International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | Jun 2022 www.irjet.net p-ISSN: 2395-0072

Dual Axis Solar Tracking PV System using Arduino UNO

Goutam Barma[1], P. Uday kiran[2], B. Balaram[3],G. Vamshi krishna[4]

[1]Assistant professor at ACE Engineering College, Dept of Electrical and Electronics Engineering, Telangana, India
[234]Students of ACE Engineering College, Dept of Electrical and Electronics Engineering, Telangana, India

---

Abstract – *Sun is the major source of energy and there is an abundant energy available, to utilize this energy we have solar power plants which converts light energy into electrical energy. The solar panels will produce more output if it is perpendicular to the sun rays. The objective of this project is to develop a working model of the Dual axis solar tracking system using an Arduino UNO which has a ATmega328P microcontroller as the controlling part of the system, this prototype has the ability to show the practical tracking of the sun through out in a day and in different seasons, as the sun's path is not always in same path, it changes from season to season, this prototype employs four LDRs(light dependent resistors), two servo motors, a solar panel and a Arduino UNO board.*

Key Words: *Microcontroller, ATmega328P, Servo motors, LDR, Arduino UNO.*

1. INTRODUCTION

It can be observed that the conventional energy are sources are going to exhaust soon, the renewable resources are the best replacements for the fossil fuel resources, in which solar energy is the most favourable resource which has an abundant availability. The Photovoltaic(PV) systems are emerging now-a-days a lot, as a result the solar energy consumption is also increased by analyzing the consumption rate from last decades, in a PV system a PV module or a solar panel can generate more output when it is perpendicular to the sun's beams, the output will also depend on the intensity of sun light.

To maintain the solar panel in a position that it is perpendicular to the sun rays throughout the day, a single axis solar tracker is enough, which track the sun's path in only one direction i.e, from east to west for a day. But sun doesn't follow the stationary path throughtout the year, it's path changes from season to season. So for tracking the sun in both east-west direction as well as in north-south direction a Dual axis solar tracker is introduced in this paper. A Dual axis solar tracker is a bit more efficient than the single axis solar trackers.

2. CONSTRUCTION AND WORKING

The main components in construction of a Dual axis solar tracking are, the sensors to sense the light intensity, here we are using LDRs(light Dependent Resistors), the servo motors, here we need two servo motors to move the panel in both East-West direction and North-South direction, and a microcontroller to control the movement of the servomotor's position on which the solar panel is mounted, here we use Arduino uno as the microcontroller, a closed loop is formed to control the position of the solar panel.

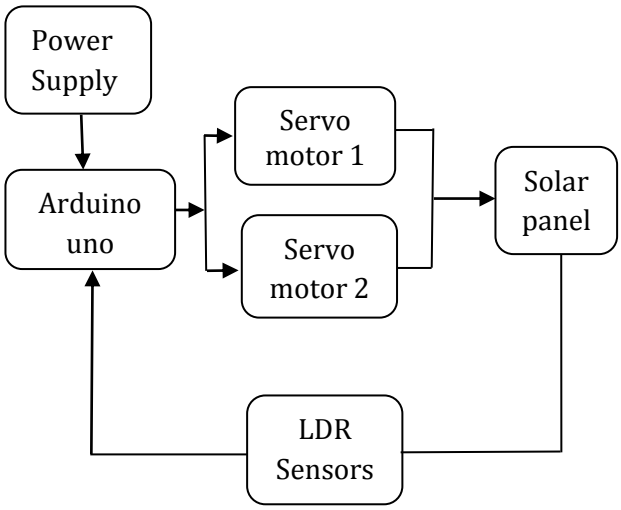


Fig-1: Block Diagram

2.1 LDR (Light Dependent Resistor)

LDR is a photoresistor, also known as light dependent resistor, it is light sensitive device, when light falls on the LDR it's resistance decreases. More the intensity of the light lesser the value of resistance of the materials inside the LDR which allows the current to pass through it fast.

Fig-2: LDR

2.2 Servo motor

Fig-3: Servo motor SG90

A Servo motor is has a small DC motor in it with a feedback circuit, a gear system for torque build up.

It has three terminals Vcc, GND, Signal. It has an output shaft is position is given as feedback, a PWM(pulse width modulation) signal is given to the signal terminal for positioning the output shaft at a particular angle, with the feedback circuit it attains the desired position. Two servo motors are used in this prototype for the panel movement in both paths.

