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AUTOMATIC SOLAR PANEL CLEANING SYSTEM

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ABSTRACT

The solar PV modules are generally employed in dusty environments which is the case in tropical countries like India. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun. It reduces the power generation capacity of the module. The power output reduces as much as by 50% if the module is not cleaned for a month. In order to regularly clean the dust, an automatic cleaning system has been designed, which senses the dust on the solar panel and also cleans the module automatically. This automated system is implemented using ATMEGA 328 microcontroller which controls the DC gear motor. This mechanism consists of a sensor (LDR). While for cleaning the PV modules, a mechanism consists of a sliding brushes has been developed. In previous technology, PV panel is fixed on the roof top and it detects solar rays only in east-west direction. But in this technology that we had developed the PV panel detects solar rays not only in east-west direction but also in north-south direction. To achieve this feature the PV panel rotates in 180º and the base of whole assembly rotates in 360º with the help of DC motor. In Heliotex technology, cleaning of PV panel was done manually. But for this technology, cleaning is done by automatic system i.e. spray mechanism. DMU will activate the spray mechanism through microcontroller by using a timer. In this paper we discuss about new mechanism for solar panel cleaning to achieve better efficiency.

Keywords: µC, DC, DMU,PV

I. INTRODUCTION

here is urgency in improving the efficiency of solar power generation. Current solar panels setups take a major power loss when unwanted obstructions cover the surface of the panels. The obstruction turns the shaded cell into a resistor, causing it to heat up and consume extra power. To address this issue, we have successfully engineered a self-cleaning solar panel. This specific panel detects the obstruction with a Differential Measurement Unit (DMU). It makes the decision from the Microcontroller unit to either clean the panel with the Wiper and Sprayer Mechanism or continue to charge the battery with the Battery Charger. Our mechanism to combat the power loss is unique, self-reliant, and easy to use.

There are many factors that affect PV power efficiency, such as shadow, snow, high temperatures, pollen, bird droppings, sea salt, dust and dirt. The main factor that affects a PV panel's efficiency is dust, which can reduce its efficiency by up to 50%, depending on the environment.

To explore the possibility of using a more sustainable power source. The possibility of installing many PV panels into the area brought about the need to consider how to increase long term efficiency by the regular removal of debris from the PV panels. In particular, dust which is made up of pollen, sea salt and dirt particles. This paper investigated the possibility of using the cleaning robots to remove dust, sea salt and pollen from the surfaces of PV panels.

The most important part of these systems is the solar panel where the solar energy is converted to electricity for the others. There are many types of the solar panels. In the countries those have dusty environment accumulation of dust on the solar panels leads to reduction of the transmittance of the panel. The effect of the accumulated dust will be reduced with the increasing of tilt angle, since the tilt angle will affect the exposure time to the sunlight also. But the best way to eliminate the effect of the accumulated dust on the solar panels is to clean the panels. Cleaning the solar panels is normally by washing which is tedious and cumbersome and also expensive in terms of the labor involved and time. In practice cleaning of solar panels should be frequently done which makes the process more laborious and expensive.

II. REVIEW OF LITERATURE

Photovoltaic panel production has increased globally in response to the growing demand for solar energy. This has been the result of an increased awareness of the damage to the environment that using fossil fuel sources has had over the years.

1. Heliotex Technology:

Heliotex is an automatic cleaning system that washes and rinses solar panel surfaces. The cleaning system can be programmed whenever it is necessary, depending on the environment. It does not require any further attention except the replacement of the water filter sand the occasional refilling of the soap concentrate. It contains a five-gallon reservoir for soap, which does not cause any damage to the solar panels.

The Heliotex system sources the water from the residence via a hose or pipe connected to the pump and attached to nozzles on the solar panel surface without causing rubbing. (SeeFig.2-1) The Heliotex system can be installed for any size or number of solar panels.

Figure 2-1: Heliotex cleaning technology using water and soap to clean the surface of PV panels.

