NATIONAL SENSOR TECHNOLOGY FORUM 2023

18 July 2023 (Tuesday)
8:30am - 5:00pm

Jointly organised by

AKADEMI SAINS MALAYSIA

KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

SENSOR MALAYSIA

In collaboration with

UPM UNIVERSITI PUTRA MALAYSIA

IEEE NANO

IEEE Sensors Council Malaysia Joint Chapter

AGENDA

8.30 - 8.50 am	Arrival of guests Registration of Participants
8.50 - 9.00 am	Arrival of VIPs
9.00 - 9.05 am	Negaraku and Doa Recitation
9.05 - 9.10 am	Welcoming Remarks by **Professor Dato' Ir Dr A. Bakar Jaafar FASc** Vice President of Academy of Sciences Malaysia
9.10 - 9.15 am	Opening Speech by **YBhg Datuk Ts Dr Aminuddin Hassim** Secretary-General of Ministry of Science, Technology and Innovation
9.15 - 9.30 am	Memorandum of Agreement (MoA) Signing Ceremony

Theme 1: Healthcare and Medical
Mainstreaming Sensors for Healthcare and Medical Applications

9.30 – 9.50 am	Plenary Session I **Biosensor Technologies for Point-of-Care Diagnostics** **Professor Ir Dr Fatimah Ibrahim FASc** Universiti Malaya
9.50 - 10.10 am	Plenary Session II **Mainstreaming Sensors for Healthcare and Medical Applications** **Ts Dr Iffah Izzati Zakaria** Malaysia Genome and Vaccine Institute (MGVI)
10.10 - 10.30am	Interactive Demonstration Democratising Sensor Technology in Healthcare Dr Mohd Hanif Abdul Gaus MAIA Sdn Bhd
10.30 -10.50 am	Tea break

Theme 2: Smart City and Transportation
The Role of Smart Sensors in Smart Cities

10.50 – 11.10 am — Plenary Session III
Enabling Smart Cities through AI-Driven Solutions: A Pilot Project for Sustainable Development in Malaysia
Associate Professor Dr Ammar Zakaria
Universiti Malaysia Perlis (UniMAP) & IDERIA Sdn Bhd

11.10 - 11.30 am — Plenary Session IV
IoT in Action: How Smart City Observatories Drive Data-Driven Decision Making
Dr Mazlan Abbas
FAVORIOT Sdn Bhd

Theme 3: Agriculture, Environment, and Biodiversity
Adoption of Sensor Technology for Sustainable Agriculture and Environment

11.30 - 11.50 am — Plenary Session V
Unlocking Insights from Sensors: A Comprehensive Update on Low-cost Air Quality Monitoring in Malaysia
Associate Professor Dr Mohd Shahrul Mohd Nadzir
Universiti Kebangsaan Malaysia (UKM)

11.50 - 12.10 pm — Plenary Session VI
Integrated Electrochemical Biosensor System for Plant Disease Management and Food Safety
Dr Nur Azura Mohd Said
Malaysian Agricultural Research and Development Institute (MARDI)

12.10 – 12.30 pm — Plenary Session VII
NET-PEAT: Networked ASEAN Peatland Forest Communities for Transboundary Haze Alert
Professor Ir Dr Aduwati Sali FASc
Universiti Putra Malaysia (UPM)

Theme 4: Automation, Manufacturing, and Energy
Unleashing the Potential of Sensor Technology to Advance Manufacturing and Energy Industry

12.30 - 12.50 pm	Plenary Session VIII **Integration of Sensor Technologies and AI: Unlocking Productivity and Traceability in Malaysia's Industry 4.0** **Dr Syed Muhammad Mamduh Syed Zakaria** (CEASTech) Universiti Malaysia Perlis (UniMAP)
12.50 - 1.10 pm	Plenary Session IX **Advancements in Self-Powered Sensors: Towards AI Integration and Antenna Design for RFID** **Professor Dr Lim Eng Hock FASc** Universiti Tunku Abdul Rahman (UTAR)
1.10 - 2.30 pm	Lunch and Poster Exhibitions
2.30 - 4.30 pm	**Forum** Sensor Technology in Malaysia: Leveraging Strengths, Addressing Weaknesses and Charting a Dynamic and Competitive Course • **Dr Pannirselvam Kanagaratnam** MIMOS Berhad • **Dato' Ts Dr Amirudin Abdul Wahab FASc** Cybersecurity Malaysia • **Associate Professor Dr Ammar Zakaria** Universiti Malaysia Perlis and IDERIA Sdn Bhd • **Mr Tang Kok Mun** Biogenes Technologies Sdn Bhd
4.30 - 5.00 pm	Programme Concludes

