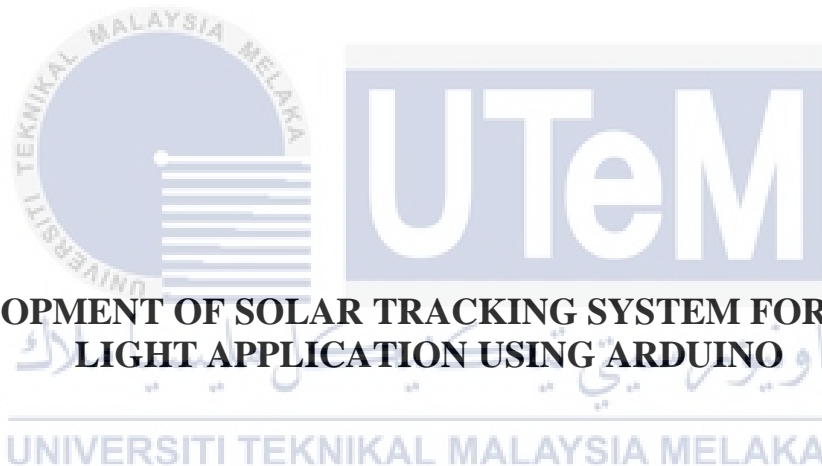




Faculty of Electrical and Electronic Engineering Technology



**DEVELOPMENT OF SOLAR TRACKING SYSTEM FOR STREET
LIGHT APPLICATION USING ARDUINO**

NIURUL NABILA BINTI ISMAIL

Bachelor of Electrical Engineering Technology with Honours

2022

**DEVELOPMENT OF SOLAR TRACKING SYSTEM FOR STREET LIGHT
APPLICATION USING ARDUINO**

NIURUL NABILA BINTI ISMAIL

**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

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

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Using Arduino

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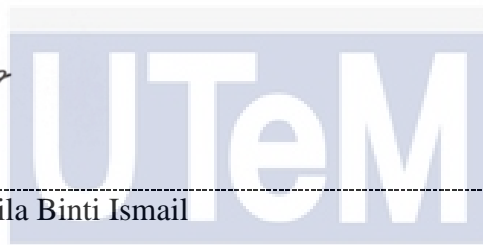
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APPROVAL

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

I acknowledge my sincere dedication, honours and gratitude to my beloved father, Ismail bin Mohamed, and mother, Wahidah binti Yusof, for all their love, encouragement, support, understanding, and sacrifices throughout whole of my life especially in education journey. Without their sacrifices and encouragement, impossible for me to reach at this stage. Special gratitude also dedicated to my grandmother, Siti binti Damiri which always support me in whatever I do in my life, sacrifices her time to comfort me whenever I at my lowest and for my siblings, thank you for always support me.

To my dearest Muhamad Nazmi bin Mohd Nazri, thank you for always been there for me since first year of degree, thank you for all your support and sacrifices throughout my degree life. Without you, I may not be finished by Bachelor Degree Project successfully. Last but not least, I wanna thank me, I wanna thank me for believing in me. I wanna thank me for doing all of this hardwork, I wanna thank me for no days off. I wanna thank me for never give up and the passionate.

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ABSTRACT

Examples of renewable energy resources include solar energy, hydropower, wind energy, biomass energy, and geothermal energy. Renewable energy, often known as clean energy, is produced from natural sources or processes that are continually refreshed. Despite the fact that their availability is based on time and weather, sunlight and wind, for example, continue to shine and blow. Humans today use solar energy for a variety of purposes, including powering electronics, generating electricity, heating water, and so on. Because of the high energy consumption in industrialised countries, solar energy is widely employed, particularly in countries with the biggest population. Using an Arduino Uno microcontroller as the project's main brain to control all of the components is one of the project's goals. Additionally, during the day, an LDR sensor detects light and adjusts the position of the solar panel toward the sun for consistent efficiency output. It will give the microcontroller digital information about the presence and absence of light intensity. For the solar panel, a servo motor is employed to create a free rotation X-Y axis. Then, at night in the highway, LEDs that act as street lights will collect electrical energy from the sun to power them. As a result, a solar tracking system was developed, which can modify the position of an item in reference to the sun. To deliver the greatest electrical energy to the highway street lights, the efficiency of the solar panels will be determined. A solar tracking system is one of the applications for boosting the efficiency of solar panels. It will adjust the solar panel's movement and direction so that it remains pointed toward the sun. The goal of this project was to provide benefits to people who drive in the dark or at night in order to save lives and avoid fatal accidents. The street light will have a higher electrical energy efficiency as a result of this solar tracking system, allowing it to run for longer periods of time at night.

