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Hardware Modelling Of Automatic Solar Tracking System

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Abstract: In this paper the hardware Implementation of solar tracking at all states are presented. First static flat plate solar tracking is used, in this method only 50 % of solar energy is collected. By using the moving solar panel the efficiency is increased up to 75% to 80%.The unique feature of the proposed system is that instead of taking the earth as its reference, it takes the sun as a guiding source. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum. The light dependent resistors do the job of sensing the change in the position of the sun which is dealt by the respective change in the solar panels position by switching on and off the geared motor. An improvement in the hardware design of the existing solar energy collector system has been implemented in order to provide higher efficiency at lower cost.

Keywords: Solar panel, LDR, Automatic solar tracking system, control circuit and driver circuit.

Introduction[1-10]

In this time power demand is very high but compare to the power generation is not much and also the source of the power generation is also decreased to overcome the problem renewable energy is the necessary thing

Solar energy is the most abundant and uniformly distributed from among all the available non-conventional sources. Even though technology for trapping solar energy is already in existence, the process can be further improved to increase its efficiency. Solar energy is freely available, needs no fuel and produces no waste or causes any pollution. Moreover solar power is renewable. The sun will keep on shining anyway, so it makes sense to utilize it.

A photovoltaic system is based on the ability of certain materials to convert the radiant energy of the sun into electrical energy. The total amount of solar energy that lights a given area is known as *irradiance* (*G*) and it is measured in *watts per square meter* (*W/m*2). The instantaneous values are normally averaged over a period of time, so it is common to talk about total irradiance per hour, day or month. Of course, the precise amount of radiation that arrives at the surface of the Earth cannot be predicted with high precision, due to natural weather variations. Therefore it is necessary to work with statistical data based on the "solar history" of a particular place.

Problem Statement And Solution[1-10]

Existing method

Now a days the solar energy conversion is fast growing .but the existing method is the solar panel is fixed and it got the energy whatever the sun falls on it. Only 50% of solar energy is received ,some amount of energy is wasted due to losses and remaining energy is lossed due to stationary panel.

Proposed method

In this method the solar panel is movable according to the sun direction so we got the solar energy around 75% to 80%.so in the moving system we have the automatic solar tracking and also to reduce the cost

The proposed system consists of a small and less complicated control circuits which is supplied with the output of light sensors and based upon these inputs it controls the operation of the geared motor. Also the circuits consume less power and are easy to implement with readily available electronic components.

Using geared motor which is controlled by an electronic controller. In the existing system maximum energy from the sun is receives only from morning 11 am to afternoon 2 pm, because solar panel is always kept tilted 30°north and charges a small alkaline (12 volts) battery. A new method has been introduced, where sun light is tracked from morning 6 am to 6 pm by moving the solar panel along with the movement of the sun using geared motor which is controlled by an electronic control circuit. On implementation of the proposed system, at least 30% extra energy will be trapped compared to the existing system .The solar cells forms the fundamental solar-energy conversion component.

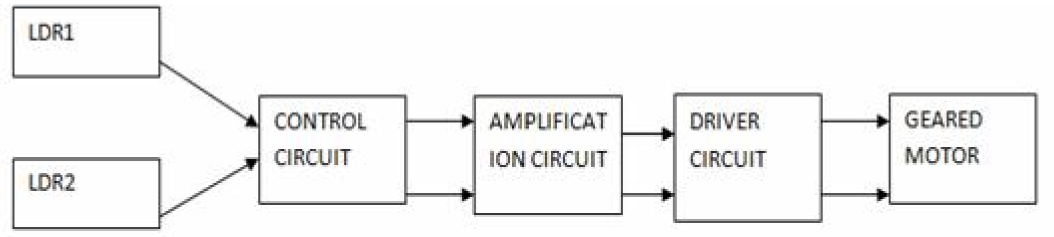

Fig.1 Block Diagram Of Proposed System

Conventional solar panel tilted and rigidly fixed at a certain angle, limits their area of exposure to the sun during the entire course of the day. Therefore, the average solar energy is not maximized. Solar tracking systems are essential for solar energy based power generation systems. The control circuit is used to sense sunlight falling on the LDR, the switch in the circuit will be closed. The LDR and a trim pot form a voltage divider which is used to apply bias to a transistor. As the LDR changes resistance the change in potential is detected by the circuit and the relay is activated.

Hardware Implementation[1-10]

Amplification circuit

Amplification circuit is used to convert the 5v of voltage to 12v voltage why because to rotate the geared motor 12v is mandatory. So that instant the amplification circuit is used.

