2022
SEPT

OREPA

NEWSLETTER

OLD ROYALISTS ENGINEERING PROFESSIONALS' ASSOCIATION

CONTENTS

EDITOR'S NOTE

When Mr. Lakdinu asked me to be the editor for OREPA newsletter there was nothing much to say other than accepting it. But sooner I realized that this was not a mere magazine it should be professional and up to the standard that this was issued by the Engineering Professionals Association of my alma mater the Royal College. I'd like to thank following individuals for their immense support and contribution to the OREPA newsletter.

The Principle of Royal College Mr. M.V.S. Gunathilake for approving our request to obtain photographs of the college for the use of the newsletter.

Mr. Hayshan Kankanamge Old Royalist and a Senior prefect for year 2020/2021 and Mr. Chandathapa Senaratne for providing us College photos to use in the newsletter. The credit of all photographs of the College used in the newsletter goes to the Photographic Society of Royal College.

Mr. Sanuka Abeysooriya great Royalist and a brilliant chemical engineer, for sparing some of his valuable time for an interview. I am sure this will be and inspiring article for young engineers. Also thank you Mr. U.L.L Manujitha president of the OREPA Student chapter for getting this interview done.

This won't be possible without Mr. Lakdinu de Silva's guidance throughout the journey. Mr. Hasindu Warnapura, Mr. Didulanka Gamage for their support as the content writers and Mr. Pasan Gimhan undergraduate of School of Computing, Colombo University, Mr. Anupa Rajapaksha for their efforts in designing this.

Mr. Nimesh Ranchagoda undergraduate Faculty of Engineering University of Moratuwa, Mr. Dinuka Avinish undergraduate Faculty of Engineering University of Peradeniya, Mr. Vinura Wanniarachchi Faculty of Engineering University of Moratuwa, Mr. Samod Dharmaraja undergraduate Faculty of Engineering University of Moratuwa for providing us with the information that we need.

Mr. Tharindu Nanayakkara undergraduate Faculty of Engineering University of Peradeniya, Mr. Nelaka Soyza undergraduate of SLIIT, Mr. Sulith Perera undergraduate Faculty of Engineering University of Moratuwa for providing informative articles.
"A ship is safe in the harbor but that's not why they are made for". Thank you for pushing your limits and sacrificing your valuable time to make this newsletter a success.

Charith Belpage
Faculty of Engineering
University of Moratuwa

CYBOTS BOOTCAMP

Empowering the Royalists who Strive to Conquer the World with Robotics

Hasindu Warnapura
(First Year Undergraduate)
Faculty of Engineering - University of Moratuwa

In the swiftly developing and expanding world of engineering with the latest technology, it is very momentous to pave the path for anyone willing to become a robotic engineer. By preparing the foundation for that, The Cybots Boot Camp is organized by the Old Royalist Engineering Professionals' Association as a virtual webinar series. The main intention of this series is to introduce the concept of robotics to students looking to become engineers. The webinar series is conducted for students from grade 7 to the 2019 A/L batch. The program is conducted in two phases.

CYBOTS-PHASE 1.0

The first phase aimed to provide basic programming knowledge

"Coding is a fundamental component of robotics."

using python programming language.

The first phase consisted of six educational sessions and one introductory session. The quizzes and assignments were uploaded weekly and held a fun activity called "online treasure hunt" to engage students further with python programming language.

The weekly outline of the project was as follows;

- **Week 1**- Introductory Session
- **Week 2**- Python Basics, Variables, Data types
- **Week 3**- Arithmetic operations, Operation on Strings, Modules
- **Week 4**- Flowcharts, Control Structures
- **Week 5**- Loops
- **Week 6**- Functions
- **Week 7**- Exercises using Loops, functions, and control structures

At the end of the Phase 1.0, Students were awarded certificates after considering the average marks obtained by students for quizzes, assignments, and final assignments.

Students who completed phase 1.0 successfully, will be qualifying to phase 2.0.

CYBOTS-PHASE 2.0

Cybots phase 2.0 is to enhance the knowledge of constructing the virtual robot and programming it. An open-source robot simulation software called "Webots" is used to teach robotics Phase 2.0 consisted of eight educational sessions.

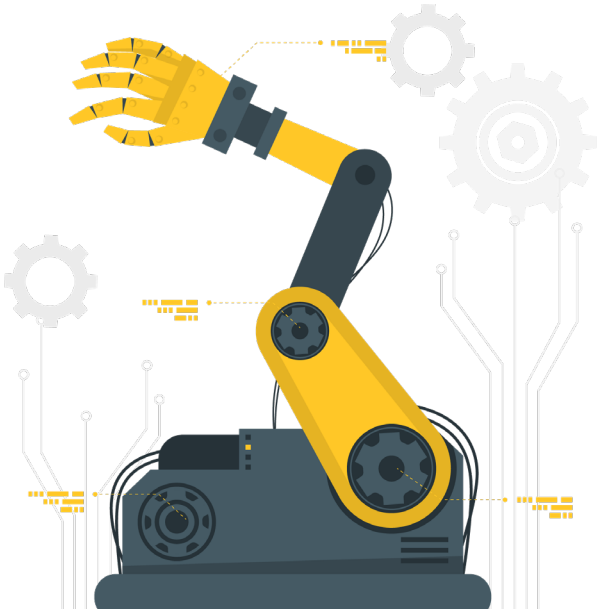
The weekly outline of the phase is as follows;

