Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF A SMART STREET LIGHTING SYSTEM FOR CONTROL AN ENERGY SAVING USING ARDUINO

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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DEVELOPMENT OF A SMART STREET LIGHTING SYSTEM FOR CONTROL AN ENERGY SAVING USING ARDUINO

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A project report submitted
in partial fulfillment of the requirements for the degree of
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DECLARATION

I declare that this project report entitled "The development of a Smart Street Lighting System for control an Energy Saving using Arduino" 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.

Signature :

Student Name : MOHD HAKIM BIN KHAIRUL SALLEH

Date : 10/1/2022

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 (Industrial Power) with Honours.

Signature :

Supervisor Name : Ts. DR. MOHD HATTA BIN JOPRI

Date : 10/1/2022

Signature :

Co-Supervisor Name (if any) :

Date :

DEDICATION

This work is also dedicated to my parents, Hj Khairul Salleh & Hjh Rosnani, who have always loved me unconditionally and whose good examples have taught me to work hard for the things that I aspire to achieve.

ABSTRACT

For the past few decades, street lighting has consumed a very large amount of energy because they are using a manual control switch. It is switch ON and switch OFF manually. These lead to a huge waste due to highly usage of electric energy. In addition, this will affect the world if we don't know how to prevent of this wastage for future. This project aim is to design smart street light control system to reduce waste of energy and to obtain the improvement for a better future. The proposed system is to control the operation of street lighting based on the movement of the object and sunlight availability by using two sensors. The microcontroller is used to control the process for a communication support. Thus, it will control the intensity of light to avoid the unnecessary usage of energy if the streets are empty. Also, to provide an energy saving as we supplied solar panel to reduce energy consumption. Whenever in the daylight, sun sends out energy in the form of electromagnetic radiation. Solar cells are used for the generation of electrical energy. The solar cells receive the solar energy. The solar cells operate on the photo-electric energy by using solar cells principle. The energy from the photovoltaic cells is used to switch on the lights. At present solar electric power generation systems are having fixed solar panels whose efficiency of generation is less. This smart system is to control the light system, using an PIR (Passive Infrared) sensor that will detect the movement of object which is human or vehicle. The light will reduce the brightness if there is no one in the streets. Once the sun light is gone, LDR (Light Dependent Resistor) sensor will activated and the system is automatically switches ON the lights. As soon as sun light is detected, it will automatically switch OFF. Hence, the result showed that this smart street light can to reduce energy consumption and replacing the old generation system to improve management system. It also can reduce the human work efficiently compared to a normal system. Thus, we can save a lot of energy. The Smart Street Lighting System for control an Energy Saving using Arduino is to provide an energy saving and autonomous operation which is to reduce power consumption when the streets are empty.

ABSTRAK

Selama beberapa dekad yang lalu, lampu jalan telah menghabiskan banyak tenaga kerana mereka menggunakan suis kawalan manual. Ia dihidupkan dan dimatikan secara manual. Ini membawa kepada pembaziran yang besar kerana penggunaan tenaga elektrik yang tinggi. Selain itu, ini akan memberi kesan kepada dunia sekiranya kita tidak tahu bagaimana mencegah pembaziran ini untuk masa depan. Tujuan projek ini adalah untuk merancang sistem kawalan lampu jalan pintar untuk mengurangkan pembaziran tenaga dan mendapatkan penambahbaikan untuk masa depan yang lebih baik. Sistem yang dicadangkan adalah untuk mengawal operasi lampu jalan berdasarkan pergerakan objek dan ketersediaan cahaya matahari dengan menggunakan dua sensor. Mikrokontroler digunakan untuk mengawal proses sokongan komunikasi. Oleh itu, ia akan mengawal intensiti cahaya untuk mengelakkan penggunaan tenaga yang tidak perlu jika jalan kosong. Juga, untuk memberikan penjimatan tenaga kerana kami membekalkan panel solar untuk mengurangkan penggunaan tenaga. Setiap kali di waktu siang, matahari mengeluarkan tenaga dalam bentuk radiasi elektromagnetik. Sel solar digunakan untuk penjanaan tenaga elektrik. Sel solar menerima tenaga suria. Sel solar beroperasi pada tenaga elektrik foto dengan menggunakan prinsip sel solar. Tenaga dari sel fotovoltaik digunakan untuk menyalakan lampu. Pada masa ini sistem penjanaan tenaga elektrik solar mempunyai panel solar tetap yang kecekapan penjanaannya kurang. Sistem pintar ini adalah untuk mengawal sistem cahaya, menggunakan sensor PIR (Passive Infrared) yang akan mengesan pergerakan objek yang manusia atau kenderaan. Lampu akan mengurangkan kecerahan jika tidak ada orang di jalanan. Setelah cahaya matahari hilang, sensor LDR (Light Dependent Resistor) akan diaktifkan dan sistem secara automatik menghidupkan lampu. Sebaik sahaja cahaya matahari dikesan, lampu akan mati secara automatik. Oleh itu, hasilnya menunjukkan bahawa lampu jalan pintar ini dapat mengurangkan penggunaan tenaga dan menggantikan sistem generasi lama untuk memperbaiki sistem pengurusan. Ia juga dapat mengurangkan kerja manusia secara efisien berbanding sistem normal. Oleh itu, kita dapat menjimatkan banyak tenaga. Sistem Lampu Jalan Pintar untuk mengawal Penjimatan Tenaga menggunakan Arduino adalah untuk memberikan penjimatan tenaga dan operasi autonomi iaitu untuk mengurangkan penggunaan tenaga ketika jalan kosong.

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LIST OF SYMBOLS

V	-	Voltage
Hz	-	Hertz
H	-	Heat Dissipated
I	-	Current
R	-	Resistance
t	-	Time
J	-	Joule
Mhz	-	Mega Hertz
mA	-	Milli Ampere

LIST OF ABBREVIATIONS

PIR	Passive Infrared
LDR	Light Dependent Resistor
LED	Light Emitting Diode
IEEE	The Institute of Electrical and Electronics Engineers
SSL	Smart Street Lighting
CO2	Carbon Dioxide
GSM	Global System for Mobile Communications
CFL	Compact Flourescent Lamp
IDE	Integrated Development Environment
PWM	Pulse With Modulation
ICSP	In-Circuit Serial Programming
AC	Alternating Current
DC	Direct Current
USB	Universal Serial Bus
FTDI	Future Technology Devices International Limited
SDA	Serial Data
SCL	System Control Layer
AREF	Analogue Reference
IOREF	Input/Output Reference
CPU	Central Processing Unit
PV	Photovoltaic

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CHAPTER 1

INTRODUCTION

1.1 Background

Street Light System is one of the major infrastructural parts of the city where most of the cities used to have such lighting system since centuries [1]. The main function of street light system is to illuminate the city’s street and highway during dark hours of the day. In order to keep the safety of the road users, street light system is an alternative during the day night. It has been an essential part in all cities and highways in order to prevent the accidents and unwanted thefts or robbery. Currently in the whole world, street lights are a significant energy consumer factor. It has developed into one of the city's largest energy expenses. Malaysia have a manual system where the street lights are turned on just before sunset and turned off the next morning when there is sufficient light outside. This is the huge waste of energy exists throughout the world and must be altered for making new improvement in this modern era. A street lighting system consumes approximately 25%-30% of all energy consumed in cities worldwide. A street light system mainly consists of a light pole, also known as a lamppost, street lamp, light standard, or lamp standard, is a raised illumination source along the edge of a road or path. Smart Street Lighting System for control an Energy Saving using Arduino design to reduce street lighting costs by 35%-70%. In addition, there is a way to find an alternative solution to reduce an energy use and costs. Smart Street Lighting System for control an Energy Saving using Arduino which protects all road users and pedestrians at night. The primary goals are to create an automated street lighting system that used a low cost microcontroller called an Arduino to obtain energy savings. There are some attempts in which of the energy wastes can be reduced. From this, we can eliminate the manual operation lighting system by reducing the energy of human work.

In the past couple of years, street lamps have become real products to be seen on the road with LEDs (light-emitting diode). For many reasons, they make sense, including their compact design, high efficiency, long life and good quality. LED sources are also useful for new designs, often with slimmer profiles than conventional metal arc lamps. Due to the emphasis on behaviour and advantages, the LED (lightening diode) is regarded as a promising solution for the modern road lighting system. In addition, the advantages of LED (light emitting diode) will replace in future traditional road lamps, such as incandescent lamps, fluorocarbon lamps and high pressure sodium lamps, but LED technology is very difficult to combine advancing production linen, superior materials and high-precision manufacturing processes. LED is also a very high quality process. This paper therefore highlights the energy efficient development of street lighting through the use of LED lamps via the smart sensor interface for control and management. Originally, the Smart Street Light System can be designed to automatically use the system to control street lights according to the sunrise, light intensity and energy saving. This control can be made reasonable by the seasonal change.

This Smart Street Lighting System for control an Energy Saving using Arduino is a smart system that provides a convenient and dynamic system to autonomously control street lighting. Two sensors handle this system which are PIR (Passive Infrared) sensor and LDR (Light Dependent Resistor) sensor. LDR (Light Dependent Resistor) sensor to detect darkness, the sensor is used to trigger ON/OFF switch. When the sun goes just below visible area of our vision, it switches ON automatically. When light is coming from the sun, lights will automatically turn OFF. PIR (Passive Infrared) sensor is used to estimate the distribution of obstruction by transmitting infrared light without making physical contact. When the PIR

(Passive Infrared) sensor detects a vehicle, it sends data to the microcontroller, an Arduino Uno. Also, with these sensing devices light intensity that's used to sense the number of humans or cars, the system automatically turned on. The Arduino Uno serves as the primary controller for this project. The major advantages of the system are reducing energy consumption and reduce costs through the integration of a solar panel. Conversion of solar energy the sun's radiant heat and light to electricity and charge the batteries. Tubular rechargeable maintenance-free batteries are ideal for this application. In addition, the direct current generated by the solar chargers is used to enlighten street lights at night.

