MONASH University

MALAYSIA

SYNC

Healthcare in Engineering

ISSUE 5, AUGUST 2020

Letter from the Editor

A hearty welcome to the readers of SYNC, the biannual newsletter brought to you to communicate research happenings at the School of Engineering of Monash University Malaysia (MUM). In this fifth instalment, we bring you a theme closely related to the global issue that has been plaguing us since the beginning of 2020, "Healthcare and Engineering".

In this issue, we talk about medical-related research, incorporating engineering principles into healthcare problems. A couple of research touches on the issue of COVID-19 and we are very proud to feature researchers that are working to combat this problem. We also have some updates regarding education in MUM and what we should expect in the future. In these uncertain times, it is important to plan ahead and most importantly, to take care of ourselves.

We have many gems in this issue and we hope there is something of interest for everyone. Many thanks for your continuous support, especially to our contributors for their time and effort. We welcome feedback and suggestions via email at mum.soe.aec@monash.edu. For those of you interested to join our team, please do not hesitate to contact us via the email below. Remember everyone, avoid the 3Cs - Crowded places, Confined spaces and Close conversations and practice the 3Ws - Wash, Wear and Warn. We would like to extend our deep appreciation to all the frontliners and heroes out there who are fighting to keep us safe and sound. Let us all do our parts and together, we can keep the virus at bay.

Let us SYNC - Say Yes 'N' Collaborate
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Feedback and Suggestions

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Insights
Biomedical Engineering

Prof. Lan Boon Leong
Head of Discipline (ECSE)
School of Engineering

Biomedical engineering is a multidisciplinary field. Biomedical engineers apply principles from various engineering disciplines and the physical sciences, and increasingly artificial intelligence, to create medical technologies to improve health and even save lives. Biomedical engineers are also developing methods to make sense of digital health data, which are collected using smart devices and wearable sensors, to provide patient care at home.

To make a real impact on healthcare, biomedical engineers need to work synergistically with medical doctors, where the doctors propose unmet needs for the engineers to develop solutions. One way to facilitate this synergistic collaboration is through close partnerships between a university and local hospitals.

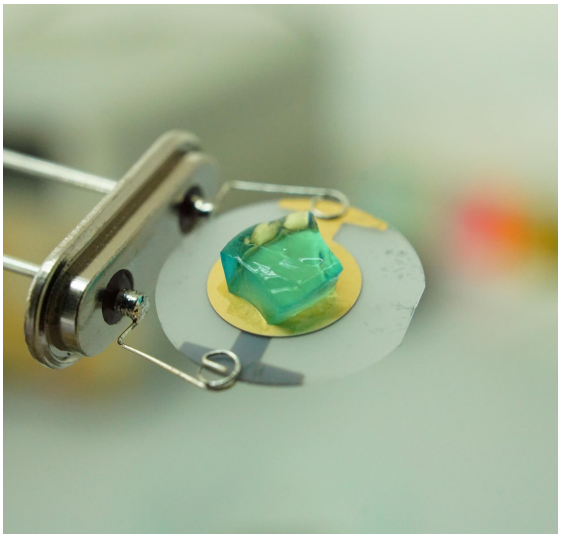
At Monash University Malaysia, we have a Smart Health Cluster, which I lead, in the Advanced Engineering Platform. In the last two years, we have obtained funding from Sunway Medical Centre to work on two projects, which the Cluster has also co-funded.

The first project was initiated by a neurosurgeon and led by Dr Ooi Ean Hin (Mechanical). Using a laboratory model of the cranium and intracranial system placed in a pressure chamber, the team studied whether air travel is safe for a patient with an air cavity in the brain after surgery. The results will be published in the journal Scientific Reports soon. For the second project, which was initiated by a radiologist and led by Dr Maxine Tan (ECSE), the team is developing a method based on AI to automatically detect small metastatic tumours, which could be numerous, in brain MRI images.

These are baby steps for the Cluster. The next step, which is rather challenging, is to forge a long term partnership with not only Sunway Medical Centre, using the co-funding model, but also with other local hospitals. But if we succeed, we can improve healthcare together.

Bioprocess Engineering

-Kang Kai Dean



The fight against coronavirus disease 2019 (COVID-19) is a major undertaking that requires hard work and collaboration between numerous parties. In 2018, Associate Prof. Ooi Chien Wei and his team received a Gold Award at the International Invention, Innovation and Technology Exhibition (ITEX) for developing a biosensor that can diagnose diseases in a simpler manner. In this interview, we ask A/P Ooi to share his research experience as a bioprocess engineer and how they can play a role to fight against a virus that has infected more than 23 million people and caused the death of more than 800,000 worldwide.

What is bioprocess engineering?
Bioprocess engineering, also known as biochemical engineering, is a branch of chemical engineering, which emphasises on the manufacturing of products derived from living organisms and the design of related processes and equipment. Most of the time, it involves mass production and scaling up of bioprocesses for commercialisation.

Some common applications are recombinant DNA-based products, protein, and the production of therapeutic products (pharmaceuticals). An example of therapeutic products is antibodies, and the manufacture of this product still relies on proteins generated from living organisms due to the non-feasibility of chemical synthesis.

How did the project materialise?
Biosensor project is a multidisciplinary research work that gathers expertise from various disciplines. At first, my team and I were involved in the design of a responsive hydrogel (carrier) to detect the antibody/antigen together with Prof. Tey Beng Ti (Chemical Engineering). The mechanism for the detection depended on the hydrogel swelling triggered by the disruption of an affinity bond. Due to the minimal swelling degree, the conventional gravitational meter cannot be used to detect the extent of swelling of the hydrogel.

Therefore, experts from ECSE stepped in to solve the problem with a Quartz Crystal Microbalance (QCM). This device converts biological interaction which is indicated by mass change into the quantifiable signal (i.e., electrical current). Moreover, the collaboration also involved an academic from University Putra Malaysia (UPM) for the supply of material (i.e., the Hepatitis B virus as a model protein) as well as the antibody production that required animal facilities.

After ITEX 2018, what were the after-effects and what are the intended future plans?
Following the competition, the project is proven to be theoretically viable by the panel. My team and I also received constructive feedback on the application of the project. Indeed, the biosensor project is still in the process of fine-tuning. We are aiming to make the biosensor portable. However, miniaturising of the biosensor requires a lot of trials and testing. Currently, we are at the 2nd phase of the research, whereby we attempt to eliminate the use of antibodies for biosensing.

We performed an economic analysis as some of the comments were focused on the commercialisation aspect of the sensor. As a result, we discovered that the product would face intense competition among other existing products in the market, partly due to the perspective of people about the price and reliability of the product on resources.