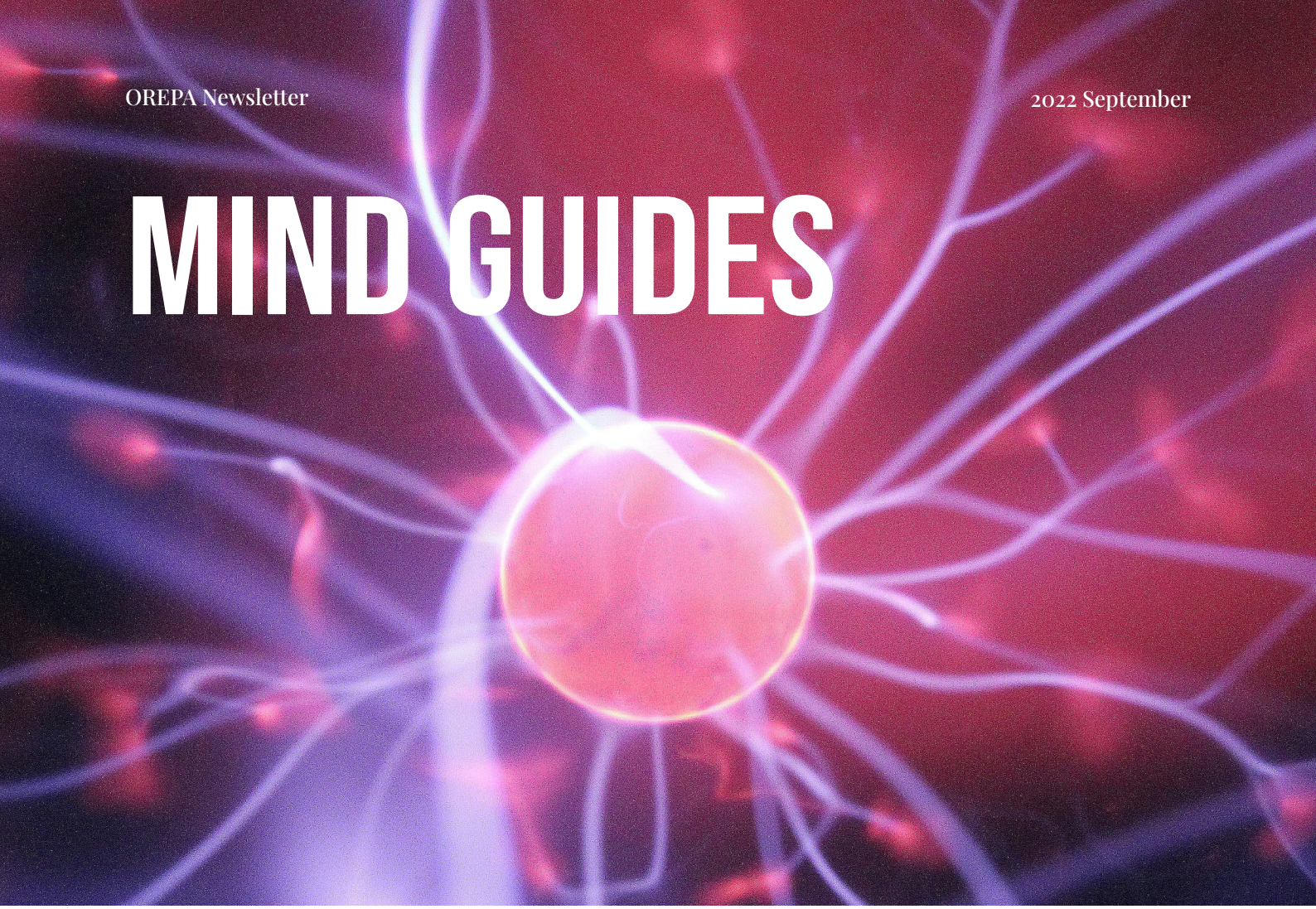
- **Week 1**- Introduction to Webots.
- **Week 2**- Introduction to actuators
- **Week 3**- How to use distance sensors?
- **Week 4**- How to implement a PID algorithm for wall following?
- **Week 5**- How to solve a wall maze?
- **Week 6**- Designing and importing simple 3D CAD models.
- **Week 7**- How to implement line following behaviors to a robot.
- **Week 8**- Introduction to the concepts of localization. The challenge for phase 2 is given.

By the end of the program, students were expected to, Understand basic programming concepts. Become familiar with the Webots simulation software. Become aware of the hardware structure of a robot.

Learn the basics of robot control systems. Be introduced to the concept of image processing.

At the end of each session, students are given the assignment to complete. After the session series, Students are given time to complete and submit a final assignment. Based on the submissions, Students are ranked and awarded the recognized certificates.





MIND GUIDES

Didulanka Gamage
(First Year Undergraduate)
Faculty of Engineering - University of Moratuwa

A/L is the recognized qualification required for entry into many university courses. Therefore, it is very much vital to understand the extreme importance or seriousness of the examination. The 'Mind Guides' program has been initiated by OREPA with the utmost intention of enhancing the results of the royalists who are about to face the A/L examination this year.

The project is primarily focused on uplifting the credence and proficiency of A/L physical science students. The main target group is the students who have potential to score outstanding grades at the examination yet need mentoring to achieve exceptional grades to secure a place at a university.

Mentor training programs and several mentoring sessions are provided to students with the aim of improving their confidence and enthusiasm to face the examination. Selected group of each students are allocated with a mentor, namely a first year undergraduate to guide and help them for their A/L examination.

