SINGAPORE POLYTECHNIC | SP

I CAN ENGINEER SOLUTIONS FOR

SP ENGINEERING SHOW 2020

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Welcome to the SP Engineering Show 2020

(From left to right)
DUNCAN SIH WEI CHEONG
Co-Chairman
SP Engineering Show Steering Committee

Deputy Director
School of Mechanical and Aeronautical Engineering

TAN ENG LEE
Co-Chairman
SP Engineering Show Steering Committee

Centre Director
TIE-Digital Healthcare Innovation Centre

LECK HWANG KENG
Co-Chairwoman
SP Engineering Show Steering Committee

Assistant Director
School of Electrical & Electronic Engineering

On behalf of the organising committee, we warmly welcome you to the SP Engineering Show (SPES) 2020.

SPES 2020 is our annual engineering showcase which highlights many of the school's innovative projects under the following themes - "Clean Tech & Built Environment", "Healthcare & Wellness", "Industrial & Automation", "Infocomm & Media" and "Transport & Mobility". There are also industry collaboration projects developed by staff from the Department of Technology, Innovation and Enterprise (TIE) under the theme "SP tech to Market".

This event is a culminating event for our graduating students. They have, over several months, worked together in teams to complete a capstone project in which they designed and prototyped solutions using the CDIO (Conceive, Design, Implement, Operate) framework. At the showcase, you will see how our students' creativity, technical knowledge and problem-solving skills were used to create innovative technology-based and market-driven solutions.

SPES 2020 brings together project teams from six academic schools - School of Architecture & The Built Environment, School of Chemical Life Sciences, School of Computing, School of Electrical & Electronic Engineering, School of Mechanical & Aeronautical Engineering and the Singapore Maritime Academy - and provides an opportunity for our staff and students to connect and celebrate with industry partners on our successful collaborative engagements and good project outcomes. The event also gives students the opportunity to pitch their ideas to industry professionals, making SPES 2020 a platform for interaction between our students and prospective employers.

To put an event of this magnitude together is no small task. To that end, we are grateful and would like to thank the organising committee, staff, student clubs and student helpers for their time and dedication in making SPES 2020 a memorable and impactful event.

We would also like to thank our industry partners for their continued support and our visitors for their participation. Your presence will make this event a great success and we hope you will have an incredible experience.

See you on 15th & 16th January 2020 @ SPES 2020!

(From left to right)

FRONT ROW
Lew Woon Cheun, Wendy Leck Hwang Keng, Tan Eng Lee, Duncan Sih Wei Cheong

MIDDLE ROW
Derrick Ting Lee Hou, Wendy Chia Boon Heng, Seow Boon Chor, Alvin Tay, Cheung Kim Kwong, Bernard Tan Boon Beng, Beh Han Meng

BACK ROW
Lynn Chhia, Selene Ang Chew Peng, Don Ng Kheng Ann, Phang Kwok Khuan, Chan Chin Loong, Chua Poh Hui, Saw Tun, Chiam Tow Ming, Chua Jiat Loong

NOT IN PICTURE
Lee Yoke Ling, Frank Chua, Janelle Teo, Lim Choon Ming, Chanon Kulchol, Esther Kang, Joseph Lee

SP ENGINEERING SHOW STUDENT COMMITTEE
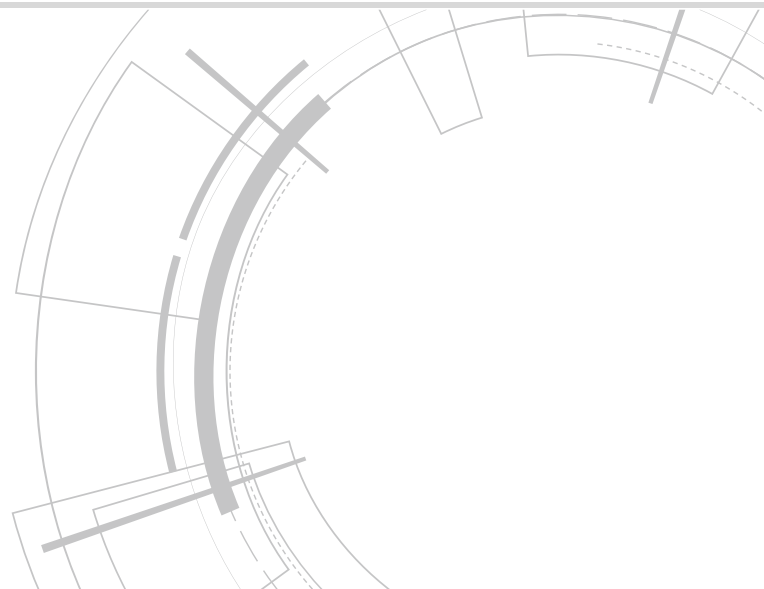
(From left to right)

