

LEE KUAN YEW TECHNOLOGY AWARD 2015

WINNING PROJECTS

Project Title	:	All-in-One Exerciser
Members	:	Edwin Tan Jia Jun (Team Leader) Donn Ong Kit Bryan Abutin Bombita Koh Yee Teck, Benjamin Lim Chin Hong, Jeremy
Course	:	<i>Higher Nitec</i> in Mechanical Engineering
College	:	ITE College Central

Cycle Your Way to Recovery

According to SingHealth, stroke is the largest cause of long-term physical disability in Singapore and with a rapidly ageing population, the burden of stroke is expected to increase exponentially soon, posing challenges to the healthcare system and society.

“Do you know that a stroke patient can easily spend more than \$3,500 per year on rehabilitation sessions? This is a huge amount for the elderly to pay and an equally daunting cost for any supporting family member to shoulder. The patient would rather stop the follow up treatment,” explained Donn Ong Kit, a *Higher Nitec* in Mechanical Engineering student.

Donn and his team, comprising of Edwin Tan Jia Jun, Bryan Abutin Bombita, Koh Yee Teck, Benjamin and Lim Chin Hong, Jeremy, from the *Higher Nitec* in Mechanical Engineering course, were convinced that making rehabilitation programmes more affordable would ultimately encourage more to follow through with treatment. After much deliberation, they decided to design and fabricate an all-in-one equipment. Bryan shared, “We designed a compact equipment suitable for home rehabilitation. We call it the ‘All-in-One Exerciser’. As the name implies, this

equipment replaces three common rehabilitative equipment; namely the hand-exerciser, the leg-exerciser and the resistant band. The simple and compact frame houses the hand cycle on top and leg cycle below. The resistance of the cycle can be adjusted varying on the degree of therapy. With this equipment, patients can continue to perform their various rehabilitative exercises at home at a greatly reduced cost, and also free caregivers from the hassle of ferrying patients to rehabilitative centres.”

During the pilot test of the prototype at St Luke’s Eldercare Centre, patients and therapists complimented the modern look of the equipment. They suggested some refinements to further enhance the safety features, such as adding restraints to the foot pedals to prevent the feet from slipping and rounding the corners of the hand-cycle handles. But, overall, they were pleased with the prospect of cost-savings for both rehabilitative centres and patients recuperating at home. A one-time payment of \$1,200, the cost of producing the ‘All-in-One Exerciser’, is definitely an incentive worth exploring. No wonder this project bagged the prestigious Lee Kuan Yew Technology Award 2015!

Project Title : Coffee Beans Separator

Members : Muhd Raihan B Muhd Imran (Team Leader)
Ridwan Ikhyar B Zailani
Muhd Fa'iz B Ja'afar
Muhd Syafiq B Mohd Yazid
Mohd Faruq B Mohd Suhaimi
Mohd Firman Ariffin B M N

Course : *Higher Nitec* in Mechanical Engineering

College : ITE College West

Espresso of Skills

When Team Leader Muhd Raihan B Muhd Imran, a *Higher Nitec* in Mechanical Engineering student, heard that his team won the Lee Kuan Yew Technology Award 2015, he could not believe it. "Compared to the other projects, my team thought that ours was so simple. But I guess simplicity is key, especially when our project serves a very practical function," said Muhd Raihan.

The project, named 'Coffee Beans Separator', has the potential to solve a real-world problem, which is how to separate coffee beans easily for packaging. The problem, selected from a list given by ITE's Technology Development Centre, stood out because it was solvable. Raw coffee beans are typically roasted with margarine before being packed for sale. However, this process causes the beans to stick together in clumps, which have to be separated first. Currently, the industry uses big turning drums to do so, where the clumps are thrown into them and in the process, get knocked against the walls until they separate. This is not a fool-proof process, as stubborn clumps have to be manually taken out of the drums and broken up into smaller portions before the action is repeated.

"Our solution, the Coffee Beans Separator, has achieved a 100% success rate, that is, all the clumps that have gone in are separated cleanly. When implemented, this product will greatly enhance efficiency," added Muhd Raihan. The prototype was

built using a 3D printer on campus, and can process up to 7.6 litres of beans at a time.