Theme 1: Healthcare and Medical
Biosensor Technologies for Point-of-Care Diagnostics

Plenary Session I

Professor Ir Dr Fatimah Ibrahim FASc
Universiti Malaya (UM)

Biosensor Technologies for Point-of-Care Diagnostics

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Abstract

Point-of-care (POC) diagnostics are essential for timely and effective management of various infectious and chronic diseases, especially in resource-limited settings. The recent COVID-19 pandemic has underscored the need for rapid and low-cost POC diagnostic sensors that can provide accurate and reliable results at the point of need. POC diagnostic sensors utilise miniaturised, integrated, low-cost, and user-friendly platforms for sensing biomarkers in various physiological fluids such as blood, saliva, and sweat. This presentation will provide an overview of microfluidic biosensors for POC diagnostics of infectious diseases such as dengue, foodborne pathogens, and sepsis pathogens. The speaker will explain the basic principles and advantages of microfluidic platforms such as compact disc (CD) microfluidics and digital microfluidics, as well as demonstrate how they can be integrated with electrochemical and electronic sensors to achieve sensitive and selective detection of target biomarkers. Furthermore, the speaker will address the challenges and opportunities in developing wearable biosensors for on-body biosensing of saliva and sweat metabolites. The speaker will also share experiences and insights on translating these biosensors from lab to commercialisation and discuss the future directions and challenges of this emerging field.

Keywords: biosensors, microfluidic, point-of-care

Ts Dr Iffah Izzati Zakaria
Malaysia Genome And Vaccine Institute (MGVI)

Mainstreaming Sensors for Healthcare and Medical Applications

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Abstract

Sensors have revolutionised the medical and healthcare systems worldwide. The current biosensor technologies utilise functional and biocompatible materials to create reliable, low-cost, and efficient devices. Biosensors play a vital role in the early diagnosis and screening of diseases. They enable rapid and precise detection of biomarkers associated with various health conditions, including infectious diseases, non-communicable diseases (NCDs), and cancer. By facilitating early detection, biosensors assist healthcare professionals in initiating timely interventions, improving patient outcomes, and reducing healthcare costs. Moreover, biosensors have found applications in point-of-care testing (POCT) market segments. These portable devices provide rapid results and are user-friendly, making them particularly useful in remote areas and resource-limited settings. POCT biosensors enable timely diagnosis and monitoring of diseases, reducing the need for laboratory infrastructure and ensuring prompt patient management. As technology advances, biosensors will likely be integrated with artificial intelligence, machine learning, and the Internet of Things (IoT) to unlock new possibilities in personalised treatment plans. In terms of networking and business development, the public-private partnership (PPP) concept might offer a platform to further strengthen the current biosensor-enabled healthcare systems. In summary, mainstreaming biosensor applications might ultimately offer solutions to an efficient medical healthcare ecosystem.

Keywords: biosensor, healthcare, medical application

Theme 1: Healthcare and Medical
Democratising Sensor Technology In Healthcare

Dr Mohd Hanif Abdul Gaus
MAIA Sdn Bhd

Company Profile

MAIA Sdn Bhd was incorporated on 24 August 2021. Abbreviated from "Medical Artificial Intelligence Augmentation", MAIA Sdn Bhd is a fast-growing AI healthcare startup that delivers state-of-the-art teleradiological solutions powered by artificial intelligence. With the vision to deliver high-tech, high-touch AI healthcare solutions for everyone, MAIA Sdn Bhd is ready to connect the world by augmenting doctors' intelligence, especially in rural areas. The company was founded with the goal to democratise artificial intelligence in the healthcare sector by making it accessible and affordable to everyone. MAIA teleradiology solution includes AI-powered software for x-ray imaging analytics that can accurately detect bone fracture, chest x-ray analysis (TB), and mammography with an image reading speed of up to 3-7 seconds and over 96% of diagnosis accuracy. An intelligent and portable heart rhythm monitoring device, myThrob, has features which include 9-in-1 heart rhythms self-detection, fast detection (< 1 second for 10 seconds ECG) and high accuracy (> 90%). We, hence, provide the perfect solution for rural communities with system upgradeability.

