Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF SOLAR TRACKING PANEL AIDED WITH TEMPERATURE EFFECT DEVICE

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Bachelor of Electrical Engineering Technology with Honours

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in partial fulfillment of the requirements for the degree of
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Sesi Pengajian : 2021/2022

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Date : 11/1/2022

APPROVAL

I approve that this Bachelor Degree Project 1 (PSM1) report entitled "Development of Solar Tracking Panel Aided with Temperature Effect Device" is sufficient for submission.

Signature : 

Supervisor Name : EN. MOHAMAD NA'IM BIN MOHD NASIR

Date : 11/1/2022

DEDICATION

To my beloved mother, SUDAN APUI, and father, MERANG EBAN,

ABSTRACT

In this modern era, the world's most important issue is the energy crisis. Conventional energy resources are not just that limited, but also the main culprit of environmental pollution. In this project, by adding a temperature effect system can improve the efficiency of the solar tracker. This project aims to develop the power absorption to maximum and with a cooling system, a high-efficiency solar system can be produced. This project uses the input and LDR sensor to determine the movement of the servo and analysed through Arduino programming. Tracking the sunlight by using the LDR sensor, the rotation of the solar panel controlled by the servo motor. The data is collected based by the solar tracker with and without temperature effect system based on current(mA), voltage(V) and power(mW). The data has been analysed whether by adding or without the temperature effect system can increase the efficiency of the solar tracker. This project proposes a way to maximize solar energy through the use of solar tracker. In the future, by adding IOT system and temperature effect system can the efficiency of this project. The operation of the cooling system can be remotely controlled.

ABSTRAK

Di era moden ini, krisis tenaga adalah masalah terpenting di dunia. Sumber tenaga konvensional tidak hanya terhad, tetapi juga penyebab utama pencemaran alam sekitar. Projek ini meningkatkan kecekapan penjejak solar dengan menambahkan sistem penyejukan. Projek ini bertujuan untuk mengembangkan mekanisme penjejakan solar untuk memaksimumkan penyerapan tenaga suria dan dengan sistem penyejukan, sistem suria dengan kecekapan tinggi dapat dihasilkan. Projek ini menggunakan sensor LDR untuk menentukan arah sinar matahari dan bacaan input akan dibaca dan dianalisis melalui pengaturcaraan Arduino. Pengesanan cahaya matahari dengan menggunakan sensor LDR, servo motor digunakan untuk mengendalikan pergerakan dan putaran panel suria. Data dikumpulkan berdasarkan voltan (V), arus (mA) dan daya keluaran (mW) yang dihasilkan oleh penjejak solar dengan sistem penyejukan atau tanpa sistem penyejukan. Data yang dikumpulkan telah dianalisis bahawa penjejak solar dapat menghasilkan kecekapan tinggi dengan sistem penyejukan. Projek ini mencadangkan kaedah untuk memaksimumkan tenaga suria melalui penggunaan penjejak solar. Di masa depan, sistem projek ini dapat diperbaiki dengan menambahkan sistem IOT ke sistem penjejakan suria atau sistem penyejukan. Sistem ini dapat mengawal operasi sistem penyejukan dari jauh.

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SYMBOLS	
I	Current
V	Voltage
W	Power

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CHAPTER 1

INTRODUCTION

1.1 Background

The exponential growth of climate change and energy demand requires huge development of renewable energy on a global scale. During the observation period, the country's electricity consumption has been gradually increasing. With the increase in power generation, it will cause more pollution to the environment. Solar energy is one of renewable energy that have an infinite energy source.

According to (Latiff *et al.*, 2020) obtained a photovoltaic (PV) cell, which can directly convert solar energy from sunlight into electrical energy. It is the cleanest energy source and has the least possibility of polluting environment. Presently, in all other renewable energy, the capacity of all installation photovoltaic systemin the world, in 2018 was 102.GW and in 2020 was 125GW.

However, many ways to encouraged the use of solar. For example, to monitor and through a solar system that follow the path of the sun-called a tracking solar system (Seme, Štumberger and Hadžiselimovi, 2020).

A sun-based tracker is a device that follows the sun's everyday revolution from east to west. The use of solar trackers increases the amount of solar energy received by the solar collector and generates the energy output of the generated heat/electricity. The solar tracker can be used in a variety of applications, such as solar daylighting systems, solar cells and solar thermal arrays. The commercial durability of solar trackers is the increase in the output of solar panels, the maximization of panel efficiency, and the ability to obtain energy throughout the day. Although it is not a continuous energy source, solar energy is often provided free of charge around the world (P.Ramya1, R.Ananth M.E, 2016).

This project has two section which is equipment and programming. It comprises of three fundamental parts which are input, main controller, and output. The info is the simple worth from the LDR sensor, Arduino as regulator and servo engine will be yield (Zolkapli *et al.*, 2013). With help of the LDR sensor, the servo motor adjacent to the system measures the intensity of the sun’s rays fixed on the edge of the solar panel, which will help the solar

panel to rotate in proportion to the movement of the sun itself in order to grab and stored as much energy (Das, 2019).

