Faculty of Electrical and Electronic Engineering Technology

THE DEVELOPMENT OF INTELLIGENT LIGHTING SYSTEM INTEGRATED WITH PV SOLAR

CHONG CHEE HUNG

Bachelor of Electrical Engineering Technology with Honours

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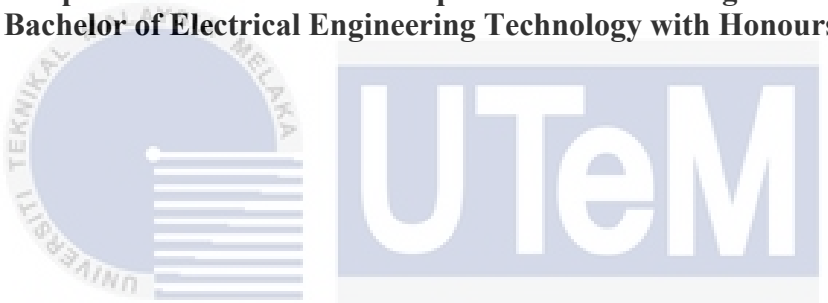
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJURUTERAAN ELEKTRIK DAN ELEKTRONIK

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Sesi Pengajian : 2021/2022

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I declare that this project report entitled “The development of Intelligent Lighting System Integrated with PV Solar” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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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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Date	:	11/1/2022

DEDICATION

To my beloved parents especially my mother, Tan Guat Ngor, and my father, Chong Koon Pow, that give their full support in my progress in completing this project mostly in term of encouragement and moral until my project is completed.

and

To my dearest siblings and friends that also help me in terms of both inspiring and moral support so that I could complete this project smoothly. Thankful for all the advises and helps I have got throughout this project.

ABSTRACT

The demand for clean electricity sources is increasing as there is a constant need for electricity while people trying to minimize the environmental impact caused by the harvesting of energy. Therefore, the use of renewable energy smart grid system has become more common these days and there are advancements in technologies in reducing the consumption of electricity. Hence, this project is developed to function self-sufficiently instead of depending on the grid. Besides, the development of the intelligent lighting system has further controlled the energy consumption of the lighting system by functioning only when needed. The development of this project involves the setup of a solar panel system, an intelligent lighting system, and a mobile application for controlling the system. The solar panels are estimated to generate at least 12Wh for the system to function self-sufficiently. Meanwhile, the controller of the system will automatically switch on the lights when the presence of a user is detected, and also switching off the lights automatically when there is no longer presence of the user. The functions and settings for the system can be easily adjusted with the mobile application developed alongside the system. As a result, the system will not only be functioning independently but also reducing the consumption of energy.

ABSTRAK

Keperluan elektrik yang dijana dari sumber bersih semakin meningkat disebabkan manusia sentiasa memerlukan elektrik dan juga ingin mengurangkan impak terhadap alam sekitar pada masa yang sama. Oleh sebab itu, kegunaan tenaga yang boleh diperbaharui sistem grid pintar semakin meningkat dan teknologi kini semakin maju dalam mengurangkan penggunaan eletrik. Projek ini dicipta untuk berfungsi tanpa elektrik dari grid luaran. Selain itu, sistem kecahayaan pintar yang direka dalam projeck ini akan menghadkan dan mengurangkan penggunaan eletrik dengan hanya berfungsi apabila diperlukan. Penciptaan projek ini mengandungi sistem panel solar, sistem kecahayaan pintar, dan juga applikasi mudah alih yang digunakan untuk mengawal sistem tersebut. Anggaran penjanaan elektrik dari panel-penel solar yang digunakan adalah melebihi 12Wh supaya sistem tersebut dapat berfungsi tanpa sumber eletrik luaran. Peranti pengawal sistem tersebut akan menyalakan lampu secara automatik apabila sensor mengesan kehadiran pengguna. Apabila sensor tidak mengesan sesiapa berada di bilik tersebut, lampu akan ditutup secara automatik. Oleh demikian, sistem tersebut bukan sahaja dapat berfungsi sepenuhnya dengan keggunaan tenaga solar, tetapi juga dapat mengurangkan kegunaan elektrik pada masa yang sama.

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PV	-	Photovoltaic
SSL	-	Solid-State Lighting
LED	-	Light Emitting Diode
OLED	-	Organic Light Emitting Diode
AC	-	Alternating current
DC	-	Direct current

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CHAPTER 1

INTRODUCTION

1.1 Background

The energy demand has drastically increased as compared to the past decades. As the global population and economic development continue to rise, the upward trend of the demand might further ascent in the future. To counter the dependencies of humans towards energy generation by using finite resources, the development of renewable energy is becoming the trend of modern technology. By harvesting the energy coming from the sun, solar power has become a reliable source of renewable energy for our daily life. With great cooperation with solar power, the development of smart grids has made good use of a more efficient way of power distribution. The smart grid provides even efficient, intelligent, reliable, and conventional use of power. By combining two of these modern technologies, an energy-efficient intelligent lighting system can be developed.

For the storage of power for this system, the battery and charge controller will be playing important role in ensuring the providing power for the system whenever needed. The suitable specification for the battery is that it has a capacity of storing power for at least 16 hours before charging again. Besides, the battery should be attached with a charge controller for preventing the battery from overcharging and being drained entirely. This combination will help the battery life span to last longer.

