

THIS year saw some amazing scientific breakthroughs come to light that could change the course of how we live, treat the planet and perceive our existence.

From massive planetary developments to small DNA and genome-based research, the advances celebrate the amazing lengths that science and research has taken human understanding and capabilities.

In terms of the Internet, Google announced that its new artificial intelligence speaks and models language as well as comprehends intricate dialogue.

In practice, its uses include helping users solve computer-related problems but it represents a significant step forward in artificial intelligence in terms of contextualising scenarios.

In the realm of space, NASA in April told the world that its rover Curiosity found water on Mars, contradicting previous assumptions that the Red Planet was too cold and dry for the existence of liquid H₂O.

Here on Earth, researchers at Duke University in Durham, North Carolina, have grown human skeletal muscle that responds to external stimuli, contracting the way typical tissue in the body does.

This discovery will enable drug testing without scientists having to make painful muscle biopsies from human subjects.

As exciting and mind-blowing these discoveries are and the thousands such as it, research and the pursuit of scientific excellence is often an arduous journey fraught with disappointments, competition and bureaucracy.

Therefore, it is a unique breed of people that continue to muster the courage and dogged determination to create breakthroughs that so many of us enjoy and benefit from.

"Our desire and curiosity has driven humanity forward. We continue our march equipped with the desire to improve our knowledge and help humanity," says Dr Ivan K. S. Yap, senior lecturer at the International Medical University (IMU).

Prof Andy Chan, associate dean (Research and Knowledge Transfer) at The University of Nottingham Malaysia Campus, agrees: "In general terms, the theme for research in the university is about world-changing research, with real positive impact it brings to the benefit of humankind, society and the country. For this, our aerospace

Refining human lives



It is crucial that science and technology research addresses local problems without ignoring collaborations further afield.

research shows what we are best at, undertaking and delivering research at the highest level that changes the world for the better."

Locals contributing locally

As much as research universities work towards having worldwide impact, it is crucial too that they look at handling problems locally as well as developing ideas and solutions for native consumption.

"We are working to develop research and technological capabilities for the aerospace industry in Malaysia, in particular addressing the aerospace needs of the country, such as aerospace manufacturing processes, aerospace manufacturing automation, composite materials processing and manufacturing and composite materials recycling," says Prof Chan.

Another local project is being undertaken by a team at Curtin University Sarawak Malaysia, which is working on technology related to the rapid detection and removal of disease-causing pathogens from food, soil, human

samples and water bodies.

"Curtin University Sarawak prides itself in making substantial contributions to meet the socioeconomic needs of local communities, and this project creates the opportunity to control disease transmission through the use of smart biosensors for rapid pathogen detection and screening to support community healthcare efforts," says Prof Michael K. Danquah, the principal supervisor at the Chemical Engineering Department in Curtin University Sarawak Malaysia.

The work carried out by Dr Roseline Yap Wai Kuan, senior lecturer at the School of Biosciences in Taylor's University, is yet another example of research being carried out for the benefit of the local community.

Her team is working on nutrigenetics, which identifies specific foods or nutrients that affect an organism's genetic susceptibility to diseases.

Dr Roseline's research focused on the interaction between two factors – genetic variation and dietary pattern – on the effects of metabolic risk factors associated with diet-related chronic non-communicable diseases in the multi-ethnic Malaysian population.

For Sunway University's Assoc Prof Dr Yau Kok Lim's research, the applications are not just local, but address a future problem linked to the country's growth and development.

"Cognitive radio will be indispensable for the future of sustainable telecommunication growth in the southern part of the peninsula, where, due to geographical proximity, the entire radio spectrum is shared between Malaysia, Singapore and Indonesia.

"With the rapid development of the Iskandar Development Region, it is especially urgent to alleviate the increasing stress on the limited and scarce radio spectrum resources," says Assoc Prof Yau.

The research – Applied Artificial Intelligence in Cognitive Radio Network – aims to overcome the issue of radio spectrum scarcity in the country.

The traditional radio spectrum allocation policy has assigned most frequency bands to licensed users such as TV and radio stations, and a significantly smaller number of frequency bands to unlicensed users such as Wi-Fi and Bluetooth.

