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RICE@UTeM

Research, Innovation, Commercialisation and Entrepreneurship



WILD IDEAS:

Becoming a Holistic Researcher: A Balance Between Hard Skills, Soft Skills and Soul Skills

Research & Commercialisation In The 4.0 Industrial Revolution Era

Persidangan dan Ekspo Ciptaan Institusi Pengajian
Tinggi Antarabangsa 2017 (PECIPTA 2017)

Business Plan & IP Protection Workshop for
Gold Medalists in Innovation Carnival: UTeMEX-2017

Collaboration between Underwater Technology
Research Group and Bumi Subsea Malaysia

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Editor's Note

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Welcome to the 6th edition of RICE. This edition focuses on the overall achievements and activities of UTeM's research and innovation in 2017. Alhamdulillah, UTeM's researchers have done very well in 2017 during their participation in the competitions. Hence, in this edition, we highlight the best efforts provided by the Centre for Commercialisation (UCC) in ensuring 100 percent winning rate in all competitions as well as the success stories of UTeM's major event in innovation: UTeMEX 2017.

On behalf of the editorial board, I would also like to thank all researchers and UTeM's staff members who have contributed to the success of this edition. A special thanks also to all readers who spare their time to read and support this RICE bulletin.

Associate Professor Dr. Massila Kamalrudin

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WILD IDEAS: BECOMING A HOLISTIC RESEARCHER: A BALANCE BETWEEN HARD SKILLS, SOFT SKILLS AND SOUL SKILLS



The way we work and conduct research are changing as we are entering the era of Industry 4.0. To become an effective researcher and player for the future economy, researchers have to equip themselves with not only the hard skills but also the soft skills and the soul skills of doing research. Besides, they also need to have a balance among these three skills.

So, what are the three skills? The hard skill is nothing new to researchers as it refers to the knowledge necessary to become a researcher. These skills include the knowledge to conduct research, publication and presentation as well as managing the research project. There is no doubt that researchers need these skills in order to complete a particular research project. The second skill that seem to become increasingly important nowadays is the soft skill. We have heard that there are many instances of research projects failures nowadays and one of the reasons for the failure is the lack of soft skill or human skill to manage research. Researchers need to have the soft skill to ensure that they can successfully complete a research project entrusted to them. The soft skills that need to be acquired are such as leadership skills, people management skills, communication skills and emotional intelligence. The third skill, which I think is becoming important in the highly competitive world of research is the soul skills. As a researcher, we need to be ethical in conducting and managing our research project. We should make a priority to report our findings and manage our research project ethically.

Unlike the hard skill, which can be easily acquired by any researchers, the acquisition of the soft and soul skills has to be nurtured as they relate to human's affective domain and soul. As such, I would like to suggest ways to nurture these skills. Firstly, researchers should have the mentoring and coaching skills. The senior or experienced researchers should be able to mentor or coach the junior. By doing this, you will be able to instill the good values to other researchers. Secondly, researchers needs to be active listeners: "Listen more rather than talk more". Being an active listener is important as you can be more understanding and empathize other people's problem. This is also one of the ways for you to develop your emotional intelligence, which has become one of the essential skills in the near future.

Finally, I would like to emphasize that researchers need to aim for becoming a holistic researcher who have all the three skills: hard, soft and soft skills. They will become future researchers characterized as strong, productive and ethical researcher for the nation.

Prof. Datuk Ir. Dr. Mohd Jailani Mohd Nor

DVC Research and Innovation UTeM

RESEARCH & COMMERCIALISATION IN THE 4.0 INDUSTRIAL REVOLUTION ERA



As we all know, the Industrial Revolution 4.0 is crucial to boost the economic and industrial growth. The Prime Minister Datuk Seri Najib Tun Razak has recently announced that the national economy is targeted at RM2 trillion in the next seven years as compared to RM1.2 trillion currently. Malaysia is not left behind in the transformation towards the 4.0 Industry or the Fourth Industrial Revolution, particularly in the combination of various forms of change agents, such as robotic, nanotechnology, automation, 3D printing, information technology and internet.

In line with the aspiration of the Ministry of Higher Education Malaysia (MOHE) to address the challenges of Industry 4.0 in the field of education, the Centre for Commercialisation (UCC) at UTeM has organised a one-day presentation session entitled "RESEARCH & COMMERCIALISATION IN THE 4.0 INDUSTRIAL REVOLUTION ERA" on the 1st August 2017 at the Auditorium Hall, Chancellery.

The program was presented by the Deputy Vice-Chancellor (Research and Innovation), Prof. Datuk Ir. Dr. Mohd Jailani Mohd Nor and was attended by 180 academic staff, especially UTeM research group members and staff from University Tun Hussein Onn Malaysia (UTHM).