What is the impact of the research project on society?
During the outbreak of COVID-19, the demand for equipment such as reverse transcription-polymerase chain reaction (RT-PCR) machines escalated quickly. The Malaysian government approached Monash University Malaysia (MUM) to enlist MUM as a centre for COVID-19 sample testing, but it was turned down. The problem faced is the limitation of equipment and resources. Reliance and dependence on nonmobile technology was high, which restricts how fast the demand can be satisfied.

Many biosensors with different working principles have been launched in the market, whereby each of them has its limitations. From here, my team and I have foreseen the potential of a portable biosensor such as walk-in biosensors, especially during this critical time. While the portable biosensor offers fast/real-time detection, the accuracy of the biosensing results needs to be juggled as well.

Though we had been working on a biosensor for Hepatitis B, we received an invitation for collaboration from Dr. Sunil Kumar from the School of Science for COVID-19 related research. The collaborative work involves the production of antigens that will trigger the immune response, which can be made as the element of the biosensor in the later stage of biosensing development. Once the biosensing platform is established, this can be quickly adapted to the detection of other viruses/diseases.

Advice to GRS
Students must take care of themselves and have a balanced lifestyle; Don't overstress and make things harder for you and your project.

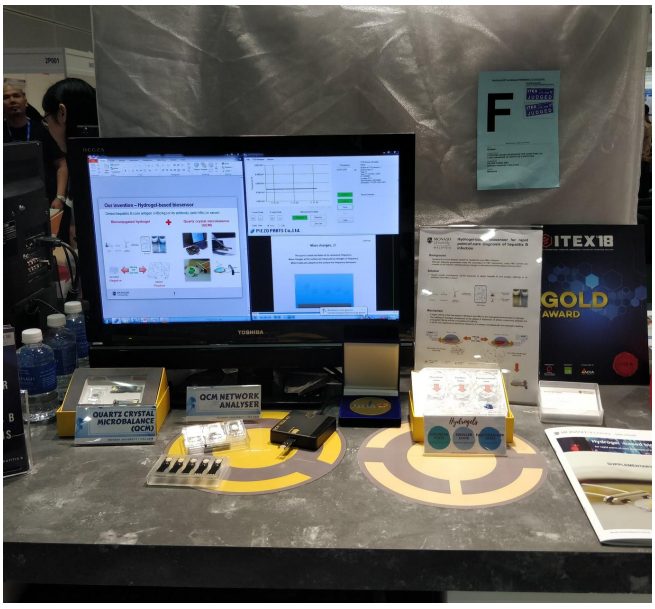
"Mental Health will determine how far you go and not how high you achieve." - A/P Ooi

What are some of the challenges you've faced and how do you overcome them?
Science indeed solves many problems; however, the developed product needs to fulfil the concerns of the market. If the product does not meet customer expectations, they can get forfeited. My team and I are torn between the commercialisation of the product or improving the current work. We eventually decided on fabricating a next-gen prototype to make a comeback.

When faced with a problem, it is important to talk to people and ask for help when things are beyond our expertise, especially in this multidisciplinary project. Different collaborators will always brainstorm and reflect on the improvements that can still be made for respective parts. Though the improvements are minor, the cumulative effort can lead to a whole new outcome.

How do you think the current pandemic affects future research?
The impact on future research can be observed in three different time frames; short, medium and long term. In the short run, a new norm has been implemented, whereby researchers have to adapt in terms of working in the lab and students/supervisor interactions. Another foreseeable impact is the lag on research projects for at least 1 to 2 years.

As for the medium-term effects, researchers will need to deal with shrinking fundings and they need to be more versatile in finding opportunities. In the long-term, the pandemic allows researchers to reflect on how to align our research to real-world problems better. I think research is indispensable to solve problems, hence it will still prevail.



For information on other ITEX 2018 winners, click here, https://bit.ly/3dSKL64
For ITEX 2019 winners, click here, https://bit.ly/2YSmqJi

Frontliner Appreciation

In this section we feature some of our Monash alumni who are working to keep us all safe. Read their thoughts here.

DR CHIA HAN SHENG (CLASS OF 2012)
DR CYNTHIA SANDANAMSAMY (CLASS OF 2015)
DR VICTORIA TAN PHOOI KHEI (CLASS OF 2016)
DR KUGNETHRAN PARMUSUAN (CLASS OF 2017)
Emergency and Trauma Department - Queen Elizabeth Hospital I, Sabah

"As medical and house officers, we shoulder the responsibility to quickly triage, assess and resuscitate patients from all walks of life, in various forms of crisis and suffering. Every second in the department is full of adrenaline, as we can encounter something as mundane as a sore throat, to a full-blown heart attack with respiratory failure. Without effective teamwork between the other healthcare staff and us, we would surely be overwhelmed by the sheer volume of cases we have to attend to!"

SHAFIQ KASSIM & FRIENDS
Monash Alumnus (Class of 2012)Volunteer - Food Distribution & Aid, Kampung Tunku

"A big takeaway for me from this was that we should always have our eyes and hearts open for those needing our help."

DR HEMA JOHNSON
Monash Alumna (Class of 2016)
SARI/PUI Ward - Hospital Sultan Ismail, Johor Bahru

"Most days, we are short of the three-layer PPE (the Astronaut looking one). If you have that, you just need to do one to two layers maximum. However, some days, we make do with a modified version. You can see from the picture with my name on it. There are two thick layers underneath with five aprons on top."

"My hope is to be able to see my wife and children soon (they live in another state). I also pray for Malaysia to get back on its feet quickly, and for us to remain hopeful for a better future in these difficult times."

DR NICHOLAS HEE
Monash Alumnus (Class of 2012)
Internal Medicine Gazetting Specialist - Hospital Enche Besar Hajjah Kalsom, Kluang

DR ABDULLAH MUHAIMIN
Monash Alumnus (Class of 2014)
Emergency and Trauma Unit - Hospital Tawau, Sabah

"In my free time, my wife and I will go to the Infection Control Unit to help make Personal Protective Equipment (PPE). Both of us are not professional tailors, but we try to catch up with our nurses when sewing. We make hoods, boot covers and many more to ensure that our hospital's supplies are sustained. A pandemic is a war fought for a long period; thus, ensuring adequate protection for our medical fraternities is of utmost importance."

CHLOE SIAW
Monash Alumna (Class of 2014)
Emergency Registrar - Austin Hospital, Melbourne

"COVID-19 is a lonely disease for patients battling this infection at home or in hospital. In my personal clinical experience, it is hard to see them fight this disease alone without any loved ones present for fear of disease transmission. There is a lot of anxiety, loneliness and uncertainties in the community during challenging times like this."

Read more frontliner stories here, https://www.monash.edu.my/news-and-events/trending

Research Focus

This section highlights the research that a few of our academic staff from the School of Engineering are working on that are leaving an impact on the healthcare sector.

