POLITEKNIK UNGKU OMAR

PHOTOVOLTAIC PORTABLE TRAFFIC LIGHT

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CIVIL ENGINEERING DEPARTMENT

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AUTHOR'S DECLARATION

DESIGN STUDIES ON
'PHOTOVOLTAIC PORTABLE TRAFFIC LIGHT'

1. We are students of Diploma Kejuruteraan Awam, Politeknik Ungku Omar, that is located at Jalan Raja Musa Mahadi, 31400 Ipoh, Perak.

2. We acknowledge that the project above and intellectual properties in it are our original work unless indicated as referred work. The project was carried out in accordance with the regulations of Politeknik Ungku Omar. In the event that our report confirmed to be violating the conditions mentioned above, I voluntarily waive the right of conferment of my diploma and agree to be subjected to the disciplinary rules and regulations of Politeknik Ungku Omar.

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We would also like to acknowledge the faculty members of Politeknik Ungku Omar, who have who have imparted their knowledge and provided a conducive learning environment for the development of my project. Their teachings and mentorship have been invaluable in shaping my understanding and enhancing my skills in this field of study.

In addition, we are thankful to our family and friends for their unconditional support, encouragement, and belief in our abilities. Their constant motivation, understanding, and patience have been a source of strength throughout this project.

ABSTRACT

Over the past several decades, traffic lights have played an indispensable role in regulating traffic and ensuring road safety. However, the inherent limitation of traditional traffic lights being fixed to permanent locations poses challenges in dynamic scenarios such as roadworks, emergency situations, and construction projects. This article explores the evolution and significance of portable traffic lights, a relatively recent innovation in the field of traffic management, designed to offer flexibility, efficiency, and safety in situations requiring temporary traffic control measures. Portable traffic lights share the conventional color-coded system with their fixed counterparts, employing red to signal a stop, yellow for caution, and green for go. Notably, they incorporate countdown timers, akin to traditional traffic lights, providing drivers with a temporal reference before the light transitions. This combination of familiar signalling and additional features contributes to a seamless integration of portable traffic lights into existing traffic management systems. The driving force behind the development of portable traffic lights stems from the imperative need for greater adaptability in traffic management. Unlike fixed traffic lights, which may necessitate intricate adjustments and consume valuable time in response to unforeseen incidents like accidents, portable traffic lights enable traffic managers to redirect traffic swiftly and efficiently. This responsiveness ensures the continuous flow of traffic, mitigating delays and enhancing overall road safety. Furthermore, the surge in roadworks and construction projects has intensified the demand for effective traffic control measures. Portable traffic lights emerge as a practical solution in these scenarios, where the need to close lanes or entire sections of roads is common. The ease of transport and rapid setup of portable traffic lights not only facilitates efficient traffic flow management but also enhances safety for both workers and motorists. Their implementation streamlines the completion of projects, minimizing disruptions and reducing the risk of accidents associated with construction zones. While challenges accompany the deployment of portable traffic lights, including coordination with existing infrastructure and potential resistance to change, the undeniable benefits propel their continued integration into contemporary traffic management practices. The adaptability and efficiency of portable traffic lights offer a promising outlook for addressing the evolving complexities of traffic management, from routine road maintenance to critical emergency situations. As technology advances, further innovations in portable traffic light systems are anticipated, promising enhanced solutions for optimizing traffic control in the ever-changing landscape of urban transportation.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Traffic lights have been essential to our modern transportation system for decades. They serve as a means of regulating the flow of traffic and ensuring safety on the roads. However, traditional traffic lights are typically fixed to a permanent location, and this can pose a problem in certain situations. For example, during roadworks or emergency situations, it may be necessary to redirect traffic temporarily or provide new traffic control measures. This is where portable traffic lights come into play.

Portable traffic lights are a relatively innovation in the field of traffic management. They are designed to be easily transportable and quickly set up at any location where temporary traffic control is required. These lights use the same color-coding system as traditional traffic lights, with red indicating stop, yellow indicating caution, and green indicating go. They also typically have countdown timers, just like regular traffic lights, to ensure that drivers know how much time they have before the light changes.

The development of portable traffic lights has been driven by several factors. One of the most significant is the need for greater flexibility in traffic management. With traditional traffic lights, responding quickly to changing circumstances can be challenging. For example, if there is an accident on the road, it may be necessary to redirect traffic quickly to avoid further delays. Portable traffic lights allow traffic managers to respond quickly and efficiently to these kinds of situations, ensuring that traffic continues to flow smoothly and safely.

Another factor driving the development of portable traffic lights is the increasing use of roadworks and construction projects. During these projects, it is often necessary to close lanes or even entire sections of the road. Portable traffic lights provide an easy way to manage traffic flow and ensure the safety of both workers and motorists. By using portable traffic lights, roadworks, and construction projects can be completed more quickly and efficiently, minimizing disruptions to traffic and reducing the risk of accidents.

In conclusion, the development of portable traffic lights represents a significant innovation in the field of traffic management. They provide a flexible, efficient, and safe way to manage traffic in a range of situations, from roadworks to emergency situations. While there are challenges associated with their use, the benefits are clear, and as the technology continues to evolve, we can expect to see even more innovative solutions to the challenges of traffic management in the future.

1.2 PROJECT BACKGROUND

Traffic lights was first invented in 1868 by John Peake Knight, a railway signalling engineer and was installed in London outside the British Parliament of Westminster and looked like any railway signal of the time. The first traffic signal consists of waving semaphore arms and red-green lamps. The traffic signal was operated by gas, and it was specially designed for night use.

The invention however faced a failure when it unfortunately exploded, killing a policeman as a result. The unexpected accident stopped further development until the era of the internal combustion engine where modern traffic lights are invented by American.

In 1912, Lester Wire, a police officer in Salt Lake City, Utah, invented the first electric traffic light. The American Traffic Signal Company installed it on the corner of East 105th Street and Euclid Avenue in Cleveland, Ohio. In 1920, police officer William Potts invented the first four-way, three-color traffic signal in Detroit, Michigan. He was concerned that police officers at four distinct light signals couldn't change their lights all at once. The solution was a third light in the colour amber, which was also used on the railway. Automatic timers were first used to operate traffic towers in 1922 based on a study by Chong, H. F., & Ng, D. W. K. (2016, December).

With the development of computers in America in the 1950s, the management of traffic signals took a significant turn. In 1952, one of the best historical examples of automated lighting control was in Denver. Toronto was the first city to use enhanced computers that were better at vehicle detection in 1967. Through telephone lines, the computers-maintained control over 159 signals in the cities.

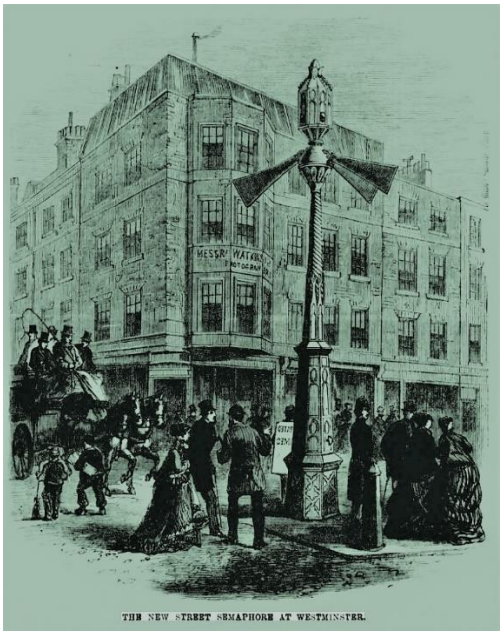


Figure 1.1: First traffic light in 1868

Figure 1.2: Lester Wire, with his two-colour traffic signal

1.3 PROBLEM STATEMENT

Novel approaches to traffic management have emerged as a result of the growing need for sustainable and effective transportation systems. Using portable traffic lights that are powered by photovoltaic (PV) technology is one such solution. Compared to conventional traffic lights, these PV portable traffic lights have many benefits, such as lower carbon emissions, increased mobility, and increased safety. To guarantee their widespread adoption and successful implementation, a few issues must be resolved.

I. TRAFFIC JAM

The purpose of this project is to develop a series of system models for junction traffic, controlled by traffic lights using solar power. Let's assume that Ungku Omar Polytechnic needs a traffic light system that can move from place to place. Indeed, this traffic light allows use at critical times such as 7 am – 8 am and 4 pm – 5 pm.

II. ACCIDENT

Furthermore, let’s assume that the driver's behavior is constrained by the rules of the road and a desire to avoid collisions with vehicles. Traffic accidents caused traffic jams in the study area, and although there were no deaths, there were few cases of serious injuries. Measures must be taken to address this to prevent any serious accidents in the future.

III. PEDESTRIAN SAFETY

In areas with heavy foot traffic, crossing the road can be dangerous, especially for student, the elderly, and people with disabilities. Without a traffic light, pedestrians may have to dodge cars and take unnecessary risks when crossing the road. Installing a traffic light with a pedestrian crossing can help to ensure that everyone can cross the road safely, reducing the risk of accidents and injuries.

