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Darul Makmur
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TABLE OF CONTENTS

EVALUATION OF CARBON FOOTPRINT IN CANTEEN AND LADIES' DORMITORY POLYTECHNIC KUCHING SARAWAK	1-8
Norain Binti Ali, Redzuan Safri Bin Abdul Rahman, Ayub Bin Abdullah, Deborah Edah Disa, Natasha Anak Milon	
KUALITI AIR DAN ISIPADU AIR LELEHAN DARIPADA PENYAMAN UDARA DI DALAM PENGGUNAAN KITAR SEMULA	9-12
Shahrulnizam Bin Bahari, Muhamad Waridi Bin Hadzali, Mohd Hazry Bin Ismail, Norain Bt Ali, Azrina Bt Mahadi	
APLIKASI GREEN PEG BAGI KERJA AMALI KURSUS DCC20063	13-25
Haslienda Binti Mohd.Iham, Nor Safizah Binti Ponachi, Maskedah Binti Kamaluddin	
MENANGANI PENCEMARAN PLASTIK	26-32
Zulkurnain Bin Hassan, Thiruchelve A/P Ramasamy	
PENGHASILAN BAHAN PENGAJARAN DAN PEMBELAJARAN INTERAKTIF BERBENTUK REALITI MAYA VR360: BASIC TREATMENT FOR SEVERE BLEEDING	33-43
Siti Zaleha Binti Ibrahim, Manisah Binti Mohamad, Rozalina Binti Ab.Rashid Che Ku Ahmad Fuad Bin Che Ku Abdullah	
KELESTARIAN BINA-TEMPAT DESTINASI PELANCONGAN DI MALAYSIA MENERUSI RANCANGAN MALAYSIA DARI TAHUN 1957-2020AN	44-61
Mohamad Kazar Bin Razali, Habibah Binti Ahmad, Er Ah Choy, Hamzah Jusoh	
ANALISA PRESTASI PENGGUNAAN SISTEM PAIP DOMESTIK SEBAGAI PENYEJUKAN DINDING	62-69
Muhamad Asrul Affendi Bin Mat Nor, Farah Waheda Binti Othman, Muhammad Razuan Bin Abdul Razak	
SOLAR POWERED ELECTRIC GENERATOR LEARNING KIT	70-75
Tan Chin Chai	
SELF SUSTAINABLE VERSATILE PERSONAL FLOTATION DEVICE	76-81
Ibrahim Bin Burhan, Izza Mahirah Binti Ibrahim, Alimran Bin Ahamed Nijamudin, Syazwan Haziq Bin Sharmin Asrol, Muzill Mu'izz Bin Mohd Rafi	
DEVELOPMENT OF SMART ZEB SYSTEM FOR INCREASING EFFICIENCY OF ENERGY CONSUMPTION USING THE INTERNET OF THINGS TOWARDS LOW CARBON BUILDING	82-92
Ts. Zainolrin Bin Saari, Ts. Suhana Binti Ismail, Abdul Aziz Bin Jamaludin, Siti Farah Binti Hussin	
INVESTIGATION ON THE FLY ASH AND WASTE CLAY ROOF TILES IN CONCRETE MIXTURES	93-98
Ts. Dr Hassan Bin Ismail, Mohd Ruzi Bin Hamzah, Syazwina Mat Zainuddin	
ADAPTIVE GREEN DESIGN SOLUTION IN RETREAT SPACES	99-103
Nor Akmal Binti Mohamad	

