Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF TWO AXIS SOLAR TRACKER FOR WATER PUMPING SYSTEM.

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Bachelor of Electronics Engineering Technology with Honours

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DEVELOPMENT OF TWO AXIS SOLAR TRACKER FOR WATER PUMPING SYSTEM

WAN NOOR HAZIMAH BINTI WAN MOHAMAD

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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DEDICATION

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ABSTRACT

Renewable energy is very important to human life as humans always rely on energy to supply electricity. Futhermore, renewable energy such as sunlight, wind, rain, water and others is one of energy sources that are continually replenished. This mean that, humans can utilise them as often as they want and are not concerned if the energy is running out. It is unlike fossil fuel, coal, oil or natural gas that if use it to the end, it means it will run out and can not be renewed. Beside, when fossil fuels are used, they release carbon dioxide into the atmosphere, which contributes significantly to global climate change. Hence, solar energy is often significantly more ecologically friendly because humans can get solar energy directly from sunlight. Moreover, solar energy can be used more beneficially by contribute in it solar panels to improve renewable energy consumption. Therefore, the purpose of this project is to develop two axis solar tracker for water pumping system. By using two axis solar tracker it can captured solar rays to generate maximum sunlight and free energy from the solar panel. On top of that, two axis solar tracker is more efficient since it can move the solar panel horizontally and vertically. By implementing solar pumping will reduce the water wastage and helps the consumer for consumption by having water storage tank. Method used are four LDR sensors that is connected to the solar panel. Arduino will send the signal an act as a brain for this system. To manage the panel movement, this project uses two 5 V servo motor. Water level sensor is put in water tank and used to measure the water levels. If it is sensing low water level, 12 V DC water pump will on. For the result, two axis solar traker system for water pumping can successfully implemented. Solar tracking can tracks sunlight efficiently to give energy for water pumping that can be used if necessary by pumping the water via water tank.

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ABSTRAK

Tenaga boleh diperbaharui amat penting kepada kehidupan manusia kerana manusia sentiasa bergantung kepada tenaga untuk membekalkan tenaga elektrik. Tambahan pula, tenaga boleh diperbaharui seperti cahaya matahari, angin, hujan, air dan lain-lain adalah salah satu sumber tenaga yang sentiasa diisi semula. Ini bermakna, manusia boleh menggunakannya sekerap yang mereka mahu dan tidak bimbang jika tenaga kehabisan. Ia berbeza dengan bahan api fosil, arang batu, minyak atau gas asli yang jika digunakan sehingga habis bermakna ia akan habis dan tidak boleh diperbaharui. Selain itu, apabila bahan api fosil digunakan, ia membebaskan karbon dioksida ke atmosfera, yang menyumbang dengan ketara kepada perubahan iklim global. Oleh itu, tenaga suria selalunya lebih mesra ekologi kerana manusia boleh mendapatkan tenaga suria terus daripada cahaya matahari. Selain itu, tenaga solar boleh digunakan dengan lebih berfaedah dengan menyumbang di dalamnya panel solar untuk meningkatkan penggunaan tenaga boleh diperbaharui. Oleh itu, tujuan projek ini adalah untuk membangunkan penjejak solar dua paksi untuk sistem pengepaman air. Dengan menggunakan penjejak suria dua paksi ia boleh menangkap sinaran suria untuk menjana cahaya matahari maksimum dan tenaga bebas daripada panel suria. Selain itu, penjejak solar dua paksi adalah lebih cekap kerana ia boleh menggerakkan panel solar secara mendatar dan menegak. Dengan melaksanakan pam solar akan mengurangkan pembaziran air dan membantu pengguna untuk kegunaan dengan mempunyai tangki simpanan air. Kaedah yang digunakan ialah empat sensor LDR yang disambungkan ke panel solar. Arduino akan menghantar isyarat bertindak sebagai otak untuk sistem ini. Untuk menguruskan pergerakan panel, projek ini menggunakan dua motor servo 5 V. Sensor aras air dimasukkan ke dalam tangki air dan digunakan untuk mengukur paras air. Jika ia mengesan paras air rendah, pam air 12 V DC akan dihidupkan. Untuk hasilnya, sistem pengesan suria dua paksi untuk pengepaman air dapat dilaksanakan dengan jayanya. Penjejakan solar boleh menjejaki cahaya matahari dengan cekap untuk memberi tenaga untuk mengepam air yang boleh digunakan jika perlu dengan mengepam air melalui tangki air.