The journey towards a successful prototype was not without challenges. The first prototype, which consisted of just one cylinder, was deemed too slow. Upon refinement, the Coffee Beans Separator now has two cylinders and can work through a full load of clumped beans in 15 seconds. The team also had to prepare sticky clumps for testing, which they did so using a microwave oven in school to heat a mixture of raw coffee beans, margarine and sugar with.

The team remains reflective on improvement areas of the prototype. Muhd Raihan said, "Being Mechanical Engineering students, the product is now a mechanical prototype, where the worker has to physically turn the knob to rotate the cylinders. There is definitely room to work with students and staff from other Engineering disciplines to automate it. We can also build a bigger prototype to increase productivity."

Project Title	:	Flexi-MoRBaSC
Members	:	Wee Hong Kiat (Team Leader) Muhammad Firdaus Bin Khuzairi Muhammad Hirman Bin Tahir Muhammad Faiz Bin Shabudin
Course	:	<i>Nitec</i> in Mechanical Technology
College	:	ITE College East

Caring for Caregivers

Shower time can be a problematic affair for wheelchair users. When the floor is wet and slippery, it can be hazardous for a caregiver to manage the weight of the elderly and clean him. Moreover, the wheelchair user tends to be stuck in an upright position, where water and shampoo flows directly down the face and into the eyes. Realising that there is a need to address this issue, a team of ITE College East students swung into action.

“We set out to address issues that the elderly face, bearing in mind that Singapore is an ageing society. For the wheelchair-bound, more can be done for them and their caregivers in managing daily activities. For them, going to the toilet and showering can pose risks, not to mention being a hassle. As *Nitec* in Mechanical Technology students, we tried to apply our skills at finding a solution,” said Team Leader Wee Hong Kiat.

Going ‘mechanical’ appears to be the right approach, given that electrical components are best left out of any device that will be exposed to water. After a year-long journey, the team created a device named ‘Flexi-MoRBaSC’, shortened from ‘Flexi Mobile Reclining Backrest Shower Commode for Elderly Wheelchair Bound’ that has won the Lee Kuan Yew Technology Award 2015.

Broadly, it is still a wheelchair, but designed to facilitate safe transport to and from the shower; and it allows the user to ‘slide’ with minimal effort onto toilet bowls of all shapes and sizes. The Flexi-MoRBaSC is constructed of alloy, which is tough, light and rust-resistant. Its backrest is adjustable and allows the user to recline

comfortably to facilitate washing of hair and showering. The swivel grab bars of the wheelchair can also be lifted and locked in position, so that the user can access the toilet bowl with support, but yet without being blocked by them.

“Along the way, we refined the prototype to fit a person of up to 1,000 kg in weight. The current prototype has been tested at three elderly homes and caregivers have given good feedback. We know that we are on the right track when they say that it helps their work and is easy to use,” added Hong Kiat. The team also plans to improve on the device, by including a safety catch for the user, to prevent the reclined commode from tipping forward, should the user decide to stand up during the shower.

Project Title : Harvest Today's Rainwater for Tomorrow

Members : Tan Jin Hui (Team Leader)
Wong Yong Zhi
Ee Zhi Hao

Course : *Higher Nitec* in Electrical Engineering

College : ITE College West

Powered by the Sun and Rain

In Singapore, sunny and rainy days are aplenty. A group of Electrical Engineering students recognised this, and have decided not to let the sun's energy and rain water go down the drain. Using a solar panel and a micro hydroelectric system, they successfully devised the gadget aptly named *Harvest Today's Rainwater for Tomorrow*.

Created to be installed on the rooftops of high rise buildings, the device includes a solar panel which converts sunlight into electricity. During rainy days, rainwater will be collected via a water channel below the solar panel. The water would be collected in a main water storage tank and used to generate electricity to power corridor lightings in the building. This means that electricity can be generated both during sunny and rainy days without taking up additional land space, which is a perfect solution for land-scarce Singapore.

The collected water can also be used for other purposes, like cleaning the floor or watering the plants. The device ensures that every drop of rain water and ray of sunlight is harvested for energy and uses.

