Street light monitoring and Control using low cost microcontroller system

Saif Aldin Saleh Abdelhamid Hassan

A report submitted in partial fulfillment of the requirements for the degree of Electrical Engineering (Industrial Power)

Faculty off Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

June 2016

I hereby declare that I have read through this report entitled “Street light monitoring and Control using low cost microcontroller system” and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)

Signature: .....

Supervisor’s Name: Prof. Dr. Mohamad Rom Bin Tamjis

Date: 13 June 2016

I declare that this report entitled "Street light monitoring and Control using low cost microcontroller system" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature: ……

Name: Saif Aldin Saleh Abdelhamid Hassan

Date: 13 June 2016

To my beloved mother and father

Abstract

Nowadays,a rapid advancement in the field of area construction in which large number of streets are paved. As the number of streets increase a large amount of energy is required to provide light to the streets. Street lights is an essential thing in order to improve the human life quality .Life quality implies accidents prevention due the darkness, road safety and providing clear vision .In most of global streets ,a traditional street lighting system is utilized to take control of the street lights switching during day (high intensity) or night (low intensity).This traditional system is widely used due to the simple and easy construction as well as the long time life of the system .Apart from that ,with new era of technological growths, new smart lighting system has been used to control the street light switching .This project aims to develop Street light monitoring and Control using Arduino system which implement various intelligence options. The working principle of the system utilize LED lights and two sensors attached to each light, a LDR is implemented in the system to off the light during day time,however, during darkness, two sensors are employed to detect the presence of the vehicle an send the signal to Arduino to light up the corresponding light for 100% and two surrounding light by 50%. The objectives of the project have been successfully achieved by prototyping a smart street light system which intelligently control the light of the street and hence save cost and energy consumption.

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1. INTRODUCTION

1.1 Research Background

A bulb is an electrical device which converts an electrical current crossing it into light energy. Lighting is very important need for people to provide them with visibility during dark times. Road lighting is essential requirement as well, in order to make any moving object in the road such as humans, vehicles or any other objects are visible so that any obstacles due the darkness avoided. With rapid technology growth where green issues havepresented, many scientists and engineers are focusing in producing modern techniques to minimize the energy consumption, less environmental impacts equipment and maximize the equipment efficiency. Among various methods, smart system found to be the best method to be implemented in industrial and residential and commercial areas. Smart system can be defined as dependent system which can senses the variation in the environment with the help of sensors implantation and can response to modify the variations causes as desired.

` Street light is very advantageous system which contributes to extend the people life quality during the darkness periods. Life quality includes the crime prevention and traffic safety on the street. The amount of energy street light consumes almost two percent of the world energy, also the street light is responsible for the yearly millions of Co2 emission which more detrimental to environment and contribute largely to increase the global warming. Street lighting normally involves energy waste as well as lack of controllability and arrangements. It is remarkable idea to develop a smart system that can provide a well-organized control mechanism of the street lighting, hence reduce the energy consumption

The basic concept of Street light monitoring and Control using low cost microcontroller system is that, the system is implemented utilizing the latest technology light emitting diode. With the aid of sensors, the movement of vehicles or human can be detected. As the sensors detected the presence of human or vehicle the light intensity goes on in increasing for few seconds till the vehicle passes the light intensity deceased

1.2 Problem Statement

Nowadays, with rapid advancements in technology and the globe is increasingly becoming more modernized. Day after day the number of roads and streets are increasing in accordance the intensive population growth, as well the large usage of vehicles. Apart form that the street lighting is very important in order to comfort the life quality of human as well as provide a vision across the street so that the accidents rate and traffic problems occurred on the street due to the darkness is narrowed out. Most of streets lighting system utilized nowadays are conventional and consume a big number of energy as well as produce environmental effects

However, by utilizing Street light monitoring and Control using low cost microcontroller system all these problems are minimized. A system that utilize the latest technology light emitting diode .As well as the system utilize various sensors so that the lighting system is operating according to the sensor detection .When the sensor detect the presence of vehicle the light intensity will increase for a certain time ,as the vehicle passed the light intensity goes back to normal .Moreover the system will utilize microcontroller driving mechanism for the system .Implementing such system contribute largely to reduce the energy consumption as well as the lighting system managed well .

1.3 Objectives

The goal of this project is to achieve these objectives:

- To develop a smart lighting system to reduce energy consumption
- To use latest technology light emitting diode (LED)
- To carry on the system implementation in single street

1.4 Scope

The scope of this project includes building a smart street lighting system to be implemented on the streets so that the energy consumption and street arrangement are improved. The basic construction of the system utilizes latest modern technology of LED, sensors and the microcontroller. The system demonstration is carried out utilizing Single Street. The key concept of the system is that the sensors will detect the presence of the vehicle or human so that the microcontroller will control the light intensity based on the sensor detection

1.5 Expected outcomes

Upon the completion of this project, it is expected to:

- Reduce the energy consumption to minimum rate
- Produce less impacts to environment
- Produce a well-organized street lighting system
- Overcome the shortcoming of conventional street lighting system drawbacks

1.6 Report outline

This report consists of five chapters which are presented as below:

Chapter 1: **Introduction**-This chapter presents and illustrates the aim of this project, discusses the problem fundamentals. As well as detail information about Street light monitoring and Control using low cost microcontroller system

Chapter 2: **Literature Review** - This chapter provides a detailed background of speed lighting system and taking in the consideration the fundamental concepts of smart lighting system. It also provides comparison study in other previous related work has been done in Street light monitoring and Control using low cost microcontroller system.

Chapter 3: **Methodology**- This chapter presents the approaches and procedures used to build this project in sequence. As well as the project flow chart, provide specifications, components used and present the project flow

Chapter 4: **Result and discussion**- This chapter illustrates and analysis the result of this project and discusses the achieved results of the developed system.

Chapter 5: **Conclusion and recommendation**- This chapter provides a summary of the project. The strengths and advantages of the project will be discussed as well. Furthermore, some suggestions for future works will be offered.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Introduction

Nowadays, with the intensive development in technological and industrial field in which the world becoming more modernized and sophisticated. Overtime, the number of streets are increasing as the number of population and new cities created increase. Street lighting is an important need to provide a clear vision to people during darkness times so that the any crime occurrence or road accidents is avoided. In developed countries, a sophisticated street lighting system is implemented where the light ON and OFF is controlled automatically by the detection of darkness. Apart from that, the need for smarter lighting system to reduce the energy consumption [1].

Smart lighting system is new lighting system that can be implemented in street lighting to reduce the energy consumption as well as organize the street lighting. The process of traditional street lighting system consume a large amount of energy since, the traditional system implies that the all the lights will be one at 100% intensity during darkness periods, however it is unnecessary the street light is ON all the time with 100% intensity even though there is no presence of vehicle or human. The smart lighting system is capable of providing control mechanism of the street light intensity. With the existence of Arduino a integrated control tool, the smart system utilize it to provide full controllability of the system .In the smart system, sensors will be installed to detect the presence of light as well as the presence of vehicle or human .Therefor, the light intensity will be controlled in accordance with the sensor detection .The advantageous feature of Street light monitoring and Control using low cost microcontroller system is the energy consumption is minimized as well as the street lights are managed well [2].

2.2 Theory and Basic Principles

This particular subtopic is specialized for studying the theoretical concept of the street lighting system. The system concept is discussed to visualize the working approach of the system. As well as the system fundamental components are studied along with their working principle and significant contribution in forming the street lighting system.

2.2.1 Traditional Street Lighting System

Traditional street light system is commonly used nowadays in most streets. The main goal of such system is to provide control mechanism of the street lights to save energy. The basic construction of the system is that it utilizes only light sensor to detect the presence of the light, hence automatically turn on or off the light. The working principle of the system implies that the street light will be off during the daytime while will be on at nighttime or in the presence of heavy clouds that cause darkness. In The presence of vehicle or pedestrians, the system wills not response. The system main components are transistor and light dependent resistors (LDR) as the main components [3]. Figure 2.1 show the circuit diagram of traditional street lighting control

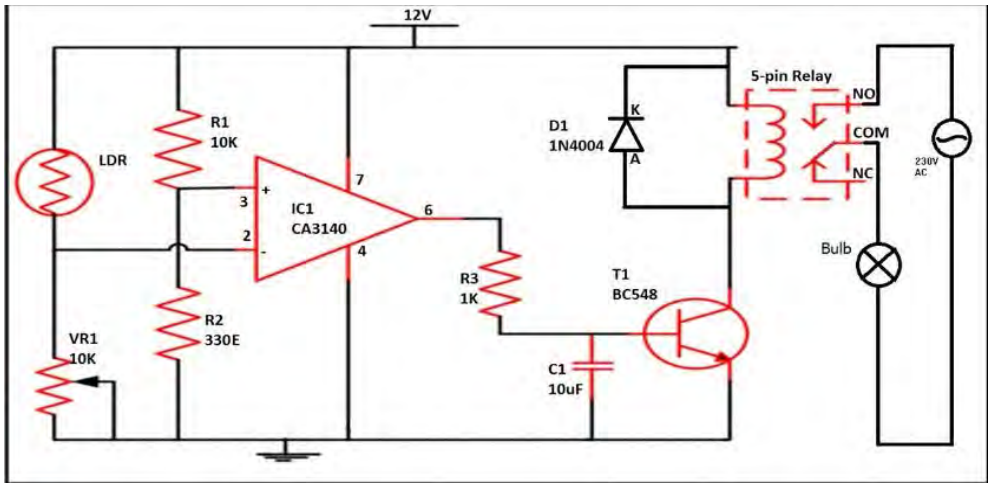

Figure 2.1 Traditional street lighting system circuit diagram

2.2.1.1 Traditional System Components

The implementation of the common conventional street lighting system is quite simple .it comprises set of fundamental components that integrate the system in order to control the light of the street automatically

