- Site Identification

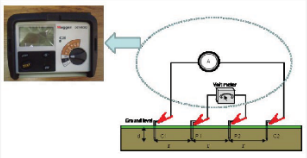
MMU Site

UPM Site

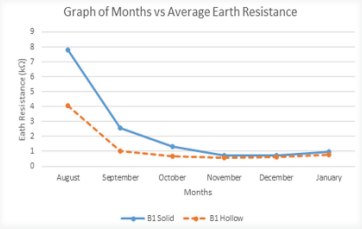
- Material acquisition

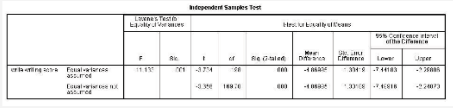
Solid electrode | Hollow electrode

- Periodic measurement of earth resistance and soil resistivity



- Statistical analysis of the measured data





Findings

Rod location	Solid (Ω)	Hollow (Ω)
A1	58.5	53.5
A2	63.1	83.5
A3	87.4	77.3
A4	89.3	116.8
A5	91.6	66.2
B1	2351.8	1287.1
B2	6085.1	2274.5

Rod	Equal Variance Assumption	Sig.	t	df	Sig. (2-tail)
A1	Equal Variance Assumed	0.119	2.023	68	0.047
	Equal Variance Not Assumed		2.023	58.462	0.048
A2	Equal Variance Assumed	0.048	-5.498	68	0.000
	Equal Variance Not Assumed		-5.498	50.812	0.000
A3	Equal Variance Assumed	0.035	2.139	68	0.036
	Equal Variance Not Assumed		2.139	55.828	0.037
A4	Equal Variance Assumed	0.003	-3.362	68	0.001
	Equal Variance Not Assumed		-3.362	54.914	0.001
A5	Equal Variance Assumed	0.000	2.989	68	0.004
	Equal Variance Not Assumed		2.989	43.354	0.005

Rod	Equal Variance Assumption	Sig.	t	df	Sig. (2-tail)
B1	Equal Variance Assumed	0.123	1.389	36	0.173
	Equal Variance Not Assumed		1.389	24.281	0.173
B2	Equal Variance Assumed	0.000	2.746	36	0.009
	Equal Variance Not Assumed		2.746	24.280	0.011

Conclusion

- Performances of both solid copper rod and the hollow copper rod are indeed statistically and significantly different.
- Hollow copper rod actually demonstrates lower earth resistance than solid copper rod in most of the cases.
- It is possible that the effective contact surface area between the hollow electrode and the surrounding soil is larger than solid electrode resulting in a lower earth resistance as seen in five of the seven pairs of rods.

Life Made Easier™ TM Group

Project Investigators:

1) Ir Dr Siow Chun Lim (FOE-CEEA)
2) Mr. Tuan Haziq (FOE-CEEA)

Collaborator:

Centre for Electromagnetic and Lightning Protection, Universiti Putra Malaysia

Spiritual Fitness Tracker (SiFiT)

1. Abstract

- SiFiT is a **smartwatch app** that utilizes smartwatch physiological sensors to track Muslim spiritual activities without disturbing the focus in solat (khusyu').
- SiFiT is a solat-companion virtual assistant that provides **tracking & monitoring facilities.**

2. Problem Statement

Many Muslims **rarely reflect on the quality** of their prayers especially when they are in a rush.

Muslims might **recite their prayers wrongly** due to the lack of knowledge or being too shy to ask.

3. Features

Solat Assessment Report

- During an actual solat, the smartwatch will **record the duration for each posture.**
- It can track Muslim daily solat punctuality.
- Generate daily assessment report.

Step-by-Step Solat Training

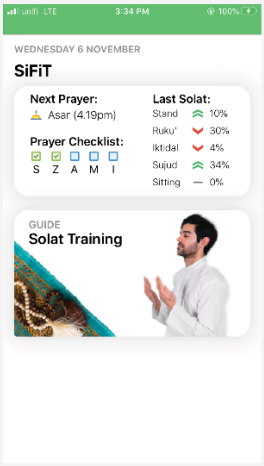
- Provide a guide by **playing the correct recitation** during that posture.
- Muslims can follow the step-by-step guide from SiFiT.

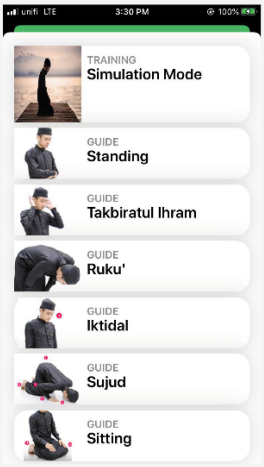
4. Benefits

Muslims can track and improve the quality of their daily solat from the daily assessment report that **provides solat analysis.**

Muslims can learn & improve their solat by **listening to the correct recitation.**

6. Results





7. Conclusion

- SiFiT is still ongoing and will be completed in May 2020.
- This project is funded by FRDGS grant.

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THERMO-FLUIDS EFFECTS DUE TO MOTION IN ARTIFICIAL HIP JOINT

Project Leader : Dr. Tso Chih Ping
Project Members : Dr Chen Gooi Mee, Dr Kok Chee Kuang, Mr Hor Chee Hao
Faculty of Engineering and Technology, Multimedia University, Melaka, Malaysia.

Introduction & Objectives

- To investigate the thermo-fluids behaviour in the macro and micro gap sizes through mathematical modelling.
- Possible application to analyze the synovial fluid in an artificial hip joint, thereby enabling better design of the artificial hip joint.
- To devise progressively more complex thermo fluids models to study the synovial fluid motion by using analytical techniques and verified with numerical solution/reported experiments.