ROW 1 (Top)
Tan Chung Ray, Jordan Yap Sheng, Abdillah Goh Jin Long

ROW 2
Carine Ang Pei Qi, Rushdan Mikail, Muhammad Darwase Bustami

ROW 3
Krystle Vinothini David, Jade Lu Zheng Wei, Chong Leann, Chia Kei Fong

ROW 4
Ng Hui Xin, Ho Zi Qi, Kaung Khant Kyaw , Lim Hong Zhi

ROW 5
Jannessa Nita Bernard, Yeoh Kia Jael, Mohamed Ameen Khan, Garry Teo Hao Jie

ROW 6
Kimberly Suriya, Hariz Danial Bin Rohaizad, Muhammed Sahil Bin Saju

ROW 7
Heidi Shih Jing Yun, Alissa Chong, Kolbe Archer Peterson, Muhammad Zikry Matin Bin Junaidi
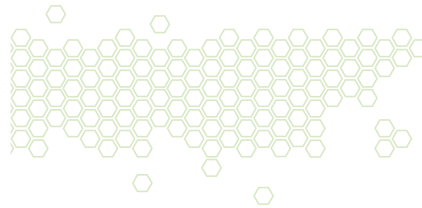
ROW 8 (Bottom)
Chloe Peck Yun Kai, Lim Boon Heng Norvin, Amirul Arif, Ashlyn Lim

CLEANTECH & BUILT ENVIRONMENT

These projects use technology which is environmentally friendly, is economically competitive and generates less waste. Students work on increased performance, productivity and efficiency by minimizing the negative effects on the environment.

W3B Asphalt Mixes Containing Various Types of Plastic Waste

Marshall Sample (Laboratory Compacted Sample)

W3B   W3B-LDPE   W3B-PP   W3B-LLDPE

SUSTAINABLE TROPICAL ALGAE PROPAGATION FOR FOOD, FEED AND FUEL

SUPERVISOR
Handojo Djati Utomo

TEAM MEMBERS
Dhanwansyah Dinata, Yong Ken Lip,
Helga Rovita Septiani Togatorop,
Leong Khee Shuen

INDUSTRY PARTNER
Liew Strategics

Algae is commonly viewed as scum and considered a by-product in water systems. However, it should be known that algae is a form of life and has beneficial properties that would allow it to be used as feed for agriculture, food for human consumption and as bio-fuel. The aim of this project is to study and find out the optimal conditions to maximize the growth rate of algae by investigating the limiting factors that affect algae growth in a bioreactor. These include factors such as the different types of nutrients consisting of nitrates, potassium, ammonia and carbon dioxide.

W3B Raw Material.

LEACHATE TESTING FROM MODIFIED BITUMINOUS ROAD PAVEMENT MATERIALS

SUPERVISORS
Handojo Djati Utomo, Tan Poh Seng

TEAM MEMBERS
Nay Yi Lin, Goh Hong Wei, Htet Htet Lin Kyaw,
Eindray Oo, Lim Li Wen, Lam Shi Qi Justine,
Tan Li Yan

INDUSTRY PARTNER
Samwoh Corporation Pte Ltd

This is an R&D laboratory based project. The students will be working together in both the AMTC lab and Samwoh. Prototypes of road samples containing different percentage of chemicals will be tested in the AMTC lab. The students will be trained to use advanced analytical instruments to measure various water contaminants that leach out from the samples.

Heat test on different wall panel materials.