1.4 PROJECT OBJECTIVES

This study delves into the design, construction, and evaluation of cutting-edge traffic management systems, with a primary focus on moveable traffic lights and portable traffic control devices. Recognizing the growing need for adaptable solutions in diverse traffic scenarios, the research explores the practicality and efficiency of these innovations. Additionally, the study investigates the functionality of photovoltaic portable traffic lights, aiming to establish their viability as ecologically responsible and cost-effective alternatives to conventional traffic signals. In this short but comprehensive introduction, we set the stage for a closer look at the transformative potential of these advancements in the realm of traffic control.

To design moveable traffic lights to control traffic flow. Portable traffic signals have many advantages for road users. They can be used to control vehicle movement at intersections, roadworks zones, and other locations where traditional fixed traffic lights may be impractical. To guarantee that these lights can be easily set up and altered as needed, they must be designed with elements such as power supply, visibility, and programmability in mind.

To build portable traffic control devices. Portable traffic control systems are critical for managing traffic flow not just for PUO main entrance but in a few situations, including construction zones, events, and emergencies. These devices may incorporate signage that may be readily installed and removed as needed. Building these devices necessitates careful consideration of characteristics such as durability, visibility, and travel and storage convenience. This consideration will eventually lead to cost saving and high performance.

To test the functionality of photovoltaic portable traffic light. Portable photovoltaic (PV) traffic lights generate electricity using solar panels, making them an ecologically responsible and cost-effective alternative to standard traffic signals. The functionality of these devices is tested by evaluating their performance in a variety of lighting and weather circumstances, as well as verifying that they fulfil appropriate safety regulations and are conveniently transported and installed.

So, with this, this photovoltaic portable traffic light objectives are:

I. To design moveable traffic lights to control traffic flow.

II. To build portable traffic control devices.

III. To test the functionality of photovoltaic portable traffic light.

1.5 PROJECT SCOPE

The scope for this project is temporary traffic control. This photovoltaic portable traffic light can only be used if there are no fixed traffic light at a certain area with heavy traffic flow. This is because the project is designed to aid a certain area at a certain time such as in peak hours and not to be fixed as its ability can't surpass the ability of common traffic light. Next, the photovoltaic portable traffic light can only be use in emergencies. There are many examples of emergency that requires temporary traffic

control such as accident or traffic light malfunction. By using this initiative, it will help control traffic flow and lessen the burden of policeman.

Lastly, it can be used for events such as wedding ceremony, concert, or exhibition where traffic rate is high and traffic management is needed most of the time. With the usage of this photovoltaic portable traffic light, it will reduce the cost of hiring the member of Jabatan Sukarelawan Malaysia (RELA) to control the traffic flow.

1.6 THE IMPORTANCE OF THE PROJECT

The project's significance lies in ensuring an orderly flow of traffic. Traffic flow in front of the PUO main entrance may be controlled without the use of labour by using this solar portable traffic light, resulting in good traffic movement sequences. By creating a good traffic movement sequence, it will avoid time consuming and stressful traffic delay that allow PUO attendee to save times and their mood will not be affected.

Next, make it possible for pedestrians or automobiles to cross an intersection. As previously stated, taking this step reduces the risk of danger that pedestrians face while crossing the street and ensures their safety. This will also allow car or motor users to easily cross the intersection and access or exit the PUO main gate without having to wait for long periods of time. This project can also save money on paying RELA members to regulate traffic for events with high traffic and reduce the workload for main gate security guards who must assist students crossing the road.

Finally, to reduce the number of collisions between vehicles approaching intersections from different directions. This will give vehicles right-of-way on each approach, improving traffic handling performance and resulting in efficient traffic movement.

1.7 PROJECT DEFINITION

The Photovoltaic Portable Traffic Light project definition is a portable device that can be simply moved from one location to another to offer temporary control over traffic flow. This portable traffic light is also powered by solar energy, making it environmentally friendly and cost-effective. This device will only be used at peak hours, for events, and in emergencies.

1.8 THE EXPECTED RESULT OF THE PROJECT

This project will hopefully end up resulting in a regulated and safe traffic flow for all PUO attendees and other road users, avoiding time-consuming traffic delays and reducing vehicle conflicts. It is also supposed to relieve the security guard's workload by assisting pedestrians who wish to cross the street.

1.9 CONCLUSION

Portable traffic lights are a useful tool for managing traffic flow in areas where conventional traffic signals are not practical or feasible. They are commonly used in construction sites, events, and emergency situations to guide traffic and ensure the safety of drivers and pedestrians.

Based on my research, I can conclude that portable traffic lights offer several benefits, including increased safety, improved traffic flow, and reduced congestion. Additionally, they are versatile and can be quickly and easily deployed in various settings.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

Photovoltaic portable traffic lights are innovative solutions that utilize solar energy to power temporary traffic control systems. These compact and self-contained units are designed to provide safe and efficient traffic management in areas where traditional traffic lights may be impractical or unavailable.

With the increasing need for temporary traffic control during roadwork, construction zones, special events, or emergencies, photovoltaic portable traffic lights offer a flexible and sustainable alternative. They eliminate the need for external power sources or extensive wiring, making them highly adaptable and easy to deploy in various locations.

The key component of these traffic lights is photovoltaic technology, which converts sunlight into electricity. The solar panels integrated into the system harness solar energy during the day and store it in rechargeable batteries. This stored energy is then used to power the LED lights during nighttime or low-light conditions.

One of the significant advantages of photovoltaic portable traffic lights is their mobility. These units are designed to be lightweight, compact, and easily transportable. They can be quickly set up or relocated as needed, providing flexibility in managing traffic flow in different areas.

Another notable feature of these traffic lights is their energy efficiency. By utilizing solar power, they reduce dependence on fossil fuels and contribute to a cleaner and more sustainable environment. Additionally, their low power consumption helps toextend the battery life and ensures reliable operation even in prolonged periods of cloudy weather.

Photovoltaic portable traffic lights are equipped with a range of safety features to enhance visibility and maintain orderly traffic flow. They typically include high-intensity LED lights, which offer excellent brightness and visibility from a distance. Some units also incorporate advanced technologies such as automatic brightness adjustment and adaptive timing to optimize their performance based on ambient lighting conditions.

These traffic lights often come with user-friendly control systems, allowing traffic personnel or operators to adjust the signal patterns, timing, and other parameters remotely. Wireless communication capabilities enable centralized control and monitoring of multiple units, further enhancing their convenience and effectiveness in managing traffic situations.

Malaysia has three types of traffic signals. The pre-timed traffic light is the most common, with the signal timing cycle length typically ranging between 45 and 120 seconds. The timing of each signal is controlled by the volume and pattern of traffic in each location. The second type is a sensor-equipped traffic signal. This technique maximizes traffic junction efficiency by providing green time for each approach to a traffic junction based on traffic demand. This means that if the sensor identifies a larger demand for a specific approach, it will redistribute the green period to optimum traffic junction usage. A countdown timer is another form of traffic light. It's a two-digit timer placed on the pole above the traffic light. Its objective is to decrease congestion at traffic intersections, to help motorists understand traffic flow, and to keep motorists aware of the remaining time on the green phase.

2.2 HISTORY OF TRAFFIC LIGHTS

Based on a study by Ahmadin, M. (2023) (pp. 1-6). IEEE, even though automobiles initially appeared in the late 1800s, vehicle control was still being studied. The first such device appeared in the United Kingdom in London, England in 1868, consisting of a revolving lamp fixture mounted on a busythoroughfare.

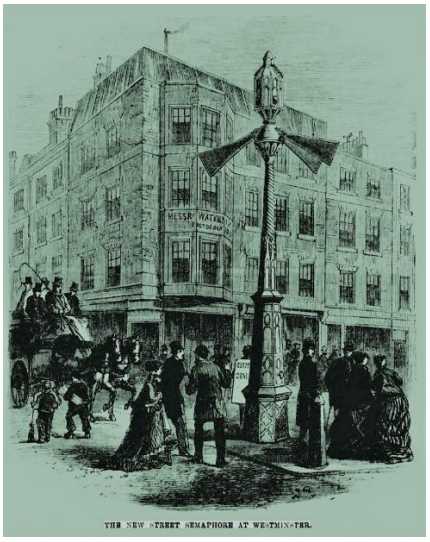


Figure 2.1 the first traffic light in 1868

Lester Wire, a Salt Lake City, Utah police sergeant, designed the first electric traffic light in 1912. It was installed by the American Traffic Signal Company on the crossroads of East 105th Street and Euclid Avenue in Cleveland, Ohio. In Detroit, Michigan, police officer William Potts designed the first four-way, three-color traffic signal in 1920. He was concerned that police officers at four different light signals would be unable to change their lights at the same time. The remedy was an amber third light, which was also used on the train. In 1922, automatic timers were utilized to operate traffic towers for the first time.

The emergence of computers in America in the 1950s marked an important change in traffic signal control. Denver had one of the best historical examples of automatic lighting control in 1952. In 1967, Toronto was the first city to employ improved

computers that were better at detecting vehicles. The computers-maintainedcontrol over 159 signals throughout the cities via telephone lines.

Figure 2.2 Lester Wire, with his two color traffic signal

2.3 TRAFFIC CONGESTION

According to a study Suryani, E., Hendrawan, R. A., EAdipraja, P. F., Wibisono, A., & Dewi, L. P. (2019, March) (Vol. 1196, p. 012029), traffic congestion occurs when demand exceeds the capacity of the transportation system. Congestion is initiated from the driver's perspective when the driver feels obligated to drive at a slower speed because of the slower automobiles in front of the driver.