KAJIAN PROSES PEMULIHAN HABA DARIPADA PENYAMAN UDARA MUDAH ALIH DAN PENAPIS AIR DENGAN MENGGUNAKAN KESAN PELTIER	104-111
Muhamad Asrul Affendi Bin Mat Nor, Farah Waheda Othman, Sharul Nizam Yaakop	
PERFORMANCE AND RESILIENCE OF POLYCERA® TITAN MEMBRANE FOR INDUSTRIAL WASTEWATER TREATMENT	112-121
Ernie Bt Zulkifli, Zazurah Binti Mat Zuini, Siti Norzaemah Bt Mohd Rashid	
KEKUATAN TEGANGAN KOMPOSIT BERTETULANG SERAT BULUH	122-129
Norliana Binti Bakar, Nor Isha Bin Nordin	
PEMBANGUNAN ALAT PEMAMPAT HABUK KAYU DAN SISA PERTANIAN UNTUK BAHAN BIOJISIM	130-136
Zulhishamuddin Abd Rahman, Aida Haryati Binti Muda, Mazilah Binti Abu Bakar	
APLIKASI SISTEM MAKLUMAT GEOGRAFI DALAM MENGENAL PASTI TAPAK PELUPUSAN SISA PEPEJAL (KAJIAN KES: DAERAH KUANTAN, PAHANG)	137-143
Gs. Sr. Muhamad Firdaus Bin Che Amat	
KAJIAN KUALITI UDARA PADA PENAPIS UDARA DI SALURAN UDARA SISTEM PENYAMANAN UDARA JENIS AIR HANDLING UNIT (AHU)	144-151
Muhamad Asrul Affendi Bin Mat Nor, Farah Waheda Binti Othman, Shafri Bin Saad	
MEREKA BENTUK ALAT PENYEMBUR BERODA UNTUK KEGUNAAN PEKEBUN KECIL	152-158
Miskiah Binti Wakijan, Muhamad Farhan Bin Mat Atan, Mohamad Norfirdaus Bin Norhan	
KAJIAN PENGUMPULAN TERMA TENAGA SOLAR BAGI KITARAN RAKINE ORGANIK	159-166
Muhamad Asrul Affendi Bin Mat Nor, Farah Waheda Binti Othman, Zulkurnain Bin Hassan	
MANAGING ENERGY REDUCTION BY OPTIMIZING AWJM INPUT PARAMETERS IN CUTTING HYBRID MMC AL7075 MATERIAL	167-174
Saipul Azmi Bin Mohd Hashim, Sufandi Bin Mohd Johan, Meor Hamzah Bin Mohamed Zawawi	
KAJIAN AMALAN PENGURUSAN SISA PEPEJAL DALAM KALANGAN PENGUSAHA INDUSTRI KECIL SEDERHANA PELANCONGAN DI CHERATING, PAHANG	175-182
Suhaini Binti Ibrahim, Rusiana Binti Rahim	
KAJIAN MENGENAI KAEDAH MEMINIMUMKAN SISA BAHAN BINAAN DI TAPAK BINA	183-188
Noor Azma Binti Abu Bakar, Mohd Khairul Anuar Bin Haron, Nurul Izzah Binti Joha Jamil	
KAJIAN BAHAN CEMAR (KANDUNGAN FERUS) DALAM SISTEM BEKALAN AIR DI POLITEKNIK PORT DICKSON	189-195
Noraziela Binti Mokhtar, Saiful Razwan Bin Ismail	
IMPROVEMENT OF INDOOR AIR QUALITY IN REDUCING THE AMOUNT OF CO2 (CARBON DIOXIDE) USING GOLDEN POTHOS PLANT AS BIO-FILTER GREEN WALL	196-202
Saiful Razwan Bin Ismail, Khirwizam Bin Md Hkhir, Azrul Affandi Bin Eliah	

