DUAL AXIS SOLAR TRACKING SYSTEM

U. NANDU, B. MOHAN KRISHNA REDDY, S. NAVEEN

K.Srivani

Sree Dattha Institute of Engineering and Science, Hyderabad.

Abstract:-

Solar energy is rapidly advancing as an important means of renewable energy resource. Solar tracking enables more solar energy to be generated because the solar panel is able to maintain a perpendicular profile to the sun's rays.

Though initial cost of setting up a solar tracking system is high, this paper proposes a cheaper solution. Design and construction of a prototype for solar tracking system with single degree of freedom, which detects the sunlight using Light Dependent Resistors (LDR), is discussed in this paper. The control circuit for the solar tracker is based on an ATMega8 microcontroller. This is programmed to detect the sunlight through the LDRs and then actuate the motor to position the solar panel where it can receive maximum sunlight.

Theoretical analysis and research results have been shown in this project to advocate that the designed system realized precise automatic tracking of the sun and can greatly improve the utilization of solar energy.

INTRODUCTION:

In this project electrical energy from solar panels is derived by converting energy from the sun rays into electrical current.To achieve maximum solar energy through solar panels digital automatic sun tracking system is proposed. This system is built by using balanced concept of four signals from the different sensors. In this project we used Light Dependent Resistor (LDR) as a light sensor which is optoelectronic device is mostly used in light varying sensor circuit and in light and dark activated switching circuits. If the solar panel is not perpendicular to the sun it will create a variation in light intensities sensed by the light sensors, which are actually separated by divider who creates a shadow on one side of light sensor. Data will be received from the sensors and then the microcontroller Arduino will help in control the movement of the motors via motor driver IC (L298n). To confirm the solar panel is perpendicular towards the Sun

Arduino will send the processed data to the Bi-directional DC-geared motor via motor driver IC (L298n). This Motor driver IC(L298n) controls the rotation of the motor either to rotate clockwise or anticlockwise, so solar panels attached to the motors will be reacted according to the direction of the motors. The position of the panel must always be perpendicular to the light source to get maximum intensity of light and zero voltage difference. The position of the sun will changes according to the position of installed solar tracker and make the panel no more perpendicular to the sun which affects the output power. Therefore, dual-axis solar tracking moves the solar panel to be always perpendicular to the sun. The tracker will track the sun throughout the years and maintain the output power generated by the solar panel. The solar panel is aligned according to the intensity of sunlight under the control of the microcontroller. This microcontroller uses much less voltage than a DC motor, so, we need to Interface a DC motor with the microcontroller, usually H-bridge is the preferred way of interfacing a DC motor. An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it.So in this project we have used four LDRs to sense the light falling on the solar panel is perpendicular to all four directions. So, the values of all four LDR should be the same to achieve the correct direction for the solar panel. A DC geared motor is a device that uses DC electricity to produce mechanical energy. The energy in electric current causes the DC geared motor to spin. Any devices attached to the motor can then take advantage of this spinning motion to create another type of motion. In a gear motor, the magnetic current turns gears that are either in a gear reduction unit or an integrated gearbox. A second shaft is connected to these gears. Gear head or gear motor was used in solar trackers which has the advantage of producing high torque. The amount of power available to a solar panel is proportional to the amount of light that reaches it. The more light it gets, the more power it produces.By using a single-axis solar tracker can only capture the minimum power tracking sunlight in one direction which is the elevation movements from east to west by rotating the structure along the vertical axis. The use of single-axis tracking can increase the electricity yield by as much as 27% to 32%, but by using a dual-axis solar tracker, it can capture the maximum sunlight in two movements at the same time, so, dual-axis tracking increases the electricity output as much as 35% to 40%. Dual-axis solar trackers allow for two degrees of flexibility, offering a much wider range of motion. The primary and secondary axes work together to allow these trackers to point the solar panels at specific points in the sky.

2. LITERATURE REVIEW

For preparing the best design of Dual Axis Solar Tracker System, a lot of technical papers and reduction processes were studied before deciding upon the most feasible process for the project. The following list presents a list of the main papers referred to till now regarding the project.

2.1- M.M. Abu Khader observed an experiment under Jordanian climate on the cause of utilizing two-axis sun tracking systems. They found that the power outcome improved by 30-45% compared to a static system for a particular day. 2.2- Dhanalakshmi.V, Lakshmi Prasanna H.N presented a smart dual axis solar tracker. They used arduino uno for the development of their proposed model. After the experiment, they observed that maximum voltage was tracked about 25% to 30% and the generating power increased by 30% compared to a static system. 2.3- M.Kacira overlooked the cause of a dual axis solar tracking with development of power energy compared to a fixed PV panel in Sanliurfa, Turkey. They found that everyday power gain is 29.3% in solar radiation and 34.6% in power generation for a particular day in the month of july. 2.4- In 2017, Chaitali Medhane, Tejas Gaidhani implemented a microcontroller based dual axis model working on a solar panel. Through this model, they observed that the solar panel extracted maximum power if the solar panel was aligned with the intensity of light received from the sun. It improves the power output and also precautions necessary for the system from rain and wind. 2.5- S.B. Elagib, N.H. Osman describes the development of a solar tracking system based on solar maps using microcontroller, which can forecast the real detectable position of the sun by latitude's location for maximizing the efficiency of energy level. Their main motive of this design was to work with minimal operator interaction in the isolated areas where there is lack of network coverage.

