

Faculty of Electrical and Electronic Engineering Technology



MOHAMAD SYAHMEZAN BIN AMAT

Bachelor of Electronics Engineering Technology with Honours

2021

PORTABLE WIRELESS TRAFFIC LIGHT

MOHAMAD SYAHMEZAN BIN AMAT

A project report submitted in partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology with Honours



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this project report entitled "Portable Wireless Traffic Light" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honours.

Signature :	Wisia as
Supervisor Name :	Vigneswara Rao A/L Gannapathy
Date :	29 / 1 / 2023
Signature	اونيۇىرسىتى تيكنىكل مليس
Co-Supervisor	SITI TEKNIKAL MALAYSIA MELAKA
Name (if any)	
Date :	

DEDICATION

First of all, I would like to express my gratitude to Allah for providing me with the strength necessary to complete this research and see my thesis become reality. This study and research are dedicated to my beloved parents, Amat bin Ibrahim as well as Hazlin binti Sarip, who have always supported and encouraged me in completing my study. Not forget to mention my siblings, supervisor Dr.Vigneswara Rao A/L Gannapathy, and my friends who have supported me throughout my education journey. Thank you for all your assistance, which I will always appreciate and will never forget.



ABSTRACT

Reconstruction and maintenance of road is unavoidable and has always been a safety hazard if there is no safety system during the process. Therefore, humans or traffic light were normally used to control the safety system of a road lane. However those method pose some flaws in term of effectiveness, reliability and cost. For example, common problem faced when using labourers are regarding to their safety, careless and selfish driver often cause injury and accidents to this labourers. Besides that, cost also is a major factor where company often try to avoid using labourers to increase profit margin and prefer to use automated ALAYS. system. This paper presents a new design and development of Portable wireless Traffic Light to replace labourers and improve the existing traffic light system. . An Arduino UNO board, sensors and lights were used to command the entire control system and perform the automatic functions of the PWTL machine. Software development and testing were conducted to determine which hardware components could be utilized for this project. Based on the analysis and result, this machine is able to save motorist delay by a little amount and also low the risk of vehicle accident in the work zone. In conclusion, PWTL machine is able to cut cost by reducing the amount of labourers required to manage the safety system. Moreover, less workers and labourer are less likely to involved in an accident or injury thanks to the automated PWTL system that eliminates the risk of using humans.

ABSTRAK

Pembinaan semula dan penyelenggaraan jalan tidak dapat dielakkan dan sentiasa menjadi bahaya keselamatan jika tiada sistem keselamatan semasa proses tersebut. Oleh itu, manusia atau lampu isyarat biasanya digunakan untuk mengawal sistem keselamatan lorong jalan raya. Bagaimanapun kaedah tersebut menimbulkan beberapa kelemahan dari segi keberkesanan, kebolehpercayaan dan kos. Sebagai contoh, masalah biasa yang dihadapi semasa menggunakan buruh adalah mengenai keselamatan mereka, pemandu yang cuai dan mementingkan diri sering menyebabkan kecederaan dan kemalangan kepada buruh ini. Selain itu, kos juga merupakan faktor utama di mana syarikat sering cuba mengelak daripada menggunakan buruh untuk meningkatkan margin keuntungan dan lebih suka menggunakan sistem automatik. Kertas kerja ini membentangkan reka bentuk baru dan pembangunan Lampu Isyarat wayarles Mudah Alih untuk menggantikan buruh dan menambah baik sistem lampu isyarat sedia ada. . Papan Arduino UNO, penderia dan lampu digunakan untuk mengawal keseluruhan sistem kawalan dan melaksanakan fungsi automatik mesin PWTL. Pembangunan perisian dan ujian telah dijalankan untuk menentukan komponen perkakasan yang boleh digunakan untuk projek ini. Berdasarkan analisis dan keputusan, jentera ini mampu menjimatkan kelewatan pemandu dengan jumlah yang sedikit dan juga mengurangkan risiko kemalangan kenderaan di zon kerja. Kesimpulannya, mesin PWTL mampu mengurangkan kos dengan mengurangkan jumlah buruh yang diperlukan untuk menguruskan sistem keselamatan. Lebih-lebih lagi, kurang pekerja dan buruh kurang berkemungkinan terlibat dalam kemalangan atau kecederaan berkat sistem PWTL automatik yang menghapuskan risiko menggunakan manusia.

ACKNOWLEDGEMENTS

First of all, Alhamdulillah thanks to Allah S.W.T for giving me a chance and helping me in completing this final year project report. In addition, I would like to give my full credit to all my family members for their continued encouragement throughout the preparation of this report.

I would like to share my excitement and acknowledgment to anyone that has helped and assisted me to finalize this report. Besides that, I would like to express my feeling and gratitude to my supervisor Vigneswara Rao A/L Gannapathy for his guidance and advice that is related to the project "Wireless Portable Traffic Light" and manage to complete the project smoothly.

I am very thankful for all my lecturers and friends that commit to the preparation of completing the report and always supported me in completing my work and provide me with undivided moral support so that I could prepare a comprehensive report within a set time.

Finally, I would like to thank all my fellow colleagues and classmates, the faculty members, as well as other individuals who are not listed here for being cooperative and helpful.

TABLE OF CONTENTS

			PAGE
DEC	LARAT	ION	
APP	ROVAL	,	
DED	ICATIO	DNS	
ABS	TRACT		i
ABS	TRAK		ii
ACK	NOWL	EDGEMENTS	iii
ТАВ	LE OF (CONTENTS	i
LIST	Г ОГ ТА	BLES BLAYSIA	iv
LIST	r of fi	HIRES	v
T ISI	T OF SV		vii
			vII
		BREVIATIONS	VIII
LIST	COF AP	PENDICES	İX
CHA	PTER 1 Backo	اويوم سيني بيڪ INTRODUCTION مالات	10
1.1	Proble	em Statementinti TEKNIIKAL MALAVELA MELAKA	12
1.3	Projec	t Objective	13
1.4	Scope	of Project	13
1.5	Summ	nary	14
CHA	PTER 2	LITERATURE REVIEW	15
2.1	Introd Portak	uction de Traffic Light	15
2.2	2.2.1	Controlling System	15
	2.2.2	Hardware Components	18
		2.2.2.1 Sensor	18
		2.2.2.2 Transmiter and Receiver	20
	2.2.3	Model Design	22
	2.2.4	Routine maintenance	23
		2.2.4.1 Routine maintenance takes at least a half-day project	24
		days per month	24
2.3	Type of	of Maintenances	25
	2.3.1	Roadside Maintenance	25
	2.3.2	Emergencies	26

	2.3.3 Bridge Maintenance	27	
	2.3.4 Special Events	27	
2.4	Advantages of Portable Wireless Traffic Light Project	27	
2.5	Guideline in establishing the work zone		
2.6	Work zone characteristic	31	
	2.6.1 Determining length of the work zone	31	
	2.6.2 Sight Distance Designing	31	
2.7	Summary	35	
СНАН	PTER 3 METHODOLOGY	36	
3.1	Introduction	36	
3.2	Project Flowchart	37	
3.3	Operation of the PWTL	38	
3.4	Maximum wait time	42	
3.5	Project Integration	43	
3.6	Project Design	45	
	3.6.1 Proteus 8.12 Profesional	46	
	3.6.2 AutoCAD	46	
	3.6.3 Arduino IDE	48	
3.7	Hardware Development	50	
	3.7.1 Arduino UNO	51	
	3.7.2 Digital Adjustable Infrared Proximity Sensor	51	
	3.7.3 RF Module(HC-11)	52	
	3.7.4 I2C LCD 16x2	54	
	3.7.5 LM2596 DC – DC Buck Converter	55	
	3.7.6 Active Low Relay Module	55	
	3.7.7 Prototype Model	56	
	3.7.7.1 Controller Unit	5/	
	3.7.7.2 First Sensor	50	
20	Tasting Drassdurg	59	
3.8	2.8.1 Troffic Signal Testing	59	
	2.8.2 Date Collection	00 60	
	5.8.2 Data Collection	02	
CHAF	PTER 4 RESULTS AND DISCUSSIONS	63	
4.1	Introduction	63	
4.2	The Variables and Parameters of the Test	63	
4.3	Result and Analysis	64	
	4.3.1 Result Data	64	
	4.3.2 Data Analysis	65	
	4.3.3 Relationship between Speed and Time taken(T cycle)	67	
CHAF	PTER 5 CONCLUSION AND RECOMMENDATIONS	69	
5.1	Conclusion	69	
5.2	Future Works	71	
REFE	RENCES	72	
APPE	NDICES	75	

LIST OF TABLES

TABLE	TITLE	PAGE
Table 3.1	List of Components	43
Table 3.2	Procedure to Develop Program.	49
Table 3.3	Traffic Signal testing procedure	60
Table 4.1	Parameters and Components	63
Table 4.2	Time taken to complete 1 cycle(70m)	64
Table 4.3	Time taken to complete 1 cycle (80m)	65
Table 4.4	Time taken to complete 1 cycle (90m)	65