AUTOCLAVED AERATED LIGHTWEIGHT CONCRETE

SUPERVISOR
Chan Chin Loong

TEAM MEMBERS
Mao Weijie, Chen Min, Marcus Su Feng Hao,
Nur Aishah Binte Saddeli, Chua Zong You,
Tan Khang Chau, Liew Kai Boon,
Hay Thi Aung Htay

INDUSTRY PARTNER
Buildo Engineering Pte Ltd

To reduce the number of workers on site and to achieve better site productivity, the construction industry has to adopt more labour efficient designs and use prefabricated products. Some of these products include hollow core wall panels and Autoclaved Aerated Lightweight Concrete (ALC) wall panels. The objectives of this study are to (i) compare the various non-structural wall panels in the market in terms of their structural and mechanical properties; (ii) investigate the impact on cost and productivity in using lightweight precast wall panels for housing projects. Comparisons will be made between conventional construction methods and precast construction methods.

Concrete workability and strength test.

EFFECT OF FINE CONTENT IN MANUFACTURED SAND AND FIBERS ON FRESH AND HARDENED CONCRETE PROPERTIES

SUPERVISOR
Tan Poh Seng

TEAM MEMBERS
Chin Zhi Qi Emily, Siew Cheng Mun Nicole,
Leung Chun Sing Sam, Aw Zhi Wei

INDUSTRY PARTNER
Samwoh Corporation Pte Ltd

The properties of the fine aggregate varies from different sources. This will affect the performance of the resulting concrete. This project aims to form a correlation between the fine content property of manufactured sand and the resulting fresh and hardened concrete properties. 2. Fiber Reinforced Concrete (FRC) is a type of concrete which contains fibrous material which increases the concrete's structural integrity. This project aims to determine the effect of fibers on fresh and hardened concrete by comparing an FRC sample with control concrete samples.

Application of hardware and software for project works where the students adopting self-directed learning.

MEASURING EARTHWORK EXCAVATION VOLUME WITH REMOTE SENSING

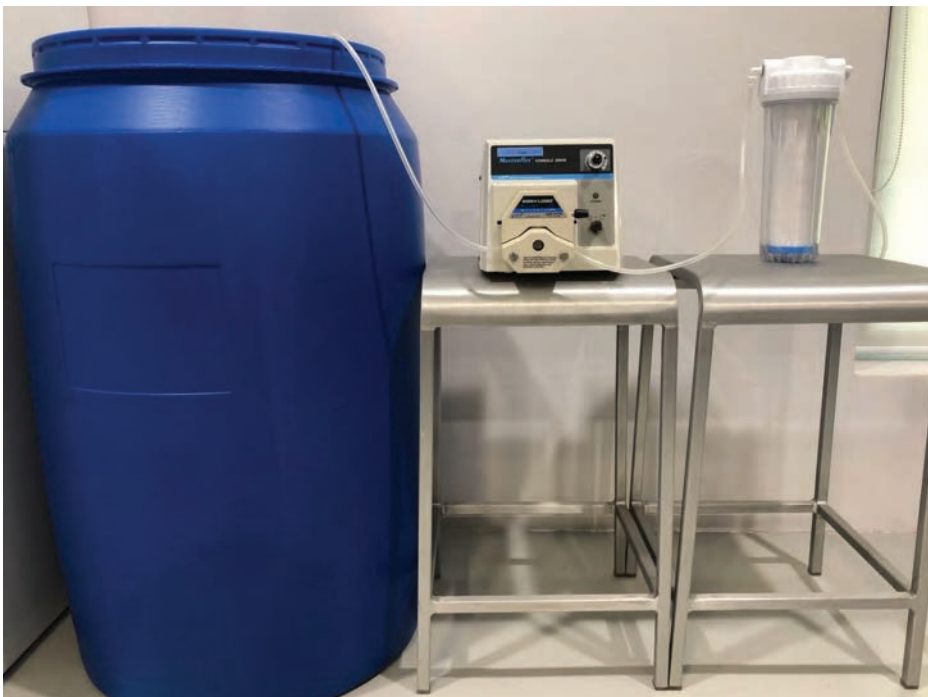**SUPERVISOR**
Teo Kian Hun

TEAM MEMBERS
Chwa Mei Yen, Nicholas Tan,
Sheikh Muhammad Zubair Bin Shekh Zainol,
Quek Xian Chun

INDUSTRY PARTNER
National University of Singapore

This project is part of an NUS research collaboration involving the use of photogrammetry as a remote sensing technique to measure volume of excavation. This work involves taking a multitude of photographs at different angles of the construction site with a camera to create a 3D model. The coordinates of the features obtained from the 3D model will be validated with land surveying. A UAV fitted with camera and GPS will be flown at the later stage of this research. The eventual field test will be carried out on a real excavation-in-progress site at Kim Chuan Extension Depot.