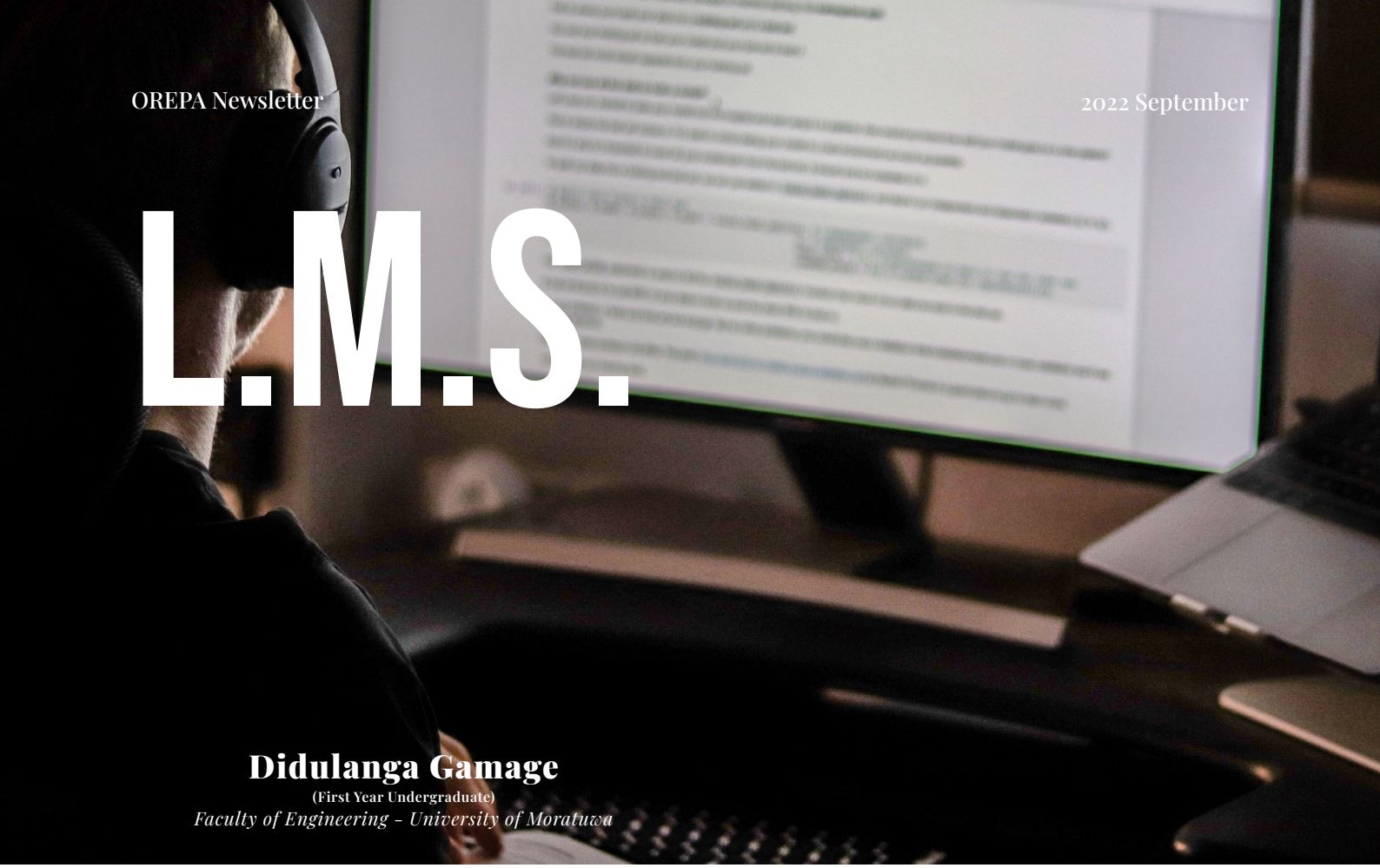
Students are provided with an ample space of improving various learning techniques and strategies, clarifying subject gray areas upon one's necessity and boosting up their determination with the aid of the allocated mentor.

The most significant merit given out by the project is providing the mentees with a precious opportunity to grasp the personal experience of the mentors on the procedure of facing the examination while learning the methodology of getting prepared , confronting challenges arisen and coming up with appropriate sustainable alternatives to face the obstacles came across.

Online connecting platforms such as Zoom and Whatsapp are used by the mentors to get interrelated with their mentees to provide them the best. The key performance indicators of the project include; percentage improvement in the results compared to the last term test and helping the students to improve their performance at the A/L examination.

It is affirmed that the 'Mind Guides' program pay dividends in the journey of amplifying college dignity and excellence in the academics.

L.M.S.



Didulanga Gamage
(First Year Undergraduate)
Faculty of Engineering - University of Moratuwa

With the cumulative effects of the *COVID-19* global impact, education is one of the immensely interrupted aspects. As a result, students are entitled to virtual learning platforms. OREPA LMS was inaugurated by *OREPA Student Chapter* as a sustainable solution to the impact caused with the sight of delivering help and guidance to A/L students.

MAIN OBJECTIVE

The main objective of the project is to maintain a LMS to support A/L students by uploading relevant quizzes, discussions, videos and other learning materials.

MCQ PORTALS

MCQ portals and online revision sessions embedded with quick subject recaps are included in the LMS to give out an extra guidance to students. Moreover, weekly quizzes were uploaded for each subject along with video discussion forums. LMS is being developed, maintained and upgraded by OREPA Student Chapter members and are mixing up the experience they've obtained to handover the best to younger royalists. School term test papers and model question papers especially designed by student chapter members are also included in the LMS in order to build up confidence in facing timed pilot papers. Along with, graded assignments and quizzes play a major role in improving mastery in subject areas.

FURTHER

Furthermore, LMS comprises of a series of robotics learning sessions carried out concurrently to the Cybots Boot Camp which mainly include topics on python programming language and robot simulation software. Pre-engineering lessons are a great initiative provided via LMS to the students who are eager and passionate about starting their career path in an engineering field in foreseeing future. This is a prodigious opportunity bestowed to A/L and engineering enthusiastic students to have a gross understanding on engineering related fields and aspects.

COLLABORATIONS

In addition, OREPA is currently focusing on collaborating with the RC Doctors' Association to expand the LMS portal in order to ameliorate and modify the subject territory.