With the rising numbers of HDB flats and other buildings already fitted with solar panels, this new device will complement existing resources by combining two gadgets – the solar panel and the micro hydroelectricity generator. The creative design has won the Encouragement Award at the Green Wave Environment Competition 2014, and now, the Lee Kuan Yew Technology Award.

The team faced problems initially, as they did not know where to source for materials. But they did not give up, and their lecturer pointed them to various resources. Team Leader, Tan Jin Hui, a second year student in the *Higher Nitec* in Electrical Engineering course at ITE College West, shared, “We were not confident at first, but we kept trying. Eventually, we learned to put together two different devices for a new purpose. I feel a great sense of accomplishment at having completed this product. This six-month journey has encouraged me to continue tinkering with devices and thinking of new devices.”

Project Title : Trio Walking Aid

Members : Benjamin Kam (Team Leader)
Muhd Luthfi Bin Ramzi
Noor Hidayat B R Affandi
Amir Hamzah B Mohamed Zulkifli

Nitec in Mechanical Technology

College : ITE College East

Helping Aid

For those with weaker legs, walking a short distance can be exhausting and difficult. Can you imagine how difficult it will be for them to climb up stairs? A four-member team from the *Nitec* in Mechanical Technology course at ITE College East recognised this problem, and wanted to help such people with their mobility.

The team designed and developed the 'Trio Walking Aid' – a three-in-one walking aid that conveniently changes into three different types of walking aids. From a walking stick to help those who have difficulty walking from place to place, it can transform into crutches if users are injured. It can even help users climb up the staircase, as it provides an intermediate step to support them.

The team's leader, Benjamin Kam, explained, "The uniqueness of the prototype is its three-in-one functionality. Users can change features manually to customise it to their needs. Instead of having three different devices to help them with their mobility, this multi-functional walking aid will serve all their needs. It can also be used for rehabilitation."

Most walking aids may not be useful when climbing stairs, as users have to shift from one leg to another to manoeuvre. Benjamin and his team are especially happy that they have been able to think out-of-the-box to develop an innovative way of helping those who have difficulty climbing stairs.

However, developing the prototype did not come without challenges. Since it is targeted at those with difficulty in walking, their main concern was the stability of the

prototype. Careful consideration and hours of brainstorming were spent to ensure the materials, gadgets, fixtures and other functions are safe, user-friendly and easy to use.

The team is currently working on commercialising the walking aid so that it can be used during physiotherapy for those with weak legs. “Seeing our product being used in hospitals or nursing homes, will be the biggest achievement for us,” shared Benjamin.

Project Title : SCALAR LRL (Left Right Light)

Members : Anuar Hassan (Team Leader)

Higher Nitec in Shipping Operations & Services

Lim Hui Shi
Timothy Toh Wen Bin

Higher Nitec in Business Studies (Administration)

College : ITE College Central

Road Safety a Priority

Anuar Hassan, a cycling enthusiast, was shocked when he came across a motionless rider next to a crashed motorbike in an early morning road accident. Shaken by the incident, he started wondering how road safety could be improved for cyclists.

The unpleasant incident sparked a brilliant idea to improve communication between road users and cyclists through the SCALAR LRL (Left Right Light). To indicate their intentions, cyclists can click on one of these three buttons – Left, Right or Stop, on the bicycle handlebar. Harnessing wireless connectivity, the click of the button would light up blinking LED lights at the back of the bicycles, as a signal to other road users. The LED lights and the device on the handlebar are weather proof, have a battery life indicator and are USB rechargeable.

As a start, the team spent hours at Changi Village – a hot spot for cyclists – to understand user preferences. As avid cyclists consider the design and look of their bicycle to be of top priority, the product had to complement the look of the bicycle, while being practical and easy to use. The team decided that the product had to be wireless to appeal to cyclists. Yet, they had little technical knowledge on programming an embedded hardware. Also, they did not know how to carry out 3D printing, which they wanted to use to enhance the design of the product. To perfect their prototype, they did extensive self-learning and research through various videos, forums and online websites. They also sought help from personal friends to enhance their knowledge and skills.

Anuar, who led the three-member team, shared, "It was such a huge learning curve as we had no background knowledge in these areas. However, it was important for us to grasp new knowledge to perfect our prototype. It required a lot of perseverance and many failed attempts at programming and 3D printing, to achieve the product that we had envisioned." Having faced several challenges, the team feels extremely proud and rewarded that their efforts have paid off. They hope to make further improvements to the product to make it more commercially marketable in future.