- Khanisya Palaniandy

Research Focus
We have international collaborators from New Zealand, Belgium, Germany, and Hungary in developing model-based methods to improve mechanical ventilation (MV) treatment for respiratory failure patients. MV treatment which is the primary treatment for these patients until they recover from their underlying disease is difficult to set as the patient's disease state and response to treatment are variable. In addition, sub-optimal MV treatment may further harm the patients, delay in recovery, and cause prolong MV dependency, repeating the cycle. Our research potentially provides a unique solution to improve the overall MV treatment.

Source of inspiration
Patients with a severe form of respiratory failure are associated with poor patient outcome and high mortality rate of up to 60%. MV treatment is also expensive, with an estimated additional cost of USD1,500 per patient per day. In addition, there is limited MV research, and the research is gradual and laborious. Thus, research to better manage MV treatment potentially offers a significant return on social and economic costs.

Importance of collaboration between healthcare and engineering
Engineering solutions are focused, specific, and objective-based, which can be helpful in solving complex healthcare problems. During the pandemic, it is enlightening to see people working together to solve specific healthcare problems. For example, proposing simple ventilator design and circuits to increase ventilator capacity, preparing affordable PPEs, creating sanitizers, innovative designs to help reduce contacts, using telecommunications for contact tracing, and even simulations for modelling and predicting virus spread.

Dr Chiew Yeong Shiong, Mechanical Engineering

"I believe healthcare engineering will be a part of people's lives more so than ever"

Do you think the current pandemic affects the view on healthcare engineering?
I think the current pandemic shows people the importance of healthcare engineering and how everyone can contribute equally. It is not just a unique engineering field that involves multidisciplinary practices, but it also requires significant human and financial resources to maintain balanced healthcare. Malaysia was ranked 1st for the healthcare category in the 2019 International Living Annual Global Retirement Index, citing accessible and affordable healthcare. In the same year, the Malaysian Government allocated RM29 billion for the healthcare sub-sector (Near 10% of a RM316 billion total budget, and 8% of the total GDP). Thus, for Malaysia (or any country) to sustain their healthcare model, significant work is required in healthcare engineering.

Dr Maxine Tan
Electrical and Computer Science Engineering

Research Focus
Developing computer programs/ methods to help doctors detect or diagnose diseases in medical images. My work helps to address a key question in cancer research, namely early detection of cancers in medical images.

Source of inspiration
To do something that benefits the society.

Importance of collaboration between healthcare and engineering
Although engineering and artificial intelligence (AI) is currently used in other fields, such as natural language processing (i.e., language translation) and reinforcement learning (including self-driving cars), there is a great need and potential for its study and development in the field of healthcare. For example, studies show that doctors (i.e., radiologists) frequently disagree with one another in making diagnoses, e.g., detecting lung cancer locations in computed tomography (CT) scans. In contrast, the engineering and AI-based methods are completely objective, not subject to human error or fatigue, and preliminary studies show that they outperform the state-of-the-art in lung cancer detection/ diagnosis.

Dr Chan Ping Yi
Mechatronics Engineering

Research Focus
We work mainly on a system that measures tremor of Parkinson's disease. The algorithm quantifies tremor in multiple-degrees-of-freedom motions of hand-arm. The system allows a more objective quantification by considering the coupled motions, which is found naturally in human joint. Initial study shows that the system has high test-retest reliability as compared to clinical rating. Though further studies are still required, it has shown that the system can complement the standard clinical rating by providing the displacement of joint motions. Currently, we are working on differentiating Parkinson's disease tremors that have amplitude as low as normal tremor by using artificial intelligence. Another team also works on devices that control severe tremor of the Parkinson's disease. The challenge is to bring these technologies to practical products that can benefit patients and doctors. I welcome anyone interested in the projects to join our research team.

Source of inspiration
In general hospitals, particularly, the doctors have very hectic working conditions. Given limited time, they have to provide professional assessment and diagnosis to a large number of patients. This motivated us to come up with tremor measurement system that can be used by nurses while maintaining the required standard to assess the severity of the tremor. The objectivity of the system potentially reduces the problem arises when the tremor is assessed by different doctors.

Importance of collaboration between healthcare and engineering
Thanks to the feedback by the doctors, we have understood the need of certain technologies such as tremor differentiation algorithm to overcome their difficulty in practising medicine. This indicates the importance of having such multidisciplinary interaction in healthcare advancement. With the collaboration, the problem solved in engineering has a direct impact on the society and technology that is more likely to be adopted.

Do you think the current pandemic affects the view on healthcare engineering?
In my opinion, a slight shift in the focus to healthcare-related engineering problems, especially those related to the pandemic, is observed. It is viewed as a more urgent research area because of the situation. The importance of existing studies and technologies that support the healthcare has been reconfirmed.

Research Focus
Instrumentation, machine learning and rehabilitation engineering. At the moment, my current research focuses on the prospects of using wearable devices and internet of things (IoT) framework for use in rehabilitation and physical conditioning with the aim of monitoring and quantifying progress through useful user interaction. I also delve into the possible prevention and early detection of common physical injuries using innovative exoskeleton designs with the integration of machine learning techniques.

Source of inspiration
This research area has always been a source of motivation for me. Working at understanding the human body and its anatomy has never stopped to awe and amaze me. In my research, we (the research team) usually work at understanding underlying causes of injuries and then figuring out the best way of measuring, estimating and quantifying a certain motion or movement. This process has never ceased to intrigue me. A similar principle is used when we work on monitoring rehabilitation process.

Dr Alpha Agape Gopalai
Mechatronics Engineering

Importance of collaboration between healthcare and engineering
All technological solutions/advancements made in healthcare requires an engineering team at its core. Healthcare and engineering are inseparable if we are looking to make breakthroughs in healthcare. Engineers, on the other hand, do not have a very anatomical thinking and would need healthcare professionals to ensure solutions are on the right track (and useable!).

"Someone once said to me before, healthcare and engineering is a marriage made in heaven"

Do you think the current pandemic affects the view on healthcare engineering?
No, it only reinforces it. For example, in the wake of COVID-19, new norm is being formed - changing the way we interact and communicate with each other. All this is done to ensure that we practice a new standard of personal hygiene. However, there are some aspects of our lives where these new standards of social distancing and usage of face masks may become a hindrance or just not feasible. One such area would be rehabilitation and physiotherapy. Rehabilitation has always been a field which requires practitioners and patients to be in proximity and in physical contact. This puts both parties at risk. However, with strong collaboration between healthcare and engineering - self-rehabilitation devices and technologies can ensure rehabilitation outcome is not sacrificed while ensuring adequate measures are taken to keep both patients and practitioners safe.

Research Focus
To describe and to understand complex medical engineering problems related to the human body through mathematical and computational modelling strategy. At present, my focus is on the development of mechanistic models to simulate and to study the tissue biophysical response during radiofrequency ablation (RFA) treatment of liver cancer. This is aimed at understanding how best to enlarge the size of the thermal coagulation zone during RFA. My research group is also exploring alternative cost-effective techniques for cancer treatment, to enable cancer treatment more accessible and affordable to the general population.

