Faculty of Electronic and Computer Technology and Engineering

DESIGN AND DEVELOPMENT OF AUTOMATIC ROAD REFLECTOR LIGHT SENSING USING LDR WITH ROAD CONDITION NOTIFICATIONS

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Bachelor of Electronics Engineering Technology with Honours

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DESIGN AND DEVELOPMENT OF AUTOMATIC ROAD REFLECTOR LIGHT SENSING USING LDR WITH ROAD CONDITION NOTIFICATIONS

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

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DEDICATION

I dedicate this project to Almighty God, who is my steadfast supporter and a constant source of wisdom, knowledge and insight. Throughout this program, He has been my source of strength. I also dedicate this work to my parents, Maganthiran and Subamalar, as well as my beloved sister, Nirosshnie, who have always supported me and ensured that I give it everything I have to accomplish what I have started. Not to be forgotten are my classmates and friends, who have supported me and held me accountable during this entire trip. Without the assistance provided, completing this assignment would have been a tremendous hardship for me. May the blessing of God be with them now and always.

ABSTRACT

The goal of the project "Design and Development of Automatic Road Reflector Light Sensing Using LDR with Road Condition Notification" is to increase road safety by combining Light Dependent Resistors (LDRs) with road reflector lights and incorporating a notification system to alert drivers to specific road conditions. The goal is to create a cutting-edge system that improves visibility and gives drivers timely information to ensure safer navigation on winding or inclining sections of road. In order to monitor ambient light levels and regulate the activation or deactivation of road reflector lights in accordance, the project requires the integration of LDR sensors with a micro controller. Road users can get information about changes in the state of the road via their mobile devices or displays inside their vehicles thanks to the implementation of a wireless communication module. These alerts give drivers important information about impending road conditions, enabling them to modify their driving habits and increase road safety. Choosing appropriate LDR sensors, creating a lighting system that is effective, creating a notification system, and carrying out comprehensive testing are all steps in the development process. The project intends to provide an automated and intelligent solution that improves road visibility and warns drivers of possible risks in order to overcome the limits of human control systems. This project aims to contribute to a safer and more effective road infrastructure, lowering the risk of accidents and enhancing the overall driving experience for road users. It does this by implementing the Design and Development of Automatic Road Reflector Light Sensing using LDR with Road Condition Notification.

ABSTRAK

Matlamat projek "Reka Bentuk dan Pembangunan Penderiaan Cahaya Pemantul Jalan Automatik Menggunakan LDR dengan Pemberitahuan Keadaan Jalan" adalah untuk meningkatkan keselamatan jalan raya dengan menggabungkan Light Dependent Resistors (LDR) dengan lampu pemantul jalan dan menggabungkan sistem pemberitahuan untuk memberi amaran kepada pemandu tentang jalan tertentu. syarat. Matlamatnya adalah untuk mencipta sistem canggih yang meningkatkan keterlihatan dan memberi pemandu maklumat tepat pada masanya untuk memastikan navigasi yang lebih selamat di bahagian jalan yang berliku atau condong. Untuk memantau tahap cahaya ambien dan mengawal pengaktifan atau penyahaktifan lampu pemantul jalan selaras, projek memerlukan penyepaduan penderia LDR dengan pengawal mikro. Pengguna jalan raya boleh mendapatkan maklumat tentang perubahan dalam keadaan jalan raya melalui peranti mudah alih mereka atau paparan di dalam kenderaan mereka berkat pelaksanaan modul komunikasi tanpa wayar. Makluman ini memberi pemandu maklumat penting tentang keadaan jalan raya yang akan datang, membolehkan mereka mengubah suai tabiat pemanduan mereka dan meningkatkan keselamatan jalan raya. Memilih penderia LDR yang sesuai, mencipta sistem pencahayaan yang berkesan, mencipta sistem pemberitahuan dan menjalankan ujian komprehensif adalah semua langkah dalam proses pembangunan. Projek ini berhasrat untuk menyediakan penyelesaian automatik dan pintar yang meningkatkan keterlihatan jalan raya dan memberi amaran kepada pemandu tentang kemungkinan risiko untuk mengatasi had sistem kawalan manusia. Projek ini bertujuan untuk menyumbang kepada infrastruktur jalan raya yang lebih selamat dan meningkatkan keseluruhan pengalaman pemanduan bagi pengguna jalan raya. Ia melakukan ini dengan melaksanakan Reka Bentuk dan Pembangunan Penderiaan Cahaya Pemantul Jalan Automatik menggunakan LDR dengan Pemberitahuan Keadaan Jalan.

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LIST OF SYMBOLS

θ	-	Voltage angle
$	-	Euro / US Dollar
°C	-	Degree Celsius

LIST OF ABBREVIATIONS

LDR	-	Light Dependant Resistant
Lx	-	Illuminance of Lux
DC	-	Direct Current
mm	-	Millimeter
ms	-	Milliseconds
Volt	-	Voltage
IP	-	Ingress Protection
IoT	-	Internet of Things
ADC	-	Analog to Digital Converter
CdS	-	Cadmium Sulfide
LCD	-	Liquid Crystal Display
I2C	-	Inter-Integrated Circuit

CHAPTER 1

INTRODUCTION

1.1 Background

This chapter of the project "Design and Development of Automatic Road Reflector Light Sensing using LDR with Road Condition Notification" provides a concise background on the significance of street reflector lights for visibility and safety during night-time driving and harsh weather conditions. The limitations of manual control systems for these lights are highlighted, emphasizing their inability to adapt to changing ambient light levels. Light Dependent Resistors (LDRs) are identified as a promising solution for autonomous light sensing. The chapter aims to investigate the feasibility of using LDRs as light sensors and develop a prototype system that effectively manages road reflector lights and detects variations in ambient light levels. The background chapter sets the context for the research, defines the objectives, and outlines the structure of the project report. It establishes the need for an automated system to enhance road safety and visibility, setting the foundation for the subsequent chapters.

1.2 Addressing Sustainable Cities and Communities Through Automatic Road Reflector Light Sensing Project

Building sustainable cities and communities is a primary focus of this project. By boosting road safety through automated modifications of reflector lights depending on ambient light levels, the initiative helps to safer and more efficient urban traffic. Together with intuitive interfaces like the LCD and 6-way switch, the real-time data processing capabilities supports the goal of developing responsive and intelligent urban infrastructure. This effort uses smart technology to enhance urban life and transit networks, which contributes to the larger goals of sustainable development.

1.3 Problem Statement

The issue statement in the introductory chapter of the project "Design and Development of Automatic Road Reflector Light Sensing using LDR with Road Condition Notification" discusses the drawbacks of conventional manual control systems for road reflector lights. Due to the inability and impracticality of these systems to adapt to abrupt changes in ambient light levels, visibility and traffic safety are impaired. The capacity to adjust the road reflector lights to variable light intensities and road conditions in real-time is hampered by the absence of an automated and responsive solution. It is necessary to create an autonomous road reflector light detecting system that makes use of Light Dependent Resistors (LDRs) as sensors to precisely determine ambient light levels and effectively activate or deactivate the road reflector lights in order to address these difficulties. By warning drivers of winding or hilly sections of the road, the inclusion of a road condition notification function will further improve road safety. The project's goal is to solve these issues in order to increase road visibility, safety, and overall transportation effectiveness.

