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Interfacing of Solar Panel with Maximum power point Tracking in off Grid

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Abstract*—Energy generation is the most important issue in today's life. Non-Renewable energy resources are not only limited but also problem create for environmental pollution. Renewable energy resources are only solution for this problem. Solar energy is rapidly gaining the focus as an important means of expanding renewable energy uses. Solar panel those convert solar energy into electrical energy are costly and inefficient. So that Different mechanisms are applied to increase the efficiency of the solar panel to reduce the cost. Solar tracking system is the most important technology to increases the efficiency of the solar Panel by tracking the sun. A microcontroller based design of an automatic solar tracker is presented in this paper. Light dependent resistors are used as the sensors of the solar tracker. A model of solar tracking system is also constructed for implement the design methodology.*

Keyword— Photovoltaic cell, solar tracking, photo resistor, microcontroller, servo motor

I. INTRODUCTION

The world population is increasing day by day and the demand for energy is increasing accordingly. Oil and coal as the main source of energy nowadays, is expected to end up from the world during the recent century which explores a serious problem in providing the humanity with an affordable and reliable source of energy. The need of the hour is renewable energy resources with cheap running costs. Solar energy is considered as one of the main energy resources in warm countries [1].

In general, India has a relatively long sunny day for more than ten months and partly cloudy sky for most of the days of the rest two months. This makes our country, especially the desert sides in the west, which include Rajasthan, Gujarat, Madhya Pradesh etc. very rich is solar energy [1]. Many projects have been done on using photovoltaic cells in collecting solar radiation and converting it into electrical energy but most of these projects did not take into account the difference of the sun angle of incidence by installing the panels in a fixed orientation which influences very highly the solar energy collected by the panel.
In this paper simple design of automatic solar tracking system is presented based on microcontroller easily program.

II. PHOTOVOLTAIC CELL TECHNOLOGY

A solar cell (also called a photovoltaic cell) is an electrical device that converts the energy of light directly into electricity by the photovoltaiceffect. The word photovoltaic comes from "photo" means light and "voltaic" means producing electricity.

Therefore, the photovoltaic process is "producing electricity directlyfrom sunlight".

The operation of a photovoltaic (PV) cell requires 3 basic attributes:

1. The absorption of light, generating electron-hole pair.
2. The separation of charge carriers of opposite types.
3. The separate extraction of those carriers to an external circuit.

III. TECHNOLOGY TO IMPROVE OUTPUT POWER FROM SOLAR PANEL

For Increasing Solar Panel efficiency, maximizing the output power and employing a tracking system with solar panel arethree ways to increase the overall efficiency of the solar panel[4]. To Increase efficiency from solar cell is an ongoing research work and researcher are activelydoing research on this. Maximizing the output power fromsolar panel and integrating solar tracking system areanother ways where electronic design can bring success in research work.