2.2.1.2 Light-Dependent Resistor (LDR)

Light Dependent Resistor (LDR) or a photo resistor is a light variable resistor. Its resistance is inversely proportional to the light intensity, as the light intensity increases, the LDR resistance decrease and vice versa. LDR is created utilizing a high strength semiconductor. In darkness period, it can possess very high resistance reaching a mega ohms ((MΩ), but in the light, it can have a very low resistance not more than hundred ohms .The working concept of LDR is, whenever it exposed to lights that exceeds a specified frequency, photons resolved by the semiconductor produce bound electrons enough power to go into the conduction cycle [4]

In the street lighting system, the using LDR is beneficial where; it can provide a simple control mechanism for the street light system. In the time of darkness or when there is no light, the resistance of LDR is very high so that the street light will turn on, but in the presence of light or in brightness, the LDR resistance is very, hence the street light is off. Figure 2.2 show the type of Light Dependent Resistor (LDR)

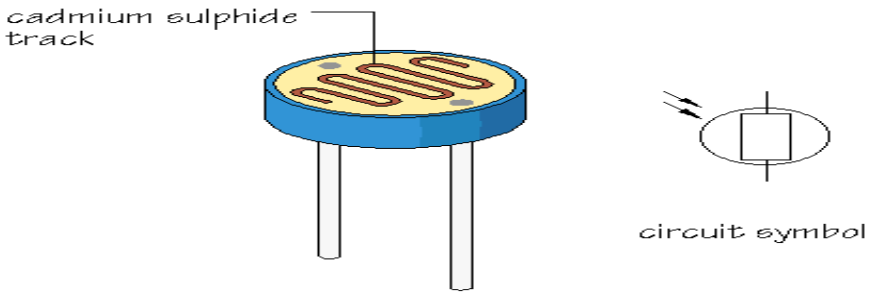

Figure 2.2 Light Dependent Resistor (LDR) with its symbol

2.2.1.3 Resistor

A resistor is a passive electrical element which has two terminals can be utilized as electrical resistance in the electrical circuit. Usually the main purpose of the resistor is to act as the current limiting component. It is utilized to provide protection to desired part of an electric circuit from an excessive current .For street lighting system in particular, various resistor used in order to manage the current flow in the circuit and prevent some part of the circuit from receiving high current .There are two type of resistor, fixed value resistor in which the value is constant and unchangeable or variable resistor where there resistance value can be varied as desired [5].Figure 2.3 shows the typical shape of electrical resistor along with its electrical symbol.

Figure 2.3 typical shape of resistor with its symbol

2.2.1.4 Operational Amplifier (CA3140IC)

CA3140 can be referred as Operational Amplifier utilizing MOSFET as an inputs and Bipolar as an output. This Op Amp comprises the features of PMOS transistors and high voltage bipolar transistors. It possesses gate prevented MOSFETs (PMOS) transistors in the input design to produce very high input resistance roughly around 1.5T Ohms. The IC utilizes very less input current as low as 10pA to alter the output state, high or low. The IC possesses very fast changes and high speed of characteristics. The output phase of the IC utilizes bipolar transistors and involves formed inprevention against damage from load port short circuit to either supply rails or to ground [6]. In the case of street lighting system, The CA3140 works as a comparatorand gives fast response &high speed. Figure 2.4 shows the circuit diagram of CA3140 utilized in traditional street lighting system.

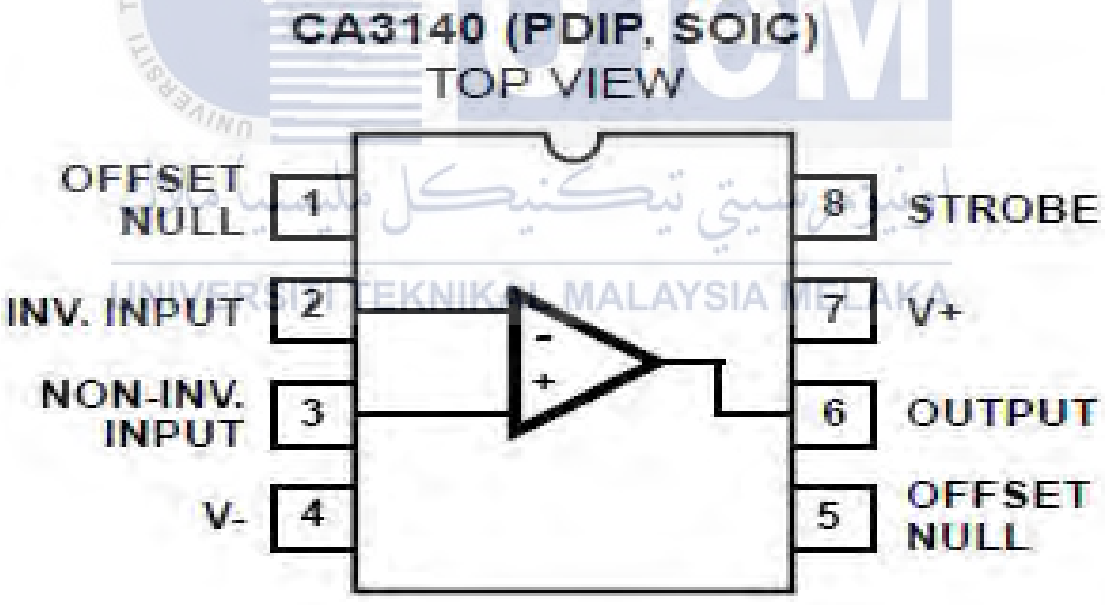

Figure 2.4 CA3140 IC circuit diagram

2.2.1.5 Relay

Relay can be defined as an electrical switch which utilize electromagnetic to operate as switch in mechanical way. The main purpose of relays is to be used to control a circuit utilizing low power signal with completely electrical isolation between control and controlled circuit. Also it can be used to control various circuits utilizing one control signal. In the past relays usage was intensively on telegraph as well as in telephone and early computer in order to achieve logical operations .The usage of relays also can utilized in electrical motor control in which relay can control moving parts instead using semiconductors which require switching. Lastly, relays can be used to protect electrical circuits against overload as well as fault occurrence [7]. There different type of relay with 3 or 4 pins ports, in the case of street lighting system a 5 pins relay is used which provide a simple way for LED to indicate the presence of current in the relay coil. Figure 2.5 shows the simple circuit of relay.

Figure 2.5 Relay circuit configuration

2.2.1.6 Transistor

A transistor can be defined as semiconductor device that can be utilized to enlarge switching signal. In its basic construction utilizes a set semiconductor material, in order to be implemented in circuit must contains at least three terminals. The existence of such device contribute largely to minimize the size of the equipment. Transistors can be used as switch to turn on or off a circuit as desired. The basic operation of transistor includes an input power fed into a transistor terminal can alter the power through the other terminal; hence transistor can be used as amplification device to produce higher output power than the input. The most advantageous features of transistoristhat, it contribute significantly to produce a smaller and cheaper equipment [8]. In traditional street lighting system, transistor utilizedfor switching purpose. It isbiased so that it remains on if there is signal at its base, otherwise it is always off. Figure 2.6 shows the circuit of transistor.

Figure 2.6 Transistor circuit

2.2.1.7 Working principle of Traditional Street Lighting System

The working principle of the designed traditional street lighting system circuit is quite simple, where the designed circuit will be incorporated the bulb street light .As the main component of the system is the LDR which a high sensitivity device so that as for the day time ,the LDR will sense the light ,hence comprise low resistance .Low resistance is low voltage fed into the relay so that the output of the relay is low which connected to the transistor and will be off, hence the light is off. While at night time, LDR by its property will experience a high resistance. Therefore, voltage is inputted into the relay which will produce high output to the transistor and make on state, hence the light bulb is on [9]. Figure 2.7 shows the diagram of working principle of traditional street lighting system.

