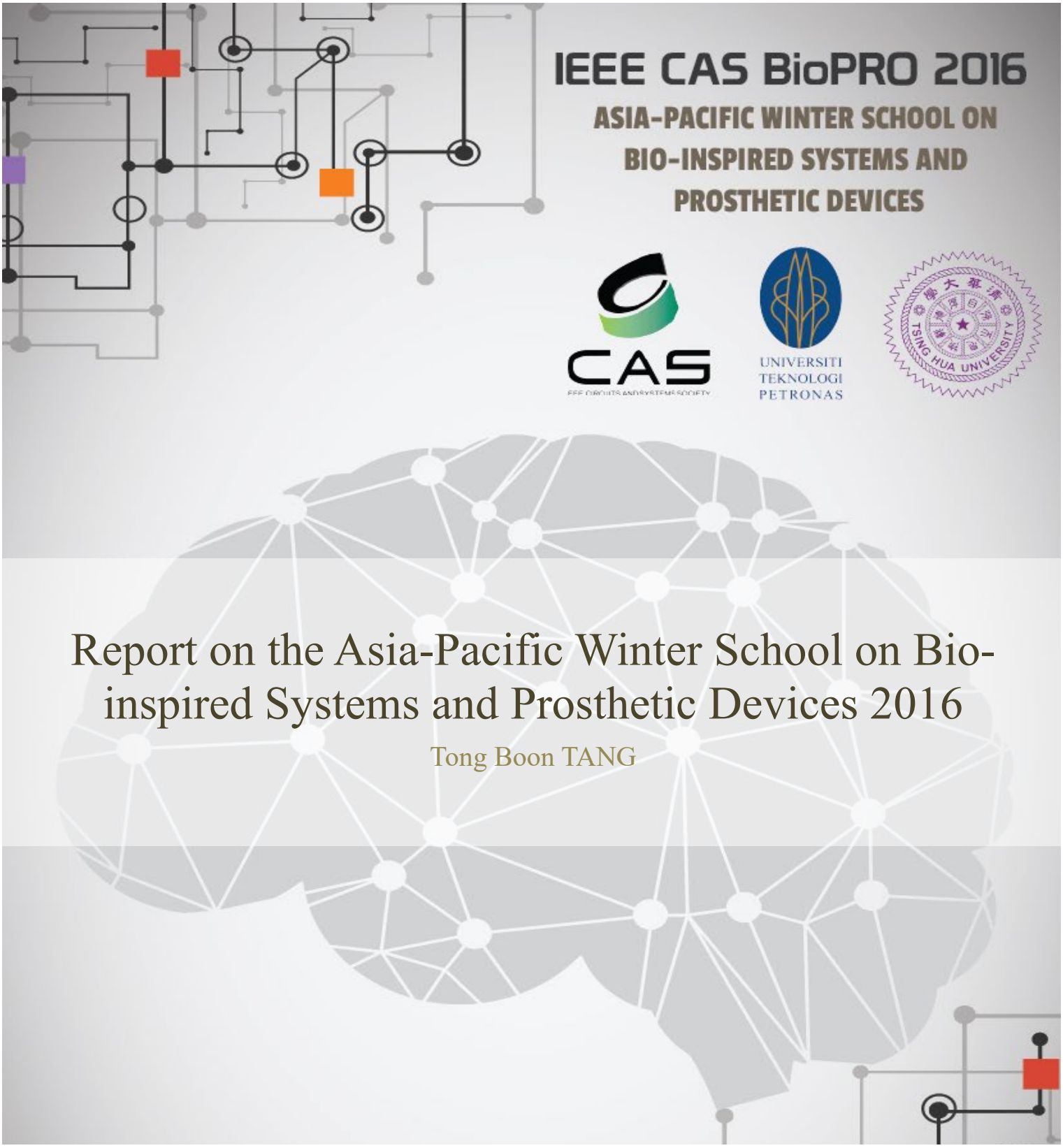

Report on the Asia-Pacific Winter School on Bio-inspired Systems and Prosthetic Devices 2016

