

# Solar Panel with Automated Cleaning and Cooling

Chandana B<sup>1</sup>, Deekshith H S<sup>2</sup>, Tahreem Suman<sup>3</sup>, Zakir Shariff<sup>4</sup>, Ravikumar H<sup>5</sup>

<sup>1,2,3,4</sup>UG Student, Dept of ECE, Maharaja Institute of Technology, Mysore, Karnataka

<sup>5</sup>Asst Professor, Dept of ECE, Maharaja Institute of Technology, Mysore, Karnataka

**Abstract-** solar energy is the energy obtained by capturing heat and light from the sun. Solar energy is abundantly available and has been utilized since long both as electricity and as a source of heat. As we all are aware of load shedding and the problems related to it, it indicates that the energy which is produced is less than the energy required. Hence, in energy deficient country like India, where power generation is costly, solar energy is the best alternate means of power generation and India being a tropical country receives solar radiation throughout the year. This solar energy poses a problem related to the percentage efficiency. The high temperature of the solar panel, results in reduced efficiency of electricity production. The wind storm, bird droppings and other objects on the panel further reduce the efficiency. Hence, it is essential to have regular and proper cooling and cleaning of panel. To improve the percentage efficiency of electricity generated from solar power plants the efficiency of solar panels must be maximized. In this paper we are implementing an automated cooling and cleaning system using arduino and sensors for the better performance of the panels. The operating temperature is reduced by a layer of water flow at regular intervals over the panel and cooling system is implemented. For cleaning system, a wiper moves over the surface of the panel through motors. Also the voltage generated by the panel itself is used for the automation system and hence it reduces the use of an external power. The system reduces the human interference and is also simple to implement.

**Keywords-** PV, IR

## I. INTRODUCTION

Due to major problem related to environment such as global warming, it is very difficult to fulfil energy demand of world with the help of conventional energy source. To overcome the issues of energy depletion we need to find another source like non-conventional sources. Solar energy is well known source of renewable energy. Solar power is the conversion of energy from sunlight into electricity, directly using PV, indirectly using concentrated solar power a combination. The solar power system uses mirrors & tracking system to focus a large area of sunlight into a small beam. PV cells convert light into an electric current using PV effect. Unlike fossil fuel based technologies, solar power doesn't lead to any harmful environment during operation. PV solar panel absorbs sunlight as a source of energy to generate electricity. PV module constitutes the PV array of PV system that generates and supplies solar electricity in commercial and residential application. As solar panel is plated outside it is necessary to clean the panel & also to cool the panel because of overheating that absorbed by the sun. The solar PV modules are generally employed in dusty environment which are in the case of tropical countries like India. The dust gets accumulated on the front surface of the module & blocks the incident light from the sun. So it reduces the power generation capacity of the module. The power output reduces as much as by 50%, if the panel is not cleaned. The cleaning system has been designed that cleans the module by controlling arduino programming to remove dust in PV modules to improve power efficiency. After cleaning, the panels must be cooled as the temperature of PV modules increases when it absorbs solar radiation, causing a decreasing efficiency. As increase of ambient temperature it is necessary to cool the panel, the automatic solar cooling is designed by using DC water pump. The PV modules with cooling system improve the efficiency of the panels.

## II. LITERATURE SURVEY

[1] "Electrical performance evaluation of PV panel through water cooling technique" by Calebe Abrenhosa Matias, Licinio Moraes Santos, Aylton José Alves, Wesley Pacheco Calixto : This paper presents the development of a cooling apparatus using water in a commercial PV panel in order to analyze the increased efficiency through decreased operating temperature. The system enables the application of reuse water flow, at ambient temperature, over the front surface of PV panel and is composed of an inclined plane support, a perforated aluminum profile and a water gutter. Through use of this cooling system the PV module showed a net enhancement in the power conversion efficiency by 16.66%. The results show that the water distribution system, under PV panel can be improved to optimize the efficiency of the water flow used.