اونيۈم سيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

iv

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1	Complete Traffic Signal Cycle for Previous Portable Traffic Signals[6]	17
Figure 2.2	HC-SR501 PIR Motion Sensor Module	19
Figure 2.3	E18-D80NK Infrared Sensor	20
Figure 2.4	Zigbee Transmitter and Receiver	21
Figure 2.5	HC-11 433MHz	22
Figure 2.6	Previous Design of Portable Traffic Light[1]	23
Figure 2.7	Maintenance of Portable Traffic Signal	24
Figure 2.8	Installation of a portable traffic signal for temporary work zone control	29
Figure 2.9	Placement of Traffic Control Devices for Short-Term Stationary Maintenance Work Using Portable Traffic Signals	31
Figure 2.10	Driver Line of Sight Impeded by Vertical Geometry[6].	32
Figure 2.11	Horizontal Geometry and Roadside Objects Obstruct Driver Line of USight[6]: SITI TEKNIKAL MALAYSIA MELAKA	32
Figure 2.12	Increasing the length of a work zone to ensure adequate line of sight.	33
Figure 2.13	Portable Stop Bar	34
Figure 3.1	Flowchart of Overall Project	37
Figure 3.2	Flowchart of PWTL	40
Figure 3.3	Complete Traffic Signal Cycle for Portable Traffic Signals	42
Figure 3.4	Three parts of circuit in Proteus	46
Figure 3.5	Portable Wireless Traffic Light Design	47
Figure 3.6	Possition of Sensor 1 and Sensor 2	47
Figure 3.7	Possition of the PWTL(with sensor) during construction	48
Figure 3.8	Startup Interface of the Arduino IDE	49

Figure 3.9	Arduino UNO R3	51
Figure 3.10	E18-D8ONK IR Proximity Interfacing	52
Figure 3.11	HC-11 433MHz Module	53
Figure 3.12	Set of I2C LCD 16x2	54
Figure 3.13	16x2 LCD Module with I2C Interface	54
Figure 3.14	LM2596 DC-DC Buck Converter	55
Figure 3.15	Active Low Relay Module Interface	56
Figure 3.16	Full Prototype Model	57
Figure 3.17	Controller Unit Closeup View	58
Figure 3.18	First Sensor of PWTL	58
Figure 3.19	Second Sensor of PWTL	59
Figure 3.20	Position of sensor 1 and 2	60
Figure 4.1	Graph of Table 4.2	65
Figure 4.2	Graph of Table 4.3	66
Figure 4.3	اويوبرسيني تيڪنيڪل Graph of table 4.4	67
	UNIVERSITI TEKNIKAL MALAYSIA MELAKA	

LIST OF ABBREVIATIONS

PWTL	-	Portable Wireless Traffic Light
LED	-	Light Emitting Diode
DSD	-	Decision Sight Distance
PIR	-	Proximity Infrared
PVC	-	Polyvinyl Chloride
PTS		Portable Traffic Signal



LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix A	Manual of IR Sensor Switch E18-D80NK	75
Appendix B	A000066-Arduino-datasheet	77
Appendix C	Manual of HC-11 433MHz	78
Appendix D	Turnitin Report	80



CHAPTER 1

INTRODUCTION

1.1 Background

Work zones are an unavoidable part of our society's efforts to maintain and develop our transportation infrastructure[1]. As a result, we must recognise that four elements are always in tension in the design and execution of a work zone: minimising the delay and disruption to the travelling public, maintaining the safety of both the public travelling through and the workers within the work zone, containing the costs to the public, and maintaining a profit margin for the contractor doing the work[1]. All of these elements are directly affected by traffic control within the work zone.

There are numerous sorts of work zones and traffic control within work zones. For an example, pavement repair, roadside maintenance, bridge maintenance and far more than this page can completely explain[2]. As a general rule, lane closures in work zones on two-lane, two-way highways necessitate some manner of coordinating opposing traffic flows in the remaining open lane[3]. This road closure is improtant for safety measurement for both construction workers during their working period and road user.

Traffic accidents [4], on road building sites are a persistent issue. Authorities change safety regulations on a regular basis in an effort to provide a safer working environment on a road building site, with the primary concern being the safety of road users and construction workers. According to the acts indicated in the road construction safety regulation, adequate

safety measures have always been considered in all means, particularly those endangering human life. DOSH produced statistics on road construction accidents[3].

In the effort to maintain safety and smoothness in traffic flow on the road construction site, the usage of a traffic controller or so called "flagman" is essential[4]. Such a practise was developed some time ago, and it has since spread throughout the world. The best way to stop traffic is to put the flagman's life in danger. Contractors, unbeknownst to them, have put the flagman's life in high risk, with the majority of tragic cases among them. Flaggers have been stationed at each end of the lane closure in order to control the traffic flow as smooth as intended. During road construction, the motorist must obey the flagman's instructions in order to avoid an accident involving the flagman, workers, and road users [5]. Sometime, little tolerance for error on the part of either the flagger or the driver occured. Flagging is such a time-consuming and dangerous activity. They need to monitor the approaching vehicle all the time during the repairement by standing at both end of the construction. This will consume so much energy to maintain untill the end.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ونيومرسيتي تيكنيكل مليسيا ملاك

1.2 Problem Statement

Construction work on roads can take place everywhere. As a direct consequence of this, traffic must be carefully managed and regulated. The passage of traffic is regulated and controlled by this flagman who stands at the intersection. The use of labourers comes with a hefty price tag attached to it. Because training sessions are so expensive, the vast majority of flagmen currently in use lack the necessary level of education and experience. During the time that the road is being constructed, the flagman, the employees, and the drivers on the road are all susceptible to a number of risks. In addition, there is a significant risk that a flagman will become injured or killed when working on a road that is currently under construction.

The Department of Occupational Safety and Health found that careless drivers were the leading cause of accidents that occurred on road construction sites. Flagmen are typically quite visible in their bright orange vests as they monitor traffic around a road construction site. They hold up "Stop" and "Go" signs or flags to notify cars what they need to do to get through a one-lane bypass. Accidents occurred as a direct result of the decision made by some careless drivers to disregard these warnings. In many countries, disobeying the flagman and speeding in road construction zones is considered a serious offence that can result in penalties or even jail time if it leads to an accident that results in physical damage. Aside from that, veteran motorists are aware that the pavement in a bypass lane is likely not to be as smooth as the pavement on the highway. In all likelihood, it will be rough and uneven, riddled with potholes, as well as muddy and treacherous to navigate. The skilled driver approaches the on-ramp to the bypass with caution and ease. On the other hand, careless drivers who enter the bypass at speeds that are higher than the posted speed limitations risk losing control of their vehicles. This reckless attitude will result in fatalities among those working on the construction project as well as other users of the road. Drivers

are responsible for adhering to traffic laws as well as security and safety requirements for not only their personal safety but also the safety of other people who use the road and employees who are engaged in road construction [2].

1.3 Project Objective

The main aim of this project is to propose a systematic and effective methodology to control traffic during any construction which also to avoid flaggers becoming involved in an accident. Specifically, the objectives are as follows:

- a) To investigate the safety of flagman and road users at road construction side.
- b) To design a new portable traffic lights that able to control traffic automatically at road construction side.
- c) To test and validate the developed portable traffic light system at road construction side.
 اوينون سيني نيڪنيڪل مليسيا ملاك
 UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.4 Scope of Project

To avoid any uncertainty of this project due to some limitations and constraints, the scope of the project are defined as follows:

- a) Range of transmitter covered a 100 meter(maximum length) of construction.
- b) The equipment is used a minimum of one to three working days per used.
- c) The Traffic light can work under several weather condition.

1.5 Summary

In conclusion, Background, problem statement, and objectives are essential for determining the path of the investigation and focusing the importance of generating the study. The following chapter will conduct research on past studies, relevant methodologies, related components, and ways to design a prototype based on the issue description and purpose. The project scope secures the bounds of a project in order to simply fulfil the objectives.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter covers design concepts, requirements, and other project-related information. This is established through researching prior similar projects as well as researching portable traffic lights that are currently in development and on the market. This chapter also describes the theory underpinning the system that will be utilised to build the machine.