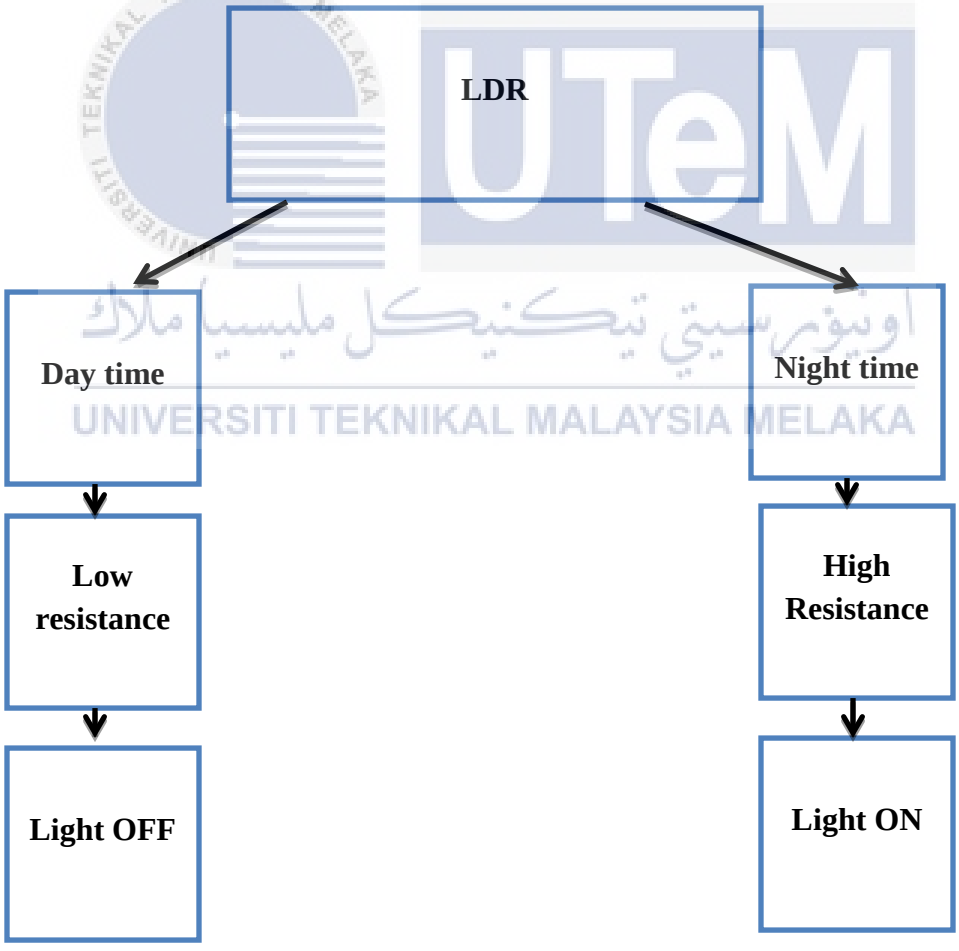

Figure 2.7 Working principle of traditional street lighting system

2.2.2 Traditional Street Lighting System Advantages

Traditional street lighting system is widely deployed and implemented in most of streets in the globe. The simplicity of this system make more remarkable to be used .Such system utilize less component which enable it to be produced at low cost and easy construction. Despite of the system simplicity and easy implementation it contributes largely to introduce more features, hence the most remarkable features that can be obtained from the traditional street lighting system can be discussed below:

I. No man power required, in which the system utilize full automotive working principle, so that doesn't require the involvement of humansto operate of control
II. Simple Construction, where simple and less components used to design the system
III. Efficient method, since it utilizes effective components that doesn't waste energy
IV. Less Consumption of electrical energy, the main function of the system is to turn off street light in the day time which save electrical energy
V. Less maintenance, the system is well-built and accurately designed so that a regular maintenance is not required
VI. Cheap and economical, due to simple and cheaper components used the system is presented at low cost so that it is more economical.

2.3Smart street lighting system

Smart street lighting system, as the name implies it provides a smart control mechanism for the street lighting. The system achieves the function of traditional system and added more advantageous features, where a smart system besides the turning on and off a street light during day and night time. It also automatically controls the light intensity in accordance to the presence of vehicle andpedestrian. Moreover, the system can control thelight on and off states inlate time of the night where most of the streets are free of vehicles andpedestrian. The system implementation utilizes a microcontroller as control mechanism of the entire system, Infrared Sensor (IR) to detect the presence of vehicles orpedestrian in the road so that the light intensity will be adjusted accordingly. Figure 2.8 shows street lighting implementing smart system []

Figure 2.8 Smart street lighting

2.3.1 Smart Lighting system components

The Street light monitoring and Control using low cost microcontroller system utilize a set of components namely, microcontroller,infrared sensor(IR) ,light dependent resistor (LDR) ,Light Crystal Display (LCD).In this section the main components form up the smart lighting system will be discussed individually.

2.3.1.1 Real Time Clock

Real time clock RTC can be defined as a computer clock usually in form of integrated circuit which continues tracing the current time. RTC is very important where it exists in almost every electronic device that requires maintaining exact time. In microcontroller the RTC is used largely to interface with microcontroller to provide the accurate time [11]. The main purpose of including real time clock in the street smart lighting system is that to store the data of time during day and night. In smart lighting system, sometimes the street light will be off in the darkness period .This because the data information stored in real time clock to turn off the light or reduced in accordance to specified time like after midnight where the street is free of vehicles and people. Figure 2.9 shows the circuit real time clock interfacing with microcontroller.

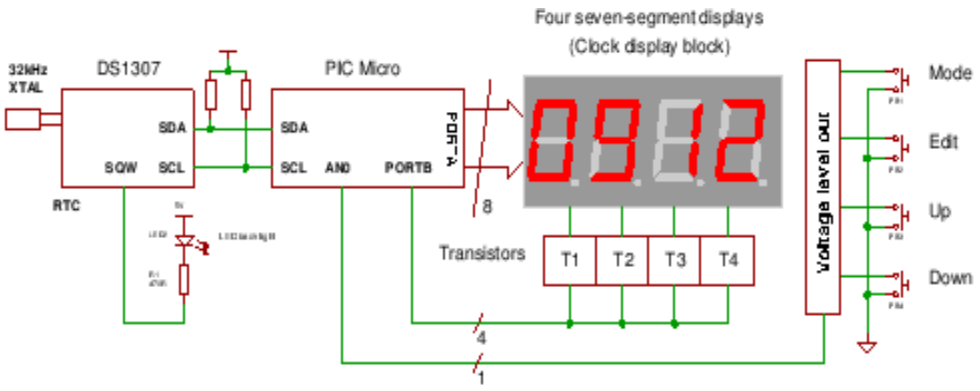

Figure 2.9 Real time clock design

2.3.1.2 Light Dependent Resistor (LDR)

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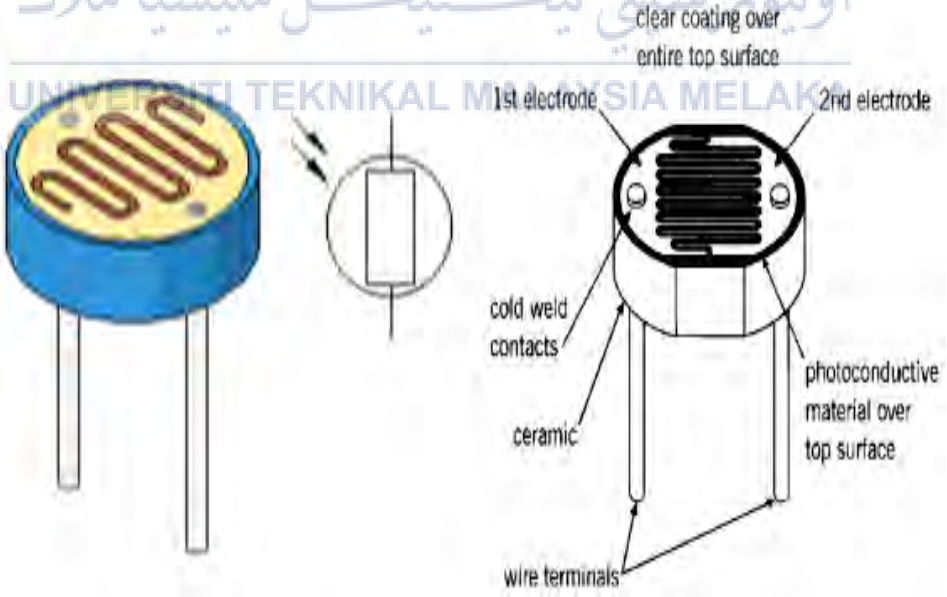


Figure 2.10 Light Dependent Resistor (LDR)

2.3.1.3 Ultrasonic Ranging Module HC - SR04

A. Product features:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning. Test distance = (high level time velocity of sound (340M/S) / 2,

B. Electric Parameter

Table 2.1: Electric Parameter

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
MeasuringAngle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**
Dimension	**45*20*15mm**

Figure 2.11Infrared sensor

C. Timing diagram

The Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal

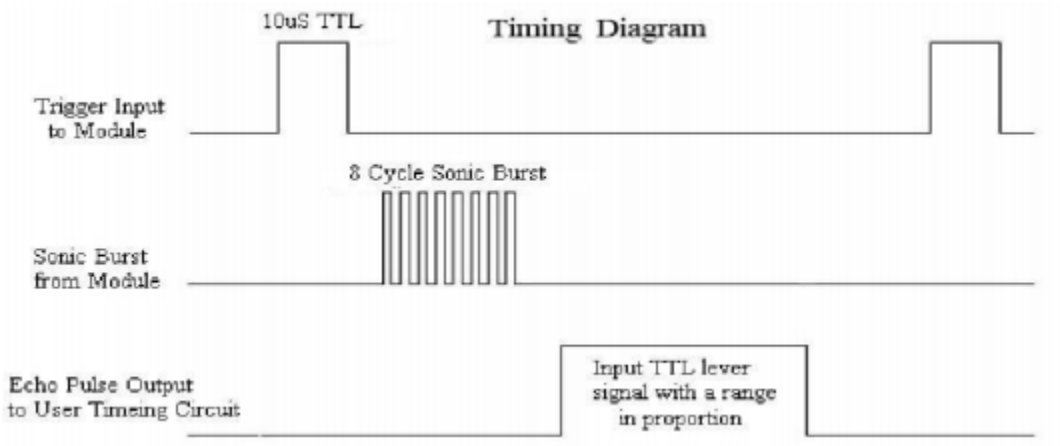


Figure 2.12Timing Diagram

2.3.1.4 Microcontroller (Arduino)

Figure 2.13Arduino

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world. Arduino boards may be purchased preassembled.

I. Overview

Arduino is based on a family of microcontroller board designs manufactured primarily by Smart-Projects in Italy, and also by several other vendors, using numerous 32-bit Atmel ARM processors or 8-bit Atmel AVR microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various extension boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C and C++ programming languages.