ACHIEVEMENTS OF UTeM'S RESEARCHERS

PERSIDANGAN DAN EKSPLO CIPTAAN INSTITUSI PENGAJIAN TINGGI ANTARABANGSA 2017

Pecipta '17

The "Persidangan dan Ekspo Ciptaan Institusi Pengajian Tinggi Antarabangsa 2017 (PECIPTA 2017)", jointly organized by Universiti Malaysia Terengganu (UMT) and Universiti Sultan Zainal Abidin (UniSZA) was held from 7th to 9th October 2017, at the Stadium Negeri Kompleks Sukan Negeri, Gong Badak, Kuala Nerus, Terengganu Darul Iman. This Expo is a platform for researchers to promote their research findings, innovation and new invention that have significant contributions in research and innovation development at the national level.

UTeM has sent a total of 10 products to be contested and exhibited during the PECIPTA 2017 and has received several awards. During the event, UTeM has won two (2) gold medals, three (3) silver medals and five (5) bronze medals with the success rate of 100% for the participation. The details of the winning products are as follows:

NO.	PRODUCT NAME	MAIN RESEARCHER	FACULTY	MEDALS
1.	Sistem Penilaian Kebolehbacaan Bahasa Melayu	Dr. Mohd Hafiz bin Zakaria	FTMK	Gold
2.	Voice-Assisted Wheelchair	Ahmad Fauzan bin Kadmin	FTK	Gold
3.	Eco-Door Automotive Inner Panel	Dr. Jeefferie bin Abd Razak	FKP	Silver
4.	26 GHz Open Ended Air Gap Cavity RLSA Antenna for the Next Generation Broadband Wireless Access	Dr. Imran bin Mohd Ibrahim	FKEKK	Silver
5.	Microwave Bio-Sensor With High Measurement Accuracy For Material Properties Detection	Assoc. Prof. Dr. Zahriladha bin Zakaria	FKEKK	Silver
6.	Multiband Isolation of DPDT Switch with Switchable Transmission Line Stub Resonators for WiMAX and LTE in 2.3 and 3.5 GHz Bands	Dr. Noor Azwan bin Shairi	FKEKK	Bronze
7.	Low Cost & Fast Semiconductor Wafer Number Counting System Based on Piezoelectric Excitation Measurement	Assoc. Prof. Dr. Kok Swee Leong	FKEKK	Bronze
8.	Flexible Metasurface-Enabled Textile Antenna	Dr. Mohd Sa'ari bin Mohamad Isa	FKEKK	Bronze
9.	TestMereq	Assoc. Prof. Dr. Massila binti Kamalrudin	FTMK	Bronze
10.	Low Cost Metal 3D Printing Machine	Ir. Dr. Mohd Rizal bin Alkahari	FKM	Bronze



With the 100 percent success rate, UTeM has managed to get the first position in comparison to other MTUNs and UTeM is very proud of this achievement. Summary of UTeM's achievements in comparison to other MTUNs is shown below.

MTUN	PARTICIPATION	TOTAL WIN	% SUCCESS	GOLD MEDAL	% GOLD (MYRA)
UTeM	10	10	100%	2	20%
UMP	16	14	87%	6	37%
UTHM	10	10	100%	1	10%
UniMAP	10	9	90%	2	20%

Congratulations to UTeM's researchers for the achievement and recognition. Hopefully, this achievement can ignite our research and innovation culture and uphold UTeM's name in the international arena.



CEREMONY FOR PECIPTA 2017 MEDALIST

A presentation of the medals and certificates to celebrate the success of UTeM's researchers in the PECIPTA 2017 was held on the 3rd November 2017, at the Auditorium Banquet Room, Chancellery. The purpose of the event is to celebrate and give recognition to the researchers for their success in PECIPTA 2017. This event is also one of the initiatives made by the university to ensure continuous motivation among UTeM's researchers in the field of research and innovation.

اونيورسيتي تیکنیکل ملیسيا ملاک

UNIVERSITI TEKNIKAL MALAYSIA MELAKA





THE SEOUL INTERNATIONAL INVENTION FAIR (SIIF) 2017 FLAG SUBMISSION CEREMONY

The Seoul International Invention Fair (SIIF) 2017 Flag Submission Ceremony was organised by the Centre for Commercialisation, UTeM to officiate the departure of UTeM's delegates to the SIFF 2017 competition from 28th November to 4th December 2017. A total of eight products was contested in the event.

