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Solar Tracking Development using Arduino along with an Efficient Boost Converter and Charge Controller

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Abstract—

As solar energy in non-conventional energy sources and widely recognized form of energy; the solar energy source is available free of cost in the nature and it does not produce any pollution, so it is eco-friendly. In this for better performance and for maximization the output power of solar panel the Arduino based single axis solar panel tracking control method is used. And for maximum sun rays capturing the sensor based system is used for keeping the solar panel approximately at right angle with the incident rays. Also to provide proper charge electric current charge controller is used and for prevention of battery overcharging the boost converter is used to overcome the lower output voltage of solar panel for not fulfilling the minimum charging voltage requirement of the battery thus maximum power extraction is possible from the solar panel to battery.

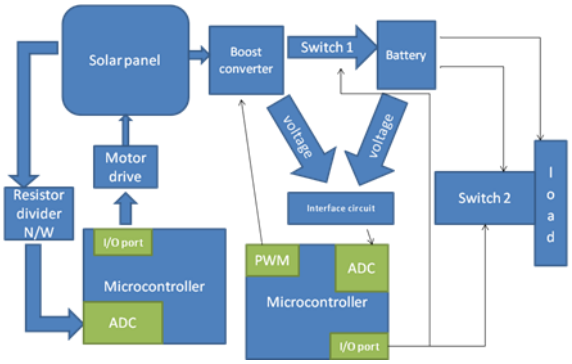
Keywords— Single Axis Solar Tracking, Boost Coverter, Charge Controller, Arduino, Boost Converter, Microcontroller ATmega 16.

I. INTRODUCTION

The renewable-energy sector is fast gaining ground as a new growth area for numerous countries with the vast potential it presents environmentally and economically. Solar energy plays an important role as a primary source of energy, especially for rural area. Solar energy is the technology used to harness the sun's energy and make it useable. Today, the technology produces less than one tenth of one percent of global energy demand. A non-conventional energy sources such as

solar energy, wind energy, biofuels etc. are takes a vital role in the global growth because conventional energy sources are exhausting rapidly due to enormous consumption. At present, the scientists are eager to find out the various non-conventional energy sources that occupy the place of conventional energy sources.

Variation in insolation level causes the output of solar panel deviation from the maximum power available due to solar position changing, the tracker needs to response within a short time to the change to avoid energy loss. To maximizes the power extracted from solar module and power delivered to the load which is shown in following block diagram. Various scheme based on the use of conventional DC-DC converter, voltage change in LDR where combination of voltage and tracking position can be implemented with use of artificial intelligence algorithm. This result in a single axis tracking strategy along with charge controller and boost converter that makes tracking response faster.



Overall System Block Diagram

II. OPERATION OF SOLAR TRACKING

Solar tracking is one of the important aspects for the power quantity level in case of non-conventional energy sources. This tracking module is design on the basis of Light Dependent Resistor (LDR) characteristics. LDR is the light sensing device which make the resistance is changed according to the light intensity. Solar tracker are been classified in various types according to varying cost, performance and sophistication. One of which is one having static solar panels, single axis and duel axis solar tracker. To yield better performance from solar panels which held to increase 30 to 60% by utilizing tracking system instead of stationary array. An extra power upto 40% can be produce per annum using a variable elevation solar tracker. The tracker deals with specific design methodologies pertaining to Light Dependent Resistor (LDR), servo motors, solar panel, programmer selection and a software/system operation.

With the usage of Arduino as a programming platform the single axis tracker is very compatible system which to be developed. The output given to the servo motor will determine the movement of the solar panel which takes its analog input from the Light Dependent Resistor (LDR) and converts it into digital signal by Analog-to-Digital converter.

III. METHODOLOGY

Figure 1 shows the system design block diagram of tracking system with the Arduino based microcontroller. To maximize the output power of the solar panel and to have higher efficiency this system works perfectly which is done by Arduino microcontroller. The charge controller are used to provide proper charge electric current and to prevent battery overcharging. The boost converter which overcomes the lower output voltage of solar panel for not fulfilling the minimum charging voltage requirement of the battery.

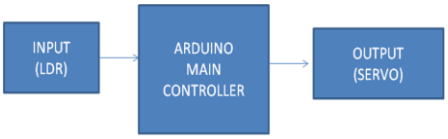


Fig.1 Block Diagram Of System Design

IV. HARDWARE USED

Basically in tracking system the component of hardware used are Light Dependent Resister (LDR), Servo Motor, Solar Panel, Charge Controller, Boost Converter and Arduino Based Controller.

a. Light Dependent Resister (LDR)

A Light Dependent Resistor (aka LDR, photoconductor, photocell, or photoresistor.) is a device which has a resistance which varies according to the amount of light falling on its surface, when light falls upon it then the resistance changes. Light dependent resistors or LDRs are often used in circuits where it is necessary to detect the presence of light, or the ambient level of light, often to create a light triggered switch. Different LDR's have different specifications, a typical LRD has a resistance in total darkness of 1 Mega Ohm.

b. Servo Motor

Servo motors may be classified according to size or torque that it can withstand into mini, standard and giant servos. Usually mini and standard size servo motors is shown in Fig. 2 can be powered by Arduino directly with no need to external power supply or driver. There are two types of servo motor required, either 4.5V or 6V supply to operate. The basic scheme for controlling servo motor is Pulse Width Modulation (PWM) technique.