Theme 2: Smart City and Transportation

Enabling Smart Cities through AI-Driven Solutions: A Pilot Project for Sustainable Development in Malaysia

Plenary Session III

Associate Professor Dr Ammar Zakaria
Universiti Malaysia Perlis (UniMAP) & IDERIA Sdn Bhd

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Abstract

The convergence of the Internet of Things (IoT) and artificial intelligence (AI) technologies has paved the way for the realisation of smart cities. As a developing country, Malaysia is actively embracing the smart city concept to foster sustainable societies. Through a collaboration with Selangor Industrial Corporation, a pilot project for smart city deployment is being conducted in Selangor Cyber Valley (SCV), under Sepang Municipal Council, which serves as a model for other cities. This project leverages an AI-driven system built on cloud-edge technology and rides on seamless fibre connectivity. The project's main focus is developing a unified AI platform for various applications such as Smart Surveillance, Smart Flood Monitoring, Prediction and Warning, and Smart Traffic Management. It is the first comprehensive solution to be implemented in Malaysia where AI will generate multi-layer models for flood, environmental, traffic, and surveillance analysis. The primary objective of this solution is not only to forecast and mitigate potential environmental disasters or traffic disruptions, it is also to provide a unified management dashboard that offers valuable insights for local authorities to enhance their management and mitigation efforts. Additionally, the integration of CCTV cameras into the smart city infrastructure serves the purpose of measuring the carbon footprint as well as detecting and addressing issues such as illegal dumping and littering, amongst others. This functionality aims to raise awareness and promote positive environmental impacts within the community. Moreover, our objective is to develop an affordable AI solution that not only benefits Malaysian authorities, but also provides an open platform for collaboration amongst researchers, scientists, academicians, and industry professionals. Through this collaborative effort, we aim to accelerate the implementation of AI technologies and contribute to the realisation of a smarter nation.

Keywords: AI, carbon footprint, surveillance, smart cities, sustainable society

Theme 2: Smart City and Transportation

IoT in Action: How Smart City Observatories Drive Data-Driven Decision-Making

Plenary Session IV

Dr Mazlan Abbas
FAVORIOT Sdn Bhd

Dr Mazlan Abbas
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Abstract

This abstract provides a concise overview of the role of IoT in Smart City Observatories, highlighting its impact on urban planning, infrastructure management, and citizen engagement. The integration of IoT in Smart City Observatories has revolutionised the way cities operate, enabling real-time data collection, analysis, and visualisation from interconnected devices and sensors. The seamless data flow facilitated by IoT empowers city administrators and planners to make informed decisions, optimise resource allocations, and enhance urban services. This abstract also emphasises the importance of addressing challenges such as data privacy, interoperability, scalability, and security to ensure the successful implementation of IoT in Smart City Observatories. The abstract concludes by showcasing successful case studies, such as in Amsterdam, Songdo and Putrajaya, where IoT has been effectively integrated into Smart City Observatories to create sustainable, efficient, and liveable urban environments.

Keywords: IoT, Smart City Observatories, urban planning, resource management, citizen engagement

Theme 3: Agriculture, Environment, and Biodiversity

Unlocking Insights from Sensors: A Comprehensive Update on Low-Cost Air Quality Monitoring in Malaysia

Plenary Session V

Associate Professor Dr Mohd Shahrul Mohd Nadzir
Universiti Kebangsaan Malaysia (UKM)

Mohd Shahrul Mohd Nadzira,*, Muhsin Kolapo Otuyoa, Utbah Rabuana, Sawal Hamid Md Alib, Zaki Khaslana, Haris Hafizal Abd Hamida and Mohd Talib Latifa
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Abstract

Air quality monitoring plays a crucial role in assessing pollution levels, yet traditional gas analyser methods can be expensive to install and maintain. To complement these techniques, low-cost air quality sensors (LAQS) offer a cost-effective solution with higher spatial and temporal data precision. This paper introduces 'AiRSYNC,' a versatile sensor used in smart city initiatives, public transport monitoring, drones, and COVID-19-related studies in Malaysia. We discuss the evolution of AiRSYNC from prototype to commercialisation for measuring ambient air pollutants across various settings, from rural-urban to oil and gas industries. Emphasis is placed on quality control experiments including calibration and validation, prior to field measurements. Our findings highlight the challenges encountered during drone and public transportation measurements compared to fixed ground measurements. The quality control (QC) results demonstrate the AiRSYNC sensor's superior statistical performance and strong correlation coefficients ($0.8 < r < 0.95$) with reference instruments, indicating promising calibration capabilities for improved accuracy. The validation tests reveal consistent measurement patterns during field tests and excellent agreement with reference stations in side-by-side validation tests.