<p>TAHAP KESEDARAN TERHADAP TANGGUNGJAWAB SOSIAL KORPORAT (CSR) DI KALANGAN PELAJAR SEMESTER TIGA DIPLOMA PELANCONGAN REKREASI DALAM MEMASTIKAN PEMULIHARAAN KELESTARIAN ALAM SEKITAR DI TAPAK RAMSAR TASIK BERA</p> <p>Farrah Waheeda Binti Azan, Muhammad Hazwan Bin Mohd Rafien, Nur Muhammad Fuad Farizul Bin Che Pak</p>	<p>203-209</p>
<p>STUDY ON ALOE VERA, CACTUS, AND BANANA STEM AS BIO-COAGULANT IN REMOVAL OF TURBIDITY</p> <p>Azzah Syahmina Binti Azman, Noor Farahin Binti Bain</p>	<p>210-215</p>
<p>PENGGUNAAN BOLA LUMPUR SEBAGAI MEDIUM PEMULIHARAAN KUALITI AIR TASIK</p> <p>Jusma Binti Jaafar, Norliana Binti Bakar</p>	<p>216-224</p>
<p>IMPLEMENTASI KONSEP PEMBERIAN MATA GANJARAN KEPADA PELANGGAN MELALUI APLIKASI SISTEM MY BALAS BEG (MBB) BAGI MENGURANGKAN PENGGUNAAN BEG PLASTIK DALAM URUSAN JUAL BELI</p> <p>Siti Sarah Malini Bt Mohd Hanifa, Rasmaliza Bt Rashid, Wan Noorhishamudin Bin Wan Mohd@Mohd Khairi</p>	<p>225-238</p>
<p>TINJAUAN PENGGUNAAN BEKAS MAKANAN PLASTIK DALAM KALANGAN PELAJAR JABATAN PELANCONGAN DAN HOSPITALITI (JPH) DI POLITEKNIK MUADZAM SHAH, PAHANG (PMS)</p> <p>Mohd Rahimi Bin Mohd Shahimi, Norsuriaty Binti Sopi, Nardiahtul Aini Binti Kamarudin</p>	<p>239-246</p>
<p>IMPLEMENTATION OF GREEN ELEMENTS BUILDINGS FOR DESIGN PROJECT IN DESIGN STUDIO COURSE AMONG POLYTECHNIC'S ARCHITECTURE STUDENTS</p> <p>Farida Binti Zakaria, Nurul Fadzleen Binti Mohamad, Masita Binti Hassan</p>	<p>247-255</p>
<p>BICYCLE HUB: A GREEN DESIGN PLAN FOR PARKING A, POLISAS, KUANTAN</p> <p>Wan Noor Hin Binti Mior Sani, Rozalina Binti Ab Rashid, Nurul Faizatul Hanim Binti Othman</p>	<p>256-263</p>
<p>POTENTIAL OF PRODUCING POLYMER COMPOSITE FROM DRY LEAVES WASTE</p> <p>Nor Shaufina Binti Md Jaafar, Muhamad Soffi Manda</p>	<p>264-271</p>
<p>KAJIAN KEBERKESANAN PENGURUSAN TENAGA LESTARI DI POLITEKNIK PORT DICKSON</p> <p>Nurul Huda Bt Jamil, Azrinawati Bt Samaon</p>	<p>272-278</p>
<p>APPLICATION OF STUDENTS IN THE PRACTICE OF GREEN TECHNOLOGY IN THE PRINTING PROCESS</p> <p>Muhammad Nasuha Bin Yusop, Zulhelmi Bin Ahmad, Nur Shafinda Wani Binti Shaikh Azmee</p>	<p>279-284</p>
<p>PELUPUSAN SISA MENGGUNAKAN KAEDAH PELUPUSAN TERBUKA (OPEN DUMPING): KAJIAN KES DI DALAT, SARAWAK</p> <p>Arni Rahida Binti Abd Rafal</p>	<p>285-292</p>

BIOFUEL: KAJIAN TERHADAP PRESTASI ENJIN MOTOSIKAL 110 CC MENGGUNAKAN CAMPURAN BAHAN API PETROL-ETANOL	293-301
Ahmad Ridhwan Bin Abdullah, Md Syahrizal Bin Mohd Nawawi, Ilyas Bin Ishak	
THE STUDY OF GREYWATER QUALITY FROM DIFFREANCE RESIDENTIAL AREAS	302-307
Mohd Zamri Bin Jamaludin, Awangku Isma Muzafar Bin Pangeran Bagul, Nur Sayidah Binti Mohamed Ali, Nur Aisyah Binti Azman, Amirul Asyraf Bin Aslin	
THE LEVEL OF AWARENESS TOWARDS THE GOAL OF BLUEPRINT SMART GREEN POLYCC 2021-2026 (BSGPC) AMONG POLYTECHNICS AND COMMUNITY COLLEGES ACADEMICIANS	308-314
Dr. Lee Yoke Lai, Dr. Suzaliza Mustafar, Dr. Norliana Mohd Abbas, Rohaniah Binti Mohd Nor, Zulhairie Adni Bin Abdul Halim	
KECEKAPAN PENGGUNAAN TENAGA ELEKTRIK DI KOLEJ KOMUNITI SUNGAI SIPUT	315-322
Siti Izwani Binti Zainal Abidin, Suzzana Binti Noordin, Mohd Zairulniza Bin Jaludin	
KEPENTINGAN PROGRAM GEOMATIK DAN ALAM SEKITAR	323-330
Noor Khairul Idham Bin Nordin, Sharifah Izyani Binti Syed Yusoff	
PENGURUSAN MAMPAN; PENGGUNAAN BAHAN BUANGAN SEBAGAI BAHAN ALTERNATIF KITAR SEMULA	331-340
Ahmad Yusri Bin Mohamad, Abd Rahim Bin Awang, Syurina Binti Samsudin	
MODELLING THE SUSTAINABILITY OF HEAVY GOODS VEHICLES IN SUPPORTING TOWARDS GREEN LOGISTICS DEVELOPMENT	341-347
Muhammad Firdaus Abd Rashid, Nik Reduan Abu Zakaria, Muhammad Akmal Asyraaf Adlan	
PENGURUSAN PENYIMPANAN LAPORAN SMART PMKU DI POLITEKNIK METRO KUANTAN	348-354
Nurrul Hasanah Binti Md Teni, Nor Akashah Binti Kassim, Sadariah Binti Mohd Ariff	
SENARIO PENGURUSAN SAMPAH DAN SISA PEPEJAL DI MALAYSIA: PERANAN SERTA SUMBANGAN INSTITUSI PENDIDIKAN TVET	355-358
Zarulrizam Bin Ab Jalil, Zaini Bin Ahmad, Mohd Aznan Bin Janal	
E-BOOK: INFOGRAPHIC TRANSPORTATION SEBAGAI ALAT BANTUAN PEMBELAJARAN	359-363
Norsidah Binti Othman	
KEBERKESANAN PENGGUNAAN SISTEM KEMANJA UNTUK MENGURANGKAN MASA MENGISI BUTIRAN PELAJAR	364-369
Muhamed Harries Bin Sazali, Azmawati Binti Salleh	
IMPAK PENGGUNAAN APLIKASI MUDAH ALIH RP CARE TERHADAP MOTIVASI PENGGUNA DI KALANGAN KOMUNITI RANTAU PANJANG	370-380
Mohd Azian Bin Husin @ Che Hamat, Wan Mohd Tarmizi Bin Wan Othman, Azre Bin Arifin	
GREEN TECHNOLOGY AWARENESS AMONG ENGLISH TEACHERS FROM TECHNICAL HIGHER LEARNING INSTITUTIONS	381-392
Nadrah Binti Zainal Abidin, Nadiah Binti Zainal Abidin	