Source of inspiration
The ability to assist doctors and clinicians at understanding and addressing medical problems from a different point of view; one that is based on the fundamental principles of Engineering. Hence, my research has provided me with the chance to apply what I have learnt onto something to which I can relate to personally and academically.

"I have always been fascinated by how human body works in spite of my background in Mechanical Engineering"

Dr Ooi Ean Hin
Mechanical Engineering

Importance of collaboration between healthcare and engineering
With the work that I do, I believe that the importance lies in the ability to utilize fundamental engineering principles to describe and understand the very complicated biophysical processes that take place inside the human body. The human body is sufficiently complex, with significant variability among patients in terms of anatomy and physiology. Moreover, a lot of the problems in healthcare cannot be tested and observed in a manner that is similar to that of engineering problems. As such, if we are able to help doctors explain some of these medical problems, even if it is at the fundamental level, this I believe can be a first step towards advancing healthcare.

Do you think the current pandemic affects the view on healthcare engineering?
Engineering has always played an important role in healthcare and the current pandemic has only helped to reinforce this view. For instance, researchers have used computational fluid dynamics to investigate the movement of droplets in the air to better understand how the disease spreads. We have also seen how 3D printers were used to address the shortages in PPE among frontline workers.

Research Focus
Application of engineering principles and technology to measure, evaluate and assist human motion. It includes the use of the optical motion capture system, wearable sensors, and several computing methods to investigate the biomechanical behaviour of the limbs in performing a specific activity and to design various rehabilitative and assistive devices.

Dr Darwin Gouwanda
Mechanical Engineering

Source of inspiration
From an engineering perspective, human body is complex. Even a simple motion, such as picking and placing an item from one place to another, requires the full coordination of human neuromusculoskeletal system and the proprioception. Despite the great advancement in biomedical engineering and science in recent decades, there are still plenty of unknowns in this field and so, yes, it is a very interesting and exciting area to explore.

Importance of collaboration between healthcare and engineering
Medical practitioners and even general public would require engineering expertise and skills to design and develop medical devices and technologies. Vice versa, engineers would also need medical practitioners' knowledge to build human-centric and clinically relevant tools. In this current pandemic, we have seen famous engineering companies such as Airbus and Rolls-Royce working together to manufacture ventilators. Various businesses, universities, and NGOs also used their 3D printing facilities to print Charlotte valves and face shields. With the help of their medical partners, some engineers used their knowledge and expertise to create computing tools that can simulate the spread of virus in the community. In addition, recently, Japanese and Singaporean teams used sophisticated tools to investigate typical sneeze speed and the droplet spread in a room to get a better idea of the possible spread of the virus in a confined space.

Do you think the current pandemic affects the view on healthcare engineering?
Yes, that's for sure. Driven by the demand for a better general health and wellbeing, more practical engineering solutions will emerge in the near future, such as automatic sanitizer dispenser, thermal scanner, face shield, etc. The popularly known 3D printed Charlotte valve is an affordable and innovative solution that addresses the global shortage of ventilators for the COVID-19 patients, which has the potential to be widely adopted by many medical institutions, especially in the poor and developing countries. This pandemic will indeed accelerate research in healthcare engineering, and the development of practical and inexpensive medical devices.

Dr Patrick Tang Siah Ying
Chemical Engineering

"Collaboration breeds innovation. Creative innovation evolves around mutual openness, respect, and concerns for the needs of others"

Research Focus
Nanodrug delivery and polymer engineering. Particularly, innovative technological platforms based on nanoemulsions and ultrasound cavitation for encapsulation and controlled delivery of herbal bioactive compounds with improved bioavailability and safety. On polymer side, development of new self-healing rubber and polymeric nanocapsules with tunable properties for functional glove and cosmeceutical formulation applications.

Source of inspiration
My biggest motivation is the sense that this research matters and that it should progress for the sake of the advancement of healthcare technology. There is nothing else which can be a bigger achievement for myself than contributing to the pool of healthcare-relevant knowledge on the basis of what alternative yet safer nanocarrier carrying life-saving drugs can be designed for enhanced therapeutic efficacy with better patient compliance. For me, nanomedicine is as an intriguing journey of curiosity and creativity where you can live your passion. Contributing to human health is indeed a sublime mission. The idea of improving medication delivery and helping people heal drives me forward.

Importance of collaboration between healthcare and engineering
In the rapidly developing field nanomedicine, engineers routinely build and construct a versatile range of intelligent multifunctional nanoparticles and sophisticated miniatured medical devices for simplifying the cancer diagnosis and treating the life-threatening diseases more efficiently. These ground-breaking inventions are possible only through the contributions of multidisciplinary teams of healthcare and engineering. Many collaborations indeed lie physicians' desire to offer new, safer and affordable therapy options to their patients and engineers' passion for applying their knowledge and creativity to solve medical problems. It is therefore of paramount important for new, effective and scalable approach is developed to bring people from medical and engineering worlds to work hand-in-hand as one team to solve future healthcare challenges.

Do you think the current pandemic affects the view on healthcare engineering?
Yes. With the massively increased demand for ventilators, medical gloves, face shields, masks and other equipment in a shortage situation, we have seen the vital role that healthcare engineering plays in patient care and protection. Many people working in chemical/nano/bio/medical engineering have responded to the current pandemic by adapting their areas of expertise to do what they can to help fight COVID-19. This pandemic has helped to highlight the unseen healthcare engineering professions and demonstrate the positive impact that healthcare technology in particular can have on people's lives.

Dr Surya Girinatha Nurzaman,
Mechanical Engineering

Research Focus
I mainly work on soft robotics. I investigate the use of soft and flexible materials in robotic systems, with the expectation to realize systems that are safer, cheaper and more adaptable than the level that the conventional rigid-material robots can achieve.

Source of inspiration
Through the development of robots made of soft materials, we can have intelligent robots beyond the current technological advances in terms of flexibility, adaptability, safety and energy efficiency, which is also important for healthcare.

importance of collaboration between healthcare and engineering
Engineering can provide a solution for real-world problems faced in healthcare sector.

Paving the Future of Education

- Yasmin Zaifullizan

With the ongoing COVID-19 pandemic, the education sector is heavily impacted. Currently, we see a dramatic shift in the way we learn. We ask Prof. Rajendran Parthiban who has been serving as Deputy Head of School (Education) of SOE for more than ten years on his views of education amidst the lockdown in Monash University Malaysia.

"Challenges bring out the best in people. COVID-19 is not just a challenge, but an experience to contemplate and cherish in future. If you can make it out of this, you can make it out of anything. Stay positive, stay safe, and focus on things you can control rather than things you cannot control."

What are the changes we will witness in terms of the student learning experience?

