Dual Axis Solar Tracking System with LDR

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ABSTRACT

Main problem now a day is ozone layer depletion is a consequence of using conventional energy sources in the world.In the coming years the development of PV systems is the best choice for energy generation. To abstract the energy effectively from the solar, the PV system is to be inclined depending on the sun angle. The angle of sun depends on day time and season. The structure of the PV system is to be designed so that it has two dimensional movements. The angle of the sun is sensed using LDR sensor by sending the info flag to the controller. The controller sends the signal to the motor to change the direction of the structure. The proposed work deals with the design of the system for the dual axis rotation depending on the sun inclination. The use of this solar tracking system is beneficial for more energy generation and cost effective.

Key words: Arduino Microcontroller, Solar Tracker, LCD, Servo motor, LDR.

1. INTRODUCTION

The solar energy is a renewable energy source which is having more possibility for direct conversion into electrical energy. Solar energy conversion is silent, less maintenance cost, clean, small ecological impact and reliable [1]. The importance of PV system is increasing exponentially. In the coming decades the projection of market growth is strong [2]. Huge demand on the clean and reliable energy has given scope on research for solar energy generation. The research studies focus on implementation of more efficient and reliable solar PV system [6]. The solar energy collection can be better utilized by implementing solar tracking system. Controller plays an important role in the dual axis tracking mechanism [4].

Main objective of paper is to implement solar tracking system, specifically dual axis system to harness solar energy by following the path of the source of radiation. According to the construction, solar tracking system can rotate in both axes [5]. The prime interest lies in the validating the statement that dual axis tracker is much efficient in harnessing solar energy that of a standard solar panel [7].

The proposed system involves the usage of solar panel to harness the energy from the sun (or other illuminating sources). Utilizing the servomotors, the panel is rotated towards the direction with the maximum amount of radiation [8]. The servomotors receive commands from the ATMEGA328P microcontroller based on the values given by the LDR`s. The entire system is supplied power by the supply unit that supplies voltages at 5V and 12V respectively. The information from the LDR`s is displayed on the LCD [9] [10].

2. BASIC MODEL OF THE SYSTEM AND DESCRIPTION
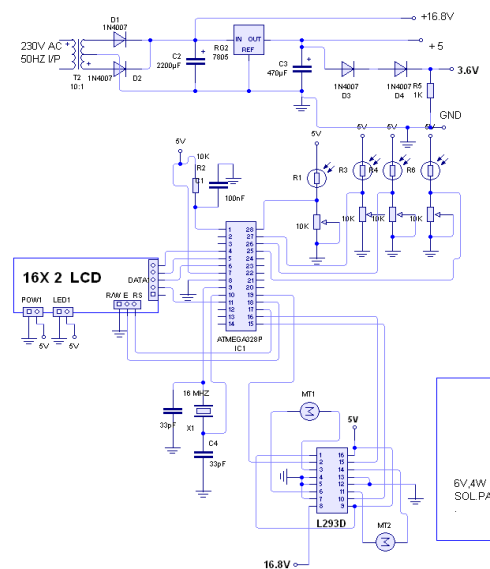
2.1 Designed Circuit Diagram

Figure 1: Designed Circuit diagram of proposed system

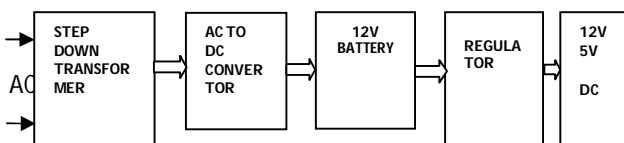### 2.2 Block Diagram of Power Conversion Stages

Figure 2: Block diagram of power conversion for the Designed system

2.3 Block Diagram of Arduino Interfacing with Other Hardware Components
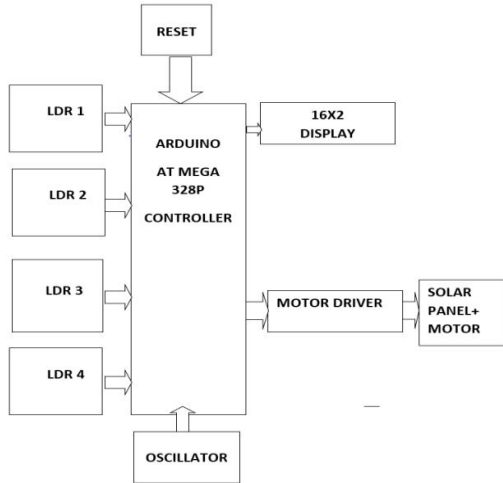

Figure 3: Block diagram of Arduino interfacing with other hardware components

2.4 Components used in the model

Microcontroller is the main part of proposed system. It constantly monitors digitalized parameters of different LDR`s and verifies them with the threshold values and checks if the values reach the threshold. In such conditions, it activates the motors to perform the operations.