ESTIMATION GLOBAL SOLAR RADIATION IN MELAKA USING ANGSTROM PRESCOTT	393-400
Nor Farhana Binti Falil, Siti Fatimah Binti Mardan, Siti Nurnajihah Binti Sulhadi, Nur'amirah Binti Mohamad Rashid	
A STUDY ON ENERGY EFFICIENT FOR LIGHTING SYSTEM IN ELECTRICAL ENGINEERING DEPARTMENT AT POLITEKNIK SULTAN IDRIS SHAH	401-410
Rasna Binti Mansur, Zharif Naquiuddin Bin Abdul Munit, Ts. Mohd At-Tarmizi Bin Abu Hassan	
FERTILIZER PRODUCTION FROM FOOD WASTE	411-417
Nur Shuhada Bt Arbaan, Mimi Malisa Bt Dolhan, Noor Farahin Bt Bain	
PHYSIOCHEMICAL ACTIVATION OF AN ACTIVATED CARBON FROM ELAEIS GUINEESES (PALM KERNEL SHELL)	418-421
Noor Farahin Bt Bain, Azzah Syahmina Bt Azman, Nur Shuhada Binti Arbaan	
INCORPORATING DESIGN THINKING APPROACH IN ECO-FRIENDLY INNOVATION PROJECT FOR COMMUNICATIVE ENGLISH ASSESSMENTS	422-427
S. Thivviyah Sanmugam, Norzilah Binti Mohd Ali	
CONSTRUCTION AND EXPERIMENTAL PERFORMANCE OF DUAL-AXIS SOLAR TRACKER PROTOTYPE TRAINER USING SIEMENS PROGRAMMABLE LOGIC CONTROLLER	428-435
Shafura Binti Shariff, Haryani Binti Hassan, Dr. Normazlina Binti Mat Isa	
THE DESIGN OF UPSIDE-DOWN WATER CHAMBER RAM PUMP FOR SMALL FARMERS	436-440
Norazlina Binti Ahmad Sarai, Ahmad Shafawi Bin Abdullah, Noriah Binti Johan, Wan Nur Ashikin Binti Wan Umar Baki, Afiq Rahiman Bin Rashid	
AMALAN PEROLEHAN HIJAU KERAJAAN BAGI PERALATAN ICT DALAM SEKTOR AWAM DI MALAYSIA	441-447
Norazila Binti Samuri	
KESEDARAN MENGENAI KEMAMPANAN ALAM SEKITAR DALAM KALANGAN PELAJAR KOLEJ KOMUNITI PULAU PINANG	448-460
Nor Azurainie Binti Adnan, Abd Muhsin Bin Baharin, Eni Binti Aznan	
AIRCRAFT PERSONAL SAFETY COMPARTMENT (APSC)	461-464
Mohd Zulfazli Bin Raub Khan, Loqman Nulhakeem Bin Jamaluddin, Muhammad Asyraf Bin Zolkefly, Hariz Uzair Bin Azhari	
GREEN WASTE MANAGEMENT PRACTICES IN KOLEJ KOMUNITI KEPALA BATAS: A REVIEW	465-469
Noor Azlina Binti Abd Rahim, Ts Sofizain Bin Adam	
POTENTIAL USE OF COCONUT FIBRE AND PET BOTTLES AS A COOLER BOX	470-477
Uzana Binti Ismail, Nurhasimah Binti Shahrhan	
DESIGN OF BATTERY ELECTRIC VEHICLE ENERGY MANAGEMENT TOPOLOGY USING LOAD SEGMENTATION	478-485
Dr Tengku Azman Tengku Mohd, Nor Suraya Aini Ngah, Dr Mohd Daud Bin Isa	