II. Technical Specifications

The technical specifications for Arduino are listed below which consists of the board, power, memory, input output, and communication. The details of each part are described below:

Table 2.2: Arduino Board Specifications

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB of which 0.5 KB used by bootloader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

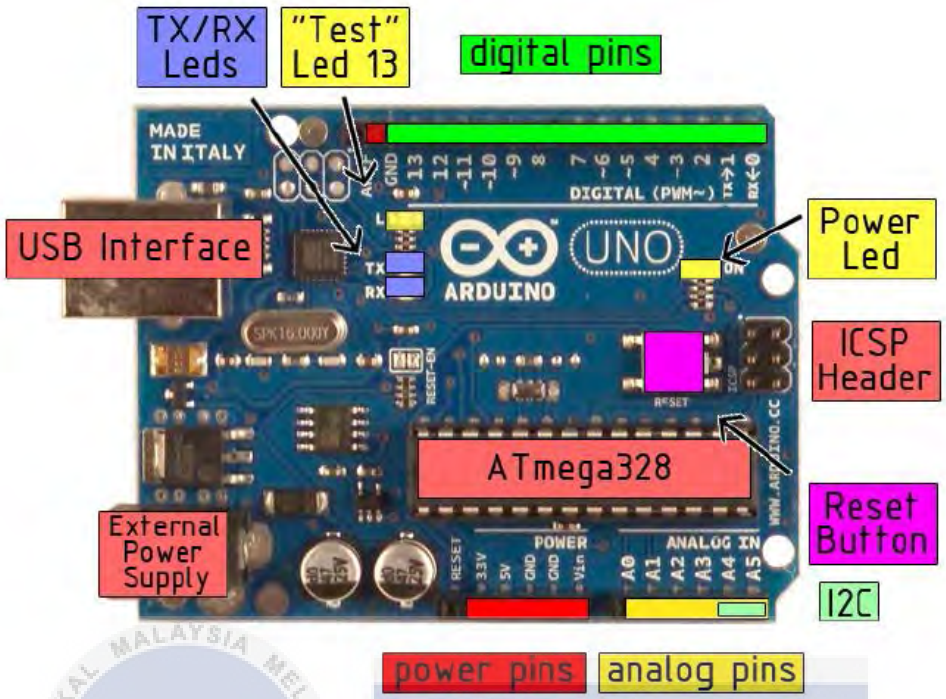


Figure 2.14Arduino board specifications

III. Power

The Arduino Uno can be powered by the USB association or with an external power supply. The power source is automatically selected. External (non-USB) power can come either from an AC-to-DC connector or battery. The connector can be associated by plugging a 2.1mm centre-positive plug into the board's energy jack. Leads from a battery can be embedded in the Gnd and Vin pin headers of the POWER connector.

The board can work on an external supply of 6-20 volts. If the board supplied with less than 7V, the 5V pin may supply less than five volts and the board may be unstable. If the board supplied with more than 12V, the voltage regulator may overheat and damage the board. 7-12 volts is the recommended range.

The power pins are as follows:

- VIN: The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). The board voltage can be supplied through this pin, even if the voltage supplied through the power jack it should access the same pin.
- 3V3: Maximum current draw is 50 mA, and its generated by the regulator on-board.
- 5V: The regulated power supply used to power the microcontroller and other components on the board. The power can be supplied either from VIN via supplied power by USB, or an on-board regulator, or another regulated 5V supply.
- GND**:** Ground pins.

IV. Memory

The Atmega328 has a flash memory for storing code 32 KB (where the bootloader used 0.5 KB); it also has a SRAM of 2 KB and 1 KB of EEPROM (which can be written and read through the EEPROM library).

V. Output / Input

Each of the 14 digital pins on the Uno can be utilized as a data or output, utilizing pinMode(), digital Write(), and digital Read() functions. They work at 5 volts. Every pin can supply or get a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. Furthermore, a few pins have specific functions:

- Serial: 0 (RX) and 1 (TX). Used to receive and transmit TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, provided by the underlying hardware, it been included in the Arduino language recently.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, each of which gives 10 bits of resolution (i.e. 1024 unique qualities). By default, they measure from ground to 5 volts, however is it attainable to change the upper end of their reach utilizing the AREF pin and the analogReference() function. Furthermore, a few pins have particular functionality:

- I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library.

There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

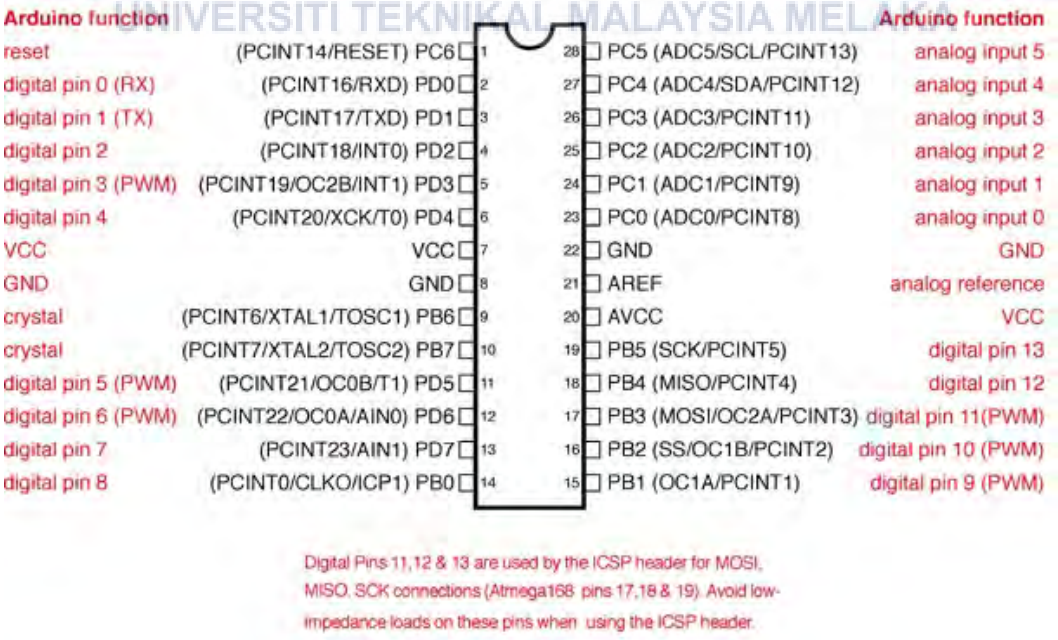


Figure 2.17 Mapping between Arduino pins and Atmega328 ports

VI. Communication

The Arduino Uno has various facilities for communicating with a personal computer (PC), another Arduino, or different microcontrollers. The ATmega328 supports UART TTL (5V) serial communication, which is accessible on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and shows up as a virtual com port to software on the computer. The '8U2 firmware utilizes the standard USB COM drivers, and no external driver is required. In any case, on Windows, a *.inf document is needed.

The Arduino software contains a serial screen which enables straightforward textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted through the USB-to-serial chip and USB connection to the computer (however not for serial communication on pins 0 and 1).

VII. Arduino Applications

Nowadays, Arduino is used in many applications for how many benefits it has and the simplicity and time consuming, and some of this applications are:

- Arduino Phone
- Water quality testing platform
- OBDuino: a trip computer that uses the on-board diagnostics interface found in most modern cars
- Arduinome: a MIDI controller device that mimics the Monome
- GertDuino, an Arduino mate for the Raspberry Pi
- Xoscillo: open-source oscilloscope
- Ardupilot: drone software / hardware
- Scientific equipment

