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Dual Axis Solar Tracking System

Dr. Eranna[1], Nagappa[2],Rakshitha m p[3], Rohit[4], Kishore d n[5]

[1]Associate Professor, [2345UG] Student
[1,2,3,4,5]Department of Electrical and Electronics Engineering,
[1,2,3,4,5]Dr. Ambedkar Institute of Technology, Bangalore, India

A B S T R A C T

The goal of our proposed project was to develop a laboratory prototype of a solar tracking system, which is able to enhance the performance of the photovoltaic modules in a solar energy system. The operating principle of the device is to keep the photovoltaic modules constantly aligned with the sunbeams, which maximizes the exposure of solar panel to the Sun's radiation. As a result, more output power can be produced by the solar panel.

The work of our proposed project included hardware design and implementation, together with software programming for the microcontroller unit of the solar tracker. The system utilized an ATmega328P microcontroller to control motion of two dc motors, which rotate solar panel in two axes. The amount of rotation was determined by the microcontroller, based on inputs retrieved from four photo sensors located next to solar panel. At the end of the project, a functional solar tracking system was designed and implemented. It was able to keep the solar panel aligned with the sun, or any light source repetitively. Design of the solar tracker from this project is also a reference and a starting point for the development of more advanced systems in the future.

***Keywords*:** Solar panel, Arduino board, servo motors, LDR, Sensors,

1. INTRODUCTION

With the unavoidable shortage of fuel sources within the future, renewable forms of energy became a subject of interest for researchers, technicians, investors and decision makers all round the world. New varieties of energy that have gotten attention include hydroelectricity, Bio-energy, solar, wind and heat, Tidal power and wave power. due to their renewability, they're considered as favorable replacements for fuel sources. Among those sorts of energy, solar photovoltaic (PV) energy is one among the foremost easily and in-exhaustive available natural resources. This technology has been adopted more widely for residential use nowadays, an intensive research and development has been during this direction to enhance solar cells' performance and lower the price. consistent with International Energy Agency (IEA), worldwide PV capacity has grown at 49% per annum on the average since early 2000s. Solar PV energy is very expected to become a significant source of power within the future. However, despite the benefits, solar PV energy remains faraway from replacing traditional sources on the market. it's still a challenge to maximise power output of PV systems in areas that don't receive an outsized amount of radiation. We still need more advanced technologies from manufacturers to boost the potential of PV materials, but improvement ofsystem design and module construction may be a feasible approach to create solar PV power more efficient, thus being a reliable choice for patrons. Aiming for that purpose, this project had been administered to support the event of such Promising technology.

One of the most methods of accelerating efficiency is to maximise the duration of exposure to the optimum radiation. Tracking systems help achieve this by keeping PV solar panels aligned at the acceptable angle with the radiation at any time. The goal of this project is to create a prototype of sunshine tracking system at smaller scale, but the look are often applied for any alternative energy system in practice. it's also expected from this paper a quantitative measurement of how well tracking system performs compared to system with fixed mounting method.

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2. OBJECTIVE

- To utilize the maximum solar energy by using solar panel.
- The solar panel tracks the sun from east to west automatically from maximum intensity of light.

3. LITERATURE SURVEY

Paper 1

"Solar tracker robot using micro controller" by A.B. Afarulrazi, W.M Utomo, K.L Liew and M. Zarafi published in 2011 international conference on business, engineering and industrial Applications.

Summary

In this paper entitled, "Solar tracker robot using micro controller" by A.B. Afarulrazi, W.M Utomo, K.L Liew and M. Zarafi published in 2011 international conference onbusiness, engineering and industrial Applications describes to design and develop an automatic solar tracker robot (STR) which is capable to track maximum light intensity. The efficiency of solar energy conversion can be optimized by receiving maximum light on the solar panel. STR is micro controller based and built to move the solar panel in one axis which is from east to west and vice versa. Servomotor is the actuator used to move the solar panel due to the high torque and small in size.

Paper 2

Design and construction of an automatic solar tracking system by Md Tanvir Arafat khan,S.MShahrearTanzil, Rifet Rahman, S.M shafiulalam published in 6th international conference on electrical and computer engineering ICECE 2010. 18-20 December 2010 Dhaka, Bangladesh.

Summary

In the paper entitled, "Design and construction of an automatic solar tracking system by Md Tanvir Arafat khan,S.MShahrearTanzil, Rifet Rahman , S.M shafiulalam published in 6th international conference on electrical and computer engineering ICECE 2010. 18-12-2010 Dhaka, Bangladesh, describes a microcontrollerbased design methodology of an automatic solar tracker. Light dependent resistors are used as the sensors of the solar tracker. The designed tracker has precise control mechanism which will provide 3 ways of controlling system. A small prototype of solar tracking system is also constructed to implement the designed methodology presented here.

