Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF DUAL AXIS SOLAR TRACKER WITH IOT MONITORING SYSTEM

KU MUHAMAD FIRDAUS BIN KU MUDZIR

Bachelor of Electronics Engineering Technology with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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Faculty of Electrical and Electronic Engineering Technology

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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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Sesi Pengajian : Semester 1-2021/2022

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I declare that this project report entitled "Development Of Dual Axis Solar Tracker With IOT Monitoring System" 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.

Signature :

Student Name : KU MUHAMAD FIRDAUS BIN KU MUDZIR

Date : 10/1/2022

APPROVAL

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

Signature : Mazree

Supervisor Name : EN MAZREE BIN IBRAHIM

Date : 10/1/2022

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Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

To my beloved mother, Norzaini Binti Othman, and father, Ku Mudzir Bin Ku Desa

and

To my friends, Puteri Iffah Irdina Binti Izrul Syahril and Idham Zabidi

ABSTRACT

Solar energy is a technology used to obtain energy based on sunlight. Solar energy has been much of a traditional technology for centuries and is widely devoid of other energy supplies. Its use will be widespread if awareness is related to environmental costs and its supply is limited by other energy sources, such as fuel. Solar energy storage system is an effective technology to increase the efficiency of solar panels by detecting and following the sun's movements. With this system in place, solar panels can improve the way sunlight is managed, allowing for the production of more electricity since the solar panels can maintain a stable position. As a result, this project combines the development of a two - axis solar tracker developer with the use of an Arduino Uno as the primary system's controller. To help in the development of this project, four of light-dependent resistor (LDRs) has been utilized for daily light execution and maximum light intensity. Two servo motors were utilised to turn the solar panel in response to the LDR's detection of the sun's light source. Next a WIFI ESP8266 device is utilised as an intermediate between device and Blynk application. Blynk is an online application that serves to store data, and this system is known as the Internet of Things (IOT). The system's capabilities have been evaluated and compared to those of single axis solar. As a result, a dual-axis solar system generates significantly more power, voltage, and current.

ABSTRAK

Tenaga suria adalah teknologi yang digunakan untuk mendapatkan tenaga berdasarkan cahaya matahari.Tenaga suria adalah banyak tradisional teknologi selama berabad-abad dan adalah secara meluas tanpa adanya bekalan tenaga lain. Kegunaannyaakan meluas jika kesedaran berkaitandengan kos persekitaran danbekalannya dibatasi oleh sumber tenaga lain, seperti bahan bakar. Sistem simpanan tenaga suria adalah teknologi yang berkesan untuk meningkatkan kecekapan panel solar dengan mengesan dan mengikuti pergerakan matahari. Dengan adanya sistem ini, panel suria dapat meningkatkan cara pengelolaan sinar matahari, memungkinkan untuk menghasilkan lebih banyak tenaga listrik kerana panel surya dapat mempertahankan posisi stabil. Hasilnya, projek ini menggabungkan pengembangan pemaju pelacak solar dua-pakis dengan penggunaan Arduino Uno sebagai pengawal sistem utama. Untuk membantu pengembangan projek ini, empat perintangbergantungcahaya (LDR) telah digunakanuntukpelaksanaancahaya harian dan intensiti cahaya maksimum. Dua motor servo digunakan untuk memutar panel suria sebagai tindak balas terhadap pengesanan LDR mengenai sumber cahaya matahari. Seterusnya peranti WIFI ESP8266 digunakan sebagai perantaraanantara peranti dan aplikasi Blynk. Blynk adalah online aplikasi yang berfungsi untuk menyimpan data, dan sistem ini dikenal sebagai Internet of Things (IOT). Keupayaan sistem ini telah dinilai dan dibandingkan dengan tenaga solar paksi tunggal. Hasilnya, sistem solar paksi dua menghasilkan lebih banyak tenaga, voltan, dan arus.