2. Electrostatics cleaning:

Electrostatics cleaning technology is named "Harvesting electricity". This cleaning technology was first developed by scientists to solve the problem of dust deposits on the surfaces of PVs. This technology can also be used in dry dusty areas on Earth. Electrostatic charge material is used on a transparent plastic sheet or glass that covers the solar panels. Sensors monitor dust level sand activates the system in to cleaning mode.

The dust is shaken off the solar panels when an electrically charged wave breaks over the surface material. This is not a safe way for home owners who are using solar panels because the panel shakes which may loosen its connection to the roof and it could fall down and cause injury. However, it is an effective solution for larger systems elsewhere. The structure of the panels is strong and flexible to avoid breakage that may be caused by shaking. As shown in Figure2-2.

***Figure 2-2:** Structure of PVs system that uses electrostatic cleaning.*

In two minutes this system can remove up to 90% of dust from the surfaces of the PV panels by sending an electrical dust deterring wave which causes the dust to fall off onto the ground. However, this system is not going to remove dust when it gets wet, or if it is in a moist environment. The movement of the wave mechanism requires only a small amount of electricity which makes it a power efficient system however at present; the worldwide usage of the harvesting system is only 4%.

III. PROPOSED SYSTEM

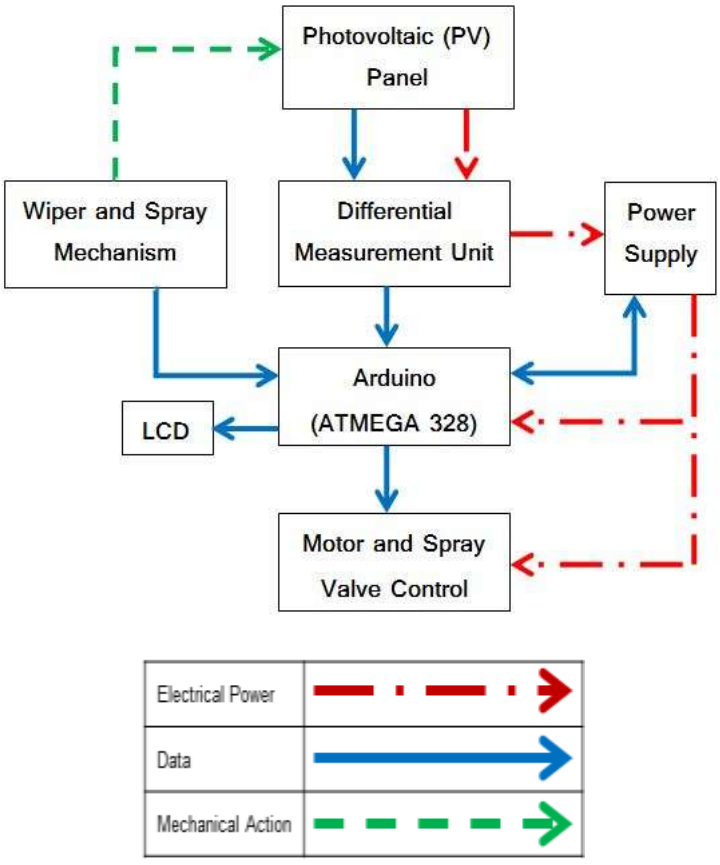

Figure 3-1: Block diagram of solar panel cleaning system

1. Photovoltaic Panel (PV Panel):

Solar panels absorb the sunlight as a source of energy to generate electricity or heat. A photovoltaic (PV) module is a photovoltaic solar cell. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given the same rated output. We can use this system for any multicrystalline type of solar panel for prototype; we have considered here a panel which is generating 17Watts 18 Volts.

2. Differential Measurement Unit (DMU):

It is a decision making component of this paper. DMU makes decision from the microcontroller unit that either cleans the panel with wiper and spray mechanism or to continue the conversion.

DMU consists of adjustable timer so that we can make a timer for cleaning of PV panel after set time interval.

As time elapsed and timer reaches its count value then DMU activates the wiper and spray mechanism and start the cleaning of PV panel.

3. Wiper and Spray Mechanism:

As its name stats that it is a mechanism which is use to clean the PV panel. It consists of wiper or brush mounted on PV panel.

