LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Fire Prevention System Using IoT

Members: Shing Foo Chuan Zheng (Group Leader)
Muhammad Irfan Adam Bin Ibrahim
Mohamed Hariz Bin Mohamed Ridzah
Dominic Chow Shi Fu
Miguel Antonio Gutierrez Escanan

Course: *Nitec* in Aerospace Avionics

College: ITE College Central

Curbing the Blaze

Personal Mobility Devices (PMD) are a common sight in our daily lives. The team noticed that several cases of fire occurred due to overcharging of batteries in PMDs. A course module on the fire prevention system in aircraft inspired them to design a device that monitors battery charging via an Internet of Things (IoT) application.

The team created a sensor pack comprising a microcontroller board, heat sensor and buzzer that can be attached to a PMD's battery while it is being charged. A smart plug is also used to control the electricity flow to the battery charger. The IoT application sends data from the sensor pack to a cloud dashboard, triggering actions and alerts preset by the team. If the PMD's battery reaches the threshold of 75 degrees Celsius, the application will activate the smart plug to stop the charging. At the same time, the user is alerted to the high temperature via the buzzer and SMS sent to a designated mobile phone number. If this project is successful and commercialised, this prototype can reduce fire hazards by preventing the overheating of batteries.

Innovators' Inspiration

"Being engineering students, we had zero knowledge and experience in coding. Yet we managed to pick up Python Coding from scratch and learnt how to interface it with the microcontroller. We took a risk and it paid off! So I would say 'If it scares you, do it!'"

- *Shing Foo*

What's So Special?

- This monitoring device is unique as there is currently no similar product in the market.
- With a magnetic surface, it can attach easily to the metallic surface of batteries. It even has a secondary velcro fastener to strengthen the attachment.
- Being lightweight at only 140 g, it is portable and convenient for the user to carry around.
- It is affordable as this device can be created at a low cost.
- It can be used to monitor the battery charging of other electrical appliances such as power-assisted bicycles, mobile phones and vacuum cleaners.
- It can preserve the battery's life, minimise fire risks and save electricity. The reduction of carbon emission supports the Singapore Green Plan 2030.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Moneta

Members: Ong Glenn Bryan Ersando (Group Leader)
David James Raiemer Pudiquet Hidalgo

Course: *Nitec* in Electronics, Computer Networking & Communications

College: ITE College Central

Memory at Your Fingertips

In an increasingly digital world, more services have become accessible online. As the elderly explore digital platforms, they often face difficulties in remembering their usernames and passwords for various accounts. To address this issue, the team developed a device that can store passwords and automate log-ins to different online accounts.

Named after the Roman goddess of memory "Moneta", it takes the form of a USB drive fitted with three buttons. When the device is plugged into the USB port of a computer, the press of each button facilitates the log-in to a linked account.

Innovators' Inspiration

"My grandfather often forgets the passwords for his online accounts and will ask me for help. This formed the inspiration for our creation. We wanted to develop something that can assist other elderly people who forget their online passwords or are less tech-savvy. The process was very challenging but fulfilling. We struggled to programme the microcontroller for the device, as it was not taught in class. We had to learn from scratch on our own through online research. After spending a week trying to figure things out, we were overjoyed when we finally got the device to work. This experience has taught us the values of perseverance and determination."

- *Ong Glenn Bryan Ersando*

What's So Special

- By facilitating log-ins with just a press of a button, the device is useful for physically-impaired people who may have difficulty typing.
- Being simple to use, the device supports digital inclusion for seniors and can encourage more elderly people to embrace online services.
- Each button on the device can be configured to enable concurrent log-ins to multiple websites or online accounts.
- To ensure security, a one-time password can be generated and sent to the user's mobile phone upon each log-in attempt with the device.
- The linking of accounts to the device can be done via an app, which the team plans to develop further in the future.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Smart Firewatch IoT System

Members: Evan Lim Ze Long (Group Leader)
Boo Kyler
Tan Ding Han

Course: *Higher Nitec* in Electronics Engineering

College: ITE College Central

Detection of Embers

After a fire, firefighters would be deployed at the incident site, on a rotational basis, to protect the property and ensure no harm comes to the dwellers. It is also necessary to preserve evidence for fire investigation. To reduce manpower required for this task, the Singapore Civil Defence Force (SCDF) sought ways to leverage technology. This resulted in the collaboration between the team and SCDF, to create a device that could detect potential signs of deep-seated embers at an incident site for SCDF's follow-up actions, if needed.

