Solar tracking systems and heating engineering essay

ASSIGN BUSTER

CHAPTER 1

INTRODUCTION

Solar tracking systems and heating and cooling systems are defined in this report. In addition to our current knowledge, we are adding some new literature surveys which is useful for solar tracker project. Moreover, this report also mentions about initial problem statement and literature review for investigation and evaluation on the solar heating and cooling system of a house.

1. 1 INTRODUCTION

There are many different applications for solar power systems, but there are also many limitations to these applications. The cost-benefit is too low for solar power systems to be widely used for powering homes, businesses, or even individual products. As the range of applications for solar energy increases, so does the need for improved materials and methods used to harness this power source. There are several factors that affect the efficiency of the collection process. Major influences on overall efficiency include solar cell efficiency, intensity of source radiation and storage techniques. The materials used in solar cell manufacturing limit the efficiency of a solar cell. This makes it particularly difficult to make considerable improvements in the performance of the cell, and hence restricts the efficiency of the overall collection process. Therefore, the most attainable method of improving the performance of solar power collection is to increase the mean intensity of radiation received from the source. There are three major approaches for

maximizing power extraction in medium and large scale systems. They are sun tracking, maximum power energy.

1. 1. 1 Initial Problem Statement:

Solar energy is a very clean and renewable way to generate electrical power. Solar panels are consists of photovoltaic cells, that converts the sunlight into the electrical power, every cell individually generates a little amount of electricity, then the panel adds them together and gives a single output. The problem is the efficiency here, the electricity that the panel produces is not enough to be used in daily life. Because of the statically replaced panels, the sunlight can not be received efficiently by the panel all day long, which causes the solar system to generate less electricity then enough to be used in daily life.

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CHAPTER 2

LITERATURE SURVEY

2. 1 LITERATURE SURVEY

The aim of the project is to build a solar tracking system, as to improve the efficiency of the electricity produced by the sun panel. Nelson Kelly A. and Thomas Gibson L. (2009) claim that it is well-known that 2-axis tracking, in which solar modules are pointed at the sun, improves the overall capture of solar energy by a given area of modules by 30-50% versus modules with a fixed tilt. There are many researches and many different types of two axis sun tracking systems. In this chapter there are some literature surveys

added on this project. In addition to this, most important systems are analyzed, and explained.

The study of Ashok Kumar Saxena and V. Dutta had designed a microprocessor based controller for solar tracking in 1990. The controller capaicty were useful in autonomous photo voltaic systems that control system were monitoring in remote areas. Solar tracking was achieved in both open loop and closed loop modes. The controller was totally automatic and did not need any operator interference unless needed. The system is very useful beacuse [Ashok Kumar Saxena and V. Dutta, 1990].

Another study of Konar and A. K. Mandal had given a microprocessor based automatic position control in the year of 1991. They had designed for controlling the azimuth angle of an tilted photovoltaic solar panel and cylindrical reflector to get the illumination surface for positioned because of the collection of maximum solar irradiation. The system resulted in saving of solar energy. The system was designed as a fake tracker in which step tracking way, which system had been used to keep the motor idle for saving energy. Temperature variations in environmental parameters caused by fog, rain, snow., distance from the location where the solar panel was lcoated, the system did not affect proper direction when the system try to finding sun. This system is very efficient way because the solar tracker have a saving energy mode.[A. Konar and A. K Mandal, 1991]

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The study of Zeroual had designed an automatic sun-tracker system for optimum solar energy collection in the year of 1997. They used electro-

optical sensors for sun finding and a microprocessor controller in this system. Moreover, this system allowed to use solar energy collectors to follow the sun position for optimum efficiency. The solar tracker system had a modular structure which the system have facilitates its application to different systems without any modifications. The system had been applied to control a water heating solar system for houses in domestic uses. Many parameters had been controlled for system security such as temperature, pressure and wind velocity. The solar tracker system had been tested for a long period in variable illumination of the sun. The results are showed that it works with high accuracy. In addition to this, this system is very efficient for our solar tracker with use in heating and cooling systems in the houses. [A. Zeroual et al., 1997].