BREAKING THE SILENCE: SUSTAINABILITY ENTREPRENEURIAL EDUCATORS TOWARDS GREEN ENTREPRENEURSHIP	486-491
Ayu Indayu Binti Mohd Zohdi, Nurul Syamshida Binti Mokhtar, Rosmanizah Binti Derahman	
INSPIRASI PANTUN DALAM PENDIDIKAN HIJAU	492-499
Saliza Binti Ghazali, M. Shariff Bin Aziz	
PENGGUNAAN CAMPURAN PLASTIK KITAR SEMULA PVC DAN PETE DALAM PENGHASILAN JUBIN KEMASAN LANTAI	500-508
Hazriesyam Amir Bin Mustapha, Nurul Shuhaida Binti Shamshuri, Umie Umairah Binti Ibrahim, Nur Syazreen Armeida Binti Sabri Rahimi, Nur Khadijah Binti Ahmad	
PERBANDINGAN PRESTASI, SERTA PARAMETER ELEKTRIK BAGI PANEL SOLAR STATIK RATA DAN SUDUT BOLEH LARAS	509-514
Muhammad Masri Bin Ahmad Tarmizi, King Diaw A/L Eh Sut, Muhamad Reduan Bin Abu Bakar	
PENGAJARAN DAN PEMBELAJARAN SECARA TRANSFORMATIF DI POLITEKNIK SULTAN HAJI AHMAD SHAH KUANTAN DALAM MEMBUDAYAKAN AMALAN HIJAU	515-519
Mohammad Hafeez Bin Md Ramli, Razana Fatin Abdullah @ Razali Wan Ahmad Razif Bin Wan Abd Ghani, Kamal Hisam Bin Abdul Halim, Fadhili Bin Muhammad	
IMPAK PERUBAHAN IKLIM TERHADAP PERMINTAAN DAN PENJANAAN TENAGA ELEKTRIK	520-530
Azreen Harina Binti Azman, Siti Khatijah Binti Mohamad, Nazmiah Binti Nawati	
EVALUATION PINEAPPLE WASTE AS A SUBSTITUTE FERTILIZER TO OKRA GROWTH	531-536
Wan Nor Afzan Bt Mohd Azmi, Wan Muhammad Irham Fitri Bin Wan Ashaari, Nurul Izzatie Binti Mohd Nazita, Siti Aisyah Binti Mohd Nor	
CONCEPTUAL OVERVIEW OF KODUNDUNGAN PADDY FIELD: THE LAST REMAINING TRADITIONAL PADDY FIELD IN THE URBAN LANDSCAPE OF KOTA KINABALU	537-542
Meltina Masanti, Ahmad Firdaus Masazhar, Jominin Goropos	
MULTI-PURPOSE PRO-TECHTOR HELMET (MPHT)	543-549
M. Nasiruddin B. Hushim, N. Aqil B. Aidy, Damian Ajeng Belawing, Rizq Faiz B. Azmi	
MOVEABLE AVIATION LIGHT (MAL)	550-555
Mohd Khairun Nizam Bin Sa'adan, Vishnuu A/L Narayanan, Muhammad Ferhan Bin Mohamad Salim, Salleh Wong Kok Ming, Mohamad Sandarshah Bin Suaidi	

Multi-Purpose Pro-Techtor Helmet (MPTH)