Keywords: LAQS, air pollutants, quality control (QC), Internet of Things (IOT)

Theme 3: Agriculture, Environment, and Biodiversity

Integrated Electrochemical Biosensor System for Plant Disease Management and Food Safety

Plenary Session VI

Dr Nur Azura Mohd Said
Malaysian Agricultural Research and Development Institute (MARDI)

Nur Azura Mohd Said[1]*, Norhafniza Awaludin[1], Hazana Razali[1], Noor Sheryna Jusoh[1], Faridah Salam[1], Kogeethavani Ramachandran[2] and Siti Norsuha Misman[2]
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Abstract

Conventional means for the detection of plant pathogens and agriculture contaminants still rely on plate culturing and instrumentation methods such as liquid or gas chromatography with various detectors. These techniques, albeit sensitive and reliable, are often hampered by their portability, high sampling cost and requirement of technical personnel to perform the analysis. With this regard, biosensor technique offers advantages over the conventional methods, which include rapid and sensitive detection for practical on-site application. Although biosensor application in agriculture and food safety have been extensively explored, they are yet to be deployed on-site. Early detection of disease occurrence and agricultural contaminants will allow intervention and mitigation steps to be taken, hence both damage and yield losses can be minimised. We report here the development of an electrochemical biosensor system employing in-house polyclonal antibodies on functionalised screen-printed carbon electrodes (SPCEs). For on-site application strategy, these immuno-functionalised SPCEs are attached to an Android-based portable electrochemical device. The device is equipped with a 4G connection and Global Positioning System (GPS) features that can pinpoint sampling location. Analysed and collected data are then stored on a central cloud server which is accessible by authorised supervisors for surveillance or monitoring purposes. The miniaturised biosensor system has been successfully tested on rice fields in Tanjong Karang, Selangor and grain corn fields in Chuping, Perlis, to detect rice disease and mycotoxins, respectively. Analysis performed were validated using conventional/instrumentation analysis and showed good correlation. This integrated biosensor system offers a potential application of real-time detection, and the portable reader serves as an excellent tool for point-of-care in routine monitoring.

Keywords: electrochemical biosensor, mycotoxins, rice diseases, point-of-care, portable electrochemical device

Theme 3: Agriculture, Environment, and Biodiversity

NET-PEAT: Networked ASEAN Peatland Forest Communities for Transboundary Haze Alert

Plenary Session VII

Professor Ir Dr Aduwati Sali FASc
Universiti Putra Malaysia (UPM)

Lu Li1,* , Aduwati Sali[1],* , Marsyita Hanafi[1] , Sheriza Mohd Razali[2] , Nurizana Amir Aziz[3] , Imas Sukaesih Sitanggang[4] , Lailan Syaufina[5] , and Ati Dwi Nurhayati[5]

Abstract

The tropical area has a large stretch of peatland, an important ecosystem that is regarded as home by millions of people, plants, and animals. However, the dried-up and degraded peatland becomes extremely easy to burn, and in cases of fire, will further release transboundary haze. In order to protect the peatland, an improved tropical peatland Fire Weather Index (FWI) system is proposed by combining the Ground Water Level (GWL) with the Drought Code (DC). In this paper, LoRa based IoT system for peatland management and detection was deployed in Raja Musa Forest Reserve (RMFR) in Kuala Selangor, Malaysia. The feasibility of data collection by the IoT system was verified by comparing the correlation between data obtained by the IoT system and the data from Malaysian Meteorological Department (METMalaysia). An improved model was proposed to apply the Ground Water Level for Fire Weather Index formulation in Fire Danger Rating System (FDRS). Specifically, DC is formulated using GWL instead of temperature and rain in the existing model. The GWL aggregated from the IoT system predicts the parameter using machine learning based on a neural network. The results show that the DC calculated from the IoT system is highly correlated with the data METMAlaysia released. This shows that DC can be calculated using predicted GWL. The machine learning prediction is essential for tropical peatland Fire Danger Rating System (FDRS). In return, the innovation can be used to help predict and reduce the fire risk of tropical peatlands.