The main reason LED (Light-emitting diode) It was chosen to minimize the energy consumption as the lighting and low light decay of life were very efficient. The LEDs have an emissions angle of approximately 110°. In the meantime, conventional lamps are usually 360° and require a reflector that directs the light to the target. Smart Street Light System utilises the most advanced and energy-efficient illumination technology as part of LED (light-emitting diode) lamps, which consume very little energy and have a significantly longer life span than other forms of electric illumination. Recent advancements in LED (light-emitting diode) technologies have resulted in lamps that provide the same illumination level while using less electricity. Therefore, when the solar panel is unable to generate enough power to charge the battery due to cloudy weather, LED (light-emitting diode) lamps can support the Smart Street Light System.

1.2 Problem Statement

In most cities, street lights are turned on when they are not required and turned off when they are not required [2]. As a result of these circumstances, a city's enormous energy expenditures are squandered. However, the lights are typically turned on during the evening following sunset and remain off manually after the sun rises the following morning. This project aims to conserve energy by simply turning street lights on and off. When vehicles approach the street/road, the sensor detects their movements and automatically turns on the lights. Otherwise, the lights will remain dimmed automatically.

In recent years, smart street light systems have become a critical component of the infrastructure of smart cities. The critical function is to light city streets with sensors to conserve current or power energy. In the existing system, standard street lamps are used. However, it consumes more current and incurs additional costs. Therefore, utilise LED (light-emitting diode) lamps to conserve current while consuming a negligible amount of energy. However, if we keep it continuously ON until it switched off manually, we would not still cut the costs and reduce the power. In order to avoid energy waste, the system will provide a solar panel into each light poles as it will generate the power from the solar during the night time. Solar panel is used to absorb an energy from sunlight to keep the power and transform into electricity. Unfortunately, this solar only use during daylight because of the sun. Without sun, it will not generate an energy. As a result, the current street lighting systems have high power usage, incompetent control systems and a insufficient renewable energy use. The Intelligent Street Lighting System for energy saving control using Arduino means solving such problems, in particular with the development of Smart City. We have designed and manufactured in this project a green, solar panel wireless control system. The system is developed based on the energy-saving street illumination, using two motion sensors PIR and LDR (Light Dependent Resistor) to turn on street illumination only when both sensors meet the darkness level and the motion condition. For short distance wireless communication, a transmitter/receiver module can be inserted to Arduino UNO by transmitting a signal between circuit detection and circuit control. Solar panels are provided to supplant incandescent and other high-energy-consumption lights for LED (light-emitting diode) lighting (one per street light panel). Only if the PIR sensor detects all movement and the LDR sensor (Light-Disposable Resistor) detects a little light intensity on the road, the lights only turn on. The Solar power is used in this system to generate energy itself, which is an example of an energy saving system with a green effect.

1.3 Project Objective

The main aim of this project is to design Smart Street Lighting System for control an Energy Saving using Arduino which seeks to target the potential for savings in energy usage and self governance. Specifically, the objectives are as follows:

a) To design a smart street lighting system for saving energy and utilizing renewable energy sources efficiently.

b) To fabricate and implement an Arduino based wireless system to control the operation of street lightings depends on light intensity and motion detection.

c) To validate the effectiveness of the developed system and its impact on environment.

1.4 Scope of Project

The scope of this project are as follows:

a) Operate the circuit with real hardware.

b) Arduino R3 as a microcontroller compile coding by using Arduino IDE.

c) 230V single phase, 50Hz power sources are required for operation.

d) Required Solar Panel and sensors by using Proteus Software.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Throughout the years, a few proposed research are made such as [3] describes the a street light control system's design and implementation based on Zigbee allows for the control and monitoring of conjunction with the installation of street lighting loads. This system's control command is used to turn ON/OFF lights. The control system additionally uses the communication channel to keep track of its local information about the status. ON/OFF status information, the status of the energy saving mode, the condition of the control group, and safety related information are all kept track of. Control commands and status information are transferred between the control system for street lights and the installed control of street lights from afar terminals on each lamppost using a variety of communication media and protocols. Wireless or power lines are commonly utilised as communication mediums. Wireless scenarios make use of a variety of bands of frequencies ranging tens of megahertz to rebranding. You can save time by using this street light control system and money on maintenance while also increasing safety.

2.2 LED street lighting system

Next, [4] explained regarding a control network for a system of LED lighting for streets. Due to their increased Color rendering index, lifespan, and luminous efficiency, LEDs are considered a promising solution for contemporary street lighting. The proposed controlling network enables street lighting systems during peak loads to be disconnected and thus reduce their impacts on automatic consumption of the distributed power system, lower management costs and monitor the status of each street lighting unit. an IEEE 802.15.4TM-based wireless sensor network is used to meet the system's requirements. Its network layer is built utilising a geographical routing technique that offers a minimal overhead and excellent scalability. A novel routing method is proposed in light of the well documented inadequacies of conventional routing approaches. This approach considerably increases routing performance when used to sparse large scale settings, such as street lighting systems, according to simulations. Wireless control devices that comply with IEEE 802.15.4 have been put through their paces in the field. The results of the experiments demonstrate that the proposed control network meets the requirements of an LED street lighting system. It focuses on making roads safer by installing sophisticated lighting systems that use less energy. This device changes the intensity of street lights based on vehicle activity and turns them on and off according to the light ambiance. This will help to reduce electricity consumption during periods when there isn't much traffic on the roads. A specific distance is followed when installing the street light module. Additionally, by identifying driver alcohol intake, this article intends to prevent road accidents. An alcohol sensor module with a skin sensor, an alcohol breathing sensor and a sensor for proximity, can be used to do this. The proximity sensor detects alcohol, whereas the skin sensor and breath alcohol sensor detect it. assists in detecting any form of fraud. The novelty of this paper is that it demonstrates how to effectively reduce street light energy consumption through intensity control, sensing both human and vehicle movement, as well as reducing harm and death from intoxicated driving through the use of a simple.

2.3 Power consumption

Moreover, [5] described a system for lowering street light energy by eliminating inefficient lighting, it can reduce the energy consumption that wastes significant each year's budget. During moments of low traffic, the lights are dimmed. A PIR sensor is utilised, which enables the unit to detect movement. Additionally, the goal of this project is to prevent alcohol related fatal crashes and traffic accidents. This is accomplished through the use of skin sensors are mounted in vehicle doors, and breadth sensors are used inside the vehicle as well. The death rate from drunk driving can be drastically lowered if this is implemented. The prototype has been implemented and functions as expected; if carried out on a large scale, it will prove extremely useful and will meet all of the current constraints. Additionally, it aims to detect the driver's alcohol consumption and, if it exceeds a predetermined level, preventing the driver from getting into the car This eliminates the possibility of collisions that result in death. This will support the government in energy conservation while satisfying domestic and industrial demands.

2.4 Solar energy

However, [6] deal on solar energy powered street lights with system for auto tracking to maximise solar system output and thus increase its efficiency. To maximise the solar panels output, it is necessary to maintain alignment with the sun. As such, some method of sun tracking is necessary. This is a significantly more economic solution than adding other panels of solar. By using a tracking system instead of the stationary arraster, solar panel outputs can be increased by up to 60%. This article describes an automatic path tracking system to ensure maximum efficiency for solar panels. The sensor for sun tracking is a sensor that continuously senses the sun's position and the amplifier provides a sunlight density sensing output. In this case, an LDR is the sun tracking sensor. Using this amplifier unit, the LDR signals are amplified and high level signals are converted, which are then transferred to the comparator via the comparator output. An amplifier is the integrated LM324. The comparator compares the signals and sends an instruction to microcontroller AT89C51. A cost effective approach in remote areas to exploit solar energy is described in this paper. This system consumes very little energy and provides extremely efficient lighting. We use an auto sun tracking system, this increases the battery's energy supply. This system has no negative impact on the environment due to its pollution-free nature. Our system also includes LED lamp automated control ON/OFF, which eliminates the need for manual operation and eliminates the need for operators.

2.5 Energy efficient pedestrian

Besides that, [7] proposed a pedestrian aware Smart Street Lighting (SSL) system for dynamic street lamp switching. This system is capable of tracking a pedestrian's location using his or her smartphone and establishing desired safety zones. These systems will help to reduce CO2 emissions. The system's limitations have been identified as trees interfering with wireless communication between lamps and global positioning system detection inaccuracy.

2.6 Smart embedded system

Furthermore, [8] developed with an intelligent embedded system that automatically adjusts road lights in response to vehicle detection or other road obstacles. When an obstruction is detected on the roadway within the defined period, and the light turns on and off to alert the user of the danger. The same information may be accessible on the internet in the event of an obstruction being detected. The PIR and LDR sensors detect people's presence and light amount in a specific area and wirelessly transmit the data to the EB section via Zigbee.

2.7 Intelligent street light control system

Therefore, [9] presents a system for intelligent control of street lights that allows the use of light sources for multi phase automatically adjust their potency in response to changes in the surrounding environment. In scenarios involving intelligent cities, they have developed adaptive behaviour for lamp control devices. To this end, lamp posts automatically adapt to obstacles and the level of ambient light around them. They compared their system's estimated energy savings to those of non-adaptive systems and discovered that their system saves more than 35% of energy.

2.8 Traffic flow based street light control system

Nevertheless, [10] in 2015, they implemented a street light control that works in conjunction with traffic flow that maximises the solar power use. They used renewable energy sources such as solar energy to power street lighting. Additionally, they used an 8052 series microcontroller to develop the device, which is powered by LEDs rather than conventional bulbs, resulting in a threefold reduction in power consumption. Sensors can track vehicle motions and transmit the microcontroller orders to switch the lights on and off on each side of the road. Here, all street lights are turned off and only illuminate when a vehicle is detected. As a result of the microcontroller, the lights are switched off even at night.

