Integrated Cleaning Unit and Rotation of Solar Panel

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***Abstract*- Solar energy is one of the major future energy source and now it is a major research area. Large solar power plants are emerging in different places of world. Therefore the efficient utilization of the solar energy is required. Main aim of this project is to increase the efficiency of the solar panel. The efficiency of the solar panel can be increased by cleaning the surface of the solar panel and by orienting the position of the solar panel to the direction of position of the sun.**

Monthly cleaning of the panel is preferred for maximum efficiency. Improper cleaning of the solar panel will reduce the efficiency upto 25% per day. Cleaning is done manually which is very difficult especially when the solar panels are kept at high altitudes. So this project introduces an automatic cleaning unit integrated to the solar panel. Cleaning unit consist of a wiper which is drive by a motor. The motor is being interfaced with the microcontroller. During the wiping action an effective cleaning agent is sprayed.

Another factor which affects the efficiency of solar panel is the position of the sun. The ideal situation is when the sun is hitting the panel at a perfectly perpendicular angle. So this project introduces an automatic rotation of solar panel. Solar panel is rotated to that direction where the intensity of sunlight is maximum.

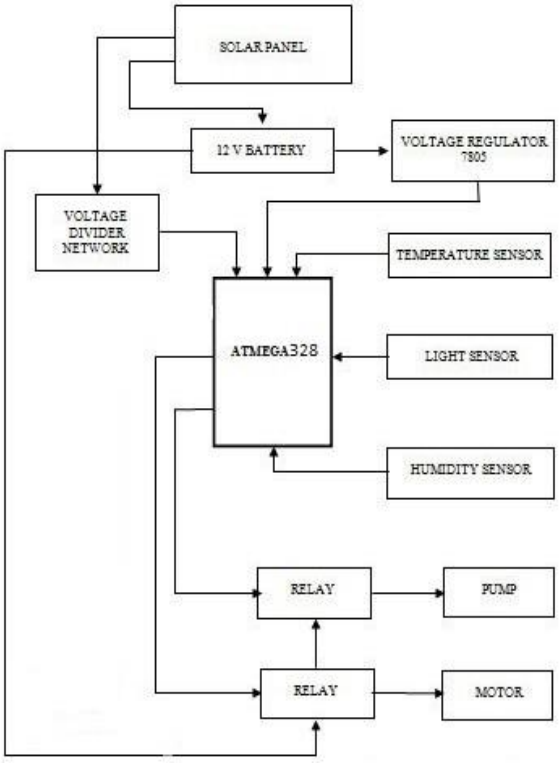
All mechanisms in the system are controlled automatically, thus the system become easy. A MATLAB program is introduced in this project to calculate the efficiency. The system incorporates with different type of sensors such as temperature, humidity and light. Thus solar panels which are assembled in a higher altitude can be monitored in safe way.

Keywords—MATLAB- Matrix laboratory

I. INTRODUCTION

Solar panels work by allowing light into the solar cells. The more light that hits a panel, the more power it will generate. Due to the upwards angle of solar panels, they are more prone to bird dropping and built-up of general dust and dirt that does not wash off with just rain. This reduces the amount of light hitting the panel and reduces its output. As the projected energy figures claimed by solar panel manufactures and installers are based on the optimum performance of clean solar panels, this build up of dirt can adversely affect the panel's ability to meet those projections. So it is important to clean solar panel in order to protect and maintain our investment. In present condition, solar panels are cleaned manually which is very difficult and will not provide good result. So the automatic cleaning system will be an efficient method. Another factor which affects the efficiency of solar panel is the position of the sun. Solar panels are installed differently based on their geographic location throughout the world. The premise behind this is simple, the sun is in a different place in the sky, panel need to be directed according to this position. So here a MATLAB program is being introduced which shows the direction to which the solar panel should rotate according to the position of the sun.