[2] "Increasing Efficiency of an Electricity Production System from Solar Energy with a Method of Reducing Solar Panel Temperature" by Bancha Sreewirote, Akeratana Noppakant, and Chaichan Pothisarn : In this paper an experimental set up of a solar energy system integrated with a heat ventilation system is proposed. The results of the system showed that the system enabled the output of voltage, current and power to increase the experimental setup consists of a 258-watt solar panel, a charge controller, an inverter, a battery, a temperature controller and a cooling system. To decrease temperature of the solar panel, a cooling system of a vehicle is modified. The result of the experiment indicates that the current of a solar panel depends on solar irradiance incident on its panel and the surfaces of the solar panel.

[3] "Self-Cleaning and Tracking Solar Photovoltaic Panel for Improving Efficiency" by Bandam Abhilash, Ashish K Panchal : This paper gives the brief description of the design and construction of micro-controller based cleaning and tracking system. The efficiency of the panel has been improved when we are going with the tracking and cleaning system. Mainly, the effects of the dust and intensity of light on the efficiencies of the PV panels have been highlighted. The total system which automatically tracks and cleans the panel, using the microcontroller (P89V51RD2) is used to achieve the requirement with the low cost. Tracking is best suited only when the dust on the panel is cleaned.

[4] "A New Solar Energy Converting System with Vertical Photovoltaic Panels by M. Adochitei, C. Harabagiu, D. Astanei, R. Burlica : In this paper the new system to remove the active substrate of the solar cells from the cleaning system is proposed The upper part of the system covered with glass allows automatic cleaning by electrostatic or ultrasonic methods. In order to remove the active substrate of the solar cells from the cleaning system, a new design of the solar panel has been developed. The new system proposed in this paper uses two vertical solar panels sided mounted along a forty five geometrical degrees mirror prism. The light coming from the sun is reflected horizontally, perpendicular, due to the prism to the photovoltaic panels. The system does not affect the efficiency of the photovoltaic panels.