OREPA LMS showcases the importance and practicality of distant learning under pandemic situation. Its current user base is a prominent example for that. Proactive student engagement interprets the success and the advantageous impact of the project on students' academia.

It is guaranteed that LMS will provide the students with necessary practical approach towards A/L examination and enhance the academic standard of the college through distant learning.

AN ENGINEER AT A REFINERY

Eng Mr. Sanuka Abeysooriya

Chemical Engineer (Area 1)
CPC Refinery
Sapugaskanda

HOW DID ROYAL COLLEGE HELP YOU TO REACH YOUR CARREER GOALS IN YOUR LIFE NOW?

I entered the Royal College from the grade five scholarship. It was the turning point of my life. During the time I had spent in the Royal College, I experienced that the school had developed me as a good person/behaviour as well as in terms of education (learnt of books and learnt of men). Most importantly, the level of the education system (good level of term tests especially in A/L), qualified teachers and other facilities like libraries, laboratories etc. were key things in achieving my university goal. I am grateful to the Royal College for guiding me to the number one Engineering faculty in Sri Lanka. Also, the school always motivated us to engage in sports rather than sticking to the books (I was a member of the school football team as well).

WHAT IS YOUR UNIVERSITY EXPERIENCE LIKE? DID YOU ALWAYS WANT TO BE A CHEMICAL AND PROCESS ENGINEER AND WORK IN THE PETROLEUM INDUSTRY?

When I was entering the UOM, I wanted to become a civil engineer. But during the 1st semester, I realized my interest and potential. Also, I had an interest in fluid dynamics, heat transfer, process equipment design and processing-related areas and I selected my stream as chemical and process engineering and specialized in food and biochemical engineering. During my university time, I was an active member of Rotaract club of UOM, Committee member of the Chemical engineering student society & etc.

I didn't have any dream job or specific industry for the work. But I had some interest in the petroleum industry after my industrial training period. My first working place was MAS Active Linea Intimo and I worked there for three years in the product development and innovation department. In 2018, I got the opportunity to work at CPC Refinery after a competitive selection process.

AS AN UNDERGRADUATE, DO YOU THINK SHOULD WE FOLLOW; A POTENTIAL SALARY OR THE PASSION OF MAKING A CHANGE IN A PARTICULAR FIELD?

Honestly, both passion and potential salary make us for change in a particular field. Both matters.

LET US KNOW ABOUT THE INTERESTING FACTS ABOUT THE REFINERY YOU WORK IN.

It is not an easy place to work. It is a hazardous environment. But it is a place which gives more and more exposure and experience in the chemical and processing industry. It operates in equipment with high pressure and high-temperature conditions. As engineers, we can apply our learnings to the workplace directly. Engineers have to go inside the columns, vessels, tanks, reactors & etc for visual and technical inspection during the shutdowns. Also, they have to work at extreme heights (more than 90 feet).

Continued...

DO YOU THINK INVOLVING AS AN UNDERGRADUATE INTERN WITH THE REFINERY MADE YOU WORK IN THE REFINERY ITSELF AFTER YOUR GRADUATION? OR IS IT JUST A HAPPY COINCIDENCE?

It's just a happy coincidence.

WHAT IS YOUR WORKPLACE LIKE FOR A CHEMICAL ENGINEER?

It is one of the most important industries in which chemical and process engineers can find employment opportunities. It consists of several unit operation equipment/processes such as distillation and extraction. In addition to this, chemical engineers have the opportunity to gain valuable experience by participating in the operation of catalytic reactors, hydro treating and demineralizing processes, boiler and cooling tower operations, gas sweetening processes, combustion technology, and other similar pursuits.

WHAT TYPE OF ENGINEERS CAN WORK AT A REFINERY? IS IT A WORKPLACE ONLY FOR CHEMICAL AND PROCESS ENGINEERS?

Chemical engineers
Mechanical Engineers
Electrical and Instrument Engineers
Civil Engineers

WHAT ARE YOU IN CHARGE OF AT THE REFINERY AS OF NOW?

Process Area I - Chemical Engineer

ARE YOU WORKING ON ANY IMPORTANT PROJECTS AT THE REFINERY THESE DAYS?

Due to the crisis, projects have been held.

THE REFINERY HAS BEEN A HOTSPOT IN SRI LANKA SINCE THE START OF THE ECONOMIC CRISIS, WHY DO YOU THINK THE REFINERY DIDN'T GENERATE NEWS BEFORE? IS IT BECAUSE OF A LACK OF PUBLIC AWARENESS OF ITS IMPORTANCE?

It is due to a lack of public awareness of its importance.
Normally, if we are getting something continuously without any delay, we are not bothering about that. It is human nature. But if it deviates from the natural behaviour, then only we focus on it or keep looking at its operation etc.

HOW IMPORTANT IS A REFINERY TO A COUNTRY'S STABILITY? AND THE CURRENT REFINERY IN SRI LANKA, DOES IT PROVIDES THAT STABILITY TO OUR COUNTRY?

Energy is the key factor in determining the economic and social stability of any country. The refinery is the nation's primary source of both energy production and distribution. As a result, the production of electricity, transportation, industry, aviation sector, and other sectors are dependent on the refinery. When the refinery is running normally, it contributes to the overall stability of the nation.

CAN UNDERGRADUATES AND OTHER ACADEMICS INVOLVE IN THE OPERATIONS OF THE REFINERY? IF SO WHAT ARE THE WAYS WE CAN GET INVOLVED AND SEE THE PROCESS IN REAL-TIME?

In reality, of course, interns are not allowed to participate in the operation of the refinery because of the severity and the risk involved. However, refineries often offer learning opportunities in the form of internships to undergraduate students and professors. Additionally, the refinery offers tours of the surrounding fields.
The training division and refinery manager need to receive a request for such a facility from the educational institutions that are interested in pursuing such chances.