LCD is utilized to indicate present status of the parameter values. The information display can be interfaced to operation of the system with respective changes in irradiation.
The working principle of LDR is photo conductivity [3]. Photo conductivity means electrical conduction takes place because of absorption of electromagnetic radiation. Conductivity of material decreases as it absorbs light. When LDR absorbs light the electrons in valence band are eager to move to conduction band. This is possible only when photons of the incident light have more energy than the band gap of material. The number of charge carriers depends on whether intrinsic type or extrinsic type semiconductor is used in LDR.As the more current starts flowing, resistance of material decreases.

Solar panel is prepared with a number of small photovoltaic cell. The panel absorbs the radiation from the surrounding and generates electricity which can be utilized for various purposes.

Solar tracker orients payload towards Sun. Payload may be a solar panel or parabolic or dish collectors or Fresnel lenses or heliostat mirrors. For flat panel PV systems, tracker reduces the incidence angle between sun irradiation and PV array. The light dependent components used in the tracking mechanism are to be oriented properly to trap the maximum solar irradiation and convert it to equivalent other form of energy.

Dual axis tracker consists of two degrees of choice to operate as axes of rotation. Axis that fixed to ground is taken as primary axis and referred to primary axis is taken as secondary axis. There are two methods used for implementation of dual axis trackers. They are tip-tilt dual axis trackers and azimuth-altitude dual axis trackers. When modelling performance is taken, orientation of the module plays vital role for the tracker axis. This tracker has modules oriented in shunt to the secondary axis. This tracker permits the panel structure to follow the Sun in both vertical and horizontal directions.

Servomotor is a main moving device of the entire system. As per the input given by the microcontroller, the servomotor rotates as per the direction determined through comparison of the values by the LDR`s.
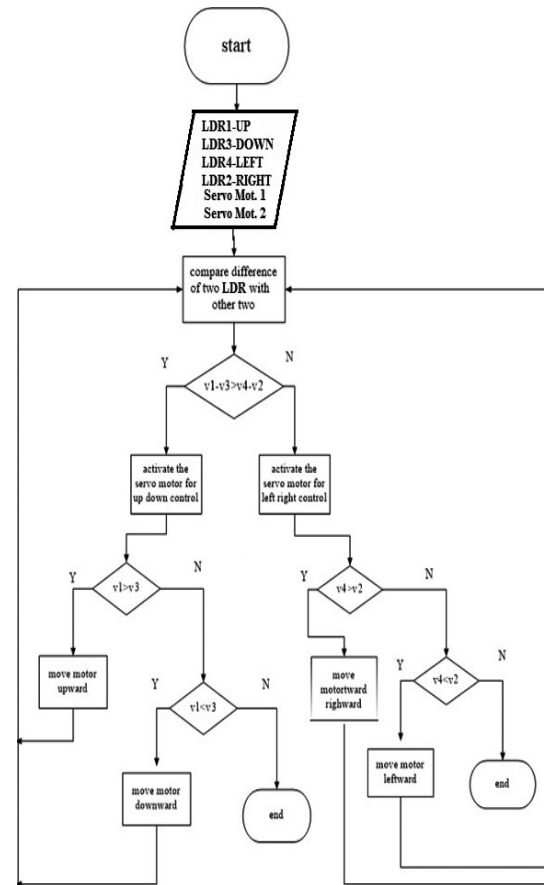
3. FLOWCHART

Figure 4: Flow chart for the proposed system

4. RESULTS AND DISCUSSIONS

The below figure shows the overview of the implemented hardware of the proposed system.

