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Integrated System for Enhancing the Solar Power Generation

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Abstract:- The unsustainable nature of fossil fuels that are used for generation of power in large amount has promoted the use of renewable energy methods. Sunlight is the major source of renewable energy and it is converted into electricity using solar panels. There are numerous factors which hinder the performance of the solar panel and there are factors which increase its efficiency. Considering all these factors, numerous features have been accommodated in the solar panel design to improve the efficiency of the solar panels. Among them are solar tracking, solar concentration and solar panel cooling. By integrating the above three methods, we can improve the output power that is generated. For the tracking of sunlight, LDRs are used and with the help of DC motor the panel is rotated. The light is concentrated to a particular area in order to utilize maximum sunlight using simple mirrors and water is made to flow below the panel to reduce the heat losses.

Keywords:- *Solar Tracking ;Solar Concentration ;Solar panel Cooling; LDR sensor; Temperature sensor;*

I. INTRODUCTION

The current methods of mass energy production have a lot of destructive effects on the environment. Furthermore the fact that fossil fuels are not to last forever and nuclear energy had a history of disasters whenever manhandled. Due to this in the past few years, the development of renewable energy methods for facilitating the masses has been getting popular. Among them are the solar panels which have a positive impact on the environment and are climate friendly. Due to their simplicity in operation, popularity, and a strong prospectus future, they have become a booming industry Goddard. Solar panels were also developed and were facilitated with various performance enhancing features like Solar Tracking, Solar Concentration, and Solar Panel Cooling. If a system has all of them integrated into it at once and it utilizes common features that do not classify as a required inputs. Then it is possible that solar panels can be used to satisfy higher energy demands and ultimately reduce the energy demands from the conventional methods. Apart from that as fresh water pipes are a common feature in the modern day world and gravity has been utilized as a source of power since the start of history. It would be a good choice to utilize them together if they can deliver promising results in enhancing a solar panels performance. Looking at this prospectus the objective of this paper was to design and evaluate a prototype that would house a solar panel and would have the Solar Tracking, Solar Concentration and Solar panel Cooling for enhancing its performance.

II. LITERATURE REVIEW

A. Existing system

- *Solar Tracking*

Solar tracking refers to pointing the solar panel toward the sun all the time. This makes the sun perpendicular to the solar rays thus generating maximum possible power output for that time of the day. In order to achieve this ability solar trackers are used. A solar tracker is a combination of electric devices which are controlled by a pre-programmed microcontroller. There are a wide variety of solar trackers; some provide a single axis of motion while some provide a double axis of motion.

- *Solar Panel Cooling*

It is an established fact that if the temperature of a solar panel is high its efficiency will decrease. Hence, for it, various cooling methods have been made. The most commonly cited were by using air and water or simply water.

- *Solar Concentration*

It is a known fact that solar panel produces power because of the light which falls on it. Hence, if more light falls on it then more power it produces. For this mirrors and different optics are used to concentrate more light on the solar panel thank its surface area can be exposed to directly. This technique is called Solar Concentration. However, the only drawback of the Solar Concentration technique is that it raises the temperature of solar panels.

- *Proposed system*

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The proposed system consists of the combination of the solar tracker, solar panel cooling and solar concentration. The tracking mechanism makes the solar panel to point towards the sun always in the daytime. The mirrors can enhance the light falling over the panel which may cause a increase in temperature due to this increase in temperature there would be heat loses. To reduce the heat of the solar panel to a considerable amount we employ the solar panel cooling system which would reduce the heat to some extent and thus protecting the panel from radiation. This combined approach can enhance the output of the solar panel. In this system we use dual axis tracking system to track the sunlight using LDRs. And by using mirrors we concentrate maximum sunlight and using temperature sensor we constantly monitor the temperature of the panel. Whenever the panel temperature is increased the DC pump is turned ON in order to get a water flow below the solar panel. The water flows through a copper tube.

III. COMPONENTS

A. LDR sensor

It consists of a led and LDR. The led and LDR are placed in parallel and when the light intensity is high the resistance is also high. Similarly when the light intensity is less, the resistance is also low.

B. Liquid crystal display

A liquid crystal display is a thin, flat panel display and a optical device that uses the light modulating properties of liquid crystals. Liquid crystals use a backlight or reflector to produce images in color or monochrome. It is a low power consuming device. Liquid crystal display screen works on the principle of blocking light rather than emitting light.