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PV	-	Photovoltaic
LCD	-	Liquid Crystal Device
LDR	-	Light Dependent Resistor
IOT	-	Internet of Things
LCD	-	Liquid Crystal Device
LDR	-	Light Dependent Resistor
IOT	-	Internet of Things

LIST OF ABBREVIATIONS

V	-	Voltage
P	-	Power
C	-	Current
%	-	Percentage
°C	-	Temperature in Degree Celcius

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CHAPTER 1

INTRODUCTION

1.1 Background

Due to the lack of electricity, mankind has always looked for the most available and environmentally friendly type of electrical energy in the course of growth [1]. Renewable energy is energy obtained from natural renewable natural resources, such as sunlight, wind, tides, hydropower, biomass energy and geothermal energy . Today, Malaysia **r**egards solar energy as a viable renewable energy source. The country's power generation is 30 ,875 .23 MW, of which solar panels account for 0.55 percent [3]. This shows that Malaysia has the highest solar radiation that can be used to generat**e** electricity**.** Renewable energy sources, such as electricity, have surpassed fossil fuels as the primary source of electric energy. From now on, the extinction of fossil fuel resources is predicted to end over the next hundred years. Solar energy is the most effective energy for producing electricity generation when it comes to renewable energy. It is mostly used as a primary energy resource in countries with warm climates around the world. Solar technology is always accessible, inexpensive, pollution - free, and environmentally friendly. Diffused, direct and reflected solar radiation shown in Figure 1.1.

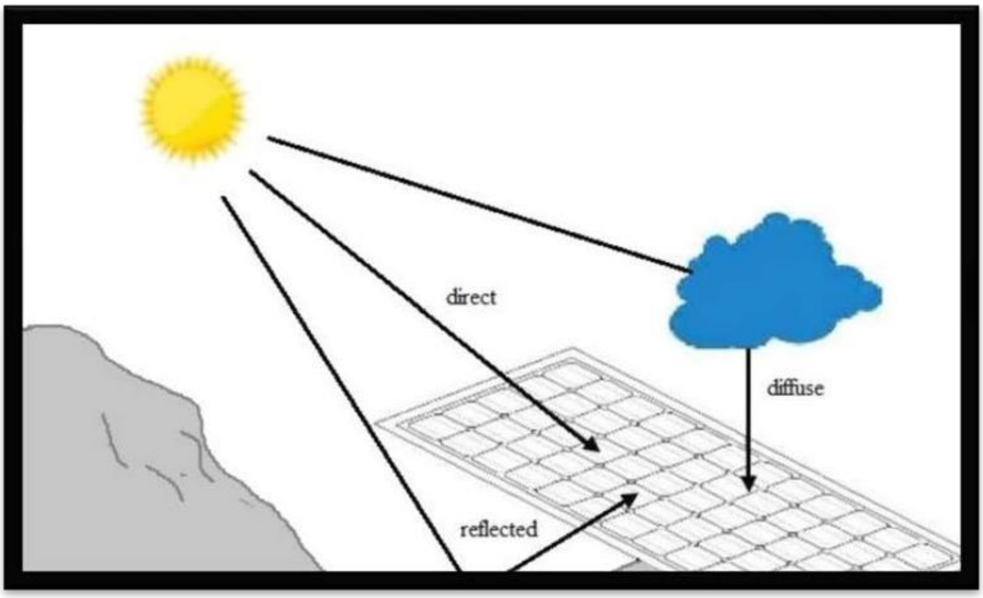

Figure 1.1 Types of solar radiation [1]

Furthermore, the issue with solar photovoltaics is their low performance. This is a challenge when it comes to generating the full amount of output power from sunlight. The only solution, according to researchers, is to increase the production of output power by implementing a solar tracking system. It is now commonly used in today's world of technology. It functions by aligning the solar PV panel so that it is perpendicular to the sun's radiation. The elements of electrics, electronics, and mechanics came together to build and design this solar tracking device.

The solar energy efficiency can thus be increased and enhanced by using a tracking system for solar PV. This system will assist in increasing the production power efficiency to achieve the best results.

1.2 Problem Statement

Solar panels were widely used in the globalized world to absorb the sun's rays as a source of energy that converts solar radiation to electrical energy. Most of the solar panels are in a static position which does not face straight forward to the sun. In Malaysia, fixed solar systems and single solar systems are the two most common types of solar systems. But fixed solar panel are lack of energy collection by sun throughout the day. However, the problem with both solar trackers is that they have a poor anti-interference function, particularly in terms of shading. Besides, the limitation of the solar system can be monitored via LCD only and not via an online system. Lastly, fixed solar panel is very expensive due to install more solar panels to produce enough power.