3. OBJECTIVE

1. To design a solar tracker that can work in X and y direction (dual axis).

2. Design with systems that work at most efficiency to give the desired output.

3. To install different kinds of sensors that will act as a feedback loop for proper functioning of the overall system.

4. The goal is to design in such a way that different components can be easily added and replaceable if required.

5. Aim is to design to have a simple and efficient algorithm which can better form in any circumstances.
6.More Simplicity in design so that we can add additional panels in case required.

4. PROBLEM DEFINITION

1. Problem is that solar trackers do not fluctuate continuously, which leads to use of unnecessary energy to drive the motors.

2. The constraint is to study different parameters and to summarise their data and to restrict solar plate motions motion in either direction to get maximum sunlight.

3. Challenges are how it works in case there is obstacle in direction of sunlight i.e. clouds in the sky or in case of lighting the idea is to make a smart system that will automatically gets shut down to save energy, the system will have to react wisely in rainy or lightning conditions

4. The different sections of design do not cause hurdles in order to add necessary components which are part of simple and compact design.

5. METHODOLOGY

During our project we have been through the following steps

1. Study the literature related to Solar tracker design and its improvement in performance referring to various resources.

2. Obtaining design data of existing models of dual axis solar tracker and selecting the preferable design.

3. Selection of all hardware and software aspects of the system.

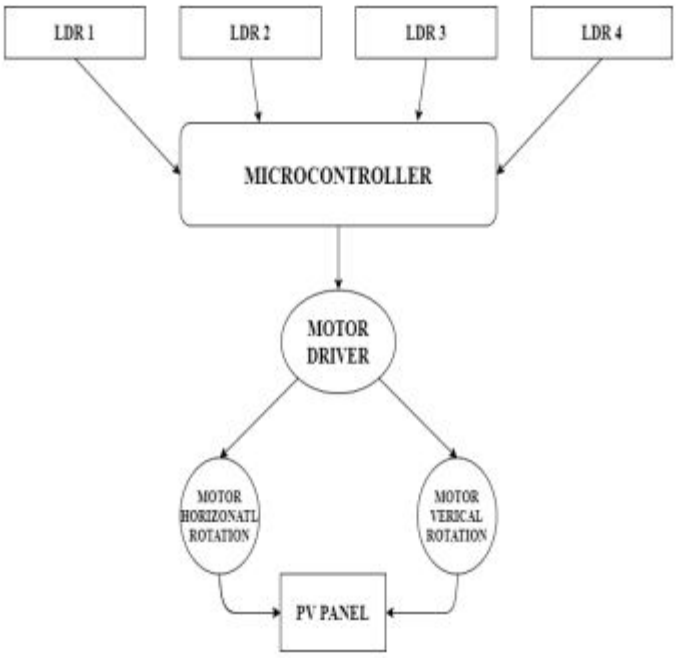
4. Modelling of the system as per design objectives.

5. Assembling the system as per designed model.

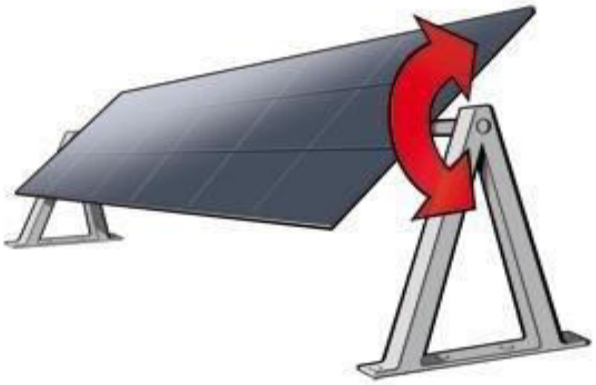
6. Checking the system performance under various conditions.