ABSTRAK

Contoh sumber tenaga boleh diperbaharui termasuk tenaga suria, tenaga hidro, tenaga angin, tenaga biojisim, dan tenaga panas bumi. Tenaga boleh diperbaharui, yang sering dikenali sebagai tenaga bersih, dihasilkan daripada sumber semula jadi atau proses yang sentiasa disegarkan. Walaupun ketersediaan mereka berdasarkan masa dan cuaca, cahaya matahari dan angin, sebagai contoh, terus bersinar dan meniup. Manusia dewasa ini menggunakan tenaga suria untuk berbagai tujuan, termasuk menggerakkan elektronik, menghasilkan elektrik, memanaskan air, dan sebagainya. Kerana penggunaan tenaga yang tinggi di negara-negara perindustrian, tenaga suria digunakan secara meluas, terutamanya di negara-negara yang mempunyai populasi terbesar. Menggunakan mikropengawal Arduino Uno sebagai otak utama projek untuk mengawal semua komponen adalah salah satu matlamat projek. Selain itu, pada siang hari, sensor LDR mengesan cahaya dan menyesuaikan kedudukan panel solar ke arah matahari untuk output kecekapan yang konsisten. Ia akan memberikan maklumat digital mikropengawal mengenai kehadiran dan ketiadaan keamatan cahaya. Untuk panel solar, motor stepper digunakan untuk membuat paksi X-Y putaran bebas. Kemudian, pada waktu malam di lebuh raya, LED yang bertindak sebagai lampu jalan akan mengumpul tenaga elektrik dari matahari untuk menghidupkannya. Akibatnya, sistem pengesanan solar telah dibangunkan, yang boleh mengubah suai kedudukan item merujuk kepada matahari. Untuk menyampaikan tenaga elektrik terbesar ke lampu jalan lebuh raya, kecekapan panel solar akan ditentukan. Sistem penjejakan solar adalah salah satu aplikasi untuk meningkatkan kecekapan panel solar. Ia akan menyesuaikan pergerakan dan arah panel solar supaya ia tetap menunjuk ke arah matahari. Matlamat projek ini adalah untuk memberi manfaat kepada orang yang memandu dalam gelap atau pada waktu malam untuk menyelamatkan nyawa dan mengelakkan kemalangan maut. Lampu jalan akan mempunyai kecekapan tenaga elektrik yang lebih tinggi hasil daripada sistem penjejakan solar ini, yang membolehkan ia berjalan untuk jangka masa yang lebih lama pada waktu malam.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my good supervisor, Rohaina Binti Jaafar for their precious guidance, words of wisdom and patient throughout this Bachelor Degree Project. Thanks for giving me this opportunity and give knowledgeable ideas and opinions and time consideration while completing my Bachelor Degree Project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support which enables me to accomplish the project. Not forgetting my both of my panel, Dr. Mohd Badril Bin Nor Shah and Mazree Bin Ibrahim that willing to observe my BDP, giving the positive comments which is helps me to gain new knowledge and improvise my project.

My highest appreciation goes to my parents and family members for their love and prayer during the period of my study. An honourable mention also goes to my roommates for all the motivation and understanding and we gone through this journey together. Finally, I would like to thank all my classmates, the Faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

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LIST OF SYMBOLS

δ	-	Voltage angle
%	-	Percentage
Ω	-	Ohms



LIST OF ABBREVIATIONS

V	-	Voltage
MW	-	Megawatt
cm	-	Centimeter
kg	-	Kilogram
mAh	-	Miliampere/hour
mA	-	Miliampere
MHz	-	Megahertz
KB	-	Kilobyte
A	-	Ampere
C	-	C-rate



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CHAPTER 1

INTRODUCTION

This chapter consist of the research background of the project, problem statement, the objectives, and the scope of research. This should set out the key reason for doing this project and the concept of how it will be making this project.