1.4 Project Objective

The project aims to investigate the feasibility and effectiveness of employing LDRs for automatic control of road reflector lights. Specifically, the objectives are as follows:

a) To study the limitations of manual control systems, feasibility and advantages of road reflector lights, emphasizing the need for an automated solution.

b) To develop a prototype system that integrates LDRs and a micro controller to enable accurate detection of ambient light levels.

c) To demonstrate improved road visibility, safety and overcoming the drawbacks of manual control systems.

1.5 Scope of Project

The scope of this project are as follows:

a) Create a functional prototype system that integrates the LDRs and micro controller.

b) Feasibility and effectiveness of using LDRs as reliable and cost effective light sensors.

c) System will be evaluated to access its ability to accurately respond to changes in ambient light levels.

d) Include a function that alerts drivers to specific road conditions, including uphill and winding sections, to increase driver awareness andboost safety on the road.

e) Address the limitations of the proposed system and provide recommendations for future enhancements and advancements in automatic road reflector light sensing technologies.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this part of the project, roadside lights can improve our visibility and ensure safety, especially at night or in bad weather. These lights are usually operated manually, although this is not always the best option and can be difficult. For the lights to automatically turn on and off, a solution is needed. To do this, a unique sensor called a Light Dependent Resistor (LDR) is used. The amount of light around the LDR can be detected. The headlights can be controlled by turning on when it's dark and off at dawn, and thanks to this sensor and some advanced technology. Lights can help to keep safe by improving the ability to see the road ahead. To further improve the system, researches from the past and documented lessons are done.

2.2 Addressing Sustainable Cities and Communities in the Literature

The project, "Design and Development of Automatic Road Reflector Light Sensing using LDR with Road Condition Notifications," is a perfect fit for the larger discussion on "Addressing Sustainable Cities and Communities." Growing recognition of the need for intelligent infrastructure that adapts to improve safety and expedite mobility in cities is occurring in the context of promoting urban sustainability. By using Light Dependent Resistors (LDRs) in conjunction with real-time data processing to autonomously control reflector lights, this study makes a significant advancement in this field. These technological interventions are consistent with the literature's focus on using innovation to solve urban problems, especially those related to safety and traffic management. The integration of a Passive Infrared (PIR) motion sensor enhances the system's flexibility and reactivity, hence promoting safer driving

environments and fortifying the resilience of urban transportation infrastructure. Notably, the incorporation of elements that are easy to use, such the 6-way switch and LCD interface, is in line with the literature's recommendation that smart city programmes should priorities accessibility and equality. The initiative highlights the value of community involvement in developing sustainable urban solutions by placing a strong emphasis on user interaction. This project essentially reflects the literary depiction of intelligent, sustainable urban environments attained by means of cutting-edge technologies and community engagement.

2.3 Traditional Lighting System

The article titled "Optical design of a road lighting luminaire using a chip-on-board LED array" by Ge et al. (2017) discusses the optical design of a road lighting luminaire that utilizes a chip-on-board (COB) LED array. Although this specific article focuses on a modern lighting system, it provides insights into the traditional road reflector lighting systems as well. The term "traditional road reflector lighting systems", as mentioned in the article, refers to the time-honored practise of illuminating roadways using reflecting materials. These components are frequently constructed of materials with reflecting qualities, such as reflectors or retro reflective road studs. The simplicity and affordability of the conventional road reflector lighting systems define them. They rely on the illumination provided by the headlights of moving vehicles to illuminate the reflective components, which then reflect the light back to the driver's eye to increase visibility and define the borders of the road. These systems are employed all around the world since they don't need an external power source. Refer simply to the reference number [1] Ge, A., Shu, H., Chen, D., Cai, J., Chen, J., & Zhu, L. (2017). Optical design of a road lighting luminaire using a chip-on-board LED array. Lighting Research & Technology, 49(5), 651-657.

2.4 Photo diodes and Photo transistors

In the article titled "Organic light detectors: photo diodes and photo transistors" by Baeg et al. (2013), the authors discuss the concept of organic light detectors, specifically focusing on photo diodes and photo transistors. Semiconductor devices called photo diodes transform light energy into electrical current. They are composed of a p-n junction where photon absorption produces electron-hole pairs, which then cause a photo current. Due to its great sensitivity and quick reaction time, photo diodes are frequently utilized for applications involving the detection and measurement of light. On the other hand, photo transistors are a kind of transistor that reacts to the level of light. They function similarly to photo diodes but also have the ability to amplify light. A collector, a base, and an emitter normally make up the three layers of a photo transistor. When photons hit the photo transistor, they form electron-hole pairs that change the conductivity of the transistor and increase the output current. Refer simply to the reference number [2] Baeg, K. J., Binda, M., Natali, D., Caironi, M., & Noh, Y. Y. (2013). Organic light detectors: photodiodes and phototransistors. *Advanced materials*, *25*(31), 4267-4295.

2.5 Light Dependent Resistor (LDR)

In the article "Using an Arduino in physics teaching: LDR as a simple light sensor" by Kinchin (2020), the author explores the use of LDR (Light Dependent Resistor) as a simple light sensor in physics education. It is made of a semiconductor material that has a high resistance when there is no light and a low resistance when light is present. The semiconductor material in the LDR absorbs photons when light strikes it, creating electron-hole pairs. As a result, the material's resistance decreases and its conductivity increases. In contrast, the LDR has a larger resistance when there

is no light because fewer electron-hole pairs are produced. Numerous applications, including as light detection, autonomous lighting systems, photography, and optical communication, frequently make use of LDRs. The essay emphasizes how LDRs may be used with Arduino micro controllers to provide straightforward light-sensing experiments and demonstrations in the context of physics education. Refer simply to the reference number [3] Kinchin, J. (2020). Using an Arduino in physics teaching: LDR as a simple light sensor. *Physics Education*, *55*(5), 053005.

2.6 Problems faced with Automatic Road Reflector

Lists	**Problems**
Traditional Lighting System	Despite the benefits of smart lighting systems for environmental sustainability and energy efficiency, the implementation and integration of such systems into existing road infrastructure remains challenging. One of the key issues was creating a reliable light sensing system that could accurately sense ambient light levels and cause high beams to turn on or dim in response. This requires an accurate sensor that can adapt to changing lighting conditions in real time. The design and installation of the collection system must also take into account factors such as weather resistance, durability, and maintenance requirements. To maximize the benefits of smart lighting and strike a balance between energy efficiency, traffic safety and environmental sustainability, it is imperative to address these issues. [1] Siddula, S. (2023). Design of Modern Technology Lighting System for Automobiles Check for updates. *Emerging Technology for Sustainable Development: Select Proceedings of EGTET 2022, 1061*, 1.