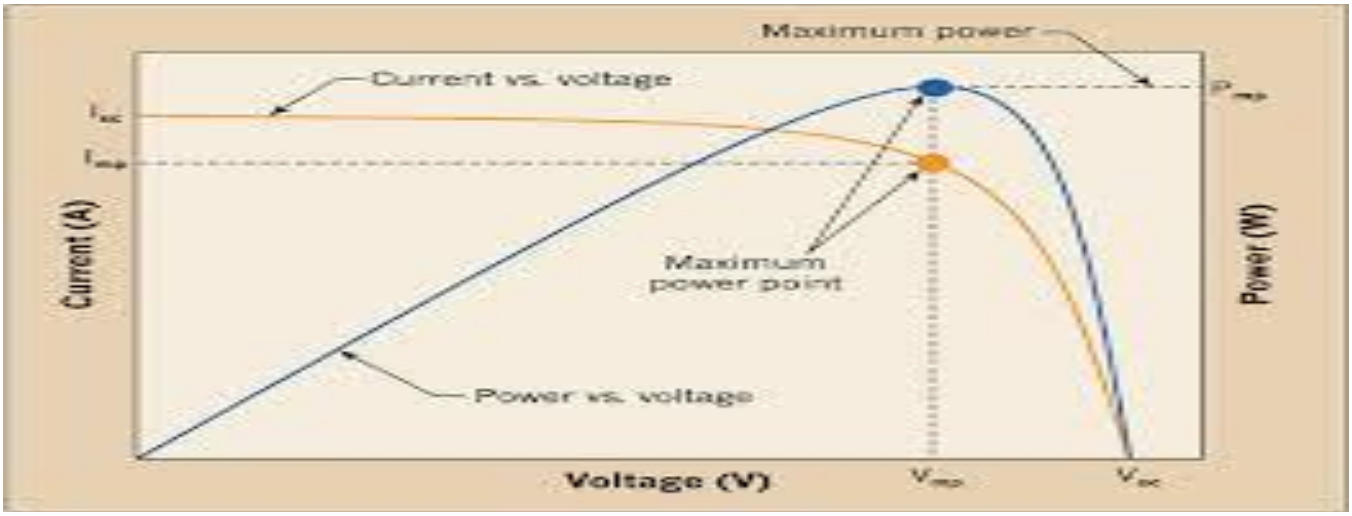

Figure 1I-V and P-V characteristics of photovoltaic cell.

Maximum power point tracking (MPPT) is the process to increase the output power from solar cell panel by keeping the solar panel's operation on the knee point of I-V and *P-V* characteristics (Fig. 1). A Many number of Maximum powerPoint tracking algorithms have been developed and employed in the world [6].

Microcontroller Based Automatic solar tracker improves the solar panel efficiency by keeping the solar panel against sun according to sun position. Solar tracking is a method to track the sun's position for increase output power of solar panel 35% to 65% than the stationary system [6]. From literature review it is prove that sensing of sun light, providing initial position of the solar panel and power consumption of the motor for the tracker are the major challenges of the solar tracking system.

Diffused radiation is another way to improve the efficiency of the solar panel. Maximum rays from the solar sun reach on the earth's surface through interaction of clouds, dusts, atom, water and particles. So that diffused rays reduces the output power of solar cell. If those rays are reflected on the panel by the reflectors and mirror it will increase the overall output power of the Solar cell panel [9].

IV. MODEL OF AUTOMATIC SOLAR TRACKER

Current Development of solar panel tracking system has been today's research area and ongoing for several years. As the sun moves in the sky during the day, it is advantageous to have the solar cell panels to track the position of the sun, such that the panels are any time perpendicular with the position of the sun. The major components used in this model are listed below:-

- Photo resistor
- Microcontroller
- Servo motor

A. Photo resistor

A photo resistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. According to sun position both Pair LDR (East and West or North and South)

generate some voltage difference of this voltage is given to the microcontroller.Fig. 2 represents the resistance value of the photo resistor according the intensity of light.

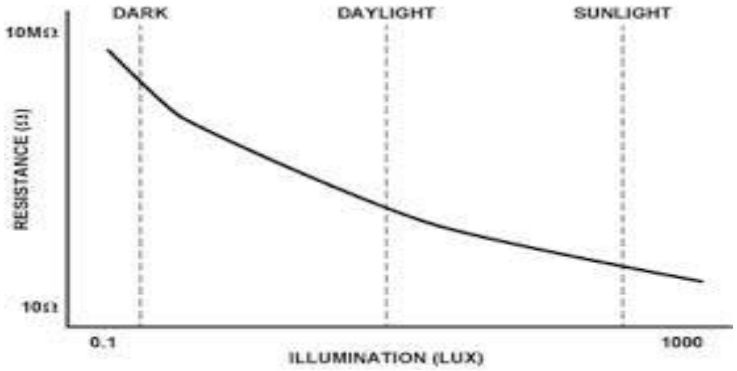

Figure 2 Resistance value of LDR at various intensity level of light

As shows in the Fig. 3 schematic diagram of the prototypedesigned in Proteus 8 professional software.