2.2 **Portable Traffic Light**

In this system design, portable traffic lights played an important role. Between these two sets of traffic lights, there is a wireless communication system in place. The portable nature of the traffic signal can be attributed to the absence of wires. In addition to this, this may eliminate the usage limit that the traffic signal has, and it may be installed anywhere. The traffic light system is fully automated, meaning that it may function at any moment without the assistance of a human operator. The Intelligent Traffic Light is one of the best devices in work zone traffic control systems. This system can replace one or both flaggers during the lane closures for the construction[4]. In a normal situation, it is difficult to monitor and manage the flow of traffic, particularly on a two-way road, when it is raining, or when the temperature is really high. As a direct consequence of this, the traffic issue may be resolved by utilising the solution that was offered. Beside, the system is designed to help in the effort to control the traffic and decrease the number of accident without having a flagman during the road construction[5]. This idea has been used for many years to replace flagmen in various constructions. As a result, there are numerous of previous designs or systems in

controlling traffic that may be addressed to make this project more efficient and advanced. For an example;

- i. Controlling System
- ii. Hardware Component
- iii. Model Design
- iv. Routine Maintenance

2.2.1 Controlling System

Some of the old systems are still using outdated algorithms that use local knowledge. Majority Traditional traffic lights use a delay method to operate the traffic signal. Calculation and prediction of traffic levels are required in order to set the timer for green and red traffic lights. Therefore, it is possible to see the various timing components of portable traffic signals setting for work zones[6]. There are many factor need to consider when developing the timing of PTS include:

- I. Length of the work zone.
- II. Number and variability of vehicles expected to approach each side of the work zone.
- III. Speed of traffic approaching each side of the zone
- IV. Amount of buffer time used to separate departing traffic from entering traffic



Maximum Wait Time (Eastbound Traffic) = 240

Figure 2.1 Complete Traffic Signal Cycle for Previous Portable Traffic Signals[6]

Figure 2.1 shows a step-by-step illustration of the various signal timing aspects that contribute to the longest possible waiting time[6]. If the work zone were any longer than 336 meter, motorists in the eastbound direction (and probably the westbound direction also) would have a wait time longer than the upper limit of 240 seconds. All timings shown in Figure 2.1 are for example purposes only; actual signal timing will be based on work zone

characteristics, field conditions, and engineering judgement. Using this kind of methode will consume a lot of time and energy before and during the construction begin(Field check of phase timing).

Furthermore, rather than using one of the automatic cycling modes of the signal controllers, previous traffic lights can also be operated manually by a member of the repair crew[7]. If there are short-term detector difficulties, if highly fluctuating volumes exceed the designed maximum green times, or if work zone activity mandates an irregular schedule of traffic flow interruptions, such operation may be advantageous. The controller in manual mode can be advanced to green in either direction or set to red in both directions.

2.2.2 Hardware Components

2.2.2.1 Sensor

A device that detects the changes in its surrounding environment and responds to some output on another system is known as a sensor. When a physical phenomenon is detected by a sensor, it is converted into a quantifiable analogue voltage (or, in certain instances, a digital signal), which is then either displayed or transmitted so that it can be read or further processed. Appropriate to the purpose of this project, vehicle counting, a sensor capable of detection was necessary. It will be more focused on digital sensors rather to others such as position sensors, strain gauges, force sensors, and so on. Because PWTL can be mobilized, the ground loop sensor cannot be used because it contradicts the term portable itself. As a result, the proper sensor that correlates with the characteristics of this project is required. There are numerous types of digital sensors capable of meeting the criterion, but each one will have its own standard to distinguish itself. The most crucial aspects to consider before selecting the best one for this PWTL are speed, pricing and distance.

a) HC-SR501 Motion Sensor

A motion sensor, sometimes known as a motion detector, is an electronic device that detects nearby people or objects using a sensor. HC-SR501 not only can distinguish between object and human movement but it also can cover a distance of about 120° and 7 metres. But, this kind of sensor takes approximately 30 to 60 seconds after being turned on to go through the initialization sequence(response time). At that time it learns the ambient infrared signature of the environment. This device is used widely for not only automatic room light detection [8] [9] and for home surveillance [10] but also in smart homes [11]-[12]. But the device cannot be switched off completely without being unplugged. This HC-SR501 has been used in [8] to control the pedestrian crossing.



Figure 2.2 HC-SR501 PIR Motion Sensor Module

b) E18-D80NK Infrared Sensor(IR Sensor)

Infrared sensors IR sensors using reflected light intensity to estimate the distance from an object are not common, and only a small number have been reported in the bibliography [13][14–15]. Infrared sensors can also be used to determine distance and closeness. The

reflected light is detected, and the distance between the sensor and the object is estimated. The E18-D80NK is a high-performance, low-cost IR Proximity Sensor with a detection range of 3 cm to 80 cm. The use of a modulated IR signal shields the sensor from interferences caused by ordinary light from a light bulb or sunlight. This E18-D80NK goes through the startup sequence in less than 2 milliseconds after being turned on. In mobile robots, infrared sensors are almost solely utilised as proximity detectors. Some IR sensors reported in the bibliography, however, are based on phase shift measurement and offer medium resolution at long ranges (approximately 5 cm for distances up to 10 m [16]).



Figure 2.3 E18-D80NK Infrared Sensor

2.2.2.2 Transmiter and Receiver

c) Zigbee(Xbee)

IEEE 802.15.4 device Zigbee is utilised for communication. Zigbee is a communications standard that enables short-range. It was created with a focus on low-cost battery-powered applications in mind. The Zigbee wireless network also includes X-bee [6]. This Zigbee standard covers mesh, star, and cluster tree network topologies, as well as data security and compatible application profiles [17]. It necessitates longer battery life, lower data speeds,

and less complexity than present standards. The Zigbee network node is meant to be battery powered or to save energy by searching for available networks, transferring data from its application as needed, determining whether data is pending, requesting data from the network coordinator, and sleeping for lengthy durations [18]. Furthermore, this sort of gadget is employed in project[2] because it has a long range of radio transmission, with an outside range of up to 750m. The PIC microcontroller controls the Zigbee. Currently, the market pricing for this type of component is roughly RM 135, however PWTL required the same component for each traffic light in order for them to interact with one another.



Figure 2.4 Zigbee Transmitter and Receiver

d) HC-11 433MHz

The HC-11 [9] is an RF communication module that operates on the 433 MHz frequency range and has a serial interface. Thus, it may be used as the Serial () function by connecting to the Arduino hardware serial ports No. 0 and 1, or as the Software Serial library by attaching two digital pins. HC-11 can be 100 m up to 200 m. Power consumption can also be adjusted according to mode setup. Finally, the price is relatively low when compared to the xbee model, even if the functionality to transmit and receive data is the same.



Figure 2.5 HC-11 433MHz

2.2.3 Model Design

AALAYSIA

In the beginning, portable traffic signals had many difficulties[1]. Because there was no other visible way to create the system, the signals had to be hardwired to the main control unit. The signals were illuminated by industry standard incandescent lights in order to meet ITE lighting criteria. These lamps used far more energy than today's LED indicators. As a result, the cables were long, heavy, and cumbersome, and they had to be routed through the work zone in some way. The power has to be provided by diesel-generated alternating current (AC). The diesel – smelly and noisy - constantly needed fuel, lubrication and attention – no awards for labor reduction or environmental consciousness there. This system was ultimately effective, but not cheap nor easy, nor even very portable[1]. Figure 2.6 show the application of previous Portable Traffic Light system which need a total time to set up the signals and put them into operation is approximately 45 minutes[7].



Figure 2.6 Previous Design of Portable Traffic Light[1]

2.2.4 Routine maintenance

It is technically possible to transfer technologies from long-term construction projects to day-to-day maintenance responsibilities[6]. Even though clear usage limits may be required in exceptional circumstances in maintenance work zones, the question that needs to be answered is whether or not the anticipated frequency of use is sufficient to justify the cost. Under these general conditions, the efficiency and effectiveness of previous portable signals for two-lane work zones are optimum;

- i. Routine maintenance takes at least a half-day project[7].
- ii. The equipment is used minimum of eight to ten working days per month[7].

2.2.4.1 Routine maintenance takes at least a half-day project



Figure 2.7 Maintenance of Portable Traffic Signal

The example of normal maintenance is shown in Figure 2.7, and it includes things like regular machine servicing and inspections. Regular checks and upkeep are carried out on the system. It is essential to do routine maintenance in order to maintain systems up to date and operational. The configuration of the signals and the beginning of their use will take around a quarter of an hour. In point of fact, it is possible for other equipment mobilisation and work area setup procedures to take place at the same time.

2.2.4.2 The equipment is used a minimum of eight to ten working days per month

This simple rule of thumb ensures that the return on investment for the equipment will take place within one years, based on the efficiencies that may be realised from its operation. When the signals are put to use on a more regular basis, it won't be long before they pay for themselves and start helping the user save money. The greater the frequency with which maintenance equipment is used as a result of its shared use between neighbouring portions, the better the return on investment will be. On the other hand, if you use it less times each year, the payback period will be greater, and there will be a longer window of time before yearly savings become apparent.

2.3 Type of Maintenances

Maintenance, sometimes known as technical maintenance, is a collection of activities and practices aimed at ensuring the continued and efficient operation of machinery, equipment, and other forms of assets. Implementing a good maintenance programme requires diligence to ensure the successful operation and lifespan of assets, buildings, and whole organizations. That is where our Portable Traffic Light can be useful as a traffic controller. It is because to manage traffic flow, this sort of maintenance will necessitate the PWTL instead of use man power(flagman). As a result, there are a few types of maintenance that may be applied to this sort of project, which include;

2.3.1 Roadside Maintenance

Maintaining different roadways is what we mean when we talk about road maintenance. There are two possible classifications for these roadways: main thoroughfares and secondary highways. The purpose of this maintenance is to guarantee that these highways are in a safe condition. This is only an example of a very lengthy subtopic level 2 title, which consists of two or more lines and ensures that roads of all types continue to be reliable, risk-free, and productive. The term "road maintenance" can refer to a wide variety of tasks, ranging from filling in little potholes (which can be done in about an hour) to completely resurfacing an entire section of highway. No matter what the duty is, the ultimate purpose of this activity is to ensure the safety of those who use the road, to manage traffic, and to maintain upkeep. Because of this, the roadway will continue to function as effectively and for as long as it can for as long as it can. Forms of road maintenance can include the following:

• Road resurfacing

Resurfacing is a simple maintenance method that involves applying a new layer of material over the existing surface rather than replacing the entire road. Resurfacing roads and other high-traffic areas when damage occurs can extend the life of the road and make it as safe to travel on as possible.

