ANALYSIS OF EFFICIENCY OF SOLAR PV WITH SOLAR TRACKING SYSTEM IN MALAYSIA CLIMATE

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SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design & Innovation)"

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DECLARATION

"I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledged."

Signature : .....

Name : .....

Date : .....

I dedicated this thesis to my beloved family especially my parent for all the support that has been given to me in doing this project.

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Assalamualaikum w.b.t

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ABSTRACT

Solar energy is becomes more popular nowadays because its form that free from the greenhouse effect and any wasted harmful to the environment. Solar energy can be converting into electrical energy using the solar panel. Commonly, there are two type of technology that applied in solar system which is solar thermal and solar photovoltaic (PV). Solar thermal is converting the heat energy to any other form of useful energy such as kinetic energy. Solar PV is converting the sunlight energy directly into electrical energy by using solar panels to maximize the power produce by using either active of passive system. Solar tracking system is one of the technologies used in solar PV system which is to maximize the use of solar energy. This research was conducted in order to analyze the efficiency of solar PV with solar tracking system by using automated of data collection. The research is focusing on designing the data acquisition system in order to automatically collect the data of electrical parameter which are voltage and current value to calculate the power produce. A data logger has been built by using Arduino UNO to collect this data. The power produce by solar tracking system will then be compare with solar fixed mount system in order to find out the efficiency of the system. The efficiency of solar tracking system is seemed to be higher that solar fixed mount proved by analyzing the data that have been collected. The power increase compare to fixed mount system was in excess of 10% and it can be considered as a high percentage in solar energy technology. Based on the result and analysis, it proves that all the objective of this project was successfully achieved.

ABSTRAK

Tenaga solar semakin menjadi perhatian pada masa kini kerana penggunaannya yang bebas daripada kesan rumah hijau dan bahan buangan yang berbahaya kepada alam sekitar. Tenaga solar boleh ditukarkan kepada tenaga elektrik menggunakan panel solar. Kebiasaannya, terdapat dua jenis teknologi yang digunakan dalam sistem solar iaitu teknonologi haba solar dan teknologi cahaya solar. Teknologi haba solar menukarkan tenaga haba kepada apa-apa bentuk tenaga yang berguna seperti tenaga kinetik. Teknologi cahaya solar menukarkan tenaga cahaya matahari secara terus kepada tenaga elektrik dengan menggunakan panel solar untuk memaksimumkan hasil kuasa dengan menggunakan sama ada sistem aktif atau sistem pasif. Sistem pengesan solar adalah salah satu teknologi yang digunakan dalam technologi cahaya solar iaitu untuk memaksimumkan penggunaan tenaga solar. Kajian ini dijalankan untuk menganalisis kecekapan teknologi cahaya solar dengan penggunaan sistem pengesan solar menggunakan alat pengumpulan data secara automatik. Kajian ini memberi tumpuan kepada mereka bentuk sistem perolehan data bagi mengumpul data parameter elektrik seperti nilai voltan dan nilai arus untuk mengira hasil kuasa secara automatik. Satu pengumpul data telah dibina dengan menggunakan Arduino UNO untuk mengumpul data ini. Hasil kuasa oleh sistem pengesan solar kemudiannya akan dibandingkan dengan sistem solar tetap untuk mengetahui kecekapan sistem. Kecekapan sistem pengesan solar dilihat menjadi lebih tinggi berbanding system solar tetap dibuktikan dengan menganalisis data yang telah dikumpulkan. Peningkatan kuasa berbanding sistem solar tetap adalah melebihi 10 % dan ia boleh dianggap sebagai peratusan yang tinggi dalam teknologi tenaga solar. Berdasarkan keputusan dan analisis, ia membuktikan bahawa semua objektif projek ini telah berjaya dicapai.