When timer activate this mechanism then mechanism will start moving from one end of PV panel to clean it and it will move towards the other end of a PV panel.

This mechanism is controlled by motor and spray valve control block.

4. Microcontroller:

It will control the whole system. µC will control various blocks of this paper i.e. DMU, Wiper and Spray Mechanism, Motor and Spray Valve Control etc.

As per the coding we can control these blocks. For coding it requires a C programming.

5. Motor and Spray Valve Control:

This block is use to control the motor assembly and spray valve. It will pump the water from water tank to wiper and spray mechanism. Motor assembly will move the wiper and spray mechanism across the PV panel.

6. Power Supply:

As its name suggests that it will generate the power which requires for operation of whole system. A 12 V DC supply will require to operate the motors for rotating the PV panel and to move the robot on the PV panel. Another power supply of 5 V DC supply will require to operate the ICs in the circuit e.g. Microcontroller.

7. Liquid Crystal Display (LCD):

Here we used LCD to display the current state of the paper. Size of LCD is available from 8x2 to 40x4. For this paper we have used 16x2 LCD. 16x2 represents the rows and columns i.e. 16 columns and 2 rows.

PV Panel	
Microcontroller	ATMEGA 328
LCD	16x2
Power Supply	12V DC
Motor	Simple DC Motor