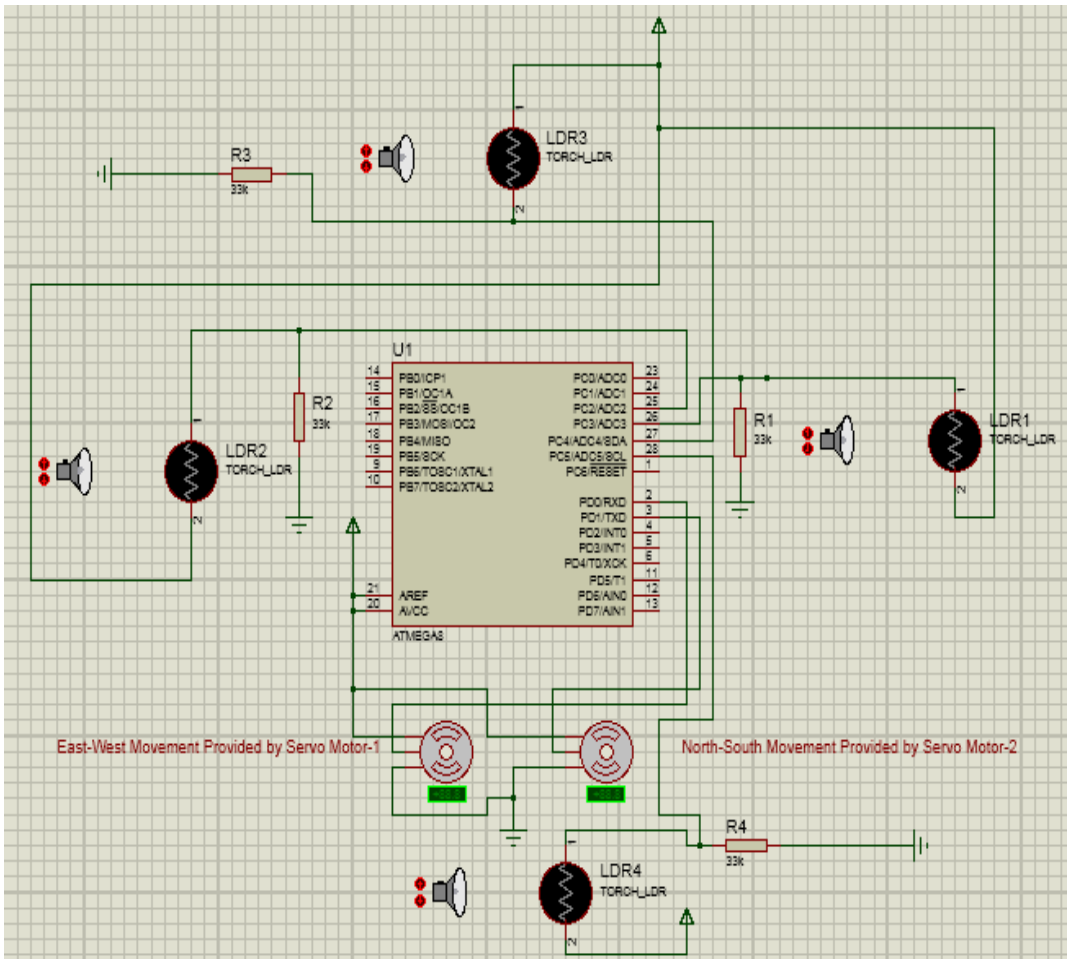

Figure 3 Schematic of solar tracker circuitry

In the solar tracker Model, it is desired that output Voltage will increase as the light intensity increases and so the photo resistor is placed at the top position in series connection with resistor

B. Servo motor

Servo motors are commonly used in precision positioning control applications. Five characteristics of the servo motor have been considered while choosing servo motor for the solar tracker prototype. Servo motor is brushless, load independent, has open loop positioning capability, good holding torque and excellent response characteristics. The Servo motor that has been used in the model has the specifications of 12 volts, 33 kΩ resistances, 4 phases, bipolar. Servo motor moves proportional according to sun position in this sky.