Methods of Investigation

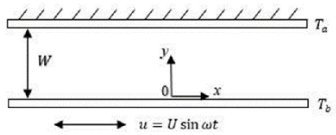


Fig. 1. Schematic diagram of the problem

- Fig. 1 shows the schematic diagram of this problem.
- In this study, conservation of momentum and energy equations are used to study the velocity and temperature profiles as in Eqs. (1) and (2), respectively.

$$\rho\left(\frac{\partial \vec{v}}{\partial t} + \vec{v}\cdot\nabla\vec{v}\right) = -\nabla p + \mu\nabla^2\vec{v} + \rho\vec{F} \quad (1)$$

$$\rho c\left(\frac{\partial T}{\partial t} + \vec{v}\cdot\nabla T\right) = k\nabla^2 T + \mu\Phi + q''' \quad (2)$$

The reduced dimensionless forms of conservation of momentum and energy equations are:

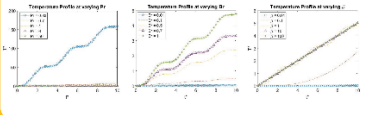
$$\frac{\partial u^*}{\partial t^*} - \frac{\partial^2 u^*}{\partial y^{*2}} = 0 \text{ , and}$$

$$Pr\left(\frac{\partial T^*}{\partial t^*}\right) - \frac{\partial^2 T^*}{\partial y^{*2}} = Br\left(\frac{\partial u^*}{\partial y^*}\right)^2.$$

As an example, one possible set of boundary conditions:
$u^*(0,t^*) = sin(\omega^* t^*)$, $u^*(1,t^*) = 0$ and $u^*(y^*,0) = 0$.

$\frac{dT^*}{dy^*}(0,t^*) = 0$, $\frac{dT^*}{dy^*}(1,t^*) = 0$ and $T^*(y^*,0) = 0$.

Example of results are



Results and Discussions

Synovial fluid is a biological lubricant used and acts as shock absorber in the artificial hip joint. It is encapsulate within the acetabular cup and the head of femur, taking Fig. 2 as reference. The fluid filled in the microscale gap size, made the effect of viscous dissipation by the synovial fluid be a important factor in the overall thermal study of the artificial hip joint. The low thermal conductivity of human bone is assumed as insulated boundary conditions, for analysis here.

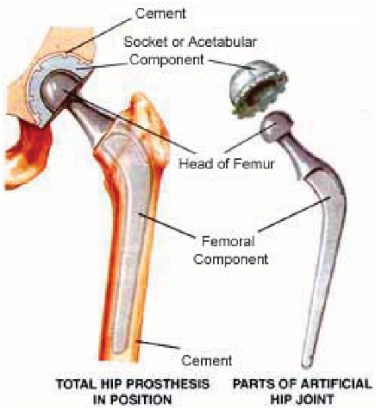


Fig. 2. Diagram for artificial hip joint

Source	Condition	Frequency (Hz)	Duration (min)	Increase in temperature (°C)
Present study	Insulated	1	60	0.45 – 11.18
Pritchett, 2011	In vivo	0.55 – 0.73	20	2 - 8
			60	3 - 8
Bergmann et al., 2001	In vivo	1	60	6.1
Uddin & Majewski, 2013	In vivo	0.55 0.73	20	2 - 8
			60	3 - 8
	In vitro	1	Max.	3 - 14
Tepic et al., 1985	In vitro	0.80	40	2.5
Imado et al., 2004	In vitro	2.19	30	12

Fig. 3. Summary of reported experimental results for temperature increase for different conditions of hip joint

Figure 3 shows the reported of temperature increase for various types of hip prosthesis, with the result of present study. The results from present model lies within the reported literatures.

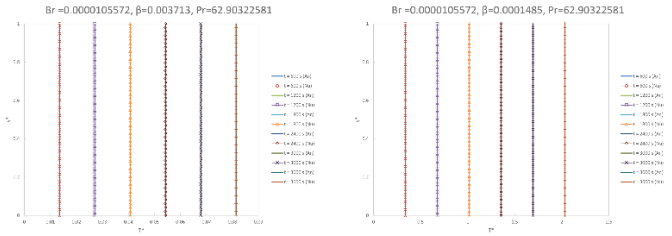


Fig. 4. Minimum temperature rise (left) and maximum temperature rise (right) in the synovial fluid.

Figure 4 shows the minimum and maximum temperature rise in range within 10 to 60 minutes. The temperature rise in 1 hour mark are $T^* = 0.0814$ for $\beta = 0.003713$ and $T^* = 2.0321$ for $\beta = 0.0001485$, which equal to $0.45\ °C \leq T \leq 11.18\ °C$. In conclusion, it is seen that the viscous dissipation effects does contribute towards the heat generation due to the periodically motion of the artificial hip joint.

List of Publications:

1. C.P. Tso, C.H. Hor, G.M. Chen, C.K. Kok, Heat induction by viscous dissipation subjected to symmetric and asymmetric boundary conditions on a small oscillating flow in a microchannel, Symmetry. 10 (2018) 499.
2. C.P. Tso, C.H. Hor, G.M. Chen, C.K. Kok, Fluid flow characteristics within an oscillating lower spherical surface and a stationary concentric upper surface for application to the artificial hip joint, Heliyon. 4 (2018) e01085.
3. C.H. Hor, C.P. Tso, G.M. Chen, C.K. Kok, Characteristics of the internal fluid flow field induced by an oscillating plate with the other parallel plate stationary, Journal of Advanced Research in Fluid Mechanics and Thermal Sciences. 55 (2019) 136–141.
4. C.H. Hor, C.P. Tso, G.M.Chen, Viscous dissipation effects in a microchannel caused by oscillation of one surface, Journal of Engineering Technology and Applied Physics. 1(1), 15-19.

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