Photo diodes and Photo transistors	For automated line-reflected light sensing systems, photo diodes and photo transistors provide an alternative light sensing technology, but their implementation presents some challenges. Choosing the best technology to reliably detect ambient light levels and provide feedback to the operation of roadside reflectors is one of the key issues. This requires a thorough understanding of the variations between LDRs, photo diodes, and photo transistors in terms of operating principle, sensitivity, response time, and spectral range. In addition, the technology selected must be able to withstand a variety of environmental factors, including changes in temperature, humidity, and frequent road vibrations. To get maximum performance and life from an automated line-reflected light sensing system, a balance must be struck between the performance, affordability, and durability of different light sensing technologies. [1] Baeg, K. J., Binda, M., Natali, D., Caironi, M., & Noh, Y. Y. (2013). Organic light detectors: photodiodes and phototransistors. *Advanced materials*, *25*(31), 4267-4295.

Light Dependent Resistor (LDR)	There are several issues that need to be addressed despite the potential benefits of combining LDR-based light sensors and smart city infrastructure. Creating a strong and reliable communication network between LDRs and centralized control systems is one of the main issues. Seamless connectivity, data transfer, and synchronization between LDRs and other smart city components must be achieved to achieve this. The system must also be able to process the huge amount of data generated by the LDR in real time while ensuring the security and privacy of the data. In addition, to manage additional sensors, communications equipment, and computing resources, installing such an integrated system can require significant infrastructure changes and costs. To effectively use LDR-based light sensors in a comprehensive smart city framework, it is important to balance cost, scalability, and compatibility with smart city infrastructure. [1] Hapidin, D. A., Hernawan, M. Z. P., Krisnanto, F., Syahbana, A., Fiordi, M. I., Munir, M. M., & Khairurrijal, K. (2018, December). The study of velocity measurement using single light dependent resistor (LDR) sensor. In *2018 3rd International Seminar on Sensors, Instrumentation, Measurement and Metrology (ISSIMM)* (pp. 111-114). IEEE.

2.7 Types of Road Reflectors

Types	Description
Aluminium Road Reflectors 	As the name suggests, the reflective material is encased in an aluminum housing and aluminum road studs. This is durable and strong. They can be placed in the middle of the road.
Plastic Road Reflectors 	They are made of high quality engineering plastic materials and are often used when temporary installations are required in low-traffic areas. They are easy to install and come in a variety of colors. They are not as sturdy or durable as aluminum road studs. They can be used on curbs, bridges and in the middle of the road.
Ceramic Road Reflectors 	Since they are made of durable ceramic, they are wear-resistant. They are commonly used on construction sites, busy intersections, public events and temporary traffic stops.

Glass Road Reflectors 	The sturdy diameter studs are made of tempered safety glass. The coating on the bottom of the reflector creates a reflective effect. When light enters the reflector, it is directed 360 degrees in the direction opposite to the direction it came from.
Solar LED Road Reflectors 	These are solar powered devices that charge throughout the day and illuminate the road with LED lights at night. They are widely used in remote areas or places without electricity. Bright LEDs make them significantly easier to see, whether they have small reflectors or not.
Raised Pavement Markers 	They are designed to be installed flush with the pavement and can be made of plastic, metal or ceramic. To improve the safety of drivers, cyclists and pedestrians, they cover the road surface with visible and reflective lines.

Table 2.1 The types of road reflectors / stud

2.8 Conventional Road Reflector System

In order to improve drivers' vision at night, passive reflecting pieces are usually positioned strategically along highways in the standard road reflector system. These traditional reflectors, which are frequently composed of materials with reflecting qualities like glass beads or microprisms, refract incident light from passing cars to improve road visibility and assist drivers. Although traditional road reflectors do the job of improving visibility in low light, they are not as flexible and intelligent as the solution that is being suggested in the project "Design and Development of Automatic Road Reflector Light Sensing using LDR with Road Condition Notifications."

Under the customary method, standard road reflectors don't change their intensity in response to changes in surrounding light; instead, they stay stationary. They only have access to the light that comes from car headlights, which may not be enough in some situations. Moreover, traditional reflectors are unable to deliver alerts or messages in real time regarding certain road conditions.

On the other hand, by combining real-time data processing with Light Dependent Resistors (LDRs), the project's suggested solution brings about a paradigm change. This makes it possible for reflector lights to be automatically adjusted in response to ambient light levels, guaranteeing the best visibility under various lighting circumstances. Road safety is greatly increased by the system's responsiveness to ambient light and its capacity to use a passive infrared (PIR) motion sensor to detect approaching cars or pedestrians. The idea introduces a clever and adaptable solution to solve the difficulties of contemporary urban road infrastructure, marking a break from the restrictions of standard road reflectors.

2.9 Issues faced with conventional road reflector system

The project "Design and Development of Automatic Road Reflector Light Sensing using LDR with Road Condition Notifications" attempts to overcome the limits and problems that the standard road reflector system suffers, while being a crucial component for improving nighttime vision. The following are some of the main problems with the conventional system.

Significant obstacles prevent the traditional road reflector system from providing the highest level of traffic safety. Its static intensity is a significant drawback since conventional reflectors only provide a certain amount of reflectance. This is troublesome, particularly in environments with dynamic ambient light circumstances where different reflectivity levels are necessary for the best possible sight. Another major disadvantage is the reliance on car headlights for illumination. When there is less traffic or a decrease in vehicle speed, the headlights become more ineffective, which reduces visibility as a whole. An further crucial concern is the absence of real-time flexibility. The ambient light level, the presence of people or vehicles, and other unique road circumstances cannot be dynamically responded to by conventional reflectors. This restriction means that there are lost chances to notify drivers in a timely and targeted manner, underscoring the need for a road reflector system that is more responsive and adaptable.

2.10 Summary

The chapter starts by discussing about the value of traffic safety and how road reflector lighting systems improve visibility and provide drivers with guidance. Road reflector lighting systems now in use, including both conventional approaches and developments in sensor-based automated control systems, are examined in the literature study. It explores the drawbacks and difficulties of conventional systems, such as their reliance on manual control and their incapacity to adjust to shifting external conditions. The pros of adopting Light Dependent Resistors (LDR) in road reflector light sensor systems are highlighted in the review. LDRs are ideal for automated control applications because of their inexpensive cost, ease of use, and great sensitivity to ambient light. The integration of LDRs with microcontrollers for effective and energy-saving activities is also covered in this chapter. The study also looks on the use of LDRs to alert drivers to changes in the state of the roads. By warning drivers of potential dangers or changes in the road environment, this function improves traffic safety.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter outlines the design and development of the automatic road reflector light sensing system using LDR with road condition notification. In order to develop a clear understanding of the system's purpose, the chapter opens by giving an overview of the project's scope and objectives. Following that, the process is described, beginning with the choice and procurement of suitable materials and components, such as LDRs, micro controllers, and sensors. The development of software, which covers programming, algorithm design, and user interface design, as well as the design and implementation of the electrical circuits, LDR integration, and integration are all described. The methods for testing and validating the system's performance, accuracy, and dependability are provided for both lab and field situations. Considerations for safety, upkeep, and scalability are also covered. Overall, this chapter provides a thorough explanation of the technique used to create a reliable and effective system that improves road safety through accurate light detection and prompt warnings of road condition.

3.2 Selecting and Evaluating Tools for a Sustainable Development

Beginning with a discussion of the significance of sustainable development and how it relates to the project, the chapter emphasizes how important it is to take environmental, social, and economic considerations into account when selecting tools and technology. The criteria and factors for tool selection, including as energy

efficiency, material sustainability, recyclability, and compatibility with the overall system design, are described in the methodology section. The sustainability characteristics of various devices and parts, including micro controllers, sensors, and communication modules, are assessed.