Anti-scaling testing.

ANTI-SCALING PROPERTY OF AN INNOVATIVE FILTER

SUPERVISOR
Liu Qishan

TEAM MEMBERS
Tan Kar Jung, Ng Xi Ning,
Nur Nadhirah Binte Djasman, Aung Myat Moe

INDUSTRY PARTNER
Nanyang Tech-Transfer Laboratory Pte Ltd

Hard water, mostly due to the fact that it contains dissolved compounds of calcium and magnesium and, sometimes, other divalent and trivalent metallic elements, typically causes scaling in pipes and water heaters. This causes numerous problems in, for example, laundry and kitchen use. This study considers an innovative filter that has an excellent anti-scaling property. The filter can be simply applied in water purifier units, boilers, and reverse osmosis (RO) membranes to eliminate the scale issue in water and to help to prolong the life span of these systems.
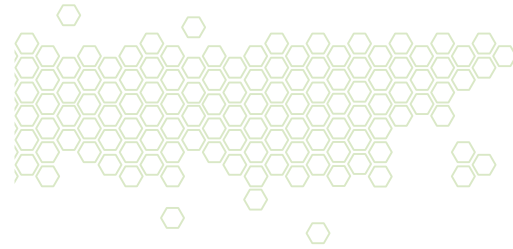
Compressed Stabilised Earth Blocks (CSEB).

SUSTAINABLE BUILT ENVIRONMENT

SUPERVISOR
Chua Yina

TEAM MEMBERS
Sathasivam Krishna Rekha,
Duanghathai Sonna, Huang Zihuang,
Muhammad Dzulhafiz Bin Abdul Rahim,
Choy Wee Lin Amabel, Tew Wen Xin,
Khairul Bariah Binte Hairul Anwar,
Foo Ke Yun Corinne,
Siti Nurhayyimah Binte Mohamed Fadila,
Thang Khan Khual

The project team consist of 3 sub-groups each looking at different areas of the Built Environment. 1. Green Materials : Compressed Stabilised Earth Blocks (CSEB) 2. E-cycle : Upgraded e-waste recycling bins using technology and a reward system to increase e-waste recycling 3. Health, Fitness and Interaction : Active play, exercise, community interactions, wellness and intergenerational activities in a community within a HDB estate, through the design of sustainable programs and the design of the HDB estate.

Mixing of raw materials.

GREEN MATERIALS

SUPERVISOR
Loo Ching Nong

TEAM MEMBERS
Bazil Bin Akhbar Angullia, Jerald Ang Yu Liang,
Wong Yuen Han Marcus

This project aims to study concrete strength using plastic waste as a cement replacement material in the concrete mix design. Replacement of sand in concrete with plastic waste is one way to deal with and manage the plastic waste problem in Singapore. It also has the potential to increase the recycling rate of Singapore's waste plastics from a meagre 4 percent. More studies will have to be done to convince Singapore agencies that the use of plastics in concrete is perfectly safe and that it will not compromise, to any significant extent, the strength of the resultant concrete.

ADHESIVES FROM RENEWABLE RAW MATERIALS

SUPERVISOR
Ting Kok Eng

TEAM MEMBERS
Chan Kai Qing, Tay Yong Yue,
Chen Zi Ling, Teo Hon Seng

Most adhesives today are manufactured from petroleum-based materials. However, researchers are increasingly devoting their efforts to the possible use of renewable feed-stock as raw materials for production due to increasing oil prices and global warming concerns. Presently, there is much research looking into synthesizing bio-based wood adhesives using lignin, starch, plant proteins, tannin, bark, vegetable oils, animal fats and collagen and other biomass as renewable feed-stock. This project studies adhesives synthesized from different renewable materials to eventually formulate one that is versatile and that can be productized.

Microbial Fuel Cell set-up.

