Faculty of Electrical and Electronic Engineering Technology

THE DEVELOPMENT OF IOT BASED SMART SOLAR STREETLIGHT WITH FAILURE DETECTION

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Bachelor of Electrical Engineering Technology with Honours

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THE DEVELOPMENT OF IOT BASED SMART SOLAR STREETLIGHT WITH FAILURE DETECTION

UGEN RAJ A/L MOHANA RAJAH

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

Faculty of Electrical and Electronic Engineering Technology

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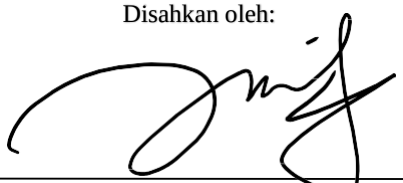

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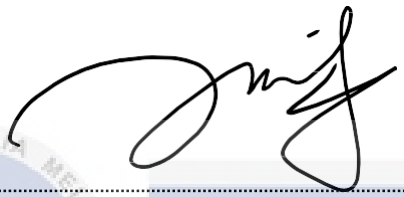
Signature : 

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DEDICATION

To my beloved mother Venkadeswari Letchimanan

and

To My dearest Siblings and My friends

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ABSTRACT

The main objective of this project is to give a better streetlight system which is included with a new technology of sensor and light. The proposed design is based on Arduino, and it is supported with the ESP8266 microcontroller which is a Wi-Fi enable system on chip (SoC) that support speed up to 2.4 GHz. With this, the technology of IoT (Internet of things) has been included to detect a failure to the current or light and send the messages to the app called Blynk with using Wi-Fi module which is include in the microcontroller. Other than that, this project also included with a light sensor (LDR) to sense the presence of light in 2 different condition (daytime/nighttime) and turn on the light automatically according to the reading of the LDR value. Moreover, this project also has included with a solar panel and rechargeable battery that make the streetlight to be operate fully using the DC current which may save the cost of electricity because DC is not expensive as AC, and it can be recycled many times using the technology of solar charging. Finally, a motion detection sensor (PIR sensor) has been added in this project to save the battery energy consumption by controlling the intensity of the light. Where the initial condition of the light when turned on is dim but when a vehicle is detected by the PIR Sensor than the led will glow in full brightness. Then after few seconds the led will back to initial condition after the PIR sensor detected there were no any movement of vehicle in the range of given time.

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ABSTRAK

Objektif utama projek ini adalah untuk memberikan sistem lampu jalan yang lebih baik yang disertakan dengan teknologi penderia dan cahaya baharu. Reka bentuk yang dicadangkan adalah berdasarkan Arduino, dan ia disokong dengan mikropengawal ESP8266 yang merupakan sistem pada cip (SoC) membolehkan Wi-Fi yang menyokong kelajuan sehingga 2.4 GHz. Dengan ini, teknologi IoT (Internet of things) telah disertakan untuk mengesan kegagalan arus atau cahaya dan menghantar mesej ke aplikasi yang dipanggil Blynk dengan menggunakan modul Wi-Fi yang disertakan dalam mikropengawal. Selain itu, projek ini turut disertakan dengan sensor cahaya (LDR) untuk mengesan kehadiran cahaya dalam 2 keadaan berbeza (siang/malam) dan menghidupkan lampu secara automatik mengikut bacaan nilai LDR. Selain itu, projek ini juga telah disertakan dengan panel solar dan bateri boleh dicas semula yang menjadikan lampu jalan beroperasi sepenuhnya menggunakan arus DC yang mungkin menjimatkan kos elektrik kerana DC tidak mahal seperti AC, dan ia boleh dikitar semula berkali-kali menggunakan teknologi pengecasan solar. Akhir sekali, penderia pengesanan gerakan (sensor PIR) telah ditambah dalam projek ini untuk menjimatkan penggunaan tenaga bateri dengan mengawal keamatan cahaya. Di mana keadaan awal lampu apabila dihidupkan adalah malap tetapi apabila kenderaan dikesan oleh PIR Sensor maka led akan menyala dalam kecerahan penuh. Kemudian selepas beberapa saat, led akan kembali ke keadaan asal selepas sensor PIR mengesan tiada sebarang pergerakan kenderaan dalam julat masa tertentu.