VIII. Advantages of using Arduino

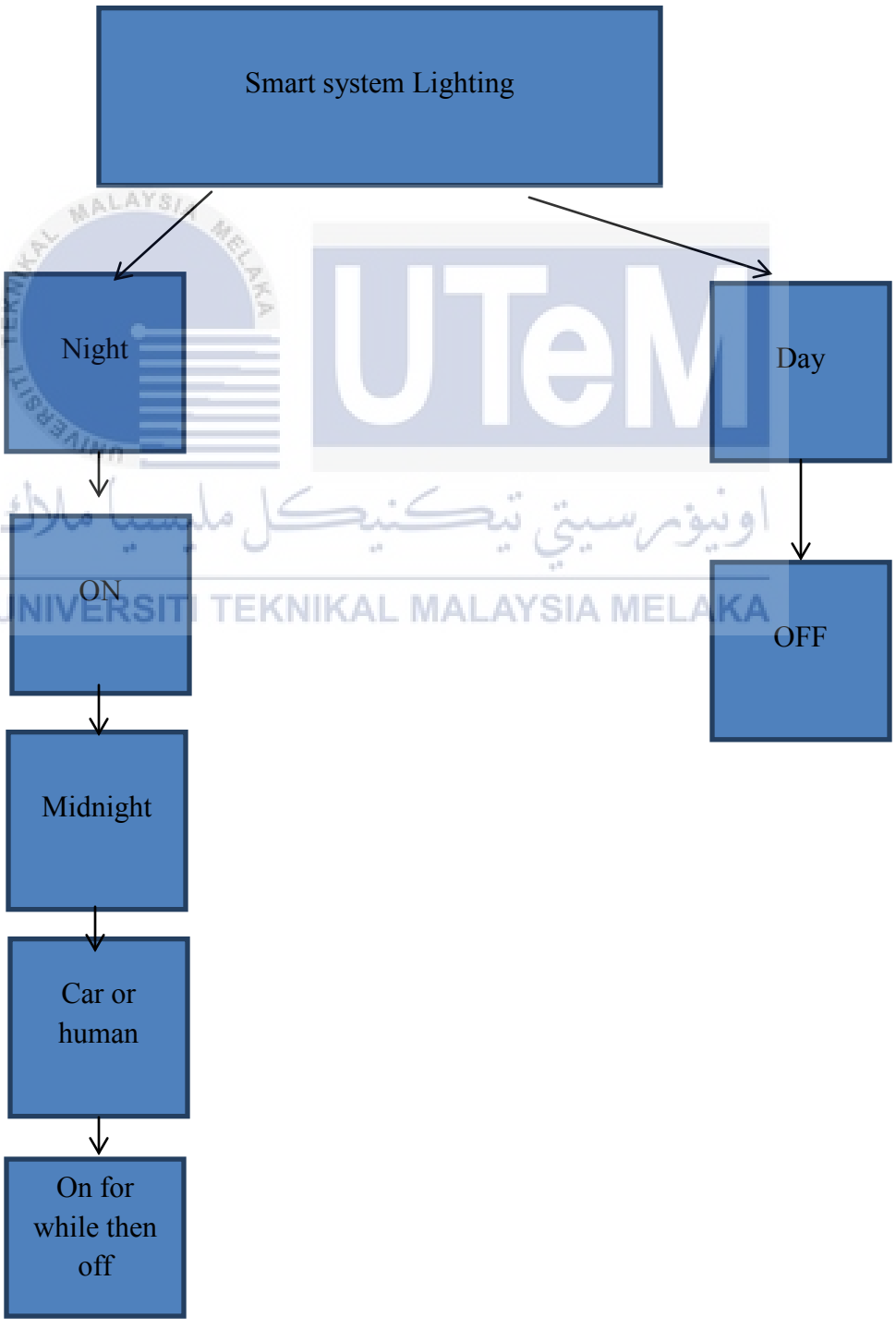
- Using an Arduino can simplify the amount of hardware and software development that the user need to do in order to get a system running.

- The Arduino hardware platform already has the power and reset circuitry setup as well as circuitry to program and communicate with the microcontroller over USB. In addition, the I/O pins of the microcontroller are typically already fed out to sockets/headers for easy access (This may vary a bit with the specific model).

- On the software side, Arduino has various libraries to make programming the microcontroller simpler. The easiest of these are functions to control and read the I/O pins as opposed to needing to interfere with the bus/bit covers ordinarily used to interface with the Atmega I/O (This is a moderately minor troublesome). More beneficial are things, for example, having the capacity to PWM at a certain duty cycle using a single command or doing Serial communication.

2.3.1.5 Working principle Smart Street Lighting System

Basic purpose of this project is to make street lights intelligent so that it can turn it on and off itself. Another feature of this project is that street lights intensity varies according to intensity of light and number of vehicles on road.



2.3.1.6 Advantages of the System

Figure 2.15Smart System Lighting

Smart street lighting system is its name implies it is system that control the street light in smart way. The system main function is to provide more intelligence methods to control the street light. Beside the basic function of older system which is turning the street light off during day or high intensity light and on during night time or darkness period. The smart system includes other situations that can switch the lights on or off. Smart system as it name suggests it makes use of street lights very easy. Some of the main advantages of them are given below:

1. No need to control street lights manually. Since the system utilize the microcontroller as driving tool for entire system. The system is fully automatic operating
2. Electrical power saving. Besides the function of traditional system of turning off light on and off at day and night respectively, the smart system utilizes other periods and circumstances to turn off or on the light, hence more energy is saved.
3. Increases life time of street lights. Commonly as the street light operated long time it reduces its time life, hence the smart system increases the possibility of street light turning off so that it last long time
4. Intelligent street lights. As the system utilize intelligent instrument such sensors and microcontroller, so that the street lights is controlled intelligently.
5. Vehicle or human detection. The most remarkable feature of the smart system is that it utilizes sensors to detect the presence of objects so that a street light will be on for the period of the object is facing the street light.

2.4 Review of previous works

The street light control and developments is area of interest forengineers, researchers as well as economical department in developed counties. The smart street lighting system is not fortuitous, many researches and smart system has been previously achieved. In this section, some previously achieved studies about the smart street lighting system will be discussed.

A study has been done in [15] that have proposed an energy efficient street lighting system. The idea of the project comes from the fact that, the traditional street lighting system in places with less cross are on all the night with no aim, so that large energy is wasted. The study utilizes the existence new sophisticated lighting technology such Light Emitting Diode (LED) lamps, also the internet connection availability. The study developed a dynamic switching of street lamps based on pedestrians' locations and desired safety areas. The developed system working principle includes, each pedestrian based on his/her smartphone. The location and pedestrian transferred to the system server so that street light will be controlled accordingly. The proposed system in this study utilize a Sigsbee-based radio device to receive control information form the system server

Another study as in [16], has presented a smart street light control .The study propos a design of street light controller based on ZigBee self-controlling wireless network. The study comprises the function of traditional streets light with ZigBee technology. The study developed a system that uses ZigBee wireless energy-saving, also the proposed system improve the management effectiveness as well as the operating cost. The concludes by emphasizing that the system testing indicates an obvious effectiveness of energy consumption reduction

Moreover, another study related to smart street lighting has been proposed as in [17]. The study proposed street light control system by designing and implementing of zero power wake-up for PLC modems. The study significant gained from the fact that, power line communication is increasingly becoming more essential as leading technology. The study aims to present a new system to mitigate the energy consumption of the line power modems by utilizing zero-power

stand. The incoming wake up signal is a simple PLC frame and its corresponding power used to power on the logic. The proposed system in this study mainly designed to be utilized in street lighting system which uses power line communication and the stand-by power is a problem due to the existence of thousands of lamps in a city. The study proposed the system architecture as well as the design selection. The study concludes that, with accordance to the experimental results of the proposed system when it is subjected to street light network, it is applicable to wake up selected lamp from a distance up to 250m

2.5 Summary

At the end, this chapter mainly focused in discussing the theoretical concept of street lighting system. The chapter commence by demonstrating the commonly used street lighting system in which a simple and easy construction is required. followed by illustrating the smart street lighting where a latest technological instrument is utilized. The chapter includes a demonstration of the working principle of the smart street lighting system along with advantageous feature that can be provided by the system. The chapter concludes by discussing a previous related studies in the field of smart street lighting.

CHAPTER 3

3. METHODOLOGY

This chapter describes the methodology of this project. This project involved studies and development of Smart street lighting system technology software and hardware to achieve the development in the system. The literature studies have been done, by collecting the data on the Smart street lighting system systems and previous work. Afterwards, the programming can be started to show the new settings and the development of the hardware.

3.1 Description of the Work

This project was conducted to build and implement a hardware using Smart street lighting system with Arduino microcontroller and to program an interface using Proteus Professional to show the final results.Description of the proposed system is shown in Figure 3.1.

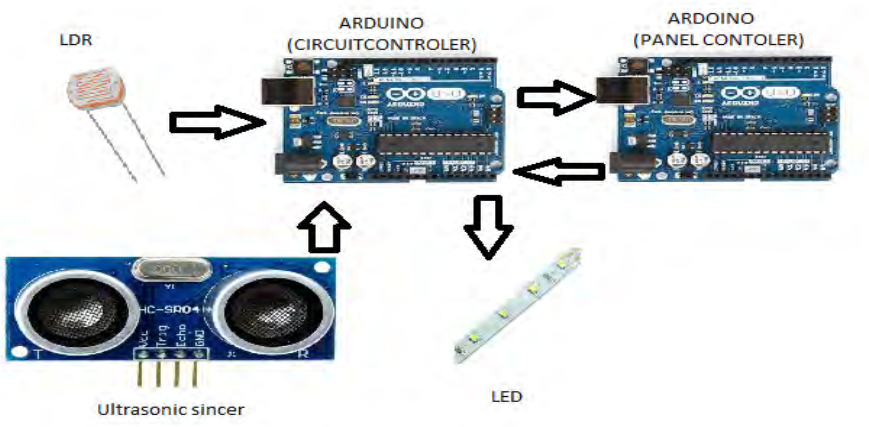


Figure 3.1Description of the proposed system

For these project the smart system hardware was designed and implemented using multiple components, set of wiring and programming codes to achieve the final design.

3.2 List of Components

1. Arduino Board and Software (6 Unit).
2. Resistance 10KΩ. (5 Units)
3. Resistance 10Ω (10 Units)
4. PC or Laptop (1 Unit).
5. Ultrasonic sincere (10 Units)
6. Strip board.
7. Wires.
8. LED (10 Units)

3.3 Block diagram

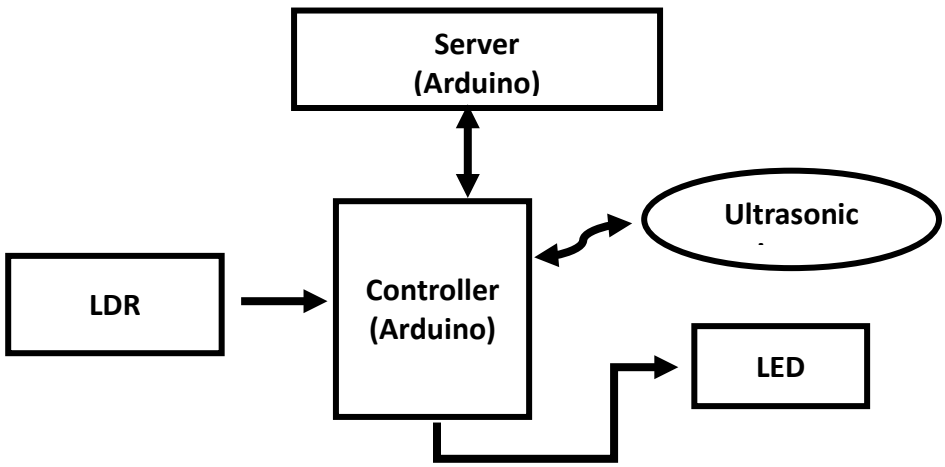


Figure 3.2RFID Tag Scanner (PART 1) Block Diagram

The block diagram in figure 3.2 shows the design process of the Smart street lighting system where the input is the signal from LDR and the output is displaying the LED and also transmit the data to the server to be saved for any checking requirements.