MUM had already started the transition from the traditional one-way learning to more interactive style workshops, even before the Movement Control Order (MCO). For example, workshops incorporate audience response tools such as **Flux, Kahoot** etc. to capture student attention and increase engagement. Some learning spaces have been redesigned to facilitate this engagement.

During the MCO, Monash focused on providing a ***'Virtual Classroom'*** environment rather than an *'Online Learning'* session. For example, Zoom has many features to reproduce the real classroom environment, albeit virtually. Student-lecturer interactions are made more accessible through features such as "yes"/"no" responses, polls, "go slower"/"go faster" etc. Lecture recordings were used to deliver typical didactic content before the interactive sessions. COVID-19 has encouraged lecturers, who were reluctant earlier, to experiment with these types of features.

With regards to assessments, COVID-19 has encouraged the design of *open book* format assessments. Some of these are *'take-home exams'* ranging between 6hrs - 24hrs. These exams allow more challenging questions to be designed since the time limit is extended.

The most difficult features to convert online are the hands-on activities of courseworks. At the moment, we have converted the laboratory assessments of almost 75% units to *computer simulations*, but students still prefer the value of hands-on experiments. Incorporating Virtual Reality (VR) technologies in future activities may provide immersive experience, while giving students chances to make mistakes and learn through trial and error.

What are some of the drawbacks that come with these new advances?

Resistance comes with change, but we need to bear in mind that this is a work-in-progress as we continuously revise and improve the experience. Some students and lecturers were slow to make the jump to virtual learning. However as time went by, it has become more acceptable. We need to have open minds and be clear on the expectations of both parties to facilitate this transition. Effective communication is the key to making this work.

From the students' perspectives, there are a few issues that require attention. For virtual classroom experience to work in the future and in a long term, students must have:

1. The ability to work remotely
2. Proper workspace
3. Serious time management skills, and
4. The ability to balance online, on-campus and social aspects of their lives

The University and the School are working hard to provide support to both staff and students to create a conducive learning environment. We hope to see improvements in these aspects for Semester 2 2020.

Other than taking care of their material needs, are there measures taken to ensure the psychological well-being of students? Especially for those who are far away from family.

The University recognises the struggles that come with isolation and lockdown. There are three aspects we try to focus on - physical, social, and mental health. We first find out the specific problems students and staff face through Town Hall sessions. We send regular updates to students about the support we provide. For social and mental health, we organized interactive sessions with the help of MUSA representatives that give some relief from isolation. We also conduct live Zoom workout sessions to help take care of physical health. For those who need them, we provide free counselling and support. As the lockdown gradually eases, we recommend students to go back to their normal lives slowly – go out, socialise and exercise, while keeping a safe distance.

Work from Home –
Stay 'FOCUSED' and 'CALM'

- Dr. Tang Wai Mun
School Research Office (SRO)

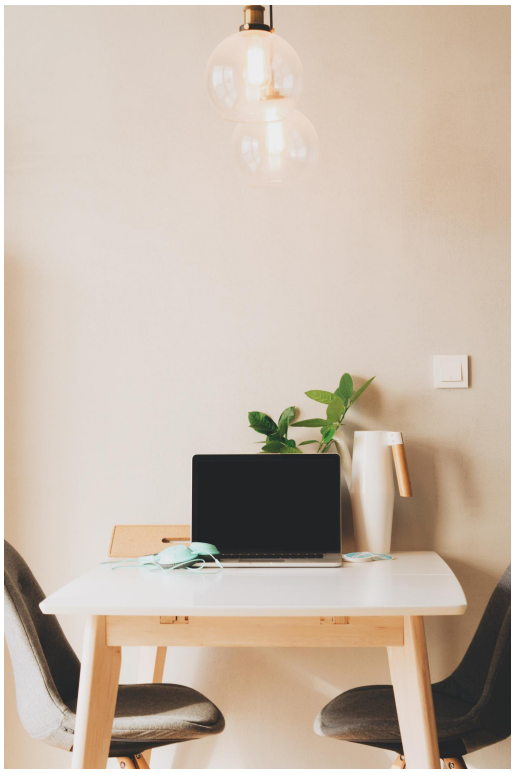
Work from home is a stormy experience for most of us due to the ever changing environment and overwhelming amount of information that we keep on feeding our mind. The greatest challenge for most of us would be to stay 'FOCUSED' and 'CALM'. The following are the strategies that we can adopt in order to help us to maintain a balance in working from home.

- **Start the day with encouraging words**

Starting our day with encouraging words can boost up our entire day. It is relatively easy to do that by downloading some of the apps that would deliver motivational or positive quotes to us every day. As what the wise would say: "The words of the reckless pierce like swords, but the tongue of the wise brings healing."

- **Slash fake information**

The COVID-19 pandemic has flooded the media with lots of information and news – with most of them containing negative connotations. The constant feeding to our minds, with these information and news could be harmful to our psychological health. A simple trick for this is to replace our social media time with other types of activities that would make us feel good.



- **Stick to a structured day-to-day routine**

Constant change in life creates uncertainties and a sense of insecurity. A structured day-to-day routine would help us to stay calm and regain our sense of resilience over time. Creating and sticking to the same workstation could be helpful too. Our body and mind respond more effectively when we use familiar work gadgets / furniture / apps etc.

- **Schedule connection with people that we love**

A purposeful activity (i.e., dinner, phone call, home activities, prayer time etc.) with family members / loved ones or even colleagues each day or every other day could be therapeutic. We are meant to be connected with people and by sharing our lives, we are also restoring our emotional and social well-being.

- **Show love to yourself**

Lastly, it is important to acknowledge that we are human beings. Therefore, it is absolutely 'OK' for not being 'OK'. Work from home does not mean that we should be at work all the time. We need to learn to love ourselves by having quiet 'me' time to recharge and restore our body and mind.

Introducing
New Academic Staff

Name: Dr. Aditya Putranto
Position/Department: Senior Lecturer, Chemical Engineering Discipline, School of Engineering
Expertise: Drying Technology, Food Processing, Transport Phenomena
Projects Handled/Ongoing:

- Energy minimization and product quality optimization of drying processes
- Multiphase approach in heat mass transfer
- Modeling of drying processes: coupling microstructure and transport processes
- Transport phenomena in chemical and environmental processing

For more information, please visit https://bit.ly/2D2Ksca

Name: Dr. Oon Cheen Sean
Position/Department: Lecturer, Mechanical Engineering Discipline, School of Engineering
Expertise: Fluid Mechanics, Heat Transfer, Computational Fluid Dynamics, Nanomaterials
Projects Handled/Ongoing:

- An experimental and simulation of heat transfer to turbulent separation fluid flow in a concentric pipe
- Convective heat transfer to colloidal suspension fluid flow in an unique geometry conduit.
- Cost-effective optimization of chambers curing retreaded tyres using CFD simulation

For more information, please visit https://bit.ly/3eyWVBr

"ANCORA IMPARO" with Dr Mark Ng

- **Abishek Pravin Manoharan**

Dr Mark Ng, an alumnus of MUM, is currently a lecturer at the School of Engineering, Ulster University (UU), UK. He is also affiliated to MUM as an Adjunct Senior Research Fellow. His primary research interests include fault diagnosis, control systems, mathematical modelling, and data analytics for anomaly detection and classification. He has recently published a research article that focuses on the transmission dynamics of the COVID-19 pandemic. In this edition of SYNC, Dr Mark shares some of his learning and career experiences, the COVID-19 publication, and some valuable tips for researchers.