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LIST OF SYMBOLS

δ	-	Voltage angle
	-	
	-	
	-	
	-	
	-	
	-	
	-	

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LIST OF ABBREVIATIONS

LDR Sensor	-	Light Dependent Resistor
PIR Sensor	-	Passive Infared Sensor
IoT	-	Internet On Things

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CHAPTER 1

INTRODUCTION

1.1 Background

A streetlight is very important to us when we are driving on the road moreover when we are driving at the night-time. This because on that time the road will be dark and if the streetlight is not operating that will be a challenging ride for the driver to drive in that road because it is not that easy in that situation with using the light only from the vehicle to observe an obstacle in the road. So, we need a streetlight which is designed well that allow users to travel with good visibility in the sense of safety and comfort, especially on the night-time. On the other hand, poorly designed existing lighting systems can lead to poor visibility which may not be helpful for any footer and the people that passing by that street. So that the user of the street or highway recommend for more streetlight and highly quality build streetlight for their driving experience to avoid any accident.

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In our country the largest energy expenses is the street light system. This because many places in Malaysia still equipping timer on the streetlight. So, when this system is used in many places, there will be an energy wastage happens and the cost spent on the electrical energy also will be high. So, to overcome this problem we must reduce the energy consumption of an AC electrical energy and try to use renewable energy to save the expanses and the environment. This because when using the renewable energy there will be no any greenhouse effect and it is very cheap and can be recycled for many times. Other than that, when a streetlight is stop operating in term of current failure the issue cannot be detected by

the old system, and this make the user of the road hard to drive in the highways that have less visibility

So, an invention has done to gives the solution to those overall problems of a streetlight. And the title given for this invention is Development of IoT Based Smart Solar Streetlight with Failure Detection. This project is based on Arduino and to support the IoT technology that include in this project a Wi-Fi enable system on chip microcontroller have been used and that is ESP8266 microcontroller. Moreover, this project also using renewable energy where the source of energy fully from the solar system and in this project a rechargeable battery will be used at the night-time as a source of electrical with the help of solar charging technology. And to control the energy consumption from the battery a smart system with using LDR and PIR sensor (motion sensor) have been used to control the automatic on-off light and brightness system. The LDR (Light Dependent Resistor) will detect the weather condition and identify the environment of a highway weather it is bright or dark. And when the LDR detects the environment is dark it will automatically on the streetlight and when the environment still bright it keeps the lights off. Then the uses of PIR sensor is to capture the motion of vehicle and control the brightness of the light to save the energy where initially the light will be in dim condition which have around 30-40 percent of brightness and when there was vehicle detected the light will glow up with full brightness and will be dim again after a few seconds when there was no any vehicle detected. Moreover, this project also included a failure detection system with the help of monitoring app which is called as Blynk app. With this application we can detect the current reading, the condition of light whether its bright or Dim and also the message whether its day or night. And when a faulty is detected in current or the light we can easily fix it before any unwanted incidents happens.

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1.2 Problem Statement

Power As we know, all the places in Malaysia still equipping timer system for the streetlight whether it is the cities or highway. From this we can understand that these streetlights will be turned on at the night and will be turned off in the morning. Hence from this there will be a lot of energy wastage between these ON and OFF. This because at nighttime around 12 or 1 am there will be less car passing through this streetlight and there also have chances of zero vehicle passing throughout that night on that highway or cities.

Furthermore, using AC voltage for the streetlight to operate is also a problem when a wastage of energy happens. This because the cost spent on the electrical energy will be huge when all the streetlights use sodium vapor lamp that consume more power to operate. And the last problem is when a streetlight stops working in term of any error. From this the user will have poor visibility in their driving experience and this also may lead to an accident because the highway or cities will be totally dark in situation.