2.9 GSM for intelligent street lighting system

In addition, [11] presented a GSM based approach for intelligent street lighting systems that focuses on energy conservation and autonomous operation at a cost that is affordable for the street. This system is comprised of two LDR sensors, one of which monitors the day/night cycle and the other of which monitors the lamp's health. The GSM module collects status data on their server.

2.10 Smart lighting

Last but not least, [12] the project investigates various approaches to smart lighting, such as variable lighting, part night lighting, and light trimming, and develops a solution that incorporates motion detection and dimming, as well as wireless communication. Dimming is the process of adjusting the brightness of LEDs so that they operate at a lower level when there are no pedestrians or cars on the streets.

2.11 Summary

The purpose of this review was to examine recent trends in composition studies and to determine how commentary on research writing has evolved and continues to evolve. The research reviewed demonstrates that evaluative commentary is deeply embedded and widely practised throughout today's university composition programmes. This field of inquiry is critical because it is concerned with assisting students in becoming better writers. Assisting researchers in becoming better writers and convincing them of the importance of developing as independent writers is also critical in today's society. The methods implemented and used by each one are simple and easy to understand according to this review of literature. These papers and newspapers have generated a number of ideas for a more accurate system and automation process.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The street lighting that delivers the same functionality is known as “Smart Street Lighting” functions as traditional street lighting, but with extra features to improve its efficiency, performance and offerings. Smart Street Lighting System for Control and Energy Savings Using Arduino, A smart street lighting system, also known as an intellectual lighting control system, is a streetlights monitoring system that responds to road user, bike rider, and vehicular traffic. In other words, a smart street lighting system is one that is adaptive, dimming when no activity is detected but brightening when a sensor detects movement.

3.2 Methodology

As we all know, "Street Lights" are the primary energy consumers in any city. We frequently come across numerous instances of street lights being turned on during the day, which is completely in violation of the energy conservation rule. As a result, In order to ensure the integrity of electricity infrastructure, constant light may lead to an increase in rates and charges. A primary goal of streetlamps is to make it safer to walk, bike, or use public transportation after the sun goes down or when light intensity drops. As such, street light design and control is imperative for daily transportation safety. Researchers from across the world have done many research papers in order to make the street light system more energy efficient. In this project, we have worked hard to design a street light system that uses less energy than competing systems. One way we did this was by studying various street lighting setups, such as compact fluorescent lamps (CFLs), incandescent bulbs, and LED (light-emitting diodes). LEDs are a far more efficient light source than CFLs, light bulbs, and LEDs. A recent study has found that LED (light-emitting diode) light has a longer operational and working life than any other lighting sources. Public access to LED lights for lighting is one of the reasons for which some governors have begun to produce them. The Arduino UNO board serves as the brain of the project, controlling all of its operations. The sensors and all other equipment that we will be using will be connected to the breadboard and Arduino UNO via jump wire.

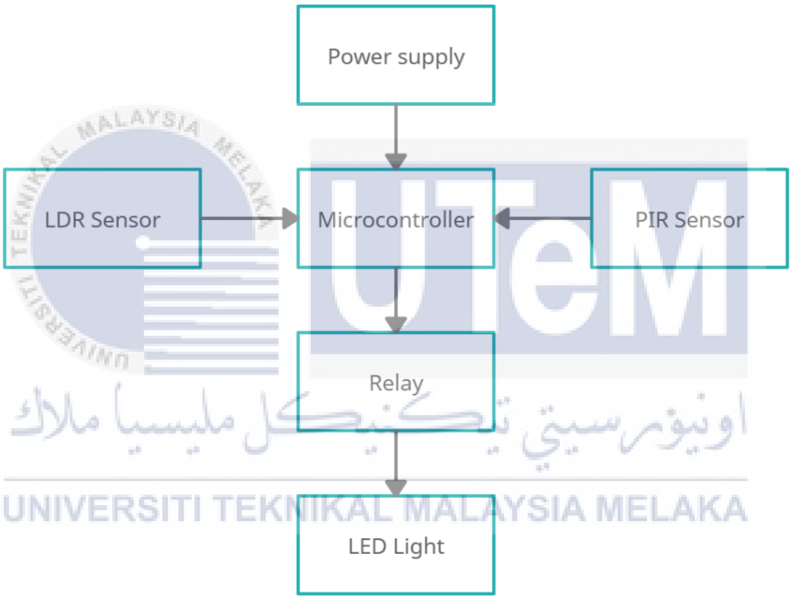


Fig. 3.1 Block diagram of Smart Street Light System

We are utilising renewable energy sources in this project, such as solar energy for street lighting. Apart from that, we replace incandescent bulbs in street lighting with LED (light-emitting diode) bulbs, which results in a threefold reduction in power consumption. Additionally, we employ PIR (Passive Infrared) sensors to detect object movement and switch on the lamps a few metres away before the object approaches the lighting area. Photovoltaic cells in solar panels convert solar energy into electricity, which is then saved in a battery backup system. Now, this battery backup is used to power street lighting in the evening. This street lighting system is controlled automatically by PIR (Passive Infrared) sensors that detect any object passing through the sensors that move. In this project, PIR (Passive Infrared) sensors were used to see the movement of vehicles on the street. The light from the emitter hits the aim, and the reflected back is diffused by the surface at all angles. If the sensor detects a sufficient amount of reflected light, the output will change states. When there is no light reflected back to the sensor, the output reverts to its initial state. The emitter is perpendicular to the target in diffuse scanning. The sensor will be angled to pick up on some of the scattered (diffuse) reflections.

3.2.1 Operation System

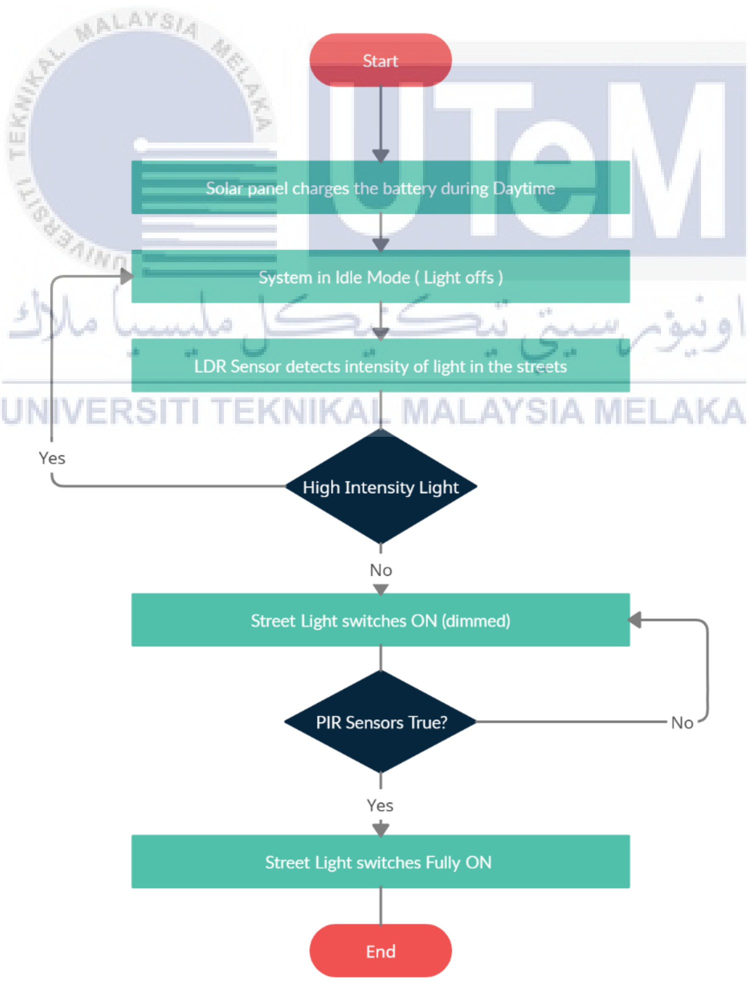


Fig. 3.2 Flowchart of the system operation

To begin, during the day, the system harnesses sunlight to generate electricity via a solar panel. In a battery, charges are stored. A solar charge system to control the amount of power that comes from the solar panel to the batteries. When the system start, the system will be in idle mode where the system is in steady state. During idle state, the system will read the data from LDR (Light Dependent Resistor) sensor when the sensor detects intensity of light in streets. A light detection and response (LDR) sensor is a device that detects whether it will be day or night. When the LDR detects the intensity of sunlight, it turns off the LED (light-emitting diode) regardless of the presence of motion. At night (or in low-light conditions), the output of the PIR (Passive Infrared) sensor is considered. The PIR (Passive Infrared) sensor to detect movements in the monitoring range of the sensor. The PIR sensor is a passive infrared sensing electronic device that monitors motion through infrared fluctuations. The light intensity must be lower than the actual value for a motion to be detected, an Arduino UNO message with the value "1" is sent. The Arduino will then provide an output to the relay, which will activate the street lights. At night, the PIR (Passive Infrared) sensor emits infrared waves within the range of its coverage. When the PIR detects motion in front of it PIR (Passive Infrared) , the infrared obstacle avoidance value is set to HIGH, instructing the Arduino UNO to turn on the street light fully. Otherwise, if no motion is detected, the street light will remain dimmed. A relay is used as a switch to turn on and off lights. Finally, the system returns to the first step and repeats the procedure.

3.2.1.1 System Requirement

Software Requirement

The requirements for a system are a description of the task that the system should perform, the service or services that the system provides, and the constraints on its operation.

Smart Street Lighting System for control an Energy Saving are using both which is software and hardware. Both of these requirements are given details below.