Designed for mounting on a ceiling or wall, it is fitted with sensors that measure the surrounding temperature, humidity, carbon dioxide and particulate matter levels. Through its built-in wireless connectivity, the device can transmit data captured to a cloud dashboard for monitoring and analysis. With a set of specially catered algorithms, normalised trends of the environment are monitored and users will be alerted to any abnormalities. The IoT technology supports more efficient fire management and decreases fire watch rotation by firefighters.

Recognising the fact that this innovation can improve efficiency and impact manpower planning, the SCDF has since worked with ITE College Central's School of Electronics & Info-Comm Technology to produce 24 sets of this device for an operational trial.

Innovators' Inspiration

"We found out from the SCDF about the importance of detecting deep-seated embers in a fire scene to prevent fire from reigniting. That left an impact on us and motivated us to create this device to help save lives. We kept encountering and fixing different problems during each round of testing. We got this far because of the passion we have for this project. We put our heart into making it work. It was difficult and frustrating at times, but I never thought of giving up. For the first time in my life, I felt that I was working on something that is bigger than myself that can help others."

- *Evan Lim*

What's So Special

- The device was built with 4G mobile network connectivity, so that it could still transmit data in the absence of Wi-Fi during a fire.
- A ventilation fan is embedded within the device to draw in more surrounding air to the sensors via inlet holes for faster detection.
- The device has a power bank encased within, which ensures that it could function safely without connection to electrical points.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: IoT Beehive Monitoring System

Members: Zamien Ng Qian Hang (Group Leader)
Hans Leong Ee
Agnes Peh Qi Geok
Harold Goh Xuan Kai

Course: *Higher Nitec* in Electronics Engineering

College: ITE College East

A Buzzworthy Device

Bees do more than make honey. As pollinators, they play an essential role in maintaining a thriving plant community, both agriculturally and in the wild. That is why Colony Collapse Disorder (CCD), a phenomenon where the majority of the bees in a hive disappear, is a major problem, both economically and environmentally. No bees means there will not be any crops!

A team from ITE College East wants to "bee" of help in saving the bees and in turn, alleviate the risks of CCD. They designed a hive-monitoring device, making it easier for beekeepers to remotely keep track of their hives' health, and improve response time should something happen to threaten the bees.

Innovators' Inspiration

"We consulted local company, Bee Amazed, to familiarise ourselves with bees and their needs. They were interested in our project, as no one else in Singapore has created a bee-monitoring device. It would be very expensive to outsource it from overseas. We are glad that we can help in creating and customising a device that suits the needs of the local beekeepers."

- Zamien Ng

What's So Special

- The IoT Beehive Monitoring System is a multisensory platform designed to measure the various parameters that can determine a hive's health.
- Internet of Things (IoT) sensors are placed in the hive to monitor temperature and humidity, which can have a big impact on the bees' health. It also measures carbon dioxide and sound – the higher the levels, the higher the hive temperature.
- Using Raspberry Pi, the Beehive Monitor is able to collate the data and offer it as real-time information via a dashboard.
- The Beehive Monitor will help cut down on manpower and time needed to actively monitor hives.
- The prototype costs $200 to $300 and took the team two to three months to complete.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: iStrike

Members: Yong Hui-En, Colette (Group Leader)
Muhammad Izryanshah Bin Sulaiman
Joonas Yap Chu Ming
Ahmad Rayyan Bin Ahmad Lukman

Course: *Nitec* in Mechanical Technology
Nitec in Built Environment (Mechanical & Electrical Services)

College: ITE College East

Scoring a Perfect Strike

Generally, people with cerebral palsy find it hard to aim and throw a ball because the condition affects their movement, balance and posture. In a bowling game, players with cerebral palsy require an assistive device to release the bowling ball. iStrike is a bowling ramp designed to help people with cerebral palsy participate in bowling games more effectively. The ramp allows the user to independently aim and adjust the ball to the left and right, by a simple press of buttons. The user can take aim and the ramp will automatically release the ball.