During the ceremony, the Deputy Vice-Chancellor (Research & Innovation), Prof. Datuk Ir. Dr. Jailani Mohd Nor, congratulated the researchers who have been selected to participate in the event. He also gave an aspirational speech to the delegates with a strong message - "Lautan Biru Selat Melaka, Selamat Maju Jaya".





Seoul International Invention Fair 2017

The Largest Annual Invention fair in Asia
The Best Way to Enter the Global Market

Nov. 30th - Dec. 3rd, 2017
COEX, Seoul, Korea

THE ACHIEVEMENTS OF UTeM's RESEARCHERS AT SEOUL INTERNATIONAL INVENTION FAIR (SIIF) 2017, KOREA

The Seoul International Invention Fair (SIIF) 2017, Korea organised by the Korea invention Promotion Association (KIPA) was held from 30th November to 3rd December 2017, at COEX, Seoul, Korea. This Expo is an opportunity for UTeM's researchers to assess the potential of their new technology inventions in relation to other inventions at the international level. It also serves as a venue for consultation of successful commercialisation of intellectual property for a new market.

UTeM sent a total of 8 products to be contested and exhibited in the SIIF 2017 and has achieved 100 percent success rate. Specifically, UTeM won two (2) gold medals, two (2) silver medals and four (4) bronze medals with the success rate of 100% for the participation. The results are as follows:

NO.	MAIN RESEARCHER	PRODUCT NAME	FACULTY	RESULT
1.	Assoc. Prof. Dr. Massila binti Kamalrudin	Trust Crawler	FTMK	Gold
2.	Dr. Noor Azwan bin Shairi	Reconfigurable and Integrated Microwave Bandpass Filter Notched Band for Wireless Applications	FKEKK	Gold
3.	Dr. Aziah binti Khamis	Re-VOLT 8.0 Reversed Voltage Topology Single Phase Multilevel Inverter	FKE	Silver
4.	Dr. Maaspaliza binti Azri	E-IV 3000 High Power Efficiency 3 Phase Cascaded H-Bridge Multilevel Inverter	FKE	Silver
5.	Assoc. Prof. Dr. Hambali bin Arep @ Ariff	Suci- Male Urinal System (S-MUS)	FKP	Bronze
6.	Assoc. Prof. Dr. Kok Swee Leong	Self-Powered Machinery Vibration Monitoring Via Internet-of-Things (IoT)	FKEKK	Bronze
7.	Ahmad Fauzan bin Kadmin	Voice-Assisted Wheelchair	FTK	Bronze
8.	Assoc. Prof. Dr. Kok Swee Leong	Self-Powered Vehicle Collision Notification Via Disc Break Thermal Energy Harvesting (C-Note)	FKEKK	Bronze

Congratulations to UTeM's researchers for the achievement and we hope that this achievement and recognition will continue to enliven UTeM's research and innovation culture and uphold the name UTeM in the international arena.



UTeM EX 2017

اونيورسيتي تكنولوجيكل مليسيا ملاك





INNOVATION CARNIVAL UTeMEX 2017

The Innovation Carnival (UTeMEX 2017) was held at UTeM on three occasions which are: 31st October – 2nd November 2017 (CETRI & CERIA research groups), 7th - 9th November 2017 (AMC & CARE research groups) and 14th - 16th November 2017 (C-ACT & C-TED research groups). Each occasion was participated by three different research group. The highlight of this program is the Opening Ceremony and the Prize Presentation Ceremony, which were completed by the Secretary General of the Ministry of Higher Education, Tan Sri Dr. Noorul Ainur Mohd. Nur, on the 28th November 2017 (Tuesday). This carnival serves as a medium to integrate UTeM joint ventures and small-scale, more focused industries and hopefully it continues to intensify research and innovation activities strategically.

The participation for this carnival was mainly members from research groups under each of UTeM's Centre of Excellence (CoE). The products contested by the respective CoE groups were evaluated by the University's panel and the designated industries. The results are as follows:

	GOLD	SILVER	BRONZE		SPECIAL AWARD
AMC	5	9	11	25	2
C-ACT	7	12	17	36	2
C-TED	3	9	31	43	1
CARE	5	12	16	33	1
CERIA	8	8	19	35	2
CETRI	2	13	16	31	1
	30	63	110	203	9

Congratulations on the success of our researchers and hopefully they continue to elevate the dignity of UTeM's research and innovation at the international level.



RESEARCH AND COMMERCIALISATION ACTIVITIES

BUSINESS PLAN & IP PROTECTION WORKSHOP FOR GOLD MEDALISTS IN INNOVATION CARNIVAL: UTeMEX 2017

A workshop related to IP Protection & Business Plan to UTeM's researchers who have won the Gold Medal and Special Award in conjunction with the Innovation Carnival: UTeMEX 2017 was held on the 31st October – 16th November 2017. The purpose of the workshop was to inform and educate UTeM's researchers on business planning as well as the importance of intellectual property protection against their innovation.