Tong Boon TANG

Date: December 5 – 9th, 2016

Venue: Universiti Teknologi PETRONAS, Malaysia

Website: http://biopro2016.wixsite.com/biopro2016

Photo: https://drive.google.com/drive/folders/0B3qtJmmxhhzKcmZxaW1mbFVLeGs

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1. INTRODUCTION

Asia-Pacific Winter School on Bio-inspired Systems and Prosthetic Devices (BioPro) 2016 is considered as analogous to the annual cognitive neuromorphic workshops in Telluride for the US region and in Capo Caccia for the European region. The ultimate goal of the annual Asia-Pacific Seasonal School is promoting the applications of bio-inspired systems to real industrial or medical problems. BioPro has been held in Taiwan from 2009 to 2015, with the support from IEEE Circuits and Systems Society under Outreach Initiative. This year BioPro was organized by IEEE Circuits and Systems Society (Malaysia Chapter) as one of the IEEE Seasonal Schools in Circuits and Systems, in collaboration with Department of Electrical and Electronic Engineering, UTP and National Tsing Hua University. The hosts are Tong Boon Tang (UTP) and Hsin Chen (NTHU). This workshop has been made possible with the generous support from the 2016 IEEE Seasonal Schools in Circuits and Systems of IEEE CAS Society, the Department of Electrical and Electronic Engineering, UTP and National Tsing Hua University.

The winter school received a total of 52 registered participants comprising both local and foreign nationalities, e.g. Pakistan, Egypt, Taiwan, South Africa, Bangladesh, Yemen and Sudan etc (Fig.1). Besides the keynote lectures by eight invited speakers, we had a special session on microfluidic technology and applications with an additional six speakers from local universities to share their research projects and outcomes. The winter school further provided (a) a demo session of brain controlled game and robot, (b) a hands on project for practicing the knowledge from the lectures, and (c) a brainstorming day tour on 7th December for all the participants to have a close interacts with speakers to discuss innovative ideas and future collaborations. The final program is summarized in Fig. 2.

Fig. 1: Group photo of speakers and participants at BioPro venue.

