



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SOLAR TRACKING SYSTEM USING ARDUINO

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

by

MUHAMMAD IKMAL EZANI B BADRUL ZAMAN

B071610824

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Date : 12/12/2019

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow

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(Encik.Ts Ramlan B Latip)

ABSTRAK

Pada masa kini, tenaga yang boleh diperbaharui ataupun dengan nama yang lain ialah 'Green Energy' adalah salah satu bentuk tenaga yang pesat membangun di negara kita. Terdapat pelbagai jenis tenaga yang boleh diperbaharui yang ada tetapi di negara kita, sistem solar menjadi pilihan oleh kerana kedudukan Malaysia yang terletak di garisan khatulistiwa. Di samping itu, sistem ini adalah sistem yang cekap untuk menghasilkan tenaga elektrik daripada cahaya matahari. Akan tetapi, solar panel yang banyak digunakan di Malaysia bersifat static. Oleh kerana kedudukan matahari yang berubah mengikut masa, kecekapan solar panel untuk mendapatkan cahaya matahari yang cukup untuk menghasilkan tenaga adalah minima. Oleh sebab itu, projek ini dihasilkan untuk menambah baik sistem solar panel yang sedia. Projek yang dihasilkan membolehkan solar panel bergerak mengikut tempat yang mempunyai kadar cahaya yang tinggi untuk penghasilan tenaga. Untuk mengerakkan solar panel pada 2 axis yang berbeza. Dua servo motor digunakan dan ia juga disambung kepada arduino. Bagi mengesan kedudukan cahaya matahari, photoresistor sensor digunakan. Tujuan utama projek ini adalah untuk menghasilkan "Solar Tracking System using Arduino". Sistem ini akan membantu mengerakkan solar panel selari dengan cahaya matahari untuk penghasilan tenaga yang maximum. Sistem ini juga mampu mengambil data penghasilan voltan yang dihasilkan oleh solar panel pada masa tertentu. Hasil daripada projek ini, pelajar dapat memerhati kadar voltan yang dihasilkan oleh solar panel pada masa tertentu dan mencipta penyelesaian bagi masalah perolehan tenaga yang kurang cekap pada solar panel.

ABSTRACT

Nowadays, renewable energy or another nickname is 'Green Energy' is a rapidly developing energy in our country. There are many types of renewable energy available, but in our country, a solar system is an option because of the Malaysia position located on the equatorial line. Besides, this system is an efficient system for producing solar energy from sunlight. However, the widely used solar panels in Malaysia are static. Since the sun's position changes over time, the efficiency of the solar panel to get enough sunlight to produce minimum energy. Therefore, the project is produced to improve the existing solar panel system. The resulting project allows solar panels to move according to a place that has a high rate of light for energy production. To move solar panels on two different axes, two servo motors are used, and they are also connected to Arduino. To detect the sun's position, sensor photoresistor is used. The primary purpose of this project is to generate a 'Solar Tracking System using Arduino'. This system will help move parallel solar panels to sunlight for maximum power generation. The system is also capable of collecting voltage generation data generated by solar panels at a given time. Outcomes of this project, students can observe the volatility caused by solar panels at a given time and create solutions for energy efficiency problems in solar panels.

DEDICATION

Parents,

Badrul Zaman B Idris and Zubaidah Bt Ahmad

Specially dedicated to each of you for never being discouraged by unwavering enthusiasm and pride. I pray that both of you live in healthy and happy life forever.

Siblings

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Thank you for giving us lots of guidance and advice. Becomes a happy bond of the hereafter and no one can separate us apart from death. Hopefully continue to succeed in their respective career.

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BEEI 2016/2017

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

IPU	-	Air Pollution Index
I / O port	-	Input and Output port
PWM	-	Pulse Width Modulation
PIC	-	Peripheral Interface Controller
RISC	-	Reduced Instruction Set Computing
DC	-	Direct Current
PV	-	Photovoltaic
LDR	-	Light Dependent Resistor
NIR	-	Near-infrared
IDE	-	Integrated Development Environment
LCD	-	Liquid Crystal Display
AC	-	Alternating Current
CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering

CHAPTER 1

INTRODUCTION

1.1 Research Background

Now is the modern era, electricity is the most important things that need in all everyone life especially human. Reading of energy consumption graph increasing every day because growing in industries in all country. Because of that, to balance a lack of sources to produce electricity, many researches to find a solution to this problem. From the research and study, many types of energy that be found, conventional method and non-conventional method. Some of the energy sources that use to generate electricity like fossil, charcoal, and gas can reduce due that is non-renewable sources and it is said to be non-conventional. To overcome that problem, the new system of renewable energy have been developed. It uses the ability of nature such as solar, wind, sea wave, and others to generate electricity for user's demand.