II. BLOCK DIAGRAM



III. BLOCK DIAGRAM DESCRIPTION-

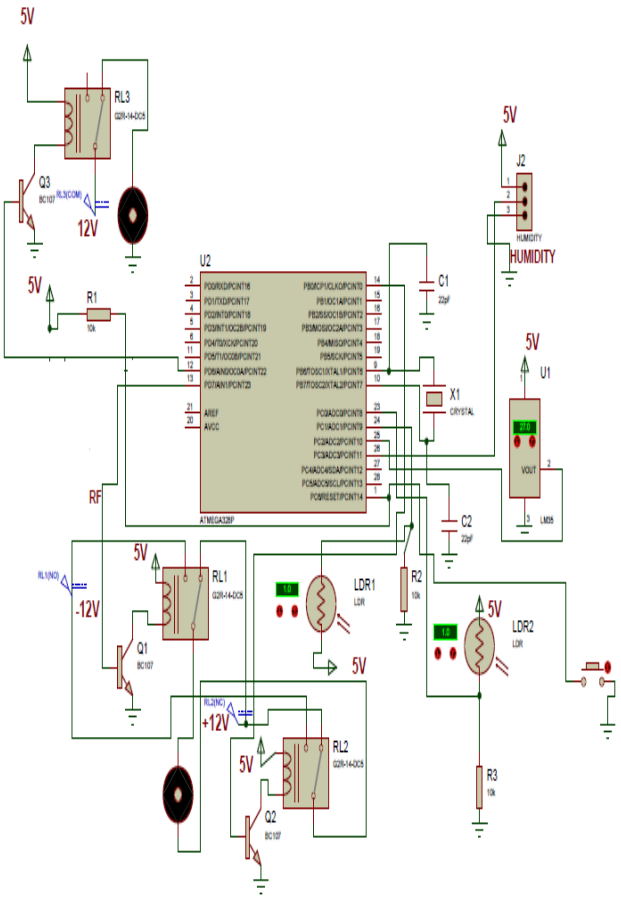
Our main aim is to increase the efficiency of the solar panel. Efficiency can be increased by automatically controlling the cleaning and rotating the solar panel to the direction of position of the sun. A 12 volt battery gets charged by the solar panel and the stored charged is being delivered for the functioning of other components. A 7805, 5v regulator is used to maintain constant DC voltage to

power the microcontroller Atmega168. Atmega168 is an 8 bit microcontroller. The output voltage from the solar panel is given through a voltage dividing network to the Atmega328 to calculate the efficiency

Initially the efficiency of the solar panel is being checked whether it is below the cut off efficiency for which it is being designed. If it is below the cut off then the intensity of light falling on the light sensor is being measured. LDR is used as the light sensor. There are total 2 LDR which is used to measure the intensity of light. The solar panel is being rotated to the direction to which the intensity is maximum. Again the efficiency of panel is measured, if it is below the cut off then atmospheric condition is checked. The temperature is being measured using LM35. If the measured temperature is above a particular level then the microcontroller checks for the humidity using the humidity sensor. The humidity check is performed to detect whether the climate is cloudy or rainy.

The atmospheric condition is not the reason for decrease in efficiency indicates that it is due to accumulation of the dust particles on the surface of the solar panel. Therefore the panel should be cleaned. Microcontroller switches the 5V relay which is connected to the pump and the pump sprays a cleaning agent. Another 5V relay is switched which is being connected with the motor. Motor is attached to the wiper. Wiper is used to clean the surface of the solar panel.

