Solar Tracker Design for PV System using Microcontroller ATmega16

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Abstract- The main aim of conducting this project is to utilizing the sunlight energy into electricity in dc form .For that reason, the sunlight direction should be matched with normal to the photovoltaic modules/cell. As the intensity of sunlight on earth's surface is varied at different projection that makes it difficult to track required direction. To overcome this difficulty, the solar tracker should be provided to drive PV modules/cell in the respective direction. In this, the solar tracker is implemented based on microcontroller ATMega16 and the position is adjusted based on the Digital Light Sensor response .The Digital Light Sensor is able to regulate the movement of photovoltaic modules based on the intensity of light through motor drive. This is smooth and safe to track and easily accessible and reliable. It can also be installed on vehicles for tracking in cloudy condition.

Keywords: Solar tracker, microcontroller, Digital Light sensor , dc motor(load), PV system

I. Introduction:

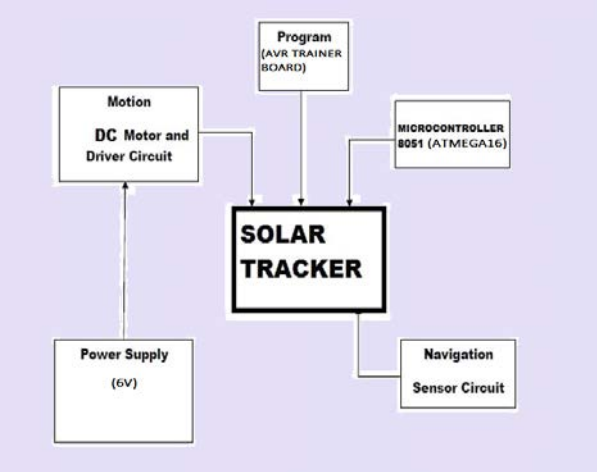
The huge amount of sunlight arriving on the Earth surface leads to utilizing the solar power into electrical form. It is challenging for PV module to track optimum sunlight due to orientation of sunlight at different time. Moreover, due to nature characteristics of irradiance which are non-linear, random and affected by other climate phenomena, it causes to vary the output of PV module. So, to overcome this problem ,we are using this tracking system using microcontroller to achieve the maximum intensity on cell/modules. This system is highly effective, reliable, proper and applicable to track orientation of sunlight at different projections.

In general, the MPPT controller can be divided into two types: electronically and mechanically based methods. The main idea of electronically based MPPT controller is how to drive the voltage or current of power electronic converter devices without any moving part. On the other hand, the mechanically based MPPT controller is based on the mechanical design to drive the PV modules perpendicular towards the sunlight direction. In the design of solar tracker, there will be moving parts of PV module structure by motor rotation.

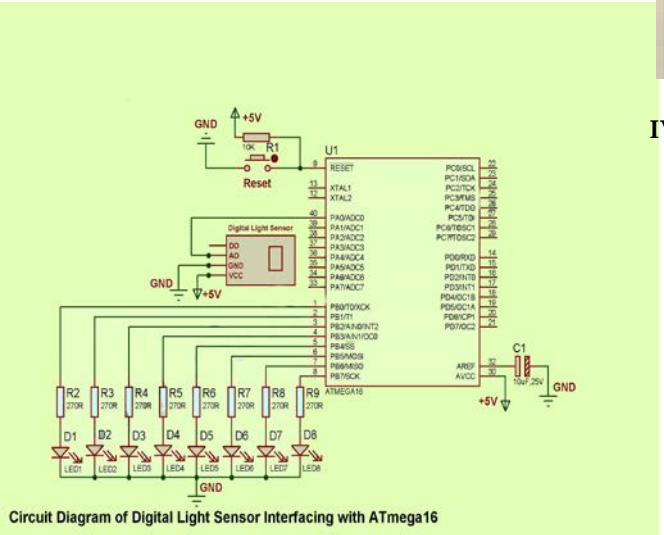
The solar tracker is not only used in the PV generation system, but also already used to drive the heliostat in the solar thermal tower applications[1]. It is to develop the solid state tracking system to be reliable and economically feasible to use with fractional voltage (5V) battery.

II. Circuit Diagram and its working:

As we have connected the VCC, GND & AO pins of Digital Light Sensor header to VCC, GND and PA0 pins of Port A header of AVR Trainer Board respectively with 1 to 1 Connectors. Further we have connected the ISP header of AVR Trainer Board-100 with the PC/Laptop's USB Port directly or with the help of USB AM-AF Cable via AVR USB Programmer header of AVR USB Programmer with a 10 to 10 FRC Female Connector. Again, switched ON the power and downloaded the Digital Light Sensor Interfacing with ATmega16 motor driver Output Hex file to AVR Trainer Board-100 with the help of SinaProg Hex downloader and AVR USB Programmer. If sun will Move in-front of the Digital light Sensor and the dc gear motor will also rotate the solar pane according to sun intensity and it will track maximum solar power .