7. Rectifying any issues and finalizing the system.

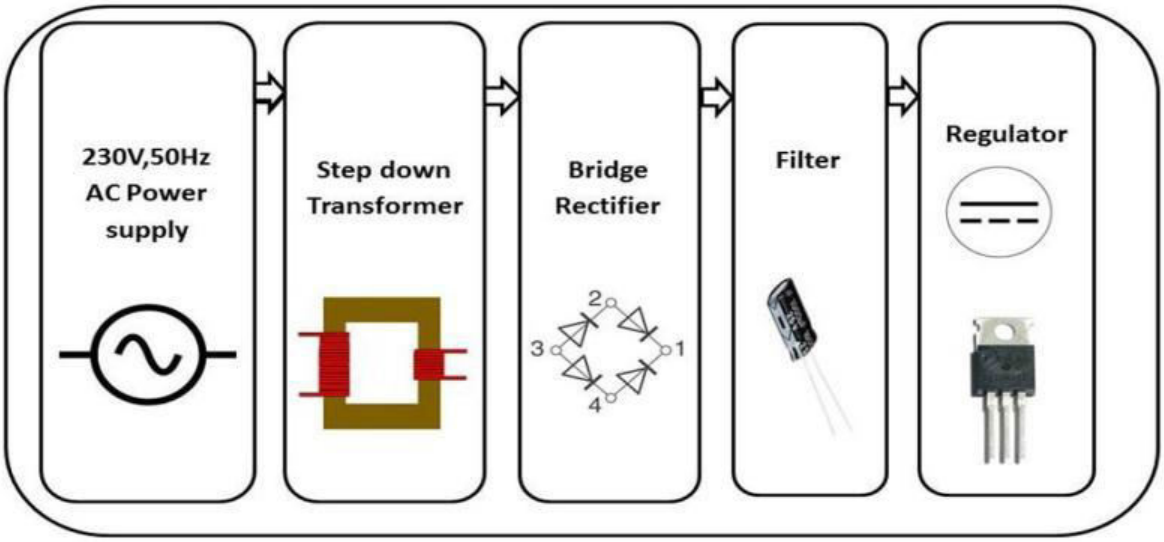
Flow chart:

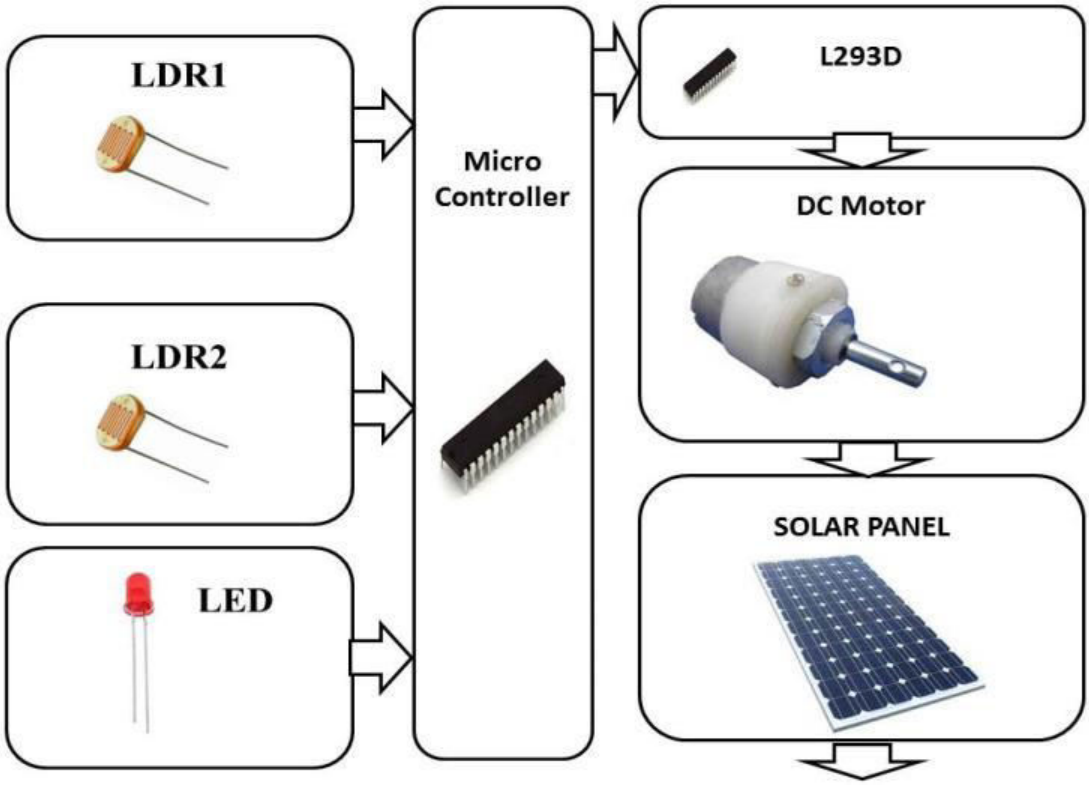


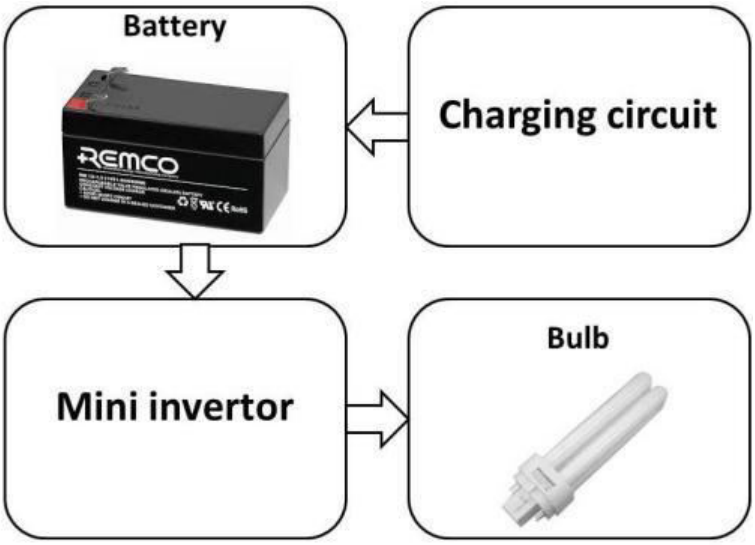
Project demo view



Block diagram


230V,50Hz
AC Power
supply
Step down
Transformer
Bridge
Rectifier
2
3
1
4
Filter
Regulator


LDR1
LDR2
LED
Micro
Controller
L293D
DC Motor
SOLAR PANEL



Block diagram using modules

1) Solar panel
2) Dc motor
3) Microcontroller
4) LDR
5) L293D motor drivers
6) Battery
7) Mini invertors
8) Power supply

Project covering topics

1) how to convert 230v A.C to 5v D.C
2) LDR working principle
3) How to work motor
4) Logic of H-bridge
5) Embedded C programming
6) Working of L293D
7) Interfacing of microcontroller
8) Working with embedded c compilation IDE
9) Working of motors
10) Delay function working

11. RESULT

The proposed model of the dual axis solar tracker is capable of tracking the sun throughout the year. The dual axis tracker provides higher output power when compared to single axis tracker

and fixed panel. According to the measured readings the efficiency of the dual axis tracker is found to be 81.68% higher than that of fixed panel.

12. CONCLUSIONS

From this study the main conclusions obtained are:

1. Proposed system is low cost and compact as compared to the other tracking systems in use for the same application.
2. It is very easy to program and modify because it is Arduino based and no external programmer is required.
3. The designed system is automatic and provides better efficiency of the panel.
4. Reflection on the Solar panel has been decreased and the efficiency of solar energy generation is increased .
5. Solar trackers are slightly more expensive than their stationary counterparts, due to the more complex technology and moving parts necessary for their operation. But solar trackers generate more electricity in roughly the same amount of space needed for fixed tilt systems, making them ideal for optimizing land usage. The purpose of renewable energy from this paper offered new and advanced ideas to help the people. It has been proved through previous research that a solar tracking system with single-axis freedom can increase energy output by approximately 20%, whereas the tracking system with double axis freedom can increase the output by more than 40%. Therefore, this work in this paper is to develop and implement a dual-axis solar tracking system with both degree of freedom and the detection of the sunlight using sensors. The proposed system is ecofriendly.

12. FUTURE SCOPE

➢ Challenges are how it works in case there is obstacle in direction of sunlight i.e. clouds in the sky or in case of lighting the idea is to make system smart that it automatically gets shut down to save energy.

➢ IoT based support is provided so we can fetch amount of power generated in our computer system or smartphone in real time.

➢ Aim is to develop system that is able to operate without battery using its own power generated through sunlight.

➢ More Simplicity in design so that we can add additional panel, if required.

➢ Idea is to make a project that match industrial standards and act as an additional blueprint for the planned future project of India named (One Sun One World One Grid)

13. REFERENCES

▪ Rizk J. and Chaiko Y. “Solar Tracking System: More Efficient Use of Solar Panels”, World Academy of Science, Engineering and Technology 41 2008.

▪ Filfil Ahmed Nasir, Mohussen Deia Halboot, Dr. Zidan Khamis A. “Microcontroller-Based Sun Path Tracking System”, Eng. & Tech. Journal, Vol. 29, No.7, 2011

▪ Alimazidi Mohammad, Gillispie J, Mazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, An imprint of Pearson Education.
▪ Mehta V K, Mehta Rohit, “Principles of Electronics”, S. Chand & Company Ltd.
▪ Principles of electrical machines- J.B.Gupta
▪ Renewable energy sources- S.R.Rao
▪ Solar Tracking Hardware and Software by Gerro J Prinsloo
▪ Design and Implementation of a Sun Tracker with a Dual-Axis Single Motor “Jing-Min Wang and Chia-Liang Lu’’
▪ www.learningaboutelectronics.com