IV. CIRCUIT DIAGRAM



V. CIRCUIT DIAGRAM DESCRIBTION

Efficiency of the solar panel can be increased by rotating the solar panel to the direction of position of the sun and by cleaning the surface of the solar panel. The microcontroller used in this circuit is Atmega 328. The output voltage from the solar panel is given through a voltage dividing network to the 28th pin of the IC. The output voltage from the solar panel is used to calculate the efficiency of the solar panel. If the efficiency is below the cut off level then the intensity of the light falling on the LDRs are being calculated. There two LDRs oriented into two different directions connected to the 23rd and the 24th analog pin of the Atmega328. The resistance of the LDR and the 10K resistor forms a voltage dividing network. The voltage available at 23rd and 24th pin is given by

Vout = Vin X 10K/(10K + Resistance of the LDR)

When no light falls into the surface of the LDR, the resistance of the LDR will be high. If any leakage voltage arrives from the LDR it gets grounded through the 10K resistor. When light falls into the surface of the LDR, then the resistance of the LDR decreases and the corresponding output voltage will be given to the IC.

The solar panel rotates to the direction in which there is maximum intensity of the light. The Panel is rotated by a motor. Motor is rotated with the help of two relays connected to the 13th and 14th pin of the Atmega328. The relay has three terminals. One is the normally closed terminal connected to -12V, second normally open terminal is connected to the +12V and the third common terminal is connected to the motor.

When the input to the transistor is low, the transistor will be OFF and thus the transistor will not provide the necessary ground for the relay and the motor will be connected to the normally closed terminal which has a +12V supply. . When the input to the transistor is high, the transistor will become ON and thus the transistor will provide the necessary ground for the relay and the motor will be connected to the normally open terminal which has a -12V supply. If the input provided for both of the transistor is low then the motor will not posses any rotation. If the input to the first transistor is low and the second transistor is high, the motor rotates in the anticlockwise direction. If the input to the first transistor is made high and the second transistor input low then the motor rotates in the clockwise direction. If the input to both transistor is made high then the motor will not posses any rotation.

If the intensity of the light falling on all he LDRs are below a cut off level then the Atmega checks the humidity and the temperature of the atmosphere. The humidity sensor used is AM2302. It has three terminals 1st terminal is provided with 5V, output voltage of the sensor is taken from the 2nd terminal and is connected to the 25th analog pin of the IC and the 3rd terminal is being grounded. Next the Atmega 328 checks the temperature using LM35. It has three terminals 1st terminal is provided with 5V, output voltage of the sensor is taken from the 2nd terminal and is connected to

the 26th analog pin of the IC and the 3rd terminal is being grounded.

If the values of humidity is above and temperature is below the predetermined cut off levels, then the microcontroller detects that the decrease in efficiency is due to the accumulation of dust particles on the surface of the solar panel. So the surface of the solar panel should be cleaned using a cleaning agent. The flow of the cleaning agent is controlled by using a relay and a pump. A crystal oscillator of 16MHZ is connected to the 9th and 10th pin of the IC to synchronise all the internal operations of the IC. A 10K resistor along with a switch connected to the 1st pin of the Atmega 328 to reset all internal operations of the IC.

VI. RESULT CONCLUSION-

Solar energy is one of the major future energy source. Therefore the efficient utilisation of the solar energy is required. As solar panel is one of the effective transducer which converts the solar energy into corresponding electrical energy, the efficiency of the solar panel can be increased by cleaning the surface of the solar panel and by orienting the position of the solar panel to the direction of position of the sun. Monthly cleaning of the panel is preferred for maximum efficiency. Improper cleaning of the solar panel will reduce the efficiency upto 25% per day. Cleaning is done manually which is very difficult especially when the solar panels are kept at high altitudes. So this project introduces an automatic cleaning unit integrated to the solar panel. Cleaning unit consist of a wiper which is drive by a motor. The motor is being interfaced with the microcontroller. During the wiping action an effective cleaning agent is sprayed.

Another factor which affects the efficiency of solar panel is the position of the sun. The ideal situation is when the sun is hitting the panel at a perfectly perpendicular angle. So this project introduces an automatic rotation of solar panel. Solar panel is rotated to that direction where the intensity of sunlight is maximum. All mechanisms in the system are controlled automatically, thus the system become easy. Thus solar panels which are assembled in a higher altitude can be monitored in safe way.

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