The creation of a road reflector light sensor system that not only improves road safety and efficiency but also minimizes environmental effect and fosters long-term sustainability is the ultimate objective of methodically choosing and assessing instruments for sustainable development.

3.3 Methodology

Studying system requirements and selecting appropriate components are the first two phases of this thesis. The software that controls the operation of the system is then developed, followed by the design of the electrical circuits. A physical prototype is built, then the system undergoes extensive testing and validation to ensure accuracy and reliability. Based on predefined criteria, the effectiveness of the system is evaluated and implied improvements are made to improve its usage. By accurately sensing ambient light levels and managing reflectors, this methodical engineering enables a reliable and efficient system to be built to improve road safety.

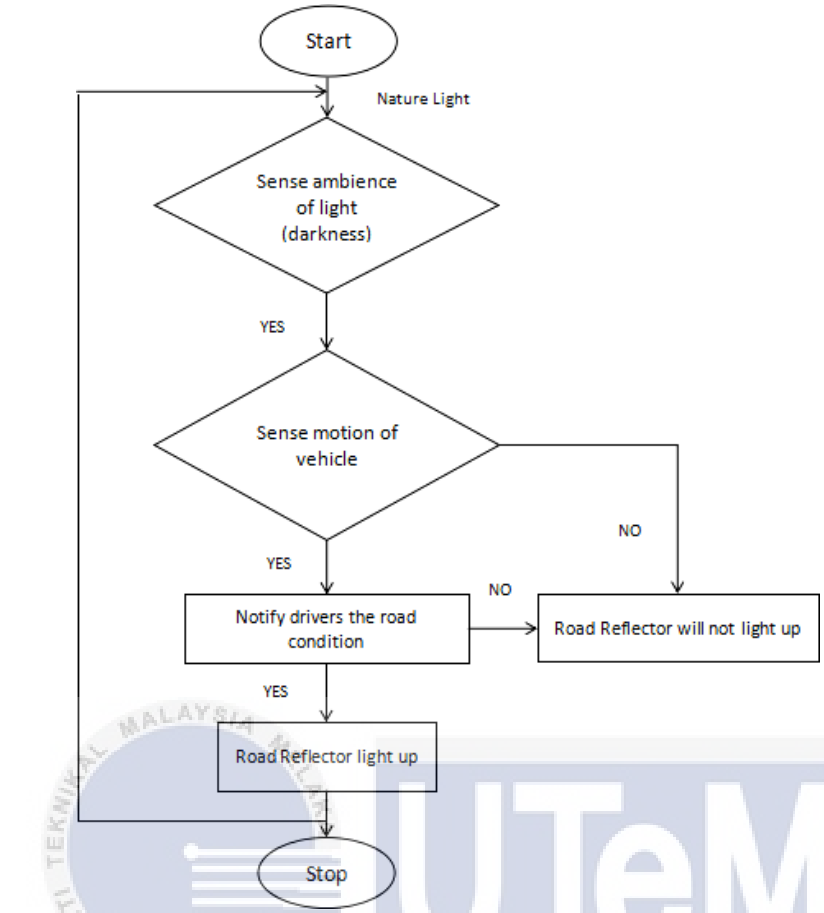

Figure 3.1 Flowchart of the system

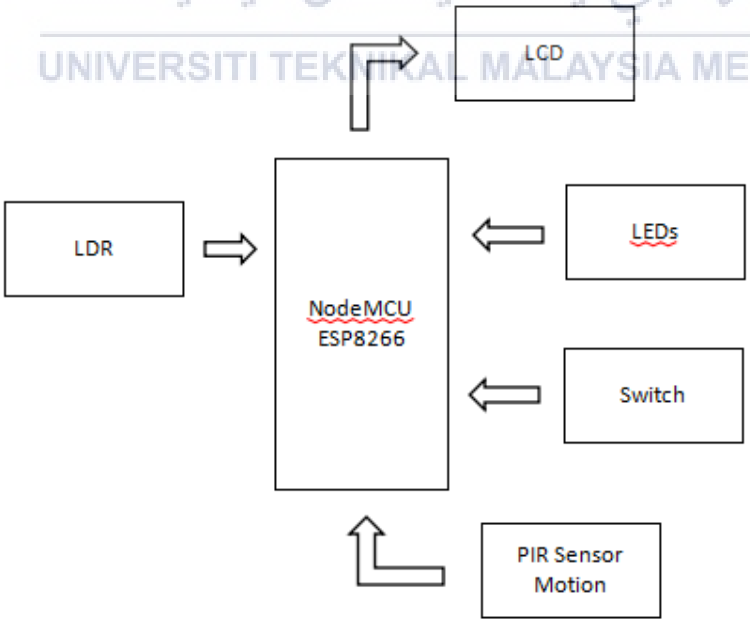

Figure 3.2 Block diagram of the system

3.4 Experimental Setup

This thesis proposes a new comprehensive analysis strategy that combines many important factors. To detect changes in ambient light levels, many LDR sensors are installed in suitable locations next to road reflectors. The main control device is a micro controller, which decides to turn on or off street lights based on information from the LDR sensors. The arrangement using real street reflectors can be managed by a micro controller. The system must include a reliable power source, proper wiring and connections, as well as data logging and analysis tools. Studies are conducted in a controlled environment that simulates real environmental factors. Researchers can evaluate the operation and performance of the system to ensure that it is successful in improving road safety by analyzing the collected data, making the necessary corrections, and evaluating system re-price.

3.4.1 Components of Automatic Road Reflector

As to build the LDR and micro controller system, a list of components required are made and enlisted. Each component is explained briefly for deep understanding to the idea of building this system and the Automatic Road Reflector itself.

3.4.1.1 Software

Proteus Design Suite is a propriety software tool suite developed for electronic design automation. The designs of system for the automatic road reflector are simulated first from the Proteus ISIS to reconfirm its functionality before applying the circuit t the hardware part. Going through the ISIS, it provides a list of features that

are required in designing a complete functioning circuit along providing a real-time of interactive simulation and the system of managing object code and source associated with the project. Figure 3.3 displays the circuit diagram that will be build using Proteus.

