

LEE KUAN YEW TECHNOLOGY AWARD 2016

WINNING PROJECTS

Project Title : Assistive Walking Device

Members : Vinod S/O A Subramaniam (Team Leader)
Muhammad Hafiz Bin Ibrahim

Higher Nitec in Mechanical Engineering

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Nitec in Mechanical Technology

College : ITE College East

A Walking Device to Aid Rehabilitation

According to SingHealth, sports injuries account for a quarter of all injuries to children and adolescents, and the incidence rate is going up due to increasing participation in sports at all ages. By far, the most common injuries are sprains and strains. “We love sports. But the pain experienced in an injury and the rehabilitative work that follows were factors close to our sport junkie hearts, that prompted us to develop the Assistive Walking Device,” shared Team Leader Vinod S/O A Subramaniam.

Aside from sporting injuries, it is also a painful and difficult period for patients recovering from medical surgery or even the elderly getting started on a rehabilitative walking programme. “We are aware of the physical and emotional challenges they face. The shortage of caregivers also adds pressure, due to their dependency on a third party to perform simple tasks like lifting themselves up,” Muhammed Hafiz Bin Ibrahim added. After almost five months of brainstorming and design thinking, the team finally fabricated a prototype they were happy with.

“Think of the Assistive Walking Device as an adult walker trainer. It functions the same way. The difference is it is devised to aid patients who are in their final phase of rehabilitative walking programme,” Vinod said. Patients on wheelchairs can wheel to the device and prop themselves up by holding on to the handles mounted on the sides. A caregiver may secure the patient to the safety harness, which also doubles up as a seat, and unlock the wheels mounted on the base of the device. Patients can start walking by maneuvering the Control Handles. The Assistive Walker enables the patient to try walking to different places, both indoor and outdoor, and makes rehabilitative time a little more interesting and enjoyable.

“We are happy with the prototype, but we can certainly improve on it. Our trial test at the Thye Hua Kwan Hospital was a success. The caregivers were happy with the design concept and its applicability,” said Vinod. The prototype was produced at a cost of \$230, but with refinement to the design, the cost could be substantially reduced. If the product is ready for commercial use, it will be a very affordable alternative to other assistive devices currently in the market.

Project Title : Humanoid Wrist Control System

Members : Tham Jiaxiong (Team Leader)
Higher Nitec in Mechatronics Engineering
Woo Yi Jie
Higher Nitec in in Mechatronics Engineering

College : ITE College Central

Armed with Technology

Mention humanoid robots, and images from the Hollywood blockbuster movie 'Iron Man' will naturally flood Tham Jiaxiong's mind. At the height of the third sequel's popularity, Jiaxiong was studying in ITE under a scholarship by the Singapore Armed Forces (SAF). With his military background as a SAF regular prior to enrolment, he was inspired to enhance a robotic system commonly used at the workplace. The system enables users to pick up objects with a gripper system, but experiences lag when the objects are irregular in shape, have smooth surfaces or are too soft.

To improve dexterity, Jiaxiong and his teammate Woo Yi Jie spent close to nine months creating an autonomous humanoid wrist control system for use in hazardous work environments. It provides the user with real-time control through a triple-functioned mechanised hand glove, powered by a system comprising 16 servos. The user is able to control the amount of force used on the object, wirelessly or wired, in real time.

Learning and writing a high-level programme for the system was a major challenge. The team started small by ensuring one servo motor was done right, followed by three servo motors on one finger, and the final 16 servos that could control all fingers on the wrist control system. This step-by-step approach allowed them to gain confidence after overcoming the obstacle at each stage of development. They were also reminded of the importance of observing safety procedures as Jiaxiong recounted an unforgettable accident. "I didn't realise that my supervisor was

checking the system while I was testing the wireless hand glove. My supervisor ended up with a cut on his hand. I felt really bad and promised him that I would never compromise anyone's safety ever again," shared Jiaxiong.

Since graduation, Jiaxiong has returned to SAF to be a Master Tech Trainer (Unmanned Aerial Vehicle). However Jiaxiong and Yijie have not given up on their project. The pair recently signed the Humanoid Wrist Control System up for the Tan Kah Kee Young Inventors' Award Competition, and won the Merit Award.