Congestion is increasing in many parts of the world, from Western-European countries to North American countries and fast-growing Southeast Asian cities like Thailand (Schallabock & Petersen, 2008). As culture, technology, and the economy evolve, so does the transportation system. According to a study Suryani, E., Hendrawan, R. A., EAdipraja, P. F., Wibisono, A., & Dewi, L. P. (2019, March) (Vol. 1196, p. 012029), intolerable congestion is defined as time spent travelling or delaying in excess of the agreed-uponnorm, which may vary depending on the mode of transportation, time of day, travel method, and geographical environment. The solid

line in figure 2.3 represents the travelpace under free-flow conditions, whereas the dotted line represents the actual travel pace. During congestion, vehicles will travel at a slower speed than they would in free flow. The shaded area between these two lines represents the entire amount of congestion.

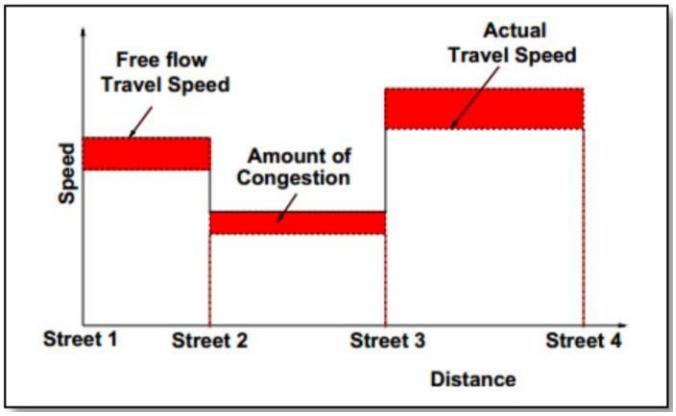


Figure 2.3 Definition of Congestion

There are two types of traffic congestion: recurring congestion and non-recurring congestion. Recurrent congestion usually occurs in the same location and at the same time. Incidents such as road repairs or accidents cause non-recurring congestion. According to Chong, D.K. (2016), the most popular reasons for traffic congestion is a lack of available road space. The study is based on the widely held belief that road capacity is a complementary civic good that should be provided bythe government to meet any stage of demand. However, not all congestion is the resultof insufficient supply. Several congestions are not recurring and are the result of specific temporary conditions such as bad weather, accidents, and road repair. Recurrent congestion is caused by a structural shortage of capacity or an equivalent surplus of demand, whereas non-recurring congestion is caused by a minor shortage of capacity or an overload of demand.

2.4 TRAFFIC LIGHT REVOLUTION COMPARISON

A study has been conducted in three cities located at the State of Sao Paulo in Brazil to compare between traffic signals with countdown displays (SCD) and the common traffic light (CTL). This study became necessary because of the increase in the implementation of this kind of traffic light (SCD).

Figure 2.4 traffic signals with countdown displays (SCD)

Figure 2.5 common traffic lights (CTL)

Long et al. (2013) showed that the countdown devices might assist drivers to decide in the dilemma zone and reduce the danger during the phase change. Empirical evidence with drivers in this research points out that they prefer the SCD, because they are more conspicuous. Nevertheless, theoretically, the uniformity of traffic signals devices is very important because drivers might misunderstand devices that are

different, and this might lead drivers to react oddly and cause an accident.

2.5 PROBLEMS

There are several reasons why portable traffic lights powered by photovoltaic (solar) energy are used:

Flexibility and mobility: Portable traffic lights can be easily transported and installed at various locations where temporary traffic control is needed, such as construction zones, road repairs, or special events. Photovoltaic technology allows these lights to operate without the need for a traditional power source, making them highly portable.

Cost-effectiveness: Solar-powered traffic lights eliminate the need for extensive electrical infrastructure, such as wiring or connecting to the grid. This reduces installation costs and avoids ongoing electricity expenses, making them a cost-effective solution, especially for short-term applications.

Environmental sustainability: Solar energy is a clean and renewable energy source. Using photovoltaic technology for portable traffic lights reduces reliance on fossil fuels and helps lower carbon emissions, contributing to a greener and more sustainable transportation system.

Increased safety: Portable traffic lights improve safety by providing consistent and visible signals to motorists and pedestrians during temporary traffic control situations. They enhance traffic flow, minimize confusion, and reduce the risk of accidents or congestion.

Reliability and autonomy: Photovoltaic systems can store energy in batteries, allowing portable traffic lights to operate even during low light conditions or at night. This ensures continuous functionality and eliminates the risk of power outages

or disruptions.

In summary, portable traffic lights powered by photovoltaic technology offer flexibility, cost-effectiveness, environmental benefits, improved safety, and reliable operation, making them a practical solution for temporary traffic control needs.

2.6 CONCLUSION

In conclusion, photovoltaic portable traffic lights offer several benefits and are a promising solution for temporary traffic control in various situations.

Firstly, the use of photovoltaic technology allows these traffic lights to operate independently from the grid, relying on solar energy to power their operations. This makes them highly portable and adaptable, as they can be easily deployed in remote locations or areas without access to electricity. The self-sustainability aspect also reduces their environmental impact, as they do not rely on fossil fuel-based power sources.

Secondly, the portability of these traffic lights allows for greater flexibility in managing traffic flow. They can be quickly and easily moved to different locations as needed, making them ideal for temporary road construction sites, emergencies, or special events. This mobility helps to enhance safety and efficiency by providing reliable traffic control wherever it is required.

Furthermore, photovoltaic portable traffic lights are designed with energy-efficient LED technology, which consumes less power compared to traditional incandescent bulbs. LEDs have a longer lifespan and produce brighter, more visible light, ensuring better visibility for drivers and pedestrians, especially in adverse weather conditions or low-light situations.

Additionally, the incorporation of smart features in some photovoltaic portabletraffic lights enhances their functionality. These features can include wireless connectivity, remote monitoring, and programmable signal timing, allowing for real- time adjustments and improved traffic management.

However, it is important to note that photovoltaic portable traffic lights may have limitations. Their effectiveness can be dependent on the availability of sunlight torecharge the batteries, which means they may not be suitable for extended periods of low sunlight or continuous nighttime operation. Additionally, their initial cost may be higher compared to traditional traffic lights, although they can provide long-term cost savings through reduced energy consumption and maintenance.

In conclusion, photovoltaic portable traffic lights offer a sustainable and flexible solution for temporary traffic control. They contribute to improved safety, energy efficiency, and adaptability in managing traffic flow. As technology advances and costs decrease, we can expect to see further advancements and wider adoption of photovoltaic portable traffic lights.

CHAPTER 3
METHODOLOGY / DESIGN

3.1 INTRODUCTION

A portable traffic light is a traffic control device that can be easily transported and installed in a temporary or remote location where classical traffic lights are not available or practical. The methodology or design of a portable traffic light requires several important considerations to ensure its effectiveness and safety.

First, the design must comply with local traffic regulations and standards. This includes ensuring that traffic light colors, time, and sequence match standard road signs and that the device is remotely visible to all oncoming traffic.

Second, the traffic light's power source and communication capabilities must be considered. Typically powered by rechargeable batteries or solar panels, portable traffic lights must be able to communicate with each other wireless to ensure synchronized operation and avoid driver confusion.

Third, the design must include safety features such as backup power, auto power off, and fail-safe mechanisms to prevent accidents in the event of a malfunction or power failure.

Finally, the design must be easy to install and maintain, with minimal installation time and maintenance. That means choosing durable materials and components that can withstand harsh weather conditions and frequent transport.

In general, the methodology or design of a portable traffic light should prioritize safety, compliance, and ease of use to ensure effective traffic control at temporary or remote locations

3.2 DESIGN PROJECT

This study was conducted using a research design. The reason why we used this type of design is that the process of organizing a research study to address a particular research question or hypothesis is known as research design. A well-designed research project can offer several advantages, such as clarity of the research topic. A clear study design makes it easier to determine the best research methods and data collection strategies by ensuring that the research question or hypothesis is well-stated and focused.

Then, Effective use of resources. A well-designed research study aids in ensuring the effective and efficient use of resources including staff, funding, and time. Based on our research we found that the data that we had collected is in quantitative form. The process of organizing a research study to address a particular research question or hypothesis is known as research design. An effective research project can demonstrate the type of data called quantitative data is one which is gathered numerically, generally by experiments, systematic surveys, or other techniques for acquiring factual data. The focus of quantitative data is on measuring and analyzing numerical data to find patterns, correlations, and trends. Quantitative data is frequently numerical in nature. Multiple methods can be used to gather quantitative data, including:

- **Surveys**: Organized forms of questioning that are used to gather information from lots of people.

- **Observations**: Systematic and organized observations of behavior or occurrences in a specific location to quantify the frequency and occurrence of particular behavior or events.

Analysis of previously collected numerical data, such as that from public records or surveys carried out by other academics, is known as secondary data analysis.

3.3 PROJECT PRODUCTION METHODS/PROCEDURES/TECHNIQUES

Portable traffic lights play a crucial role in controlling traffic flow and ensuring traffic safety in various situations such as road works, temporary road detours or events. This paper describes a comprehensive plan for the design, construction, and implementation of a portable traffic signal system. It includes aspects such as needs assessment, component selection and sourcing, mechanical assembly, electrical circuitry, solar power system integration, control system implementation, testing and quality assurance, production and deployment, and maintenance and monitoring.