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PV	=	Photovoltaic
DAQ	=	Data Acquisition System
DC	=	Direct Current
AC	=	Alternating Current
ACDB	=	Alternating Current distribution boards
V	=	Volt (unit for voltage)
A	=	Ampere (unit for current)
W	=	Watt (unit for power)

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This chapter will cover on the research background, problem statement, objective, scope and the summary of the report. All information of the research will be stated clearly in order to achieve the objective of this project. In this project, the focus is given on the study of solar PV with solar tracking system in Malaysia climate.

1.1 RESEARCH BACKGROUND

Nowadays, a lot of energy needs to be use in order to survive in human daily life. There is several type of energy that act as a main source of energy for human such as kinetic energy, potential energy, electrical energy, gravitational energy, thermal energy and heat energy. All this energy is very important in human daily life. Moreover, in this era of technology, peoples need energy in order to light up the house during night, cool down the house during daylight, switch on the computer for working, surfing internet as a source of information, and many other important things. Mostly all this thing needs a huge source of electrical energy to be working out.

Electrical energy is the energy carried by moving electrons in an electric conductor. It cannot be seen but can be measure or can be identify by using electrical instrument such as voltmeter, ammeter, and multi-meter. Electrical energy is one of the most useful forms of energy that help peoples in doing a lot of work. It is also easy to transmit and use where it work when electrons are forced along a path in a conducting substance. There a several ways of generating the electricity such as by using power plants, magnetic poles, turbine, geothermal power and many others ways. In addition, electricity can also be generated by using solar photovoltaic (PV) system.

Solar PV system is one of the technologies of generating electricity. The method used in this system is by converting solar power source which is sunlight into direct current electricity using semiconducting materials that exhibit the effect of photovoltaic. The equipment use in solar PV system is solar panels which consist of a numbers of solar cells that can detect and collect solar energy. Solar cell is a form of photoelectric cell which it electrical characteristic such as current, voltage or resistance vary when it is being exposed to light. Therefore, solar cell is mainly used as a solar energy detector to collect the solar energy before converting it in electrical power. The electrical power generated by solar PV system is categorized as a clean sustainable energy technology because it has been proved that there is no environmental emission during operation.

Solar PV system is very useful in generating electrical power and it is very suitable with climate of Malaysia. Malaysia is located between one and six degrees North latitude. Therefore, Malaysia has an equatorial climate with uniformly high temperature, high humidity, relatively light winds and abundant rainfall throughout the year. As a country which closes to equator, Malaysia naturally has abundant source of sunlight and thus solar radiation. However, it is extremely rare to have a full day with completely clear sky even in periods of severe drought. The cloud cover cuts off the sunlight as a solar energy resources. In average, Malaysia receives about 6 hours of sunshine per day but it is based on seasonal and spatial variations. It shows that Malaysia could use the solar PV system as a method of generating electrical power.

1.2 PROBLEM STATEMENT

In order to generate electricity using solar PV system, a source of solar energy is required which is sunlight that usually been used for this system. Sunlight is commonly known as one of the renewable source of energy. Renewable energy source is come from existing flows of on-going natural processes such as sunlight, wind, flowing water, biological processes and geothermal heat flows. All sources of renewable energy can generate electricity. As for solar PV system, the efficiency of the system is depending on the light intensity. Lower amount of light intensity makes the system less efficient. Therefore in order to make it more efficient, a huge amount of light intensity is required.

The used of solar PV also can be more efficient with a direct sunlight which perpendicular to solar panel. This can be done by using solar tracking system. Solar tracking system is a system where a device for orienting a solar panel towards the sun is used. This system requires high degree of accuracy to ensure that the sunlight is concentrated precisely toward the solar PV system. There are two type of solar tracking system which is single axis tracking system and dual axis tracking system. This research is focusing on the single axis tracking system where the efficiency of the single axis tracking system will be compare to the fix mounted solar panel that is conventionally use in Malaysia.