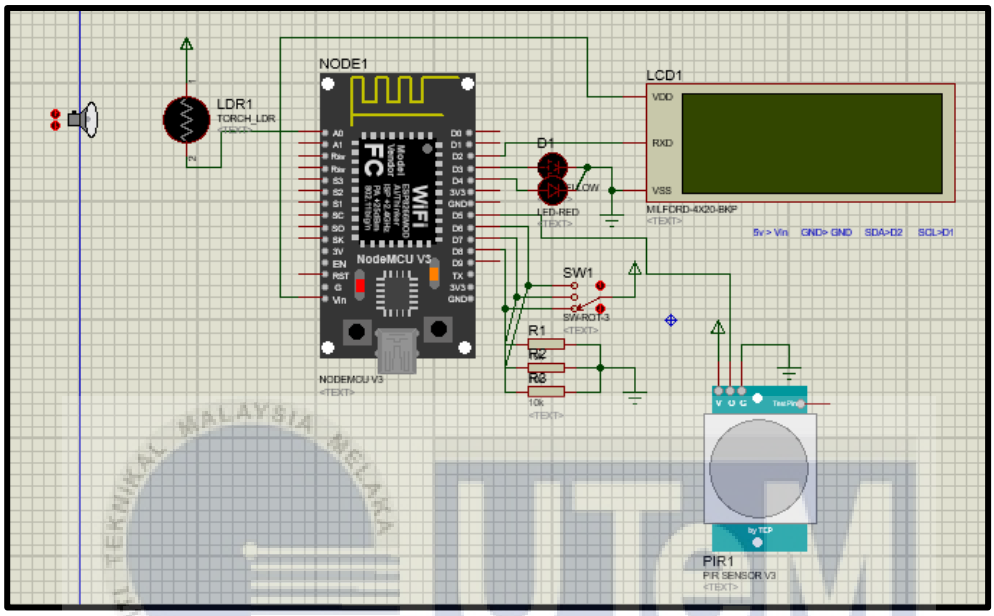

Figure 3.3 Circuit Diagram

3.4.1.2 Controller

In the development of the Automatic Road Reflector, NodeMCU is used as the micro controller for the designed system. NodeMCU is well-known globally as the one of the least complex micro controllers that can be used to perform an internet of things (IoT) system. Basically, a firmware that runs on the ESP8266 Wi-Fi system on chip (SoC) are included on NodeMCU which explains the case of integrating in an online system. Figure 3.4 display a model of NodeMCU.

Figure 3.4 Model of NodeMCU

The NodeMCU is also a popular choice as it is the lowest cost Wi-Fi compare to other modules of shields. Figure 3.5 illustrates the layout and description of each pin from NodeMCU.

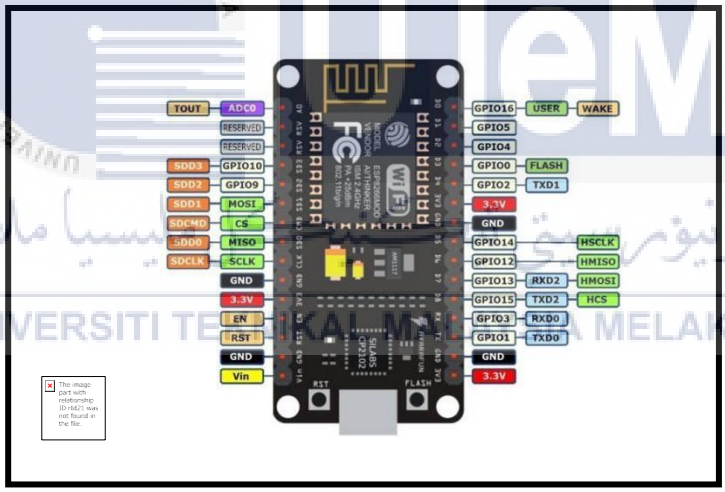

Figure 3.5 Layout and pin descriptions of NodeMCU

In this project, the NodeMCU is used to connect with other components such as the LDR, LEDs, resistors and power supply. With different input signal received, the micro controller processes and gives out output as programmed through Arduino IDE.

3.4.1.3 Sensors

The LDR is used in this project to give input signal to the micro controller before the Automatic Road Reflector proceeds to the output displays. LDR Sensor Module will be used in this Automatic Road Reflector Light project. NodeMCU will read the resistance value of the LDR and perform actions based on the value. Figure 3.6 display LDR Sensor Module interface with NodeMCU.

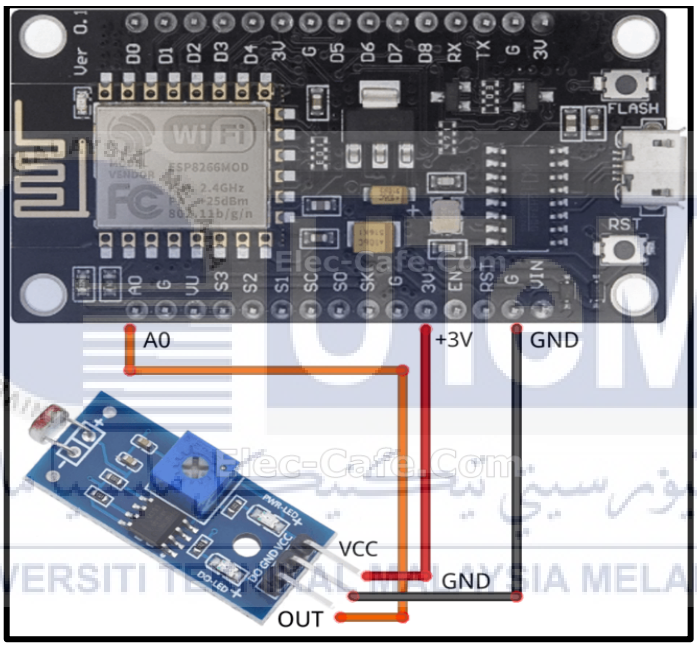

Figure 3.6 LDR Sensor Module interface with NodeMCU

To interface LDR Sensor Module with NodeMCU, it is required to create a voltage divider circuit using a fixed resistor. The NodeMCU's 3.3V power supply pin is linked to one end of the LDR, while the analogue input pin is attached to the other end. The ground (GND) pin is linked to the intersection of the LDR and the fixed resistor. The NodeMCU can detect the voltage at the junction point to estimate the resistance of the LDR since the resistance of the LDR and the fixed resistor together constitute a voltage divider. Figure 3.7 gives the view of a LDR Sensor Module.

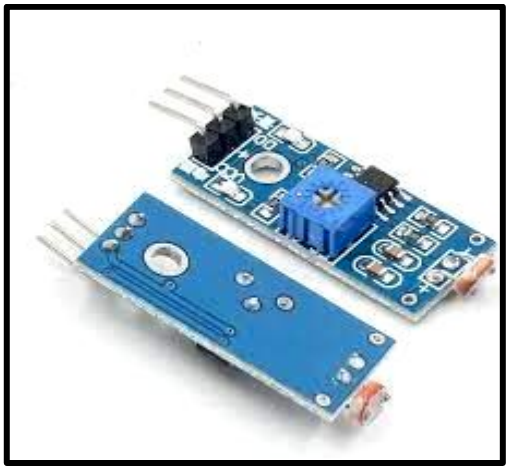

Figure 3.7 LDR Sensor Module

A pyroelectric sensor, a Fresnel lens, and accompanying electronics are some of the parts that make up a PIR motion sensor. The infrared radiation that objects within its detecting range emit is picked up by the pyroelectric sensor. An item generates heat energy in the form of infrared radiation when it travels inside the PIR sensor's field of vision. In reaction to the detected motion, the sensor recognizes these variations in infrared light and produces an electrical signal. The NodeMCU receives this signal and processes it further before reaching a decision. The PIR motion sensor is employed in the project to identify the presence of cars or people near the road

reflector lights. The microprocessor activates the necessary reaction when the PIR sensor detects motion, such as changing the brightness of the road reflector lights or alerting drivers. Figure 3.8 displays the connection of PIR Motion Sensor to NodeMCU.