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LIST OF SYMBOLS

℃	-	Celcius
Ω	-	Ohm
%	-	Percent
±	-	Plus minus

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LIST OF ABBREVIATIONS

V	-	Voltage
mA	-	Miliampere
g	-	Gram
MW	-	MegaWatt
mm	-	Milimeter
cm	-	Centimeter
Mhz	-	Megahertz
µA	-	Microampere
kHz	-	Kilohertz

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CHAPTER 1

INTRODUCTION

1.0 Background

Renewable energy or in other name, clean energy is theoretically a method of generating energy from limitless natural resources. These resources are either limitless or renew at a faster pace than they are consumed. We can generate enough heat and electricity for all of our homes, companies and industry needs by combining these natural resources with sophisticated technology especially in solar energy. Solar power mostly uses photovoltaic cells or solar cells to generate electricity. Malaysia always experiences hot weather. This is actually one of advantages to saving electricity since electricity usage in Malaysia is quite high. Malaysia is curretly one of the region's largest energy consumers per capita, with an average of 4,652 kWh per capita in 2014, more than a third more than the global average of 3,132 kWh [1]. Somehow, Malaysia also has a very high rainfall distribution since Malaysia is close to the equator line. Normally, average rainfall is 2420 mm for peninsular Malaysia and 2630 mm for Sabah and 3830 mm for Sarawak [2].

With continuous use of diesel and electricity consumption and also it is an advantage if not using abundant water properly, it will have a negative impact on the environment and people. To not waste these renewable energy sources, by using solar panels, we can invent something new to contribute in many ways to improve renewable energy consumption. So, development of a two axis solar tracking for a water pumping system is an alternative and effective way to track the sun in order to get the most sunlight incidence on the solar panel at any time of day, which will be used to provide energy to the water

pumping system. Hence, a two axis solar tracker is more efficient than a single axis solar tracking. This is because a two axis solar tracker has more flexibility and gives 40% more electricity than single axis solar tracking.

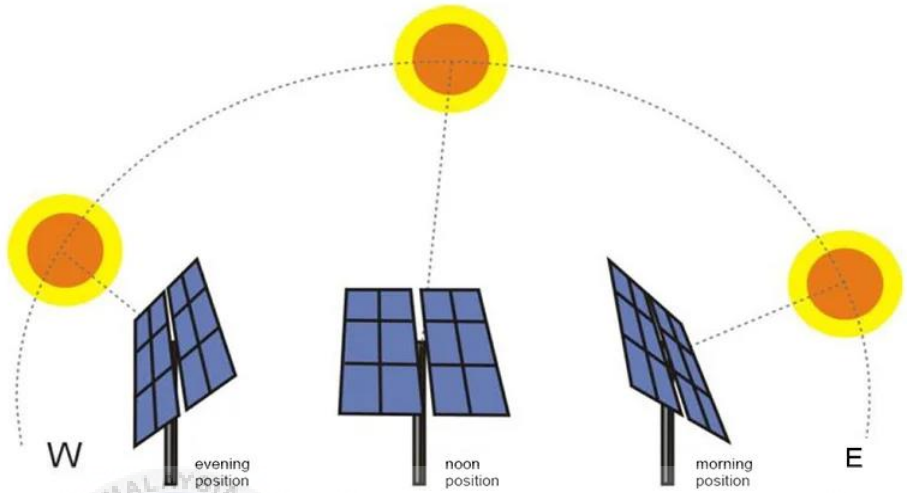

Figure 1.1: Dual Axis Solar Tracker

As we know, solar panels consist of photovoltaic cells that convert energy from the sun to electricity. Direct current (DC) electricity is generated by photovoltaic cells. This DC electricity can be used to charge batteries, which can then be utilised to power direct current equipment. Thus, to improve solar panels in efficient ways, it can be used for two axis solar tracking systems. It consists of polar and axis tracking and also altitude and azimuth tracking. This tracking is changing all the time. In simple words, it goes right, left, up and down. It can track the sun to collect high solar energy. This means that after setting up the tracker, we don't need to update or adjust anything because it will follow the sun wherever it goes. So, it can track from north to south, and east to west. For electricity generation, this method produces the best results.