This workshop is the second phase of the product/innovation empowerment process, which is a continuation from the first phase program that is the selection of potential products for commercialisation from the UTeMEX 2017.

The workshop was facilitated by the Managing Director of Adastra Company IP (M) Sdn. Bhd., Mohan K. The details of the workshop are as stated below:

- | | |
|-------|---|
| Date | : 7 th December 2017 (Thursday) |
| Time | : 8.30 am - 5.00 pm |
| Venue | : Chancellery Auditorium Room, UTeM Main Campus |
| Title | : 1. Unlocking the Potential of Your IP through Strategic IP Filing Strategies.
2. Crafting a Winning Pitch - Communicating your Innovation through Effective Business Plan. |





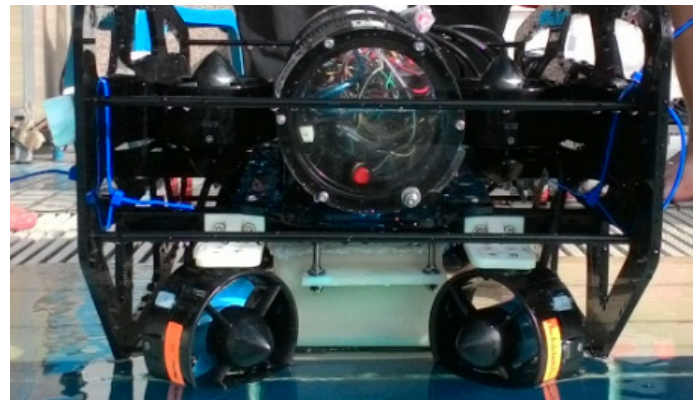
MALAYSIA AUTONOMOUS UNDERWATER CHALLENGE (MAUVC) 2017

The IEEE OES Malaysia Chapter has organized the Malaysia Autonomous Underwater Challenge (MAUVC) 2017 for the first time on 17th - 18th December 2017 at the International Islamic University Malaysia. Seven teams competed to win this challenge, in which three teams were from Universiti Teknikal Malaysia Melaka (UTeM) and the others were from Universiti Sains Malaysia (USM), International Islamic University Malaysia (IIUM), Universiti Teknologi Malaysia (UTM) and Universiti Tun Hussein Onn Malaysia (UTHM) respectively. The goal of this event is for each team to develop an Autonomous Underwater Vehicle (AUV), in which they negotiate with team members to complete the tasks put forth under a prescribed time. The Malaysia AUV Challenge aims to provide students with an opportunity to experience the challenges of AUV system engineering and develop skills in the associated technologies besides learning and having fun. Besides introducing the underwater competition among higher institutions, the challenge is one of the research activities in IEEE OES Malaysia Chapter. The list of the winners for MAUVC 2017 is as follows:

Champion	- Roboteam from IIUM	5th place	- UTHMAUV-1 from UTHM
1 st runner up	- UTeRG-FKE from UTeM		- UTeM Panthers Jr from UTeM
2 nd runner up	- UCRGUSM from USM		- UTM.
4 th place	- UTeM Panthers from UTeM		



1st runner up from UTeRG FKE UTeM



UTeRG FKE -AUV

The three teams representing UTeM were from different faculties. They were from the Faculty of Electrical Engineering led by Dr. Mohd Shahrieel Mohd Aras and Mr. Mohd Bazli Bahar, the Faculty of Mechanical Engineering led by Dr. Mohd Khairi Mohamed Nor, Dr. Ahmad Anas Yusof and Dr. Shamsul Anuar Shamsudin and the Faculty of Technology Engineering led by Ir. Mohammad 'Afif Kasno and Mr. Mohd Zaidi Mohd Tumari. With this challenge, the underwater research group in UTeM will have a fast growing involvement from all the faculties and will be one of well-known research groups in the world.