According to research [1], Solid-State Lighting (SSL) devices which including both Light Emitting Diode (LED) and Organic Light Emitting Diode (OLED) have played an important part in reducing the use of energy for the field of lighting systems. The usage of these Solid-State Lighting devices that consist of polymetric or semiconductor materials that convert electricity into the light has been popularised in competing with the traditional fluorescence and incandescent lamp as they can achieve up to 80% of energy reduction. Besides the reduction in energy consumption, SSL devices also provide other benefits such as a longer lifespan of over 50000 hours, higher durability, has a better quality of light-emitting, and is relatively safer as compared to traditional lighting devices. Hence, LED is a better choice of lighting devices in the development of this system as it can save more power as compared to traditional lighting devices.

1.2 Problem Statement

As the source of power for this system, solar power is recognized as one of the main renewable energy used globally alongside wind power, biomass, and geothermal. Solar power is the harvesting of power from the sunlight directing to the Earth by using solar panels. As compared to other kinds of renewable energy, solar power seems to be more commonly used as it is more environmentally friendly and doesn't have too much requirement. Generally, solar panels generate a flow of electricity when the electrons of their photovoltaic cells are excited by the photon from the sunlight. The electricity generated can be stored for further use. However, the efficiency of solar power is relatively low as compared to other sources of power, hence there is a need in manipulating the combination of other appliances to achieve a better generation of power in terms of consistency.

1.3 Project Objective

The objectives that needed to be achieved through this project are:

a) To design and develop an intelligent lighting system integrated with PV solar.

b) To design a smartphone program for controlling the lighting system conveniently.

c) To evaluate the suitability of solar panels, batteries, sensors, and charge controllers.

1.4 Scope of Project

The scopes of this project are as follows:

a) This project is targeted for using in indoor rooms.

b) The sensors used for controlling the intelligent lighting system are motion sensors

c) The type of solar panel used in this project is monocrystalline solar panels.

d) The type of battery chose for storing power is a lithium-ion battery.

e) The type of microcontroller used in his project is Arduino Uno.

a)

b)

1.5 Project Outline

This report will record the step-by-step process taken in the development of the project. Chapter 1 describes the introduction of the project which including the title background of the project, problem statements, objectives, and scopes of the project. Chapter 2 investigates related studies which have been carried out by other researchers previously. All relevant details which are related to this project will be captured. Meanwhile, all the methods and procedures in developing the project will be described in

Chapter 3. After that, the collection of data from this project will be recorded in Chapter 4 and then be further analyzed. Lastly, Chapter 5 of this project report will be concluding all the findings and outcomes from the project. Besides, recommendations about the project development are also stated in that chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The development of renewable energy is much more advanced in many ways as compared to the past. In the effort in combating climate change and carbon emission, the dependency on traditional methods of electricity generation has been gradually lowered. As the efficiency of solar photovoltaic systems drastically increased throughout the past 25 years, solar power has become one of the main sources of renewable energy. However, the usage of solar power only contributes a minor part to global energy generation. According to research [2], solar power is still considered a low energy-efficient method in generating energy and it only contributes about 12% of the global power capacity. Furthermore, there are several barriers found in common when it comes to the application of solar power systems in the household. As studies [3] stated, consumers face challenges in terms of finance, technical flaws, poor compatibility with existing infrastructure, lack of local experts. Etc. However, it is still undeniable that the solar energy system is a relatively better choice of energy source as compared to the traditional energy source such as burning of fuels. Hence, there is a need for the study to ensure that a high-energy efficient system can be developed through the build of the solar energy system by using the optimum selection of devices. According to Firth et al [4], these included the choices of solar panels, inverter, and batteries in terms of their types, size, shape, power, and efficiency, and the selection of suitable sensors in controlling and managing the energy-efficient of the system.

2.2 Solar radiation on the surface of the Earth

The Sun is the closest star to the Earth and it is emitting its energy throughout the entire solar system every second in the form of solar radiation. The Sun generates its energy through the process of thermonuclear. This process converts about 650-million-ton hydrogen into helium every second. During the conversion, heat and electromagnetic radiation are produced and emits into space in all directions. Electromagnetic radiation travels in many forms including infra-red light, ultra-violet radiation, and visible light. With the huge amount of radiation produced every second, only a small portion of it reaches the Earth. The solar radiation that reaches the Earth has become the indirect source of almost every energy that is used on the Earth. These energies included solar energy, motion and gravitational potential of the Sun, Moon, and Earth, chemical energy from mineral sources, geothermal energy from cooling, chemical reaction, and radioactive decay in the Earth, and human-induced nuclear reactions. The maximum flux density of solar radiation that reaches the Earth is about 1.0kW/m^2 in a wavelength band of 0.3 to 2.5 μm. The estimated potential of solar energy reaches Earth is 89000 TW with 342 W/m^2 received by the outer covering of the atmosphere. In the atmosphere, 31% of the energy received which is 106W/m^2 is reflected away from the Earth into outer space, while the remaining energy is then entering the Earth. The information is based on the research Solar power and application methods [5]. Figure 2.1 shows the solar radiation that travels to Earth.