1.1 Background

Solar energy , hydropower, wind energy, biomass energy and geothermal energy are some of the example renewable energy resources as shown in Figure 1.1. Renewable energy, often known as clean energy, is derived from natural sources or processes that are renewed on a regular basis. Sunlight and wind, for example, continue to shine and blow despite the fact that their availability is dependent on time and weather. Today, humans used solar energy in many ways such as power devices, electricity, to warm the water and etc. For developed countries, solar energy is being used widely mostly in countries that has the highest population in the world because of the energy consumption. Based on the data from Solar Power by Country 2022, China was the top countries that produce the most solar power which is 175,018 megawatts (MW), then goes to United States with 62,200 megawatts (MW). However, according to the National Renewable Energy Laboratory, “in one hour, the sun provides more energy to the earth than the entire globe consumes in a year.” It shows that still have countries that not used solar energy as their main energy consumption. As a result, a solar tracking system was created since it can adjust an object's position in relation to the sun. The solar panel's efficiency will be determined in order to provide the most

electrical energy to the highway street lights. One of the applications for increasing the efficiency of solar panels is a solar tracking system. It will change the solar panel's movement and direction to ensure that the solar panel remains towards the sun.



Figure 1.1 Renewable Energy

Other than that, almost half of all fatal car accidents, according to the National Highway Traffic Safety Administration (NHTSA), road accident occur at night due to compromised night vision as shown in Figure 1.2. Street light is important in every inch of road to ensure the safety of drivers. Transport Minister Datuk Seri Dr Wee Ka Siong said, there were 225,532 road accidents reported from January to September 2021. Based on police statistics, 3,302 were fatal from road accidents.



Figure 1.2 Road accident at night

1.2 Problem Statement

Renewable energy is sources that much less environmental impact to the climate changes because it derived from natural resources. Solar energy is used widely around the world even in rural areas. However, the efficiency of solar panels not exceed the maximum output because the position of solar panels is stationary and it do not move towards the sun. The solar panels can only work well if there is a significant presence of the sun, and it inform that the incidence of sunlight varies with the time of day. In order to verify these problems, solar tracker was introduced with dual axis to increasing the efficiency of solar panels. Solar tracker will make a free rotation in X-Y axis. However, solar energy is primarily used for residential appliances. It is rarely utilized for street lights that are on dark highways or in rural areas, as it increases the risk of a traffic accident. Therefore, in this work, solar tracker system for street light was built because it is more convenient for humans to drive at night in dark places and severe weather, as well as on highways, to avoid road accidents. This is due to the fact that many accidents occur on the road at night as a result of insufficient street lighting. Aside from that, when a dual-axis solar tracker is developed, the cost will be lower because more negative repercussions will be avoided.

1.3 Project Objective

The main objective to run this project is to increase the efficiency of solar panel to help provide electricity for street light to avoid the road accident. The objectives of this project are:

- 1.To develop dual axis solar tracking system based on microcontroller.
- 2.To integrated the system for street light monitoring.
- 3.To analyze the efficiency of the solar tracking system for street light.

1.4 Scope of Project

The scope of this project is made to inform the feature and components used in this project. Among the scope of the project is using Arduino Uno microcontroller as main brain to control all the components used in this project. Additionally, LDR sensor is used to detect the light during day and change the position of solar panel towards sun for consistent efficiency output. It will send the digital information about presence and absence of light intensity to the microcontroller. Stepper motor is used to make a free rotation X-Y axis for solar panel. Then, LEDs that serve as street lights will receive electrical energy from the sun to power them at night in the highway.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is the review on the past journal, project and discussion of research paper regarding Development of Solar Tracking System for Street Light Application using Arduino. To ensure that this project is successful, this chapter will be used in the future as a guide to assist with the experience of problems during project implementation.

2.2 Overview of Solar Tracking System

In today's modern society, energy efficiency is identified by renewable energy. Solar energy is most of renewable energy that used widely around the world because it is supply that inexhaustible resources and it is nonpolluting. Solar energy can generate the radiation that produces by the sun that able to produce heat and generate electricity. Other than that, sunlight is the largest source of energy that earth received by and energy source from the sun is extremely powerful. Solar panels, also known as photovoltaic cells, are the most common way to harness solar energy. Photovoltaic solar panel has a different efficiency and different type such as monocrystalline, polycrystalline, HIT and thin film. The efficiency of a panel is often determined by its design and how it is constructed to catch various frequencies of light energy. Furthermore, the factors that can impact the efficiency of solar panels is the positioning and angle of the panel installation. It is because the appropriate installation will capturing the maximum amount of sunlight and also will maximize the efficiency.