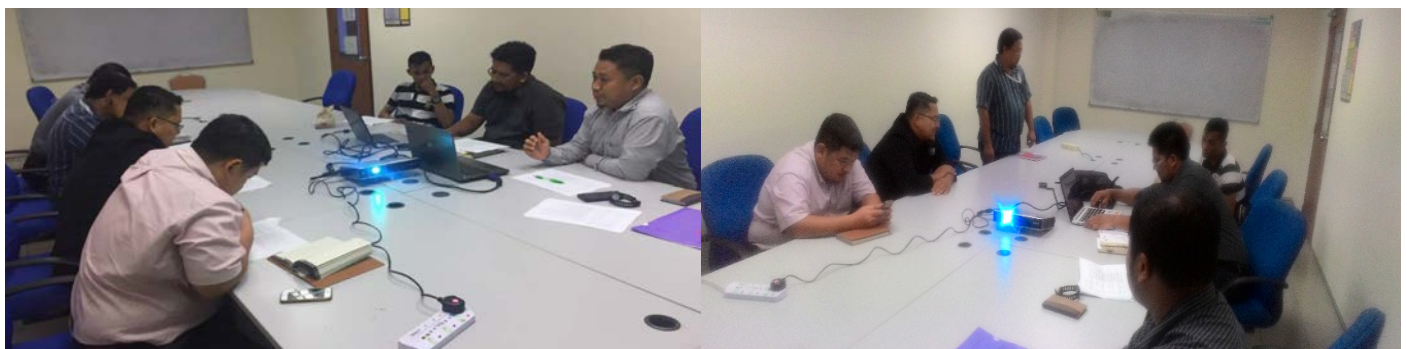
RESEARCH COLLABORATION AND COMMERCIALISATION ACTIVITIES

Collaboration between Underwater Technology Research Group and Bumi Subsea Malaysia

On the 16th August 2017, delegates from Universiti Teknikal Malaysia Melaka (UTeM) led by Dr. Mohd Shahrieel Mohd Aras visited the Bumi Subsea Malaysia in Gelang Patah, Johor Baharu. Bumi Subsea Malaysia Sdn. Bhd. was incorporated in Malaysia by a group of dedicated mariners and oil and gas professionals in 2009. The Bumi Subsea Group has built up competencies to deliver offshore engineering, construction works, and other services to various international and local oil & gas players. Bumi Subsea operates through 3 offices in the Southeast Asia region-Malaysia, Indonesia and Singapore- catering to the offshore oil and gas industry and also a wholly owned Bumiputra company and a holder of required PETRONAS Licenses. Bumi subsea owns and operates a total of 6 units of ROVs, which includes Observation Class ROVs- Seaeye Tiger, an Inspection Class ROV – Seaeye Panther and Work Class ROVs- C-ROVs. This ROVs are capable of deepwater installation projects with up to 150HP. Bumi subsea has experienced team members and they are fully capable of operating each of 6 ROVs for various scopes of work. With careful routine checks, all equipment are maintained and ready to be operated.



On the 14th November 2017, Underwater Technology Research Group UTeM invited Bumi Subsea Malaysia to give a technical and experience talk on Remotely Operated underwater Vehicle (ROV) operation. This technical talk was led by Ir. Mohammad 'Afif Kasno and held at the Dewan Seminar 1 Faculty of Technology Engineering. Bumi Subsea Malaysia was represented by Mr. Syamsul Nizam Azmee, who is the Senior Manager Marketing of Bumi Subsea Sdn. Bhd. He has an in-depth knowledge and proficiency in Malaysia Oil and Gas, especially in the Subsea Engineering and Subsea Technology Research and development segment during his engagement over 10 years in the Oil and Gas Industry. Almost 80 students from Mechatronics program, Faculty of Electrical Engineering and Software and Computer program, Faculty of Technology Engineering attended his talk.



After the technical talk, a short meeting was carried out to discuss research and collaboration between the Underwater Technology Research Group and the Bumi Subsea Malaysia Sdn. Bhd. The meeting was held at the Faculty of Mechanical Engineering. Based on the discussion, Bumi Subsea highlighted that a joint-research can be carried with the Underwater Technology Research Group and they are willing to provide any data related to the research. Bumi Subsea also can provide facilities for testing underwater platforms, such as the ROV and AUV for real time testing.



RESEARCH HIGHLIGHTS

SOCIAL ROBOTS AND THEIR SOCIETAL CONTRIBUTIONS

Syamimi Shamsuddin
Phd. CEng MIMechE MIEEE

Robotics is a branch of engineering that involves the operations and applications of robot technology. The research trend in this area is experiencing a paradigm shift from industrial robots towards socially assistive robotics and human-friendly robots. Rehabilitation robotics is part of the notion for robots to play substantial role in specific rehab interventions for individuals who suffer depression, elderly people affected with dementia and persons affected by neurodevelopmental disorders such as Autism Spectrum Disorders (ASD). With robotic intervention, it is hoped that the quality of life for the disabled can be made better and they may gain more independence in their daily lives. In this light, social robots have potential to contribute by socially interacting with the patients to help increase their mood and make them happy.