C. PIC Controller

The PIC microcontroller PIC16f877a is one of the advanced microcontrollers in the industry. This controller can be easily coded and very convenient operation. It is an 40 pin controller, in which 33 pins are used as input and output pins. The main advantage of the PIC microcontroller is that it can write or erase any number of times. It consists of two 8 bit and one 16 bit timers.

D. Temperature sensor

The temperature sensor used in this system is IC LM35DZ. It is a precision centigrade temperature sensor. It has a temperature range of 0°C to 100 °C. Further it has a linear output with a linearity of 10mV/°C. It has another advantage that it has no problems of self heating during operation thereby having only least errors at its output. This sensor has a voltage output proportional to Celsius value of temperature and is also suitable for remote operation. The sensor is a Resistance Temperature Device (RTD). The working principle is that as the temperature changes, the resistance of the material also changes. The resistance varies linearly with the temperature of the device. The pin diagram of the temperature sensor IC LM35DZ in TO-92 package is shown in Fig.1

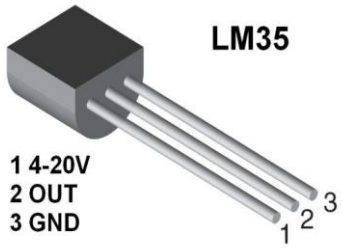

Fig 1:- Temperature sensor

E. Electromagnetic relay

In our project we will be using an electromechanical relay, which will be a 5 pin relay. When the relay driver circuit receives a particular signal from the microcontroller, then relay can be turned ON/OFF to power ON/OFF the supply to the motor. The relay will receive signals only when the LDR values different.

F. Limit Switch

The limit switch is an electromechanical device that consists of an actuator mechanically linked to the contacts. When an object comes into the contact, the device makes or breaks the electrical connection. We used the limit switch to set up a limit to the solar panel's rotation. Whenever the limit switch is operated, the motor stops rotating.

G. Flowchart

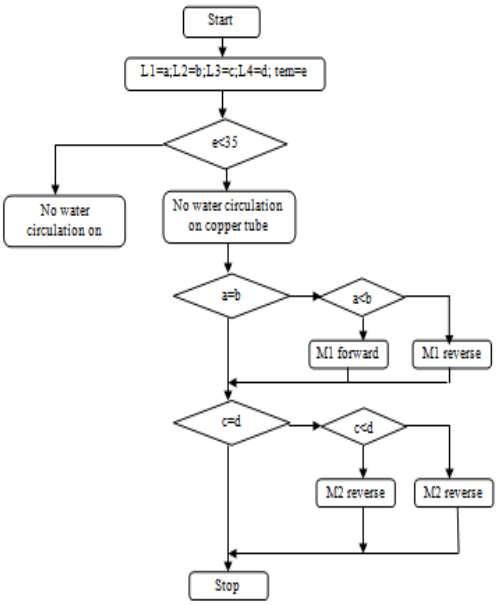

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Fig 2:- Flowchart

IV. SIMULATION RESULT

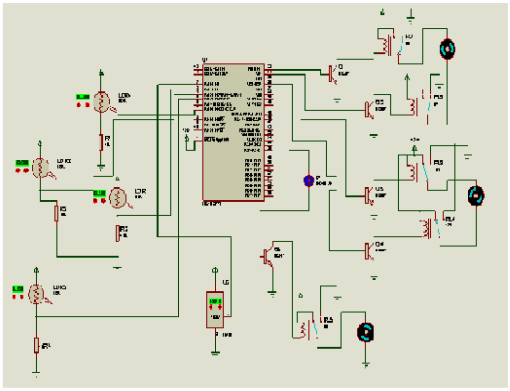

Fig 3:- Simulation

The above diagram shows the simulation of the project . The proteus design suite is a proprietary software tool used primarily for electronic design automation. The proteus design suite is a windows application for schematic capture, simulation and PCB layout design. The microcontroller simulation in proteus works by applying either a hex file or a debug file to the microcontroller part and the schematic. The components present in the simulation are pic microcontroller (16f877a) , dc motor, lcd, relay, battery, power supply, light dependent resistor sensor(LDR), driver circuit. All the functions are controlled by the microcontroller except the light dependent resistor sensor. The programming is done in the MPLAB software and the reference value at which the message will be sent from the module to the virtual terminal will be programmed in the software.