A solar tracking system was designed to boost the efficiency and maximise the energy produced by the solar panel. In fact, solar tracking system has a two types which is single axis solar tracking and dual axis solar tracking. Single axis solar tracking just has one degree of movement and to tracks the daily motion of the sun and capture the direct sunlight. While for dual axis solar tracking has two degrees of movement tp tracks and daily and seasonal motion of dirent sunlight. So basically the solar panel is positioned at an angle to the sun using a solar tracking system. The most typical application of a solar tracker is to place a photovoltaic (PV) panel perpendicular to the sun's rays. More sunlight strikes the solar panel if it is kept perpendicular to the sun, less light is reflected, and more energy is absorbed.

2.3 Research, Ideology and Concept Previous Project

2.3.1 Arduino based Dual Axis Smart Solar Tracker

his project is made by Jyoti Mishra, Ritula Thakur and Alok Deep on May 5, 2017[1]. The function of dual axis smart solar tracker is changing the orientation at the day just to follow the sun's path to maximize the energy. The effectiveness of solar panels can be greatly boosted if they rotate continually, according to this article. When comparing solar trackers to fixed solar, the electricity generation from solar trackers can rise by up to 40%. As a result, this solar tracker is necessary to increase energy generation and improve conversion efficiency of energy into electrical energy.

Furthermore, this solar tracker should be integrated with the solar panel in order to provide a more precise reaction in a variety of scenarios. However, the author claimed that this technique was inefficient because to the LDR's low sensitivity and disruption. Apart from that, a pre-programmed 2K microcontroller device PIC 18F4560 was utilized to

intelligently manage the rotation in this project, which gives a straightforward programming approach through C language. Next, this project proposes a more efficient, low-cost, and simple-to-use approach for developing an effective solar tracker that detects voltage and displays the result in an Android app utilizing a Bluetooth module. Figure 2.1 shows the block diagram and component that used such as Arduino UNO, Bluetooth module, Solar panel, servo motor, and light dependent resistor (LDR) were utilized in this project.

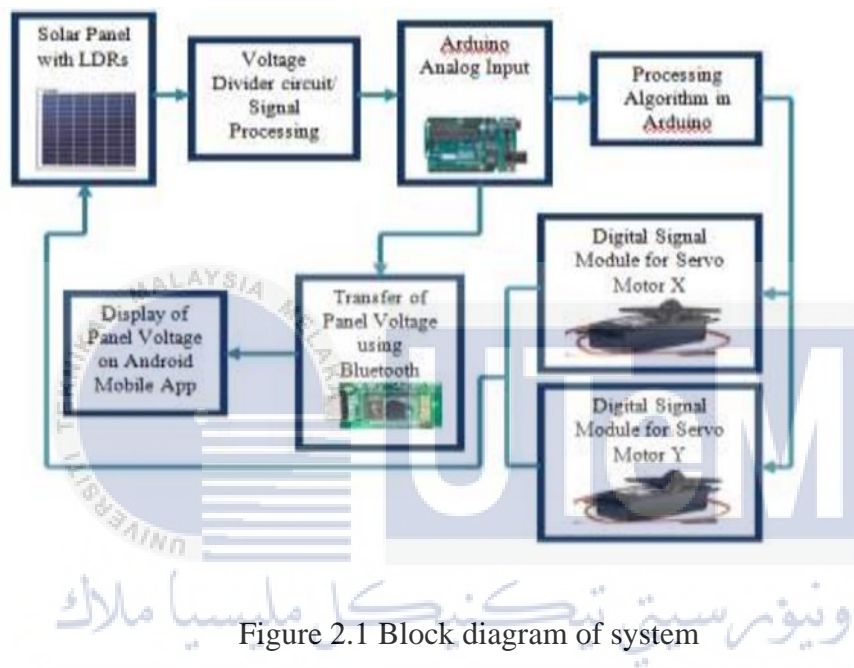


Figure 2.1 Block diagram of system

2.3.2 Dual axis solar tracker with IOT monitoring system using Arduino

This journal was published by Mohamad Nur Aiman Mohd Said, Siti Amely Jumaat and Clarence Rimong Anak Jawa on August 7, 2019[2]. Because Malaysia has the most solar radiation that may be utilised to generate electricity, the goal of this project is to construct a dual axis solar tracker with an IOT monitoring system using Arduino. According to this source, solar tracking systems are the most effective technique for increasing solar panel efficiency, and when compared to single axial solar trackers, this system creates more power, voltage, and current due to its two-axis solar tracking. To assure the performance of the solar tracker, the internet of things (IOT) will be used to monitor the project.