Fig.2 Model of Servo Motor

c. Solar Panel

The basic principal of solar panel is to convert solar energy i.e. light into electrical energy. A solar panel is a package or assembly of photovoltaic cells as shown in Fig.3. The working principle of all today solar cells is essentially the same. It is based on the photovoltaic effect. It is used to generate and supply electrical energy in commercial and residential application along with tracking for maximum efficiency.

Fig.3 Model of Solar Panel

d. Charge Controller

The PWM controller is in essence a switch that connects a solar array to the battery as shown in Fig.4 block diagram. The result is that the voltage of the array will be pulled down to near that of the battery. The main function of the charge controller is to measure the battery voltage and to compare the value of highest and lowest threshold value of the battery from being overcharged and discharge condition.

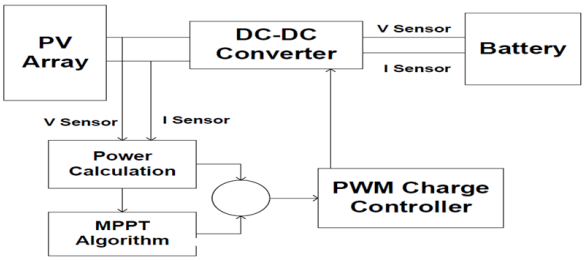


Fig.4 Block Diagram Of System

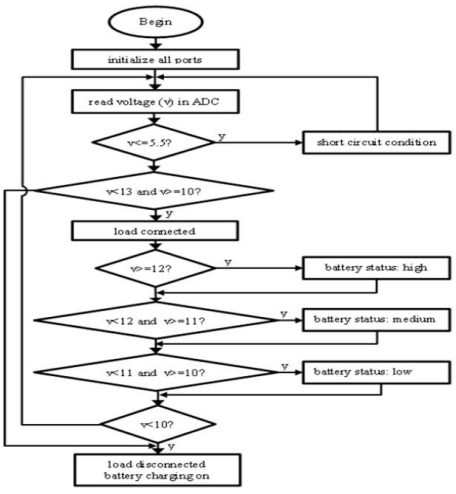
e. Boost Converter

DC-DC power conversion with an output voltage greater than its input voltage as shown in Fig.4 block diagram. It is a class of switched mode power supply containing at least one energy storage element C or L power for the boost converter can come from any suitable DC source such as batteries, solar panel, rectifier and DC generator. A boost converter is sometimes called a step-up converter since it step up voltage.

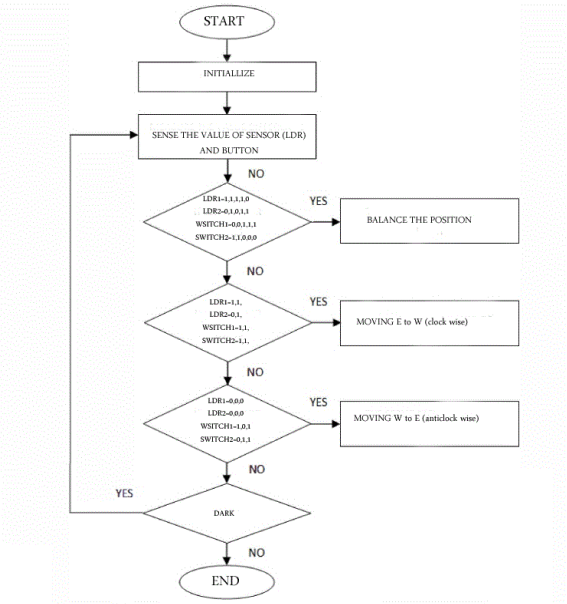
f. Arduino Based Controller

Basically Arduino is not a chip or any programming language. Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Along with Arduino the microcontroller ATmega 16 is used for better performance and for maximum efficiency.

V. FLOWCHART OF CHARGE CONTROLLER



VI. SOLAR PANEL TRACKING FLOWCHART



CONCLUSION

With the implementation of the above given components, the single axis solar panel tracking using DC-DC boost converter along with Arduino based microcontroller can be used for a PV maximum tracking system. This system will also comprise of the charge controller in conjunction with the microcontroller unit. It is assume to be having high efficiency, compact size and also economical and environmentally develop technique to use renewable energy sources more widely and wisely.

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