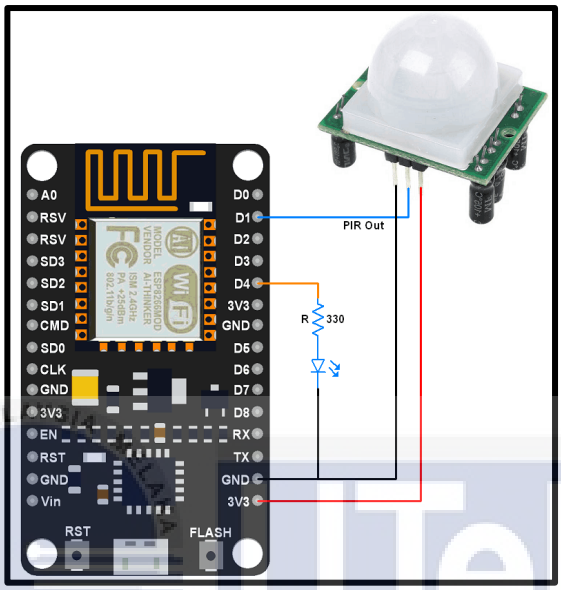

Figure 3.8 PIR Motion Sensor interface with NodeMCU

open (NO) relay shut. This enables electricity to pass from the power supply to the load circuit, where the road reflector lights are linked, turning them on.

Figure 3.9 LCD interfaces with NodeMCU using I2C

I2C (Inter-Integrated Circuit) and LCD (Liquid Crystal Display) combine to improve the efficiency of information display in projects. A display technology which is used to show text or image is called a LCD. I2C makes it easier to connect LCD to a microcontroller when numerous cables are needed. I2C is a communication protocol using two wires that facilitates the simple connection of several devices.

Figure 3.10 Connection of LCD and I2C

An LCD and NodeMCU interfaced with a 6-way pin switch provides a user input device for adjusting and modifying settings. Users can cycle through many alternatives with each position of the switch denoting a distinct function or mode. The switch can be configured to allow users to change input preferences, modes, or display settings, for instance. As the microcontroller, the NodeMCU decodes the signals from the 6-way switch and carries out the preprogrammed operations in line with those instructions. The chosen switch position determines what prompts or pertinent information the LCD shows. Through this connection, users may engage with the system in a clear and tactile way, which makes it easy to use and adaptable to personal tastes.

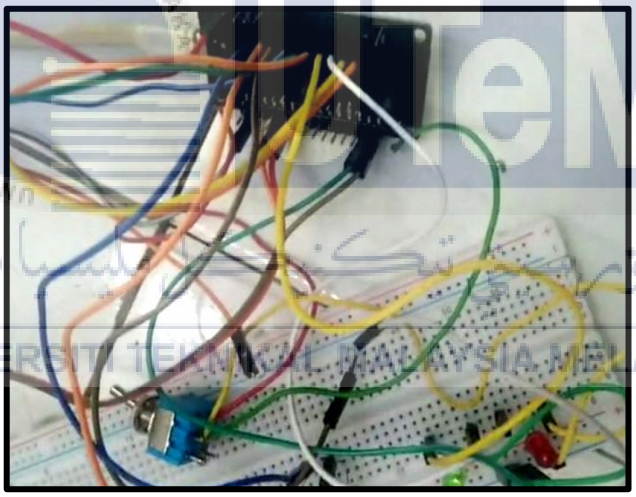

Figure 3.11 Switch interface with NodeMCU

3.5 Limitation of proposed methodology

Some limitations to the proposed LDR mechanism should be taken into account. First, issues such as changing ambient light conditions, dirt on the sensor surface, and interference from other light sources can affect the accuracy and reliability of the LDR as a sensor from light. Performance issues with the system can be caused by faulty light detection. Second, because the technique is focused on small-scale deployment, scaling it to cover a larger road network can pose challenges. Therefore the system scalability may be limited. The proposed technique also makes the irrefutable assumption that existing road reflectors are in good working order and simple to integrate, which is not always the case. Last but not least, this technique ignores environmental factors that can reduce visibility on the road, such as fog or rain. Despite these disadvantages, it is important to take them into account and come up with solutions to ensure the efficiency and reliability of the system.

3.6 Analysis approach

As to accomplish the purpose of developing Automatic Road Reflector which is to analyse the performance of system designed for Automatic Road Reflector, analysis are to be made in return that the aftermath could be defined this realizing if the Automatic Road Reflector does truly achieved the target scripted.

3.7 Summary

This chapter describes the flow of operation for the Automatic Road Reflector to be constructed. Besides that, this chapter elaborates the method of achieving the objectives scripted including the components needed to develop the Automatic Road Reflector alongside the software's used to develop the features included with the coding plus block instruction altogether. Analyzing approaches are included to give a clear view of the next chapter.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Sequence Flow of Automatic Road Reflector

Throughout the designed system of Automatic Road Reflector, the system will be explained in this chapter. The system is mainly about Automatic Road Reflector's operating system. For a full and complete built Automatic Road Reflector, the system is needed to be functioned completely.

4.2 Operating System

This project's operating system has a straightforward iterative cycle. The Light Dependent Resistor (LDR) sensor is used to detect ambient light in the beginning of the system. After then, it starts to detect the vehicle's movements. Two things happen if motion is detected by the system. It starts by informing the driver of the road's status through a PIR sensor motion. Second, it turns on the road reflector lights to improve visibility and boost safety on the road. On the other hand, the road reflector lights stay off if no motion is detected. Monitoring alterations in the outside environment and the motion of the vehicle keeps this operating system loop going. The system guarantees prompt and adaptable reactions to changing traffic conditions by repeating these

stages. An end point, which marks the end of the monitoring and notification procedure, marks the operating system's conclusion.