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IV. IMPLEMENTATION

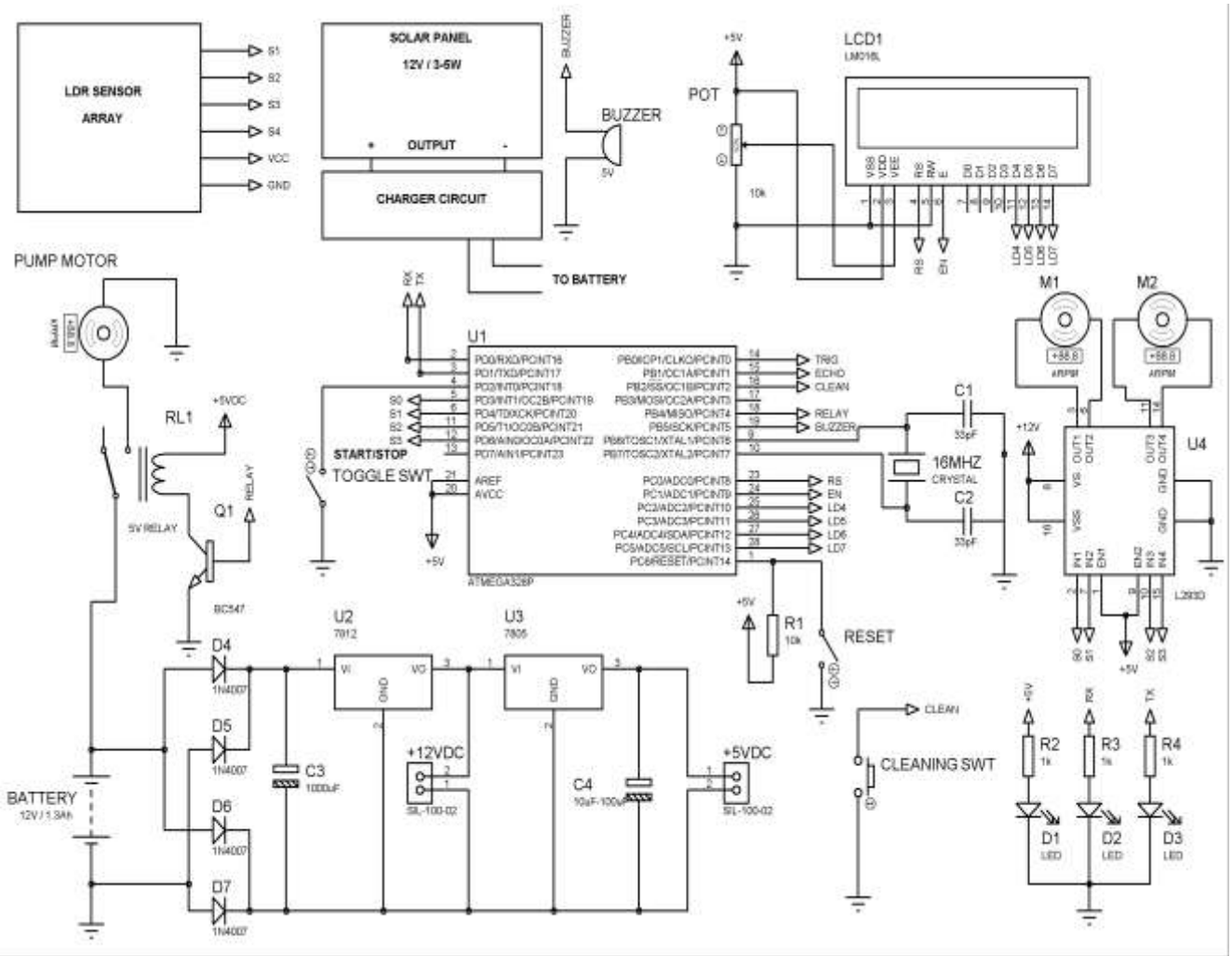
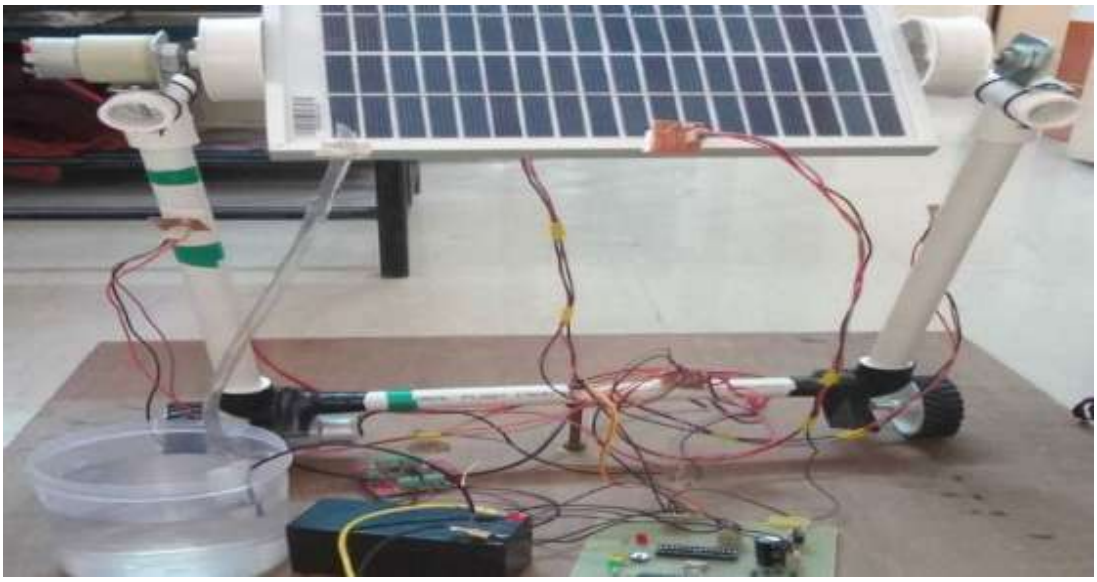