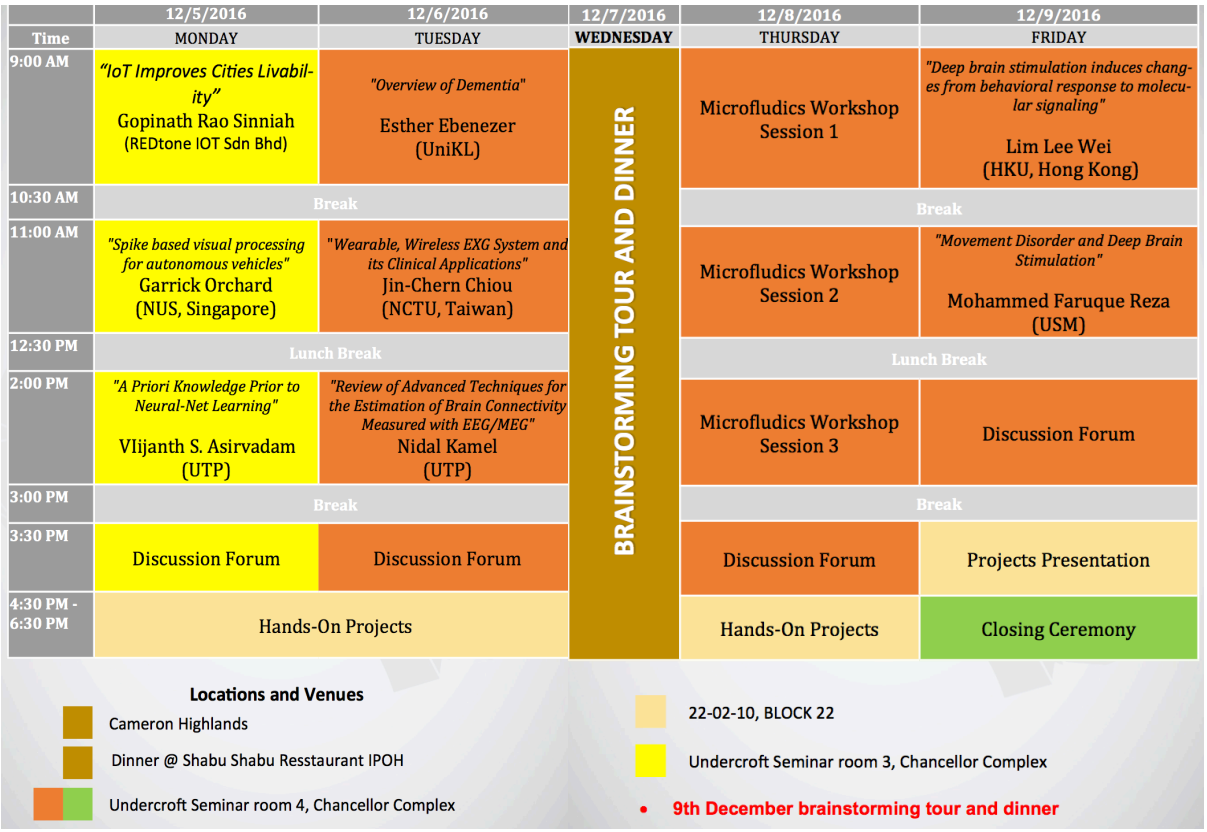

Fig.2: Final program of BioPro 2016.

2. LECTURES

The winter school featured speakers from Singapore, Taiwan, Hong Kong and Malaysia. This organization is beneficial to promote regional collaboration among researchers. We had speakers from different disciplinary (engineering, computer science and medicine) and sectors (universities, hospitals, industry and research institute). The lectures on each day were designed to focus on one specific topic (Day 1: Big, Neural Data Computation; Day 2: Neurodegenerative Disorders and Diagnosis; Day 4: Microfluidic Technology; Day 5: Neuro-rehabilitation) to allow participants to learn background knowledge of interdisciplinary fields systematically. The learnt knowledge was helpful for participants to understand and participate in discussion actively, as well as to carry out hands on project.

One of the highlights was the demo session led by Prof Jin-Chern Chiou of Industrial Technology Research Institute of Taiwan. Firstly he introduced a brain-controlled horse racing game. Based on electroencephalography (EEG) signals at prefrontal cortex, one can move the 'horse' by his/her mind. We had a competition between two participants (one student and one lecturer). The young mind won. The second demo was with a 'dragon' robot. Using eye-blinks, one could move forward/backward and turning left/right. Many participants tried and had fun with the robot. It was a very successful demo session.

Fig. 3: Lectures on various topics during BioPro by speakers from Asia Pacific.