4.3 Simulation

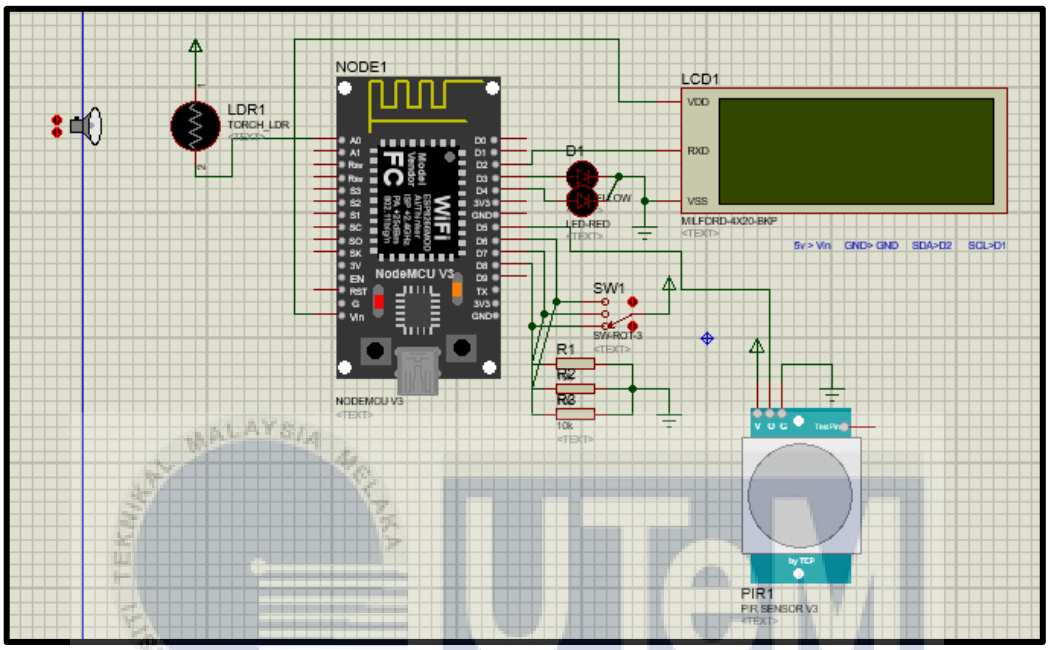

Figure 4.1 Simulation in Software

In order to simulate the behaviour of the system for this project, multiple components must interact. A PIR motion sensor, a red and a green LEDs, 10k resistors, a LDR, a switch, a 20x4 LCD and a NodeMCU ESP8266 microprocessor are among the parts. The NodeMCU micro controller receives a signal from the PIR motion sensor when it detects motion inside its field of view during the simulation. The micro controller triggers the green LED to signify motion based on this input. The road reflector lights are lighted as a result, emulating how they would turn on in reaction to motion. The micro controller turns on the red LED to show that there is no movement in the absence of motion. Since there is no need for illumination since there is no movement, the road reflector lights are left off.

```ino
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 20, 4);
const int analogInPin = A0;
int sensorValue = 0;
int led = 2;
int led2 = 0;
int sensor = 14;
int state = LOW;
int val = 0;
const int UpHill = 12;
const int DownHill = 13;
const int Curved = 15;
int buttonState1 = 0;
int buttonState2 = 0;
int buttonState3 = 0;
unsigned long lcdUpdateTime = 0;

void setup()
{
  pinMode(UpHill, INPUT);
  pinMode(DownHill, INPUT);
  pinMode(Curved, INPUT);
  pinMode(led, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(sensor, INPUT);
  Serial.begin(9600);
  lcd.init();
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("Welcome to FYP");
  lcd.setCursor(2, 1);
  lcd.print("Road Condition!");
  lcd.setCursor(0, 2);
  lcd.print("And Auto-Lighting");
  lcd.setCursor(2, 3);
  lcd.print("    System");
  delay(1000);
  lcd.clear();
}

void loop()
{
  buttonState1 = digitalRead(UpHill);
  buttonState2 = digitalRead(DownHill);
  buttonState3 = digitalRead(Curved);
  sensorValue = analogRead(analogInPin);
  Serial.print("sensor = ");
  Serial.print(sensorValue);

  // Update LCD every 500 milliseconds
  if (millis() - lcdUpdateTime >= 500)
```

```
{
  lcdUpdateTime = millis();

  lcd.setCursor(0, 0);
  lcd.print("FOG Index = ");
  lcd.print(sensorValue);

  lcd.setCursor(0, 1);
  if (buttonState1 == HIGH)
  {
    lcd.print("UpHill Ahead          "); // Pad with spaces to clear the line
  }
  else if (buttonState2 == HIGH)
  {
    lcd.print("DownHill Ahead        ");
  }
  else if (buttonState3 == HIGH)
  {
    lcd.print("Curved Road Ahead      ");
  }
  else
  {
    lcd.print("                      "); // Clear the line
  }
}

if (sensorValue > 500)
```

```
    {
      digitalWrite(led2, LOW);
    }
    else
    {
      digitalWrite(led2, HIGH);
    }

    val = digitalRead(sensor);
    if (val == HIGH)
    {
      digitalWrite(led, LOW);

      if (state == LOW)
      {
        lcd.setCursor(0, 2);
        lcd.print("LED Turned ON");
        lcd.setCursor(0, 3);
        lcd.print("Car Movement Detected");
        delay(1000);
        lcd.clear();
```

```
100         state = HIGH;
101       }
102     }
103     else
104     {
105       digitalWrite(led, HIGH);
106 
107       if (state == HIGH)
108       {
109         Serial.println("Motion stopped!");
110         state = LOW;
111       }
112     }
113   }
```