The team received positive feedback when they tested their prototype with beneficiaries of Cerebral Palsy Alliance Singapore (CPAS). They are currently doing more testing with the beneficiaries to enhance their device. The team will be donating the iStrike device to the CPAS so that their beneficiaries can enjoy bowling to the fullest.

Innovators' Inspiration

"I am happy that I can use my skills to help people with disabilities. They struggle with daily living and this project helps them enjoy life through bowling. It warmed my heart to see the people with cerebral palsy excited to play the game, when we let them use our prototype. Through this project, I have come to understand their condition more and am better able to empathise with them."

- *Colette Yong*

What's So Special?

- Unlike other solutions available in the market, iStrike does not require caregivers to help with adjustments and release of the bowling ball. This makes it a user-friendly option.
- By providing people with disabilities the opportunity to participate in recreational activities such as bowling, this device promotes social inclusion and enhances their overall well-being.
- iStrike can also be used by children, the elderly, and anyone with limited strength who wants to enjoy bowling.
- The ramp is designed to be compact and portable. The team used a walking frame and copper tubes to build a stable structure. Through 3D printing, they created a customised casing to fit the push buttons and the electrical components. They used lathe and milling machines to create a detachable customised joint to fit copper tubes and create the ramp.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Measure and Precise Liquid Extraction (MAPLE)

Members: Lew Zhan Qi Ethann (Group Leader)
Lai Shihua
Joseph Leow Chen En

Course: *Higher Nitec* in Mechanical Engineering
Nitec in Mechanical Technology

College: ITE College East

Precise Provision

In cooking or baking, one may follow a recipe and be exact with liquid measurements. Craving for a drink? You may need to mix two different liquids together, like coffee and milk, to make that perfect cup of latte. These are some of the points that the team brought up when they discussed how seemingly simple tasks might challenge the visually impaired and affect their quality of life.

Using medical and food-grade material, Measure and Precise Liquid Extraction (MAPLE) is a safe and handy device that can be used to extract, measure and dispense any liquid with precision. Drawing inspiration from a syringe in terms of design and functionality, MAPLE can be operated single-handedly with ease. Any amount of liquid, from less than 0.3 ml to more than 250 ml, can be extracted and dispensed with accuracy. This device was conceived to help the visually impaired perform everyday tasks such as administering liquid medication, cooking or fixing a drink.

Innovators' Inspiration

"Designed with the visually impaired in mind, we wanted to increase their sense of independence and allow them to enjoy the simple pleasures in life. For instance, being able to measure a precise amount of liquid medication and/or feed their service dogs with a specific amount of medication can do wonders in enhancing their quality of life."

- *Ethann Lew*

What's So Special?

- With MAPLE, users can extract and dispense the desired amount of liquid with acute precision by simply shifting a knob that is designed to move up and/or down tiered ridges of 2.5 ml intervals.
- Designed with ergonomics in mind, the device is easily gripped.
- The design is adaptable for use by both right- and left-handers.
- The device is reusable and does not need battery to operate. Hence, it is low maintenance and cost-effective.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Reducing Microplastics in the Environment

Members: Dexter Sim Yi Zhi (Group Leader)
Ho Xuan Yan Cherlyn
Ang Wei Jie

Course: *Nitec* in Chemical Process Technology

College: ITE College East

Gotta Catch 'Em All

Household activities contributed up to 35 per cent of microplastics discharged to the environment. Defined as plastic particles that are smaller than 5 mm, microplastics are non-biodegradable and can damage the marine ecosystem. Microbeads found in laundry detergents and microfibers from domestic laundry are common culprits or sources of microplastics. To reduce microplastics discharged from household washing, the team came up with an innovative device that weeds out these pollutants during each wash.