## FRUITICITY : MICROBIAL FUEL CELLS POWERED BY FRUIT WASTE

SUPERVISOR
Noel Kristian

TEAM MEMBERS
Kelvin Chua Kim Hock, Lu Jia Wei, Han Qi Rong,
Lau Hao Hang, Chang Wei Song, Lung Sze Qi,
Ong Zheng, Amirul Bahry Bin Sabar

The waste from fruit processing amounts to 50 - 60% of the weight of a fruit. One way to manage fruit waste is through bioelectricity production using a Microbial Fuel Cell (MFC) - a bioelectrochemical tool comprising anode and cathode chambers separated by a membrane. In a typical MFC, microbes are utilized for oxidation of substrates (fruit waste) in the anode chamber. The electrons released from the microorganisms go to the cathode via an external wire and can be used to power devices. The objective of this project is to optimize the performance of an MFC powered by fruit waste.
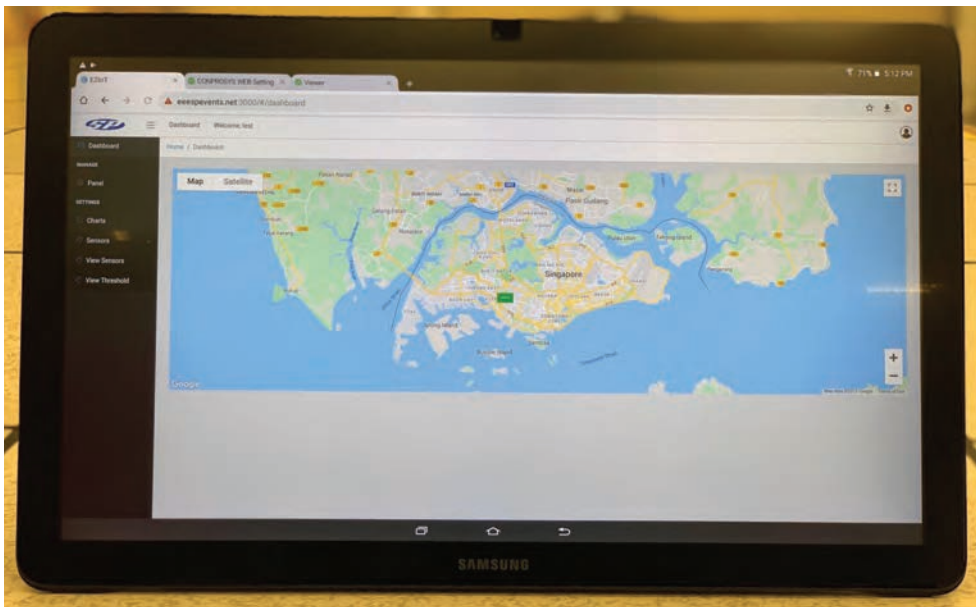
Dashboard running on the cloud server to retrieve data from the system that is deployed in Singapore.

## CLOUD-BASED INTELLIGENT MOSQUITO OIL DOSING AND CONTROL SYSTEM

SUPERVISORS
James Yee, Phyoe Kyaw Kyaw

TEAM MEMBERS
Muhammad Nur Hisyam, Huang Xin

Current mosquito control methods, like fogging and applying insecticide or anti-mosquito oils, are manpower intensive and time consuming. The project is an intelligent system connected to the cloud and uses the machine learning model for data processing and analysis. Based on the data, it will activate mosquito oil dosing at appropriate intervals. Data on carbon dioxide and temperature and from water sensors and cameras at remote mosquito prone sites help predict mosquito presence, allowing for frequency and direction of the mosquito spray to be determined, obviating the need to have manpower frequently visit mosquito prone sites.
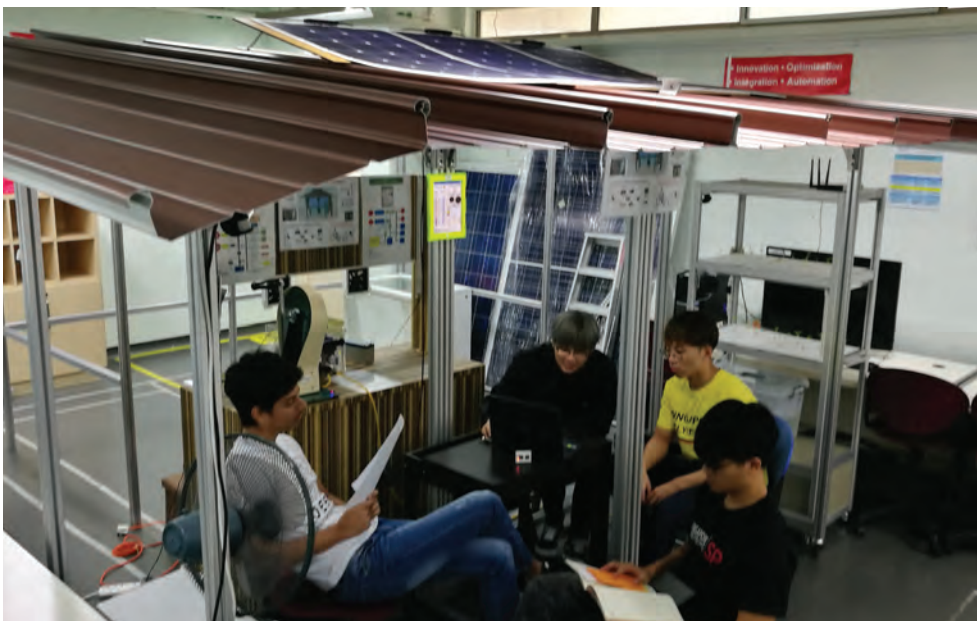
Zero Energy Garden Pavilion.