Project Title : Self-Lifting Wheelchair

Members : Fahmy B Mohamad Ramdan
Huin Wai Kit, Lester
Foo Chit Guang
Amos Sing Qiu Wan

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

College : ITE College East

A Lift to a Better Life

Getting around in a wheelchair can be difficult for those who are adjusting to the transition. For most, the daily rigours of life in a wheelchair become easier over a period of adjustment. For some, it is a constant struggle. “Any help to ease the chores of daily living for a wheelchair-bound individual is a welcome relief,” said Fahmy B Mohamad Ramdan, leader of the team that created the ‘Self-Lifting Wheelchair’, winner of the Lee Kuan Yew Technology Award 2015.

Fahmy and his team mates had a “eureka” moment when they were challenged by their lecturer to think of a way to enhance the user interface of a wheelchair. For Fahmy, this challenge struck a chord close to his heart. Having witnessed the difficulties his wheelchair-bound uncle had when he was alive, Fahmy led his team to think out of the box. “We had many interesting ideas to improve the wheelchair, but we decided to take one step at a time. The pressing issue we wanted to address was to enable wheelchair-bound people to do simple tasks on their own, and to feel independent. We decided to improve the wheelchair such that the seat could be elevated to enable the user to reach for objects placed at a height, or to match the height of their seat to their bed to make lateral transfers easier,” he explained.

The team modified the existing wheelchair by fitting a fabricated scissor mechanism to manoeuvre the height adjustment. The mechanism was wired to a Direct Current motor with jack powered by a rechargeable 12-voltage battery. Users can adjust the height of their seat using a remote control on their arm rest and perform tasks

otherwise deemed impossible on the conventional wheelchair. The 'Self-Lifting Wheelchair' is designed at a fraction of the price of similar commercial products since it enhances the existing frame of a basic wheelchair. It is also simple to install and use, unlike products in the market that may require users to self-assemble.

Fahmy and Huin Wai Kit, Lester, *Higher Nitec* in Mechanical Engineering students; and Foo Chit Guang and Amos Sing Qiu Wan, *Nitec* in Mechanical Technology students look forward to working together on another project to enhance the functionality of a basic wheelchair. "Next, we would like to design a recliner seat so that the elderly can lie down," shared Lester.

Project Title : Showering Reminder

Members : Gay Bing Shuen (Team Leader)
Dawami Fatimah Raiza Ngallih

Course : *Higher Nitec* in Mechatronics Engineering

College : ITE College West

A Reminder to Save

Many of us take for granted what flows so freely from our shower heads. But *Higher Nitec* in Mechatronics Engineering student, Gay Bing Shuen, knows better. Since young, his mother has taught him about how water is scarce in Singapore and how some countries still lack access to clean water. With the strong belief that water is valuable, Bing Shuen and his team mate, Dawami Fatimah Raiza Ngalih, used their skills to fabricate the 'Showering Reminder'.

The 'Showering Reminder' incorporates a buzzer that would sound if one uses more water than the average amount of water needed for showering. The buzzer will keep ringing until the user has completed his bath.

The device is designed to inculcate good shower habits, by helping users recognise when they have exceeded the volume of water necessary. A water flow sensor in the device triggers a buzzer when the trigger volume of water is exceeded. Simple to install and cheap to fabricate, the device has the potential to achieve cost savings in water bills, and more importantly, conserve water and the environment.

Bing Shuen's and Dawami's passion for the conservation of natural resources motivated them to work through the challenges they encountered. For example, the pair did not have knowledge on programming and had to learn new skills to fabricate the gadget. They have also learnt where to source for components, such as the water flow sensor used in the device. Their supervisor and Mechatronics Engineering Senior Lecturer at ITE College West, Mr Poh Tian Seng, played a key role in motivating them and guiding through each obstacle.

On his interest in saving water, Bing Shuen shared, “I was excited to work on this project, as I believe that water is precious. Our resources are not infinite and I am careful about how much electricity and water I use. The Lee Kuan Yew Technology Award comes as a surprise to me, and I am very grateful.”