Arduino IDE

A programme was required to operate and execute the proposed design's process on the microcontroller. The Arduino software was used to interface the project's software and hardware. The Arduino IDE simplifies the process of writing and uploading code to the board. It is written in Java and can be used with any Arduino board. After writing the code, there is a simple step to check, build, and upload it to determine whether the code contains errors or not.

Fig 3.3 Arduino IDE

Proteus

The Proteus Design Suite is a closed source software application suite primarily used for electronic design automation. Electronic design engineers and technicians primarily use the software to create schematics and electronic prints for the purpose of manufacturing printed circuit boards.

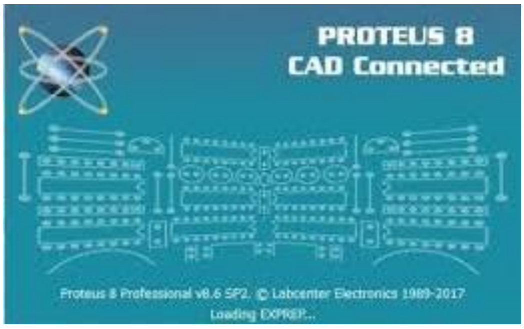


Fig 3.4 Proteus

Hardware Requirement

Smart Street Lighting System for control an Energy Saving using Arduino generates its energy through the use of a solar panel. Solar power has been found to this day to be the most direct, plentiful, and clean sources of energy in our planet. Solar cells convert solar energy to electrical energy that is then used to power the lighting fixtures. Solar energy as the source of energy for street lights saves up to 80% of energy, which results in significant cost savings. Fig. 3.4 illustrates the overall architecture for their components for the sake of clarity. As can be seen, the circuit includes PIR (Passive Infrared) and LDR (Light Dependent Resistor) motion and light intensity sensors. The two sensors are connected to one of the Arduino's input ports, which allows for real-time data updates. The Arduino UNO board serves as the brain of the project, controlling all of its operations. Thus, the lights will be turned on and will remain dimmed until the LDR or IR sensor detects no input from the light. The LDR which is daylight or atmospheric light will also be switched off; however, because there is no nighttime sun or atmospheric light, street light will remain throughout the night.

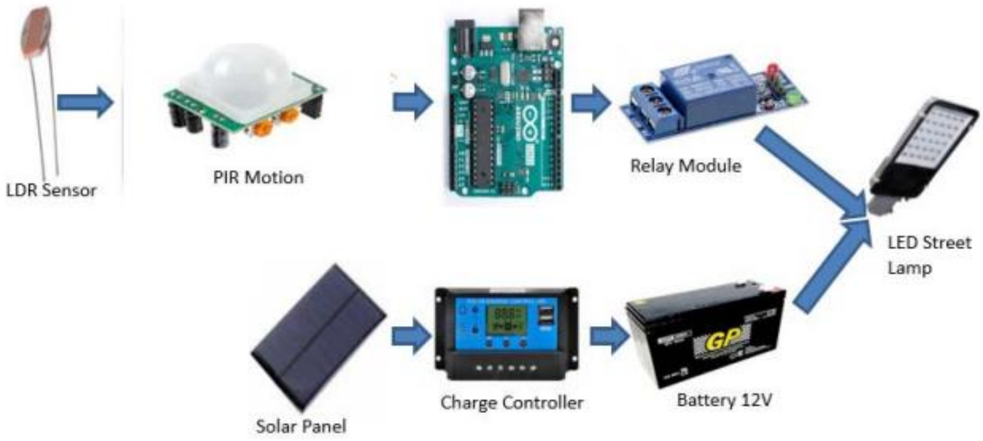


Fig 3.5 Hardware Requirement.

3.2.1.2 Equipment

LDR (Light Dependent Resistor)

As previously mentioned, LDR is an important priority. Thus, the main reason and goal for employing this LDR is that its resistance varies in terms of the amount or luminance that strikes or is consumed by it. As a result, the LDR is an important element that must be included in all light detectors and projects. LDRs are also known as light electronic equipment.

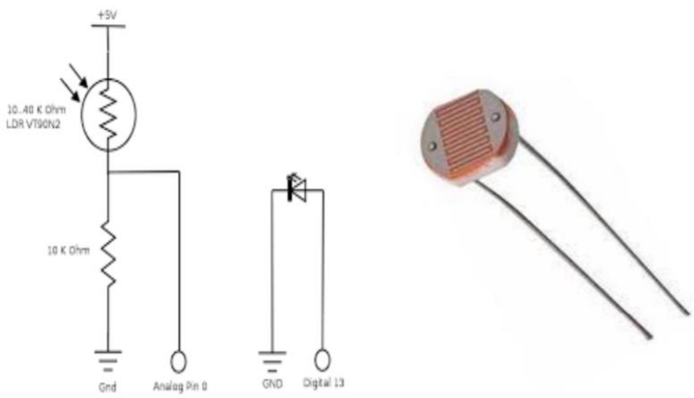


Fig 3.6 LDR (Light Dependent Resistor)

PIR Sensor (Passive Infrared)

The PIR sensor is referred to as a passive infrared sensor; It is an electrical component that can detect motion as well as measure the energy consumed by an object; this capability is known as detection system; these sensors can detect and belief only infrared radiation. Because infrared rays are impossible to detect, they can only be analysed by PIR sensors.

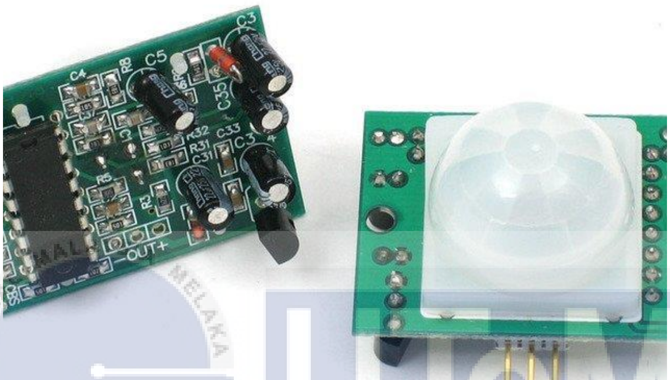


Fig 3.7 PIR Sensor (Passive Infrared)

Arduino UNO R3

It is a board for the ATmega328 microcontroller. The simplicity of Arduino makes it an ideal prototyping platform for hobbyists and novices alike. The Arduino Uno features 14 digital I/O pins (of which six can be used as PWM outputs), six analogue inputs, a An Mhz crystal oscillator, a USB port, a power jack, an ICSP header, and a reset button are included. It includes everything necessary to support the microcontroller; all you need to do is connect it via USB to a computer or power it with an AC to DC adapter or battery to get started.

The Arduino Uno R3 incorporates an ATmega16U2 microcontroller in place of the Uno's 8U2 (or the FTDI found on previous generations). This enables faster data transfer rates and increased memory. The Uno could be used as a keypad, mouse, joystick, or other input device with no drivers needed for Linux or Mac (a file for Windows is necessary and is supplied with the Arduino IDE). The Arduino Uno is distinguished from previous boards by the absence of the FTDI USB to serial driver chip. Rather than that, it incorporates an Atmega8U2 microcontroller programmed as a USB to serial converter.

Additionally, the Uno R3 adds SDA and SCL pins adjacent to the AREF. Additionally, two new pins have been added near the RESET pin. One such component is the IOREF, which enables the shields to acclimate to the board's voltage supply. The other is unrelated and is being held for future use. The Uno R3 is compatible with all existing shields but is also capable of adapting to new shields that utilise these additional pins.

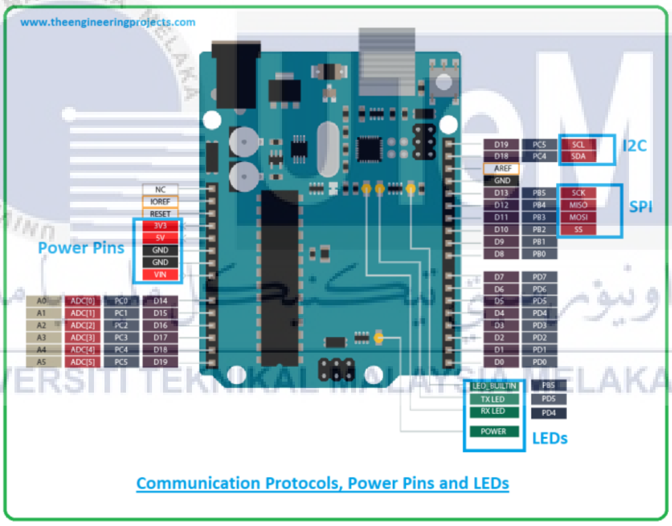


Fig 3.8 Arduino UNO R3

Bread Board

A bread board gets its name from the fact that it was originally used to slice bread; afterward, a solderless bread board was introduced. Due to the fact that bread boards are solderless, which means they can be reused, they are popular among students and many projects. Using this bread board, a wide variety of electronic devices can be prototyped, ranging from simple analogue and digital circuits to the largest CPU (Central Processing

Unit). These are called tie or contact points, and there is a gap of 2.54mm between each one. They use metal strips to connect one pin to the next.

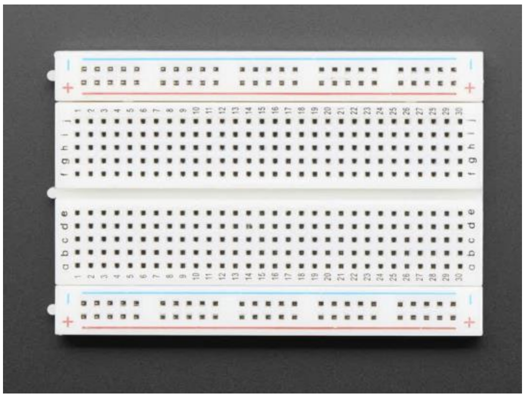


Fig 3.9 Breadboard

A light-emitting diode (LED)

When current flows through a light-emitting diode (LED), it emits light. Electrons recombine with electron holes in the semiconductor, photons as a means of dissipating energy. The colour of the light (photon energy) is determined by the energy required for electrons to cross the bandgap of a semiconductor. White light is produced by combining multiple semiconductors or by coating the semiconductor device with a light-emitting phosphor.