In Malaysia, suitable renewable sources can be used to produce electricity is a solar panel. It is because Malaysia is a country located on the equator that receives a lot of sunshine. Therefore, solar energy technology with solar power is very popular in Malaysia. The sun has generated millions of energy in millions of years. No pollution occurs due to the sun. Therefore, the sun is a clean source of energy that will not be for any pollution to the earth than other energy used to produce electricity.

For the functional solar power system, it does not need sophisticated technology to operate, but it needs a great place to put solar panels or photovoltaic panels for enough energy to meet daily needs. Furthermore, if the place to be installed is in a densely populated area such as an apartment and a crowded residential area. Therefore, the area is very limited. In order to solve the problem and want to use the

energy that uses the concept of 'Green Energy', solar energy is the best option because it is the energy that can be disseminated without polluting the surrounding environment.

1.2 Problem Statement

The source for electricity generation in Malaysia is by using coal and fossil fuel. This is because Malaysia is one of the rich countries with such natural resources. Although such resources help a lot in raising the Malaysian economy in the industry, the effect of combustion from resources make air pollution to the world. Cited news from the newspaper 'Berita Harian', in August 2018, Miri Sarawak pointed out the reading of the 203-air pollution index (API) as unhealthy effect form open combustion. Other than that, the resources used are temporary, over time the energy will decrease. To overcomes for this problem, the use of solar power sources such as solar energy is best as well as it does not pollute the environment.

As we know, the sun often changes position. Typically, the existing solar panel is static, it cannot produce energy more efficiently because of the changing sun's timing position. Therefore, the use of automatic solar tracker is ideal for maximizing power generation. Based on an article written by Hossein Mousazadeh et al (2008), two axes solar tracking collect many energy compare to normal position solar panel. Thus, developed dual axis automatic solar tracking system is a great idea to maximizing the power generated by a solar panel.

1.3 Project Objective

The aims for this project are:

- a) To design and develop prototype solar tracking system by using Arduino.
- b) To understand voltage rate during time.

1.4 Scopes

This project's scope is:

- (i) Develop a system that can control the solar panel's axis of rotation to achieve maximum power generation. The energy collected during the daytime is stored in the battery and used during the night.
- (ii) Using photoresistor sensor to send information signal to Arduino that changes the positions of solar panel according to sunlight positions.
- (iii) Voltmeter be used to collect voltage in solar panel and send data to Arduino to
- (iv) Use Arduino to run program to move all moving part and collect data from sensor.

1.5 Research Methodology

There are several steps in methodology in the production of this project. The first step is to determine the type of microcontroller to use. Take into account the spec for microcontroller board, number of i / o ports, durability, and so forth related to the project.

After that, the next step is to choose the type of motor that will be used to become the medium to move solar panels to produce maximum energy. When choosing the type of motor to use, the preferred aspect is the degree of rotation of a motor. In producing this project, the type of motor to be used is a servo motor.

Selection of solar panels is also crucial for this project. This is because there are advantages and disadvantages for each solar panel. There are three types of solar panels being studied, Polycrystalline solar panel, Monocrystalline solar panel and Thin-film solar cell.

Here are various types of sensors that have been studied for the production of this project. Among the sensors given are the sensors acting on the light called Sensor Photoresistor. This sensor will be used in four corners to enable it to detect light more effectively. This sensor works by detect position the sun between the other sensors and will send the signal to the Arduino to move the motor in the direction it detects.

After finishing selecting the components to be used for project production, the next process is to design a stand that will be used to place solar panels and motors to move them. The completed model will be connected to Arduino, and the next process is writing coding for this project.

Proteus software is used to simulate circuit simulations once it is programmed into Arduino. Data voltage will display throw LCD. This data represents the value of the voltage received in the fixed period to find the most generating time of voltage to charge the battery. Data taken will be recorded, analysed and concluded.

1.6 Project Deliverables

This project has two main parts in its production, software and hardware. This project has also been divided into two sections, Part 1 (PSM1) and Part 2 (PSM2). In the process of completing Part 1, hardware and software are simultaneously made to meet the specified time.

Part 1 (PSM 1) begins in February 2019 and ends in June 2019. The key issues contained in PSM 1 include the project title, introduction, problem statement, objective, scope, literature review and methodology. Students should also present a presentation to the panel to obtain confirmation from them to proceed with the project.