• Pothole repair

Potholes are a source of frustration for drivers and a potentially dangerous road hazard. Road authorities frequently overlook pothole distresses in asphalt pavement, despite the fact that they waste a large amount of time and money to repair. Many road workers are unaware of the materials and methods required to repair potholes.

Pavement resurfacing

Pavement is a type of hard surface made up of durable surface material that is laid down on a surface to carry vehicular or pedestrian traffic. Its principal function is to distribute applied vehicle loads across many sub-grade layers.

2.3.2 Emergencies

Portable signals are especially useful in cases where a lane must be closed for an extended length of time or overnight due to an emergency. Examples include culvert washouts, emergency pavement failures, and roadblocks

2.3.3 Bridge Maintenance

Cleaning and other routine maintenance services such as painting, patching, and vegetation control are included in bridge maintenance. Attempt to keep all contaminants out of the water during any of these maintenance tasks by blocking drains, gathering debris, and moving waste to a safe storage location.

2.3.4 Special Events

Portable signals can be set up to offer signalised control where it is not otherwise necessary when a huge influx of traffic is expected for an event. Two examples are festivals and sporting events. This field book does not cover the use of portable signals for special events or the application of portable signals at three-way or four-way intersections.

2.4 Advantages of Portable Wireless Traffic Light Project

This system has the potential to be one of the most effective types of traffic control systems for use in road building. Establishing this system with the intention of reducing the frequency of accidents involving flagmen is the key reason for doing so. As a consequence of this, the strategy may be utilised effectively in road construction, which is an environment in which the potential hazards and constraints posed by a flagman can be reduced. In addition, because it consumes so little power, it may be utilised during the night or at any time of day, depending on the environment or the conditions. In addition, in contrast to the flagman system, this one permits an unlimited number of working hours. PWTL come equipped with a system that has a built-in safety function that will only activate the red light on both sides of the vehicle when the road is clear[5]. On a road with only one lane, this is achieved by utilising an infrared sensor for the purpose of counting vehicles and an infrared sensor for the purpose of detecting moving vehicles. Arduino UNO are used in the majority of traffic lights are significantly low cost. As a direct consequence of this, not only is this approach risk-free, but it also does not break the bank. In addition, these gadgets have a low power consumption, which enables the system to function using simply batteries as opposed to a generator. One of the benefits of utilising fiaggers is that they respond to random vehicle arrivals and gaps in the traffic flow, and they may assign traffic movements across the work zone to minimise vehicle pauses and delays. Fixed-time signals are not affected by isolated random vehicle arrivals. Rather, under signal control, motorist delay is a function of the timing parameters (cycle length, green phase time, etc.). As a result, when fixed-time portable signals are utilised instead of fiaggers, motorist delay should increase. Therefore, there is a system in Portable wirelees traffic light system that can facing that kind of problems with a better solution.

solution. اونيونر, سيتي تيڪنيڪل مليسيا ملاك UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2.5 Guideline in establishing the work zone

A field evaluation needs to be carried out to determine the highway and the traffic conditions before the portable signals may be used in a normal operation[6]. This survey has to be carried out on a day and at a time when traffic conditions are similar to those that are anticipated to exist over the entirety of the project. The information that is acquired will assist in planning the work zone as well as determining the timing of the signals.



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1. Locate signal stations that are portable. When organising the traffic light, look for shoulder regions that are level and sturdy, as well as spaces that are clear. Take careful notice of the amount of space that separates each traffic location. According to recommendations made by the United States Department of Labor, the practicable maximum length of the activity area for one-way traffic signal regulation should not exceed 400 feet (or approximately 122 meter) (Occupational Safety & Health Administration). The timing of the signals may also be a factor in limiting the length of the work zone. It is best to have shorter times, especially if the activity area is on a road with poor visibility and/or if there is an increased likelihood that drivers would run red lights as a result of the increased traffic.

2. Take note of the intersections of streets and driveways. Work zone limits should be set, just like they are during a flagging operation, so that high-traffic driveways and intersections with county or state roads are kept outside of the activity zone. In the event that a driveway or roadway intersects the work zone, it will be necessary to have a maintenance professional present on the ground to assist in coordinating the flow of traffic. Notifying adjacent property owners in advance is a great strategy to lessen the amount of trouble that can be caused in the driveway, and it should also assist boost driver compliance.

3. Check the signal placements as cars approach to ensure that the signals are visible and can reach a sunlight. In the event that the rules for the bare minimum viewing distance are not met, the placements of the signals will need to be adjusted. The solar panel will convert the sun's rays into electricity, which will then be used to power the traffic signal. Any excess power will be utilised to charge the battery, which will allow it to be used continuously for 24 hours. Thus, the placement of the PWTLs towards the sunlight are also important.

Night Closures. When an emergency requires the closure of a lane for a lengthy period of time or overnight, portable signals are particularly helpful because of the flexibility they provide. Be sure to adhere to the standards, which include lighting, pavement markings, and other important prerequisites for nighttime operations. Having a clear line of sight from one end of the work zone to the other is necessary for activities that take place overnight, as shown in Figure 2.8.


Figure 2.9 Placement of Traffic Control Devices for Short-Term Stationary Maintenance Work Using Portable Traffic Signals

2.6 Work zone characteristic

2.6.1 Determining length of the work zone

The length of the work zone will be defined by the scope of the routine maintenance project and will be limited by the maximum amount of time a driver can expect to wait before receiving a green signal[6]. It takes longer for opposing traffic to clear a work zone the longer it is in place. The maximum allowable wait time for a motorist in a rural work zone is four minutes, particularly if the motorist has restricted visibility of the work activity and the opposite end of the work zone. As part of the signal timing design, a check will have to be made to be certain the reasonable wait time is not exceeded. If it is exceeded, then adjustments will have to be made to shorten the work zone length[5].

2.6.2 Sight Distance Designing

When approaching a maintenance work zone, vehicles need sufficient time to notice and respond to work zone traffic control devices[6]. This requirement applies to all work zones. Because of horizontal and vertical geometric limits, respectively, the placement of portable traffic signals is depicted in figures 2.9 and 2.10 as being accurate.



Figure 2.10 Driver Line of Sight Impeded by Vertical Geometry[6].



Figure 2.11 Horizontal Geometry and Roadside Objects Obstruct Driver Line of Sight[6].

• Dealing with Work Zone Speeds

When it comes to determining how much of a clear line of sight is required to view the signal heads and the work zone, the most significant factor to consider is the pace at which cars are approaching from each side of the work zone[6]. Lengthen the work zone to include the hill, curve, or roadside object that obstructs the clear line of sight of approaching motorists, and then check the available line of sight once more. If hills or curves in the road prevent you from positioning the work zone's ends in such a way that you have the required clear line of sight, lengthen the work zone. Figure 2.11 is a diagram that shows how a work zone can be lengthened such that there is sufficient line of sight. For any traffic control device to be effective, the device must be visible and able to convey its message with sufficient time for motorist perception and safe reaction. In the case of portable traffic signals, this means that the signal must be located so that no horizontal or vertical obstructions, in reasonable

proximity to the signal, obscure the line of sight between the signal and an approaching vehicle.[6].



a) Inadequate DSD for a safe work zone approach



Figure 2.12 Increasing the length of a work zone to ensure adequate line of sight.

The rate at which traffic moves through an area where it is being regulated by a portable traffic signal is an essential component in determining the time of the signal. The red clearance interval is determined using the lowest feasible speed through the work zone, so the speed of vehicles travelling through the work zone has a direct bearing on the level of safety. This term refers to the duration of time that opposing traffic is required to wait in order for cars to pass through the work zone before the interval begins. It is essential in the application of a portable traffic light to make an estimate of the slowest speed at which motorists are anticipated to go. The problem arises when it is specified that motorists are

expected to proceed at a certain speed, when the signal clearing intervals are set for that speed, and when the actual speed of traffic is lower than expected. Because of this, there is a greater possibility that opposing traffic will be given a green signal before the current traffic has been cleared.

• Application of Stop Bars in Short-Term Portable Traffic Signal Applications

A stop bar needs to be incorporated into the work zone configuration whenever there is just one lane being worked on and portable traffic signals are being used to direct traffic. This restriction applies to work zones that are going to be in operation for longer than 24 hours. White paint or white thermal tape have historically been used in the construction of the stop bar. The locations that were investigated for this project, in addition to the applications for temporary work zones. For a one-day work zone, the use of paint or thermal tape would be prohibitively expensive, as these materials are typically used for longer-term construction zones. It is important to explore and design a low-cost, attractive portable stop bar that is capable of quick installation and removal and demonstrates uniform acceptable performance across a variety of speeds. This is a necessity. A product such as this might be utilised for temporary portable signal applications such as the ones that are being addressed in this project, in addition to other temporary applications that require a stop bar control device.



