Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF A SMART STREET LIGHTING SYSTEM WITH FAULT DETECTION USING IOT

ZAREEN ZURIKA BINTI NORIZAN

Bachelor of Electrical Engineering Technology with Honours

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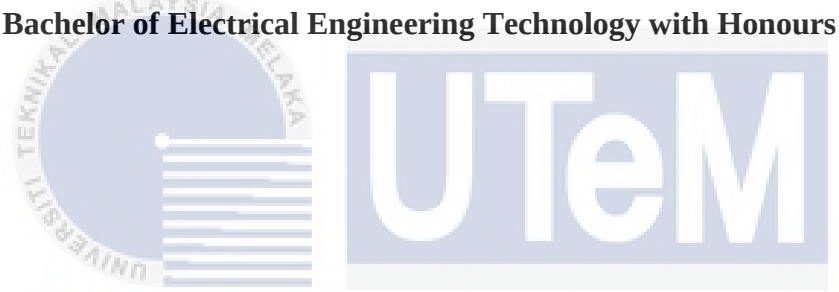
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology with Honours



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

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DEDICATION

My thesis is dedicated to my family and a friend. A special thank you to my loving parents, Encik Norizan bin Nasir and Puan Masrah binti Ismail, who supported me finish this project with their compassion and understanding.

This project is also dedicated to my friends, lecturers and supervisor who have been assisting and supporting me in completing this project on time.

ABSTRACT

Many factors contribute to the importance of proper street lighting, one of which is safety. When we think of safety, the first thing that comes to mind is accident prevention. In general, embedded intelligent controllers based on the Internet of Things (IoT) may be designed with fault detection to pinpoint which street lights are malfunctioning. By implementing fault detection in the street light, monitoring and the management of the street lights will become easier for the lighting technician as they can know when to do the preventative maintenance and also corrective maintenance. By doing preventative maintenance before the street light suffered more damage, the cost of the maintenance can be reduced greatly and the energy and current that flow through will not be wasted. As a result, this project examines a variety of concerns and challenges, as well as several unexpected case studies resulting from a faulty street light. Based on the researches done on this literature reviews from different researches in creating a smart street light with fault detection, most of the studies show almost similar way of construction. The way of construction differs only if the component used differs. These approaches and observations gave a lot of things to be considered while completing this project. The approach used for this project is based on the other research's observation and considered all other factors that can be done in creating a smart street lighting system with fault detection.

ABSTRAK

Banyak faktor menyumbang kepada pentingnya penerangan lampu jalan yang betul, salah satunya adalah keselamatan. Apabila memikirkan tentang keselamatan, perkara pertama yang terlintas dalam fikiran adalah pencegahan kemalangan. Secara umum, pengawal pintar tertanam berdasarkan 'Internet of Things (IoT)' mungkin dirancang dengan pengesanan kesalahan untuk menentukan lampu jalan mana yang tidak berfungsi. Dengan melaksanakan pengesanan kerosakkan di lampu jalan, pemantauan dan pengurusan lampu jalan akan menjadi lebih mudah bagi para peladang kerana mereka dapat mengetahui waktu untuk melakukan penyelenggaraan pencegahan dan juga penyelenggaraan pembetulan. Dengan melakukan penyelenggaraan pencegahan sebelum lampu jalan mengalami lebih banyak kerosakan, kos penyelenggaraan dapat dikurangkan dengan banyak dan tenaga dan arus yang mengalir tidak akan sia-sia. Hasilnya, projek ini meneliti pelbagai kebimbangan dan cabaran, serta beberapa kajian kes yang tidak dijangka akibat lampu jalan yang rosak. Berdasarkan kajian yang dilakukan terhadap tinjauan literatur ini dari kajian yang berbeza dalam membuat lampu jalan pintar dengan pengesanan kerosakkan, kebanyakan kajian menunjukkan cara pembinaan yang hampir serupa. Cara pembinaan akan berbeza jika komponen yang digunakan berbeza. Pendekatan dan pemerhatian ini memberi banyak perkara yang perlu dipertimbangkan semasa menyelesaikan projek ini. Pendekatan yang digunakan untuk projek ini berdasarkan pada pemerhatian penyelidikan lain dan mempertimbangkan semua faktor lain yang dapat dilakukan dalam membuat sistem lampu jalan pintar dengan pengesanan kerosakkan.

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δ	-	Voltage angle
F	-	Force
g	-	Gravity = 9.81m/s
l	-	length
m	-	mass
r	-	radius
x	-	displacement
T	-	torque

LIST OF ABBREVIATIONS

V	-	Voltage
IoT	-	Internet of Things
LDR	-	Light Dependenet Resistor
LED	-	Light Emitting Diode
I/O	-	Input Output
CPU	-	Central Processing Unit
IR	-	Infrared
SMS	-	Short Message Service

CHAPTER 1

INTRODUCTION

1.1 Background

Street lighting is the most crucial item for workers and farmers in excluded area to ensure their safety. Street light can also be used in a farm area as to lighten the place when the farmers want to check on their crops at night time. Street lighting can gives safety benefits and more vision for the farmers as well as increase the owner safety, particularly from robber and other thieves that can appeared in midnight. These lights have the potential to keep the farm lighted. Smart Street Light can also be used across the roads. These lights must be kept in good working order because they give the required visibility on the road when driving.