Figure 4-1: Circuit Diagram of Solar Panel Cleaning System



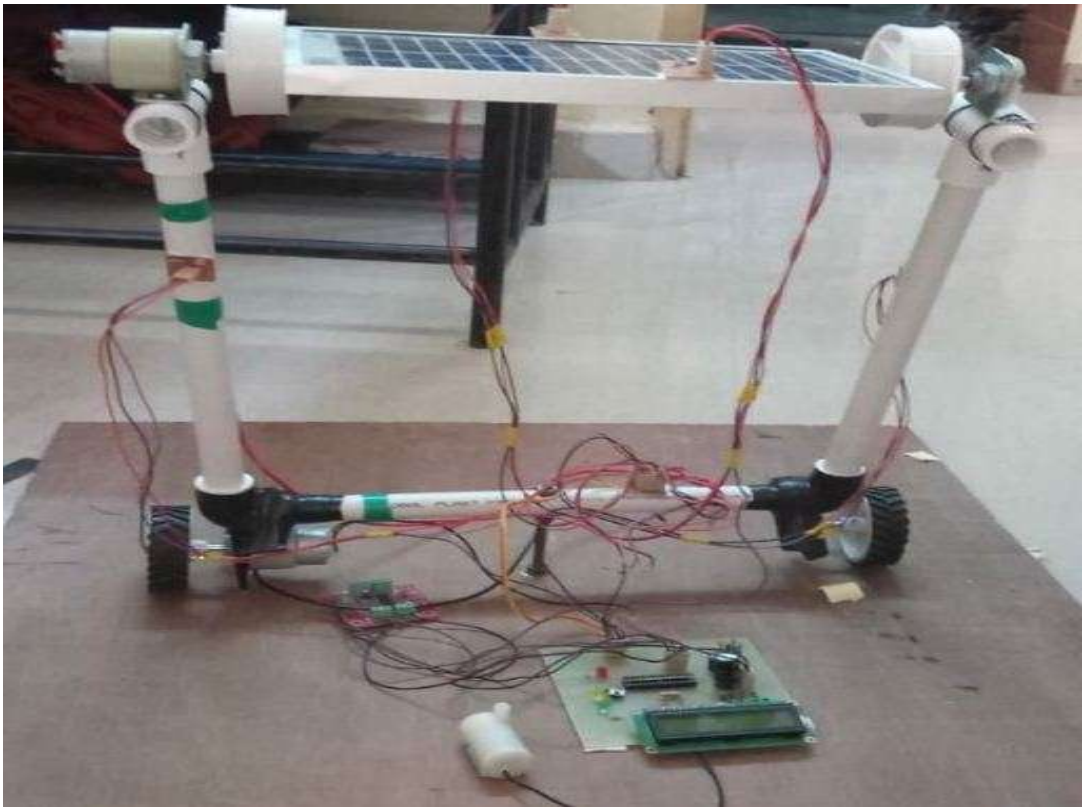


Figure 4-2: Assembly of Solar Panel Tracking System

Figure 4-3: Assembly of Solar Panel Cleaning System with Viper Control, Spray Mechanism

Figure 4-4: Assembly of Solar Panel Cleaning System with LCD Menu.

V. RESULTS

Output (Standard)	Output (Before Cleaning)	Output (After Cleaning)
Voltage 17V DC	12.8V DC	14.6V DC
Power 03 W	1.8W	2.5W
Operating Current 0.18 A	0.12 A	0.14 A

Efficiency:

We measured the voltage of PV Panel which does not contain any dust or particles which are stated in second chapter on it. The PV panel gives up to 12V DC approx. (According to intensity of solar rays falling over the panel).

Before cleaning we got 8V DC and after cleaning we got 10V DC.

VI. ADVANTAGES

- The surface of PV panel remains clean always.
- It gives better efficiency comparing with general systems
- By using adjustable timer, user can clean the panel as per convenience.
- No man power is required for cleaning.

VII. DISADVANTAGES

- Consumption of water.
- As wiper is used wear and tear increased.

VIII. FUTURE SCOPE

- It can implement on large PV panels.
- Useful at such places where humans can't reach to clean the PV panel.

IX. CONCLUSION

The losses of the output power of the fixed solar panel can be higher depending on the dust form. The dirt and bird drop make a hot spot in the panel, and it can make temporary fail in the panel. Dry cleaning can't remove all the dirt on the surface of solar panel, but it is able to remove the outer layers of the dust. Cleaning solar panel with water increases cleaning efficiency by removing majority of the dirt deposited on the panel. Comparing the

costs of cleaning by manual operation and automatic operation the costs of automatic cleaning is proved to be more economic and significantly less difficult particularly in systems having large number of solar panels. Also frequent periodic cleaning ensures that the solar panel works with a good consistency at all times.

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