Abstract— This paper focuses on a microcontroller based Dual Axis Solar Tracker with a view to grab maximum solar energy. As the tracking system is being used, it greatly improves the power gain from solar radiation. The process of development of solar panel tracking systems has been ongoing for several years now. By considering sun’s movement across the sky during the day, the solar tracking system is advantageous. Proposed dual axis solar tracker tracks the location of the sun anywhere in the sky. For producing the maximum amount of solar energy, a solar panel must always be perpendicular to the source of light. Because the sun moves in two manners such that, throughout the day as well as throughout the year, a solar panel must be able to follow the movement of the sun with a view to produce the maximum possible power.

Keywords— Solar system, solar panel, microcontroller ATmega328, LDR, DC motor, power supply, battery

I. INTRODUCTION

In recent decades the demand for effective as well as pure (pollution free) form of electricity derived from nonconventional energy sources has been increased. The best example of renewable source is solar power. The system aims to maximize the amount of power absorbed by Photo Voltaic systems. It has been found that the use of a Dual axis tracking system, over a fixed system, can increase the power output by 40% - 60%. Solar energy systems have emerged as a viable source of renewable energy over the past two or three decades, and now a days broadly used for a variety of industrial and domestic applications. These systems are based on a solar collector, which has been designed to collect the sun’s energy and to convert it into either electrical power or thermal energy. Generally, the power developed in such applications depends fundamentally upon the amount of solar energy captured by the collector, and thus the problem to develop tracking schemes capable of following the sun’s trajectory throughout the course of the day and throughout year has received good coverage in this system. The required power supply for all sections will be obtained by using power supply circuit. Fig ure bellow shows the block diagram of regulated dc power supply.

The Block diagram of the system is shown in figure 2 below.

Figure 1: Power Supply block diagram
The Block diagram of the system is shown in figure 2 below.

II. TRACKING PRINCIPLE

There are many different methods have been proposed and used for tracking the position of the sun. Among all, the simplest method uses an LDR (Light Dependent Resistor) to detect light intensity changes on the surface of the resistor. The proper and efficient use of LDR also reduces the overall cost of the system. The resistivity of LDR decreases significantly with the increase in illumination. The general resistivity vs. illumination plot of an LDR can be observed in following figure.

![Resistivity vs. illumination plot of an LDR](image)

Figure 3: Resistivity vs. illumination plot of an LDR

III. WORKING PRINCIPLE

The setup of the hardware for the greater application of this project includes the placement of LDRs on the surface of a large curvature. The mechanism should be done such that any two immediate LDRs must remain active at the same time. And the dc motor will follow the bit pattern due to which the solar panel connected on the shaft of the dc motor will always face the sun perpendicularly. The combination of LDR plays the significant role in the movement of solar panel. Actually these combinations of signals are fed to the microcontroller and this directs the motor connected to driver. The required bit pattern for motor is shown in Table 1.
Table 1: Desired Bit Pattern

<table>
<thead>
<tr>
<th>LDR 1</th>
<th>LDR 2</th>
<th>LDR 3</th>
<th>LDR 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

When the stepper motor gets the last bit sequence of the table, the stepper motor will move to its initial position again follow these steps again, as the sun traverse from the beginning in next day. Then the output of solar panel is given to the lead Acid battery. The dc power from battery is given as an input to the Inverter, which converts it into an alternating power so that it can be used with ease by home appliances and for Industrial purpose also. The proposed system will be as shown in figure below.

IV. COMPONENTS USED

The major components used in the system are as follows.
1. Solar Panel
2. Microcontroller
3. LDRs
4. Motor Driver L293D and DC Motors
5. Lead Acid Battery
6. Inverter

Other useful components are-
1. Resistor (10KΩ, 1KΩ.)
2. Capacitor (10µF, 33pF)
3. 12V and 5V dc power supply

V. CIRCUIT DIAGRAM & DISCRIPTION

![Circuit Diagram](image)
An automated dual axis solar tracking system by using Arduino is proposed. Here microcontroller ATmega328 controls the solar panel’s movement which rotates and follows the motion of the sun anywhere in sky. There are three limit switches used in the circuit. Among which two are attached to the solar panel to mark its maximum angular positions in the east and west. The limit switch’s status is read by microcontroller and the maximum angular position in either direction is indicated. When this position has been reached the panel should not be driven any further. And third limit switch is used to mark its angular position horizontally (i.e.360°). As the plane of the panel is always kept perpendicular to the direction of the sun, maximum amount of thermal energy can be obtained from the solar panel.

The Arduino Board used here is shown in Figure bellow.

![Arduino Board](image)

**Figure 6: Arduino Board**

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. This is specially designed for the ease of artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino receives an input signal from different sensors to sense the Environment, and is able to affect its surroundings by controlling motors, lights, and other type of actuators. The microcontroller mounted on the board can be programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing).

### 5.1 TECHNICAL DETAILS:

<table>
<thead>
<tr>
<th>Microcontroller</th>
<th>ATmega328</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Voltage</td>
<td>5V</td>
</tr>
<tr>
<td>Input Voltage (recommended)</td>
<td>7-12V</td>
</tr>
<tr>
<td>Input Voltage(limits)</td>
<td>6-20V</td>
</tr>
<tr>
<td>Digital I/O Pins</td>
<td>14 (of which 6 provide PWM output)</td>
</tr>
<tr>
<td>Analog Input Pins</td>
<td>6</td>
</tr>
<tr>
<td>DC Current per I/O Pin</td>
<td>40 mA</td>
</tr>
<tr>
<td>DC Current for 3.3V Pin</td>
<td>50 mA</td>
</tr>
<tr>
<td>Flash Memory</td>
<td>32 KB (ATmega328) of which 0.5 KB used by bootloader</td>
</tr>
<tr>
<td>SRAM</td>
<td>2 KB (ATmega328)</td>
</tr>
<tr>
<td>EEPROM</td>
<td>1 KB (ATmega328)</td>
</tr>
<tr>
<td>Clock Speed</td>
<td>16 MHz</td>
</tr>
</tbody>
</table>
5.2. ADVANTAGES

1. Solar power is pollution free during use.
2. More efficient compared to normal arrangement
3. Proposed system has High degree of accuracy.
4. After spending the initial capital cost of building a solar power plant, maintenance cost are extremely low compared to existing power technologies.
5. System is very useful as the sun's position in the sky will change gradually over the course of a day and over the seasons throughout the year.
6. The power obtained by solar tracking is almost constant over a period of time as compare to the output obtained by a Stand-alone (without tracking) solar panel.

5.3. APPLICATIONS

1. for solar photovoltaic (PV) panel applications
2. It is used in solar thermal dish/engine applications
3. Remote places
4. Its main application is being found in the industrial processes such as energy stations and powerhouses to produce electricity.
5. It also finds its applications in pool filtration systems, for irrigation methods in an agriculture and solar water heating systems.

VI. CONCLUSION

The proposed sun tracker automatically tracks the sun and grabs maximum solar power with the help of microcontroller. The system tracks the sun in any weather (normal and bad) condition. Still there is a scope for improvement in this system. It can be hoped that further study should be carried out for further advancement in the solar tracking system.

REFERENCES