M. Nasiruddin B. Hushim¹, N. Aqil B. Aidy¹, Damian Ajeng Belawing¹ & Rizq Faiz B. Azmi¹

¹Politeknik Banting Selangor, Persiaran Ilmu, Jalan Sultan Abdul Samad, 42700, Banting, Selangor,

*Corresponding author's email: nasiruddin@polibanting.edu.my

ABSTRACT

The Multi-Purpose Pro-TechTor Helmet was design to wear in confine space in order to comply with safety regulation in the workplace. This helmet was constructed as a shock-proof helmet and equipped with battery as the power source. This helmet using Internet of Thing (IoT) to allow all the three features built on the helmet with Arduino Uno and coding method technologies. Arduino Uno has everything needed to support the microcontroller like power it with an AC-to-DC adapter or battery to get started. As this helmet develop with new safety features, the automatic LED light associated with Light Dependent Resistor (LDR) to allow the current flow and light up the LED once the intensity of light in the surrounding is low. Combustible gas exposure level around the workplace also the matter that can detect by MQ2 Sensor on the helmet and connected to buzzer to triggered once exposure limit has been reach. The last features are push button for the purpose of emergency to call for help that linked with ESP-32 to send notification on devices. This product with all the features has time limitation for the operation. As a results, this helmet enhances the safety in the confine space during inspection or maintenance. This proves the human error can be reduce as the features on the helmet can help the workers overcome the obstacle in the confine space and provide safety features.

Key words: Safety workplace, Internet of Thing, Safety Helmet, Confine Space, Arduino UNO

1. INTRODUCTION

Safety helmet is compulsory to wear at the workplace that might have tendency for hazards to present. In the industry, there were several incidents and accidents happened previously due to gas leakage and confine space limitations that be the catastrophic history also something to learn with it as the workers experienced it. Illumination of the workplace especially confine space also compulsory in order to perform a job with safety environment and to achieve effective working procedures as a result. As the gas leakage may occur and difficult to detect without any detector device, when the gas exposure limit has reached the threshold then the explosion can happen anytime and unpredictable. In the confine space, good lighting is very essential as working with the dark environment that do not have enough light access from the sunlight or the room light. In case of emergency, safety device is really crucial to call for help immediately.

“Airplanes with closed fuel tanks are subject to less limitations in a hangar and on the ramp in general. On the ramp. There are no flammability-zone restrictions associated with ramp maintenance activities and closed fuel tanks. However, maintenance personnel must be aware that fuel vapors can escape from the airplane surge tanks, especially on a hot day and during fueling. Fuel can spill from the surge tank vents during fueling operations if the tanks are overfilled. Maintenance personnel should not use any tooling or equipment that can create an ignition source under the surge tank vent scoop or near the fueling panel. On the ramp maintenance activities and closed gasoline tanks are not subject to flammability zone rules. Maintenance staff should be mindful, however, that fuel vapours might escape from the aeroplane surge tanks, particularly on hot days and during fueling. If the surge tanks are

overfilled, fuel may flow from the vents during fuelling operations. Under the surge tank vent scoop or near the fuelling panel, maintenance employees should not use any tooling or equipment that could cause an ignition source.” (Michael D. Jones, 2010)

According to above statement, gas leakage or fuel vapors from fuel tank are really dangerous as it is invisible and can cause explosion once it is ignited by the spark of electric or fire. Fuel can produce vapors or fumes when it condenses at certain temperature and certain surrounding to the atmosphere rapidly. Fuel vapors in the tanks can escape through the filler neck while refueling the aircraft or it might be throughout crack of the tank that may lead to gas leakage. In addition, while in the confine space or in the gas industry workplace, some of the risk as same as mention above due to gas leakage or fumes in confine space that cannot be detect. Specifically in the confine space such as aircraft fuel tank or huge pipeline, the workers deal with certain limitation such as low level of oxygen, poor illumination and poor communication might encounter the emergency event in limitations of move and motion to escape from that kind of emergency scene.

Therefore, this ‘Multi-Purpose ProTechtor Helmet’ built with some addition of safety features as it will ease workers to perform a job and alert them with the surrounding. As an innovation of ‘Multi-Purpose ProTechtor Helmet’, it is a new approach towards installing three new features to the helmet for the reasons of increasing safety elements while working in workplace. This new safety helmet providing a gas sensor detector, automatic light and emergency push button and all of this are using Internet of Things.