WHAT ACTIVITIES OR INITIATIVES DO YOU BELIEVE SRI LANKANS, IN GENERAL, CAN TAKE PART IN TO TAKE FULL USE OF THE REFINERY'S SERVICES? (SOCIAL MEDIA AWARENESS MAYBE)

A policy regarding energy should be developed, and the refinery's capacity ought to be expanded. A greater understanding on the part of the general public of the social, economic, and educational significance of the refinery.

AT LAST, WHAT ADVICE DO YOU GIVE TO YOUNG ROYALISTS AS A SUCCESSFUL CHEMICAL ENGINEER IN THE FIELD WORKING AT ONE OF THE MOST CRUCIAL WORKPLACES IN SRI LANKA?

Put in a lot of effort until you have accomplished what you set out to do. In life, we experience both downfalls and triumphs, but never give up on your aspirations. You might not be able to get the career of your dreams, but you should be grateful for the one you have now and work hard to realize your goals utilizing the skills you already possess. Strive to be an informed individual who possesses admirable character traits. Be one of the best creations that the Royal College has ever produced.

TECHNOLOGY BEHIND FOLDABLE SMARTPHONES

"Are You Ready For the Next Generation of Smartphones?"

Charith Belpage
(First Year Undergraduate)
Faculty of Engineering - University of Moratuwa

By the advancement of the technology, we came so far from brick sized devices to ultra slim smartphones. Now it's a new era. Smartphone companies add new features to their latest flagships to make it more unique and advanced than the last year. Some ended up being a gimmick while some makes massive changes in the electronic industry.

Now we have foldable smartphones. No one knew that they wanted this feature in their smartphone or not until it came. Samsung Galaxy fold and Motorola RAZR are the latest foldable smartphones in the market. Let's learn about the mechanisms and technology that make foldable smartphones possible

SCREEN

Moving on to the foldable screen and here are a variety of layers on top is a protective laminate then clear capacitive touchscreen wires and then an AMOLED display. This screen is kind a similar with the key difference that the foldable AMOLED display doesn't have protective glass but rather it has a protective laminate on top which is significantly softer than glass, but it does allow the phone to bend. The other key difference is that while the AMOLED display is manufactured on top of a thin flexible metallic foil, behind the foil is a layer of plastic and foam and behind that is a solid metal layer with an accordion like hinge along the fold. This is called a living hinge and it allows for bending along the center of the display this smartphone has some rather innovative elements, but it needed a lot more rigorous durability testing and a few more redesigns during prototyping which I'm sure was cut short due to the rush to be first to market.

Continued...

DESIGN

I'll show you how it was designed to work. First, we will explore the engineering behind the hinge and then second the technology in the layers of the flexible display and after that in order to fix some of the issues with these phones. I'll give you a conceptual redesign and my take on a foldable smartphone so let's jump right in okay first let's look at the hinge.

It's not like a door hinge with two leaves held together by a pin but rather the hinge somewhat resembles the folding of a hardcover book as it has a spine with the left side and right side. After removing the back cover of the spine, you can see the internal mechanisms at the top and bottom. We have the hinges that connect the spine to each side also along the spine we have a set of four latches with buttons and springs on one side and then holes on the other. When this phone is fully open- the buttons click into the holes thus preventing it from folding closed without a small amount of force this feature gives the phone more rigidity and makes it feel more like a tablet when fully open.

Next, we have a pair of flat cables that allow the left and right sides to communicate with one another and finally in the middle we have a unique set of gears and a partial metal bushing or motion guide. This guide helps to control the motion of the two sides and prevents any twisting from left to right. Finally, these gears make sure that the two sides open symmetrically by that I mean when opening these two angles will remain equal like the wings of a butterfly which makes for a more aesthetically pleasing opening and closing feel.

MY TAKE

So, let's move on here's my conceptual redesign ends take on a foldable smartphone. First, I would separate the two screens into a primary and a secondary screen and use a cylindrical hollow hinge with wires running through the inside. This hinge is similar to those used on the Nintendo DS a wide variety of laptops and flip phones and it would be sealable from dirt dust and possibly water. Although the primary and secondary screens would be separated there would be a lot of opportunity to develop apps to utilize both halves and to separate screens would be more conducive to multitasking.

The primary side of the phone would act as a normal smartphone and the secondary side would be composed of several transparent layers. These transparent layers would be as follows toughened glass, a capacitive touchscreen in AMOLED display, a layer of polymer dispersed liquid crystal, a layer of aluminum oxynitride and then another touchscreen and toughened glass. You know what these layers do but this one the polymer dispersed liquid crystal is an electrically controlled clear or opaque glass. This material is used to turn conference room glass windows from clear to opaque. Then this layer the aluminum oxynitride also called a LAN or transparent aluminum, will provide strength and structural rigidity as it is the same material that is used as bulletproof glass on armored vehicles.

So, now that we understand the layers let's go through some functionality. When the smartphone is closed, and the secondary screen is folded on top of the primary screen the secondary screen will be fully transparent. The touch screen on the back of the secondary screen will operate the primary screen and then the phone will operate like a normal smartphone. When the secondary screen is flipped open the middle layer of polymer dispersed liquid crystal will turn it opaque and the secondary screen will function as an additional touch screen display. What are your thoughts on this concept of a foldable smartphone? That wraps it up for this article about foldable smartphones.

Samsung
Galaxy Z Fold4

The sleek 6.2" cover display unfolds to double its size, providing one expansive 7.6" 120Hz edge-to-edge Dynamic AMOLED 2X Infinity Flex screen that's like a tablet.