Figure 2.13 Portable Stop Bar

2.7 Summary

In conclusion, PWTLs have a myriad of requirements and procedures that ask for the involvement of workers as well as people in order to reduce the amount of personnel that is required as well as the number of accidents that take place. In order to ensure that there will be no interruptions to the normal flow of road traffic, it is necessary for this project to take into account every possible scenario and circumstance. Things consist of things like maintenance, the character of the work zone, the phase scheduling, and similar things. Due to the fact that other people's lives will be affected, it is imperative that these preparations



CHAPTER 3

METHODOLOGY

3.1 Introduction

This section will concentrate on the design of the system, and the prototype of the system will be produced in stages. The first thing that needed to be done in order to bring the prototype to life was to work out the control design system. This stage involved programming Arduino microcontrollers. The constructed control system was simulated and confirmed before it was used, which ensured that the controller would send the appropriate output signals. Now that the simulated circuit diagram and code have been developed, the next step is to prototype the hardware. After completion of the prototype, it was put through its paces, and its output signals were scrutinised in light of the myriad of possible outcomes.

اونيۈم سيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

3.2 Project Flowchart

This research was carried out with the goals of improving the effectiveness of the flow of traffic during road construction and lowering the number of accidents that take place.



Figure 3.1 Flowchart of Overall Project

3.3 Operation of the PWTL

Portable traffic lights allow for the programming of a number of unique situation of operation that can be used by the device. It is possible to use two different units in a pretimed arrangement that consists of a green phase that lasts for a certain amount of time followed by a period in which both lanes of traffic that are approaching are free of obstructions. The devices also have the capacity to be configured to function in one of three traffic-actuated modes, all of which are more responsive to the real traffic demand at each signal. This flexibility allows the devices to be used in a variety of configurations. There will be enough time to safely clear the roads once a vehicle reaches the one-lane construction zone thanks to the programmable portable traffic lights that are able to perform in any mode of operation. In order to guarantee that there will be enough time to transfer vehicles once they have entered the work zone with one lane, we need to assure that there will be enough time. There are 3 scenarios for the controller to consider when transmitting the output signal and those are:

Situation 1 : There are no vehicles presence at both ends of the construction.

Situation 2 : The number of vehicle going in not equal with the number of vehicle going out

Situation 3 : There are vehicle presence at ONLY one of the construction ends





Figure 3.2 Flowchart of PWTL

First and foremost, after the traffic light start functioning, both signal(east and west) will display red light until one of the sensors (S2A or S2B) detects a vehicle approaching the work site. (The position of the sensors can be seen in **Figure 2.10**). The programe will prioritize sensor S2A first to detect a vehicle then turn his lane green while interlocking the other traffic light to stay red. For example, if S2A detects a vehicle approaching, traffic light A will turn green while interlock signal B to give space for vehicle from traffic light A moving in and out safely. Traffic signal B remains red even though sensor(S2B) detected a

vehicle. During the green period, S1A will count the number of cars passing through the construction site until it turns red again. Following that, S1B will determine whether the vehicle has already left the site or not and numbers of vehicle that going in and out must be same, if not, another 30 second for red light will be add in order to make sure the road is clear and safely to move. After that, the system will give change to the other lane which is traffic light B in order for motorist to moving in the site if any vehicle detected from sensor S2B and repeated the same proccess for lane B. If there is no detection, the system will return back to traffic A.

The main highlight of PWTL feature when comparing with traditional portable trafic light is the capability to monitor the number of vehicles and manage its traffic flow accordingly. This feature is crucial because it involves the safety of driver, wokers and nearby pedestrians however it is often overlooked by the system designer. This feature is especially useful when the drivers is unable to see the full lane from end to end due to inclination or declination angle of the road hence leaving a blindspot. The way PWTL overcomes this is by counting the number of vehicles coming out and in a lane, this way the system is able to ensure whether the lane is safe to use for both ways. Futher more, using this kind of method will reduced the total waiting time of a motorist. This is because the fastest vehicle can going out the construction site, the less the vehicle at oppossing site need to wait. Another important feature is for when the construction vehicle enters the lane for fix or maintain the road, if the counted construction vehicle is has not exited the lane under a certain period of time then the systems restarts to default.

3.4 Maximum wait time

Figure 7 shows the timing components of a portable traffic signal in a construction zone, as well as how those components work together to complete a signal cycle. The signals displayed on the horizontal bars labelled "G" and "R" correspond to the signals observed by the driver on that specific approach. As an example, consider an east-west roadway. The "phase timings" are described by the adjectives above and below the bars.



Figure 3.3 Complete Traffic Signal Cycle for Portable Traffic Signals

When the Westbound platoon becomes green and begins moving, the other site (Eastbound platoon need to wait and stop because of the red time). Eastbound traffic will remain red until all vehicles have safely exited the construction zone in order to avoid any accidents. One complete cycle referring to the total time starting from transition green to red until it return back to green light. For an example, once the west platoon goes green, waiting time

for Eastbound platoon considered already start until Westbound traffic become red and turn for Eastbound platoon moving in. That period can be call as one complete cycle.

3.5 **Project Integration**

Table 3.1 shows the list of components of this project. All part data information has been described to show the function of each component. The flow of the project can be seen step by step from the input to the desired output. Figure 3.2 shows the component integration mindmap.

	Components	Brand	Product No.	Description	Quantity
1	Microcontroller	Arduino	ARDUINO-	Microcontroller for	1
1.	Microcontroller	UNO R3	UNO	the machine	I
2.	RF module	Cytron Technologies	HC-11 پي ٽيڪن	To transmit and receiving a signal.	1
3.	UDigital RSI Adjustable Infrared Proximity	LEFIRCKO	L MALAYS E18-D80NK	To detect obstacle and send signal to the microcontroller for next operation	4
	Sensor			of the machine	
4.	I2C LCD 16x2	Cytron Technologies	DS-162A-C- G	To display the machine interface	2
5.	12V Battery			Power Supply	2

 Table 3.1 List of Components

6.	DC – DC Buck Converter	Cytron Technologies	LM2596	To step down 12 VDC to 5VDC	2
7.	Relay Module	Cytron Technologies	SRD- 05VDC-SL- C	To control high current loads with small amount of current	2
8.	Push Button	A BELDA	-	To switch the machine on/off	2
9.	Plastic Box	کل ملی ۱ TEKNIKA	ي تي تيڪني MALAYS	To place the controller and other main component like battery and Rf module from being exposed to sunglight and rain.	2
10.	Steel	-	-	To become base of the traffic light in order to be stable and strong enough during construction period.	-
11.	Jumper cables and wires	-	-	To connect electrical and electronic components	-

12.	Light Emitting Diod	-	-	To show the output of the system	-
13.	PVC	-	-	Framework for the PWTLs	-

3.6 Project Design

In a project development, software development is the earliest method or procedure that can be implemented after conducting a detailed study. Software development requires atest, simulation, or design to be implemented without the use of high costs. This allows any changes to be made to a project even if the study has been carried out. This is due to the fact that when a test or simulation is carried out, there are a number of parameters that can be taken into account because it resembles the parameters that will occur in real time. To implement Portable Wireless Traffic Light, there are three software used to perform software development.

3.6.1 Proteus 8.12 Profesional

This software is used to design the electronic circuit involving the Arduino and other components such as Push Button(as a Infrared sensor), Lcd and Led. There are three parts of circuit design which is LCD display, Light emitting diod(LED) and PIR. These three parts of circuit is controlled by the Arduino, which is programmed in the Arduino IDE (will be explain in the next subtopic).



Figure 3.4 Three parts of circuit in Proteus

3.6.2 AutoCAD

To develop a model, a sketch of the traffic signal must be created to visualize the design and dimensions of the machine. In this project, AutoCad software is used to sketch the preliminary design of the Portable Traffic Light(Figure 3.2).



Figure 3.6 Possition of Sensor 1 and Sensor 2

Possition sensor 1 and sensor 2 must have a few distance in order to maximize the functionality(as shown in Figure 3.3). Furthermore, S2 can not be place to far because of the

sensor wire connected with the main controller(Arduino). Range of S2 must not exceed the opposite lane because it will disturbe the system program.



Figure 3.7 Possition of the PWTL(with sensor) during construction

3.6.3 Arduino IDE

Arduino IDE is open-source software developed by Arduino.cc for writing, compiling, and uploading code to the majority of Arduino modules. A set of coding is written in the Arduino IDE which is later compiled and exported to the Proteus software to enable to run the simulation. This is also known as programming the Arduino. The Arduino that is being utilized for this project will act as the primary microcontroller unit for the system as a whole. In order to use an Arduino board, a program must first be created using the Arduino IDE and then it can be transferred to the board. The availability of a circuit design for the project can make the process of developing the program more manageable. This is due to the fact that it will be simpler to declare the input and output of the Arduino pins, select the library that will be utilized, and choose which data will be read and displayed. The startup interface of the Arduino IDE is depicted in figure 3.5, and the steps required to develop a program using the Arduino IDE are outlined in table 3.2.