Fault detection can be used as an important technology that can detect if there is any broken street light or malfunction street light anytime. The fault in street light can be detected and controlled via the Internet of Things (IoT) innovation. It is quite an appropriate solution since it can immediately notify the owner if the streetlight breaks, including when the light has tripped the circuit breaker. This gadget can also save money by reducing the cost of testing light bulb fuses on a regular basis improved lighting, as Painter, K. (1996) pointed out, is a premium way of generating a significant impact on public safety, improving the built environment, and quality of life for people on the streets after dark [1].

When there is any malfunction street light due to burnt bulb or short circuit that makes the street light to not glowing up at night, this type of technology that can detect which street lights that have fault and did not turn on accordingly will be the greatest help

to the local authorities and the technician to do the maintenance works. The lighting technician can save a lot of time by knowing exactly the location of the fault street light coming from. They can also save their energy by checking all the street lights to see if they all function correctly. This type of technology can make the lighting technician works in more a relax situation and can work more efficiently rather than going all over the streets to conduct the maintenance when there is no need to because the street lights are working just fine.

Some of the street light in Malaysia used the timer for streetlights under the council's authority is set between 7pm/7.30pm and 7am/7.30am, according to MPSJ councillor Ken Chia, who chairs the council's infrastructure committee [2]. However, because the street light uses a timer to switch on and off, the street light is switched off automatically even if the environment is still dark at 7.30 a.m. at various periods of the year. As a result, while the streets are dark, it is difficult for vehicles, cyclists, and pedestrians to access the streets early in the morning.

Malaysia's present street lighting system has been found to be inefficient and in need of constant repair. The various street lighting systems are controlled by a light sensoror timed switch that turns on the lights at night or low light intensity during the day and turns them off during the day; therefore, by implementing and utilizing the technology of the IoT-based smart street lighting system with fault detection, energy consumed for the street lighting system can be reduced and energy will not be wasted.

1.2 Problem Statement

Currently, farmers nowadays have each have their own farm whether their farm located nearby their houses or located far away from they lived. So the farmers tend to install some street lights at their farm to have a vision when they went to visit their farm at night time. Street lights help the farmer to see their farm and to avoid thieves from insert their farm. Farmers will be much more aware as to the street light will help the farmer to notice if there is any suspicious looking stranger going to their farm at night time. The farmers will become more secured knowing that their farms are installed with street light especially those who need to visit their farm all alone in the night time frequently. Next, when there is any fault street light, bad things can happen to the farmers. The fault street light can make it harder for the farmers as to walk across those farm will not be able to see anything because it will be pitch black during the night and some incident can happen during that time.

Nevertheless, Nevertheless, the normal street light is expensive and the maintenance cost is high to test the light bulb fuse occasionally from time to time and the way to check every street light is quite inefficient. Smart streetlights that use information and communication technologies (ICT) such as the Internet of Things (IoT) can help the farm become more energy efficient. Energy will also be wasted when the current is still flowing through the street light, but the light is still not glowing. This will cause the government will still have to pay for the street light electricity so it will be inefficient for the all parties.

When the object is detected using the sensor and the lights are not turned ON consequent naturally, this is perceived as a fault has happened. Also, the message is sent as a caution and to alert the farmers. The notification massage will be sent by utilizing the Internet of Things (IoT) innovation. Consequently this system is intended to lessen the force utilization to recognize and address the flaw in the system.

1.3 Project Objective

The objective of this paper is to design and develop a smart street lighting system that can identify faults using the Internet of Things. At the end of this project, the objectives that are going to be achieved are as follow:

a) To design and develop an IoT-based simple smart street lighting system with fault detection.

b) To test the system functionality that can alert the farmers on broken lamps.

c) To analyse time taken for the message of warning about faulty street light to be delivered to the farmers.

1.4 Scope of Project

The project briefly described the boundaries of this project which focused on micro controller programming with Arduino Uno, circuit design and the purpose of developing the hardware. The details of the scopes of the project are explained in the following:

a) The circuit is design using Proteus to support the smart street lighting system using Arduino UNO micro controller as servers and to connect to the hardware. The platform used to configure the Arduino UNO micro controller to allow communication is Arduino IDE software.

b) The system functionality that can alert farmers and lighting technician on broken lamps willbe tested by looking if the message has been sent when the fault is detected.

c) Analyze the time taken for the message to be delivered to the farmers or lighting technician on duty by using a stopwatch when the message about gfaulty street light received and to check if the project is successful.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In today's modern society, Smart lighting systems make use of technology that helps to reduce power consumption while also conserving energy. The Light Dependent Resistor (LDR) detects light at first, and the resistance of the LDR varies depending on the brightness. During the night, the lights usually have a low intensity. An infrared sensor is used to detect any object that passes close to the sensor's operating area.