C. Microcontroller

The ATMEGA8 microcontroller has been used in the Model. Microcontroller is the most important part of model. ATMEGA8 Microcontroller requires a 5 volt regulated voltage supply. '7805' voltage regulator is used to providefixed 5 volts supply to the microcontroller [11]. ATMEGA8 has some features such as analog comparator (AC), analog to digital converter (ADC), Universal synchronous asynchronous receiver transmitter (USART) etc [12]. Description of these features is given below:

1) Analog comparator:

The Analog Comparator compares the input values on the positive pin AIN0 and negative pinAIN1. When the voltage on the positive pin AIN0 is higher than the voltage on the negative pin AIN1, the Analog Comparator Output, ACO, is set. The comparator's output can be set to triggerthe Timer/Counter1 Input Capture function. In addition, the comparator can trigger a separateinterrupt, exclusive to the Analog Comparator. The user can select Interrupt triggering on comparatoroutput rise, fall or toggle.

2) Analog to digital converter:

The ATmega8 features a 10-bit successive approximation ADC. The ADC is connected to an 8- channel Analog Multiplexer which allows eight single-ended voltage inputs constructed from thepins of Port C. The single-ended voltage inputs refer to 0V (GND).The ADC contains a Sample and Hold circuit which ensures that the input voltage to the ADC isheld at a constant level during conversion.

3) Timer:

Built-in timer of ATMEGA32 is utilized to create delay. The Earth rotates on its own axis, with respect to the sun 360° in a day and so it rotates, (360°/24=) 15° an hour. Delay for 1.5 minutes and 15minutes are required. These delays are mentioned as *short delay* and *moderate delay* respectively.

4) Algorithm:

In the given algorithm two variables *I* and *Count* is used. *I* represents number of rotation the motor must make to track the sun from dawn todusk. First hour after sunrise And Last hour before sunset is on consider for tracking.

As 2 hours in day time are not considered for tracking, and if we consider 1^0 rotation (2x15°=) 30° of rotation is not required to be done by the solar tracker. approximately ((180°-30°)/1°=) 150^0 rotations are required in each day to track the sun at daylight.

V. OPERATION OF THE SOLAR TRACKER

Solar Tracker is a Device which follows the movement of the sun as it rotates from the east to the west every day. The main function of all tracking systems is to provide one or two degrees of freedom in movement. Trackers are used to keep solar collectors/solar panels oriented directly towards the sun as it moves through the sky every day. Using solar trackers increases the amount of solar energy which is received by the solar energy collector and improves the energy output of the heat/electricity which is generated. Solar trackers can increase the output of solar panels by 20-30% which improves the economics of the solar panel project.

The benefit of using tracking devices is derived from the fact that the out power is near 40% is more rather than stable pv cell panel. Therefore, the instantaneous solar radiation collected by the photovoltaic modules, assembled in a tracking system, is higher than the critical irradiance level for a longer number of hours than in fixed systems. Tests have shown that up to 40% extra power can be produced per annum using a variable elevation solar tracker investigated the effect of one-axis east-west tracking on solar radiation received by a PV panel compared to fixed installation.

The circuit models simulation is done by proteus software. In this proteus software we change the radiation to get maximum output. The circuit model have mainly component is LDR, microcontroller, power supply, servo motor, control resister etc. here, two servo motor is used for control solar panel in dual axis, motor one control PV cell panel in east, west direction and second motor is control PV cell panel in south, north direction.