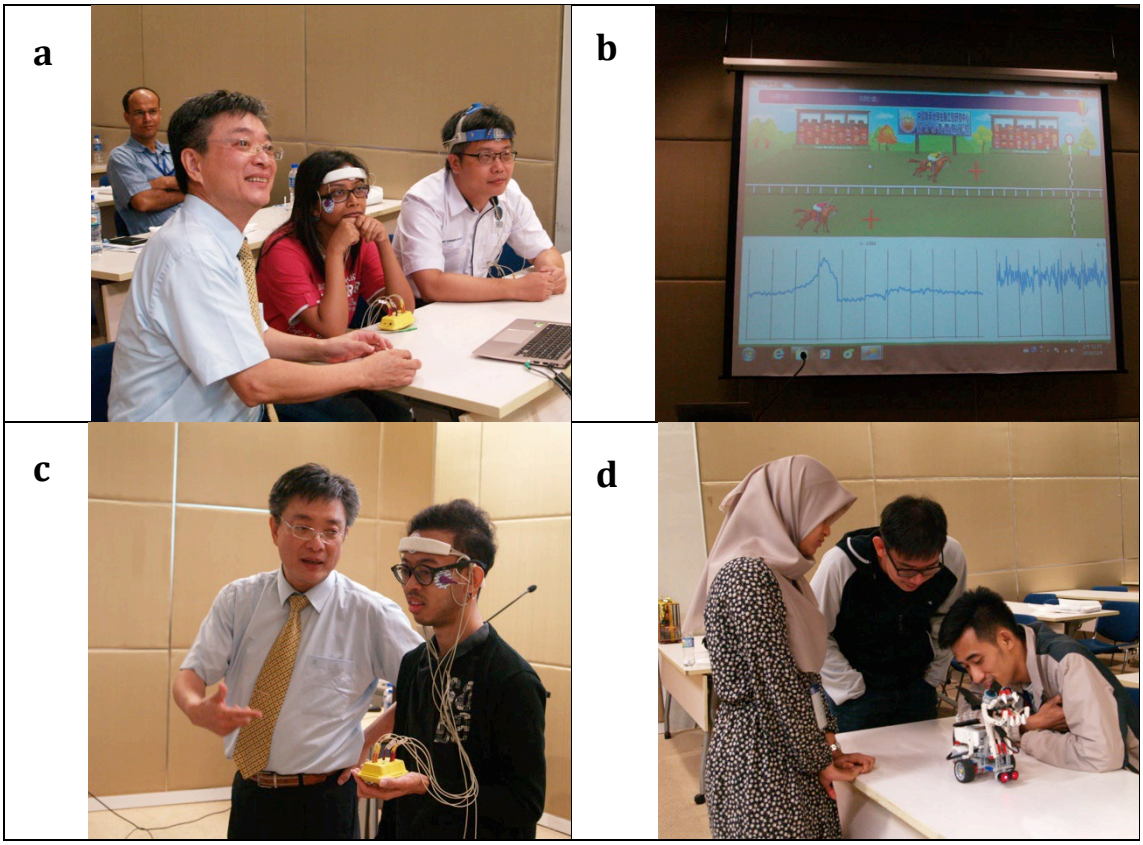

Fig. 4: Demo on brain-controlled game and robot.

3. HANDS-ON PROJECT

The BioPro winter school offered a hands-on project, running 4:30 – 6:30 p.m. every day. The instructor is Dr Garrick Orchard of National University of Singapore. The goal of the project was to applying knowledge of bio-inspired systems to real industrial or medical problems. Adopting the concepts of neuromorphic engineering, the participants used the data captured by an asynchronous time-based image sensor array using silicon retinae cameras which mimic the biological eye. To understand how brain performs the visual processing, different computational methods were used via spiking neural processors. The data was related to a road scenario where different vehicles were moving around. One of the basic but challenging parts was the noise filtering in real time process that was performed by means of average running spiking filtering. Other steps were to develop the trackers to track different objects and activities when they occur/approach in the threshold range of three different trackers, adjusting the size of the trackers according to size of the object so that one tracker would be sufficient for one object, checking the active/inactive trackers so that they could assign them with new targets, estimation of the velocities of the moving objects and assigning them to the trackers. All the aforementioned activities were related to the normal human eye operations and with the help of the silicon retinae cameras and different computational algorithms mimic the visual processing in brain. This project aims to help participants to translate learnt knowledge into their on-going projects e.g., unmanned vehicles, object tracking, velocity estimation. We had one representative of the participants to present the project to illustrate their understanding and appreciation about the project on Dec 9th.