2.3 Arduino Uno

Arduino UNO is a microcontroller board based on the **ATmega328P**. It has 6 analog inputs, 14 digital input/output pins of which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, a USB connection, a power jack. It contains everything needed to support the microcontroller**.**

Fig-3: Arduino UNO

The main principle of the operation is, there are four LDRs used in this prototype of dual axis solar tracker, this four LDRs are attached to the solar panel as shown below in Fig.no 4.

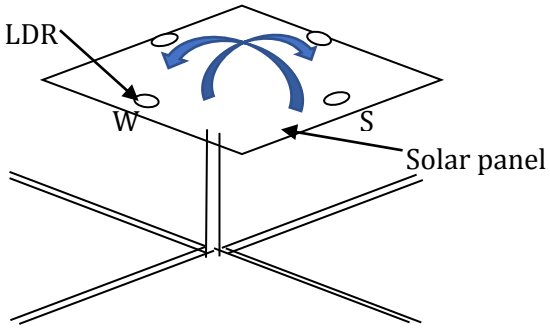


Fig-4: Arrangement of LDRs on panel

If the solar panel is perpendicular to the sun rays, then the light intensity on all the LDRs in equal, so to ensure that solar panel directly facing the sun, all the LDRs should be in the position to receive equal amount of light. The movement of the solar panel stops when this condition satisfies. To drive the solar panel in both East-West path and North-South path, the two servo motors are employed, Servo-1 whose shaft is directly attached to the panel, is responsible for the panel to move in East-West path and Servo-2 whose shaft is attached to the Servo-1 is responsible for the panel to move in North-South path, but the load on the Servo-2 is more than the Servo-1 because it handles both Servo-1 and panel. The LDRs in the East-West path determines the panel position(day position) in that path and the LDRs in North-South path determines the panel position(Seasonal position) in that path. For suppose if West LDR receives more light than East LDR then the panel moves in West direction, same followed in all directions.

A potential divider circuit is used to get the output voltage from the sensors (LDRs).The circuit is shown here.

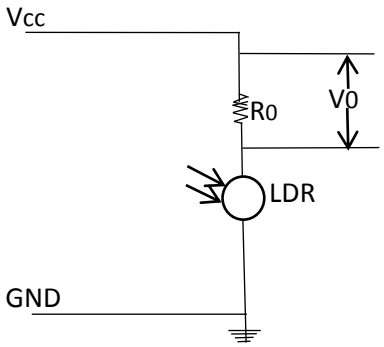


Fig-5: Potential divider circuit

As there are four LDRs, the four potential divider circuits are employed in the prototype. The LDR senses analog input, the voltage across the R0 is the voltage between 0 to 5 volts, this voltage is given to the analog pins in the Arduino, from the analog pins the input voltage is converted into an equivalent value in the range of 0 to 1023 with the inbuilt ADC(analog to digital converter). If

the light intensity on the LDR increases then the output voltage V0 also increases.

There is a C language code written to the Arduino UNO by using Arduino IDE(integrated development environment), by executing the code the Arduino can control the position of the solar panel. The code can be analyzed by looking at the flow chart in Fig.no-8.

The input supply and the control signals to the servo motors is given through the Arduino and the Vcc for the potential divider circuits is also supplied by Arduino as shown in the Fig.no-6.

In the connection diagram the LDR(E) is the LDR placed on the east edge of the panel, and also same for other LDRs and Resistors.

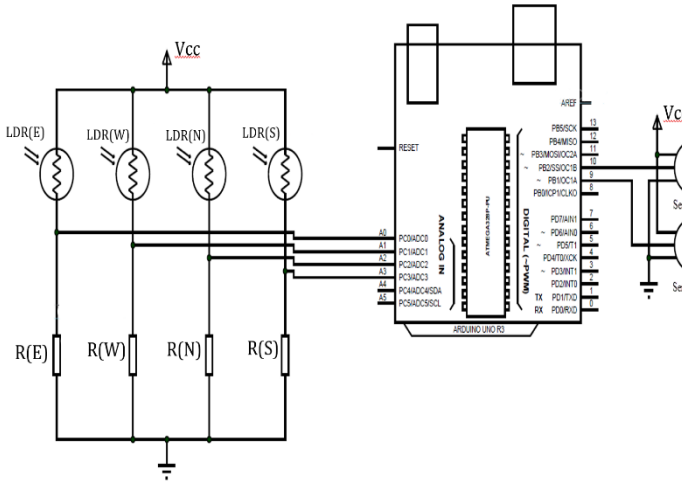


Fig-6: Connection Diagram

As there are four potential divider circuits each has a resistor and the LDR connected in series, the output voltages are also four namely VE,VW,VN,VS where VE is the voltage across the resistor connected in series with the LDR on the east edge of the solar panel.