[5] "Development of an Automatic Cleaning System for Overall System Architecture

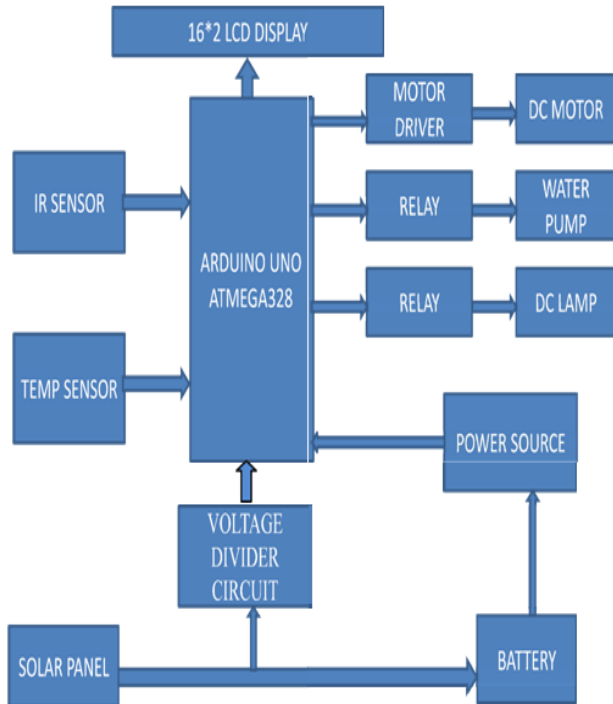


Fig.1: Block Diagram

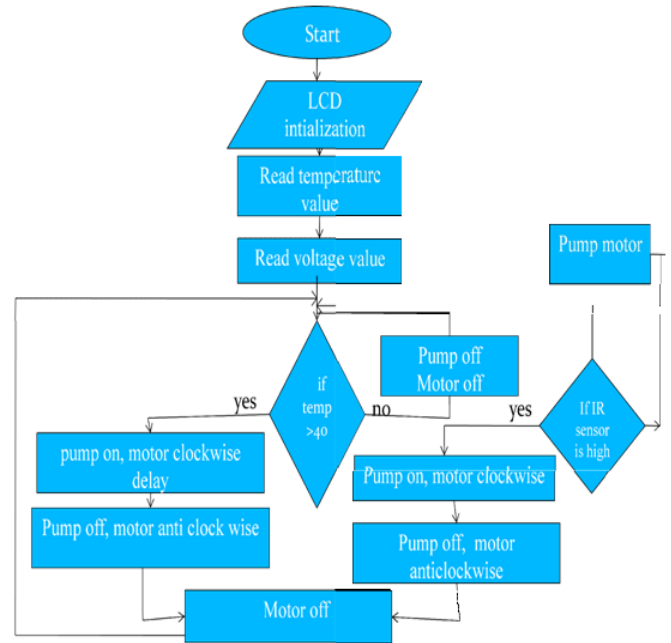


Fig.2: Flowchart

Photovoltaic Plants” by Alireza Gheitasi, Ali Almaliky, Nawaf Albaqawi : This paper aims at developing a low cost automation system to maintain the efficiency of solar panels connected in an array by providing an on demand cooling. Wireless sensor networks have been implemented to collect the data from individual panels. Monitoring data and information trends then will be used to trigger a robotic system to clean the surface of unclean panels. The cleaning system is operated whenever required and clean affected panels. A single robot should be able to cover good number of arrays. This scenario is cheaper than alternative methods as permanent instating is not required.

### III. PROPOSED MODEL

#### System Model

This work focuses on monitoring the performance of solar panel. In this paper the efficiency of solar panel is increased by cooling and cleaning the solar panels. The system is automated through arduino and sensors. Some of the components required are processor board, IR sensors, temperature sensor, DC motor and water pump. Whenever the IR sensor senses an object on the panel it invokes the cleaning system through the arduino, water from the pump will be flowed on the panel and then the motor runs and wiper moves over the panel which cleans it. And whenever the temperature of the panel crosses the threshold voltage.

The basic operation of the block diagram is, all of the components used will be interfaced to the arduino microcontroller. IR Sensor is an electrical device, whenever the IR sensor detects the object, the system invokes the cleaning mechanism and immediately triggers the wiper through the motors and the panel is cleaned and whenever the temperature sensor senses the raise in temperature (more than the threshold) the system invokes the cleaning mechanism and immediately triggers the water pump which lets the water to flow over the panel and cool it, ultimately the efficiency of the system is increased.

System Flowchart cooling system will be invoked through the arduino, the water flows on the panel through the water pump and cleans it. Hence the efficiency of the panel increases. The voltage produced from the panel is used as a power source for the arduino and the sensors and also the extra voltage is stored in the battery. The voltage from the battery is used to glow a DC lamp.

As shown in figure 2, the sensor systems check for object on the panel and the temperature of the panel continuously and if any of it is detected, the respective system is invoked and the cleaning or cooling mechanism takes place.

### IV. System Implementation Objectives and Scope of the Project

- To develop automatic water cooling system for the domestic solar arrays in turn improving its efficiency.
- To design an automated cleaning system to remove the dust and dirt which may reduce its efficiency
- To use the voltage generated by the panel and light a DC lamp.

Solar energy is genesis for all forms of energy. This energy can be made use in two ways thermal route and photovoltaic route. In thermal route heat is used for drying, heating, cooking or generation of electricity and in photovoltaic route solar energy is converted into electricity that can be used for lighting, pumping.

Solar energy is very attractive energy source. It is environment friendly. When in use, it does not release carbon dioxide and other gases which pollute the air. Hence, it is very suitable for India, India being one of the most polluted countries of the world. Solar power is inexhaustible. In energy deficient country like India, where power generation is costly, solar energy is the best alternate means of power generation and India being a tropical country receives solar radiation throughout the year.

#### Hardware Requirements

- Solar Panel.
- Arduino UNO (ATmega328).
- IR Sensor.
- Temperature Sensor (LM 35).
- 16X2 LCD Display.
- DC Motor.
- Motor Driver (L293D).
- Relay.
- Controller Circuit.
- Battery.