Timeline of research experience and academic career

My research career began in 2006 with my PhD at MUM after securing one of the six full postgraduate scholarships available during that time. I worked on the project entitled "Advancements in Robust Fault Reconstruction Using Sliding Mode Observers" under the supervision of Assoc. Prof. Chee Pin Tan from the Department of Mechatronics Engineering. I was also the first PhD researcher to graduate from MUM.

After I completed my PhD in 2009, I stayed on as a lecturer for about five years at MUM. Then, I took a sabbatical through 2014–2015 to pursue my postdoctoral research with the Division of Vehicular Systems, Linköping University (LiU) and Volvo Car Corporation (VOLVO) in Sweden. The postdoctoral research focused on the design and development of advanced fault diagnosis schemes using model-based and data-driven methods on vehicular engine systems. For this project, I was instrumental in developing a simulation testbed for realistic Model-in-the-Loop (MIL) testing of various residuals generation and fault diagnosis methods on an engine system. The results from this project were published as one of the two only featured articles in the April 2020 issue of the prestigious IEEE Control Systems Magazine. Subsequently, I went to Sweden again in 2016 for three months when LiU and VOLVO invited me to continue working on the project as a visiting researcher.

In 2017, I left MUM after close to 15 years as a student and staff to seek new challenges in my career. Currently, I am a Lecturer in Mechatronics Engineering and Control at UU here in Belfast, Northern Ireland, where I also lead the Control Engineering and Industrie 4.0 Laboratory. In addition, I am attached as a researcher to the Nanotechnology and Integrated Bioengineering Centre (NIBEC), which is one of the most advanced and innovative nanotechnology and bioengineering centres in Europe and I am currently supervising three PhD students.

I am also a co-investigator in SAFEWATER, a £5 million project funded by the UK government through the Global Challenges Research Fund (GCRF) where we work with collaborators in Brazil, Colombia, and Mexico to develop low-cost and sustainable safe drinking water technologies to improve the quality of life in developing countries. For this project, I lead the development and optimisation of embedded algorithms used for controlling low-cost water disinfection technologies.

How did you pursue opportunities such as the one in Sweden?

Like most good things in life, it didn't come easily. It takes a lot of perseverance, faith, and a little bit of luck. I had always wanted to learn and explore more in my research. and one of the ways to achieve that is by doing a postdoc. However, a good position with an interesting project attached to a reputable research team or industrial company is very hard to come by, and the competition is very stiff having to compete with other candidates from all around the world!

Therefore, quality peer-reviewed publications are important to show that you have a good track record in your research and that they are recognised by other experts in the field. Besides conducting research and publishing papers, it is also crucial to attend and present your results in conferences, seminars, webinars, and workshops. These activities help not only to showcase your research, but also to encourage new collaborations. Hence, I was very lucky as during the same time, through a mutual network, I came across an open position for a research fellowship in Sweden in the exact research field that I was looking for. And that was how I got onboard the project at LiU and VOLVO.

Tell us about your COVID-19 publication

It all started off as a joke between my wife and me when she asked if I could do something for the current pandemic situation. So, we started working on the mathematical model and we got the first preprint out to secure the research idea within a few days. We were exploring the novel idea of including into the model, specific information such as ageing factor of the population, time delay on the development of the pandemic due to control action measures, as well as potential resusceptibility due to temporal immune response. We developed the model to inform the transmission dynamics and trajectories of confirmed infected cases and deaths. We then verified the model using public data available from South Korea and Northern Ireland. In addition, we made some predictions on the possible future trajectories of the pandemic. The simulation results are able to demonstrate scientifically that 1) Timing is crucial when taking control measures to help stop the spread of the virus, protect the healthcare capacities, and reduce deaths, and 2) If there exists a potential for resusceptibility, the virus will remain in our society for a very long time until a full vaccine is developed. The full version of the paper is now published in the Physica D: Nonlinear Phenomena.

Currently, I lead the COVID-19 Modelling Task Force at UU, where we work closely with the Government's Specialist Modelling Response Expert Group in Northern Ireland. We have been using my model as the main output for analysis of the current situation and also to make informed predictions on the transmission dynamics of COVID-19 in Northern Ireland.

Through our studies, we also help and advise the Department of Health (equivalent to Ministry of Health in Malaysia) on the up-to-date situation of COVID-19 in the country so that better control measures can be planned to protect our health services from being overwhelmed, and to ultimately flatten the curve.

Encouraging words for GRS

- Excellent networking, quality publications, and the ability to adapt to new research environments.
- It is very important that you enjoy doing your research. Once you learn to love what you do, quality results and outputs will come naturally.
- Read more and explore other parts of life outside of academia to get new ideas.
- Research is a "never-ending adventure". I am most fortunate to learn new knowledge, cultures, and languages in every stage of my career thus far. As the Monash motto goes, "ANCORA IMPARO! — I am still learning".

Personal research website: www.markusng.com

Research on COVID-19

- Link to the publication: https://doi.org/10.1016/j.physd.2020.132599
- Brief video on modelling activities of COVID-19 at Ulster University: https://youtu.be/DGoU2zCu63o
- Read more about the project: https://bit.ly/3je1LYk

Events

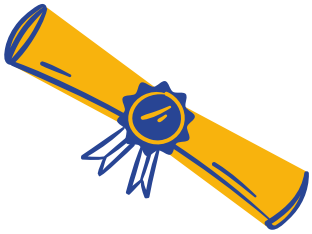
CONGRATULATIONS TO OUR MAY 2020 GRADUATES!

Doctor of Philosophy:

- Jacob Febryadi Nithanel Dethan
- Foo Yuan Teng
- Chot Chun Yuan
- Chang Jang Sen
- Chong Tune Hau

Master of Engineering Science (Research):

- Chin Chun On
- Ho Mun Chun



Alumni News

Our Monash alumni, Dr Jayasree S Kanathasan is a Postdoctoral Researcher in Biomedical Engineering at the Jeffrey Cheah's School of Medicine and Health Sciences, MUM. She completed her Bachelor of Hons degree in Biomedical Science at Tunku Abdul Rahman University in 2012. She worked as a Technical Officer at the Genetics and Biology Lab in School of Science, MUM for 2.5 years.