ZERO ENERGY GARDEN PAVILION

SUPERVISORS
Jiang Hao, Wang Huaqian

TEAM MEMBERS
Clarence Tan Wen Yang, Jet Law, Amanraj Singh Dhillon, Joseph Tiong Shan Cheng

INDUSTRY PARTNERS
Singapore Polytechnic Graduate's Guild, Yan San Metals Pte Ltd, SIF Pte Ltd

A "green" space, powered by solar panels, designed and built with integrated smart technologies, the Zero Energy Garden Pavilion explores enabling technologies such as sensors, 5G communication, solar panels, machine learning, cloud and mobile app programming. Its solar PV system provides the energy needs for cooling, lighting and mobile device charging as well as auto water pumping for a vertical farming rack that exists in the pavilion. The pavilion is portable for convenient deployment and modular in design for easy assembly. Students and staff can book the pavilion through a mobile app online booking system using crypto tokens.

HEALTHCARE & WELLNESS

These projects help maintain an optimal level of wellness which is crucial for living a high quality life.

Students will develop tailor-made integrated solutions to make a difference in people's lives.
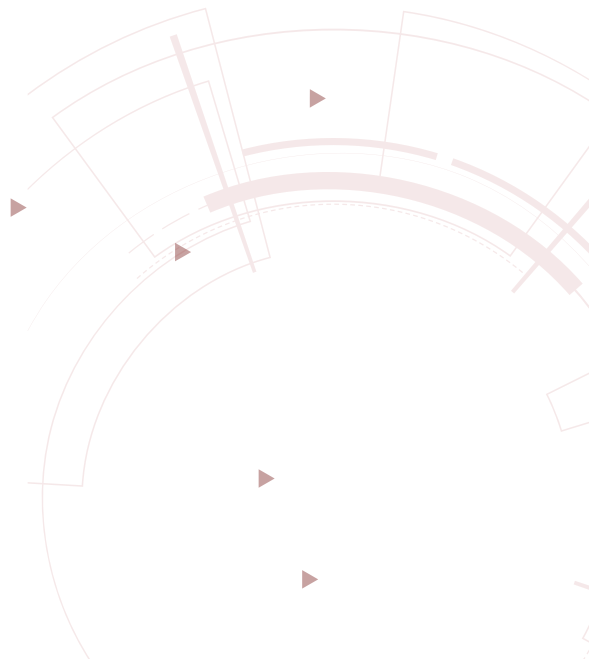
FUN AND PLAY
REHABILITATION

SUPERVISORS
Arun Kumar, Lee Kah Mein Tracey,
Sampath Kumar

TEAM MEMBERS
Murali S/O Saminathan, Mohamed Asri,
Michael Charles Walker,
Daichi Daniel Tan Henglong

INDUSTRY PARTNERS
KK Women's and Children's Hospital (Music System),
Kwong Wai Shiu Hospital

This system engages patients and helps to motivate them to better adhere to the tasks and exercises in the arm rehabilitation programme. At the initial phase, a Biofeedback (EMG) signal detects a patient's arm movements, and an arm brace, developed with its control algorithm, uses this signal to assist him. During the regular phase, patient is engaged in creating music using a setup that is easy to interact with. During assessment, patient is engaged interactively in a Box and Block Test (BBT) where the blocks' positions are scored, with higher points for blocks that are more difficult to move.