The output of comparison circuit supplies power to the driver circuit, which in turn supplies power to the servo motor and changes direction according to the higher amount of light received by the sensor. This makes the direction of the solar panel perpendicular to the sun. this paper introduces the development of a single-axis tracker simulation model using Proteus and AutoCAD software. According to the voltage difference of the LDR sensor based on the sunlight intensity, the Arduino microcontroller is also programmed to the control of the rotation of the servo motor.

1.2 Problem statement

These days the electricity power production and demand are rising continuously with the accessible alarming pace of utilization main resources energy such as natural gas, petroleum and coal. Therefore, in order to support electricity demand, solar energy is introduced as an alternative source of renewable energy. Solar (PV) panel are equipment that can cleanly convert sunlight into electrical energy and provide practical solution.

In this project will be evaluated the comparison of energy between solar tracker with static solar. Solar that is in a static state actually greatly affects the efficiency in energy absorption. Therefore, solar tracker is the best initiative to increase the absorption efficiency to the maximum.

On top of that, this project needed to develop a solar tracking panel aided with temperature effect device which is the result will be controlled by the Arduino microcontroller as the brain in this project. Temperature also greatly influences test results. The higher the temperature the less energy can be absorbed. In some aspect, to monitor the output voltage, output current and output power.

Besides, the investigation on the efficiency of absorbing the sunlight during the day. Solar trackers are used as part of movement changing to detect the sunlight. At that point, it is active sensor constantly monitors the sun and turn the panel towards the direction of the maximum sunlight. The solar panel will come to the reset position when the sun sets down.

1.3 Objective

There are two main objectives of this project:

1. To design a solar tracking panel aided with temperature effect device.
2. To develop a solar tracking panel aided with temperature effect device based on Arduino.
3. To investigate the efficiency and performances of the overall system.

1.4 Scope

The scope of this project is to clarify the functional parts and components used for this project. The scope of the project includes the use of Arduino Uno the microcontroller that acts as the brain to control all the components used in this project. Thus, the output of the project was controlled by the implementation of a microcontroller. In addition, choose a suitable motor to control the angle of the solar panel in order to always follow the sun. LDR sensor is used to detect light during the day. Then, using the right method to determine the solar panel angle direction.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The project describes the development of solar tracking efficiency. During the day, the sun moves from east to west and in the seasons also move in the north-south direction.

However, when the panel is perpendicular to the sun rays, the PV panel system will provide the maximum power absorption. Therefore, it is advantageous for the solar panel to track the position of the sun in order to obtain the maximum power output.

2.2 Solar tracking system

Solar energy collection can be as simple as putting solar panels on the roof, or as a large and complex system such as a large solar power plant. In a simple conventional design, the solar receiver is usually fixedly installed in a certain position, and due to the movement of the earth, this fixedly installed solar receiver always has a cosine loss angle, because there are more opportunities to open the solar panel than good angle. Tracking system able to compensate from the loss of fixed solar receivers. The tracking system minimizes the angle of incidence, the angle between the incident sunlight and the panel, thereby increasing the energy generated. Thus, the tracking system can generate more electricity that fixed solar panels because it increasing the ability to be directly exposed to the sun (Ucd and Col, 2017).

There are two types of trackers, which is single-axis tracker and dual-axis tracker. For a single-axis tracker, only one axis can be adjusted, depending on where the tracker is installed, either vertical or horizontal axis. While for a dual-axis tracker, the horizontal and vertical axis can be adjusted to the point it can track the sun at any position. For high-concentration solar systems or large-scale concentrated solar energy, these systems require high precision to collect solar irradiance with maximum efficiency.

2.3 Photovoltaic system

Photovoltaics is referred to as a way to generate electricity by using solar cells encapsulated in photovoltaic modules, usually with multiple electrical connections as a solar photovoltaic array to convert energy from the sun into electrical energy. To explain the photovoltaic solar array more simply, the photons from the sunlight impact electrons into a better energy state, thereby generating electricity. The term photovoltaic refers to the unbiased operating mode of the photodiode, where the current flowing through the deviceis entirely due to the converted light energy. Almost all photovoltaic devices are some types of photodiodes. Solar cells generate direct current through light, and direct current may not be able to power the device or charge the battery. The first application of photovoltaics was to power orbit satellites and other spacecraft, but today most photovoltaic modules are used for grid-connected power generation. In order to convert from DC to AC, an inverter will be used.

2.4 Solar panel

Solar cells are a set of photovoltaic cells that convert sunlight into electrical energy. When producing solar panels, the manufacturer must ensure that the solar cells are electrically connected to each other in the system. Solar cells also need to be protected from moisture and mechanical damage, as this will significantly reduce the efficiency of the solar panel and reduce the expected service life. Solar cells usually have a lifespan of 20 years, which usually means that solar panel owners will not experience a significant reduction in inefficiency. Nonetheless, most recent advances in innovation, most business sun based boards right now arrive at 15% effectiveness and this is positively one of the primary reasons why the sun oriented energy industry is as yet unfit to contend with petroleum derivatives. Once in a while business sun powered boards go past 20% effectiveness. Sun based boards are not difficult to keep up on the grounds that there are no moving parts. The solitary thing to stress over is making a point to dispose of whatever can hinder daylight from thesunlight based boards (Septiadi, 2009).