The cylindrical device with two angled plates is placed with the laundry in a household washing machine. With large holes punctured into its sides, the device can trap microplastics within it, preventing them from being flushed out of the washing machine and into the drain after each wash cycle. This project is the team's endeavour to save the earth, one spin at a time!

Innovators' Inspiration

"There were many complexities to this solution. We had to design a prototype that fulfilled several conditions - the device should be able to capture microplastics of varying sizes and be made of light, renewable and biodegradable material. Most importantly, it should not damage clothes during the wash. Using CAD and 3D printing technology, we designed and developed three different prototypes and conducted rigorous tests to determine the most effective one. We are very pleased and confident of its practical adaptability and scalability to tackle this serious problem in the real world!"

\- *Cherlyn Ho*

What's So Special?

- The device achieved almost 30 per cent microplastics removal effectiveness in just 20 minutes.
- It is low-cost and easy to use.
- It can be introduced to laundry shop owners to help them reduce microplastics discharge to the environment.
- Should this device be scaled up, it can potentially be used for filtration at a wastewater treatment plant, eliminating the need to use costly technologies such as sand filtration and membrane filtration.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Smart Trolley

Members: Muhammad Amirul Danial B M R (Group Leader)
Ayhan Escandar Bin Mohammad Talib
Gue Yi Peng
Koh Ming Lun Kenneth

Course: *Higher Nitec* in Electronics Engineering

College: ITE College East

Tracking Trolleys the Smart Way

It is not uncommon to see unreturned supermarket trolleys strewn around housing estates and neighbourhoods, abandoned by irresponsible users. Abandoned/unreturned trolleys are not just an eyesore, but can also pose safety risks for motorists, cyclists and pedestrians if they are left carelessly along the street or curbsides.

To address this problem, the team came up with a smart device that is able to track the location of trolleys using long-range (LoRa) technology. Once a trolley moves out of a defined geographical range, a buzzer will sound to prompt the user to return the trolley. At the same time, the GPS coordinates will be transmitted via LoRa technology to the device owner who would be able to view the exact location of the trolley on a specially-designed in-house mobile phone application. Device owners can also access a dataset containing the date, time and location of unreturned trolleys and use it to plan for its retrieval.

Innovators' Inspiration

"It never fails to bug me whenever I see unreturned supermarket trolleys abandoned/discarded carelessly around housing estates or neighbourhoods as I believe in always returning what one borrows. I figured that this problem could be solved with engineering ingenuity on my part, and decided to apply what I had learnt in school about LoRa technology to come up with a smart device that is able to track and trace the location of abandoned supermarket trolleys."

- Muhammad Amirul

What's So Special?

- The smart device can be easily fitted onto an existing trolley without any modification.
- Price per unit is affordable and in fact, it is cheaper to deploy than commercial GPS trackers, which require SIM, card registration and data plan with 4G connection.
- No other hidden fees as the smart device does not require 4G/wifi/bluetooth connection.
- Device owner can view GPS coordinates, as well as the location of the trolley on Google Map.
- Dataset containing the date, time and location of trolleys can be accessed via an in-house mobile phone application.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Nutrient Film Technology

Members: Yeo Jing Xuan Jaclyn (Group Leader)
Muhamad Zulfan Poa Jia Hao

Course: *Nitec* in Mechatronics & Robotics

College: ITE College West

Grow More with Less

In Singapore, aside from apprehension and inexperience, the likelihood of someone dropping their interest in growing plants or vegetables at home is high. This can be due to a lack of time and space as most Singaporeans hold nine-to-five jobs with many staying in HDB flats that have little room to spare for gardening.