Project Title : Rotatable Plug

Members : Malcolm Ang Soon Wei (Team Leader)
Higher Nitec in Mechanical Engineering
Ma Shi Qiang
Higher Nitec in Mechanical Engineering
Muhammad Ridha Bin Mohamad Radzi
Higher Nitec in Mechanical Engineering

College : ITE College Central

Plug into Safety

Plugs and sockets are designed as a system to meet standards for safety and reliability. However, the mismatch in the placement of the sockets and the electronic devices that they are connected to often result in bending and breakages of cables. Many fire incidents are caused by exposed wires from damaged cables. Malcolm Ang Soon Wei and his *Higher Nitec* in Mechanical Engineering classmates, Ma Shi Qiang and Muhammad Ridha Bin Mohamad Radzi, realised that exposed wires are very common at home and even in school.

“There must be a way to prevent the cables from breaking in the first place. We wanted to come up with a solution that is simple, affordable and compact. It wasn’t easy as we had to go through many rounds of rigorous brainstorming,” said Malcolm. Malcolm and his teammates finally decided that they would enhance the plug to suit cables. The idea of creating a rotatable plug was thus born. Since the plug could be rotated, the cable would not be subject to unnecessary stress and bending, reducing the possibility of becoming damaged and exposing wires. This, in turn, reduces the possibility of short circuits and fire incidents.

After testing their prototypes, they improved on the design to facilitate usage in the long term. The size of the Rotatable Plug is intentionally smaller than conventional electrical plugs so that the mechanism can be integrated with other bulky plugs,

adapters and electronic devices. When the need arises for the plug to fit into a cramped area, the Rotatable Plug can be rotated to suit different angles.

“The tiny parts and components of the final design were really difficult to create. Thanks to our supervisor, Mr Teo Lin You, we have developed something useful that we believe will make a great difference in others’ lives. There is potential for this idea to grow, and we expect a demand for the product should it appear in the market,” added Malcolm. He is hoping that the team’s design can be patented as they explore obtaining venture capital investment from companies.

Project Title : SG Hydrant Locator

Members : Chia Jia Yang Nicholas (Team Leader)
Chen Si Heng
Tan Jin Hao
Damian Lee Jun Xian

Nitec in Info-Communications Technology (Networking & Systems Administration)

College : ITE College Central

Fighting Fire the App Way

During fire-fighting, fire and rescue specialists need to tap on fire hydrants for water resources. As speed is of the essence, the time taken to locate a fire hydrant should be as short as possible. If a fire is not put out quickly, lives and properties may be lost.

To help firemen locate a fire hydrant quickly, four *Nitec* in Info-Communications Technology (Networking & Systems Administration) students Chia Jia Yang Nicholas, Chan Si Heng, Tan Jin Hao and Damian Lee Jun Xian took part in the Ministry of Home Affairs' call to participate in the Security Awareness for Everyone (SAFE) Competition, and rose to a challenge raised by the Singapore Civil Defence Force (SCDF) on being able to locate fire hydrants more efficiently.

After a trip to the Sengkang Fire Station, the students found out more about the process of fire-fighting by SCDF, and worked on an android application (app) that not only locates a fire hydrant with Global Positioning System (GPS), but added more information including the last maintenance results of each hydrant. The project was limited to the areas of Sengkang and Punggol.

After six months of coding, the team managed to create an app for delivery to SCDF. It was hard work though, and tested the team's resourcefulness and can-do spirit. Team Leader, Nicholas Chia said, "Although we knew how to do basic coding through our coursework, we had to read a lot more from online articles and books on how to produce a better app. It was also a tedious process, where we had to

carefully import information and details of each hydrant one at a time on the GPS coordinates. Previously, these hydrants were only located on a physical map. Overall, we found the project meaningful because efficiency in SCDF's work can save lives."

Project Title : Smart Leg Brace

Members : Leow Jun An (Team Leader)
Nurazlan Shah Bin Shahrudin
Wong Sui Yuan
Muhammad Rahmat Bin Md Yunos

Nitec in Mechanical Technology

College : ITE College Central

Powering Strides

Going for a walk? Why not charge your mobile phone at the same time? This will soon be possible, as the prototype of Smart Leg Brace gets an upgrade in the near future. Seeing the prevalence of mobile devices everywhere, *Nitec* in Mechanical Technology students Leow Jun An, Nurazlan Shah Bin Shahrudin, Wong Sui Yuan and Muhammad Rahmat Bin Md Yunos sensed an opportunity to create a way for people to charge their devices on the go, without using a power bank.

“It started as an idea to tap on the mechanical energy generated in movement, like walking. If we can convert that to electrical energy, it is another source of green technology to support our lifestyle needs, one of which is to charge our mobile devices,” said Team Leader, Jun An with a grin.