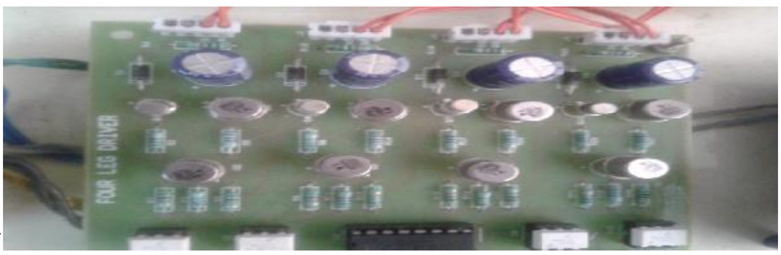

Fig.2 Amplification circuit block

In this amplification circuit darlington transistor is used for amplification. In the amplification circuit the darlington pair is used. The Darlington transistor (often called a Darlington pair) is a compound structure consisting of two bipolar transistors (either integrated or separated devices) connected in such a way that the current amplified by the first transistor is amplified further by the second one. This configuration gives a much higher common-emitter current gain than each transistor taken separately and, in the case of integrated devices, can take less space than two individual transistors because they can use a *shared* collector. Integrated Darlington pairs come packaged singly in transistor-like packages or as an array of devices (usually eight) in an integrated circuit.

Control Circuit

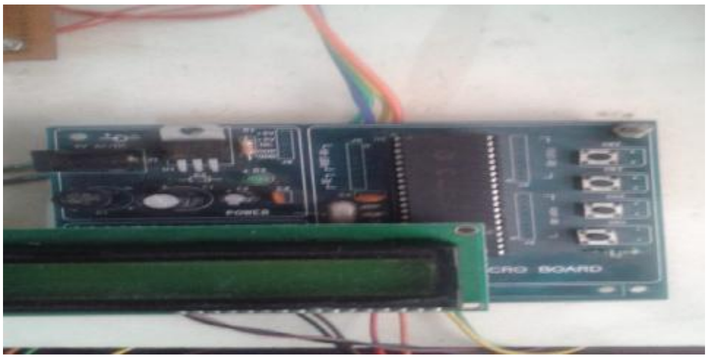

Fig. 3 Control circuit block

The control circuit is used to sense sunlight falling on the LDR, the switch in the circuit will be closed. The LDR and a trim pot form a voltage divider which is used to apply bias to a transistor. As the LDR changes resistance the change in potential is detected by the circuit and the relay is activated.

Driver Circuit

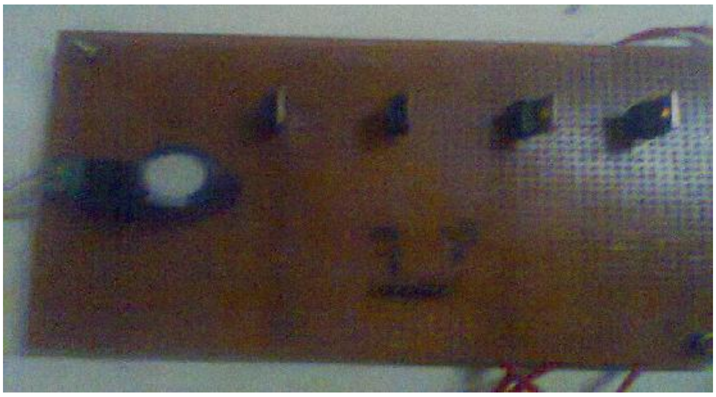

Fig. 4 Driver circuit block

Sensors (LDR)

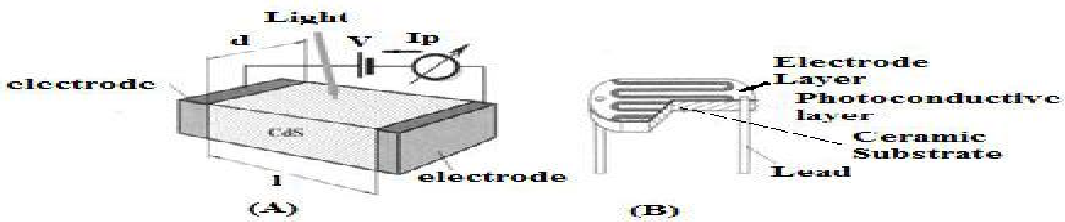

Fig.5 Sensor circuit

An Electrode is set at each end of the photoconductor. In darkness, the resistance of the material is high. Hence, the applied voltage V results in a small dark current which is attributed to temperature effect. When light is incident on the surface, the current *I*, flows

A Proximity sensor can detect objects without physical contact. A proximity sensor often emits an electromagnetic field or beam and look for changes in the field. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive or photoelectric sensor might be suitable for a plastic target; an inductive proximity sensor requires a metal target.

Fig.6 Hardware Model of proposed system

Working Of Solar Panel And Stand Alone System

The proposed system consists of a small and less complicated control circuits which is supplied with the output of light sensors and based upon these inputs it controls the operation of the geared motor. Also the circuits consume less power and are easy to implement with readily available electronic components.

A photovoltaic module or photovoltaic panel is a packaged interconnected assembly of photovoltaic cells, also known as solar cells. A typical silicon PV cell is composed of a thin wafer consisting of an ultra-thin layer of phosphorus-doped (N-type) silicon on top of a thicker layer of boron-doped (P type) silicon Regardless of size, a typical silicon PV cell produces about 0.5 – 0.6 volt DC under open-circuit and no-load conditions. The current (and power) output of a PV cell depends on its efficiency and size (surface area), and is Proportional to the intensity of sunlight striking the surface of the cell. The photovoltaic module, known more commonly as the solar panel, uses light energy (photons) from the sun to generate electricity through the photovoltaic effect. Table 1,2,3 gives the specifications.