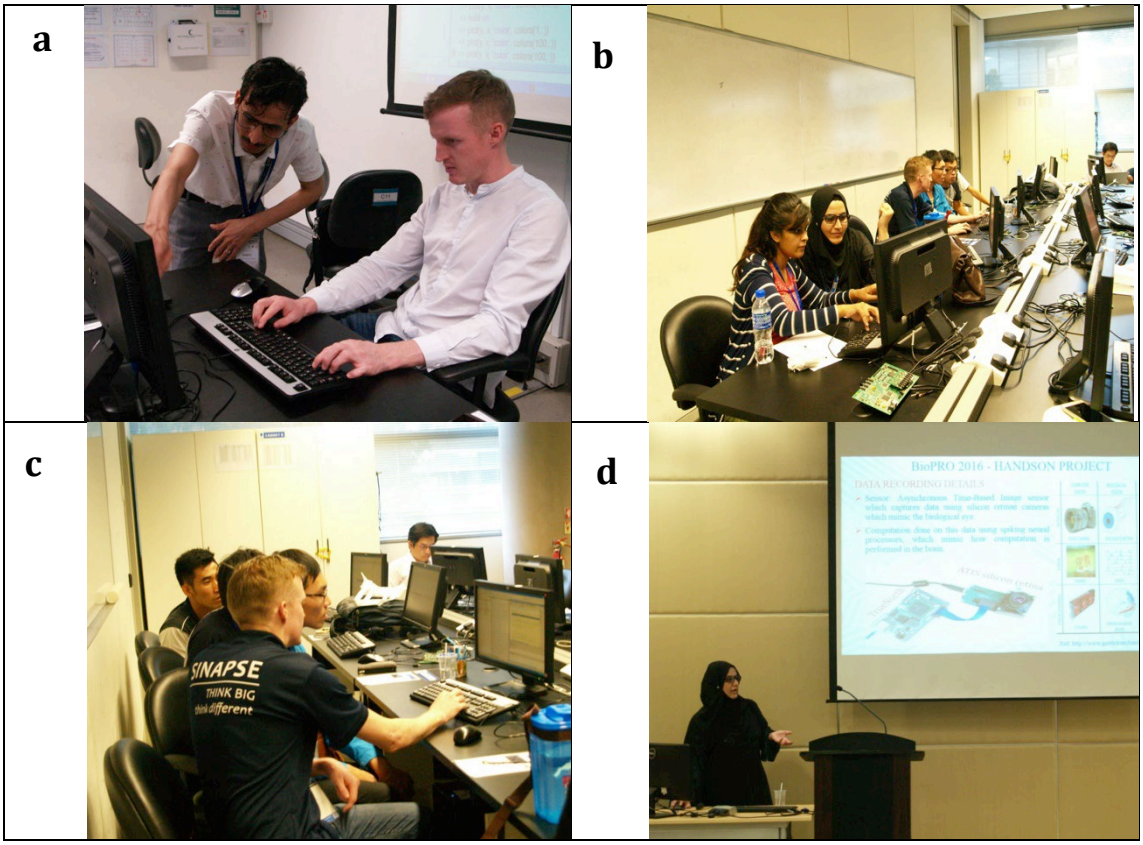

Fig. 5: (a)-(c) Hands on project and (d) a final presentation by a representative from the participants on the final day of BioPro.

4. SPECIAL SESSION ON MICROFLUIDIC TECHNOLOGY

Microfluidics and Lab on Chip (LOC) is an emerging technology which leverages on the miniaturization of fluid handling system to enable precise control and manipulation of small fluid volumes for various applications, such as point-of-care and clinical diagnostics, pharmaceutical and life science research, analytical and monitoring devices, and drug delivery. The aim of this special session is to have different university representatives to present Microfluidics Research Activities and Initiatives at their respective institutions. It provides a platform for researchers with interests and efforts in microfluidics to learn and align their research activities, identify potential areas for collaborations and discuss further development and technology transfer in this exciting field. We had a total of six speakers from both public and private universities:

- Dr Nor Hisham Hamid (Universiti Teknologi PETRONAS)
- Dr Ku Zilati Ku Shaari (Universiti Teknologi PETRONAS)
- Dr Asrulnizam Abd Manaf (Universiti Sains Malaysia)
- Dr Nurul Amziah Md Yunus (Universiti Putra Malaysia)
- Dr Mohd Ridzuan Ahmad (Universiti Teknologi Malaysia)
- Dr Jit-Kai Chin (University of Nottingham, Malaysia Campus)

All expenses (food, beverages and souvenirs for speakers) for Dec 8th Special Session on Microfluidic Technology were supported by Mission Oriented Research (MOR) Nanotechnology of Universiti Teknologi PETRONAS.