The tracker move in the direction in which the light intensity is more, if there is more intensity on LDR at west the panel turns towards west until there is equal intensity on both the pair of LDRs in East-West path. By analysing the control algorithm and the flow chart the operation can be easily understood.

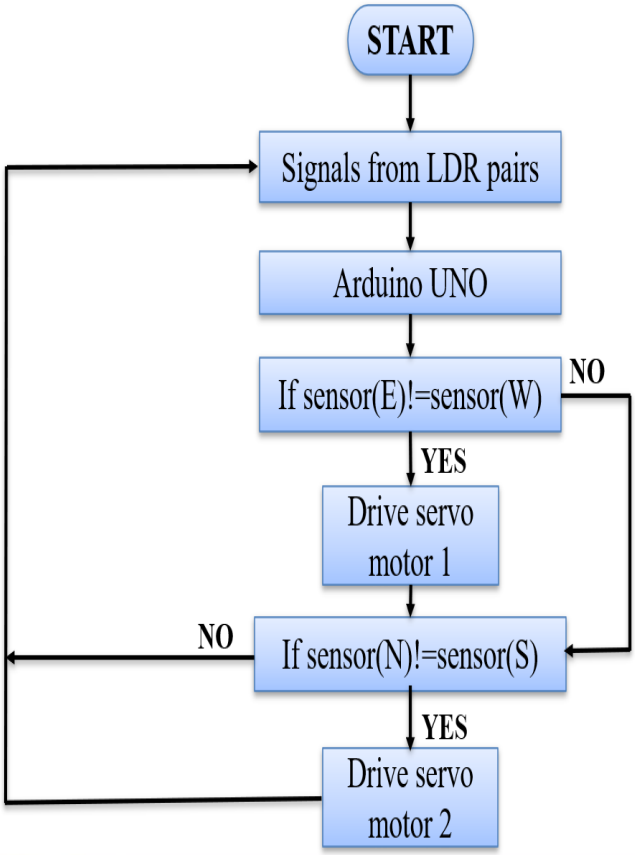


Fig-7: Control Algorithm

The tracking operation is always in active condition, the LDR sensors always sense the intensity of light on four of them, the microcontroller int the Arduino sends the PWM signals to the servo motors and the servomotors always position the panel in the direction of maximum intensity, the maximum intensity on the panel will be the vector sum of all the light sources present over the panel this process will continues.