4. BLOCK DIAGRAM AND CIRCUIT DIAGRAM

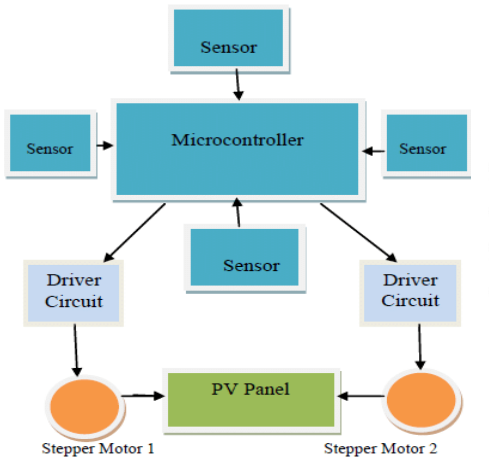

Fig: block diagram of the model

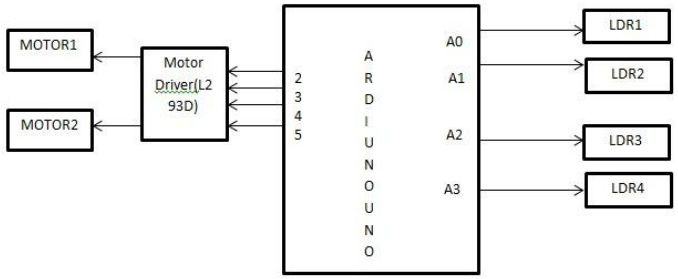

Fig: circuit diagram of project

5. METHODOLOGY

The solar tracking system comprises of a electrical device, Arduino microcontroller and sensors. For this technique to work there must be emission of sunshine radiation from sun. The LDRs function the sensors to detect the intensity of sunshine entering the solar panels. The LDR then sends information to the Arduino microcontroller. The servo motor circuit is then constructed.

The servo has 3 pins of which the positive terminal is connected to the +5v of the Arduino microcontroller. The negative terminal of the servo is connected to the bottom. the information point on the servo is connected to the analog point on the microcontroller. A potentiometer is connected so on regulate the speed of the servo motor.

6. CALCULATION

Practically:

Voltage at vertical sun position =Vmax =5.88v

And at 45˚ =5.5v

Theoretical:

To calculate voltage at 45 theoretically, split the light ray into two components vertical component and horizontal component. Only the vertical component of the light ray is utilized to generate power from solar panel (i.e. the rays perpendicular to the solar panel).

Vmax *cos(ɵ1)=4.16v ; 5.88*cos(45)=4.16v To

find angle of refraction : 5.88*cos(ɵ2)=5.5

ɵ2 =20.7

refractive index = incident angle/refracted angle = ɵ1/ɵ2 = 45/20.7 = 2.17To find voltage theoretically without tracker = Vmax * cos(ɵ1/2.17)

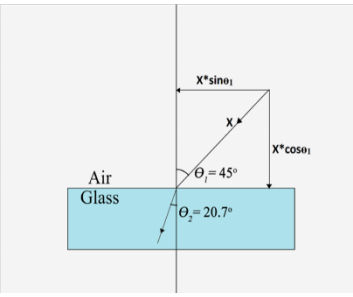

Fig. Calculations of angle for solar panel

Voltage:

Time	Angle of sun w.r.t horizontal	Incident angle ɵ1	V without tracker	V with tracker	% reduction in voltage
7am	30	60	5.2v	5.88v	11%
8:40am	45	45	5.5v	5.88v	6%
10:20am	60	30	5.7v	5.88v	3%
12pm	90	0	5.88v	5.88v	0%

Current:

Time	Angle of sun w.r.t horizontal	Incident angle ɵ1	I without tracker	I with tracker
7am	30	60	200mA	300mA
8:40am	45	45	260mA	300mA
10:20am	60	30	290mA	300mA
12pm	90	0	300mA	300mA

Average power without tracker = 1.5W

Average power with tracker = 1.8W

Energy for 10hrs without tracker = 15Whr

Energy for 10hrs with tracker = 18Whr

6. HARDWARE AND SOFTWARE COMPONENTS

- **HARDWARE**

  - LDR
  - ARDUNIO UNO R3
  - DC MOTORS
  - S0LAR PANEL
  - VOLTAGE REGULATOR/POWER SUPPLY
  - RESISTANCE
  - BATTERY
  - PATCH CORDS
  - WIRES
  - MOTOR DRIVER(L293D**)**

- **SOFTWARE**

- Arduino IDE

7 RESULT

In this Dual Axis Solar Tracker, when source light falls on the panel, the panel adjusts its position per maximum intensity of sunshine falling perpendicular thereto.

This was achieved through using light sensors that are able to detect the number of sunlight that reaches the electrical device. The values obtained by the LDRs are compared and if there's any significant difference, there's actuation of the panel employing a servo motor to the purpose where it's almost perpendicular to the rays of the sun.

This was achieved employing a system with three stages or subsystems. Each stage has its own role.

The stages were;

An input stage that was responsible for converting incident light to a voltage.

A control stage that was responsible for controlling actuation and higher cognitive process.

A driver stage with the servo motor. it absolutely was answerable for actual movement of the panel.

8. AKNOWLEDGEMENT

We thank our guides Dr.Eranna (Associate Professor, EEE department) and Dr.G.V.Jayaramaiah (Professor & HOD, EEE department) Dr.Ambedkar Institute of Technology, Bangalore for their continuous support and guidance for this project.

9. CONCLUSION

- In this 21st century, as we build up our technology, population & growth, the energy consumption per capita increases exponentially, additionally as our energy resources (e.g.fossils fuels) decrease rapidly. So, for sustainable development, we've got to think alternative methods (utilization of renewable energy sources) so as to fulfil our energy demand.
- In this project, Dual Axis Solar Tracker, we've developed a demo model of solar tracker to trace the utmost intensity point of sunshine source so the voltage given at that time by the electrical device is maximum. After plenty of trial and errors we've successfully completed our project and that we are proud to speculate some effort for our society. Now, like every other experiment, this project has few imperfections.
- Our panel senses the sunshine in a very sensing zone, beyond which it fails to retort.
- If multiple sources of sunshine (i.e.diffused light source) appear on panel, it calculates the vector of sunshine sources & moves the panel therein point.
- This project was implemented with minimal resources. The circuitry was kept simple, understandable and user friendly.

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