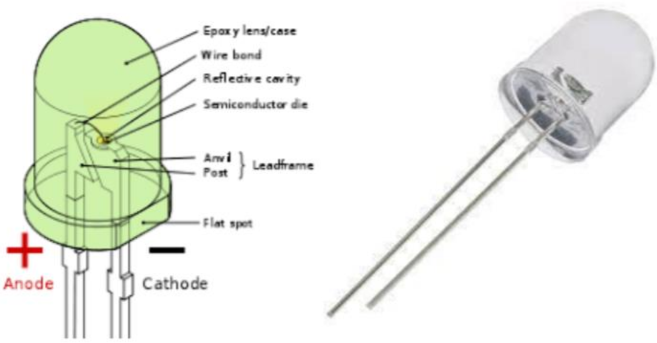


Fig 3.10 Light-emitting diode (LED)

Solar Panel

A photovoltaic (PV) panel is a type of solar panel system, is a group of photovoltaic cells mounted in a framework. Solar panels generate direct current electricity by harnessing the energy of the sun. A collection of photovoltaic modules is referred to as a PV panel, and a collection of panels is referred to as an array. A photovoltaic system's arrays provide solar energy to electrical equipment.

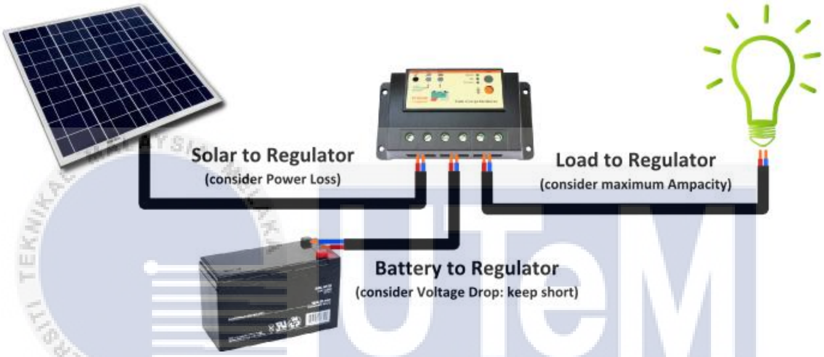


Fig 3.11 Solar Panel

Relay

Typically, a relay is a mechatronic device that is activated by an electrical current. One circuit is opened or closed as a result of the current flowing through it. Despite the relative simplification, long lifespan, and stated high reliability, relays, which become similar to tv remote switching devices, are used in a wide array of uses. While relays are frequently associated with electrical circuitry, they come in a variety of other configurations, including pneumatic and hydraulic. Electrical inputs can be used and mechanical outputs can be used directly, or vice versa. Relays are primarily used to perform two basic functions. One is for low voltage application, while the other is for high voltage application. For low voltage applications, greater emphasis will be placed on reducing overall circuit noise. They are primarily used in high voltage applications to prevent arcing.

Fig 3.12 Relay

Charge Controller

The rate at which electricity is added to or extracted from batteries is regulated by a charge controller, a charge regulator or a battery regulator. It guards against overcharging and overvoltage, decreasing battery performance and longevity while also posing a safety risk. Additionally, depending on the battery technology, it can prevent a battery from entirely drained ("deep discharging") or execute controlled discharges to increase the life of the battery. The phrases "charge controller" or "charge regulator" can apply to separate devices as well as control circuitry built into a battery pack, battery-powered device, or battery charger.

Fig 3.13 Charge Controller

Battery

For our project, we will be using a 12V battery as a power supply. A battery is a type of energy storage a device made up of one or more electrochemical cells connected in series externally. It is used to power electrical devices such as flashlights, cell phones, and electric cars. When a battery generates electricity, the positive terminal is referred to as the cathode, and the negative terminal is referred to as the anode. The negative terminal serves as a source of electrons that will flow to the positive terminal via an external electric circuit. When you connect a battery to an electric circuit load, a redox reaction in which high energy reactants are converted to reduced products, and the predicted free energy difference is supplied to the external load as electrical energy via the external circuit. Traditionally, the term "battery" linked to a device composed of multiple cells; after all, the term has come to respond to any device composed entirely of one cell.

Fig 3.14 Battery.

3.3 Summary

This chapter discusses the methodology used to collect and analyse the data necessary to answer the research questions and test the hypothesised relationships developed in this study. The chapter begins with a description of the research design, then discusses the population from which data will be collected and the sampling strategy that will be used..

Following that, the chapter discusses questionnaire design, data collection, and scaling. Following that, a discussion of data collection methods is held, with a particular emphasis on the mail survey. Finally, we will discuss the various methods of data analysis.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The project's goals were to diminish the existing street lighting system's negative impacts and to create a new way of conserving energy. Configuring the system input and output nodes is the first phase in this project. Below is a completed and functioning prototype of our proposed solution. If implemented on a large scale, it will prove extremely useful and will address all of the current constraints.

4.2 Results and Analysis

This section summarises the results of testing and validating a Smart Street Lighting System for energy conservation via an Arduino based practical prototype, as illustrated in Figure 3.15. streetlights are typically turned on from dusk to dawn in conventional street lighting systems. Many streetlights are only active between the hours of 7 p.m. and 7 a.m., and are shut off during the daytime. For estimated 12 hours per day, actual streetlights are turned on. Compared to the Smart Street Lighting System, which only turns on when motion is detected, the proposed Arduino based Intelligent Lighting System turns on only when movement occurs. The country location of the street causes road user and vehicle traffic to be lower. When the public doesn't use the street during the night, the streetlights stay in a lower-powered "idle" mode, with all the light remain dimmed. Only when a car crosses by on the main road will the lights be on. The savings that are made here because street lamps are only fully bright when they are needed are considerable.

Circuit Diagram

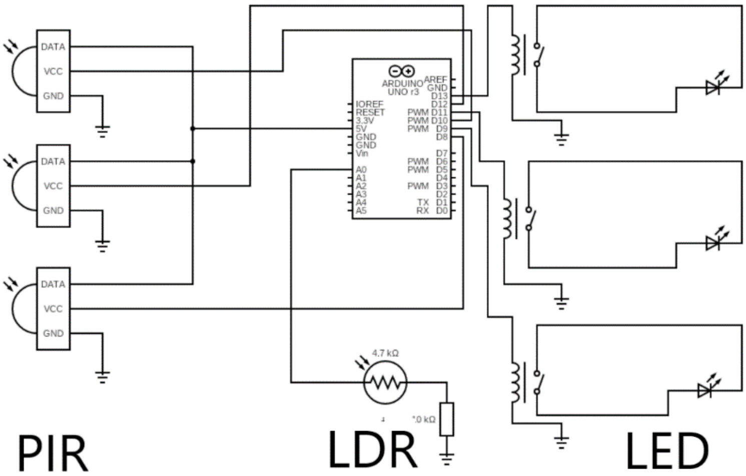


Fig 4.1 Proposed Circuit diagram

Simulation Circuit

This circuit diagram below show illustrates the connection between the components in Proteus simulation that will be use in the circuit. The system's components include Solar panel, Arduino UNO, LED, LDR sensor, PIR sensor, and relay. All sensors will be connect to Arduino UNO which is act as a microcontroller for decision making.

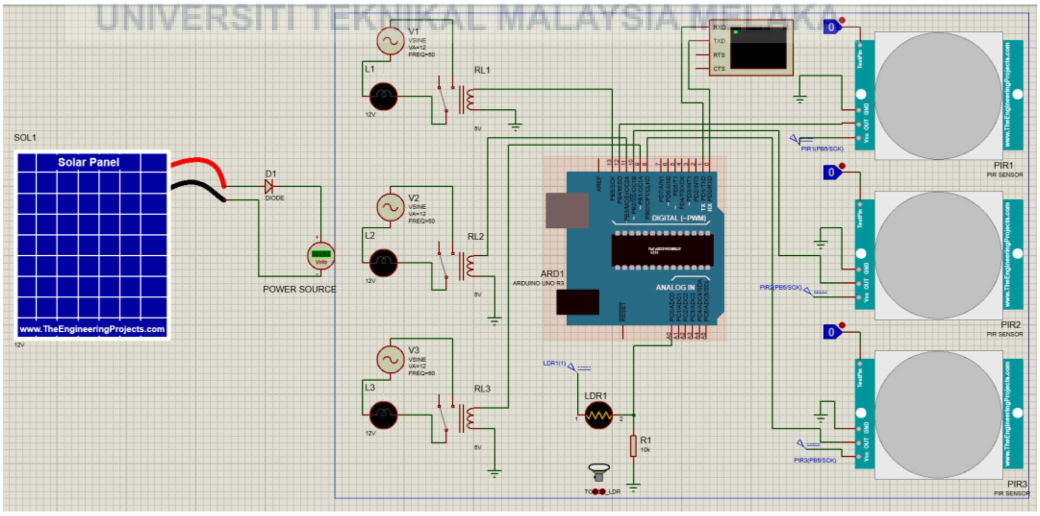


Fig 4.2 Simulation circuit

Coding from Arduino IDE

Smartstreetlight | Arduino 1.6.10

File Edit Sketch Tools Help

Smartstreetlight

```
int relay1 = 13;
int pir1 = 12;
int pir1Status;

int relay2 = 11;
int pir2 = 10;
int pir2Status;

int relay3 = 9;
int pir3 = 8;
int pir3Status;

int ldr1 = A0;
int ldr1Status;

void setup() {
  // put your setup code here, to run once:

  Serial.begin(9600);

  pinMode(relay1, OUTPUT);
  pinMode(pir1, INPUT);

  pinMode(relay2, OUTPUT);
  pinMode(pir2, INPUT);

  pinMode(relay3, OUTPUT);
  pinMode(pir3, INPUT);

  pinMode(ldr1, INPUT);

  digitalWrite(relay1,LOW);
  digitalWrite(relay2,LOW);
  digitalWrite(relay3,LOW);
}

void loop() {
  // put your main code here, to run repeatedly:

  Serial.println("");
  Serial.println("");

  pir1Status = digitalRead(pir1);
  pir2Status = digitalRead(pir2);
```