Autism is a complex neuro-cognitive disorder that results in a child's behavior being markedly different from those of typical children. Autism is characterized by three deficits, which are the impaired social interaction and communication skills together with stereotypical behaviors such as hand flapping, body rocking and object spinning. For each individual, these 'triad of impairments' occur in varying degrees. It is estimated that one in every 91 children in the United States and one in every 600 children in Malaysia are diagnosed with autism. Hence, the need of suitable rehabilitation measures are critical. As autism prevalence rate escalates, more research labs have started to explore the possibilities of employing robots to be a part of autism therapy. To date, the humanoid robot NAO by Softbank Robotics is the most widely used robot in aid of children with autism. NAO possesses simpler features compared to real humans, hence will be more approachable and appealing to autistic children. Additionally, NAO is also one of the most advanced and commercially available humanoid, providing ease of programming to support the therapy architecture for the intervention of autistic children.

Meanwhile, robots also show potential to help patients with depression. Depression is present in 25-30% among stroke patients. Stroke survivors may experience stress, worry, sadness and hopelessness in different degrees.



The author with PARO, the seal robot used in rehabilitation therapy



The author and Dr. Fazah Akhtar Hanapia, who is a consultant rehabilitation physician during Disability We Care Conference (DWCC) 2017 in Sungai Buloh. Dr. Fazah is holding the animal robot PARO.

They may also experience low mood, feelings of hopelessness, withdrawal from daily social activities and even suicide. Animal-assisted therapy (AAT) is a helpful addition to the rehabilitation regimen for depression. AAT helps motivate and makes therapy more enjoyable and less stressful for stroke patients. Nonetheless, AAT is unsuitable for patients who are afraid of animals or have allergies.

PARO is a seal robot designed and developed by Professor Takanori Shibata in 1993. PARO features a soft furry coat with built-in intelligence providing psychological, physiological and social effects through physical interaction with humans. It reacts to petting and stroking by blinking its eyes and moving its flipper. PARO is a robot readily equipped with processors and tactile sensors making it suitable to be directly integrated into current therapy regime for patients with depression.

At the Mechatronics Laboratory under the Intergrated Manufacturing System (I'Ms) research group in UTeM, our research motivation lies in our long-standing goal for robots to help the individuals in our society who are affected with mental health problems. This is a collaborative work with the Psychosocial Department, SOCSO Tun Razak Rehabilitation Center, Melaka. Current results suggest that PARO effectively uplifts mood and helps patient to be calm.

Though the efficacy of social robots is still in the exploratory stage, we cannot deny that robots are attractive and they do encourage positive social and emotional communication. Hence, using knowledge in engineering coupled with the motivation to help people with mental disabilities; breakthroughs can be made and achieved.

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THE FUTURE OF ENERGY STORAGE DEVICE? A ROBUST PROTOTYPE OF GRAPHENE/MOS₂ SUPERCAPACITOR



Assoc. Prof. Dr. Mohd. Asyadi Azam bin Mohd. Abid
Carbon Research Technology, Advanced Manufacturing Centre, FKP

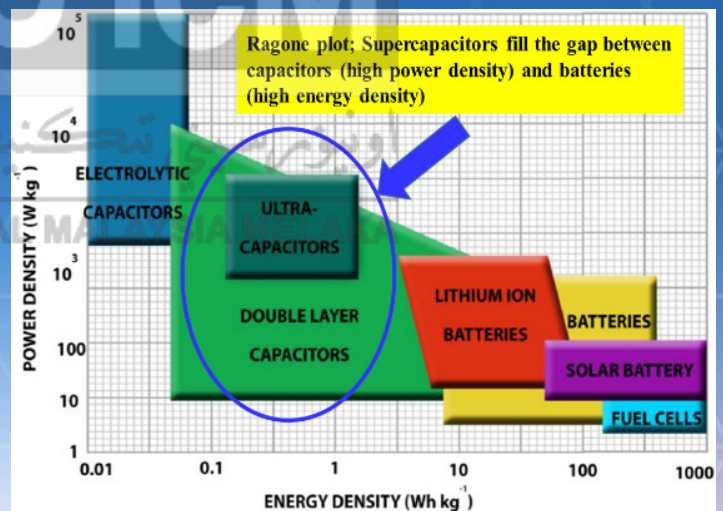
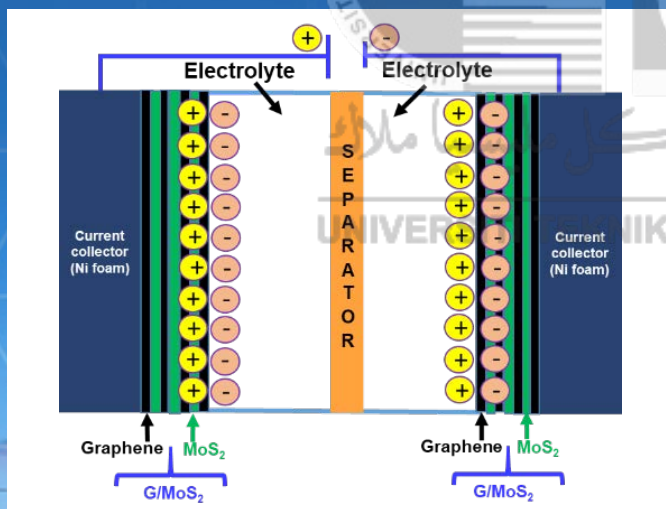
Co-Researchers:

Raja Noor Amalina binti Raja Seman & Dr. Syahriza binti Ismail

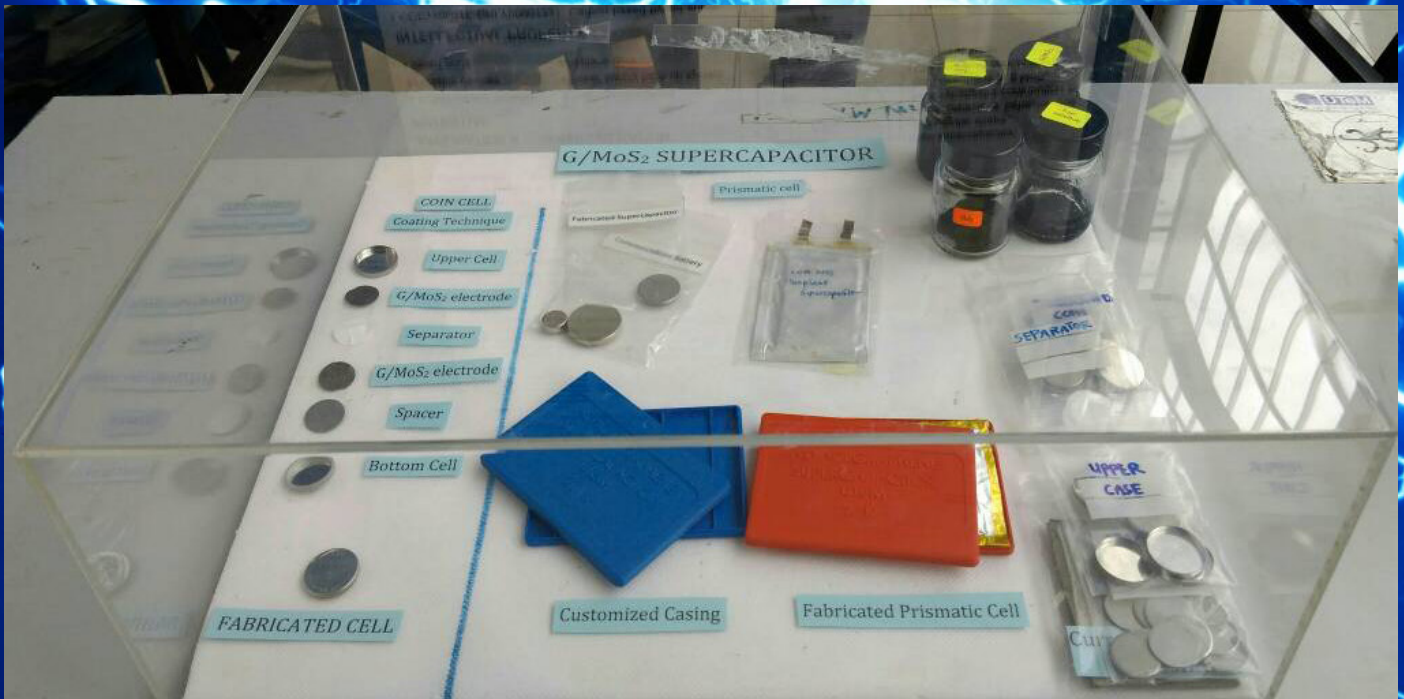
Recent achievement: UTeMEX 2017 Special award and Gold award

Supercapacitors have been considered as one of the most promising candidates for the next-generation energy storage devices due to their attractive properties, including high power density, long cycle life, fast recharge capability, and light weight. Supercapacitors are attractive in wide variety of applications, such as in hybrid electric vehicles and smart grids. Herein, we fabricate graphene/molybdenum disulfide (G/MoS₂) hybrid electrodes with a novel combination of high electrical conductivity from graphene and high intrinsic ionic conductivity from MoS₂. The interaction between graphene and MoS₂ materials produced a synergistic effect and resulted in outstanding energy storage performance in terms of the greatest capacitive property, good rate and cyclic performances.