THE WHEEL REINVENTED

Lakdinu De Silva
(First Year Undergraduate)
Faculty of Engineering - University of Ruhuna

Since the dawn of human history humans have always ventured into the unknown for the sake of curiosity and for the prospect of a better future. With the advent of the space age, humans ventured far beyond our home planet and began exploring the universe. Each exploration is backed by brilliant engineering designs and discoveries which contribute to the success of the mission. In certain missions unexpected challenges arise and the world looks towards engineers to find a solution to these challenges.
In this article, we will discuss a challenge faced by a rover on the Martian surface and how brilliant engineers engineered a solution for future missions by utilizing materials science engineering.

THE MARTIAN TERRAIN

Mars is the fourth planet from the Sun in our solar system preceded by Mercury, Venus, and Earth. From a scientific standpoint, it is the planet which is most similar to Earth in the solar system and hence it has been the destination of many missions to understand the surface of mars and its evolution. Mars is also known as the 'red planet' due to the iron oxide in its' surface soil which gives it a reddish colour similar to that of rust. The colour of mars is even visible to a naked eye in a clear night. The mean surface temperature of Mars is approximately -65□C and the terrain is non uniform, having a rocky surface with volcanoes, canyons, and dry lake beds.

To date, there have been 20 missions to mars, of which 9 were rovers which landed on the Martian surface. Of these rovers, Curiosity, insight, and perseverance are currently in their mission of exploration. Let us now explore the challenges presented to the Curiosity rover by the Martian terrain and how the wheels of future rovers should be modified to face these challenges.

LESSONS LEARNT FROM CURIOSITY

The Curiosity rover landed on mars at 10.32 p.m. pacific standard time on the 5th of August 2012. In 2013, NASA noticed that there was significant damage on the rovers' wheels. The reason for this was that the Martian terrain was rougher than was anticipated. The rough terrain coupled with the fact that Curiosity is a heavier rover than most, caused certain regions of the wheels to undergo permanent deformation and even fracture. NASA understood that this is a problem that will be faced by any rover in the future which attempts to navigate any rough terrain in mars or any extra-terrestrial planet. Hence a solution to the permanent deformation must be found and an ideal wheel for future space missions must be engineered.

THE IDEAL WHEEL

If we consider most wheels on earth, they have a pneumatic tire mostly formed by a synthetic material. The use of the pneumatic tire is that it can deform in the face of an obstacle and distribute the force over a larger surface area which reduces the stress on the tire. However, these elastic properties of rubber exist only within a particular temperature range. As described before, the Martian surface temperature is approximately -65 degrees Celsius. A temperature at which the synthetic rubber becomes a brittle glass like material showing little to no elastic properties. Furthermore, the Ultraviolet radiation the rover will be exposed to on the Martian surface will degrade the rubber with time. In addition to this, rubber tires are quite heavy and would increase launch costs for the mission. Hence pneumatic wheels are not practical to be used for missions on mars.
The lunar rover carried by the Apollo 15, 16 and 17 spacecrafts had spring tires as shown in the diagram below.

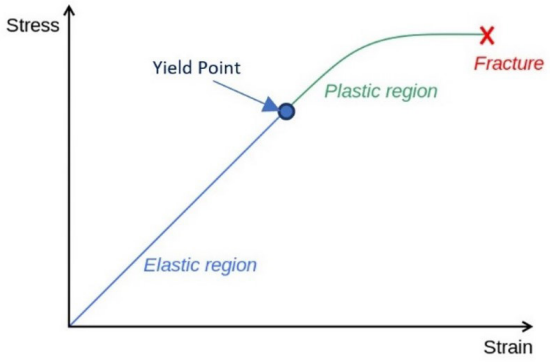
The rover used flexible steel mesh wheels (spring wheels) with a stiff inner frame to prevent over deflection, however since the Curiosity rover is about twice as heavy as the lunar rover and the fact that Mars's gravity is more than twice that of the moon means that the wheel would permanently deform due to the strain. Hence the spring wheel of the lunar rover would not be suitable for rovers such as Curiosity on Martian terrain.

An ideal wheel should have the ability to deform in the face of an obstacle and then retake its original shape once the obstacle is past. It should also be able to maintain traction on the loose Martian sands and be durable for long missions. The wheel should retain all these properties at the surface temperature of mars and should be lightweight to reduce launch costs.

HOW DEFORMATION WORKS.

To understand the physics of deformation and what it means, a stress strain curve must be referred. It shows how the stress on a particular material varies when a strain is applied to it. The point marked represents the yield point of the material. Basically, if the material is subjected to a stress less than the stress at the yield point (yield stress) the material can revert to its original shape once the stress is removed. This is known as elastic deformation (this is the type of deformation that we are interested in).

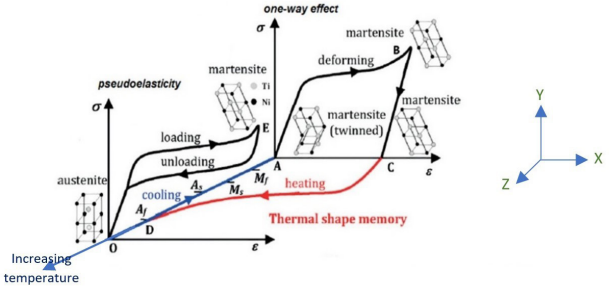
If the material is subjected to a greater stress, then the material undergoes plastic or permanent deformation. Which means that the material will not revert to its original shape once the stress is removed. It can be observed that the curve ends at a particular point. This point is known as the fracture point. If a large enough stress is applied the material will break. Both fracture and plastic deformation were problems for Curiosity's wheels.



When viewing the crystal structure during permanent deformation, a limited number of atomic bonds break and allows crystal planes of the metal to slip past one another. This is the reason why the material cannot revert to its original shape even after the stress is removed. We shall now look at the stress strain curve of an interesting metal called 'nitinol' and how this metal creates the ideal wheel for extra-terrestrial missions.