Smartstreetlight | Arduino 1.6.10

File Edit Sketch Tools Help

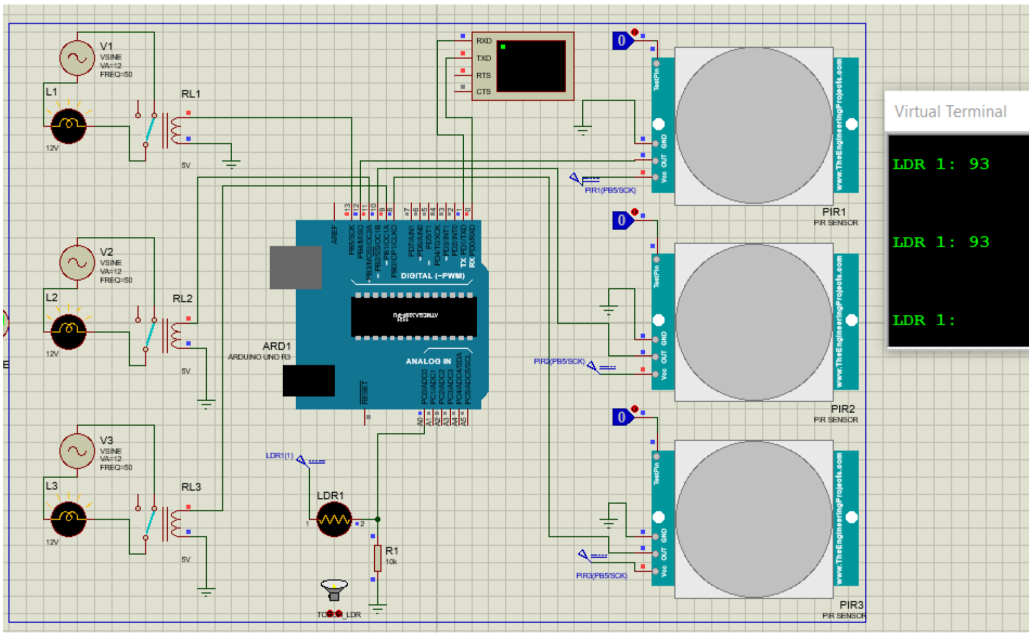
Upload

Smartstreetlight

```
  pir3Status = digitalRead(pir3);

  ldr1Status = analogRead(ldr1);


  Serial.print("LDR 1: ");
  Serial.println(ldr1Status);
  Serial.println("");

  if (pir1Status == 1 && ldr1Status<800){

    digitalWrite(relay1,HIGH);

  }

  else if (pir1Status == 0 && ldr1Status>800){

    digitalWrite(relay1,LOW);

  }

      pir1Status == 0;

  if (pir2Status == 1 && ldr1Status<800){

    digitalWrite(relay2,HIGH);

  }

  else if (pir2Status == 0 && ldr1Status>800){

    digitalWrite(relay2,LOW);

  }

      pir2Status == 0;

  if (pir3Status == 1 && ldr1Status<800){

    digitalWrite(relay3,HIGH);

  }

 else if (pir3Status == 0 && ldr1Status>800){

   digitalWrite(relay3,LOW);

 }

     pir3Status == 0;
```

Fig 4.3 Coding from simulation

Light switch state ON



Light switch state OFF

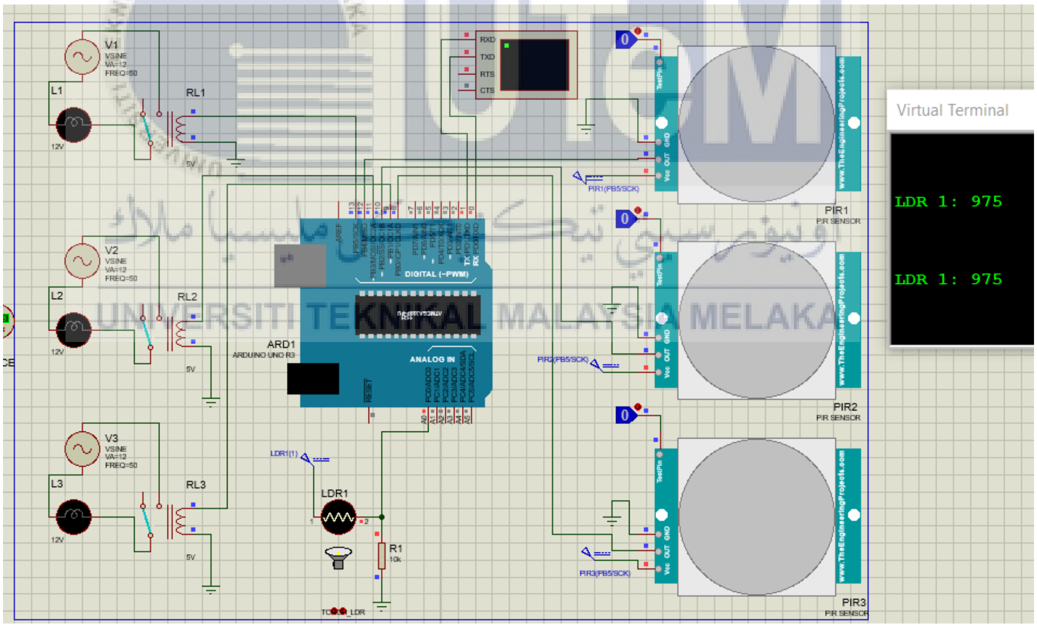


Fig 4.4 Circuit simulation (Light switch state ON & OFF)

The Fig 4.4 is the Smart streetlight's circuit diagram. It adjusts to the changing sunlight. When there is sufficient sunlight in the environment, the LDR exhibits a high resistance and acts as an insulator; however, when it is dark, the LDR behaves as a low resistance path, allowing electricity to flow. This LDR is activated by infrared sensors that are activated under low illumination conditions and are controlled by an Arduino UNO R3 microcontroller. When an object enters the range of infrared sensors, the object emits radiations that are reflected back to the infrared photodiode by the IR LED. As a result, an object is detected. The intensity of LEDs is initially kept low (when no object is detected or there is no natural light) by Arduino using the Pulse Width Modulation (PWM) technique, which converts analogue signals to digital signals. The ON/OFF process of LEDs occurs so rapidly that the LEDs appear to glow dimly when viewed with the naked eye. As a result, the duty cycle of LEDs is used to control their intensity. When it comes to the functional blocks, such as LDRs, LEDs, and IR sensors, these components are less expensive, smaller in size, less complex, highly reliable, and suitable for low power applications. They also pose less risk and provide greater accuracy. The project has been successfully implemented in a variety of fields as a result of experimental verification demonstrating that it can save significant amounts of electrical power while completely eliminating manual labour; the system served as the foundation for future advanced intelligent systems that save both human and electrical energy. The LEDs are activated and deactivated using code executed in Arduino via the Aduino software.

The smart street light's objective is to reduce an individual light's power consumption and to help reduce the overall power consumption of the lighting network in an area. Assuming the sensor detects an average current of 45mA for 12 hours, assume that a street lamp lights up for 12 hours.

Equation for power (heat dissipated) is given as for non-smart street light system:

$H = I^2 \text{ x } R \text{ x } t$

Where, I = Current flowing through LED

R = Resistance

t = On time duration

The non-smart street light system's power consumption is estimated using the power equation calculated as = 19,245 J

The amount of heat dissipated by a smart street light system is represented by an equation : Let's suppose there are pedestrians and vehicles who are travelling at different times, and that the delay at the PIR sensor is about 3 seconds for example When the PIR sensor detects an object, it activates the light and instructs it to stay illuminated for three seconds at full intensity. This street light system dissipates power by the equation of power dissipated as:

$H = I^2$ x R x t x No. of pedestrians

Table 1 Consumption of electricity at various time intervals.

Time Interval	**No. of Pedestrians**	**Power consumed (in J)**
6pm to 8pm	Assuming 2500 person	3,341.25 J
8pm to 12am	Assuming 1500 person	2,004.75 J
12am to 6am	Assuming 500 person	668.25 J

Also at night the LED’s are also glowing at 10% intensity throughout the night when there is no traffic: $H = \frac{10}{100}$ x 19,245 = 1,924 J

Hence total power calculated for a smart street light is

= 7,938.25 J + 1,924.50 J = 7,938.75 J

The total power saving = 19,245 J – 7,938.75 J = 11,306.25 J.

Thus, by using smart lights we can have 58.74 % of power saving.

4.3 Software Testing

This project was thoroughly tested using both software and hardware. The application was performed and simulated from the Arduino IDE to the output monitor on the COM5 port during this software testing. From the output monitor in COM 5, the output value of the LDR sensor's status was displayed. The values given in Figure 4.5 indicate whether the LDR sensor detects light from the project circuit or not. The LDR sensor acts as an insulator, preventing electricity from flowing across the circuit. As a result, when the resistance of the LDR sensor status in figure 4.5 becomes extremely low, the circuit will be unable to conduct electricity. As a result, the LEDs will remain turned off. When darkness falls and the resistance of the LDR sensor state in figure 4.6 gets extremely high, the circuit will enable current to pass through. As a result, the LEDs will be barely lit. As a result, the monitor displayed the resistance value of the LDR sensor's current state.