With the increasing demand for mobile and ubiquitous connectivity, the unlicensed bands have become crowded.

This research embeds artificial intelligence in cognitive radio networks so that each unlicensed user can sense and be aware of "white spaces" (or the under-utilised licensed frequency bands) in the spectrum, learn, and access the white spaces.

Many minds make sense

Collaborations with both local and foreign institutes help research by providing access to funding and facilities as well as help the research gain depth and breadth.

It is hard to divide research into just one discipline or classification and therefore many minds are often necessary for thorough and well-executed projects.

The team at Asia e University (AeU), led by Prof Dr Syed Malek Fakar Duani Syed Mustafa and supported by Prof Dr Roshayu Mohamad, collaborates with Mimos (where they are working with Dr Chew Yew Chong, Nagendran Perumal and six system developers) on an intelligent knowledge flow monitor system that will be able to, among other things, function as a knowledge-sharing platform, in which the composition of the modules are customisable and they function in a service-orientated manner.

Mimos is Malaysia's national research and development centre in information and

communications technology under purview of the Malaysian Ministry of Science, Technology and Innovation.

The research would enable knowledge-sharing activities as well as generate and regenerate knowledge products in various forms – sharing resources, mind-mapping, web browsing and navigation path, video viewing and uploading and document categorisation.

On the other hand, the work being carried out on pathogens and food by doctoral candidate Caleb Acquah and Prof Danquah at Curtin University Sarawak Malaysia includes collaborations with both local and foreign universities, bringing a global set of expertise to the table.

They are working with Dr Charles K. S. Moy of the civil engineering department at Jiaotong-Liverpool University in China who specialises in studying material properties; Dr Amandeep Sidhu, a senior researcher with Curtin Sarawak Research Institute who specialises in bioinformatics; and Dr Clarence M. Ongkudon at the Bioresearch Institute of Universiti of Malaysia, Sabah, who is an expert in bioaffinity processes.

"The main goal of this research is to develop a biosensor that has a rapid detection ability with high sensitivity and specificity. The biosensor is chiefly being developed through the use of a synthetic single strand DNA known as aptamers coupled on macroporous monoliths. The chosen target being used as a proof-of-concept is *Escherichia coli*," says Acquah.

Dr Roseline's research in nutrigenetics has also brought about international collaborations.

"My co-researchers include Prof Yoshihiro Shidoji from the Graduate School of Health Science, University of Nagasaki, Japan, who specialises in the field of Biochemistry, and Yap Wai Sum, from the Faculty of Applied Sciences, UCSI University, Malaysia, who is working in the biotechnology field," she says.

Collaborations with companies bring another element of strength and global flavour to research as proved by UNMC's Asia Aerospace City Research and Technology Centre – a collaboration between Aerospace Malaysia Innovation Centre (AMIC) and the university.

"Among the projects being carried out are robotics for composites, development of biojet fuels by micro- and macro-algae, recycling of carbon fibres, development of immersive virtuality training system for aerospace maintenance work and development of scalable fixtures for turbine blades," says Prof Chan.

Currently, the projects are sponsored by Rolls-Royce, Airbus and Strand Aerospace Malaysia, no doubt highlighting the projects under the centre to a global audience.

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Future research

THE implications of these global events will be critical areas for postgraduate study in the coming decade:

- Rising population in the developing world and the implications it brings in terms of urbanisation and overcrowding
- Increasing occurrence of severe weather events
- Increasing water stress – An estimated four to five billion people in the world suffer from strained access to clean water, with the Middle East in particular likely to be a hotspot for struggles around water supply
- Migration – The events of war, climate change and

economic conditions is leading to mass migration of people

- Healthcare – From the spread of infectious diseases to genome understanding to coping with new pandemics and epidemics
- Cybersecurity – Data fraud/theft and cyber attacks
- Climate change – Implications brought on by the failure to adapt resolutions
- Biodiversity loss and ecosystem collapse
- Systems and data management of a global population increasingly going digital
- Food security