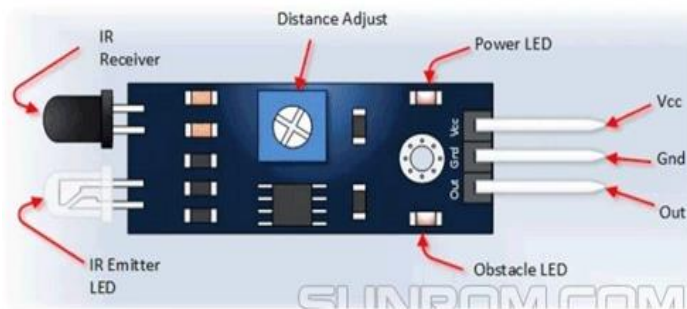


Fig.3: IR Sensor



Fig.4: Temperature Sensor



Fig.5: Arduino Mega Board

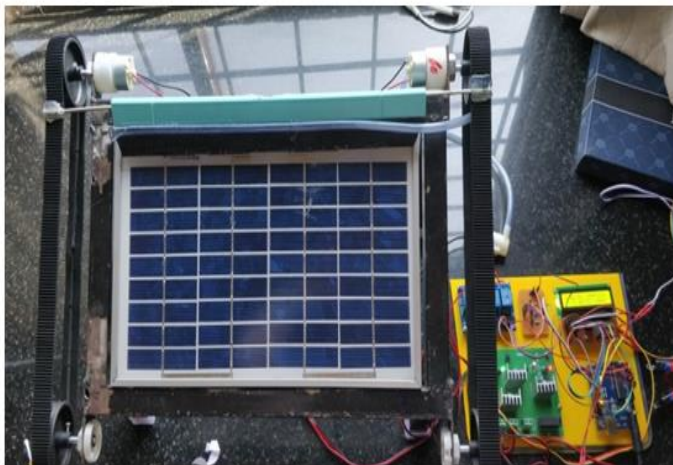


Fig.6: Solanpr Panel Cleaning System.

#### Software Requirements

##### 1. Arduino Software (IDE):

- The Arduino can be programmed using Arduino software or IDE
- ATmega328 comes preburnt with a boot loader that allows us to upload new code to it without the use of external hardware programmer.
- The open source IDE makes it easy to write the code and upload it to the board.
- Version used is Arduino 1.6.9
- It connects to Arduino and Genuino hardware to upload programs and communicate with them.

##### 2. Proteus software:

- Arduino simulation is done using Proteus software.

- It includes ultimate support for Arduino ecosystem.
- Includes both hardware and firmware design.
- World leading system level simulation and debug programming of physical hardware.
- Direct support for over 50 Arduino shields and breakout boards
- Can write the code in Arduino C++ or with flowchart blocks.

#### V. APPLICATION INTERFACE

Arduino UNO ATmega 328 is interfaced with system using IDE and Proteus ISIS Professional software. The interface is shown:

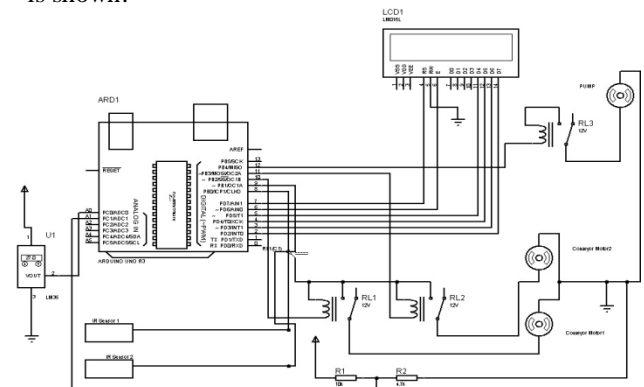


Fig.6: Circuit Interface

#### VI. OBJECTIVES

- To develop automatic water cooling system for the domestic solar arrays in turn improving its efficiency.
- To design an automated cleaning system to remove the dust and dirt which may reduce its efficiency.
- To use the voltage generated by the panel and light a DC lamp.
- Improve overall solar panel efficiency.

#### VII. CONCLUSION

The development of cooling and cleaning system can solve the problems and improves the efficiency of solar panels. The project helps in using renewable energy source and maintains the atmosphere as it is pollution free. It is an eco friendly project. No external power is required to implement the systems. It is an innovative technology and reduces the human interference.

#### VIII. REFERENCES

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