Figure 4.5 Arduino Output Value of LDR sensor during low resistance

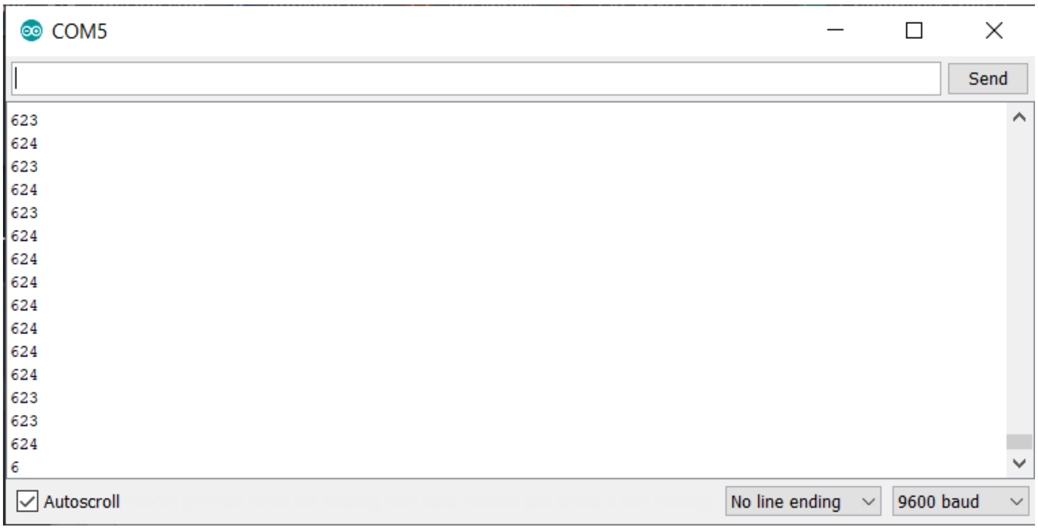


Figure 4.6 Arduino Output Value of LDR sensor during high resistance

4.4 Hardware Testing

The physical circuit project demonstrated the visual output of components, as illustrated below. This section details the steps involved in the organisation of the entire research project. After the components have been installed and connected, sample screenshots are presented. All components are connected to one another, completing the system configuration and allowing for a simple and straightforward understanding of the stages. On the cardboard, the hardware's primary component was constructed and organised. The final hardware project circuit is depicted in Figure 4.7 below, which is enabled during the project. As a consequence, the results indicated that the developed project is successfully operating.

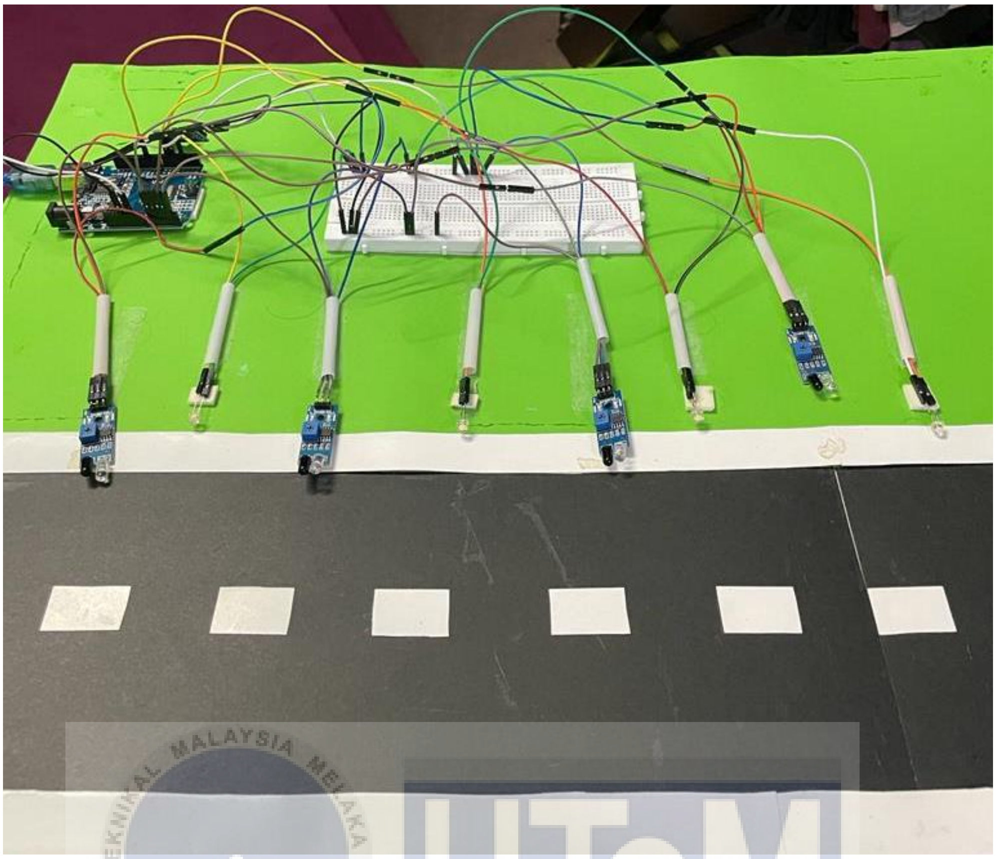


Figure 4.7 Initial Setup of hardware circuit

The Initial Setup section describes how the hardware is configured initially. Each component is interconnected. The four infrared sensors are located in close proximity to the LEDs. The Arduino board is now prepared for placement and connection to the external power source. The Arduino board will be attached to four infrared sensors, one LED, and one LDR sensor. The breadboard is used to connect all wires.

4.5 Experimental Result

As previously discussed in the report, the LDR detects light that has fallen on it, as does the IR sensor, and as soon as they detect or obsorb light, they send a signal to the microcontroller, which then turns on the street light. Additionally, the IR sensor detects vehicle motion and sends a signal to the microcontroller, which then turns on the street light. This will occur as a result of the Smart Street Light Control System that is being suggested.

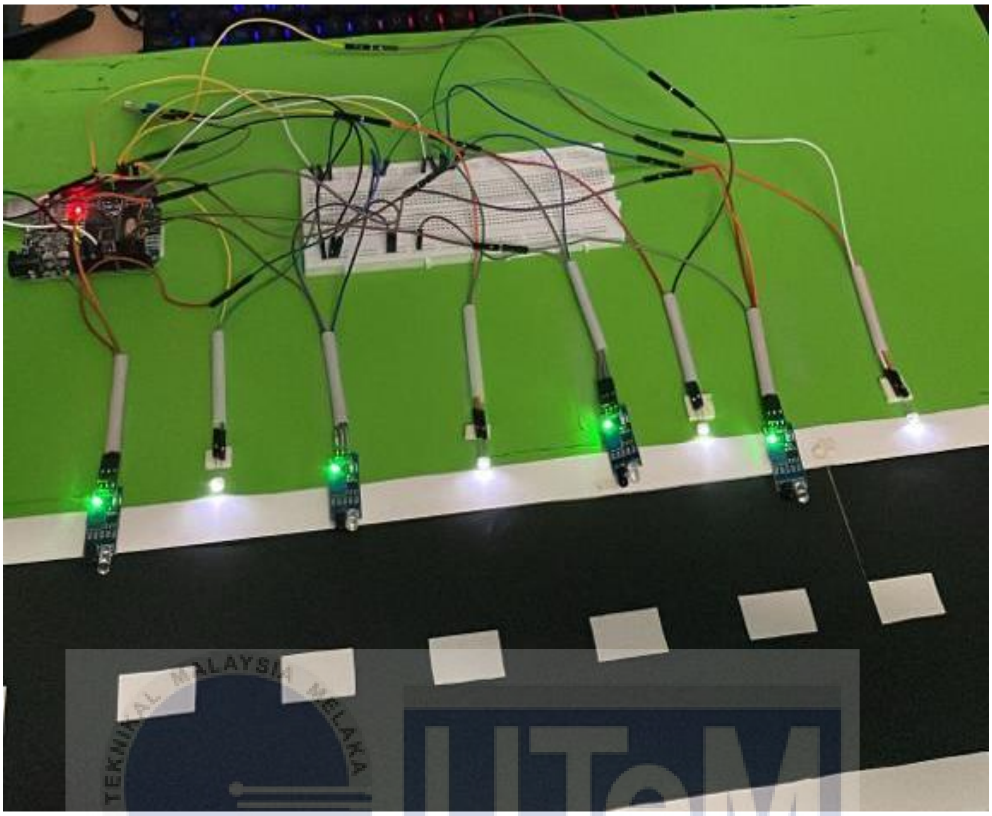


Figure 4.8 Operation Phase 1 of hardware circuit

As illustrated in Figure 4.8, when a 5V power supply is connected to the input Arduino throughout the night, the circuit begins to operate flawlessly. When the LDR sensor detects darkness, it generates a natural dark condition. Due to the absence of light, the resistance of the LDR circuit becomes extremely low, allowing electricity to pass through it. As a result, LEDs glow dimly.

Figure 4.9 Operation Phase 2

Figure 4.9 shows that when an object is detected by the first sensor, the first LED illuminates fully while the remaining LEDs remain dimly lighted.

Figure 4.10 Operation Phase 3

The repeating process of Operation Phase 2 was depicted in Figure 4.10. When the sensor detects an object, the sensor illuminates the LED completely, while the surrounding LEDs remain weakly lighted.