1.3 OBJECTIVES

The objective of doing this research is to:-

i. Install an automatic data collection system by using Arduino UNO.
ii. Analyse the efficiency of Solar PV with solar tracking system in Malaysia climate.

1.4 SCOPE

The scope of this research will be cover on the installation and monitoring of the data collection system of solar PV with solar tracking system and without solar tracking system. Comparison of electrical power between both types of solar PV system will be made in order to analyse their efficiency in Malaysian climate. A data acquisition system will be use in order to collect the data. Since the research needs the source of sunlight, the research will be conduct and will be monitoring during daylight.

1.5 SUMMARY

This chapter is explaining briefly about the important of energy used in human daily life. Electrical energy is one of the important energy that help human to working out during the day. There a several ways of generating the electricity such as by using solar PV system, power plants, magnetic poles, turbine, geothermal power and many others ways. In this project, the objective is to analyse the efficiency of Solar PV with solar tracking system in Malaysia climate. Since Malaysia is located in an equatorial climate with uniformly high temperature, high humidity, relatively light winds and abundant rainfall throughout the year, it shows that Malaysia could use the solar PV system as a method of generating electrical power. In order to analyse the efficiency, a data acquisition system will be use to collect all the data need.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter will describe briefly on the solar PV tracking system. All information related to this project will be explained in order to increase the understanding in doing this project. There will be also explanations about the data collecting system that will be used on this project.

2.1 SOLAR SYSTEM

2.1.1 Renewable Energy

Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are naturally replenished[1]. In this various forms, it derives directly from the sun or from heat generated deep within the earth. Included in the definition is electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, and biofuels and hydrogen derived from renewable resources[2]. Figure 2.1 show that natural gas and nuclear power are expected to grow slowly over the upcoming years. It also expected that the renewable energy is growing faster from 2000 and also hope that a new clean energy source of fusion energy will be demonstrated at increasing scales from 2030 to 2070 which will then become commercially competitive[3].

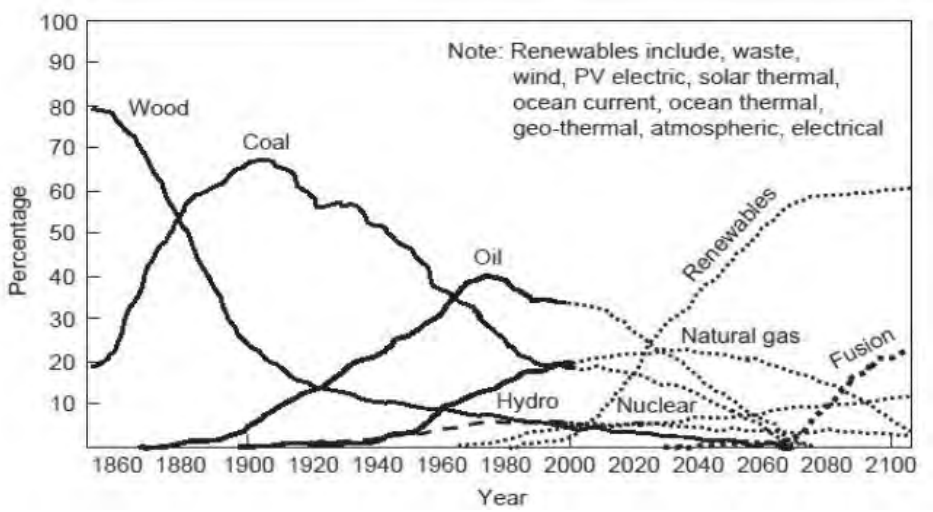

Figure 2.1: Percentage of energy used

Renewable energy replaces conventional fuels in four distinct area which are power generation, water and space heating, transport fuels, and rural and remote areas energy services[1]. Globally, as estimated 193 million households depends on renewable energy systems. The most important of renewable energy is solar energy. However, grid-connected PV increased the fastest of all renewable technologies, with 60 percent annual average growth rate for the five year period[1]. Nowadays, solar energy has been widely used and it is expected to be increase in the next upcoming years.