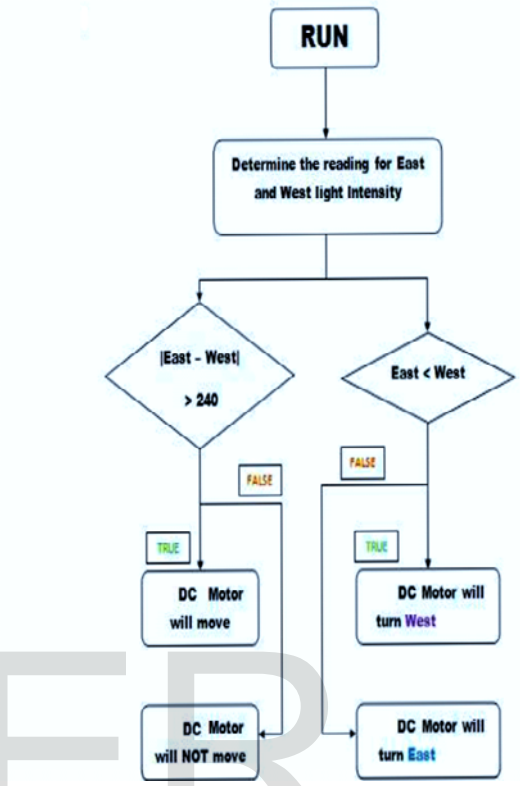


The LDR that we are going to interface with ATmega16 microcontroller sense the light in analog signal form and takes input. Further it gives output to the microcontroller of input port channel[2].But the microcontroller cannot read analog signal. So, the microcontroller will convert the analog output of the digital light sensor to digital value through its analog to digital converter.Again the microcontroller gives the output as per sensing of light a high intensity and output data is transmitted to the motor driver [3] which defines in two direction : forward towads east and backward towards west. In this project , we try to track optimum solar power in either direction including cloudy condition with AVR ATmega16 microcontroller .Further motor driver is connected with Gear dc motor which is able to regulate the movement of photovoltaic modules based on the intensity of light in either direction. This can also be able to track if reqiured pv module is installed on roof of vehicles like Rickshaw,Car,trains,ships,aeroplane etc.



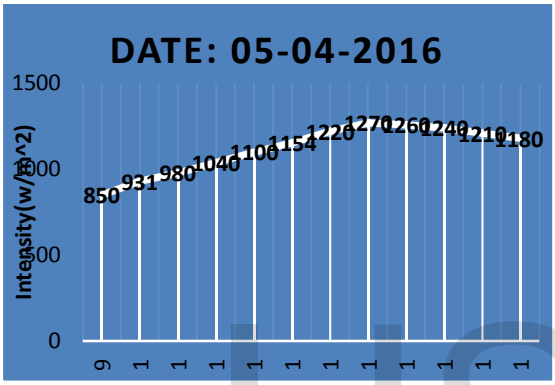
Circuit Diagram of Digital Light Sensor Interfacing with ATmega16

III.FLOW CHART



IV. RESULT

Hour	PV Module position		Error (%)
	Mound setting	Solar Tracker	
8a.m	30°	27°	10.00%
9a.m	45°	44 °	2.22%
10a.m	60°	58°	3.33%
11a.m	75°	73°	2.67%
12a.m (noon)	90°	89°	1.11%
1p.m	105°	103°	1.90%
2 p.m	120°	119°	0.83%
3 p.m	135°	133°	1.48%
4 p.m	150°	147°	2.00%
After 4 p.m	30°	29°	3.33%



V. FUTURE MODIFICATION:

1. More sensitive LDR can be used.
2. Panel can be replaced as per as requirements.
3. It is portable and easily can be installed on the roof of the vehicles.

VI. ADVANTAGES:

1. Very simple and easy to implement and does find true MPPT.
2. It can be taken as either an Analog or Digital technique of MPPT.
3. Most commonly used so information is widely available.
4. Provides predictive an accurate solutions to MPPT under PSC.
5. No oscillation during tracking and steady state operations

VII. DISADVANTAGE:

1. Under rapidly varying irradiance & load conditions the system can track in the wrong direction. 2. The size of the change in operation voltage chosen determines the speed & convergence of the MPPT and the range of oscillation.

VIII. CONCLUSION:

The proposed design of solar tracker based microcontroller ATMega16 combined with LDR is working optimally.One can imagine that the energy harvesting becomes significantly if the number of modules increase in a photovoltaic farm. The designed system has been focused on designing controller part and the main concern is to design appropriate circuits and the circuits suppose to be able to control DC motor rotation direction.The system is able to track and follow Sunlight intensity in order to collect maximum solar power.In terms of cost per Watt of the completed solar system, it is usually cheaper (for all but the smallest solar installations) to use a solar tracker and less solar panels where space and planning permit. A good solar tracker can typically lead to an increase in electricity generation capacity of 30-50%[4].The constructed system model can be applied in the residential area for alternative electricity generation especially for non-critical and low power appliances.

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