Using a leg brace to attach the energy harvesting device at the knee, one stride per second, with the knee bent at about 40 degrees, has enough power to light up an LED lamp.

For the project, the team spent eight months sourcing for the right materials, drawing the prototype on software for the 3D printer, and testing the results. From the time of conception to fruition, the team has come a long way.

Jun An said, “We had thought that the idea was impossible at first. There was just so much we didn’t know. But we kept trying and learning and believing. Eventually, when we saw the LED lamp light up after developing the prototype, we fist-bumped one another and were so happy. It is an achievement.”

More remains to be done. The team aims to improve the prototype in the coming months, by using aluminium instead of 3D printed material. Aluminium is lighter and there is lesser energy wasted from 'noise' generated while walking. This means enhanced energy efficiency, given that more power can be generated from the same amount of effort.

Before all that, the team deserves a celebration for now. "We will be going for a meal with our Lecturers to rejoice over our winning the Lee Kuan Yew Technology Award," said Jun An.

Project Title : Walking Frame Chair

Members : Noor Hidayat Bin R Affandi
Mohammed Iqbal Bin Abdullah
Muhammed Norman Bin Osman
Mohamed Faruq Bin Mohamed Noor

Nitec in Mechanical Technology

College : ITE College East

Flip-and-Seat Wonder

Overcrowding is one of the most prevalent issues faced in the use of public transport in Singapore. Trains and buses are always full of people during peak hours. Some commuters have to wait several turns in order to get on to a bus or a train. “We often complain about not getting a seat on the bus. Imagine the disappointment of elderly folk walking into a MRT cabin where all seats are taken. We really pity the elderly; it must be very tiring for them,” explained Noor Hidayat B R Affandi, Team Leader.

A casual ranting to lecturer, Mr Toh Wei Hon, on the plight of the elderly spurred ideas that energised the boys. They were motivated to design a tool that could make travelling more convenient for our greying population.

Fellow team member, Mohammed Iqbal added, “Mr Toh coined the original idea of designing a portable chair. We liked it but wanted the chair to do more. Otherwise, it would end up as an additional baggage for the user.” The team brainstormed and delved deeper into the challenges faced by the elderly. They then set out to create a device to help the elderly perform three basic and essential functions - walking, standing and sitting.

It took the team about three months to perfect the Walking Frame Chair, a simple but ingenious idea. The prototype consists of a walking frame installed with an adjustable seat. When the seat is flipped up, the elderly can walk steadily with the support of the walking frame. When they are tired or need a seat, they just need to flip down the seat and settle down. The unique thing about this device is that the

elderly can use it in the toilet as a support, too. The seat which comes in two parts, doubles up as a toilet seat for use in squat toilets. The elderly can flip the seat up, leaving the seat's base as a support. The prototype was fabricated at a cost of \$150, and the team is optimistic of its benefits.

Project Title : Treatment of Contaminated Water
Using Natural Resources

Members : Orion Lee Yong Xun (Team Leader)
Rasheed Imran Muhammad S/O Alpathoothu
Muhamad Raimi Bin Roslan

Nitec in Chemical Process Technology

College : ITE College East

Improving Lives with Dead Leaves

Despite technological advances, many parts of the world still do not have access to clean water. Often, factories contaminate water when they discharge harmful chemicals into rivers. Keen to use their knowledge to help improve lives, a trio of Chemical Process Technology students from ITE College East, embarked on a project to find a better, faster way to treat contaminated water.

“We wanted something that can make an impact to the world. So we came up with the idea of using natural resources to treat contaminated water after realising that leaves behave like sponges,” explained Team Leader, Orion Lee Yong Xun. He and his team mates, Rasheed Imran Muhammad S/O Alpathoothu and Muhamad Raimi Bin Roslan, had noticed dried leaves are often thrown away. This inspired the team to study the possibility of using fallen leaves as an alternative absorbent. If it worked, they would be using one form of waste to remove another, with zero chemical treatment and minimal energy usage.

The team took to the streets to collect dried leaves, washed them to remove dirt, boiled the leaves, dried them in an oven, and then grinded the leaves twice until the leaves became almost powdery. The ‘leaf powder’ was then scooped into a teabag and tied before being used.

The team conducted their experiment using five different types of commonly-found leaves, activated carbon (most commonly used to treat water for the absorption process), and Methylene Blue (a dye). Their results revealed that the leaves absorbed the dye much faster than activated carbon in the first three hours – up to

75.1% absorption rate for Frangipani leaves, as compared to 25.6% absorption rate for activated carbon. Aside from dye, the leaves are also able to remove chemicals such as acrylic paints and food colourants.