3.3.1 Requirements and Functionality

The first step in designing a portable traffic light system is to determine the specific requirements and functionalities. These requirements may include the ability to effectively manage traffic flow, visibility in varied weather conditions, durability, ease of transport and set-up, and compliance with applicable regulations and standards. selection and procurement of components: It is necessary to identify and select the appropriate components for the traffic light system, e.g., B. LED lights, solar panels, batteries, and control circuits. These components must meet the specified quality requirements and standards. To ensure the availability of high-quality components, they must be procured from reliable suppliers.

3.3.2 Mechanical assembly

Once the components are obtained, the physical structure of the portable traffic light must be constructed. It must be constructed to be easy to transport and to withstand outdoor conditions. LED lights must be installed at the appropriate traffic light positions to ensure a clear view for all oncoming vehicles. To use the sun's energy efficiently, solar panels must be securely integrated into the structure.

3.3.3 Circuit

The circuit connects the LED lights, solar panels, batteries, and control system. It must be designed to ensure safe and efficient operation. Appropriate wiring, connectors and protections must be installed. Energy management systems must regulate power distribution and battery charging to maximize energy efficiency and minimize power loss. integration of solar power systems: Solar power system integration involves connecting solar panels to the battery storage system to allow charging during the day. Energy conversion and regulation mechanisms should be implemented to optimize energy harvesting and storage. Charge controllers and inverters play a crucial role in controlling the flow of electricity between solar panels and batteries, ensuring reliable power supply to traffic lights.

3.3.4 Implementation of the control system

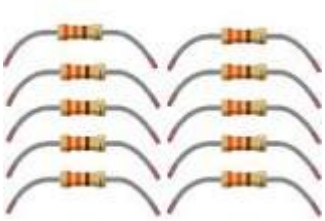
It is necessary to develop a robust control system to control the operation of traffic lights. Timing algorithms and logic circuits must be implemented to control the sequence of lights, such as red, amber, and green. Sensors or communication systems can be integrated to detect traffic conditions and adjust the signal time accordingly to optimize traffic flow.

3.3.5 Testing and Quality Assurance

Before implementation, an extensive testing phase is crucial to ensure that all components and functions of the portable traffic light system work as designed. This includes checking the reliability of the solar power system, including battery charging, storage and powering the lights. To ensure that the system can withstand different climatic conditions and temperature ranges, environmental tests must be carried out.

3.4 MATERIALS AND TOOLS

Table 1.1: Materials and Tools Table

ITEM	FUNCTION
1. LED 	It is a semiconductor device that emits light when a current flow through it. LED are commonly used as indicators, status lights, and in illumination applications.
2. Resistor-330 ohms 	Resistors are commonly used in a variety of electronic circuits, such as power supplies, amplifiers, and voltage regulators, to control the amount of current or voltage that flows through the circuit. A 330-ohm resistor can be used in a circuit to provide a specific level of resistance and help ensure that the circuit operates properly and safely.
3. Capacitor 	Timing: Capacitors can be used to control the timing of a circuit. They can be charged and discharged at specific rates, which can be used to generate time delays or pulse circuits. Power conditioning: Capacitors can be used to smooth out voltage

	fluctuations in a circuit. They can act as a buffer, providing a constant voltage to sensitive electronic components. Energy storage: Capacitors can store electrical energy for short periods of time. They are often used in flash cameras and strobe lights, where a large amount of energy needs to be delivered quickly.
4. Solar panel 	Solar panels consist of photovoltaic (PV) cells, which are made of semiconductor materials such as silicon. When sunlight falls on the PV cell, the photons in the light are absorbed by the semiconductor material, which causes the electrons in the material to become excited and move. This movement of electrons generates an electrical current, which can be harnessed and used as electricity. The electrical current produced by the solar panel is direct current (DC), which is then converted into alternating current (AC) using an inverter so that it can be used to power household appliances and other electrical devices.

5. node mcu esp8266 	The NodeMCU is a development board based on the ESP8266 micro controller. The ESP8266 is a low-cost Wi-Fi module with full TCP/IP stack and micro controller capabilities, making it ideal for IoT applications. The NodeMCU board is designed to make it easy to get started with the ESP8266, providing a convenient platform for building Wi-Fi enabled projects.
6. Wire 	Wire is a physical component used in electrical and electronic systems to transmit electrical signals or power from one point to another. The function of a wire is to provide a conductive pathway for the flow of electricity, allowing the transfer of information or energy between devices.
7. **Hollow steel** 	Begin by sketching or using design software to create a three-legged support structure. Each leg should be evenly spaced around the base of the traffic light, forming a triangular shape. Consider factors such as the size and weight of the traffic light, as well as the materials you plan to use.

8. Switch 	Switch functions, in the context of programming, refer to the switch statement or switch case statement. It is a control flow statement that allows a program to execute different blocks of code based on the value of a variable or expression. The switch statement is typically used when there are multiple possible conditions to be checked against a single variable.
9. Battery holder 	Battery holder is a device designed to securely hold batteries and provide electrical connections for them. The primary function of a battery holder is to house batteries and maintain their position while allowing for easy insertion and removal.
10. 18650 battery 	**Energy Storage**: The primary function of a battery is to store and release electrical energy. It converts chemical energy into electrical energy when it is discharged and vice versa when it is charged. **Power Supply**: Batteries are used as portable power sources to provide electrical energy for various devices, such as

	smartphones, laptops, cameras, flashlights, and other portable electronics. **Backup Power**: Batteries can act as backup power sources in case of a power outage. They can provide electricity to critical systems, such as emergency lights, alarm systems, medical equipment, and uninterruptible power supplies (UPS).

3.5 METHOD AND DATA ANALYSIS

3.5.1 Empathy Study

This method testing for empathy study among student and staff was carried out by creating a questionnaire using Google Forms and distributing it to Ungku Omar polytechnic students.

i. The first section of the questionnaire is the primary reason this project developed the photovoltaic portable traffic light.

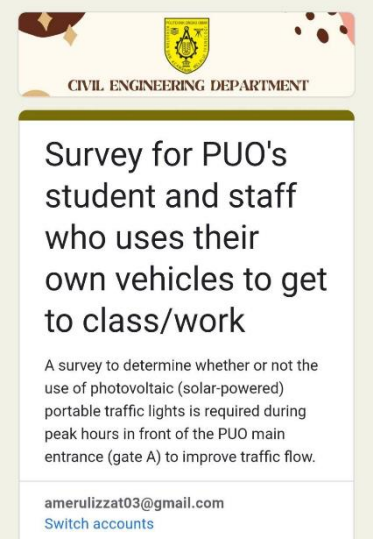


Figure 2.6: The title of the questionnaire

ii. Respondents must enter their vehicle type in the second section of the Google form.

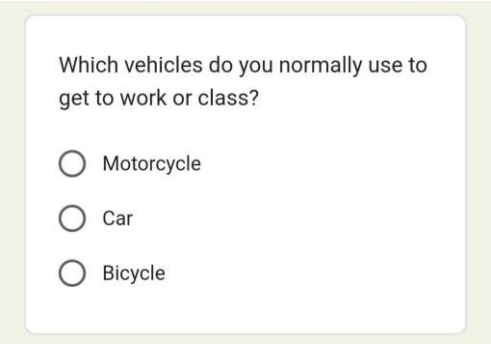


Figure 2.7: First question of the questionnaire

iii. The Google form section asks to if have you ever been late for class/work because of a traffic jam in front of the PUO main entrance?

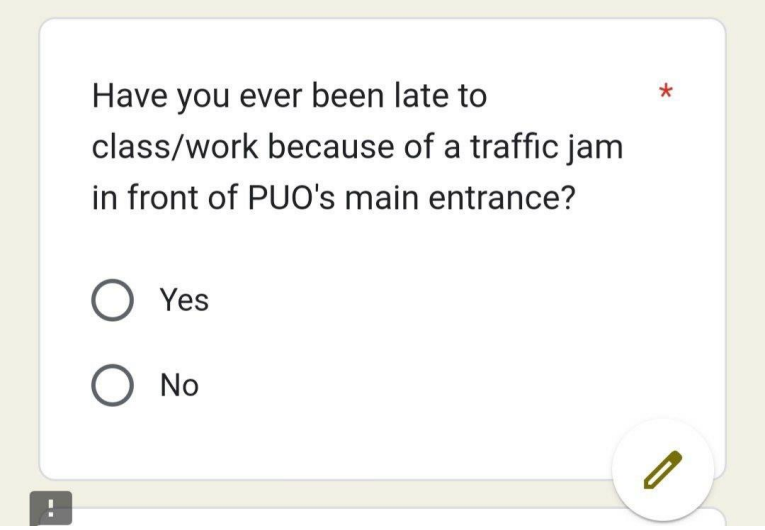


Figure 2.8: Second question of the questionnaire

iv. Next section, what typically experience a traffic jam in front of the PUO main entrance.