She has pursued her Masters (Research) in Engineering Sciences at School of Engineering, MUM on a multidisciplinary project supervised by Associate Professor Varghese Swamy from School of Engineering, Monash Malaysia, and co-supervised by Associate Professor Uma Devi Palanisamy and Professor Ammu K Radhakrishnan from Jeffrey Cheah's School of Medicine and Health Sciences in 2015. She furthered her PhD on a project developing peptide functionalized porous silicon and carbon nanoparticles in breast cancer imaging, sponsored by the Ministry of Higher Education under the FRGS Grant and graduated in 2019.

Dr Jayasree S Kanathasan
Postdoctoral Researcher
(Biomedical Engineering)

Throughout her graduate studies, she has acquired her skills in cancer nanotechnology, material sciences, molecular biology, animal tissue culture and animal imaging. Dr Jayasree has a few conference proceedings, one patent filed and several publications. Currently, she has joined several projects including pharmacological observations of diet-induced obesity and dengue infections in animal models and effects of probiotics in the immune system of athletes. As a Leading Teaching Associate, she handles practical sessions and online tutorials for undergraduate students from Year 1 Biology units and Year 2 Microbiology units in School of Science, MUM. As an early researcher, she has immense research interest in investigating the expression of biomarkers involved in inflammatory diseases and neurological diseases as well as efforts to enhance the sustainability in environmental sciences.

Events

3MT Competition Campus Final 2020

The Three Minute Thesis (3MT®) 2020 Competition was held successfully this year at Monash University Malaysia with a slight twist to it, being done virtually. We would like to applaud all contestant for their efforts. Congratulations to all the winners of the Three Minute Thesis (3MT®) 2020 Competition at Monash University Malaysia.

Winner: Caleb Cheah (School of Science)
Link: https://vimeo.com/430236869

First runner-up: Cheng Fung May (School of Engineering)
Link: https://vimeo.com/426872484

Second runner-up: Lee Mei Sin (School of Information Technology)
Link: https://vimeo.com/430280787

People's choice award: Sanggetha VP Vellachami (School of Business)
Link: https://vimeo.com/430564943

The winner of the campus round will be representing Monash University Malaysia for the Monash University 3MT® Final, for an opportunity to compete in the Asia-Pacific 3MT® Final. The winner of the people's choice award will have the chance to compete for a place in the Monash University 3MT® Final of Australia as well.

COVID-19
Global Challenge and Innovations

- **MIT COVID-19 - Beat the Pandemic Hackathon Challenge**

In April 2020, 1750 volunteers from 96 countries gathered remotely to implement solutions to beat COVID-19. Two main areas were focused in the 48-hour hackathon challenge; how to protect the vulnerable population and how to help health systems.
Read more: https://covid19challenge.mit.edu/beat-the-pandemic-2/

- **IMechE/Equal Engineers COVID-19 Student Challenge**

An open challenge to students from primary school to university level to design an innovative engineering solution that tackles hygiene, sustainability and mental health issues.
Read more: https://equalengineers.com/covid-19-challenge/

- **Detect & Protect Challenge by United Nations**

A call to action for all hardware and software developers, product designers, scientists, hackers, makers, innovators and inventors to come up with innovative ideas to cost-efficiently support COVID-19 response efforts in developing countries. Some of the innovations are shown below.
Read more:
https://sgtechcentre.undp.org/content/sgtechcentre/en/home/covid19detectprotect/

- **COVID-19 Open Research Dataset Challenge (CORD-19)**

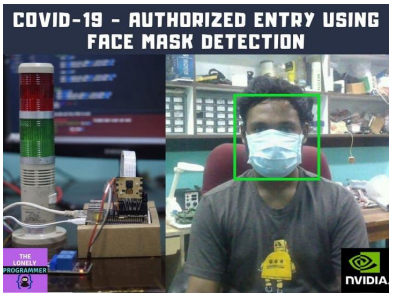
CORD-19 is a resource of over 167,000 scholarly articles, including over 79,000 with full text, about COVID-19, SARS-CoV-2, and related coronaviruses. This freely available dataset is provided to the global research community to apply recent advances in natural language processing and other AI techniques to generate new insights in support of the ongoing fight against this infectious disease.
Read more: https://www.kaggle.com/allen-institute-for-ai/CORD-19-research-challenge?select=Kaggle

- **1 Day Sooner: COVID-19 Human Challenge Trials**

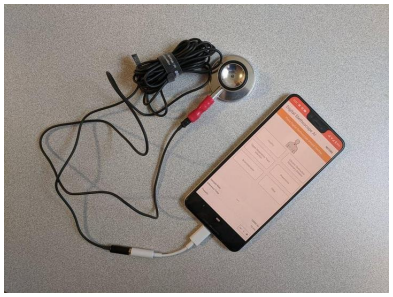
Clinical trials were conducted to expose participants to infection, to study the disease and develop vaccines or treatments. Over 30108 volunteers from over 140 countries have volunteered in this challenge.
Read more: https://1daysooner.org/

Touchless faucet using Arduino and reusing plastic containers

Simple 3D printed face shield to help frontliners with low face masks supply



A system that detects the presence of face mask on a person entering an authorized venue



Digital stethoscope which costs less than $1 using AI for diagnosing respiratory symptoms, and empowering doctors via telemedicine

TED Talks
on Technological Advances in Healthcare:

- The jobs we'll lose to machines -- and the ones we won't | Anthony Goldbloom (CEO of Kaggle)

Watch here: https://youtu.be/gWmRkYsLzB4

- Future medicine: Daniel Kraft at TEDxAcademy

Watch here: https://youtu.be/aRkA6_Ve1_s

- Future of Medicines : Download your medicines & simply 3D print it! : Lee Cronin at TEDxGateway 2013

Watch here: https://youtu.be/pZqTLGCz09I

- 3D printing human tissue: where engineering meets biology | Tamer Mohamed | TEDxStanleyPark

Watch here: https://youtu.be/nbtz8fhhMhE

Short Reads:

- Pepper, Valkyrie and Husky, Edinburgh Center for Robotics (ECR), UK

Read here: https://www.bbc.com/news/uk-scotland-39330441

- Telemedicine, University of the West of England, UK

Read here: https://horizon-magazine.eu/article/robotic-doctor-gearing-action.html