3.4 Software Implementation

First of all, the system has been build utilizing proteus software and Arduino board as depicted in Figure 3.3, the working principle of the system is quite simple, in which the Arduino receives input signal from sensors and hence control the lighting.

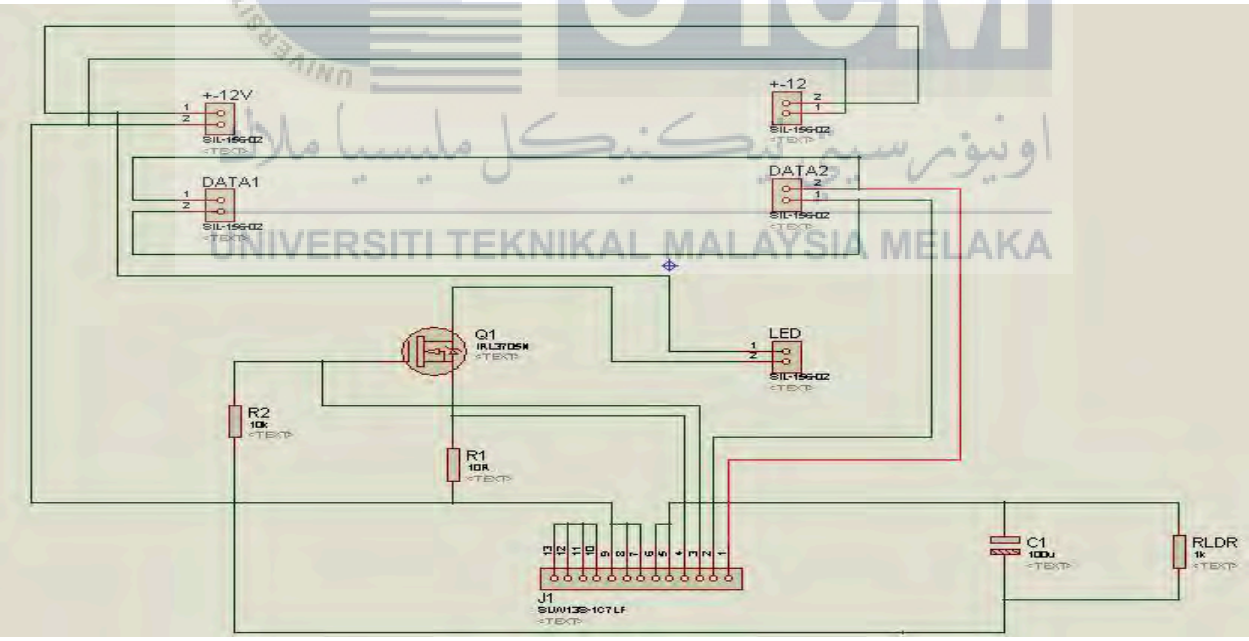


Figure 3.3 System circuit design in proteus

The designed circuit is fabricated as in figure 3.4 in order to be prototyped.

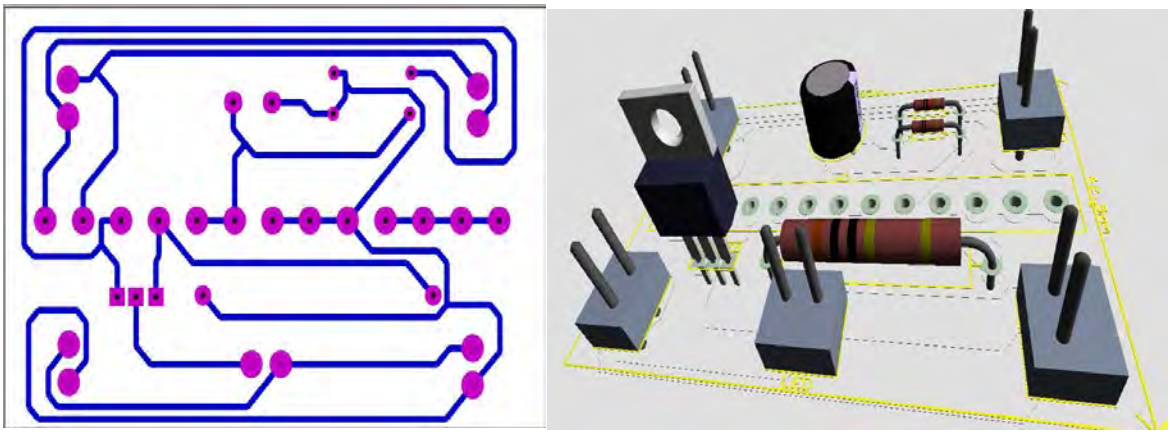


Figure 3.4 System fabricated circuit

3.5 Hardware Implementation and Setup

Firstly, all the required components were purchased and were prepared to use. Secondly the components connection was stablished subsequently with Arduino board. The steps of the components connection for each part are stated as below:

3.5.1 Ultrasonic Sensor

The Ultrasonic Sincere that has been used for the implementation is Ultrasonic Sincere HC-SR04. The reader frequency was 13.56MHz with supplying voltage of 3.3V. in each circuit there is 2 sincere to monitor the range influent and the side of the lamp.

The details of wiring are stated as below:

Arduino PIN 2 → Trig sensor 2

Arduino PIN 14 → Echo sensor 2

Arduino PIN 12 → Trig sensor 1

Arduino PIN 13 → Echo sensor 1

Arduino PIN GND →Gndsensor 1 / 2

Arduino PIN VCC →Vccsensor 1 / 2

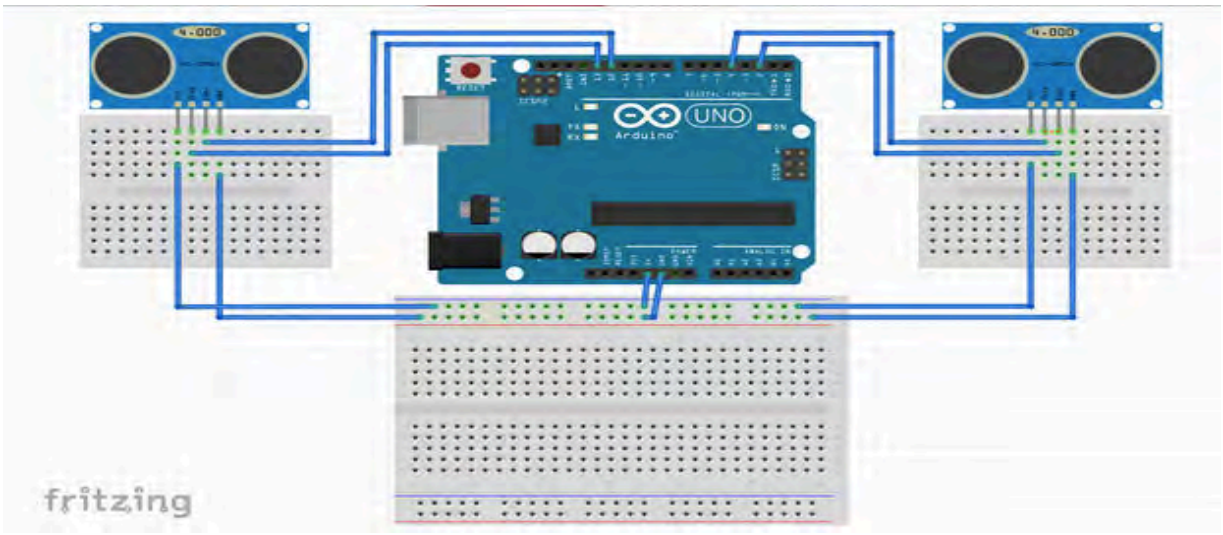


Figure 3.5RFID reader Connection with Arduino

I. LED

The LED is getting the power source from AC/DC converter.

II. LDR

The most common type of LDR has a resistance that falls with an increase in the light intensity falling upon the device (as shown in Figure 3.3). The resistance of an LDR may typically have the following resistances:

Daylight = 5000Ω

Dark = 20000000Ω

It can be therefore see that there is a large variation between these figures. When plotted this variation on a graph it would get something similar to that shown by the graph shown above.

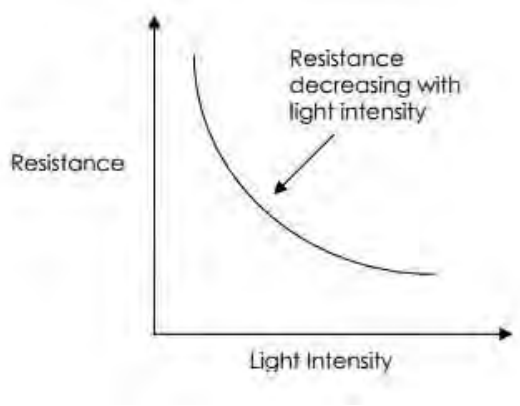


Figure 3.6 Resistance variation

Figure 3.7 present the system wiring in which the Arduino board is connected into the LDR sensor, the circuit has been designed in proteus software. The LDR is connected into the corresponding pin in Arduino circuit. As the purpose of the LDR to provide input signal into the Arduino so , it can decide whether to on or off the light .

