Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SOLAR STREET LIGHT INTENSITY CONTROLLER AND POWER USAGE MANAGEMENT MONITORING USING IOT

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Bachelor of Electronics Engineering Technology with Honours

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DEVELOPMENT OF SOLAR STREET LIGHT INTENSITY CONTROLLER AND POWER USAGE MANAGEMENT MONITORING USING IOT

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

To my beloved parents Mr.Khalidas & Mrs.Jayanthy

and

my brother Nivindas

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ABSTRACT

Green technology and intelligent cities are becoming part of the global future agenda. Street light is one of the main utilities in the smart city. A recent post from the Edge Marketing Site has said that the start-up has begun with experiments on intelligent street-light controllers, embedded in NB-IoT to improve street lighting in highways and cities and the development of intelligent cities in Malaysia. The purpose of solar street light with intensity controller and power usage monitor using IoT is to build smart cities with control intensity of LED street light mainly at late night to reduce power consumption. Plus, to develop a sustainable green and smart technology which present in a reasonable investment cost. In additional, to minimize maintenance cost for street light as much lower than existing system and for design an effective street light system which help TNB workers to monitor usage of LED street light by referring data especially at night. This project used solar panel which control by charger controller circuit to charge rechargeable battery. Thus, the supply from battery the LDR will control the intensity of the LED according to external weather. Thus, the current sensor will measure current and power that consume by LED. With reference of ESP8266 WiFi module the data of electrical parameters will send to Blynk Application for monitor power usage. Through this application, it given warning sign if it reaching zero current flowing by LED. This project is about reduce power consumption and minimize maintenance cost as much lower than existing system in Malaysia's current street lightning system on how to effectively operation of light system.

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ABSTRAK

Teknologi hijau dan bandar pintar menjadi sebahagian daripada agenda global untuk masa depan yang lebih baik. Lampu jalan adalah salah satu kemudahan bandar pintar yang penting. Baru-baru ini sebuah artikel dari laman pemasaran Edge Market menerbitkan artikel yang menyatakan bahawa permulaan dimulakan dengan bereksperimen dengan pengawal lampu jalan pintar, yang disertakan dengan jalur sempit IoT (NB-IoT) untuk merancang lampu jalan di lebuh raya di Malaysia. Tujuan lampu jalan suria dengan pengawal intensiti dan monitor penggunaan kuasa menggunakan IoT adalah untuk membina bandar pintar dengan intensiti kawalan lampu jalan LED terutamanya pada larut malam untuk mengurangkan penggunaan tenaga. Selain itu, untuk mengembangkan teknologi hijau dan pintar yang lestari yang hadir dalam kos pelaburan yang berpatutan. Sebagai tambahan, untuk meminimumkan kos penyelenggaraan lampu jalan jauh lebih rendah daripada sistem yang ada dan untuk merancang sistem lampu jalan yang berkesan yang membantu pekerja TNB untuk memantau penggunaan lampu jalan LED dengan merujuk data terutama pada waktu malam. Projek ini menggunakan panel solar yang dikendalikan oleh litar pengawal pengecas untuk mengecas bateri yang boleh dicas semula. Oleh itu, bekalan dari bateri LDR akan mengawal intensiti LED mengikut cuaca luaran. Oleh itu, sensor semasa akan mengukur arus dan kuasa yang menggunakan LED. Dengan merujuk modul WiFi ESP8266, data parameter elektrik akan dihantar ke Aplikasi Blynk untuk monitor penggunaan kuasa. Melalui aplikasi ini, ia akan memberi tanda amaran jika mencapai arus sifar yang mengalir oleh LED. Projek ini adalah untuk mengurangkan penggunaan tenaga dan meminimumkan kos penyelenggaraan jauh lebih rendah daripada sistem yang ada dalam sistem kilat jalanan Malaysia mengenai cara operasi sistem cahaya dengan berkesan.

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LIST OF ABBREVIATIONS

V	-	Voltage
kWh	-	Kilowatt/per hour
IoT	-	Internet of Things
A	-	Ampere
W	-	Watt
LED	-	Light Emitting Diode
PIR	-	Passive Infrared
IR	-	Infrared
WSN	-	Wireless Sensor Network
DC	-	Direct Current
AC	-	Alternative Current
SMS	-	Short Messaging Services
GSM	-	Global system for mobile communication

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This Chapter 1 consist motivation behind in this project, which described background, problem statement, objective and elaborate to ensure that the project is recognized. Plus, there will be explanation the scope of work of the project. Lastly, conclusion section included as a summary for this Chapter 1.

1.2 Background

Smart cities and green energy are now becoming part of the larger agenda for a better future. Among the most essential smart city features is street lighting. They provide illumination in the dark, particularly at night, to ensure the safety of the driver and to keep the city's aesthetic. At about the same time, studies suggest that proper street illumination might help reduce accidents. The crime rate is 20%, while the unemployment rate is 35%.