Part 2 (PSM 2) begins in August 2019 and ends in January 2020. The important thing contained in PSM2 is the result, discussion, conclusion and recommendation. At

present, it is also essential to ensure that the project is fully completed to be evaluated by the panel. All changes made during project production should be included in the report.

Finally, the reports on Part 1 and Part 2 are combined and bound.

1.7 System Deliverables

This project will generate a solar tracking system using Arduino. It will maximise the production of electricity from sunlight compared to static solar panels. Data on the most generating time of energy will be recorded. The data will be discussed and analysed.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Chapter 2 demonstrates that previous research has been done. It will talk about the comparison between the components to be used and used by the previous project. Below the previous study that previous research was conducted.

2.1 Microcontroller

In different sectors, a microcontroller is important, especially in controlling a system. It can control electrical and electronic component requirements following the instructions given in certain languages. The system will proceed according to the instructions provided. Some of the journals that are examined many mention the benefit of using a microcontroller (Al-Dhafer , 2001), (John Crisp, 2003) and (Ying Bai, 2016).

Okan BINGOL etc. al (2005) with the journal title ‘Microcontroller Based Solar-Tracking System and Its Implementation’ says that by using micro-controller PIC16C71 as a circuit for their project, there can keep the design simple and cheap compared to use another component. It’s because in microcontroller it consists of all function component such as a relay, timer, counter and much more in one component.

M. Zolkapli etc. al (2013) in journal title ‘High-efficiency dual axis solar tracking development using Arduino’ says that microcontroller changes the input

coding to signal that be used to control motor speed and motor direction. It can control by either one, digital signal or PWM signal that in a microcontroller.

2.1.1 Programmable Interface Controller (PIC) Microcontroller.

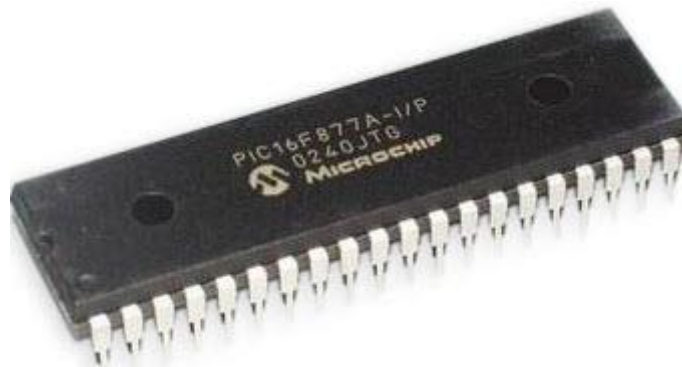


Figure 2.1: PIC Microcontroller

PIC microcontroller is type of microcontroller family that produced and created by Microchip technology from Chandler, Arizona. The microcontroller is the result of a compact microcomputer designed to control motor, light, robots etc. In the PIC microcontroller, there is a processor, memory and peripherals for it to work. Below all the advantages and disadvantages using PIC microcontroller.

Advantages:

- (a) PIC microcontroller are consistent and faulty of PIC percentages is very less. The performance of PIC microcontroller is very fast because of using RISC architecture.
- (b) When comparing to another processor, PIC power consumption very low compare other.
- (c) Interfacing by using analog devices easy without using extra circuit.

Disadvantages:

- (a) Complex Architecture have more complex compare to microprocessor so to understanding is quite difficult.
- (b) The programming for PIC quite long and difficult to beginner.
- (c) External source required because it has low power output.

2.1.2 Arduino UNO



Figure 2.2: Arduino UNO

Figure 2.2 shows the microcontroller board name Arduino Uno. Arduino Uno is a type of basic microcontroller that is produced by company Arduino. It can perform several things such sense, storing data, move the motor and much more. It's a simple and basic microcontroller because easy to write a program and easy to understand for the beginner. Arduino can be communicated to a computer, network with help third-party hardware. It's usually take input from the various sensor and controlling different types of motor or other physical equipment. Below the advantages and disadvantages using Arduino:

Advantages:

- (a) 1. Arduino board is ready for use. It consists of 5 V power supply to the sensor or other equipment.
- (b) Arduino also provides many examples in their library in the software.
- (c) It's also have a large community to help the beginner to understand more about this board.
- (d) Open source in software and hardware.

Disadvantages:

- (a) If it is to produce a small-scale project, it may argue that the large Arduino board is comparable to the use of PIC.
- (b) Arduino library needs to improve in time.