V. BLOCK DIAGRAM

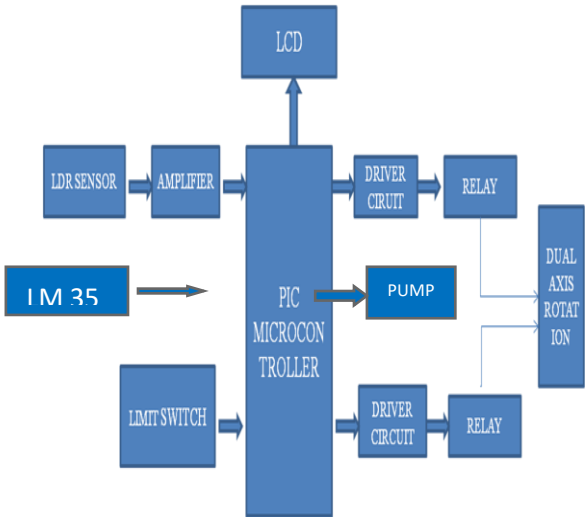

Fig 4:- Block Diagram

The solar panel is made to face the sun always by a simple LDR sensor by balancing the values of the LDRs placed in the four sides of thesolar panel (North, South, East and West).First by balancing North and South LDRs .The limit switch is used to limit the panel's movement to a particular point and to stop the motor at the right time. When in operation, while the temperature increases above certain set value according to the climate, the DC pump is operated to make the water flow. LCD is used to display the temperature of the panel continuously using temperature sensor. The PIC16f877a is used to control the entire process mentioned.

VI. HARDWARE PROTOTYPE

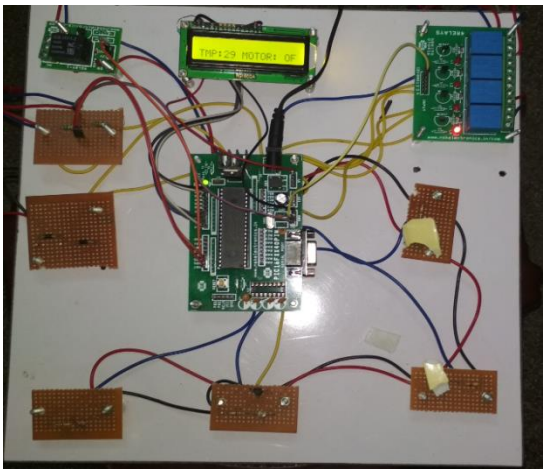

Fig 5:- Hardware Setup

Fig 6:- Top View of the Prototype Setup

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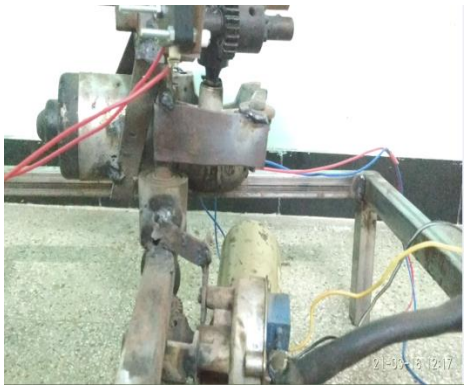

Fig 7:- Side View of the Prototype Setup

The Figures-5,6,7 represents the entire Hardware setup showing the output.

VII. FUTURE WORK

As a future work, we would like extend this system with the anti-reflective coating which can reduce the radiation in the panel. Since dust blocks sunlight, this paper can be extended with anti-dust coating.

VIII. CONCLUSION

The sun is main source of renewable energy and it is the maximum time available in this world. It is the direct source of energy available. Solar panel is the electrical source which converts sunlight into electrical energy. In our paper we have shown the integration of different systems implemented on the solar panel. The proposed system can improve the output power. The solar panels definitely are the greatest invention of mankind. We must use it effectively and efficiently. We have shown some of the ways to use the solar panel effectively. This would definitely help in future. By moving towards cleaner and safer energy, we can ensure the safety of our future by reducing the emissions of harmful gases due to the fossil fuels.

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