Youtube Clips:

da Vinci Robot Stitches a Grape Back Together - https://youtu.be/0XdC1HUp-rU

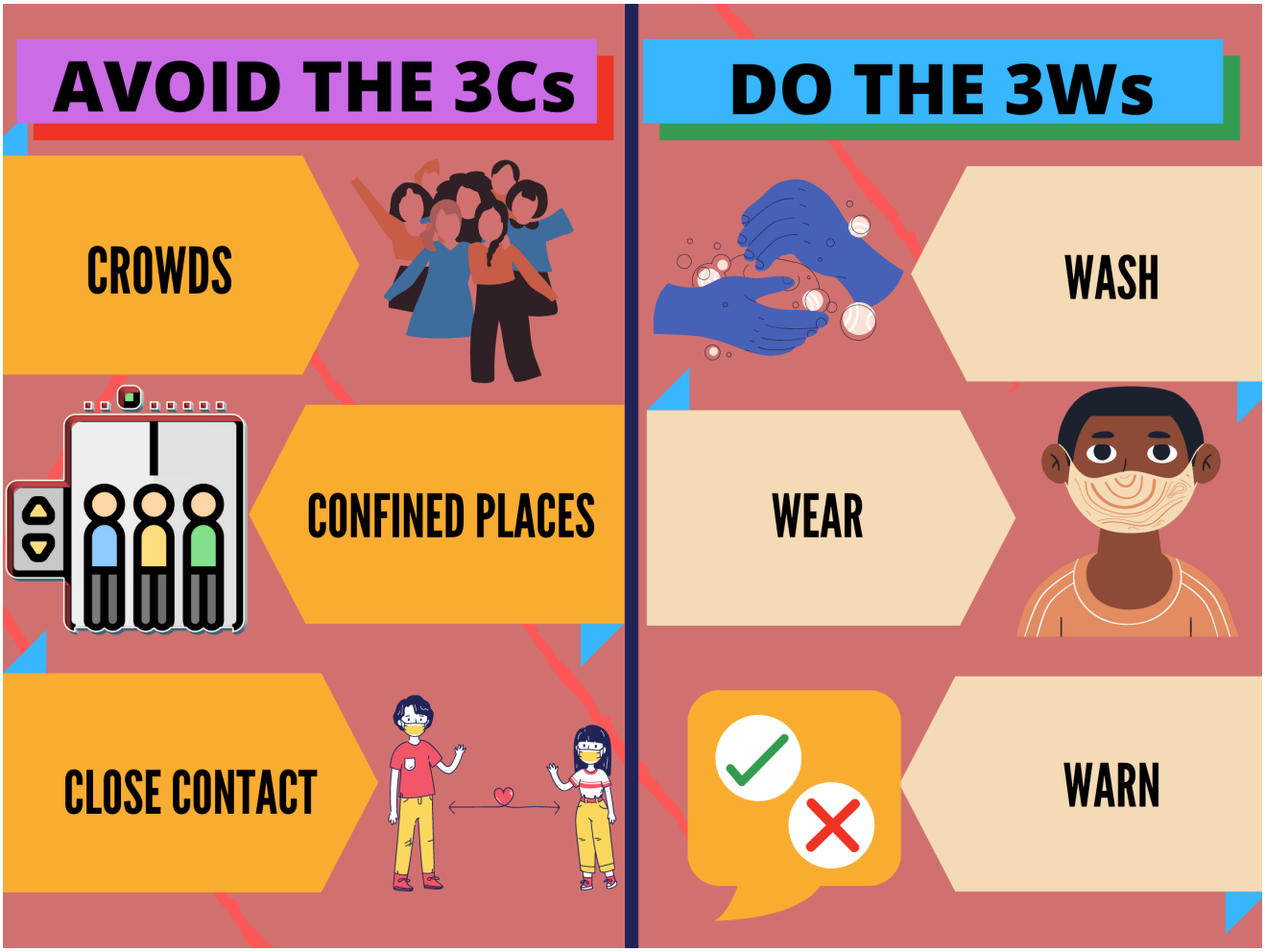
Robots Deliver Lifesaving Medical Supplies | Cedars-Sinai - https://youtu.be/bWKcjLCmX5I

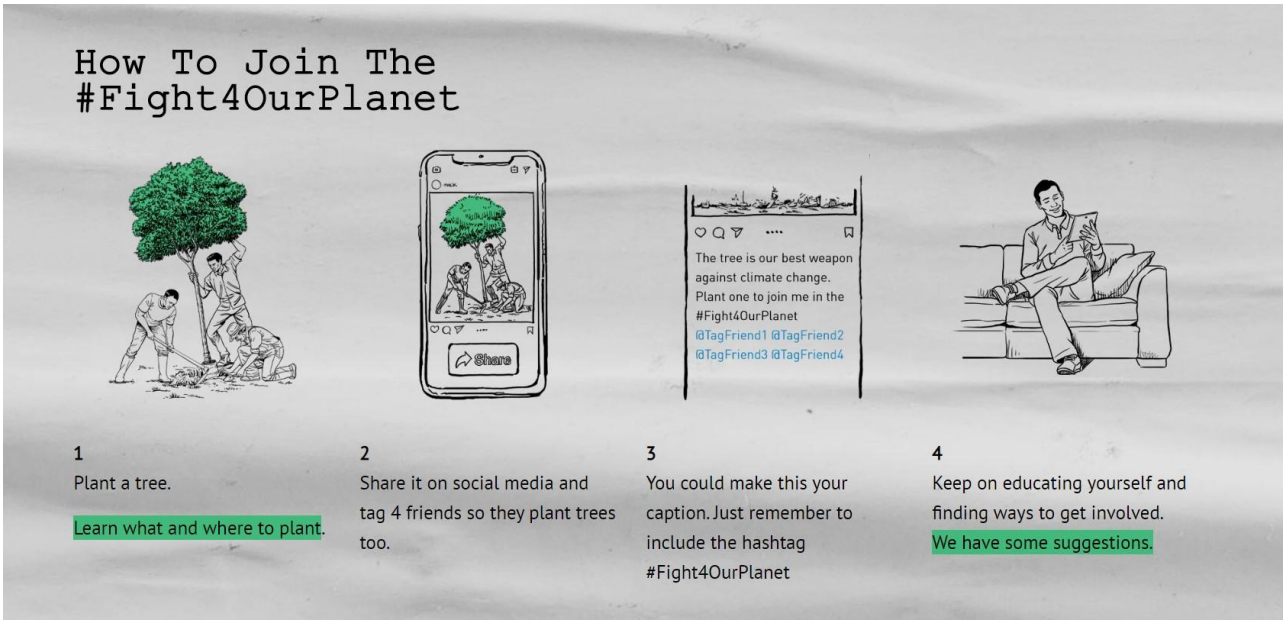
Meet HAL, The First Pediatric Patient Simulator In Minnesota - https://youtu.be/YaFHLPbYkQQ

China-developed robotic nurses help in Bangkok hospital - https://youtu.be/MwVfw-NWEUI

How the robot pharmacist works at the Dubai Hospital - https://youtu.be/j-bNu1yICMw

Robot 'doctor' has passed China's medical licensing exam - https://youtu.be/6wxEuIFt7p4





For more information head on to https://fight4ourplanet.org/ .