“Chemicals discharged from manufacturing processes can be deadly when enough is ingested or absorbed by the skin,” said Orion. “Our leaf biomass can help reduce this problem by treating the contaminated water, making it significantly less harmful to the people who use it.”

Project Title : Unmanned Fire Fighting Vehicle

Members : Nur Asyiqin Bte Mohamed Salleh (Team Leader)
Nurhidayah Bte Abdul Latif
Muhammad Fa'ed Bin Ab Ghani
Muhammad Alfandi Bin Mohamed Esa

Higher Nitec in Mechanical Engineering

College : ITE College West

Fighting Fires in the Frontline

The Singapore Civil Defence Force (SCDF) now has the Unmanned Fire Fighting Machine (UFM) to take the heat in the frontline of firefighting. This remote-controlled machine takes the place of two to three firefighters to help put out fires, and has been used to fight warehouse and factory fires. Four Mechanical Engineering students from ITE College West were tasked to make this impressive machine even better, and they did.

They created the Unmanned Fire Fighting Vehicle (UFV), which is more compact and much lighter than the UFM. The UFM tips the scales at 2,000 kg, while the UFV comes in a svelte 60 kg. These attributes mean the UFV can reach places the UFM cannot, and reduce the load on an already heavy fire engine. The UFV also helps firefighters extinguish fires in a safer and more efficient manner.

Typically, a few firefighters work together to control a high pressured water hose during firefighting. They place themselves close to the fire, and are exposed to dangers such as toxic fumes, intense heat, explosives and unsound building structures. The UFV replaces these frontline firefighters. A firefighter can remotely manoeuvre the vehicle and dictate the movement of a nozzle which can direct the projection of water in different directions.

With the UFV's lean body, it can easily navigate spaces and move up stairways of up to 45 degrees to reach specific locations.

In fact, Team Leader, Nur Asyiqin Bte Mohamed Salleh, is no stranger to the field of firefighting. One could say it is in her blood to save lives. Her elder brother and sister are both firefighters, while her father is a retired police officer, who is now a security supervisor. Inspired by their devotion to saving lives, Nur Asyiqin dreams of becoming a firefighter, too. She also drew on the experience of her siblings during the process of enhancing the machine. Having created the UFV, she now hopes she can join the Force and use her skills to contribute ideas to improve firefighting.

Project Title : Fish Slicing Machine

Members : Eng Han Rong Rayner (Team Leader)
Timothy Lee Ke Xin
Shawn Ng Zhi Sheng

Higher Nitec in Mechatronics Engineering

College : ITE College West

Speedier Slash and Slice

A decade ago, Eng Han Rong Rayner, Timothy Lee Ke Xin and Shawn Ng Zhi Sheng already showed signs of their talent in building and creating. As boys, Rayner loved building robots; Timothy adored playing with Lego blocks; and Shawn enjoyed fixing toy cars and robots. Today, these 19-year-old young men have created a Fish Slicing Machine that the Singapore Zoo has used to feed animal performers since early April.

Trained in ITE College West's *Higher Nitec* in Mechatronics Engineering course, Rayner and his team put their skills and talents together to build a machine that could slash fish slicing time by up to five times. Conventionally, the zoo warden needs 20 minutes to slice seven kg of fish by hand. With the Fish Slicing Machine, the same quantity of fish can be sliced in under five minutes. In one hour, the machine can cut up to 90 kg of fish.

The zoo warden simply needs to switch on the machine, insert the fish, press the 'start' button and let the machine work its magic. The machine also has transparent windows surrounding the cutting blades, to detect parts of fish that may jam the blades. There is savings in water consumption too, as water is recycled within the machine as a lubricant for cutting and for rinsing the fish meat. The machine can handle fish whether it is frozen, thawed or anywhere in between.

These young inventors have greater dreams for their machine, which is simple yet effective in upping productivity levels. They see potential in adapting this machine for the fish supply industry. One hospital is currently exploring the use of this machine to slice fish to prepare food in large quantity for its patients.

Developing the machine was not without its light-hearted moments. “The first time we tried out our machine, the moment we inserted the fish, it flew out!” Shawn chuckled. “But we kept improvising the machine. Still, I was happily surprised when we won the Award.” Team leader, Rayner, added that it was his dream to build machines to contribute to society. This machine is a step towards achieving his dream.