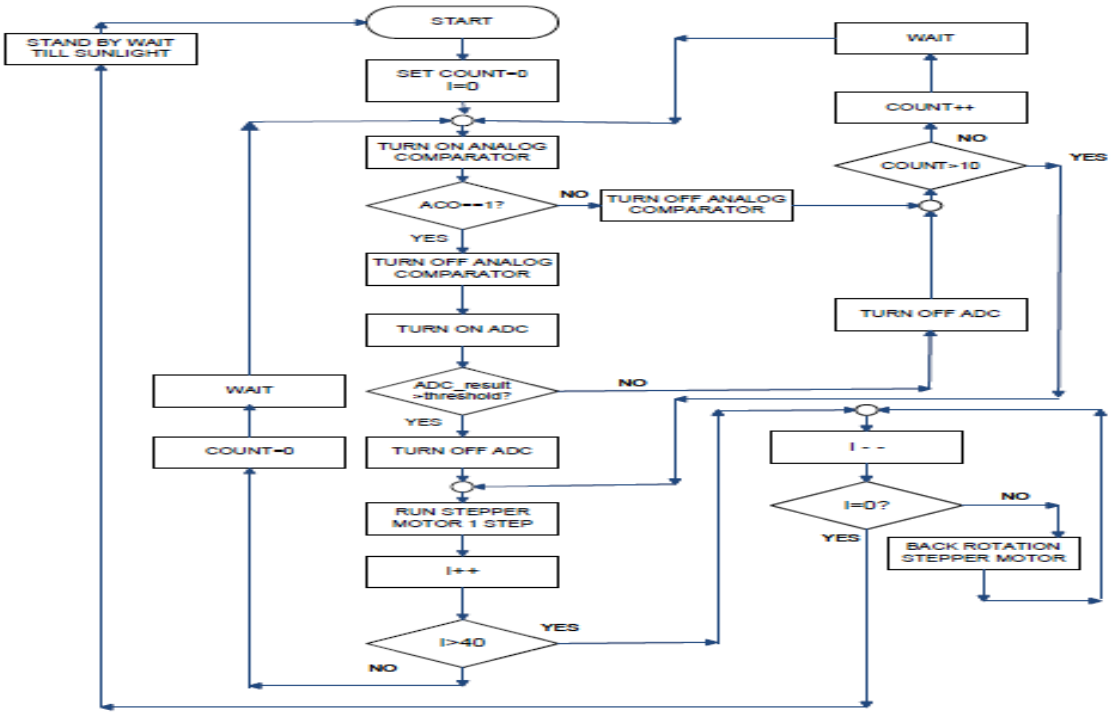

Figure 4 Operational flow chart of the solar tracker

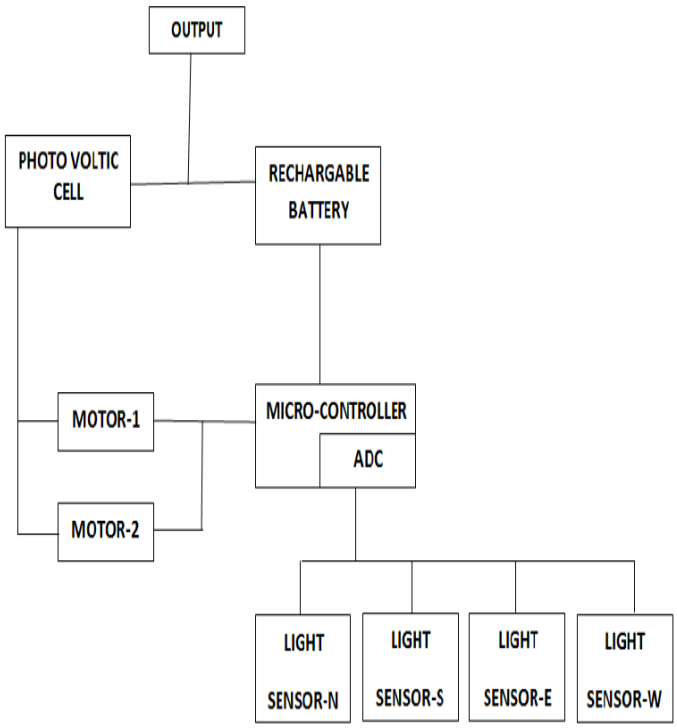

Figure 5 shows a basic schematic block diagram for MPPT PV system

VI. FEATURES & FUTURE WORK OF SOLAR TRACKER SYSTEM

When preparing overall system, hardware and software portions of the system are divided into different five stages are light detection, microcontroller input, software enhancements, motor driving and finally panel rotation.

LDR (Light dependant register) which is used in the system for better precise output. If we want to better precise output sensitivity then we can used Photo diode instead of LDR.

VII. CONCLUSION

The project has presented a means of tracking the sun's position with the help of microcontroller. Specially, it will demonstrates a working software solution for maximizing solar cell output by positioning a solar panel at the point of maximum light intensity. The renewable energy sources like solar, wind and fuel cell have become the most promising and attractive feature because of advancement in MPPT technique.

Following are the main outline of the conclusion:

- To generate electrical energy based on renewable energy source by using maximum power point tracking.
- From the modeling of photovoltaic cell getting idea about maximum power point tracking system using proteus simulator model with servo motor.

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