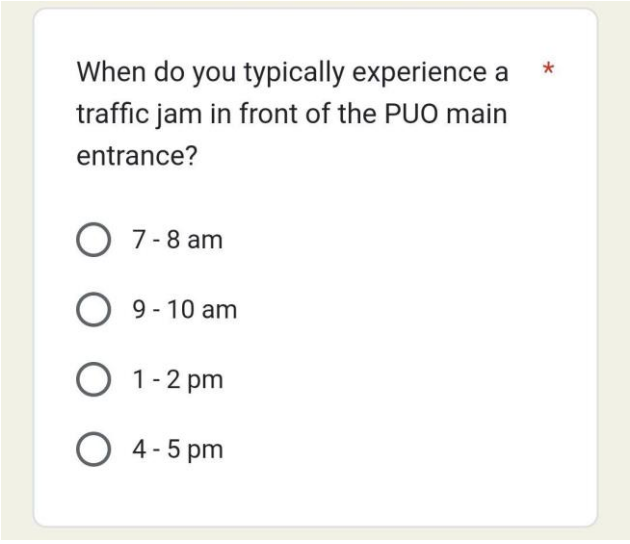


Figure 2.9: Third question of the questionnaire

v. The Google form asks for respondents' opinions about support the usage portable traffic light in front of the PUO entrance during peak hour.

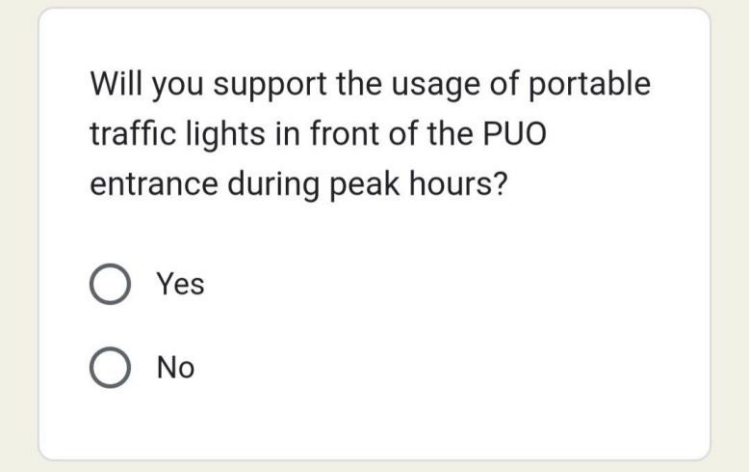


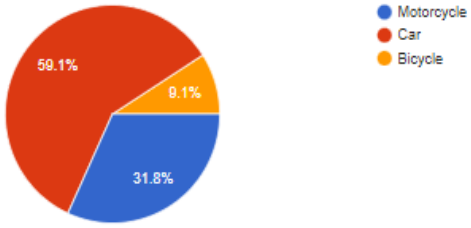
Figure 3.0: First question of the questionnaire

vi. The final section of the Google form we collected data from respondents about the importance of portable traffic lights during peak hours in front of the PUO entrance.

Which vehicles do you normally use to get to work or class?

Copy

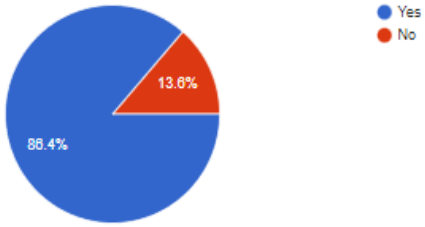
22 responses



Have you ever been late to class/work because of a traffic jam in front of PUO's main entrance?

Copy

22 responses



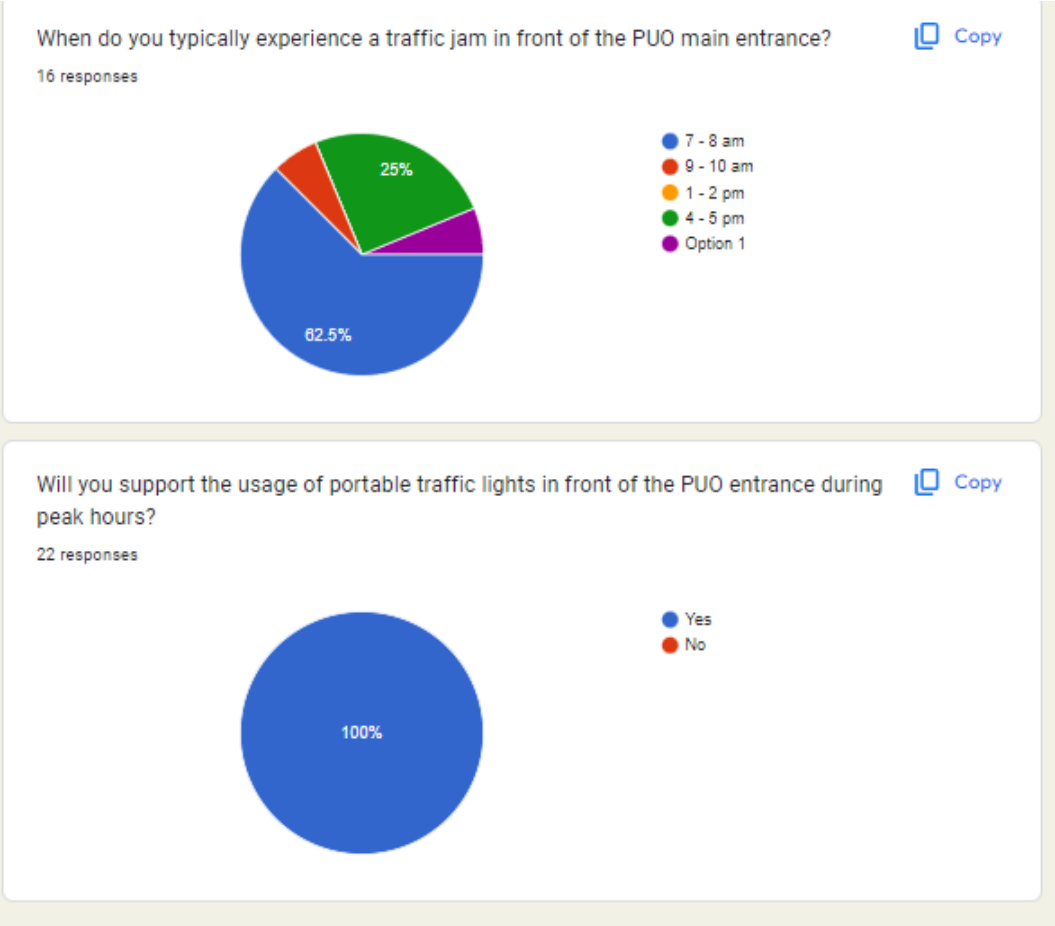


Figure 3.1: First question of the questionnaire

3.6 CONCLUSION

In conclusion, the project of introducing portable traffic lights during peak hours is a practical and effective approach to reducing traffic congestion in urban areas. Portable traffic lights are a flexible and cost-efficient alternative to traditional traffic lights, as they can be easily installed and removed when necessary, making them ideal for managing peak-hour traffic. The implementation of portable traffic lights can lead to improved traffic flow, reduced waiting times for drivers, and a decrease in emissions and accidents on the roads, which can have a positive impact on the environment and the safety of road users. This project can also have economic benefits by reducing transportation costs, increasing productivity, and enhancing the overall quality of life in urban areas. Therefore, the use of portable traffic lights during peak hours is a valuable

solution that can help to manage traffic effectively, reduce congestion, and improve the efficiency of the transportation system.

CHAPTER 4

PROJECT FINDINGS AND DISCUSSION

4.1 INTRODUCTION

This study focuses on the development and implementation of Photovoltaic Portable Traffic Light in Polytechnic Ungku Omar. Portable traffic lights with solar panels are an innovative solution to the growing problem of traffic congestion on the roads. Solar traffic lights are signaling devices powered by solar panels positioned at road intersections, pedestrian crossings, and other locations to control the flows of traffic. They assign the right of way to road usersusing lights in standard colors (red - amber/yellow - green), using a universal color code. Most solar traffic lights use LED lamps as they are more reliable and have more advantages over other lighting devices like CFL lamps as they are more energy efficient, have a longer life span and turn on and turn off quickly. SRL Traffic Systems has become one of the first companies to offer solartechnology for mobile traffic signals, enabling them to deliver projects more sustainably, cost-effectively, and safely.