To plug this gap, the team applied the Nutrient Film Technique used commonly in hydroponics and adapted it to irrigate plants automatically through a vertical PVC wall instead of a horizontal tray used in conventional hydroponics set-ups. The vertical system which takes up 0.5 sqm in area is not only space-saving, but requires minimal effort to maintain as it is fitted with a moisture sensor, microcontroller, growth lights and cameras for plant monitoring. Users can grow up to 28 plants and harvest up to 600 g of greens every three to four weeks. The team also formulated a special plant nutrients mix that does not require further blending, making it even easier for people to pick up gardening.

Innovators' Inspiration

"The inspiration for the project idea stemmed from our love for plants and the Government's call and commitment through the Green Plan 2030 to meet '30 per cent of Singapore's nutritional needs through locally produced food by 2030 using only 1 per cent of the land area'. We feel that Singaporeans are generally receptive or would like to grow plants but they are apprehensive because they do not know how to get started or may not have the luxury of space and/or time. We hope that our innovation which simplifies plant growing and cultivation process would motivate and encourage more Singaporeans, especially HDB dwellers to start growing plants."

- *Jaclyn Yeo*

What's So Special?

- One of the smallest indoor vertical hydroponic systems in the market, with a capacity to house 28 plants on a vertical plane within 0.5 sqm in area. Suitable for HDB indoor farming.
- The system is fitted with growth lights, a duo tank (main and reserve tanks), an automatic irrigation system with moisture sensor and a microcontroller that delivers water and nutrients from the main tank, and a Liquid Crystal Display (LCD) screen that shows water level in the tanks, moisture saturation and plant growth.
- Easy-to-set-up system that requires little attention and effort to maintain due to the automatic irrigation and plant monitoring.
- Formulated in the correct proportions, the plant nutrients mix frees users from blending their own fertilisers, which can be overwhelming for first-time gardeners.

LEE KUAN YEW TECHNOLOGY AWARD 2023
WINNING PROJECTS

Project Title: Unmanned Track Vehicle

Members: Muhammad Afiq Iswandy B Roslan (Group Leader)
Chan Teng Hong
Aw Te Ming
Rosmahwati Bte Rosman

Course: *Higher Nitec* in Rapid Transit Engineering

College: ITE College West

On The Right Track

Through their course, the team learnt how a track trolley was used by Mass Rapid Transit (MRT) personnel for track gauging and delivering equipment in the train tunnel. It involved intensive manpower for each usage. Hence the team brainstormed for ideas to reduce the amount of manpower involved in trackside work.

Using a wheelchair motor system, a drone controller, and an ordinary track trolley, they developed the Unmanned Track Vehicle (UTV). It is a track vehicle that is capable of complementing existing trackside tasks, such as conducting train track surveillance inspection and carrying heavy equipment and materials on train tracks. The UTV is easy to install at the track site and equipment can be mounted on the UTV or the UTV can be used to push the equipment. The UTV can be controlled by an operator onsite with a joystick or offsite using a computer via Wi-Fi network or mobile data transmission.

The team spent two years developing the UTV, from sourcing mounting brackets, motorised wheels to drone controlling equipment. From ideation, solutioning to fruition of the project, the team has been keeping track of the progress and supporting one another.

Innovators' Inspiration

"We did ample research on the drone controlling system, as nobody from our team has drone technology experience. We overcome the challenges by working together as a team and analysed the root cause of these problems. Once the cause of the problems has been identified, we can then eliminate the challenges in an effective manner."

- *Muhammad Afiq Iswandy B Roslan*

What's So Special?

- A drone controller allows the user to steer the UTV along the track using wireless remote control, or remotely in a separate location using an app in a smart mobile device (e.g., Smart Phone) or through a software on a laptop.
- When steering the UTV remotely offsite, the user can be in a safe and comfortable location.
- External devices such as a CCTV system and robotic arms can be fitted to the UTV and controlled remotely using existing Wi-Fi and mobile data connection.
- The UTV is driven by two high-torque motors with parking brakes originally used for wheelchairs. These motors can push heavy load and the built-in brakes ensure that the trolley remains stationary when these motors stop running.