2.4.1 Principle of solar panel works

Traditional solar cells work using the p-n junction principle, which is the junction between p-type and n-type semiconductors. This kind of semiconductor is composed of existing atomic bonds, with electrons as the basic component. A semiconductor with an excess of negative charge) and a semiconductor has a positive charge in its atomic structure. This situation of excess electrons and holes can occur by fixing the material with atomic dopants. For example, to obtain a p-type silicon material, silicon is doped with boron atoms, and to obtain an n-type silicon material, silicon is doped with phosphorus atoms. The figure below depicts p-type and n-type semiconductor junctions.

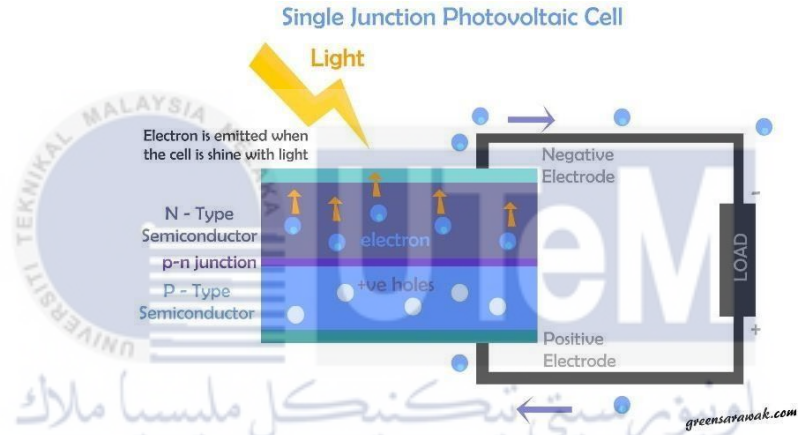

Figure 2.5.1.a: p-n type semiconductor

The function of this pn junction is to create an electric field so that electrons and holes can be extract by the contact material to generate electricity. When the p-type and n-type semiconductors are in contact, the excess electrons will move from the n-type to the p-type semiconductor, forming a positive electrode in the n-type semiconductor, and vice versa, forming a negative electrode in the p-type semiconductor. Due to this flow of electrons and holes, an electric field is formed. When sunlight hits the pn junction arrangement, it will push the electrons to move from the semiconductor to the negative contact, and then use it as electricity, and vice versa. Move and wait for the electron to arrive, as shown in the figure below.

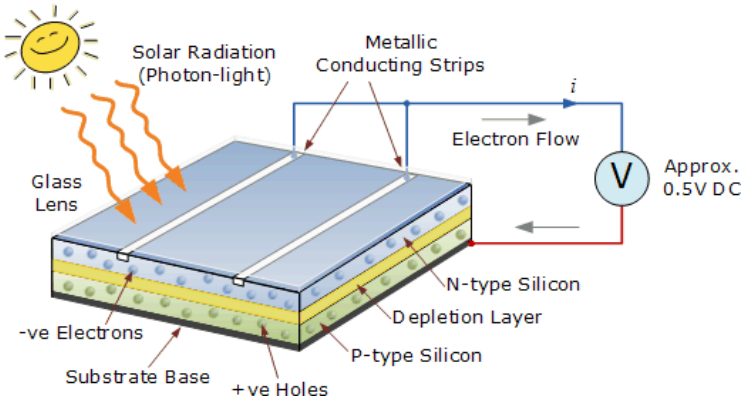

Figure 2.5.1.b: Illustration of how solar cells work with the p-n junction principle

2.4.2 Structure of solar panel

As per the improvement of science and innovation, the sorts of the sun powered cell innovation additionally create with different developments. There are called solar cells generation one, two, three, and four, with different structures or parts that make up the cell. For this sub-topic, we will talk about the construction and operations of sun oriented cells that are basic in the market today, name silicon-based solar cells which for the most part incorporate the construction and activities of first and second-generation solar cells (silicon solar cells) and (thin-film / thin layer).

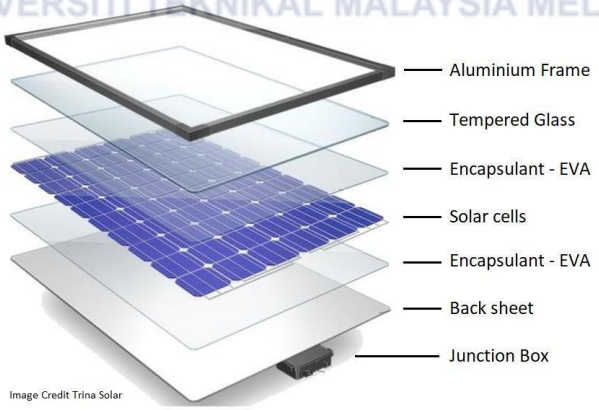

Figure 2.5.2: Structure of solar cell