NITINOL TO THE RESCUE

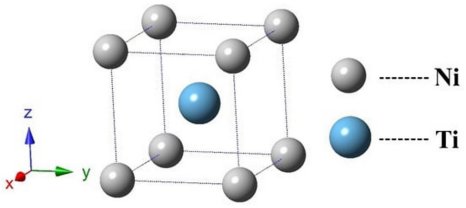
Nitinol was discovered by William Buehler and Frederick Wang in the year 1959 in the Naval Ordinance Laboratory. It is named after its' constituent elements: Nickel and Titanium and the first letters of the place in which it was made: Naval Ordinance Laboratory. Nitinol exhibits two interesting properties. One is the shape memory property and the other is the property of super elasticity. The shape memory property of Nitinol allows it to undergo plastic deformation but will revert to the original shape once it is heated. The super elastic property allows it to exhibit elastic properties for very large strains and recover back to the original shape without requiring any external heat supply. Nitinol exhibits these properties at two different temperatures as shown in the stress strain curves given below.



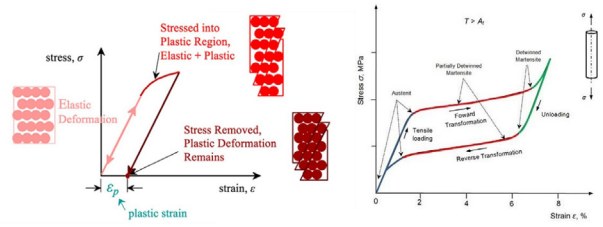
The diagram represents two curves given in a three-dimensional space. For the benefit of the reader an axis system is shown. The Y axis represents the stress on the material, The X axis represents the strain of the material, and the Z axis shows the temperature. Hence the curve shown in the top occurs at a lower temperature than the curve at the bottom. The curve at the top (the one at the lower temperature) shows the shape memory property of nitinol while the bottom curve (the one at the higher temperature) shows the super elastic property of nitinol. Since it is the super elasticity, we are interested with for the rovers' wheels, we will only be considering the lower curve.

THE SUPER ELASTIC PROPERTY OF NITINOL

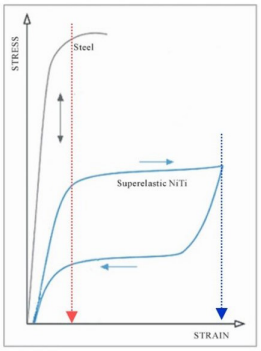
Now nitinol exhibits the super elastic property at relatively higher temperatures than for which it exhibits shape memory properties (this temperature can be changed by varying the titanium content). To analyse this property, we shall observe the lower curve. Let us observe what the nitinol microstructure looks like at point O on the curve.



Here we see that a Titanium atom is surrounded by eight Nickel atoms. The arrangement of atoms in this form is called a Body Centred Cubic arrangement or BCC. This BCC crystal structure of nitinol is referred to as Austenite. When a load is applied, the atoms will rearrange the crystal structure into a new structure called Martensite in order to better accommodate the strain. Due to this phase transition, the stress strain curve of Nitinol behaves in a different way than that of a metal like steel.



Now if steel is deformed beyond its elastic limit, and the load is released, the material will show a permanent plastic deformation named in the diagram as 'plastic strain'. In the case of nitinol, the curve comes back in on itself and joins the loading curve before the stress is completely removed. This occurs due to the transformations. During loading, the austenite is transformed to martensite and upon unloading, the martensite is reconverted back into austenite. The martensite to austenite phase transition occurs because at (relatively) higher temperatures, the martensite crystal structure is unstable. Let's put both curves on each other.



Here, it can be seen that when the strain reaches the level indicated by the red arrow, the steel specimen will undergo plastic deformation and will not return back to its original shape once the load is removed. The nitinol wire, however, can accommodate a much greater strain and still return to its original shape. Hence it is evident that nitinol can withstand a much greater strain than steel. Although it is not shown in the above figure, nitinol too has an elastic limit. If it is deformed beyond that, it too will be unable to come back to its original shape. What makes it different is that yield point of nitinol occurs at a much higher strain than for steel.

NASA and Goodyear produced the nitinol in a form similar to medieval chainmail and it was fixed to a rim. The wheel thus formed could deform even until the rim but still revert to the original shape. The nitinol in the wheel has been designed such that it forms the austenite structure at Martian surface temperatures.

The 'higher temperature' mentioned in the article was set to the temperature of the Martian surface. In essence, the nitinol wheel will act in a similar manner to a rubber tire on earth without the limitations of rubber such as weight and degradation. It also overcomes the problem of permanent deformation faced by the wheels of the Curiosity rover.

This article discussed a brilliant feat of materials science engineering to overcome a challenge to rovers on extra-terrestrial missions. This goes to show that with the proper command over material science, many engineering challenges can be overcome. We salute the great minds who engineered this material and who applied this material to solve the issue of wheel damage in extra-terrestrial rovers.

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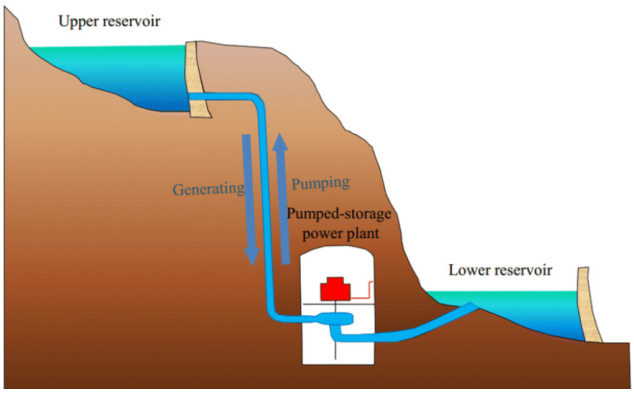
HYDRO POWER

WHAT IS A PUMPED STORAGE HYDRO POWER PLANT?