Figure 3.8 Startup Interface of the Arduino IDE

Step	Procedure	Description
1.	Sea Alles	To interact with the hardware
	Determine the set of libraries to be used	electronic components, the proper libraries must be utilised.
2.	UNIVERSITI TEKNIKAL M	ALAY SIA MELAKA
	Declare the input and output pins	Data is read and sensor feedback is received via input pins. Output pins are used to convey commands to electronic components, depending on the type of hardware component used. For example, turn on LED, show text or data on the LCD display, and
3.	State the initial condition of the system	Setup the initial condition for each of

Table 3.2 Procedure to Develop Program.

		the electronic components.
4.	Program the initial setup of the system	Setup the system condition before its
		operation.
5.	Program the system operation	The system will execute the specified
	conditionusing if-else argument.	program.
6.	Test run the program in	To determine whether or not the
	Proteussoftware	software contains errors and whether
		or not the programme functions
		properly.
7.	Determine if the program meet	The finalized program will be used for
	therequirement. If met, finalize the program. If not, repeat step 3-	the project.
	6. Formania	

اويونر, سيتي تيڪنيڪل ملبسيا ملاك Hardware Development UNIVERSITI TEKNIKAL MALAYSIA MELAKA

This subtopic will go through the physical components used in the creation of this project. The prototype's components, on the other hand, may differ from the system's core components. Given that a prototype is a product designed to test a concept or process, the variations are due to knowledge and financial constraints. The following are the materials utilised in this project:

3.7.1 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. Arduino is an opensource prototyping tool that is suited for both enthusiasts and professionals due to its ease of usage. The Arduino Uno has 14 digital I/O pins (six of which may be used as PWM outputs), 6 analogue inputs, a 16 MHz crystal oscillator, a USB connection, a power connector, an ICSP header, and a reset button. It comes with everything you need to get started with the microcontroller; simply connect it to a computer by USB or power it with an AC-to-DC converter or battery. The Arduino UNO is used in this project to run the whole automation system that has been put into the machine. This includes operating the dispenser, receiving feedback signals from sensors, loading the display on the LCD, storing data memory, and declaring each function of buttons or feedback components. For a further information, please refer to **Appendix B**.



Figure 3.9 Arduino UNO R3

3.7.2 Digital Adjustable Infrared Proximity Sensor

An infrared sensor is an electronic device that emits light in order to detect objects in the

environment. An IR sensor can detect motion as well as measure the heat of an item. These are radiations thatare invisible to the naked eye but can be detected by an infrared sensor. An infrared sensor, as shown in Figure 2.5, is an electrical device that produces infrared rays in order to detect certain features of the environment. This IR will be used to detect the vehicle or motorist at both traffic light(east and west) as an input to brain of the system. Two digital adjustable infrared proximity were used in this machine; sensor 1 to detect the approaching vehicle while Sensor 2 to count numbers of vehicle going in the construction site. For a further information, please refer to **Appendix A**.



3.7.3 RF Module(HC-11)

This project makes use of RF Module for communication. RF Module is a A small electronic device used between two devices to transmit and/or receive radio signals. It is frequently desirable in an embedded system to communicate with another device wirelessly. This wireless communication can take place via optical communication or radio-frequency (RF) communication. Because it does not require line of sight, RF is the medium of choice for many applications. A transmitter and a receiver are used in RF communications. They come

in a variety of shapes and sizes. Some are capable of transmitting up to 500 feet. RF modules are commonly manufactured using RF CMOS technology. Wireless sensor networks have recently become an established technology. However most are confined to environments where power usage and communication range is not a limiting factor. The study noted that one of the biggest drawbacks of the implemented system, was the choice of integrated radio device operating at a frequency of 900MHz. The employed hardware was specified to have a '3 mile range', but when placed in the field, was only capable of communicating up to 100m[7]. For a further information, please refer to **Appendix C**.



b) Connection of RF Module

Figure 3.11 HC-11 433MHz Module

3.7.4 I2C LCD 16x2

An I2C LCD 16x2 type display is used to show the user the machine's usage interface. This type of display has a light blue backlight that clearly matches the interface in dark areas. Connecting to the existing LCD shield is not possible due to the microcontroller's limited number of output pins. The I2C module, on the other hand, can display data on an LCD using only two pins that receive a signal or a programme from a microcontroller. This component displays data of vehicle going through the construction site. Figure 3.8 and Figure 3.9 shows the I2C LCD 16x2 and the connection respectively.



Figure 3.13 16x2 LCD Module with I2C Interface

3.7.5 LM2596 DC – DC Buck Converter

The buck converter is a common DC-DC converter that converts high voltage to low voltage efficiently. Efficient power conversion extends battery life, reduces heat, and allows for the development of smaller devices. The LM2596 DC-DC buck converter step-down power module, as shown in Figure 3.9, can drive a load of up to 3A with high efficiency and is compatible with the Arduino UNO, other mainboards, and basic modules. The LM2596 converter's efficiency is much higher than that of typical three-terminal linear regulators because it is a switch-mode power supply, especially at higher input voltages. The LM2596 has a switching frequency of 150 kHz, allowing for smaller filter components than would be required with lower switching frequencies.



Figure 3.14 LM2596 DC-DC Buck Converter

3.7.6 Active Low Relay Module

The primary purpose of the relay module is to control the on and off states of various electrical systems and devices. Additionally, it functions as a barrier between the control circuit and the device or system that is being controlled by the circuit. hey come in a variety

of shapes and sizes, but are most commonly rectangular with 2, 4, or 8 relays mounted on them, sometimes even up to a 16 relays. Relay modules contain other components than the relay unit. These include indicator LEDs, protection diodes, transistors, resistors, and other parts. This is significant because it enables the use of a microcontroller or another low-power device to control devices that have voltages and currents that are significantly higher than those of the microcontroller or other device.



The figure for the fully built prototype model is provided in this subchapter. The prototype frame is made of PVC and is welded to a steel foundation. The PWTL's foundation is made of steel. The green and red lights are made of LEDs that have been covered in plastic. Figure 3.12 depicts the Portable Wireless Traffic Light's full prototype model.



Figure 3.16 Full Prototype Model

3.7.7.1 Controller Unit

Figure 3.13 depicts the system's control panel as well as a close-up view of the controller unit smoothly. The controller unit will function as a system brain, processing or executing all tasks programmed into the Arduino UNO controller.



Figure 3.17 Controller Unit Closeup View

3.7.7.2 First Sensor

The first sensor is one of the PWTL inputs, and it will be used to count vehicles that pass through it. Then, the data will then be processed within the controller.



Figure 3.18 First Sensor of PWTL

3.7.7.3 Second Sensor

3.8

The second sensor, which is also one of the inputs for PWTL, will be used to initiate the programme by detecting any vehicle approaching the site. Because of its usage, this sensor will be placed a little further away from the controller unit (sensor 2).



Testing will identify flaws, reduce defects, and improve overall system quality due to overlooked and unavoidable human error, testing is essential because it allows us to identify bugs or errors early on, allowing them to be fixed before the application will be commercialize. By following the procedures, the project will be able to complete its tasks in an accurate and consistent manner, thereby satisfying a requirement and accomplishing its goal.

3.8.1 Traffic Signal Testing

The testing is done to see if the traffic is capable of producing the results specified in the simulation. If the project fails to meet the target or objective, an analysis must be conducted to determine the improvements that must be made. The project's ability to control traffic flow, the precision of the sensor, and the transition signal are among the components tested in this system.

Steps	Description
1.	Sensors 1 and 2 were installed as shown in Figure 3.3. To maximise
	functionality, make sure it has a few distances. Furthermore, because the
	sensor's wire connects to the main controller, S2 cannot be placed too far
-	away (Arduino). S2's range must not exceed the opposite lane, as this
	will disrupt the system programme.
-	المغاز سيتي تيكنيكل مليسيا ملاك NIVERSITI TEKNIKAL MALAYSIA MELAKA
	Distance
	Figure 3.20 Position of sensor 1 and 2
2.	The green button is pressed to start the traffic light.





3.8.2 Data Collection

Once the PWTL system has been set up and tested, the data collection can be started. There is an activities or experiment has been conducted aimed at gathering data that could be used to evaluate the effectiveness of this equipment controlling traffic flow in term of safety and total motorist waiting time. In order to collect data for this experiment, the following approach is used;

- 1. Portable wireless traffic light has been positioned like in Figure 3.6 with the distance of between these two traffic is 70 meters.
- 2. Start the operation of PWTL by referring table 3.3.
- 3. 3 vehicle has been set up to move in from Traffic Signal A and out at Traffic Signal B.
- 4. This vehicle must be operated at various speeds of 15, 20, 25, and 30 km/h. During that time, one car was spotted by sensor S2B at Traffic Signal B as a safety measure (Traffic Signal B must remain red if the numbers of vehicles entering and exiting are not the same.
- 5. Total time taken for vehicle B need to wait before moving in(one complete cycle) has been recorded in table 4.2, 4.3 and 4.4. (refer Figure 3.3 for an explaination).
- Step 1 until step 5 has been repeated using different distance which are 80 and 90 meters between those traffic signal.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and analysis on the development of a PWTL. A case studies are based on traffic flow and their relationship to parameters such as distance, speed and traffic level. The recorded data includes number of vehicles in several conditions such as: (i) length of construction, (ii) speed of vehicles. It is important to note that, this case study aims to illustrate the results of the estimated the efficiency of this PWTL which can lead to feasible approaches for future.