The other study of Eftichios Koutroulis had given the microcontroller based photovoltaic maximum power point tracking control system in the year of 2001. Maximum power point tracking (MPPT) was used in photovoltaic systems to maximize the photovoltaic array output power. A new maximum power point system tracking had developed, consisting of a dc/dc converter, which was controlled by a microcontroller-based unit. The photovoltaic arrays output power send to a load was increased using maximum power point control systems. The resulting system had high-efficiency and lower-cost. This system is shows the way how can design a solar tracker with microcontroller which is have a high efficiency. [Eftichios Koutroulis et al. , 2001].

The last study of A. Khalil had given in experimental investigation way of a sun tracking system in the year of 2004. This sun tracking system is tried to

collect the largest amount of solar radiation and converted it into usable form of electrical energy. Thus, this system stored this energy into batteries for different types of applications. The sun tracking systems could collect more energy than what a fixed panel system collected. Therefore, the system was easy to implement and efficient. The sun tracking system was an efficient system for solar energy collection. This study is useful for our high efficiency solar tracker. [A. A. Khalil et al., 2004]

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CHAPTER 3

LITERATURE REVIEW

3. 1 LITERATURE REVIEW

It has been found some sources for the literature survey about the solar tracker systems and heating & cooling systems. In the solar tracker systems, electronic logic and panel mechanism are researched by the help of the literature surveys. Moreover, some techniques about the heating and cooling system for the houses are researched and listed.

3. 2 Literature Review of Electronic Logic:

In the study of Ataman, M., YÄ±ldÄ±z, Åž. and Kal, Ä°., LDR, trimmer potentiometer, and the transistor are used to control the system. The system operates like; when the LDR receives sunlight, the resistance on the LDR decreases, the current that flows over the LDR, let’s the transistor to work as a switch. Then the motor receives the current and runs the system as to be perpendicular to sun. In this system, we use LDR for only understand the difference between day and night for sun tracking system. Thus, solar

tracker system will be working autonomously by the help of the LDR. In addition to this; since the solar tracker system is not controlled by the microcontroller, the energy waste will be much, because the system will always wants to track the sun.

Another study of Dönmez, Åž. and Ã-zdemir, A. approaches to sun tracking systems in a different way. This sun tracking system operates by the help of the solar cells. This solar cells are used in this study for detect the position of the sun. Thus, microcontroller drives the system. The system includes four solar cells are placed in the corners of the square platform as in the form of two by two matrixes; a shadowing component is placed between the solar cells in the platform. The color of the shadowing component is black, because it should not allow the sunlight to reflect. In our project, we can use the four solar cells like in this system but we have not any shadowing component in the platform. Instead of this, our solar tracker platform is different because of shape like a pyramid.

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The study of Yingzhe H. uses CdS(cadmium sulphide) photovoltaic cells, to track the sun, and mercury switches and stereogram to balance the sun panel. In this study, two motors drive the panel to the direction of sun. When setting the solar platform default, mercury switches are used for balance positioning. In general the system uses CdS to act as the main solar tracking sensor. The sensor feeds back to the FPGA(Field-programmable gate array) controller through an analog-to-digital (A/D) device. The Nios II embedded processor is the main control core and adjusts the two-axis motor so that the

platform is in the location for optimal, efficient electricity generation. This solar tracker study is similar to our project. In project, we use 4 part in reference system, but instead of LDR, we use solar cell for each platform.

Figure 1. Tracking Sensor Internal Design

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Figure 2. Solar Tracking Array Architecture Scheme

The system of Hamilton J. S. uses a pyramid reference system to track the sun. This design is useful by the help of a four sided pyramid structure with solar cells mounted on each side. The solar cells, which are acting as sensors, are positioned so they are orthogonal to the opposing sensor. While the design from Larard (1998) was kept, the size of the pyramid structure was increased to accommodate the larger solar panels used as sensors. This structure provides that when the pyramid is pointing directly at the sun the four sensors will have the same voltage reading. By having the sensors set at 45Ëš angles, when the pyramid is not pointing directly at the sun the voltage will increase on the side(s) which is the most exposed to the sun. This allows for comparisons to be made between opposing sets of sensors, which in turn can be used to control the direction of movement of the array. This system is a very efficient way to track the sun in two axis, pyramid shape reference system provides a high efficiency. In addition to this, by the help of the reference system, solar tracker use minimum energy for tracking the sun.