Figure 5: Implemented Hardware of the proposed system

The resistance developed varies according to the concentration of the radiation on the LDR. These values can be observed in the LCD present in the system. Utilizing the code available in the Arduino, the commands are sent to the servomotor which rotates thereafter. The values obtained during a particular session of the process can be displayed on LCD as shown below figure.
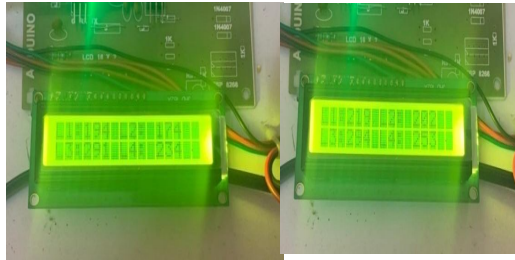

Figure 6: LCD Display of resistance value of LDR

Table: Comparison of power delivered by fixed panel and dual axis tracking solar panel

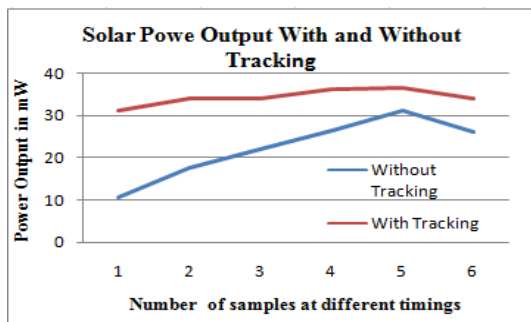| Fixed solar panel			Solar panel with dual axis tracking		
Voltage (V)	Current (mA)	Power (mW)	Voltage (V)	Current (mA)	Power (mW)
8.6	1.25	10.75	10.42	3.00	31.26
9.7	1.82	17.65	10.51	3.23	33.94
9.9	2.22	21.97	10.60	3.20	33.92
10.3	2.56	26.36	10.80	3.35	36.18
10.5	2.97	31.18	10.73	3.41	36.58
9.7	2.71	26.28	10.40	3.29	34.21
Average power in mW		22.36	34.34		

Figure 7: Solar power output with and without tracking

The comparison of power delivered by using fixed position panel and dual axis tracking solar panel is presented in the table, from the above table; the prime aim of the model is validated. The average amount of power extracted using fixed solar panel is less than that of the dual axis tracking solar panel.

Wattage from the solar panel is obtained by the multiplication of the voltage in volts and the current in mill

amperes. Calculations prove that the dual axis solar panel has around

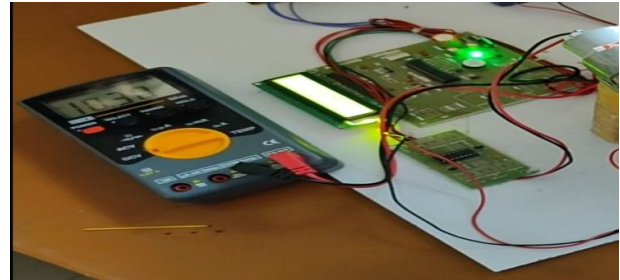35% - 50% more output when compared to the fixed solar panel.

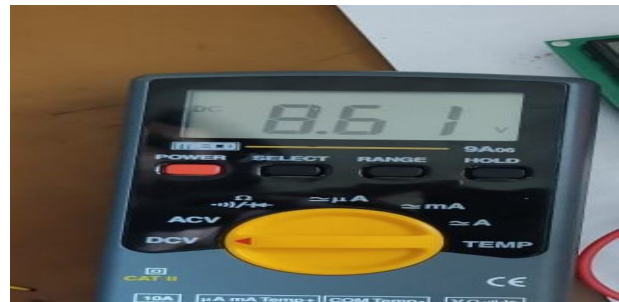**Figure 8:** Voltage measured from dual axis solar panel

Figure 9: Voltage measured from fixed axis solar panel

From the above measurements we can observe that the dual axis solar system is producing more voltage compared to the fixed solar system.

5. CONCLUSION

In this model dual axis solar tracking system with LDR was designed with the help of microcontroller. The implemented sun tracking solar PV system is a viable means to maximize energy collected from solar rays. LDR sensor is utilized for tracking the sun radiation. The controller used in this model is designed with minimum components. The servomotor is used for tracking the sun accurately by keeping track of previous position of PV array and the current solar inclination. More solar energy is collected by using automatic solar tracker. It is observed by using dual axis tracking the percentage increase in energy generated is more during morning and evening times. The percentage improvement in energy is less during afternoon time. The overall day average improvement in the energy is about 35 to 50 percentage.

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