Another initiative to reduce energy consumption and electricity bills in Peninsular Malaysia is the LED street light project, which includes the replacement of 150 high-pressure sodium (HPSV) lamps, while the wattage of a 90-watt LED light. In 2019, more than 60% of HPSV lamps were replaced (Malaysia, 2019). By setting an example, the government hopes to encourage businesses and households to follow suit. The event aims to halve the energy consumption and utility bills of local authorities responsible for street lighting.

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After the Malaysian government took action to replace high-pressure sodium vapor lamps (HPSV) with high-efficiency light-emitting diodes (LEDs), the existing street lights in Peninsular Malaysia have recently started to become brighter. Street lighting on highways and public roads. Tenaga Nasional Bhd plans to complete the replacement of LED street lights on the peninsula by December 2020. Consumes 150 watts, while LED lights consume 90 watts (Malaysia, 2019). However, this LED lamp shows that it only reduces the number of street lamp failures by an average of 15%, and consumes up to 53% of the electricity consumption, which is a private target of 35-45% of the city's municipal budget.

LED street lighting: 60% done

Between early 2018 and mid-June 2019, Tenaga Nasional Bhd had replaced almost 60% of public street lights in Peninsular Malaysia with 90 watt Light Emitting Diode (LED) bulbs. Previously, they were using 150 watt High Pressure Sodium Vapour (HPSV) bulbs. With this, 212, 639 units of the 367,000 street lights under local authorities in Peninsular Malaysia are energy efficient. This replacement exercise is an Incentive-Based Regulation initiative to reduce energy consumption in the country.

LED bulbs also reduce street lighting failure from an average 15% with HPSV bulbs to less than 1%. It also results in savings of 30-40% in electricity charges. In addition, it emits less heat, is more durable and stable and has no mercury that is harmful to the environment.

The remaining street lights in the Peninsular will be replaced from December 2020.

Source: Bernama, 21 June 2019

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Figure 1. 1 Implement of LED street lightning done in Malaysia (Malaysia, 2019)

According to the International Energy Agency, by 2030, the total demand for street lighting will be 80% higher than in 2005, and it is estimated that by 2050, 5 billion people (60% of the world's population) will live in cities (MAKUMBE, 2017). Compared with cities, energy consumption will increase significantly and put a greater burden on public budgets. In the first step, the government is relying on solar energy. By 2025, solar energy will be produced on a large scale to save energy.

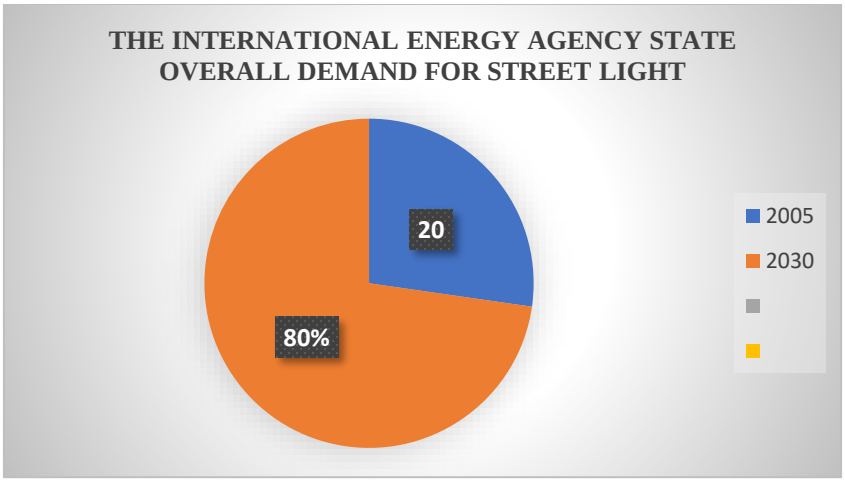

Figure 1.2 The International Energy Agency Stated that by the overall demand for street lighting (MAKUMBE, 2017)

In April 2019, Malaysian Housing and Local Government Minister Zuraida Kamaruddin announced that all roads across the country will be illuminated with LED lights to save up to 50% of energy (Malaysia, 2019). According to him, the plan to introduce LED street lights will be gradually implemented starting in September. About 80% of street lights now Malaysia uses lighting forms other than LED lamps.

It is well known that LED lamps are more energy-efficient and environmentally friendly than incandescent lamps. Through this measure, we can save about 50% of operating energy costs. "She added that the ministry will also work hard to convert illuminated signs in stores and buildings to LEDs. The lighting is too. "This measure will save more energy and create a better and more attractive urban landscape for people. We will first pilot it in my Ampang constituency (Malaysia, 2019).