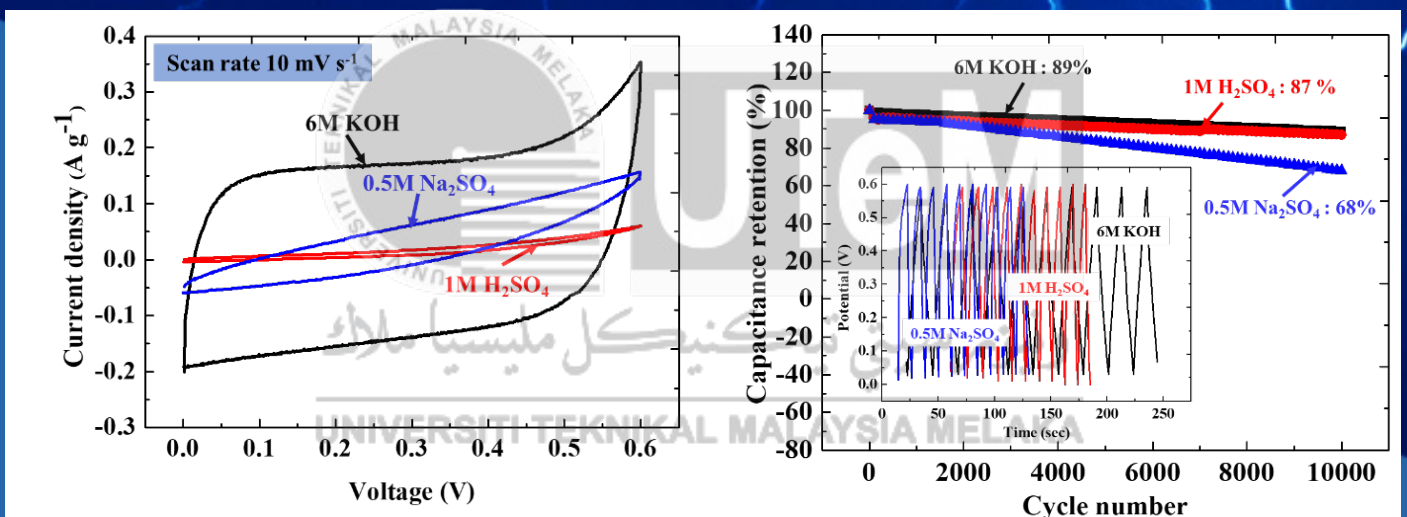
Graphene/MoS₂ supercapacitor



Supercapacitors are generally classified into three types on the basis of their charge storage mechanisms and electrode materials: electrochemical double layer capacitor (EDLC), pseudocapacitor, and hybrid capacitor. EDLCs employ reversible adsorption of ions, which store and release energy through nanoscopic charge separation between an electrolyte and an electrode interface. The advantages of EDLCs include high energy and power densities, long lifecycle, short charging time, and wide operating temperature. Pseudocapacitors faradaically store electrical energy via electron charge transfer between the electrolyte and electrode. Hybrid capacitors comprise two electrodes that electrostatically and faradaically store charges.



Electrochemical performance of Graphene/MoS₂ supercapacitor



Cyclic voltammetry and galvanostatic charge-discharge analyses

Typical CV curves of the G/MoS₂ electrodes show a rectangular shape without obvious redox peaks, which indicates that G/MoS₂ possesses a typical electrical double-layer capacitance (EDLC). It can be observed that the CV curves exhibit typical rectangular shapes even at high scan rate, suggesting an excellent rate capability. The good capacitive behavior of G/MoS₂ electrodes is due to a synergistic contribution of both graphene and MoS₂. This G/MoS₂ supercapacitor is cheaper than the conventional supercapacitor.

The charge curves of G/MoS₂ supercapacitor are almost linear and symmetrical to their discharge counterpart, which further indicates the excellent reversibility and higher current efficiency of graphene and MoS₂ electrodes. The rapid charging and discharging curves indicate the fast transfer of ions between the electrolyte-electrode interfaces. Also, the G/MoS₂ supercapacitor shows excellent cyclic performances up to 10,000 cycles and better long term cycling stability.

ENERGY



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IMPORTANT DATES

- 2-pages extended abstract submission: **15 January - 28 February 2018**
- Notification of acceptance: **31 March 2018**
- Revised 2-pages extended abstract submission: **31 March - 15 April 2018**
- Registration: **31 March - 15 April 2018**
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