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Figure 3. Pyramid shape reference system (Top view)

Figure 4. Pyramid shape reference system (Side view)

Another important and essential study of, Weissbach R., Aunkst I.(2006). The system operates by the help of microcontroller, and this system called as weather resistant sun tracking system. The type of 8051 microcontroller is used to control the system. The circuit board is placed under a weather resistant housing box, and solar cells are used to detect the position of the sun. The solar cells detects the position of the sun with a periods of 15 minutes, and a low light level sensor is used to detec the existance of the sun, that means the system is not tracking the sun in night time or in a cloudy condition. In our project, we can use this system because it prevents the system to use extra energy. Moreover, solar panel detects the existence of sun in an evcery 15 minutes so we can conserve the solar tracker energy.

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3. 3 Literature Review of Panel Mechanism:

The important and useful project is the study of, BostancÄ±. S. and Tang T. (2006). The study is a very professional industrial one. In this solar tracker panel mechanism consists of two frames that connected to each other, and motors connected in two sides. The use of two frames connected together decreases the momental force on the motors, by this way ideal energy consumption is achieved. In our solar tracker, we use this panel mechanism beacuse of this mechanism provides a low energy consumption for rotation. A frame carries three photovoltaic panels, and each can move in horizontal axis, the frame itself can move in the vertical axis, so the two axis sun

tracking is being achieved. Instead of three photovoltaic panels, we can use only one panel in this mechanism. This panel mechanism is efficient for rotation when the system tracking the sun. The system is one of the most important studies in literature. The design and the properties make the system use the lowest energy consumption to direct the panel to sun.

Figure 5. Solar panel mechanism (1)

Figure 6. Solar panel mechanism (2)

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3. 3 Literature Review of Heating and Cooling System:

The study of Kurtay, C., AtÄ±lgan, Ä°. and Ataer, Ã-. E. is a very important study in the field of heating system of an indoor area. The system consists of water tank, boiler, water pipes, water circulation pump, valves and microcontroller circuit board. The whole system is driven by the microcontroller. The water pump sends the water from the water tank to the boiler. Then, the boiler heats the water and then the hot water passes through the water pipes which are placed under the floor of a house. This system is not effective because we couldn’t use both heating and cooling, this system only us efor heating. Thus, this system is useless for our heating and cooling operation with solar tracker.

The another study in the field of cooling is the Faisal Mohammed Seif Al-Shamiry, Desa Ahmad, Abdul Rashid Mohamed Sharif Ishak Aris, Rimfiel Janius and Rezuwan Kamaruddin is the most important study in the field of cooling system. Moreover, the system contains temperature, pressure, humidity sensor, timer sensor and microcontroller circuit board. The

microcontroller of the system makes the fans work between the hours of 11. 00 am to 16. 00 pm, in addition to that, if the temperature passes 30° Celsius, the fans starts to cool the environment. Besides, if the temperature is lower than 30° Celsius the fans stop, and also if the humidity inside the system is higher than 85% the fans stop. This system have useful control algorithm by the help of the microcontroller. We can use this control system in our solar tracker.

The most important system is heating, ventilation, air conditioning system which is called HVAC. This system provides both heating and cooling for the houses. Heating is significant in maintaining room temperature especially during colder weather conditions. There are two classifications of heating: local and central. Furnace or boiler, heat pump, and radiator make up the heating system. Ventilation, on the other hand, is associated with air movement. There are many types of ventilation, but they all function similarly. Ventilation is necessary to allow carbon dioxide to go out and oxygen to get in, making sure that people are inhaling fresh air. The air-conditioning system controls the heat as well as ventilation.

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Figure 7. HVAC system in summer/winter (http://www. airconditioning-dallas. com/images/howheatpumpworks. gif)

Figure 8. HVAC in houses (http://www. auburn. edu/projects/sustainability/website/images/hvac. jpg)

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Figure 8. HVAC system scheme

(http://www. setrimeenergiu. sk/wps/PA_mi14qjq/content/b2c-vse-se. H3000/en/img/system_hvac. jpg)

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CHAPTER 3

CONCLUSION

The sun has the ability to give off lots of energy; however solar panels can only convert a small amount of solar energy to electrical energy due to inefficiency in solar panel technology. Simply connecting a solar panel to a battery or a load can further decrease the available efficiency. Solar power systems benefit from an microcontoller device in order to extract the maximum available power from the solar panels in the system. The microcontroller device is a charge controller that compensates for the changing voltage vs current characteristic of a solar cell. By LCD screen the voltage and current output of the solar panel, the solar tracks the always-changing operating point in order to draw the maximum efficient of power available during all periods of the day.

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