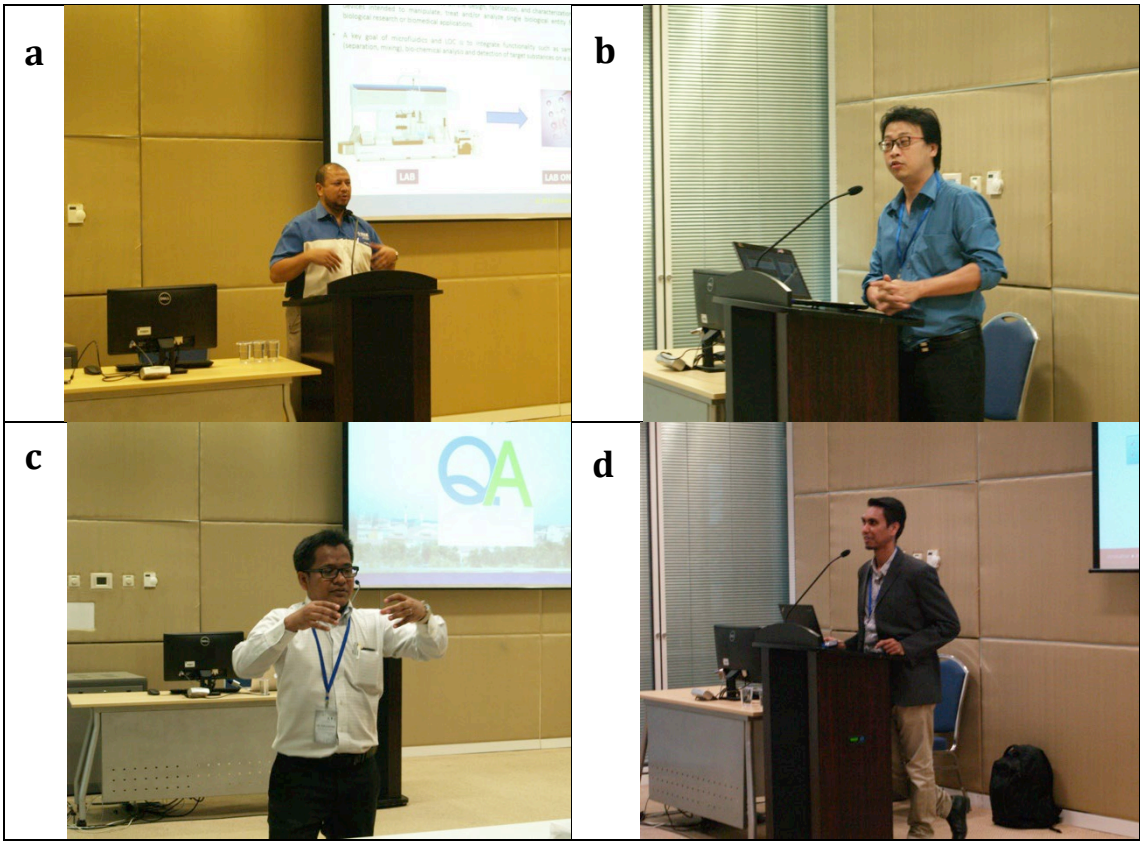

Fig. 6: A series of lectures and discussion on microfluidic devices.

5. BRAINSTORMING TOUR

On Dec 7th, participants visited Cameron Highlands which is situated at the northwestern tip of Pahang state of Malaysia. It occupies an area of 712 square kilometres, about 90 km from the BioPro venue – Universiti Teknologi PETRONAS. It is a popular venue for retreat due to its mean annual temperature about 18 °C. However, we had an unusual hot day when we visited. The participants had the opportunity to visit the Time Tunnel to see the history of Malaysia and learn about lifestyles and toys from the ancient time. One of the interesting bits of the visit was the mystery about the disappearance of Jim Thompson, an American businessman in Cameron Highlands on March 26, 1967.

Our next stop was the strawberry farm where the participants could experience strawberry picking. A more popular option was to sample delicious strawberry ice cream and yogurts. Shortly after that was a visit to Malaysia home grown BOH tea farm. It includes a guided tour to the factory to learn about the traditional processing methods and a chance to taste fresh tea at the BOH tea'ria with a spectacular view over the tea farm. That's the highlight of the day tour. The day finished with a steamboat buffer at the city of Ipoh, one of the best cities in the Asia by *Lonely Planet* 2016.

Fig. 7: Day tour to Cameron Highlands.

6. FUTURE RESEARCH COLLABORATIONS

The BioPro winter school succeeds not only to stimulate participants to get involved in the related research, but also to promote potential collaborations among Asia Pacific researchers. For instance, we will cooperate with the Taiwanese industrialist Prof Chiou to explore EEG neurofeedback to study the efficacy of the technology in Alzheimer's disease prevention. We aim to have a multi-centre study on this topic. To extend this exciting and fruitful event, all invited speakers agreed that we should continue to run this winter school. The next stop BioPro 2017 will be in Singapore, and the BioPro 2018 in Australia.