1.3 Project Objective

In order to maximize the efficiency of a great solar power system, a solar tracker is essential. This led to the three main goals of the project:

a) To design a dual-axis solar tracker that moves independently in both the X and Y axes.

b) To develope a monitoring system controlled by WI-FI module.

c) To analyze the output power parameters of solar panel.

1.4 Scope of Project

The development and design of an intelligent method using a solar tracking device is one of the project's goals. To get the best sun radiation, this system will use four LDR sensors on the top of the solar PV panel to determine the strength of light intensity. The solar PV panel's surface will be moved by the tracking device to orient and align with the incoming sunlight beam. Since the motors will rotate in a specific direction, two DC servo motors will be used in this design. The motors can switch into their desired positions, angles, and movements based on the signal emitted by the Arduino microcontroller.

There are two requirements that have been considered for this project, which are the software and hardware part that must be created. The hardware development part of this project is more focused on the Arduino, servo motors, LDR sensors and solar tracker mechanism. The Arduino is the suitable microcontroller for this project because it meets all of the project's requirements in terms of performance. The Arduino Uno's function is to control the entire system and transfer data to the Blynk application. A wifi module will be in charge of transferring data to the Blynk application.

If the LDR sensor detects and records the intensity of sunlight, the input device is working. Its sensitivity, location, and accuracy are the key factors. The motor drivers, also known as servo motors, were used in the project because of their ability to guide the location and control the solar tracker so that it moves in accordance with the sun. The first servo motor controls the vertical rotation of the solar panel, while the second controls the horizontal rotation of the solar panel. The solar tracker mechanism was developed and built to achieve the goal of creating a system that can monitor solar energy. Then use the ESP8266 WIFI device as an intermediary between the user and the IoT monitoring system. DHT 11 which is temperature and humidity sensor will be used to sense the temperature and humidity of the surrounding solar panel. Then, the data will be sent to the Blynk application within a second. In this project, a polycrystalline PV module 9 volt, 3 W will be used.

1.5 Chapter Outline

This report is divided into five chapters. All of these chapters are covered in the implementation of this project operation, which is about "Development of Dual Axis Solar Tracker With IOT Monitoring System."

Chapter 2 consists of a literature review. This section discusses previous research and studies that are relevant to this project. Previous studies used a different microprocessor as the main part of the movement mechanism and completed the entire process for the prototype. The microprocessors used in the previous research papers were Raspberry Pi 3 , ATMega 328, and Arduino Uno. All microprocessors are used in different proposals based on their advantages.

Chapter 3 discussed the methods employed in the development of this project. This project is divided into two major components: hardware and software. In general, this chapter will explain and explore the project development process briefly utilize flow charts and block diagrams to ensure a better knowledge of the process. It explains the techniques used in the project and the concept for developing the solar tracking prototype.

Chapter 4 summarizes the project's findings and analyses. The first section discusses software and hardware development, while the second section discusses monitoring a dual- axis sun tracker via the Blynk application. Following that, this chapter discusses the an analysis of the dual-axis solar tracker's output performance parameters.

Chapter 5 summarizes the project's findings. Additionally, recommendations are offered for future work to improve the dual axis sun tracker system and to broaden the scope of the evaluation.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Green energy, also known as regeneration energy, has recently received a lot of publicity. Green energy, including sun, water, wind, biomass, terrestrial heat, sea temperature differences, sea waves, morning and evening tides, and so on, can be recycled. Solar energy is the most efficient of these resources for generating electricity. For industrial continuous processes, a great energy source prospect is:

- Low cost to operate and build;
- There is almost no effect on the environment;
- Pleasant to the environment.
- Modular, and therefore flexible in terms of size and use;
- Exceptionally dependable and low-maintenance;

2.2 Solar Radiation Concept

In theory, when the sun emits solar radiation, it will emit solar radiation. Diffuse radiation and direct radiation are the two types of solar radiation. If the sunlight passes directly on the solar PV plate, this is known as direct radiation. Around 90 % of the solar radiation is carried by means of diffused energy radiation. In other words, diffuse radiation occurs when the sun is filtered due to temperature, wet environments, cloudy conditions, and other factors. It is primarily caused when solar energy is beamed into a cloud after being beamed into a solar PV panel. The biggest incident radiation that our planet has replicated is