Table 1 Control Circuit

EQUIPMENT NAME	RATING
Capacitor	470 µF,25V
Regulator	Model 7805,12V/5V
Resistor	330Ω
Capacitor	0.01µF (for reducing noise)
Crystal Oscillator	20KHz,Model-IC16F877A
Microcontroller	Model-IC16F877A
Capacitor	0.01µF (for ground signal)
LED	

Table 2 Amplification Circuit: 5V – 12V

EQUIPMENT NAME	RATING
Darlington Transistor	
Transistor 1	Model CK100,12V,1A (2)
Transistor 2	Model 2N222A
Capacitor	1000µF,25V
Impedance IC	Model CD3040,5V
Optocoupler	Model M02E1310(Isolation purpose)

Table 3 Driver Circuit:

EQUIPMENT NAME	RATING
MOSFET	IRF840,230V/5A
Capacitor	1000µF,63V (capacitor got the power from the transformer and it gives to MOSFETS) (The capacitor also gives the power to stepper motor)

SOLAR PANEL: 3W,9V,0.36A,VOC-10.7
Number of cells-18
Weight-0.5kg

Results And Discussions

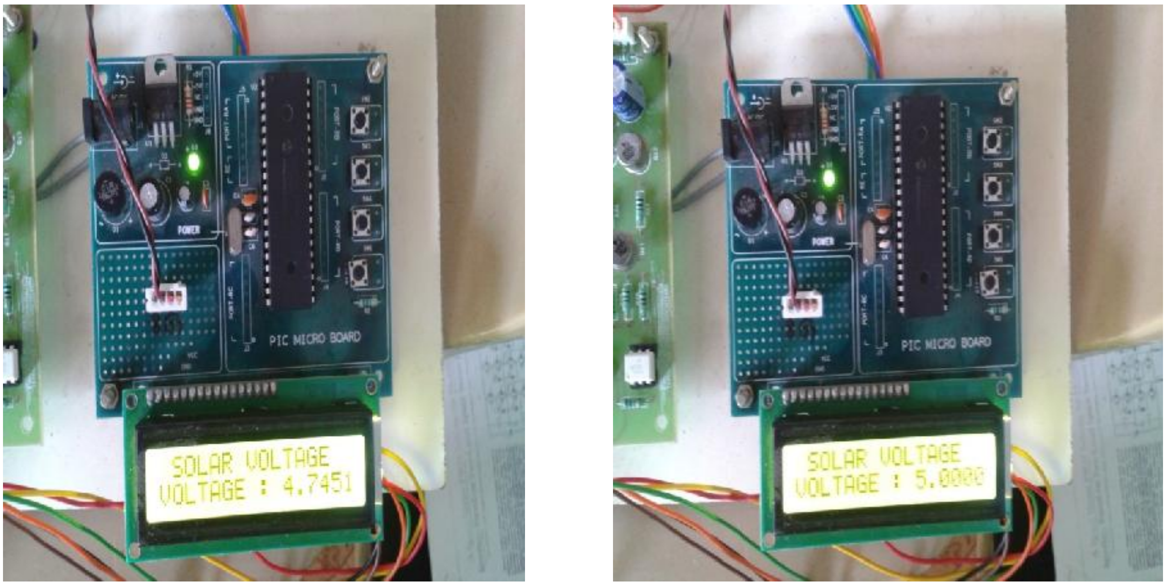

Fig.7 Result according to sun position

In the time period of Morning 8am to 12 pm the panel move according to the sun direction. So the maximum value of the output is 4.7V. The panel moves according to the sun direction as per the solar panel parameters each cell giving maximum of 0.6v and minimum 0.2V.In the time period of afternoon 12 pm to 4pm the panel move according to the sun direction. so the maximum value of the output is 5.0000V. The panel moves according to the sun direction as per the solar panel parameters each cell giving maximum of 0.6v.The effectiveness of the proposed system can demonstrated through the experimental results.

Table 5 Comparison Of Normal PV Panel With Movable PV Panel

Static solar panel (Existing Method)		Movable solar panel (Proposed Method)	
Time	Average o/p Voltage	Time	Average o/p Voltage
08am-12pm	3.8	08am-12pm	4.4
12pm-04pm	4.2	12pm-04pm	5

Conclusion

In this paper the hardware of a low cost automatic solar energy tracking system has been designed and successfully implemented. The implemented system which ensures 25 to 30% of more energy conversion than the existing static solar module system. Several tracker technologies currently are available on the market. However, the different tracker technologies come with different characteristics such as the additional cost of maintenance, added cost of solar power unit at installation, accuracies of tracking, reliability and effectiveness in improving efficiency. The designed system requires minimum maintenance with a practically good level of improvement of system efficiency for the comparative cost of acquisition of systems of similar output capacity.

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