2. LITERATURE REVIEW

Safety helmet are widely used in the industry such as construction, mining, aviation, plantation, wiring and forestry just to achieved one big purpose which is safety first. The improvement in term of safety in the working area are currently develop very fast from time to time as so many an accident and incident occurs during working. When focusing on the other part of the workplace which the hazard likely to occur with high tendency to cause fatality, the part of the workplace can be describe as confine space. As in the confine space, with the limitations of room, ventilation and illumination the human factor mostly can occur once the personnel accidentally combine several factors then lead to undesirable situation. Most of the times it is essential to use safety helmet in the confine space to prevent worker’s head strike something fixed object or protect from falling object that may cause injury. The innovation for the safety helmet needs to be develop and make an improvement to show that the safety helmet is not just to protect head but also can produces alerting system and enhance the effectiveness of communication in case of emergency. The features along with the safety helmet to make an improvement is gas detector, emergency push button, and the automatic LED light in order to make it compatible when using it in the confine spaces.

No.	Component
1	Shell
2	Harness
3	Harness Fixing
4	Headband
5	Sweatband
6	Peak
7	Chinstrap

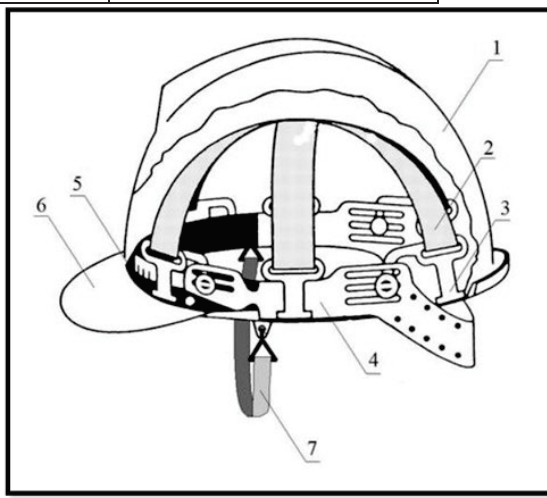


Figure 1: Safety Helmet Construction

The most well-known hazard associated with fuel-tank maintenance is jet fuel. Jet fuel is a flammable liquid that can catch fire under certain conditions, most notably temperature and vapour concentration. The "flash point" is the temperature at which the vapours of a flammable liquid can ignite." (David Sorrel, Boeing)

This is one of the examples of the hazard in the fuel tank of the aircraft that might occur. Since in the confine space there is no good illumination and communication has a limitation, sources of light are crucial and in case of emergency the instant 'calling' method need to pay attention as help and rescue can be response as soon as possible.

3. METHODOLOGY

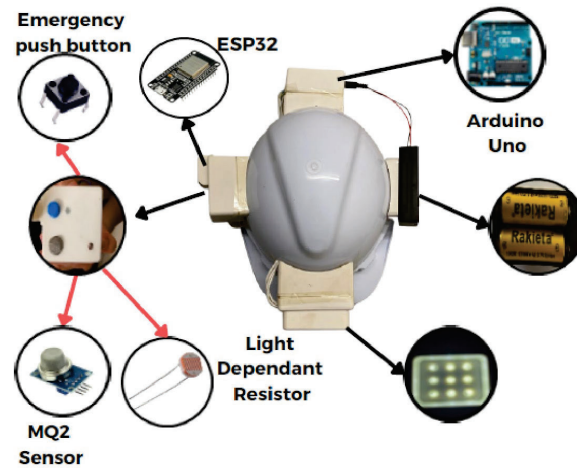


Figure 2: Multi-Purpose Pro-tection Helmet Features with Specific Parts.

The prototype as Figure 2 being produce are for workers those working in the construction site, mining, plantation, aviation, forestry and especially in the confine space. The name itself shows the features of this safety helmet which promote safety practices during working in the workplace. For safety purpose, this product is able to meet the standards and requirement that has been stated by the authority body. This safety helmet equipped with three features which is gas sensor detector, emergency button and automatic LED light. Most importantly, this safety helmet is reliable to be used in confine space.

This safety helmet has a basic component like other current safety helmet, shell, harness, harness fixing, headband, sweatband, peak and chinstrap are equipped as all of these are compulsory. Firstly, the gas sensor detector is the new features that able to detect combustible gas when an exposure occurs. Every combustible gas has its own threshold flammability limit. Exposure of gas is not just can lead to explosion but also can cause the difficulty to breath normally. With this gas sensor detector on the helmet, the exposure of gas can be detected and alerted the worker with the beeping sound from buzzer that triggered by the sensor when the reach the threshold.