Figure 4.2 Coding

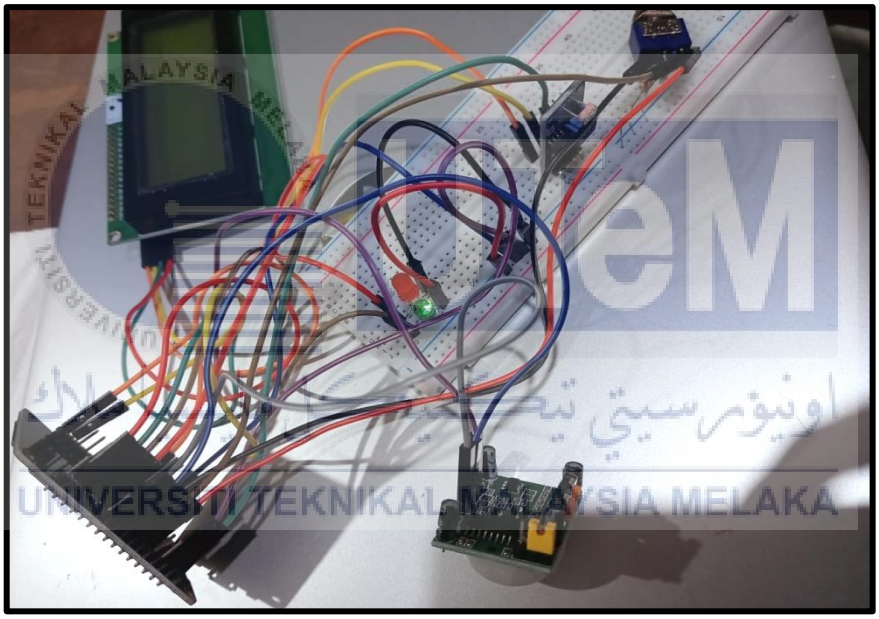

Figure 4.3 Simulation of Hardware

4.4 Preliminary Results

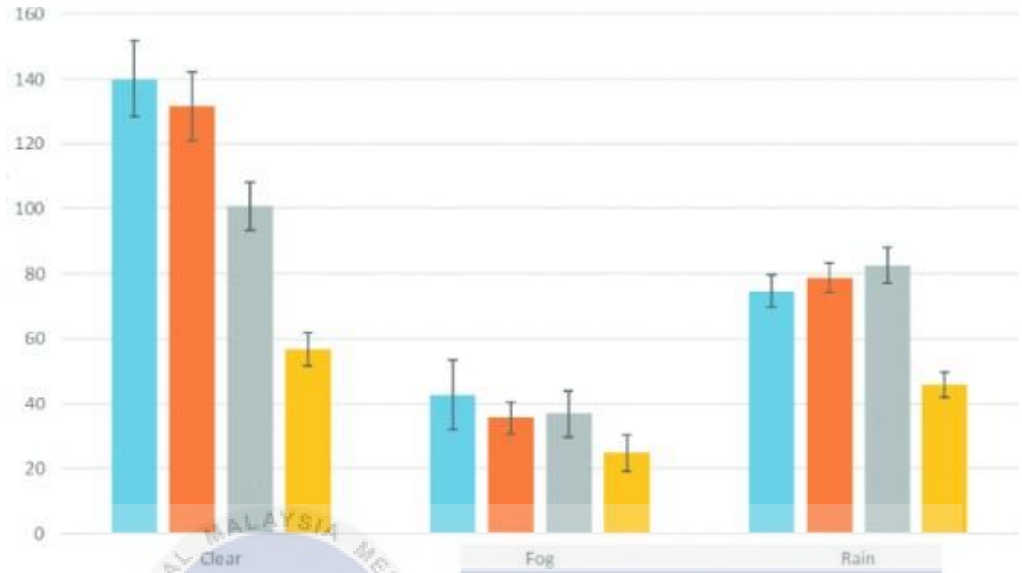

Figure 4.4 Light intensity based on weather conditions

According to initial tests, the LDR responds reliably to changes in light intensity. As the ambient light level decreases, the resistance of the LDR increases, alerting the system to turn on the reflector at the appropriate brightness level. Since the resistance of the LDR is lower when exposed to more light, this technique has reduced the brightness of road reflectors.

These first results show that automatic control of road reflectors using LDR-based light sensors is feasible and effective. By using this technology to provide appropriate lighting depending on the environment, the system can improve traffic safety. The system is constantly being evaluated and modified to increase efficiency, accuracy, and applicability.

4.5 Results/Analysis

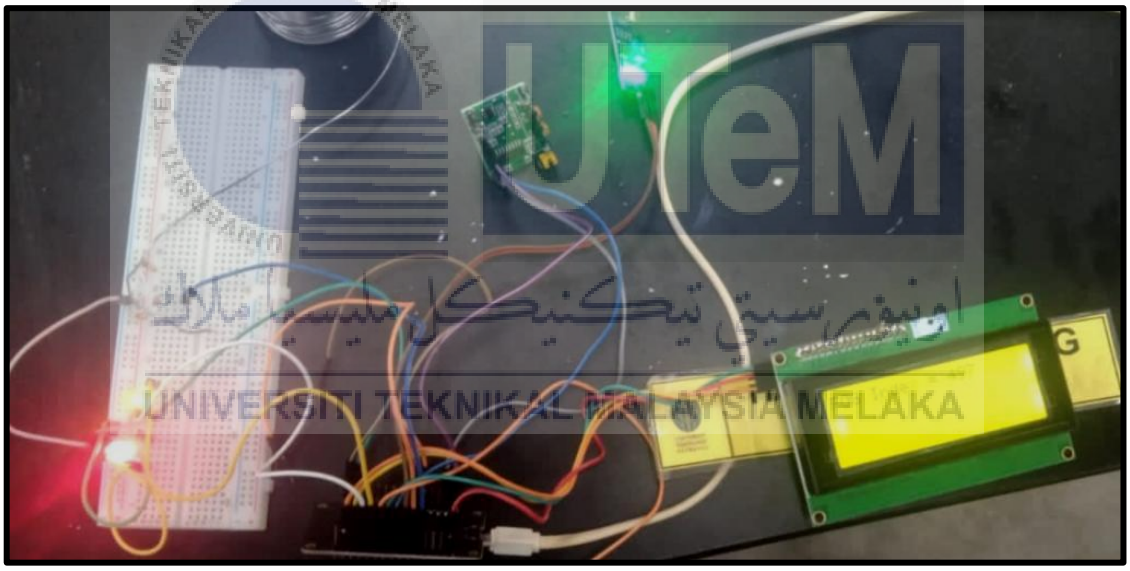

Figure 4.5 Output of Simulation

Discussion of light intensity measurements taken in different lighting contexts and situations is the focus of this chapter. The system's accuracy in detecting changes in ambient light levels and the system's response time in correcting road reflectors were evaluated using the data obtained. The system's ability to increase visibility and reduce accidents is taken into account when examining the results for the impact on fuel efficiency and road safety. Limitations or deviations from the goal are highlighted, giving suggestions for further development. Overall, this chapter provides an in-depth assessment of the system's performance, along with in-depth conclusions and suggestions for improvement.

4.6 Summary

This chapter briefly explained on the process of implementing the hardware itself to Automatic Road Reflector. Besides that, details regarding the construction of Android application are included along. Finally, analysis is made based on the data collected to determine the reliability and to justify whether all the objectives scripted does achieve.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The final chapter upon completing the thesis of Automatic Road Reflector is the conclusion where the summary of Automatic Road Reflector is briefly described along with the other given suggestions and ideas for future work. The objectives are also achieved upon the completion of this project.

5.2 Potential for Commercialization

There is a lot of room for commercialization in the areas of transport infrastructure and road safety with the goals listed. The drawbacks of manual control systems highlight the need for creative ways to improve traffic safety and visibility. Although road reflector lights are a possible substitute, automation can greatly increase their efficacy. This need is answered by the creation of a prototype system that combines LDRs and a microprocessor to detect ambient light levels in a more precise and responsive manner. This technology allows for proactive lighting condition modifications, which not only increases road visibility but also improves safety. Providing this automated solution to private companies, transport agencies, and municipalities in charge of maintaining road networks presents a business opportunity. Through the provision of a comprehensive system that tackles the shortcomings of manual control systems, enterprises may leverage the increasing need for sophisticated road safety solutions. Moreover, the prototype system's scalability enables customisation to meet different infrastructure requirements, including those of rural and urban routes. Its versatility makes it

more appealing to a diverse group of prospective customers. Furthermore, the proven increases in safety and visibility on the road provide strong arguments for commercialization. Companies can use these advantages to sell the automated solution to contractors, government organisations, and other parties involved in road infrastructure optimisation. All things considered, the combination of LDRs and microcontrollers offers a great economic opportunity and real advantages in terms of managing road networks with safety, efficiency, and general effectiveness.

5.3 Future Works

Several recommendations are provided to facilitate the commercialization of the automatic road reflector light sensing system using LDRs. These recommendations include:

i) Identify new customers, know their needs, and assess market needs for the technology under development. Target market groups, pricing plans, and marketing campaigns will all benefit from research.

ii) Create a detailed business plan detailing the go-to-market strategy, including projected financial results, a list of possible partners, and sales and distribution channels. This strategy will serve as a model for carrying out the commercialization process. Create representative LV classifiers in the system to extend the RF model to incorporate TL estimates of the LV network.

iii) Based on user feedback and technological breakthroughs, continuously upgrade and perfect the system. This involves improving the accuracy and reliability of LDR-based light detection, maximizing power savings, and adding more features to meet customer needs.

iv) Implement efficient and scalable manufacturing processes to ensure reliable, cost-effective product quality and prompt delivery. Look for joint ventures with manufacturers or suppliers to speed up the production and assembly of the system.

v) Ensure compliance with relevant road safety and electrical equipment laws and directives. It may be necessary to obtain the necessary certifications and authorizations to demonstrate the reliability and security of the system.

vi) Collaborate with government organizations, road authorities and industry partners to gain support and endorsement of the system. establish strategic alliances with road safety and infrastructure related companies to increase their visibility and reputation in the market.

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