And to overcome this problem an invention had done and given a title of smart solar streetlight with failure detection. In this invention there were no more using AC electrical supply while it will be using renewable energy with the help of solar system and to overcome the high electrical energy usage the sodium vapor lamp will be replaced with the LED lamp. Other than that, this invention also equipping an automatic on/off light system that could turn on/off the light automatically regarding to the environment. Other than that, this invention also included with a system that can control the brightness with using the motion sensor to save the energy usage. Finally, this system also can sense the failure in current and light and show the condition in the IoT app called as Blynk app. With this invention the expenses on maintaining a streetlight and the cost on electricity can reduced. With this government also can use these saved money in other development for our country.

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1.3 Project Objective

The main aim of this project is :

a) To develop a smart street light which can regulate the energy consumption by using Motion and LDR Sensors.

b) To develop an affordable smart street light prototype based on Arduino UNO.

c) To develop monitoring system based on light intensity and current reading by using Blynk apps via ESP 8266 Microcontroller.

1.4 Scope of Project

The scope of this Smart Solar Streetlight project as the following:

a) As LDR sensor is not capable of detecting light under a shading area therefore this project is suitable to use at open space area.

b) The information is collected using internet-based data management system that provides users with information on the current reading and functionality of LED

c) This project is powered by solar energy to recharge the the battery backup which acts as supply to the system

- This project focuses on rural area streets which are recorded to have less car or human presence.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In In this chapter, the researcher will survey all the previous project work that related to their project and express, evaluate and clarify on objective of the project, problem issue of the project and the innovation that have done towards the project. Other than that, there also will be a content of researcher own project such as History of their innovation projects, and technology included in their project. The reason on making this literature review is to give the researcher a clear theoretical base understanding on how the project works with using the technology which is designed in the previous project. With this they will get more ideas on how they should design their own project which is more innovative and creative.

And the search database that can be used to prepare the literature review are as follow, which is web search, Goggle Scholar, Research Gate, Science Direct and so on. There might be different source used but the research paper or any information that used in the research should related to their project and not out from the topic. Because of that there have several steps need to consider by the researcher before starting the process of making the literature review.

Firstly, the researcher should search for the relevant issue which might help to solve their problem statement and the question in them on how to design their project. Then they should evaluate the research paper to get the relevant source that might help them to get all the answer for their question and problems. Then the third step is they should understand the similarities between their research and own project and adjust if there might be any weakness

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in their own project. Finally, they should write the introduction, important points and conclusion based on their understanding based on the research paper.

2.2 Background

Without any doubt streetlight is very important for the user of highway, this because it offer safety and comfort for the driver to ride their vehicle at the nighttime. When we look back at the history the first weapon against darkness is an oil lamp which is used for all street and houses [1]. And after some years when there has an issue with using oil lamp there have innovated a new technology which is gas fired lamp. From there they have changed the old lamp with the gas fired lamp on all their street and roads.

Again, after some years which is on 20th century when the technology is getting improved, they have noticed the issue with the gas fired lamp and finally they have decided to change all the streetlamp completely with the electric lightbulbs which is safer, brighter, and light efficient on that time. Same as that again we have some issue related to the streetlight on this 21st century where some streetlights stop operating which shows that have poor maintenance, the automated system is not so satisfying, the energy consumption of each of the streetlight is getting higher days to days, and finally the brightness of lamp is quite dark and not too bright [1].

Therefore, a project is innovated to help the user to feel more comfort and safer in terms of safety when driving on the highways. This system also will make the country to save their expanses from the maintenance, energy consumption and other more problems.

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2.3 Internet of Things (IoT)

The Internet of Things (IoT) refers to a technology that allow various appliance, device, and things to exchange data or collecting data by using internet connection. It has an ability to transfer a data without requiring human to human or human to computer interaction. An ecosystem of an IoT will be consist of web enable smart device that use embedded system such as sensor, processor, and hardware to collect information from the environment. In this 21st century IoT become the most important technology in all country around the world. This because the cost of sensor is low, the connectivity is simple and easy, have more availability of cloud services platform, and it has conversational AI technology which make human easy to collect data and process a data.

With that the internet of things (IoT) can minimize the human effort and save every minute of the day by performing a lot of tasks for us. This because this device can complete most of the work without human intervention.

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Figure 2.1 The usage of IoT [2].