Nowadays, the world is shifting towards green energy due to various reasons. There, hydroelectricity plays a vital role. In a traditional hydropower plant, water is released to the stream again after generating power. Pumped-storage power plants are reversible hydroelectric facilities where water is pumped uphill into a reservoir. Then the potential energy stored in water is used to produce electricity in the same way as traditional hydropower plants. Their ability to store energy makes them an effective tool to overcome the irregular nature of wind and solar power.

THE CONCEPT BEHIND A PUMPED STORAGE HYDRO POWER PLANT

The system consists of two reservoirs at two different altitudes. When the demand in the grid is high, water in the upper reservoir is used to generate electricity. Then water is discharged to the lower reservoir. When the demand in the grid is low, turbines consume electricity from the grid and spin backward to pump water back to the upper reservoir. Then water can be again discharged to rotate the turbine and produce electricity. The procedure can be shown from the below diagram.



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PUMPED STORAGE POWER PLANTS AROUND THE WORLD

China has taken a step forward to construct more pumped storage power plants and shut down their coal power plants than other countries in the world. There are pumped storage power plants with capacity more than 3000MW located in China and America. A lot of pumped storage power plants are located in China and Europe due to their geography.

The table below shows few pumped storage hydropower facilities around the world.

Power plant	Capacity(MW)	Country
Fengning Pumped Storage Power Station	3600	China
Bath County Pumped Storage Station	3003	America
Guangdong Pumped Storage Power Station	2400	China
Meizhou Pumped Storage Power Station	2400	China
Changlongshan Pumped Storage Power Station	2100	China

SRI LANKA AND PUMPED STORAGE HYDRO POWER PLANTS

CEB conducted research in collaboration with JICA in 2014 and has identified 11 potential sites for the development of 600MW pumped storage power plants. According to the study, Halgran oya, Maha oya and Loggal oya which are located in Nuwara Eliya, Kegalle and Badulla districts were selected as the most suitable sites.

A.I. HEARING AIDS

"Harnessing the power of artificial intelligence to transform hearing healthcare."

Tharindu Nanayakkara
(First Year Undergraduate)
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Electrical engineering is an engineering discipline concerned with the study, design, and application of equipment, devices and systems which use electricity, electronics, and electromagnetism. A great progress has been made in electrical engineering field in the world today.

Electric vehicles, drones, smart grids, transfer of wireless power, wireless wearable technology , etc are demonstrating the development in this field. Actually, electrical engineering has achieved a major part in the engineering field. It can be seen that there are many applications in all the industries like transportation, medical, food industry & etc.

Wireless wearable devices in the field of digital media application in multimedia playback control and the parameters of the health monitoring, multimedia equipment data control, new media art and design, and design of VR games and entertainment and intelligent fiber, such as common armband, all kinds of gloves, VR, AR glasses, and head-type equipment are the most typical wearable devices. The development of brainwave sensors, DIY sensors, and interaction systems specifically designed in different functional interaction systems and other technologies have provided a richer range of functions for wearable devices.

The most sophisticated examples of wearable technology include artificial intelligence (AI) hearing aids, Google Glass and Microsoft's HoloLens, and a holographic computer in the form of a virtual reality (VR) headset. An example of a less complex form of wearable technology is a disposable skin patch with sensors that transmit patient data wirelessly to a control device in a healthcare facility. Over 5% of the world's population – or 430 million people – require rehabilitation to address their 'disabling' hearing loss (432 million adults and 34 million children). It is estimated that by 2050 over 700 million people – or one in every ten people – will have disabling hearing loss.

Fantastical notions of all-powerful robots, straight out of Hollywood, may come to mind when you think about artificial intelligence (AI). But set aside thoughts of the machines taking over: When it comes to your hearing aids, AI helps the devices function better. As of today, scientists have been able to invent artificial intelligence hearing aids. Artificial intelligence (AI) is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by animals and humans. For instance, AI can help wrangle one of the most challenging situations if you struggle to hear: Engaging in a conversation when you're in a crowded, loud space (think: a restaurant or cafe). Because as you know if you wear a hearing aid, louder isn't the solution. From month to month, year to year, researchers are finding more ways to harness this technology and use it to improve hearing aids. Here's what you need to know about how hearing aids use AI—and if a hearing aid with this functionality is right for you or a loved one.

Hearing aids used to be relatively simple. But when hearing aids introduced a technology known as wide dynamic range compression (WDRC), the devices began to make a few decisions based on what it heard. Essentially, a DNN allows hearing aids to begin to mimic how your brain would hear sound if your hearing wasn't impaired. In recent years, major hearing aid manufacturers have been adding AI technology to their premium hearing aid models. For example, Widex's Moment hearing aid utilizes AI and machine learning to create hearing programs based on a wearer's typical environments. In a complicated "sound scene"—picture a bustling airport or hospital emergency room—the Oticon More's neural net receives a complicated layer of sounds, known as input. The DNN gets to work, first scanning and extracting simple sound elements and patterns from the input. It builds these elements together to recognize and make sense of what's happening. Lastly, the hearing aids then make a decision on how to balance the sound scene, making sure the output is clean and ideally balanced to the person's unique type of hearing loss. With the rapid development of the technology, world has become smarter. As a result, the people who have hearing losses able to enjoy the beauty of the nature. Actually, it was a great victory which scientists have achieved.

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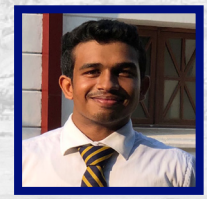

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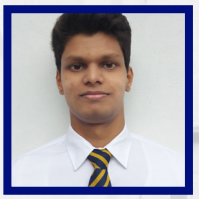

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