Keywords: IoT, machine learning, peatland forest management, Fire Weather Index (FWI), Drought Code (DC)

Theme 4: Automation, Manufacturing, and Energy

Integration of Sensor Technologies and AI: Unlocking Productivity and Traceability in Malaysia's Industry 4.0

Plenary Session VIII

Dr Syed Muhammad Mamduh Syed Zakaria (CEASTech) Universiti Malaysia Perlis (UniMAP)

Latifah Munirah Kamarudin[1]*, Ammar Zakaria[1] , Syed Muhammad Mamduh Syed Zakaria[1] , Retnam Visvanathan[1] , Noraini Azmi[1] , Xiaoyang Mao[2] and Wan-Young Chung[3]

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Abstract

The Fourth Industrial Revolution, or Industry 4.0, has revolutionised the manufacturing landscape with automation, data-driven strategies, and interconnected systems. This integration of diverse sensor technologies, artificial intelligence (AI), and wireless communication has resulted in improved operational efficiency, product quality, and cost reduction. The Malaysian manufacturing sector, supported by the Malaysian Investment Development Authority, has emerged as an attractive hub for high-value manufacturing and global services in Asia. To maximise its potential, the industry has embraced the transformative power of sensor technology and the Internet of Things (IoT) in smart manufacturing. Despite notable achievements, the manufacturing industry in Malaysia faces challenges in comprehensive production line monitoring and product traceability, often relying on manual and paper-based methods for inventory tracking, leading to inefficiencies. Embracing digitalisation through IoT and sensor technology offers significant opportunities to address these challenges and streamline manufacturing operations. This paper presents real-world implementation of Industry 4.0 solutions at Nihon Superior, Top Glove, and MMHE, showcasing practical experiences and outcomes. By integrating sensors into the production line, manufacturers can monitor and track crucial aspects of the manufacturing process, including raw material utilisation, work-in-progress (WIP), and finished goods. Real-time data captured by sensors seamlessly integrates with the enterprise resource planning (ERP) system, enabling real-time visibility and enhanced traceability. The purpose of this paper is to raise awareness amongst Malaysian manufacturing businesses about the transformative potential of digitalisation, IoT, and sensor integration. By embracing smart manufacturing practices, manufacturers in Malaysia can streamline operations, enhance productivity, and improve global competitiveness. The integration of sensor technology represents a significant milestone in shaping the future of manufacturing in Malaysia, empowering the industry to unlock its full potential.

Keywords: smart manufacturing, digitalisation, iot, sensor, artificial intelligence (AI)

Theme 4: Automation, Manufacturing, and Energy
Advancements in Self-Powered Sensors: Towards AI Integration and Antenna Design for RFID

Plenary Session IX

Professor Dr Lim Eng Hock FASc
Universiti Tuanku Abdul Rahman (UTAR)

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Abstract

Wearable sensors have made significant strides in soft robotics, health-monitoring, and human-machine interaction (HMI). However, integrating these sensors with power-intensive artificial intelligence (AI) algorithms raises concerns about battery drain. This presentation delves into the development of battery-free sensors and actuators. The central focus lies on wireless power transfer, demonstrating successful near-field activation of soft polymer actuators for drug delivery and far-field powering of electrocardiogram (ECG) outputs beyond one meter. Additionally, sensors leveraging triboelectric and ionic movement convert mechanical motion into electrical signals, functioning as strain and pressure sensors. These can be coupled with AI algorithms to detect neck muscle movement precisely. Moreover, the talk highlights the integration of RFID technology with self-powered sensors, emphasising advancements in antenna design. With its wireless identification and tracking capabilities, RFID synergises with self-powered sensors. Efficient antenna design enables optimised power transfer, extending the operational range and enhancing RFID performance. By leveraging self-powered sensors and integrating RFID with optimised antenna design, enhanced portability and autonomy are achieved. This presentation sheds light on recent advances in self-powered sensors, focusing on AI integration and antenna design for RFID applications. These advancements pave the way for more efficient and intelligent sensing systems in diverse domains.

Keywords: antenna design, self-powered sensors, wearable sensors

Forum

Sensor Technology in Malaysia : Leveraging Strengths, Addressing Weaknesses and Charting a Dynamic and Competitive Course

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