However, for this project with an upgraded smart street light system using fault detection was to innovate the embedded system with the addition of fault detection by sending messages to inform the farmers and send the alarming notification through the mobile phone telling that there has been a fault that happened to one of the smart street lights. This project utilizing GSM module to detect the faulty street light that can happen at anywhere and anytime. This procedure is carried out via the Internet of Things (IoT), which is connected to the Arduino UNO micro controller, which serves as the project's main server. The message will be sent via mobile application so the farmers will know when there is any fault happened and can go directly to the scene to do the maintenance of the faulty street light and the problem will be solved.

Other than that, these type of Smart Street light can also be implemented across the roads. According to MPSJ councilor Ken Chia, who leads the council's infrastructure committee, certain lamps in Malaysia utilize a timer for lighting under the council's jurisdiction that is set between 7pm/7.30pm and 7am/7.30am [2]. Unfortunately, because the

street light uses a timer to switch on and off, the street light will switch off automatically even if the environment is still dark at 7.30 a.m. at various periods of the year. As a result, while the streets are dark, it is unsafe for vehicles, cyclists, and pedestrians to cross the streets early in the morning. So by utilizing the LDR sensor, which can detect the presence of the light, the timer will not be needed and it can conserve lighting energy by glowing at the minimum intensity when the infrared sensor did not detect any motion around the street lights.

From TNB's Environmental Initiatives - Green Development, the UNITEN Putrajaya Campus has a Smart Street Light Showcase Project, which is a street lighting system with communications networks that able to perform tasks like as brightness control, monitoring, and digital street signs. Malaysia is one of the countries that has implemented an IoT-based smart street light system

2.2 Faulty Street Light

The faulty street light can happen at any time and there are many factors that can cause the street light to be broken. One of the factors that can cause the street light to be broken is the bad quality of light components such as burnt light bulb, damaged time-switch and other components in the street light. If the light bulbs burn out too often, the issue may fall under high wattage, insulation is near to light, poor wiring on the circuit and mains or more wattage on a dimmer switch [3]. According to the Tenaga Nasional Berhad portal, other than the bad quality of the light, the bad weather also can affect the good condition street light such as when there is a thunderstorm or heavy rain the possibility of the tree to fall and hit the street light is high [4]. This is because usually trees are planted closely to the street light so when the thunder struck the tree, it will cause the tree to fall and hit the nearby

street light. The third party also can cause a problem for street light. The examples of the third party are like damaged poles due to road accidents, damaged underground cable, etc.

So the faulty street light can happen at any time and anywhere. When the street light is not glowing, but the current is still flowing through the street lights, the energy will be wasted and it will be inefficient as the lighting technician will not know the exact location of the street light without the fault detection. By utilizing the fault detection in the street light, the lighting technician will have no difficulties to do the maintenance whenever there are any street light malfunctions.

2.2.1 Report on Faulty Street Light

In any local area, the faulty street light needs to be reported by calling the local authorized by email. The report's email address was supplied on the company's online page. Some online websites have provide a form to make the reports by the residents. The residents need to fill all the required question and provide some details of the problem street light such as the lights does not turn on, the lights does not off and other issues that related to the street light. By providing the problems, lighting technicians can do the maintenance accordingly to the report.

2.2.1.1 Common Problems with LED Lights

The term "light emitting diode" refers to a device that emits light. In comparison to incandescent light bulbs, LED lighting products produce light up to 90% more effectively. Because of its sturdy casing/housing, small components, inability to heat-up, and low energy usage, an LED light is meant to be stronger and endure longer than typical fixtures.

Among the most significant issues with modern lighting systems is purchasing and utilizing the incorrect LED bulbs. For most circumstances, low-cost LED bulbs aren't as

dependable as other lighting options. Ultimately, these components become faulty in a short period of time, exhibiting difficulties such as flickering, unusual heating, spontaneous dimming and even premature failure.

A lot of the problems LED light fixtures usually exhibit are as a result of poor installation. A faulty lighting system connection might cause plenty of issues such as short-circuits can be caused by loose or exposed cables, poor light distribution, breakdowns on a regular basis, and so forth.

2.3 Case Studied of Street Lighting

2.3.1 Case studies

Kee, K. K., Lau, S., & Affandi, M. H. [5] stated that the street lighting systems in Malaysia must follow the regulations and rules that have been set up by the Public Works Department that according to the Malaysian standard in 2020. It is also include the specification for the street lighting brightness. According to the MS852 Part I, the street light is not allowed to turn OFF in any situation, even in low condition. From the studies, it stated that by using the LED, the potential energy saving can go up to 48% compared to the conventional street lighting system. Pubic lighting, on the other hand, has been proven in tests to reduce crime by up to 20% and traffic accidents by up to 35%. When compared to more energy-efficient systems utilized in developed nations, many existing street lighting systems in Malaysia have comparatively high energy consumption and power costs. To automate the switching procedures, the system still use an ON/OFF switch, a timer, or a light-activation sensor.