Coding from Arduino IDE

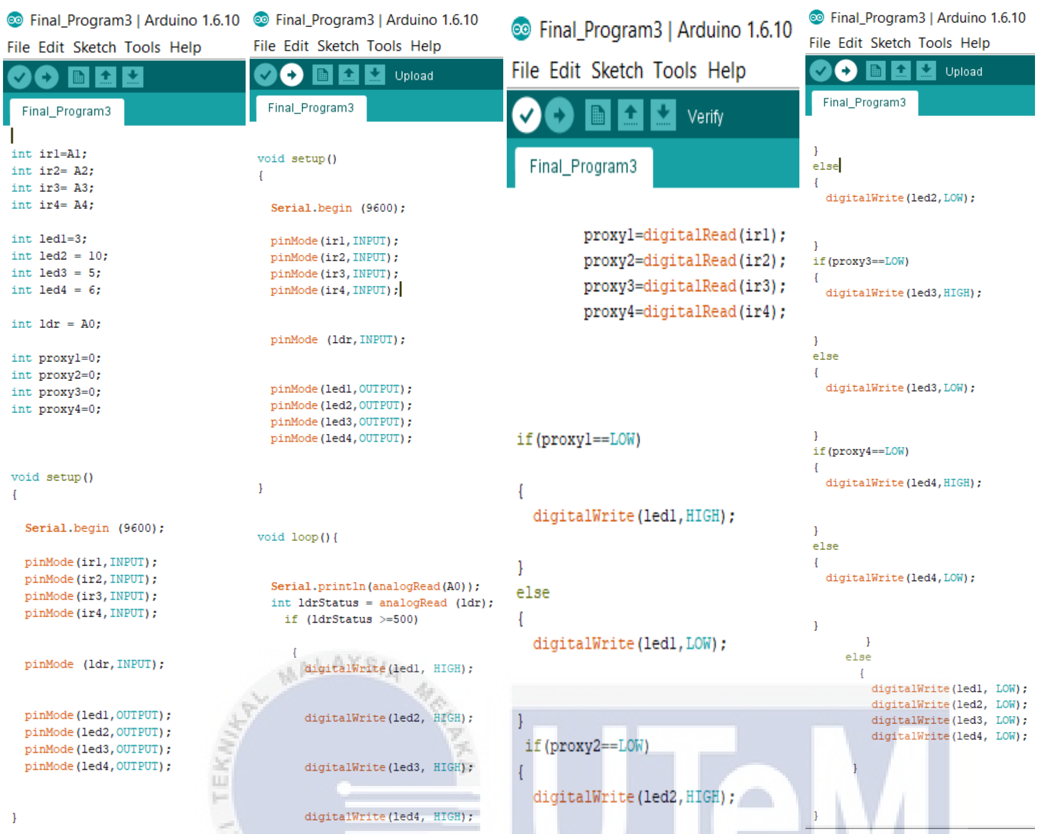


Figure 4.11 Coding from simulation

4.6 Summary

As discussed previously in this report, the system's result is that when light is shining on the LDR or IR sensor, the streetlight turns on. IR sensors not only tell the microcontroller when the vehicle moves, but they also send information to the microcontroller. When combined with the Arduino system, the Smart Street Lighting System for Energy Conservation will ultimately lead to this result.

CHAPTER 5

CONCLUSION

5.1 Conclusion

This project will design and implement an automatic system for dimming street lights that are not required during the night. The primary advantage of the current system is its energy efficiency. The system maximises energy efficiency and renewable energy utilisation by utilising an energy saving strategy and a wireless connection module. As a result, such systems are extremely beneficial for the government in terms of reducing its reliance on conventional energy (generated by hydraulic power stations). As a result, once implemented on a large scale, such systems can significantly reduce the amount of energy consumed by street lights. This initiative will assist the government in conserving energy while still meeting domestic and industrial demands. Additionally, the circuit is simple, eliminates the need for constant supervision of time, and allows for design flexibility. Additionally, the ambiance of light is assessed, with lights turned on during the night and off during the day. Our government is working diligently to ensure that customers have access to electricity. Thus, when implemented on a large scale, this paper has the potential to significantly reduce the amount of energy consumed by street lights. This initiative will assist the government in conserving energy while still meeting domestic and industrial demands. With advancements in technology and prudent resource planning, the cost of the project can be reduced, and with the use of high quality equipment, the cost of maintenance can be reduced as well. LEDs have a long life, emit a cool light, are non-toxic, and can be used for fast switching. As a result, our project offers significantly more benefits than the current limitations. Considering the long term benefits and the initial cost would never be an issue, as the investment return period is extremely short. The project also has application in a variety of other areas, such as lighting in industries, campuses, and parking lots of large shopping malls. Additionally, this can be used to monitor corporate campuses and industries.

5.2 Future Works

This project can be expanded in numerous ways to improve performance and reliability. To begin, by using a separate microcontroller for each light has its own built-in PIR sensor and can be set to any light intensity without depending on the same microcontroller. Because all sensors are controlled by the same microcontroller, it is difficult to control and operate street lighting in this configuration, because If a car passes the first detector, the first light is turned on, and the second light is not triggered until the first light is disabled when the car passes the second sensor. Second, a bi-directional connection to the grid can be provided. That is, energy can be imported and exported to the grid. Because we are using solar energy stored in batteries for street lighting in this project, we are gaining an advantage because we are utilising a renewable source of energy. Thus, The battery is completely charged when a great amount of energy from the sun is extracted, and the extra electricity that can't go anywhere will saturate the battery with excess energy. As a result, we export excess energy to the grid. In addition, the needed power from the grid can be imported in case of a backup battery problem or shortage. Similarly, the necessary power can be shipped from your grid in case of a battery backup failure or shortfall. The quantity of electricity transported from the grid can in future be calculated by developing a two directional metre, and this development process can be further expanded.

REFERENCES

[1] W. A. Jabbar, M. A. Bin Yuzaidi, K. Q. Yan, U. S. B. M. Bustaman, Y. Hashim, and H. T. Alariqi, “Smart and green street lighting system based on arduino and RF wireless module,” *2019 8th Int. Conf. Model. Simul. Appl. Optim. ICMSAO 2019*, no. October, pp. 1–6, 2019, doi: 10.1109/ICMSAO.2019.8880451.

[2] T. Santhi Sri, R. Varma, V. V. S. Hari Krishna, and K. Varun Chowdary, “Automated street lighting system,” *Int. J. Innov. Technol. Explor. Eng.*, vol. 8, no. 7, pp. 2920–2924, 2019.

[3] M. Srikanth and K. N. Sudhakar, “ZigBee Based Remote Control Automatic Street Light System,” *Ijesc*, vol. June 2014, no. June, pp. 639–643, 2014, doi: 10.4010/2014.208.

[4] R. Priyasree, R. K. H, E. Vinitha, and N. Gangatharan, “Automatic Street Light Intensity Control and Road Safety Module Using Embedded System,” no. Iccce, pp. 12–14, 2012.

[5] E. S. Budike, “(12) United States Patent (10) Patent No .:,” vol. 2, no. 12, 2007.

[6] C. Bruvaneswari, R. Rajeswari, and C. Kalaiarasan, “Analysis of Solar Energy Based Street Light With Auto Tracking,” vol. 2, no. 7, pp. 3422–3428, 2013.

[7] R. Müllner and A. Riener, “An energy efficient pedestrian aware Smart Street Lighting system,” *Int. J. Pervasive Comput. Commun.*, vol. 7, no. 2, pp. 147–161, 2011, doi: 10.1108/17427371111146437.

[8] D. R. Parkash, Prabu V and P.G, “Internet of Things Based Intelligent Street Lighting System for Smart City,” *Int. J. Innov. Res. Sci. Eng. Technol.*, vol. 5, no. 5, pp. 7684–7691, 2018, doi: 10.15680/IJIRSET.2016.0505181.

[9] S. Escolar, J. Carretero, M. C. Marinescu, and S. Chessa, “Estimating energy savings in smart street lighting by using an adaptive control system,” *Int. J. Distrib. Sens. Networks*, vol. 2014, 2014, doi: 10.1155/2014/971587.

[10] M. Abhishek, K. Chetan, and K. Arun, “Design and implementation of Traffic Flow based Street Light Control System with effective utilization of solar energy,” *Int. J. Sci. Eng. Adv. Technol.*, vol. 3, no. 9, pp. 495–499, 2015.

[11] P. K. Y. Rajput, G. Khatav, M. Pujari, and P. Yadav, “Intelligent Street Lighting System Using Gsm,” *Int. J. Eng. Sci. Invent.*, vol. 2, no. 3, pp. 60–69, 2013.

[12] A. Tran, “Smart Led Street Lighting,” pp. 604–611, 2018, doi: 10.25039/x45.2018.po36.

APPENDICES

Appendix A Example of Appendix A

PERANCANGAN PROJEK ***PROJECT PLANNING (GANTT CHART)***																																								
	SEM I																			**SEM BREAK**					**SEM II**															
Aktiviti Projek *Project Activities*	**1**	**2**	**3**	**4**	5	6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	22	23	**24**	**1**	2	**3**	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Literature Review	**x**	**x**	**x**	**x**	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**			
Finding the related journal, article,book for references	**x**	**x**	**x**	**x**																																				
Discussion with supervisor about the project objectives, problem statement, scope of project and etc.		**x**	**x**	**x**	x	x																																		

Start identify, planning, collecting data, analyzing base on journal & article for making a literature review.			x	x	x	x	x	x			SEMINAR PSM I																											SEMINAR PSM II		
Preparing Literature Review summary				x	x	x	x	x																																	
Research Methodology- a strategy to solve the research challenge systematically						x	x	x	x																																
Creating flowcharts for the purpose of documenting simple procedures									x	x		x																													
Study on how to use the software and hardware that will be used for the project									x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x																
Block diagram circuit design															x	x	x	x	x	x	x	X																			

Design, construct circuit using Proteus																					x	x	x	X														
Constructing the software simulation and its connection																								x	x	x	X											
Project testing																										x	x	x	X									
Troubleshooting any problems occur																												x	x	x	x	x	x	x				
Final checking for the project																																		X	x	x		
Presentation of the project																																					x	X