4.2 PROJECT FINDINGS

4.2.1 Overall data analysis

Table 1.2: Data analysis of the number of vehicles

Vehicles in peak hours	
8.00am – 9.00am	Car: 189 Motorcycle: 132 Bus: 3 Lorry: 8
4.00pm – 5.00pm	Car: 115 Motorcycle: 98 Bus: 4 Lorry: 10

4.2.2 Calculation

Types of flow	North	South	East	West
Actual flow	550	500	800	850
Saturation flow	2400	2000	2500	3000

North

$$Y = \frac{550}{2400} : 0.23$$

South

$$Y = \frac{500}{2000} : 0.25$$

East

$$Y = \frac{800}{2500} : 0.32$$

West

$$Y = \frac{850}{3000} : 0.28$$

Y Value

$$Y = y1 + y2$$
$$= 0.25 + 0.32$$
$$= 0.57$$

Total lost time, L

$$L = \sum (19 - 3) + 5$$

$$= 21 + 21$$

$$= 42 \text{ s}$$

Optimum cycle time, CO

$$Co = \frac{1.5\,L+5}{1-F}$$

$$= \frac{1.5\,(42) + 5}{1-0.57}$$

$$= 120 \text{ s}$$

Actual green time, k

$$G = Co - L$$

$$= 120 - 42$$

$$= 78 \text{ s}$$

$$g\,(N - S) = \frac{F1}{F}\,(Co - L)$$

$$= \frac{0.25}{0.57}\,(78)$$

$$= 34 \text{ s}$$

$$g\,(E - W) = \frac{F1}{F}\,(Co - L)$$

$$= \frac{0.32}{0.57}\,(78)$$

$$= 44 \text{ s}$$

Controller setting time, k

$K(N - S) = g + (L - a)K$

$= 34 + (5 - 3)$

$= 36$ s

$K(E - W) = g + (L - a)K$

$= 44 + (5 - 3)$

$= 46$ s

4.3 SOLAR POWER EFFICIENCY TESTING IN VARIOUS WEATHER CONDITION

Different weather conditions might have an impact on solar power efficiency. This is an examination of the ways in which various meteorological circumstances can affect solar power systems' efficiency:

Sunny Weather: Sunlight and clarity are ideal for solar panel performance. Solar panels can function at their highest efficiency under the right circumstances. The panels can convert a sizable amount of solar energy into electricity since sunlight strikes them directly. Summertime, with longer sunshine hours and less cloud cover, is generally when solar power systems operate most efficiently.

Cloudy Weather: The effectiveness of solar panels may be diminished by cloud cover. A large amount of sunlight can be blocked by thick clouds, which lowers power production. Nonetheless, solar panels can still produce power under gloomy conditions, albeit at a reduced efficiency compared to sunny conditions.

Rainy Weather: The generation of solar power may temporarily be impacted by rainfall. Raindrops can both scatter and absorb sunlight, which lowers the amount of light that reaches the solar panels. Rain, on the other hand, can also clean the panels by removing dirt and debris, which can enhance their functionality when the rain stops.

Cloudy Weather: When there is a thin layer of clouds present, sunlight can still reach the solar panels. In these circumstances, solar panels' efficiency will be lower than in sunny weather but higher than in situations with a lot of clouds.

Winter & Cold Weather: In fact, cold weather can enhance the performance of solar panels. The reduced daylight hours may result in a decrease in total energy output, but the improved electrical conductivity brought about by the cooler temperatures may lead to a marginal increase in efficiency.

Conditions of Haze or Smog: The amount of sunlight that reaches the solar panels might be decreased by haze and smog. Sunlight can be scattered and absorbed by air pollution, which reduces the amount of solar power produced.

In summary, solar panels may still produce electricity in a variety of weather situations, but with a lower efficiency. However, their efficiency is highest in clear, sunny conditions.

4.4 DISCUSSION

4.4.1 Solar energy system:

solar panels:

Selection: Choose solar panels with appropriate power based on the power consumption of LED lights and battery charging requirements. Consider the efficiency of the panels and the space available for installation.

Orientation and Tilt: Position solar panels to receive maximum sunlight. Depending on your location, the optimal tilt angle may vary. Consider using a solar tracking system to increase efficiency.

Battery:

Capacity: Calculate the power consumption of your LED lights and choose a battery with enough capacity to power the lights at night or in low light conditions. Consider using deep-cycle batteries for solar applications.

Charge Controller: Integrates a solar charge controller to regulate battery charging. This helps prevent overcharging and extend battery life.

4.4.2 Microcontroller and control system:

Microcontroller Selection: Choose a microcontroller (**Arduino UNO**) based on programming knowledge and control logic complexity. Make sure it has the required input/output pins and processing power.

Control Algorithm: Develop a control algorithm that follows standard traffic light patterns (red, yellow, and green phases). Consider installing sensors such as ambient light sensors for adaptive brightness control.

4.4.3 Accommodation and meeting:

Material Selection: Choose housing materials that are durable, weather-resistant, and provide adequate protection for electronic components.

Visibility: Ensure the home is designed to maximize visibility to traffic lights. Consider using reflective materials or additional features to enhance visibility during adverse weather conditions.

4.4.4 Wiring and Connectivity:

Wire Sizing: Use appropriate wire gauges for connections to minimize power losses and ensure safety. Follow electrical codes and standards.

Connectivity: Implement a wiring diagram that clearly defines the connections between the solar panels, battery, LEDs, and microcontroller. Consider using connectors to facilitate assembly and maintenance.

4.4.5 Testing:

Functional Test: Test the prototype under different lighting conditions to ensure that the solar panels charge the battery effectively and the LED lights work according to the control algorithm.

Reliability Tests: Conduct tests to evaluate the reliability of the entire system over time by simulating various environmental conditions.

6.Standard conformity:

Research Regulations: Understand local traffic regulations and standards that apply to portable traffic lights. Make sure your prototype meets these regulations to ensure safety and regulatory compliance.

4.4.6 Upscaling:

Cost Analysis: Evaluate the costs of materials and manufacturing processes to determine the feasibility of mass production.

Manufacturability: Optimize the design for manufacturability, considering factors such as ease of assembly, maintenance, and scalability.

4.4.7 Documentation:

Detailed Documentation – Create comprehensive documentation including design specifications, schematics, test procedures, and other relevant information. This documentation is critical for troubleshooting, replication, and possible future improvements.

4.5 CONCLUSION

In Summary, the use of solar technology in portable traffic lights offers a sustainable and cost-effective solution for controlling traffic flow. The implementation of LED lamps and advanced solar panels, such as the SRL Solar Plus, not only reduces energy consumption but also extends the lifespan of the equipment. This innovation has the potential to improve road safety and efficiency while minimizing the environmental impact of traditional traffic control systems. Solar traffic lights are signaling devices powered by solar panelsthat are used to control the flow of traffic at road intersections and pedestrian crossings. They use LED lamps, which are energy-efficient and have a longer lifespan. SRL Traffic Systems is one of the companies that offer solar technologyfor mobile traffic signals, allowing for more sustainable and cost-effective projects. Their solar technology, SRL Solar Plus, extends battery cycles, reducingelectricity consumption and the frequency of required exchanges.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

Photovoltaic portable traffic lights are a modern and innovative solution for temporary traffic control in areas where conventional traffic signals are not feasible or available. These portable units are powered by solar energy, eliminating the need for grid connections, and offering greater flexibility in their placement. There are also some steps that can be taken to improve this project and make it more beneficial for the community.

5.2 PROBLEMS AND PROPOSED SOLUTION

Energy use efficiency is a crucial consideration in the design of portable photovoltaic traffic signalling systems that combine sustainable energy practices with effective traffic control. This paper examines key aspects such as energy efficiency, storage solutions, weather resilience, and adaptive traffic control algorithms and highlights the importance of integrating these elements for a successful and reliable system.

It is important to select highly efficient solar modules that are adapted to the energy needs of the system. The use of solar tracking technology or an adjustable tilt system improves the absorption of sunlight throughout the day, optimizing energy production. This ensures that the system works effectively in locations with varying levels of sunlight, making it a versatile solution for different environments.

Project success depends on an effective energy storage solution. High-quality batteries with sufficient storage capacity are crucial and implementing a battery management system is equally important. This not only extends the life of the battery, but also prevents overcharging and reduces the risk of deep discharge, ensuring reliable power supply in adverse weather conditions or low light conditions. The synergy between efficient energy production and storage is critical to overall system reliability.

Managing resilience to extreme weather conditions is critical to system durability. Installing protective covers or shields against rain and excessive heat protects components. The use of weather-resistant materials and a robust design further contribute to the longevity of the system and make it effective in various environmental conditions. This resilience is key to ensuring uninterrupted traffic control even in difficult climates.

Implementing an adaptive traffic control algorithm is a critical factor for system efficiency. By integrating sensors or automated control technology, traffic light cycle times can be optimized, and the traffic situation can be responded to in real time. This adaptability not only improves traffic flow but also contributes to overall energy efficiency by reducing unnecessary waiting and idle time and making the system responsive and dynamic.

In summary, the success of a portable PV traffic light system lies in the seamless integration of energy efficiency, storage solutions, weather resistance and adaptive traffic control algorithms. By selecting efficient solar panels, implementing effective energy storage solutions, ensuring weather resilience, and optimizing traffic control, these systems can play a crucial role in sustainable and efficient traffic management. As technology continues to advance, the future offers even greater opportunities to improve the effectiveness and environmental impact of such systems.

5.3 SIGNIFICANCE OF PROJECT

The significance of the Photovoltaic Portable Traffic Light is to improve the traffic management in front of the Polytechnic Ungku Omar main entrance for the polytechnic staff and student. This project also aims to lessen the burden of the guard in charge at the main entrance. By using this traffic control device, the guard don't have to help manage the traffic during peak hours and this can ensure the guard's safety while working.

The other importance of this Photovoltaic Portable Traffic Light is to save cost and time of building the actual traditional traffic light. These traffic lights play a crucial role in enhancing safety on the roads. They provide clear and visible signals to drivers, alerting them to stop, proceed, or yield at intersections. By maintaining consistent traffic control, they help prevent accidents, ensure orderly traffic flow, and minimize confusion among motorists.