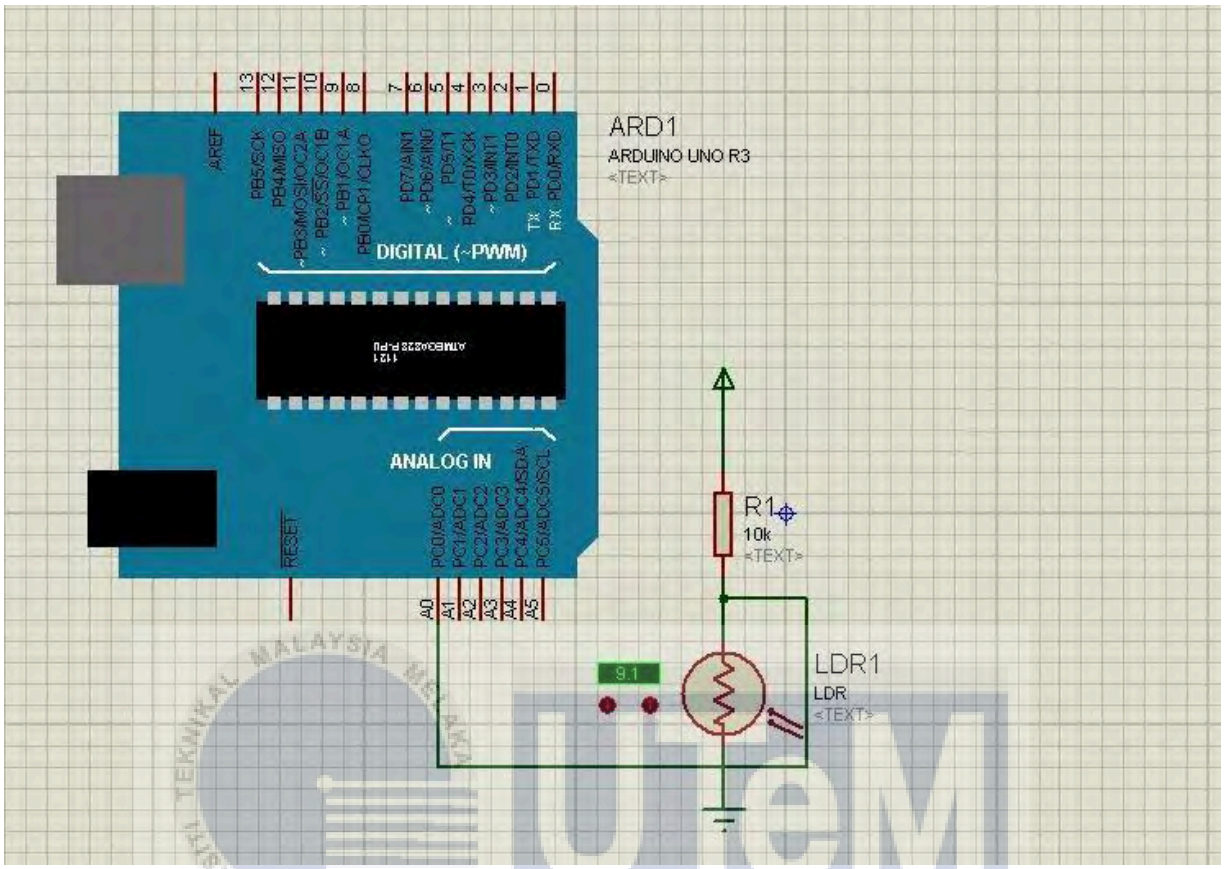
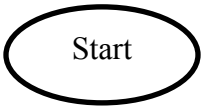


Figure 3.7The connection LDR with Arduino

3.6 SystemFlow chart

The flow chart shows the operation function for the first hardware part along with each function and options to be chosen by the user. The flow chart also shows what "messages" will appear in each step.



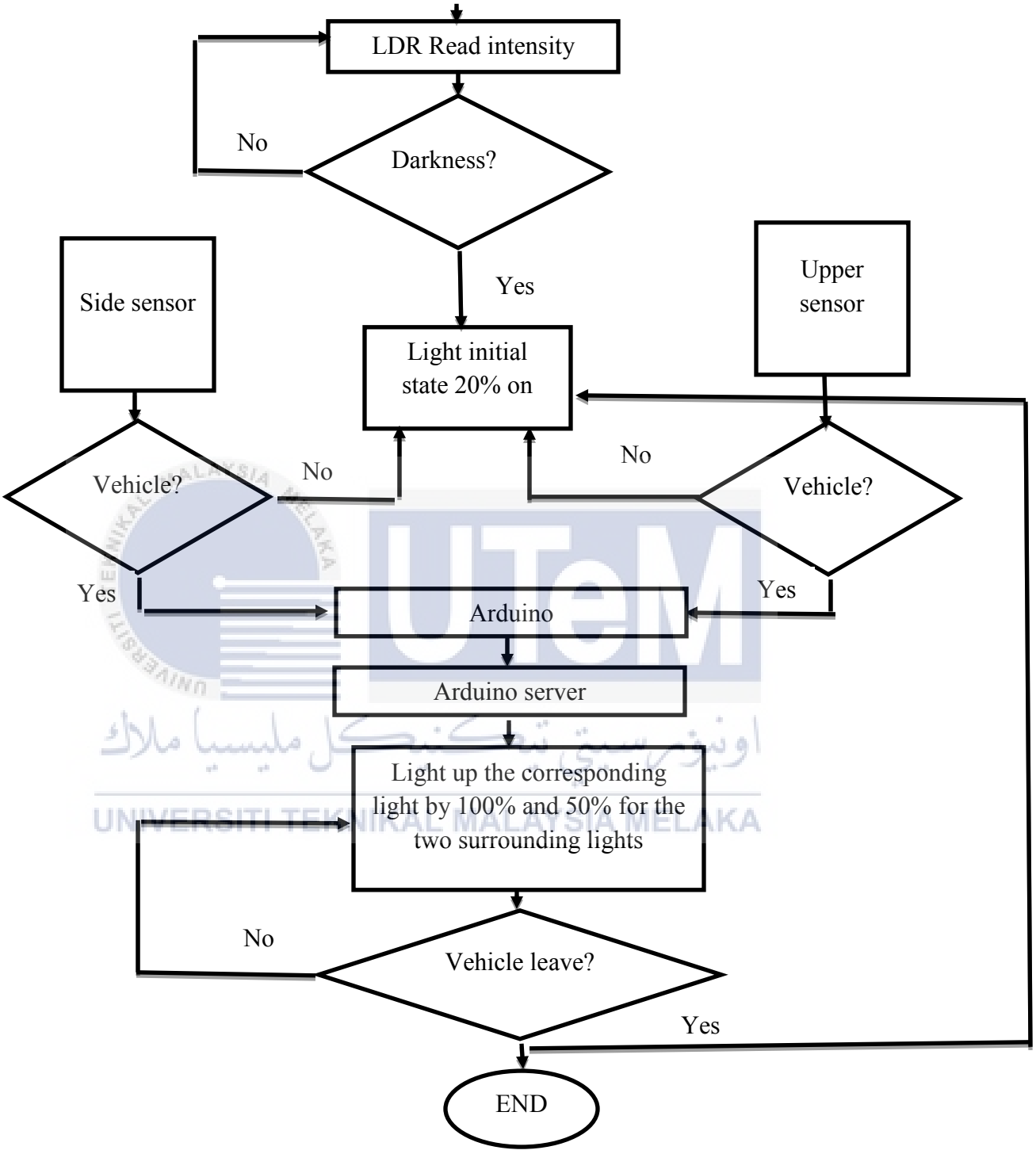


Figure 3.8 System flow chart

4. RESULTS & DISCUSSION

This chapter explains about the results achieved in the project and few discussions about problem solving during the process.

4.1 Project Description

Each night, a smart street lighting control system needs to illuminate at the perfect time and capacity consistently. A city's road lights give more secure activity conditions, more secure person on foot environment and can speak to an extraordinary change to the city's building, touristic and business yield. These advantages are not precisely shoddy however, with a normal of 40% of public in general spending plans' vitality bill being spent for road lighting alone. The expanding vitality cost, in addition to the noteworthy support costs and continually expanding desires showed by the general population put a consistent weight on the lighting spending plans.

4.2 Complete Design of the Hardware

The hardware built for this project, which is the smart lighting system. The next step after all the components assembled and working well is to furnish it with the boxes in order to keep the hardware safe, and easy to fix. Figure 4.1 shows the top view of the device. The working principle of the system is depicted in figure 4.1 a and b , the system contain main Arduino and Arduino server in which the sensors will read the presence of the vehicle and send the signal to their corresponding Arduino which will send signal to the Adruino server , hence , the Adruino will light up the corresponding light by 100% and one after and one before by 50%, while other light will stay as their initial state.

(a)

(b)

Figure 4.1Smart Street Lighting System (a) side view ,(b) upper view

In addition, Figure 4.2 shows, single light, which contain two sensors connected to it and single Arduino board, the two sensors detecting the presence of vehicle. When the any of the sensors detects a vehicle, the Arduino of that light will receive signal and send a signal to the main Arduino which will light up that light by 100% also two next light by 50%.