Moreover, with the electricity produced from two axis solar tracking it can drive a water pumping system directly. People can save water from going to waste by having a storage tank that can measure the water level using a water level sensor. With this, water

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will flow according to the level of human consumption. Water is essential for survival, as it is required for drinking, daily domestic tasks, and large-scale applications such as irrigation, construction, and hydropower generation. Water is crucial to the country's development because it is dependent on the quality and amount of water available in their area. So, by using a two axis solar tracker for water pumping systems, people can maintain the usage of water by using a water tank that constantly flows from water supply. Therefore, two axis solar tracker for water pumping systems provides water storage as a basic necessity and it has become so popular especially in the agriculture sector and micro irrigation applications.

To develop two axis solar tracker for water pumping systems to investigate the efficiency of solar tracking and effectiveness on water pumping systems. The major purpose of this project is to track the sun so that the solar panel receives maximum sunlight at all times of the day and can power the water pumping mechanism.

1.1 Problem Statement

The main issue is solar power, which is only accessible in permanent installations. As a result of this problem, the amount of electricity that may be created is limited. Previous solar which is static solar that just does not have any tracks the sun's daily motion which means it can not move at all. Hence, it has no light dependent resistor (LDR). Because the sun's position changes during the day, solar tracking panels in a fixed position may not be able to get enough solar energy to make electricity. Furthermore, the solar panel that is being employed is only one-way. Because of this issue, the amount of power that may be created is limited.

In order to address these issues, development of two axis solar tracking is produced since it can track the sun according to its position since it can rotate to 180 degree. Two axis solar tracker also has high efficiency since it can track maximum sunlight on solar panels.

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On top of that, by using LDR as a sensor, it can track solar energy. It can be implemented by four LDR sensors since it is two axis solar tracking. Using four LDRs, the solar panel can travel over a double-axis. There will be light whenever one of the LDRs detects the presence of solar energy. It will be easy to build and set up the projects in rural areas throughout the world to generate power on a regular basis. Then, with LDR, a two-axis solar tracker will be able to capture solar energy into electricity, so water will not need more time to fill in the water tank. Thus, solar tracking is required to ensure that the water pump system's precision is maintained.

1.2 Project Objective

There are three main goals of this project :

a) To design a two axis solar tracker for a water pumping sytem for the good purposes by implementing a hardware and software device.

b) To develop a two axis solar tracker system using an LDR sensor.

c) To analyze the output voltage of two axis solar tracker and output volume of water pumping system.

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1.3 Scope of Project

This project aims to develop a two axis solar tracker for water pumping systems, the scope of this project will be as follows :

a) The project will be divided into two types of implementation: software and hardware.

b) The system will be developed using the Arduino programming language and Arduino Uno microcontroller as a brain to control all of the project's components is one of the project's goals and include a sensor system and output.

c) Will be able to analysis the output voltage two axis solar tracking using LDR and output volume of water pumping.

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CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Two-axis solar trackers have a lot of benefits for renewable energy. In order to ensure this project's success, a literature review is a must as a guide to assist with problems encountered. There are a few previous discussions, journals, and research papers regarding development of two axis solar trackers for water pumping systems that will be reviewed to get more details.

2.1 Overview

Solar energy may be used to generate heat, chemical processes, and electricity as a substitute for fossil fuels. Solar energy can be categorised into three types : thermal energy from the sun for heating, solar power that is concentrated for electricity, photovoltaics (Solar PV) for electricity. Solar power consists of photovoltaic (PV) panels. Photovoltaic (PV) panels or mirrors that concentrate solar radiation are used in solar technologies to convert sunlight into electrical energy. This energy can be utilised to produce electricity, or it can be stored in batteries or thermal storage. PV cells also can be categorised into three which is monocrystalline silicon, polycrystalline silicon, and thin film are the three types of PV cell technology that now dominate the global market. Based on the efficiency that we can see from three types of PV cells, when compared to the other two kinds of solar cells, monocrystalline solar panels are known to have the best efficiency in conventional test circumstances.

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