3. FLOW CHART

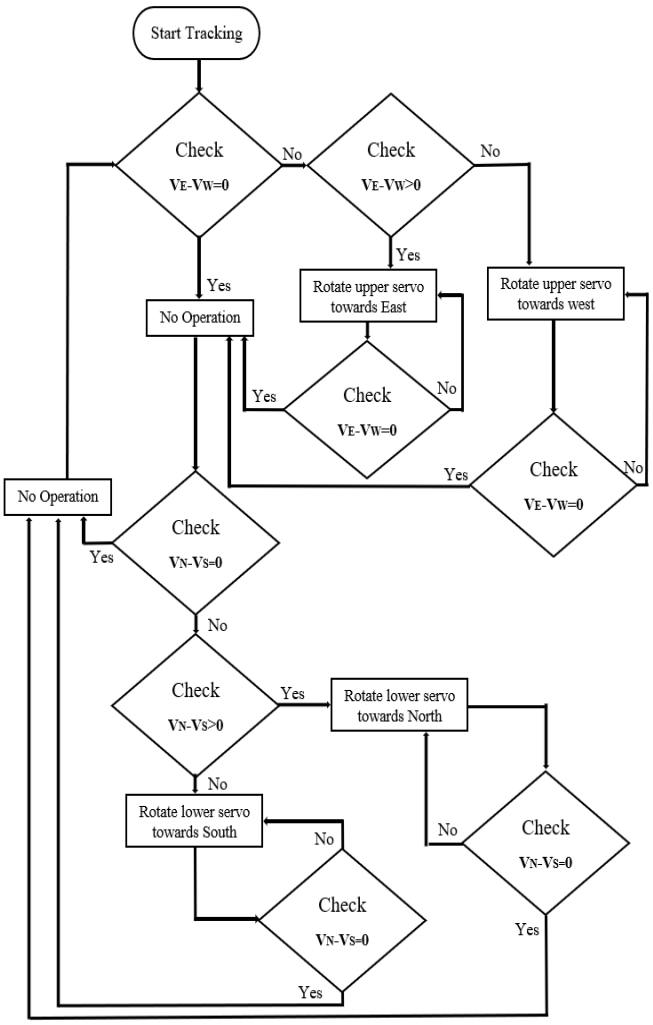
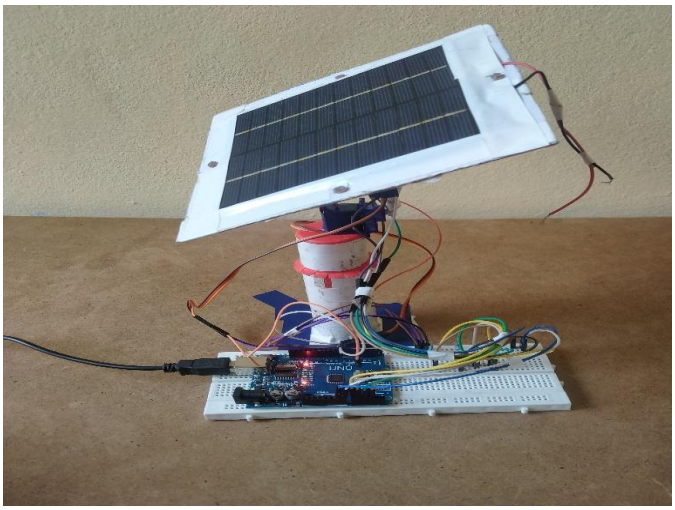


Fig-8: Flow Chart

4.Prototype



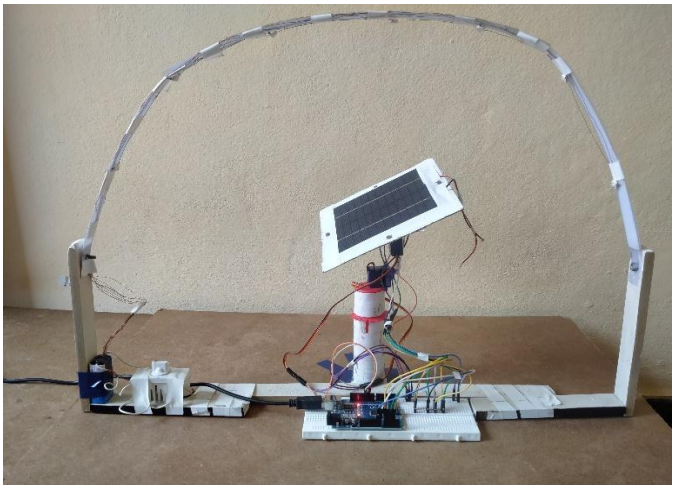


Fig-9: Prototype

5. CONCLUSION

Electrical energy is most essential for the human civilization in the modern days, solar energy would become the abundant and easily available energy in the upcoming days, the world looks for the improvement in the harvesting the solar energy, with the Dual axis solar tracking system we can improve the efficiency of the panels, a cost effective Dual axis solar tracker is implemented.

REFERENCES

[1] T. Kaur, S. Mahajan, S. Verma, Priyanka and J. Gambhir, "Arduino based low cost active dual axis solar tracker," 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), 2016, pp. 1-5, doi: 10.1109/ICPEICES.2016.7853398.

[2] Design and Implementation of a Sun Tracker with a Dual-Axis Single Motor "Jing-Min Wang and Chia-Liang Lu''

[3] S. Makhija, A. Khatwani, M. F. Khan, V. Goel and M. M. Roja, "Design & implementation of an automated dual-axis solar tracker with data-logging," 2017 International Conference on Inventive Systems and Control (ICISC), 2017, pp. 1-4, doi: 10.1109/ICISC.2017.8068708.

[4]] Solar Tracking Hardware and Software by Gerro J Prinsloo.

[5] A. Singh, S. Adhav, A. Dalvi, A. Chippa and M. Rane, "Arduino based Dual Axis Solar Tracker," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 1789-1793, doi: 10.1109/ICAIS53314.2022.9742876.