5.4 BENEFITS TO TARGETED USERS

Road safety has emerged as a critical issue in the fast-paced world of today. The significance of creative solutions has been emphasized by the sharp rise in traffic volume and the requirement for effective traffic management systems. Under those circumstances, the Photovoltaic Portable Traffic Light was proposed. In addition to improving traffic safety, these cutting-edge traffic control devices provide a host of other advantages that can dramatically lower the likelihood of collisions. Photovoltaic Portable Traffic Light offers a lot of benefits for its user to ensure safety and lessen the risk of accident.

The first benefit is energy efficiency. A photovoltaic portable traffic light is powered by solar energy, which makes it highly energy efficient. It utilizes solar panels to convert sunlight into electricity that can be used when there is high solar energy. When the solar power is unusable, the traffic light will operates using the battery. This reduces operational costs and dependence on the electrical grid.

The second benefit is portability and flexibility. Being portable, these traffic lights can be easily moved and installed in various locations as per the traffic management requirements. They are ideal for temporary installations, construction zones, or emergency situations where traditional traffic lights may not be feasible or available. This also will bring advantage to the guard in charge of the traffic as they can easily move, set up and store it without the help of any equipment as the photovoltaic portable traffic light can only be used in certain situation.

Third, the other benefit is quick deployment. Photovoltaic portable traffic lights can be set up quickly without the need for extensive wiring or infrastructure modifications. This makes them highly convenient for temporary traffic control needs, such as during road repairs, events, or detours.

After that, Photovoltaic Portable Traffic light is also environmentally friendly. Solar-powered traffic lights are environmentally friendly because they rely on clean, renewable energy. By using solar panels, they help reduce greenhouse gas emissions and dependence on fossil fuels, leading to a more sustainable transportation infrastructure.

Next, cost saving. Although the initial investment in photovoltaic portable traffic lights may be higher than traditional traffic lights, they offer long-term cost savings. Solar energy is free, and these lights eliminate the need for electricity consumption and associated utility costs. Over time, the savings in energy and maintenance expenses can

offset the initial investment. This also save the cost and time of building a traditional traffic light at the proposed location.

This Photovoltaic Portable Traffic Light also offers enhanced safety. Portable traffic lights play a crucial role in ensuring road safety by providing clear and visible signals to drivers, pedestrians, and cyclists. With their bright LED lights and standardized signalling patterns, they effectively guide traffic flow and minimize the risk of accidents or confusion.

Consequently, the other benefit is reliability. Photovoltaic portable traffic lights often come equipped with backup battery systems to ensure uninterrupted operation during low-light conditions or inclement weather. This enhances their reliability and ensures continued traffic management even in challenging circumstances.

Overall, the benefits of using photovoltaic portable traffic lights include energy efficiency, portability, flexibility, environmental friendliness, cost savings, enhanced safety, and reliability. These factors make them an attractive choice for temporary traffic control needs, offering a sustainable and efficient solution for managing traffic flow.

5.5 RECOMMENDATION

Photovoltaic portable traffic lights have emerged as a versatile solution for temporary traffic control, offering flexibility and sustainability. To further enhance their capabilities, several recommendations can be considered. By incorporating these enhancements, we can unlock new levels of functionality and convenience for both traffic management authorities and road users.

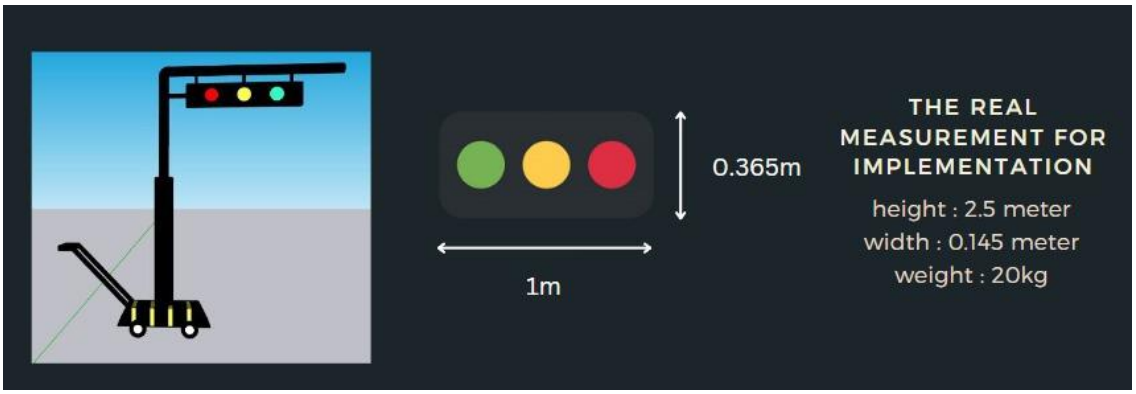
1. Creating an application for the Photovoltaic Portable Traffic Light

Connecting solar portable traffic lights to smartphone applications can be a useful step towards improving their usability and convenience. Here are some suggestions for using applications to improve these traffic lights' features:

- Develop a dedicated smartphone app that allows authorized personnel to remotely monitor and control the portable traffic lights. This feature would enable real-time status updates, such as battery levels, signal operations, and fault notifications. It would also provide the ability to adjust signal timings or activate emergency modes when needed.

- Create an interactive feature within the app that allows users to report issues or provide feedback regarding the portable traffic lights. This two-way communication channel would enable authorities to address concerns promptly, improve the system, and enhance user satisfaction. Users can also receive notifications or alerts regarding any changes in traffic conditions or upcoming roadworks.

2. The real measurement for real life implementation



5.6 PROJECT LIMITATION

Even though photovoltaic portable traffic lights have many advantages, some restrictions should be considered before implementing such projects. The following are important restrictions to bear in mind:

Placement Constraints: Space constraints, visibility in the line of sight, and obstructions like buildings or trees can all affect where portable photovoltaic traffic lights can be installed. These limitations may affect how well the lights inform drivers in a clear and visible manner. For maximum functionality, the lights' placement needs to be carefully considered.

Traffic Management Difficulties: The installation, deployment, and maintenance of portable traffic lights may call for extra resources and coordination. To guarantee that the lights are installed and taken down on time, traffic management authorities must carefully plan and distribute their resources. To manage traffic control throughout the deployment and removal process, appropriate training and protocols should be in place.

Maintenance and Durability: Regular maintenance is essential to ensure the longevity and performance of photovoltaic portable traffic lights. The lights may be exposed to harsh weather conditions, temperature fluctuations, and potential vandalism. Periodic inspections, cleaning, and necessary repairs or replacements are necessary to keep the lights functioning optimally.

Initial Cost: The initial cost of acquiring and implementing photovoltaic portable traffic lights may be higher compared to traditional temporary traffic control solutions. The cost includes the purchase of solar panels, batteries, controllers, and other necessary components. However, it is important to consider the long-term cost savings from reduced energy consumption and the elimination of the need for grid connections.

Scalability and Adaptability: Photovoltaic portable traffic lights may present difficulties in large-scale installations or intricate traffic situations in terms of their scalability and adaptability. To ascertain the appropriateness and efficacy of the portable lights, it is critical to assess the needs and traffic patterns of the project site.

5.7 CONCLUSION

To sum up, photovoltaic portable traffic lights provide an adaptable and sustainable way to temporarily manage traffic. These lights lessen reliance on conventional power sources and promote environmental sustainability by utilising solar energy. These units' portability makes it simple to deploy and relocate them, which makes them perfect for events, construction sites, and emergency scenarios.

Portable solar traffic lights have various benefits despite certain drawbacks like placement restrictions. They improve road safety by providing visible and clear signals, and when they are integrated with smartphone apps, they can improve data analysis, functionality, and remote monitoring even more. These lights can also result in lower energy usage and long-term financial savings,