INDUSTRIAL & AUTOMATION

These projects provide control systems with processes that need to interact in real-time with other applications that are significantly superior in precision and speed.
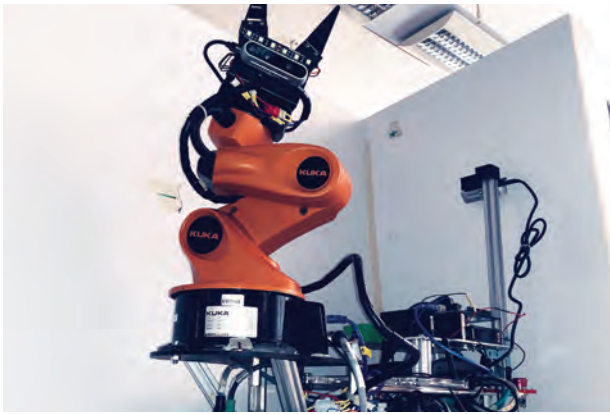
Team Robo-Erectus@Work 2020.

AUTOBOT@WORK

SUPERVISORS
Carlos Acosta, Yusuf Pranggonoh

TEAM MEMBERS
Ni Jun Hong Glenn, Tsing Chia Shuen Shania,
Sing Jing Yang, Low Chin Ann

INDUSTRY PARTNER
SICK Pte Ltd

The AutoBot@Work is an Autonomous Mobile Robot with Manipulator, and is ROS-enabled for Accurate Navigation and Path Planning with Random Pick and Place with Vision Application. It has the capability to perform work-related scenarios such as loading and unloading objects of same or different sizes, picking and delivering parts from and to structured/unstructured storage, collecting objects over spatially widely distributed areas, and cooperatively transporting objects. AutoBot@Work provides a platform for working with robotics scenarios involving mobile robot, manipulator, software and algorithm.

Flood Detection Application.

FLOOD MONITORING AND ALERT SYSTEM

SUPERVISORS
Sing Mong Nguang, Low Lee Ngo

TEAM MEMBERS
Norton Ng Chu Xun, Zoehl Tsen Chung Shen

INDUSTRY PARTNER
Infineon Technologies Asia Pacific Pte Ltd

A flood monitoring system, developed using Infineon's advanced microcontroller, pressure sensors and digital security products, monitors water level changes and gives alert warnings to the public. The system is accurate, cost-effective and scalable. Users get updated data through a mobile app. A pressure sensor in an enclosed tube container measures the air pressure internally. As the water level rises, the air pressure in the tube increases. Applying Boyle's Law, the air pressure is translated to the water-level. Water-level readings are uploaded to the AWS cloud services where they are stored and processed.

AGV.

I4.0 - SMART WORKFLOW SOLUTION

SUPERVISORS
Chung Ock Jin, Zhang Liandong,
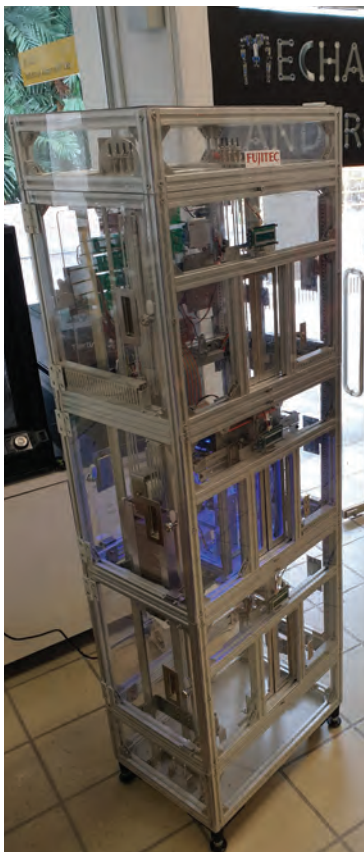Zhang Qi, Yusuf Pranggonoh

TEAM MEMBERS
Sean Chai Qixuan, Tsai Ming Feng,
Lu Yonghong, Keh Zi Hang, Ho Qi Yang,
Lee Seungmin, Cai Hongling, Lai Yao Ming

INDUSTRY PARTNER
SEW-EURODRIVE Pte Ltd

The project showcases the use of i4.0 technologies to implement a smart workflow in advanced manufacturing. It features the process connectivity through collaboration robots and mobility systems to visualize the digital integration in a factory. The smart workflow solution provides an easy platform to implement a customised solution for immediate user needs in a current factory setting and a design concept to improve workflow in a new factory. It can deliver efficiency and scalability in a factory to achieve improved productivity.