The next feature of this safety helmet is emergency button. When undesirable event occurs, this emergency button can be pressed by the worker who wear it to call for help. Most of the time, when in the confine space the action to be taken to counter the emergency situation need to be really fast either to rescue human or to prevent loss of property. With the existence of this emergency button, it may save a life of human or avoiding the fatalities of the property or facilities in the workplace. When the button presses by the workers, it will transmit signal through Wi-Fi to the devices that connected to ESP 32 and the notification will appear with alerting sound on the smartphone.

Lastly, the automatic LED light also one of the features of this safety helmet. This LED light is to provide good illumination especially in the confine space to make the workers easy to perform the job. Even in the dark surrounding, this LED light is working with LDR photoresistor that can detect the level of light of the environment. When the level of light is low, the LED will automatically light up depend on the needs around the workplace. The sufficient

light is essential in order to prevent the human error during performing the task and to achieve the satisfied results of the works.

4. RESULTS & DISCUSSION

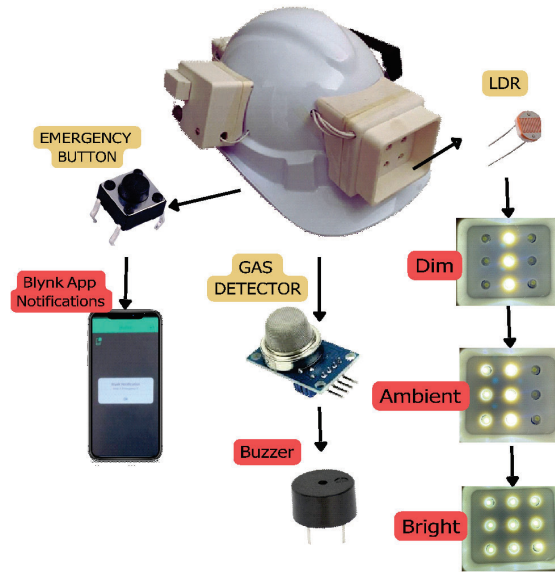


Figure 3: MPTH Prototype, the Functionality of Internet of Thing (IoT)

The development of this new innovation of safety helmet is about the functionality of Internet of Thing (IoT) working with electronic component and microcontroller. The Arduino UNO is categorized as a microcontroller that uses the ATmega328 as a controller in it. The Arduino UNO board is used for an electronics project and mostly preferred by the beginners. The Arduino UNO board I type of Arduino board only. The Arduino board is the most used board of all Arduino boards. The board contains 14 digital input/ output pins in which 6 are analog input pin, one power jack, USB connector, one reset button, ICSP header, and other components. All these components are attached in the Arduino UNO board to make it functioning and can be used in the project. The board is charged by USB port or can be directly charged by the DC supply to the board.

The three features that develop with the product when the safety helmet equipped with the casing that can be put on the helmet easily while the features of automatic LED, combustible gas detector with buzzer and emergency push button as a role in particular situation. Light Dependant Resistor (LDR) will detect the intensity of light in the thus will send signal to LED to be light up whenever dark surrounding occur.

The beeping sound of buzzer also activate when the level of combustible gas exposure exceeds the limit that sense by MQ-2 Sensor to alert the worker in just few second since the combustible gas exist. By enhancing, emergency fast response among workers, communication and alert system needs to be improve and one of the ways by using the Internet of Thing (IoT) provide by ESP-32 with Wi-Fi. ESP-32 will send notification to the connected device once the emergency push button triggered by worker when the are in emergency situation to call for help.

5. CONCLUSION

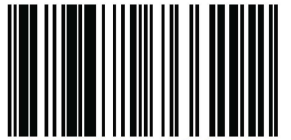
The contributions or impacts of this project to the society is to enhance the safety practices among the workers. With all the features provides on MPTH, it may also give advantages for the workers during completing the tasks on specific task that need good illumination in order to perform it. In accordance with to enhance safety and reduce serious incidents or accident in the industry, this MPTH equipped with emergency push button and gas detector. An automatic LED light on this project make the workers easy to perform works as they can use their pair of hand instead of using one hand to hold the torch light. This may relate to human factors consideration in order to avoid human error during performing task happened that lead to catastrophic. This project also always complies with the regulation that has been accomplished by Department of Safety and Health (DOSH) under Ministry of Human Resources on the rule of Personal Protective Equipment (PPE) to provide workers from several industry feel safe and comfort to use this MPTH.

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