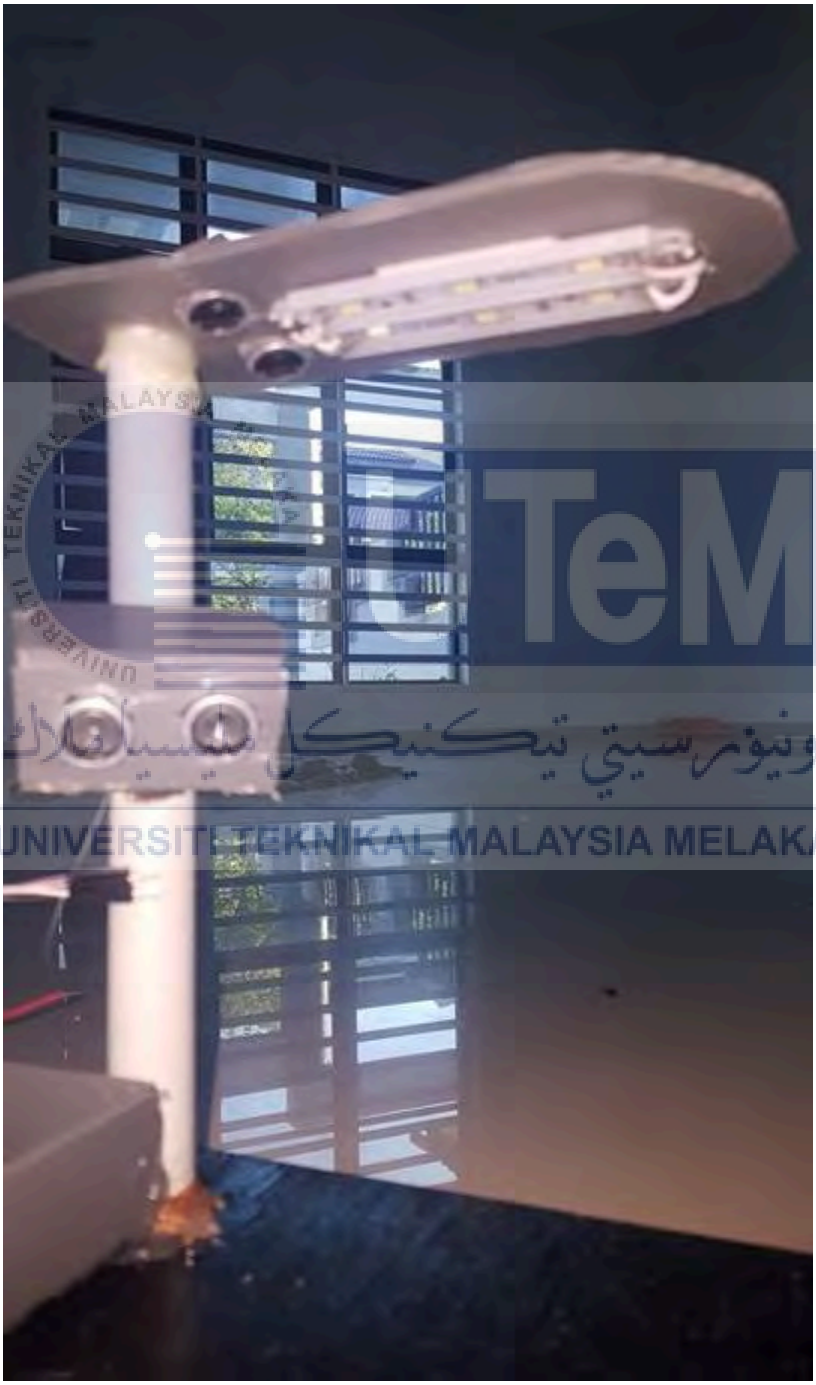


Figure 4.2 Single light Design.

4.3 System working principle

Figure 4.3 a , b , present the system working when the sensors detects a vehicle. As can be seen in Figures, when a vehicle placed in front of the light, the sensors attached to the light will automatically detects the presences of the vehicle and send signal to the Arduino which will light up the lamp by 100% and the surrounding two light by 50%. If the vehicle leaves, the light will automatically back to their initial state.

(a)

(b)

Figure 4.3 System working principle

CHAPTER 5

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In summary, smart lighting system is an intelligent street lighting system that provides remarkable features in terms of energy consumption saving as well as smart arrangement of the street lighting. The smart system utilize new and latest technology devices which are energy saving , as well as smart instruments such as sensors and microcontroller which automatically control the system and drive to the desired requirement .In addition ,the smart street lighting system comprises two phase of implementation .In the first phase a traditional street lighting system is designed and verified using Proteus software, also a smart street lighting system is designed utilizing sensors and microcontroller .to reduce the usage of the electricity an deduct the bulls for a green environment.

Recommendationand Future Work

Even though, this project as the results of comprehensive study on the previous studies with avoiding the drawbacks and striving to develop new modernized system. There still exist some future suggestions to implement as listed below:

- Low cost
- Saving the environment
- Monitoring the system easily
-

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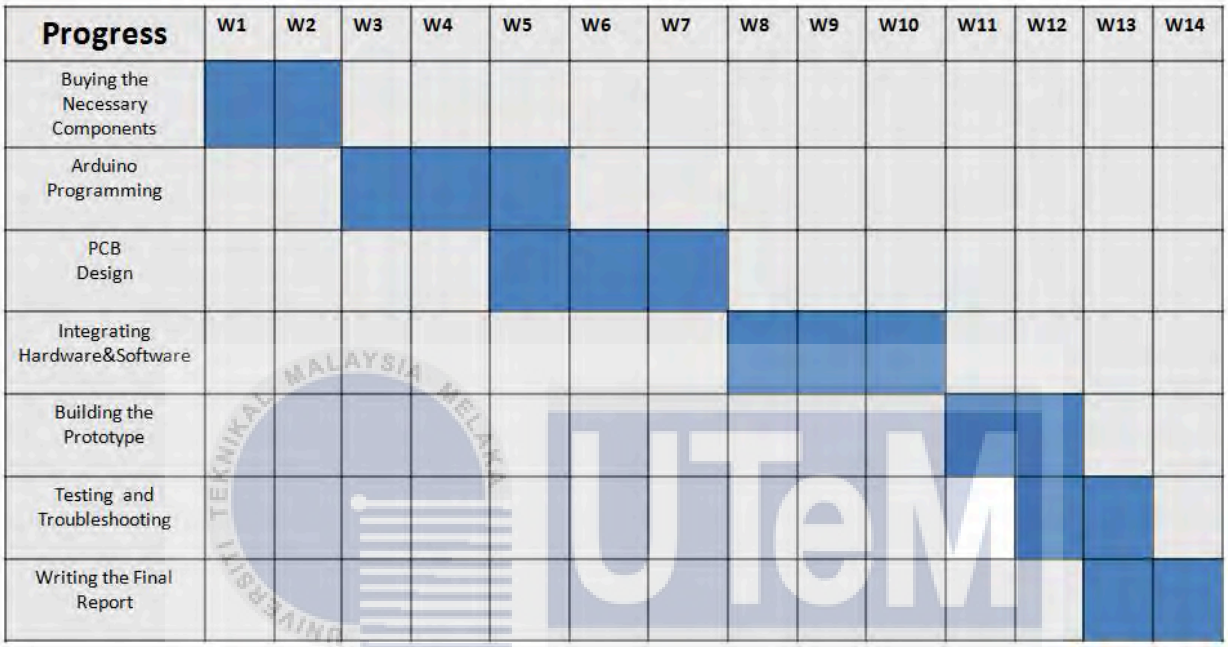
Appendices

Appendix A: Project Gantt chart



Appendix B: Codes of Communication

```
Wire.begin(8);  // Slave number 8
Wire.onReceive(receiveEvent);
Serial.begin(9600);


void receiveEvent(int howMany){
  String str = "";
  while (0<Wire.available()){
    char c = Wire.read();
    Serial.print(c);
    str = str+ c;
  }
  Serial.println();
  delay(100);
}
```

Code to get the range in centimeter:

```
long microsecondsToInches(long microseconds) {
  // According to Parallax's datasheet for the PING))), there are
  // 73.746 microseconds per inch (i.e. sound travels at 1130 feet per
  // second).  This gives the distance travelled by the ping, outbound
  // and return, so we divide by 2 to get the distance of the obstacle.
  // See: http://www.parallax.com/dl/docs/prod/acc/28015-PING-v1.3.pdf
  return microseconds / 74 / 2;
}

long microsecondsToCentimeters(long microseconds) {
  // The speed of sound is 340 m/s or 29 microseconds per centimeter.
  // The ping travels out and back, so to find the distance of the
  // object we take half of the distance travelled.
  return microseconds / 29 / 2;
}
```

Code of sensors

```
long duration, inches, cm;

  // The PING))) is triggered by a HIGH pulse of 2 or more microseconds.
  // Give a short LOW pulse beforehand to ensure a clean HIGH pulse:
  pinMode(echo1, OUTPUT);
  digitalWrite(echo1, LOW);
  delayMicroseconds(2);
  digitalWrite(echo1, HIGH);
  delayMicroseconds(5);
  digitalWrite(echo1, LOW);

  // The same pin is used to read the signal from the PING))): a HIGH
  // pulse whose duration is the time (in microseconds) from the sending
  // of the ping to the reception of its echo off of an object.
  pinMode(trig1, INPUT);
  duration = pulseIn(trig1, HIGH);

  // convert the time into a distance
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
```

Appendix C: Design circuit