2.1.2 Solar Energy

Solar energy is the energy which derived from the sun through the form of solar radiation. The basic aspects of solar energy system include components (such as photovoltaic, modules, solar cell and inverters), integration and installation. Solar powered electrical generation relies on photovoltaic. A partial list of other solar applications includes home heater, lighting, water heater, solar cooking, and even produce air conditioning for homes, businesses, and industrial application[4].

2.2 SOLAR PHOTOVOLTAIC SYSTEM

The word photovoltaic comes from the Greek meaning “light” (photo) and “electrical” (voltaic). The common abbreviation for photovoltaic is PV[5]. The sun delivers its energy to us in two main forms which are heat and light. There are two main types of solar power systems namely solar thermal system that trap heat to warm up water and solar PV system that convert sunlight directly into electricity as shown in Figure 2.2[6].

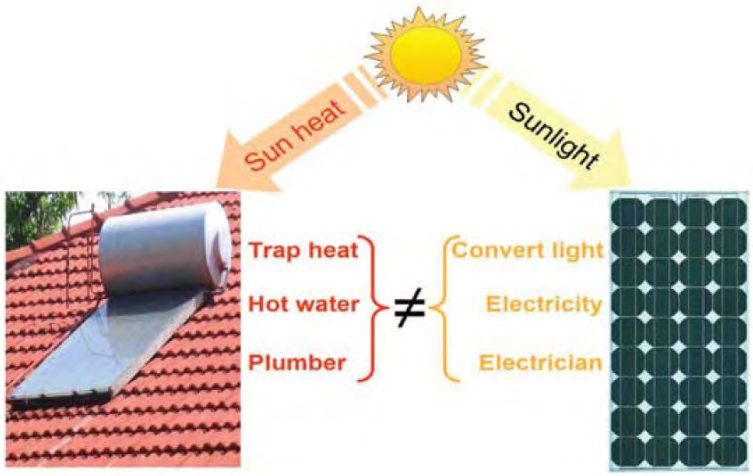

Figure 2.2: Solar power system

When the PV modules are exposed to sunlight, they generate direct current, DC electricity. An inverter then converts the DC into alternating current AC electricity so that it can feed into one of the building’s AC distribution boards, ACDB without affecting the quality of power supply[6]. PV technology converts

sunlight into electricity using no moving parts, consuming no conventional fossil fuels, creating no pollution and lasting for decades with very little maintenance. The use of a widely available and reasonably reliable fuel source-the sun-with no associated storage or transportation difficulties and no emissions makes this technology eminently practicable for powering remote scientific research platforms[7]. The need for low cost electric power in isolated areas is the primary force driving the world wide PV industry today. PV technology is simply the least cost option for large number of applications such as stand-alone power systems for cottages and remote residences, remote telecommunication sites for utilities and the military, water pumping for farmers and emergency call boxes for highways and college campuses[8].

2.2.1 Solar Cell

Bell laboratories produced the first solar cell in 1954. The efficiency of this solar cell was about 5 percent. The first solar cell was design for space applications, so the cost was not a major issue. Then solar cell efficiency increased continuously in the following years, and costs have decreased significantly in recent decades. The main material used in the construction of solar cells is still silicon, but other materials have been developed, either for potential for cost reduction or their potential for high efficiency[5].

Solar cells are converting light energy to electrical energy. When light energy is reduced or stopped, as when the sun goes down in the evening or when a cloud passes in front of the sun, then the conversion process stops or slows down. When the sunlight returns, the convention process immediately resumes, this conversion without any moving parts, noise, pollution, radiation or constant maintenance. These advantages are due to the special properties of semiconductor materials that make this conversion possible. Solar cells convert light to electricity when sunlight is available but they do not store electricity. To have electric power at night, a solar electric system needs some form of energy storage, usually batteries, to draw upon[9].