The refurbishment of LED street lights should be completed by 2020, and the government will spend RM 623 million. 367,000 high-pressure sodium vapor lamps (150 W)

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will be replaced by 90 W LED lights. As of the end of August, 238,101 lamps (64%) had been replaced, mainly in cities (Malaysia, 2019)

At the same time, the Penang state government announced in July 2019 that the island plans to become the first state in the country to use energy-saving LED lighting on all public and private roads. There are 105,813 street lights in Penang, of which 31,596 are operated by the two municipalities and the remaining 74,217 are operated by the National Energy Corporation.

Due to its energy efficiency and economic benefits, the world is turning to LED street lighting. Studies have shown that they cut carbon dioxide emissions and energy costs by half. In the UK, only about 50% of local authorities significantly switched to this energy-saving technology in February 2019. Forecast based on the report About 90% of street lights in the United States use LED lights in another ten years.

The delay was due to the initial investment in the installation of LED lighting. Although the cost of equipment has dropped significantly, some local governments have no budget or funds. However, the World Bank strongly recommends the use of LED street lights. His publication "Sustainable Energy for All" stated that in the long run, this will help reduce the financial burden on the city government. It accounts for a large part of the city's energy consumption and puts an increasing burden on the municipal budget, especially in the context of rapid urbanization. It is estimated that by 2030, Malaysia will experience rapid population growth and urbanization, which will lead to a significant increase in energy consumption.

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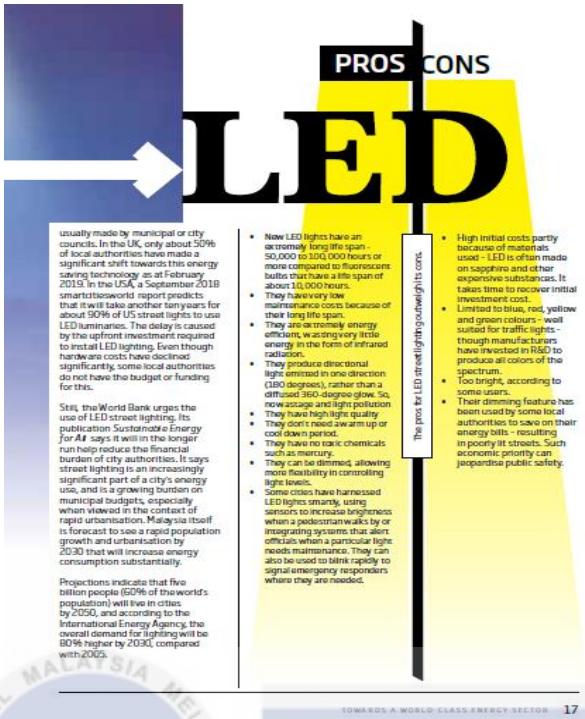

Figure 1.3 Development of LED streetlight (Malaysia, 2019)

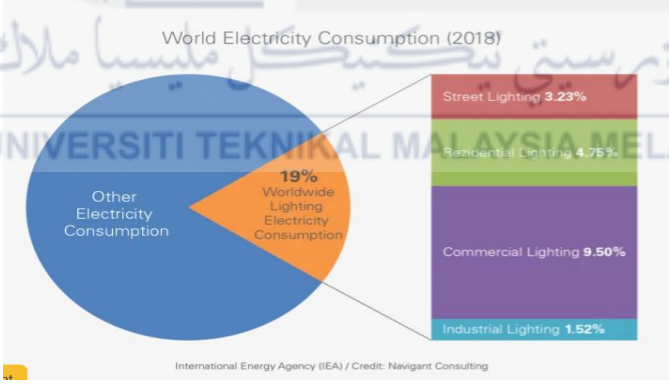

Figure 1.4 World Electricity Consumption in 2018 (Anon., 2020)

Since 2018, the focus of government policy has been to achieve a fuel balance of 20% renewable energy by 2025.Other renewable energy sources include hydropower, wind power, biomass energy and biogas. After 2050, Malaysia will continue to rely on coal and natural gas for power generation, and renewable energy sources may play a greater role in this combination.

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Figure 1.5 Development of renewable energy by 2025 in Malaysia (Malaysia, 2019)

Recently an article from Edge Market marketing site published that the start-up began by experimenting with smart street light controllers, embedded with narrowband IoT (NB-IoT) to design street light in highways and cities as well in developing smart cities are the next area of focus (Eynez Syazmeena, 2021).

Smart cities are the next priority, especially in Southeast Asia, which will become the fourth largest economy in the world by 2050. "[When we moved here from the United States, we valued smart cities very much. The United States]," said Faisal Ali, CEO and founder of Vectolas. The startup started experimenting with smart street lighting control built into the Narrowband Internet of Things NB-IoT, a low-power wide area network LPWAN technology for street and city lighting. And densely populated areas such as universities and industrial parks (Eynez Syazmeena, 2021).

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