4.2 The Variables and Parameters of the Test

To carry out tests and studies, the important thing to have is the variables and parameters to be tested. This aims to facilitate data collection and also ensure that the purpose of the test is in line with the objective of the study, where the objective of the study includes the study of traffic flow. Table 4.1 shows the variables and parameters tested and measured.

Parameter	Components
Variables	 Distance (70m, 80m, 90m) Vehicle speed (20km/h) Traffic level (Vehicle at both end)
Observed/Measured	• Number of vehicle pass through

Table 4.1 Parameters and	Components
--------------------------	------------

4.3 Result and Analysis

In this chapter, the results of the test as well as the analysis are presented. The results and analysis that were obtained were derived from the tests that were carried out in order to obtain performance data for this Traffic light. The information that was gathered is presented in the form of tables and graphs so that a general understanding of the capabilities of this project can be obtained. In all of the tests and studies, the amount of time for the green and red light have been maintained at the same level of consistency.

4.3.1 Result Data

Table 4.2 Time taken to complete T cycle(70m)													
Vehicle	Average	Average Number of vehicle pass through and time to complete 1 cycle(s)											
specu(kii/ii)	one cycle(s)	In /Wo	Out	time	In	Out	time	In	Out	time	In	Out	time
15	46.00	3	3	46.20	3	3	46.13	3	3	45.80	3	3	45.87
20	42.60	3	3	42.58	3	3	41.96	3	3	42.6	3	3	43.26
25	47.80	3	3	40.08	3	3	30.16	3	3	41.13	3	3	39.81
30	60.94	3	1	68.20	3	2	69.01	3	3	38.45	3	2	68.10
	UNIV	ERS	TITI	EKN	IKAL	MAI	AYS	IA	ME	LAK	λ.		

 Table 4.2 Time taken to complete 1 cycle(70m)

Vehicle	Average		Number of vehicle pass through and time to complete 1 cycle(s)										
speed(km/h)	time,		1 st		2 nd				3 rd		4 th		
	one cycle(s)	In	Out	time	In	Out	time	In	Out	time	In	Out	time
15	49.20	3	3	49.65	3	3	49.21	3	3	48.96	3	3	48.98
20	44.43	3	3	44.40	3	3	44.23	3	3	44.08	3	3	45.01
25	49.02	3	3	41.40	3	3	72.15	3	3	40.96	3	3	41.57
30	70.54	3	1	70.10	3	3	71.45	3	3	71.03	3	2	70.58

 Table 4.3 Time taken to complete 1 cycle (80m)

Table 4.4 Time taken to complete 1 cycle (90m)

Vehicle	Average		Number of vehicle pass through and time to complete 1 cycle(s)										
speed(km/h)	time,		1 st			2 nd			3 rd		4 th		
	one cycle(s)	In	Out	time	In	Out	time	In	Out	time	In	Out	time
15	21.60	3	3	52.05	3	3	50.90	3	3	51.58	3	3	51.87
20	16.20	3	3	45.97	3	3	46.15	3	3	46.33	3	3	46.35
25	28.04	3.4	3/3	42.96	3	2	73.05	3	3	43.16	3	3	43.02
30	40.68	3	1.4	70.76	3	2	71.06	3	2	70.53	3	2	70.38

4.3.2 Data Analysis

These analysis are used to investigate the correlation between



Figure 4.1 Graph of Table 4.2

According to Figure 4.2, for the first three speed of vehicle (15,20 and 25 km/h), their total time taken for completed one cycle are decreasing consistenly without any peculiar data. For an example, look for the first set of reading(refferring the blue color) decreases from 46.20 seconds (15km/h) to 40.08 seconds (25km/h) to make a complete cycle. The same can be said for the purple color (4th reading). 3rd time of collected data are completely reduced from the first to the last speed (referring the green color) in which intercorrelated with the theory when increasing the speed of the vehicle passing through the construction site, the time required to complete one cycle is reduced. Some of the bars from 30km/h speed are very high in comparison to the other speed. This is because some factor or causes occurs that link to the speed of vehicle that need to observed in this part.



Figure 4.2 Graph of Table 4.3

According to Figure 4.3, the first set of data decreases from 49.65 seconds (15km/h) to 41.40 seconds (25km/h). The same can be said for the colour purple (4th reading). By increasing the speed of the vehicle passing through the construction site, the time required to complete one cycle is reduced. As we can see, the number or highest bar for 25 and 30 km/h speed
are increases when compared to the data for 70 metre construction distance. When compared to previous data, the number of vehicles leaving the 80m site construction at varying speeds has increased dramatically (referring 70m distance).



According to Figure 4.1, increasing the speed of the vehicle passing through the construction site reduces the time required to complete one cycle. As we can see in the first set of data, which is the blue colour, it decreases from 52.05 seconds (1st) to 42.96 seconds(3rd). The same is true for the colour purple (4th time). Not to mention the time required when the speed is 30km/h. This means that the time it takes for the other lane to move will increase if the sensor is unable to detect one of the vehicles exiting the construction site.

4.3.3 Relationship between Speed and Time taken(1 cycle)

The speed and time required to complete a cycle are inversely related. The faster the automobile, the less time it took to complete one cycle. However, there is a slight limitation in vehicle speed due to the sensor's ability to detect the vehicle. According to the preceding section's study, the detection becomes weaker as the speed exceeds 30km/h. This error

probability is caused by the sensor or the signal transmitted by the HC-11 module itself. Furthermore, when this type of error occurs, the waiting time will rapidly grow since additional time has been added in order to reset the number of vehicle passes through. So, it will disturbe the flow of the traffic at the construction site. But, if there is no error occur, the Traffic flow will work smoothly and as intended.



CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Every day, either a mountainous route, a straight road, or a highway will be under construction. These processes must be followed while repairing or upgrading an existing road or highway. Road users, staff, and the flagman will all be involved in the road construction process. Individuals involved, particularly flagmen, are constantly exposed to the risk of an accident while working. During the road construction period, traffic will be manually directed by a flagman using red and green flags or signals (stop and go). They will control traffic throughout the day, regardless of time or weather, to avoid traffic congestion.

Many strategies are utilised to limit the number of safety incidents. Wearing protective clothes to allow road users to see the flagman and installing warning signs before road work are among the safety precautions. However, accidents do occur during road construction. As the usage of portable signals grows and drivers become more accustomed to their presence in construction zones, motorist compliance is projected to improve. The limited research presented here are simply a starting point for analysing the effects of portable signals during work-zone lane closures. This study demonstrates that portable wireless traffic light systems have a high degree of efficiency. This is in accordance with the tested

data, which shows that the transition from red to green or green to red is proportional to the precise distance at which a vehicle has been detected by the sensors.

Based on our examination of portable signals in a workplace. First, the technology exists to securely and efficiently remove flaggers from work zones. This transfers the most vulnerable person in a work zone out of harm's way, saving lives, moving traffic, and lowering expenses. This technology is convenient because it is mostly low cost and wireless. It is simple to install and uninstall. There are major disparities in how smart and versatile such systems can be, as well as how complex or simple their programming can be. That is why it is critical to "do your homework" and understand your requirements before specifying or selecting such a system.

Finally, safety is the most important concern. While a PTS cannot guarantee the motorist's compliance, it can get the flagger or police officer out of the construction zone. If there is no one in front of the vehicle, it cannot hit him or her. The PTS has the potential to and will save lives. This alone suggests that they be used more frequently in the workplace.

5.2 Future Works

For future improvements, continued research and experience with portable signals will be required before the full benefits and costs of their use can be determined. The objective of this study to design a Portable Wireless Traffic Light was successfully implemented. However, there are still many improvements that can be implemented to ensure that this traffic runs more effectively. Among the improvements that can be made is to build a traffic signal with wider range of possible RF module, so that the signal can be use for more than 100m of construction. Futhermore, the sensor use in PWTL needs to be more relible by using sensors that have high durability against the weather in Malaysia.In addition, using a better sensor which their maximum range of detection above 1meter length. Beside, extend the functionality of PWTL model so that they are able running under various condition. For an example, the traffic system is able to priotize the bussiest lane with the most car.