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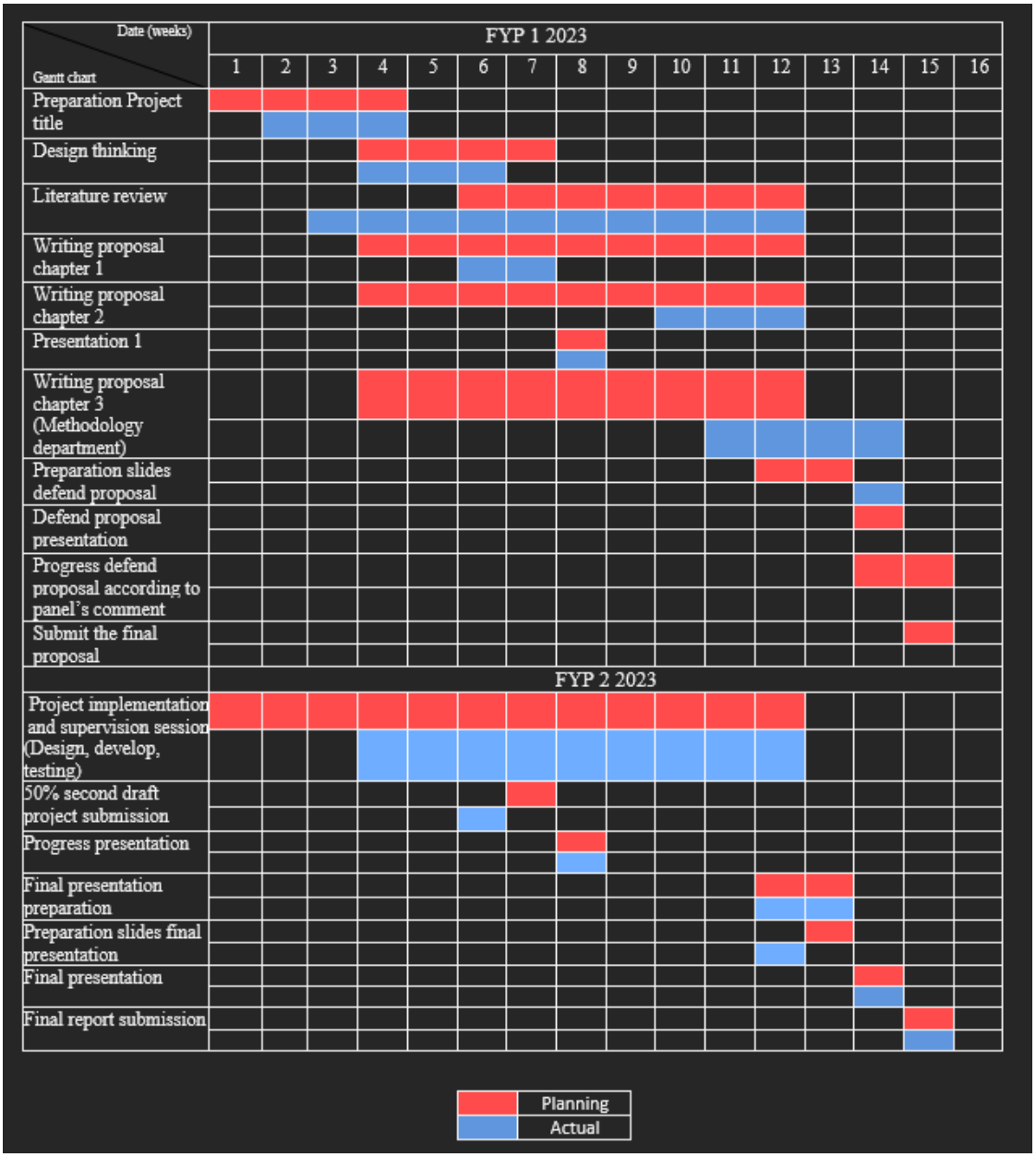
REFERENCE ATTACHMENT

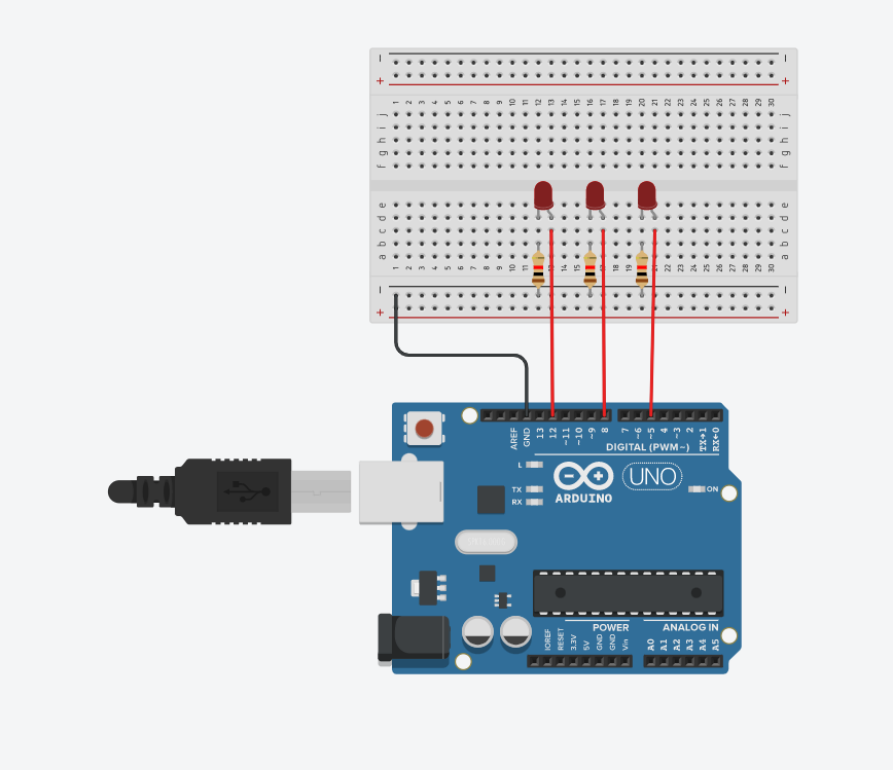
i. GANT CHART



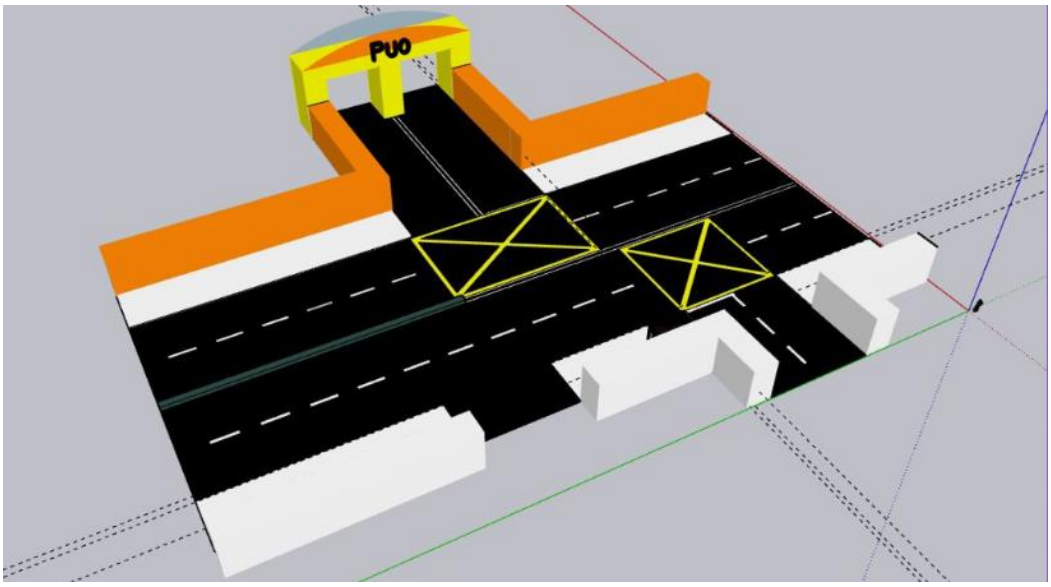
ii. ESTIMATE PROJECT COST

NO	PRODUCT	UNIT	PRICE PER UNIT	TOTAL PRICE
1.	RESISTOR-330 OHMS	9	RM 0.50	RM4.50
2.	CAPACITOR	2	RM 10.00	RM20.00
3.	SOLAR PANEL	1	RM 10.00	RM10.00
4.	LED	9	RM 2.00	RM18.00
5.	NODE MCU ESP8266	1	RM 20.00	RM20.00
6	WIRE	3	RM 3.00	RM9.00
7	HOLLOW STEEL	1	RM 60.00	RM60.00
8	18650 BATERY	1	RM 10.00	RM10.00
9	BAT HOLDER	1	RM 3.00	RM3.00
10	SWITCH	1	RM3.00	RM3.00
			TOTAL	**RM157.50**

iii. CIRCUIT DIAGRAM PICTURE

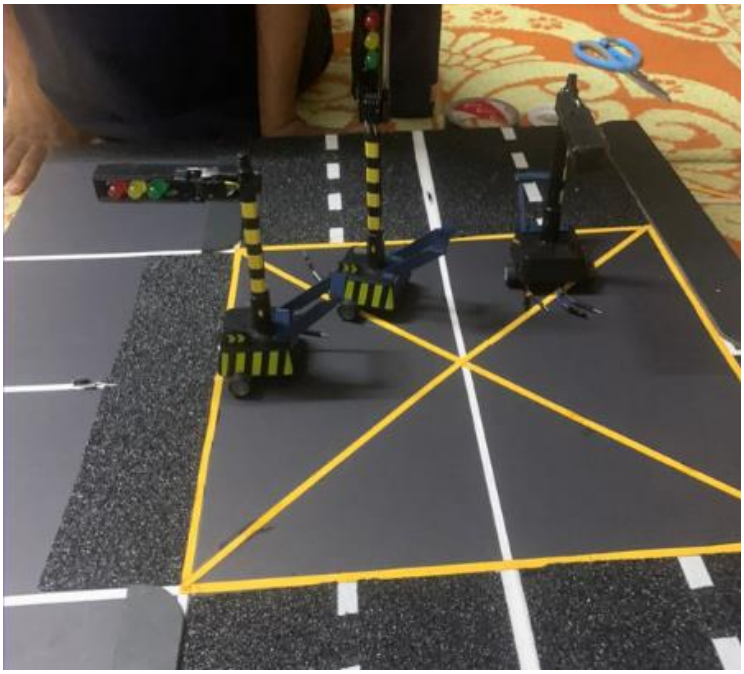


iv. Design of 3D replica of proposed location



v. Building process of PUO's entrance for 3D model of location

vi. Building process of traffic light prototype



vii. Completed prototype for final presentation