ELEVATOR

SUPERVISOR
Tan Tuan Kiat

TEAM MEMBERS
Bryan Ha Wai Kit, Ng Jun Hao, Leng Wei Zhi,
Jerriel, Xavier Kwang Jan Loon, Guan Junwei,
Lee Guo Hao Kenneth, Tng Si Jie, Koh Qin Jiang Darren

INDUSTRY PARTNER
Fujitec Singapore Corporation Ltd

Elevators are a common form of vertical transportation system that are used in residential, commercial and industrial buildings. An entire elevator system is made up of mechanical structures, mechanisms, sensors, motors and control system. A 1:5 scale elevator is designed, fabricated, assembled and integrated comprising of realistic miniature mechanisms and components can be used to demonstrate elevator fundamentals and concepts as a training model for the elevator industry.

Front left view of Elevator.
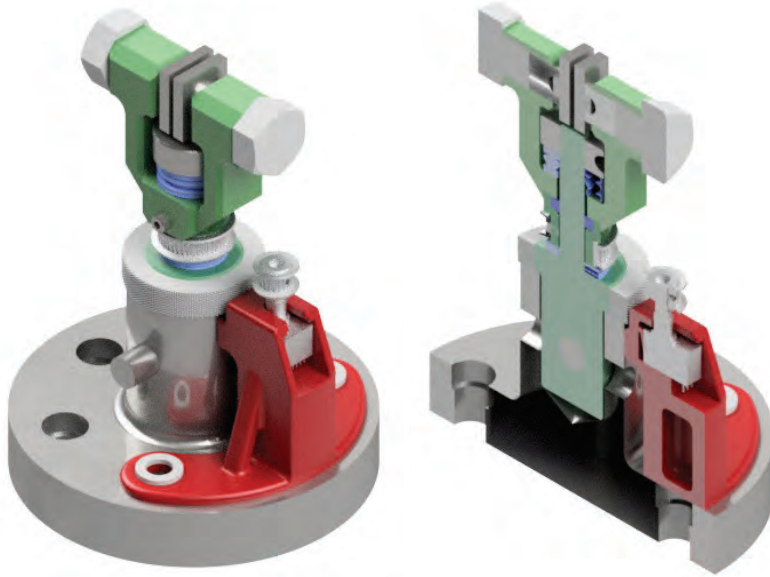
Assembled Fixture View.

DESIGN & FABRICATE FIXTURE FOR EXTENSION-TWISTING COUPLED LAMINATES

SUPERVISOR
Lee Kim Kheng

TEAM MEMBERS
Angela Tham Shi Ying, Ong Run An

This project aims to design and fabricate a fixture to be used in Universal Testing Machine for evaluating the extension- twisting coupled laminates. The default fixture of Instron 337 is designed to be stationary and thus unable to perform the extension-twisting test. However, the new fixture being designed and fabricated can be easily used and attached onto the tensile machine and is able to capture and measure the results of the rotation of the specimens which the default fixture could not.

Front View of Digitization of Legacy Machine. With point of sale, Robotic Cafe and Data Analytic.

DIGITIZATION OF LEGACY COFFEE MACHINE

SUPERVISOR
Chan Loy Soon

TEAM MEMBERS
Benjamin Lee Zhi Yuan,
Suryanarayana S/o N Panir Selvam, Justin Ang Lin Jie,
Chong Yuan Le, Teo Jing Xiang, Patrick Lim Kai Xuan,
Navin Rai

Welcome to the age of Industry 4.0. A time when technology is maximised to improve the user experience. This Robotic Café showcases how a traditional legacy machine can be turned into a connected, a fully automated machine, one with a high degree of flexibility and reliability, the kind associated with that of an industrial grade robot. Such a machine provides service that is consistent and dependable. The Robotic Café will not only provide service but will also collect data of users and the machine itself to facilitate further data analysis to enhance future user experience.