اونيونرسيتي تيڪنيڪل مليسيا ملاك UNIVERSITI TEKNIKAL MALAYSIA MELAKA

REFERENCES

- I. SMd Isa, Nl. AShaari, and A. Fayeez, "PORTABLE WIRELESS TRAFFIC LIGHT SYSTEM (PWTLS)." [Online]. Available: http://www.ijret.org
- [2] V. R. Gannapathy, S. K. Subramaniam, a B. M. Diah, M. K. Suaidi, and a H. Hamidon, "Risk Factors in a Road Construction Site," *World Acad. Sci. Eng. Technol.* 46/2008, vol. 2, no. 10, pp. 335–339, 2009.
- [3] G. S. Sorock, T. A. Ranney, and M. R. Lehto, "Motor vehicle crashes in roadway construction workzones: An analysis using narrative text from insurance claims," *Accid. Anal. Prev.*, vol. 28, no. 1, pp. 131–138, 1996, doi: 10.1016/0001-4575(95)00055-0..
- [4] W. K. Saad, Y. Hashim, and W. A. Jabbar, "Design and Implementation of Portable Smart Wireless Pedestrian Crossing Control System," *IEEE Access*, vol. 8, pp. 106109– 106120, 2020, doi: 10.1109/ACCESS.2020.3000014.
- [5] 7 Author, G. Daniels, S. Venglar, and D. Picha, "February 2000 4. Title and Subtitle GUIDELINES FOR THE USE OF PORTABLE TRAFFIC SIGNALS IN RURAL TWO-LANE MAINTENANCE OPERATIONS 6. Performing Organization Code 13. Type of Report and Period Covered Research performed in cooperation with the Texas Departme," 1996.
- [6] 7 Author, G. Daniels, S. Venglar, and D. Picha, "February 4. Title and Subtitle FEASIBILITY OF PORTABLE TRAFFIC SIGNALS TO REPLACE FLAGGERS IN MAINTENANCE OPERATIONS 6. Performing Organization Code 13. Type of Report and Period Covered Research performed in cooperation with the Texas Department of Transportation. Research Project Title: Study and Evaluate the Use of Temporary Traffic Signals to Replace Flaggers for Maintenance Operations Unclassified," 1996.

- [7] J. Wotherspoon, R. Wolhuter, and T. Niesler, "Choosing an integrated radio-frequency module for a wildlife monitoring wireless sensor network," 2017 IEEE AFRICON Sci. Technol. Innov. Africa, AFRICON 2017, pp. 314–319, 2017, doi: 10.1109/AFRCON.2017.8095501
- [8] Cheng-Hung Tsai, Ying-Wen Bai, Chun-An Chu, Chih-Yu Chung and Ming-Bo Lin, "PIR-sensor-based Lighting Device with Ultra-low Standby Power Consumption," in Proc. IMTC, pp. 1524-1529, May 2011.
- [9] Ying-Wen Bai, and Yi-Te Ku, "Automatic room light intensity detection and control using a microprocessor and light sensors," IEEE Trans. Consumer Electron., vol.54, no.3, pp.1173-1176, August 2008.
- [10] Ying-Wen Bai, Zi-Li Xie, and Zong-Han Li, "Design and implementation of a home embedded surveillance system with ultra-low alert power," IEEE Trans. Consumer Electron., vol.57, no.1, pp.153-159, February 2011.
- [11] P. Zappi, E. Farella, and L. Benini, "Tracking Motion Direction and Distance with Pyroelectric IR Sensors," IEEE Trans. Sensors, vol.10, no.9, pp. 1486-1494, Sept. 2010.
- [12] Suk Lee, Kyoung Nam Ha, and Kyung Chang Lee, "A pyroelectric infrared sensorbased indoor location-aware system for the smart home," IEEE Trans. Consumer Electron., vol.52, no.4, pp.1311-1317, Nov. 2006.
- [13] V. Colla, A.M. Sabatini, A composite proximity sensor for target location and color estimation, in: Proceedings of the IMEKO Sixth International Symposium on Measurement and Control in Robotics, Brussels, 1996, pp. 134–139.
- [14] L. Korba, S. Elgazzar, T. Welch, Active infrared sensors for mobile robots, IEEE Transactions on Instrumentation and Measurement 2 (43) (1994) 283–287.
- [15] A.M. Sabatini, V. Genovese, E. Guglielmelli, A low-cost, composite sensor array combining ultrasonic and infrared proximity sensors, in: Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Vol. 3, Pittsburgh, PA, 1995, pp. 120–126.
- [16] H.R. Everett, Sensors for Mobile Robots, AK Peters, Ltd., Wellesley, MA, 1995.

- [17] T. Augustynowicz,"ZigBee IEEE 802.15.4", 1999.
- [18] J.Lonn, J.Olsson, "ZigBee for wireless networking", 15th March 2005.
- [19] https://www.elecrow.com/download/HC-11.pdf (2012)



APPENDICES

Appendix A Manual of IR Sensor Switch E18-D80NK

IR-Sensor Swi	Ich E18 This is Sensor Infrared device for distance detection that can be adjusted in the range of 6 cm80 cm.; and			
Output is Logic 1	TTL; 0 (GND) and 1 (5V).			
Specifications	-Adjust distance detection in the range of 6 cm80 cm. by Adjustable VR and display the status by LED			
	- Sensing device should be opaque material or any material that allows less light to pass through; black color is the			
	best because Sensor device works well by using reflection of Infrared			
	-OUTPUT is Open Collector; it has to connect R 10 K Pull Up at Out Putt			
	-Signal Output is Digital TTL; 0 = GND and 1 = 5V			
	-Use Power Supply DC 5V Current 100mA			
How to setup di	stance detection: Before using, it has to setup preferable distance detection for using with Sensor as follows;			
1) Provide 5V P	ower Supply (brown cable) and GND (blue cable) to Sensor			
2) Turn the head	l of Sensor upright to the ground or wall (it is the best if ground or wall is black color)			
3) Measure the	preferable distance detection from ground or wall to the head of Sensor by ruler; and hold Sensor at the preferable			
position to de	tect for awhile			
4) Adjust VR at	the end of Sensor. Look at the change of LED at the end of Sensor as described below;			
-	Tune VK for adjust detect distance			
2	SVDC			
	our Brown			
	Wall			
	Blue G G			
. 1.	GND GND			
10	LED-Status			
	10 9 8 7 6 5 4 3 2 1 0			
- If LED is OFF	(OUTPUT = 1), please adjust VR in a clockwise direction until LED becomes ON (OUTPUT - 0) and then stop			
adjusting VR. Th	e position that LED changes the state is the specified distance detection. This is conditional operation; if the distance of			
Sensor is less tha	n or equal to the distance detection, LED Status is ON and OUTPUT becomes Logic 0; but if the distance of Sensor is			
greater than the d	listance detection, LED Status is OFF and OUTPUT becomes Logic 1 instead.			
- If LED is ON (OUTPUT = 0), please adjust VR in an anticlockwise direction until LED becomes OFF (OUTPUT = 1) and then stop			
adjusting VR. Th	e position that LED changes the state is the specified distance detection. This is conditional operation; if the distance of			
Sensor is greater	than or equal to the distance detection, LED Status is OFF and OUTPUT becomes Logic 1; but if the distance of			
Sensor is less that	n the distance detection, LED Status is ON and OUTPUT becomes Logic 0 instead.			
5) Test the oper	ation of Sensor by moving Sensor. When the head of Sensor moves and passes the specified distance detection, LED of			
Sensor is lit a	p if the distance of Sensor is less or equal to the specified distance detection; but LED is OFF if the distance of Sensor			
is greater that	n or equal to the specified distance detection. If it does not accord with any conditional operation described above, it			
means that it	fails to setup any distance detection for Sensor.			
Referre	d to experiment in use, it found that color of ground or wall or any material that is used to reflect to Sensor is not			
enough dark. If th	he wall that is used to reflect is light color, the least distance detection of Sensor is also higher; so, the specified distance			

Appendix A Manual of IR Sensor Switch E18-D80NK

Manual of IR Sensor Switch E18-D80NK-N

distance detection higher, depend on material of user. User has to test and setup distance detection by self because each color of wall that reflects to Sensor is different; and finally, user needs to return to step 1-5. Referred to experiment, the least distance detection of the black wall that can reflect to Sensor is 6 cm; the operating result accords with step 5, it means that it succeeds and Sensor is ready to use and connect.

How to use Sensor after setup distance detection

Please look at the circuit below and connect Sensor with Connectors according to the specified color; Brown Cable is 5VDC Power Supply, Blue Cable is GND, and Black Cable is OUTPUT(TTL). Next, please look at the conditional operation of Sensor to write program correctly.



Appendix B A000066-Arduino-datasheet



Appendix C Manual of HC-11 433MHz

I. Module Introduction

HC-11 wireless communication frequency band is 434M.

Multiple types of serial port transparent transmission modes have respective features, and the mode is changed by command. (V1.8)

User needn't program the modules, and four modes are only responsible for receiving and sending serial port data, and are convenient to use.

Low current consumption; the idle current is 80µA, 3.5mA or 22mA, depending on the selected mode.

The number of bytes sent to serial port of module unlimited to one time.

All functions and parameters are changed by command, and can be saved in case of power failure.



HC11 Pin Definition

Mode	FU1	FU2	FU3	FU4	Remark
Idle current	3.5mA	80µA	22mA	22mA	Average value
Transmission time delay	20mS	380mS	2mS	7 mS	Sending one byte
Loopback test time delay 1	31mS	8mS	22mS		Serial port baud rate 9,600, sending one byte
Loopback test time delay 2	31mS	18mS	40mS		Serial port baud rate 9,600, sending ten bytes

Appendix C Manual of HC-11 433MHz

Note: Loopback test time delay means the duration from the time of, after conducting short circuit on TX and RX pins of one module and sending serial port data to the other module, starting to send serial port data to the other module to the time that the returned data appear at TX pin of the other module.

