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Automatic Solar Dust Cleaning System & Time Operated MPPT

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Abstract: ***Nowadays in India, Solar Panels have become an increasingly popular form of renewable energy. With a simple beginning in 1800s, Photovoltaic (PVs) have continued to be improved and used as a form of energy. The solar PV modules are generally employed in dusty environments so that dust gets accumulated on the front surface of the module and blocks the incident light from the sun. So that, it reduces the power generation capacity of the solar module. This paper will solve one of the major problem which causes decrease in overall output efficiency of the PV module. We propose a solution in order to make the solar panel system at best power generation state in dusty environment. In this paper, we will discuss about new mechanism for solar panel i.e. automatic dust cleaning system to achieve better efficiency. In addition, we have implemented a Time Operated Maximum Power Point Tracker to receive the maximum amount of sunlight in all direction at the sun all day. This proposed system causes the solar panel to move along with sunlight across the sky, then it would be receiving the maximum amount of sunlight energy. This introduces a novel cost effective and efficient Microcontroller Based Sliding Roller Dust Cleaning Mechanism and Time Operated Maximum Power Point Tracker system for solar photovoltaic system to ensure the maximum power point operation at all changing environmental condition.***

Keywords: ***PV Solar Panel, Dust Cleaning, Time Operated MPPT, and Water Spray, Sliding Roller.***

I. INTRODUCTION

In recent years, the usage of photovoltaic solar module increases drastically. So there should be efficient use of solar energy. But Photovoltaic solar system reduces its energy output significantly due to dust or soot from local air pollution. It shows an average annual energy loss of 5% for arrays that are not periodically cleaned. To tackle with these problems we are going to share some innovative proposed solutions to increase overall efficiency of the solar panel.

This paper introduces an advanced sliding roller/wiper-spray mechanism and Time Operated Maximum Power Point Tracker. A sliding roller-Spray mechanism will regularly clean the solar panel so that no dust will accumulate on module and in turn efficiency will also increase.

As its name states that it is a mechanism which is used to clean the PV panel. It consists of sliding roller mounted on PV panel. When timer activates then this 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.

A time operated Maximum Power Point Tracker is proposed for extracting maximum power from a photovoltaic panel to charge a battery. The output power from PV system continuously varies with change in irradiance and temperature. There are number of maximum power point tracking (MPPT) methods available to operate the PV system at maximum power point. We have introduced "Perturb & Observe" (P&O) MPPT algorithm for the design and implementation.

II. AUTOMATIC SLIDING ROLLER-SPRAY CLEANING MECHANISM

In order to regularly clean the dust, an automatic cleaning system has been designed which cleans the module automatically. This automated system is implemented using 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 roller with water spray 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. For this technology, Cleaning is done by automatic sliding roller spray mechanism. Day night mode sensing is done with the help of LDR via microcontroller will activate the sliding roller-spray mechanism through microcontroller by using its internal timer.

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III. TIME OPERATED MAXIMUM POWER POINT TRACKER

The foremost way to increase the efficiency of a solar panel is to use a time operated Maximum Power point Tracker (MPPT), a power electronic device that significantly increases the system efficiency. By using it the system operates at the Maximum Power Point (MPP) and produces its maximum power output. Thus, an MPPT maximizes the array efficiency, thereby reducing the overall system cost. In addition, we attempt to design the MPPT by using the algorithm of a selected MPPT method which is "Perturb and Observe". When irradiance and temperature are constantly or slowly varying, the P&O method tracks MPP steadily and calculate operating point at which the battery is capable of producing maximum power. So a good, solid and reliable PV time based panel moving in direction of sun is a key component of any PV battery charging system to achieve systems maximum efficiency. Whereas microcontroller based designs are able to provide more intelligent control and thus increases the efficiency of the system.

Most solar panels are set at optimum angle based on the angle the sun hits at home (or any other location where the panel are installed). As the sun moves throughout the course of the day, the amount of sunlight energy will get varies on the angle to which they are set. If the sun is blocked by clouds, then the amount of sun energy hitting the solar panels would decrease, thus decreasing the power converted. So in order to get best performance of the solar panels, it would be best to make sure that the solar panels get the maximum hours of sunlight energy during the day, to do that it would need to be clear of shades and the right orientation depending on the time of the day. All these factors can be determined by looking at a solar panel characteristics curve, which is the output current and voltage graphs. The maximum power in an ideal situation for a solar panel can be found using IV curve. The peak would be the optimum point of power for the panel. The main objective is to maintain the maximum power at the peak level.

IV. BLOCK DIAGRAM

A. Block Diagram For Cleaning And Tracker Unit

1) Proposed Work

a) The MPPT control circuit is implemented in a microcontroller, which will check time using its internal clock and move the panel in Sun' direction. By using the microcontroller the whole mechanism is controlled.

b) Microcontroller unit controls various blocks of this paper i.e. Data Management Unit (DMU), Sliding Roller, Motor and Spray valve control. As Per coding we can control these blocks. For Coding it requires ALP Programming.

c) LDR is used to sense day and night mode so that cleaning of panel with water spray and sliding roller will be done in forward direction at the start of the day and reverse direction at the end of the day.

d) Storage device is 12V lead acid dry battery.

e) The DC Motor and spray valve control is used to Control the motor assembly and water spray valve. It will Pump the water from water tank to Sliding Roller and spray mechanism. Water is required for cleaning the solar panel.

f) The DC Motor assembly will move the wiper and spray mechanism across the panel.

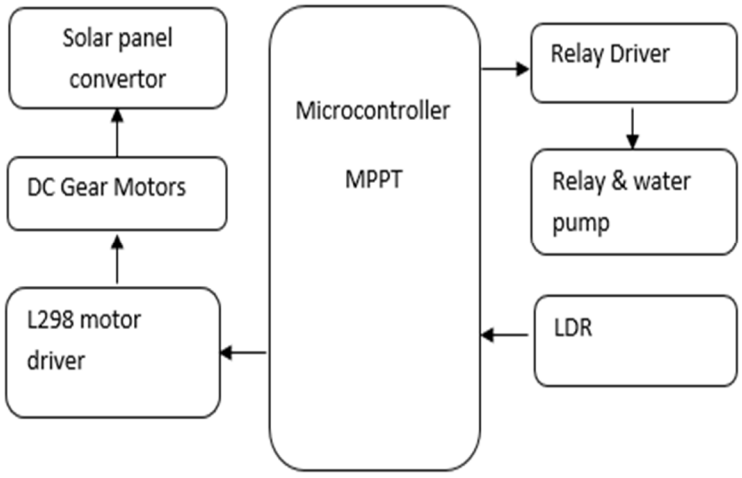

Figure 1. Proposed System Block Diagram

V. FLOW CHART

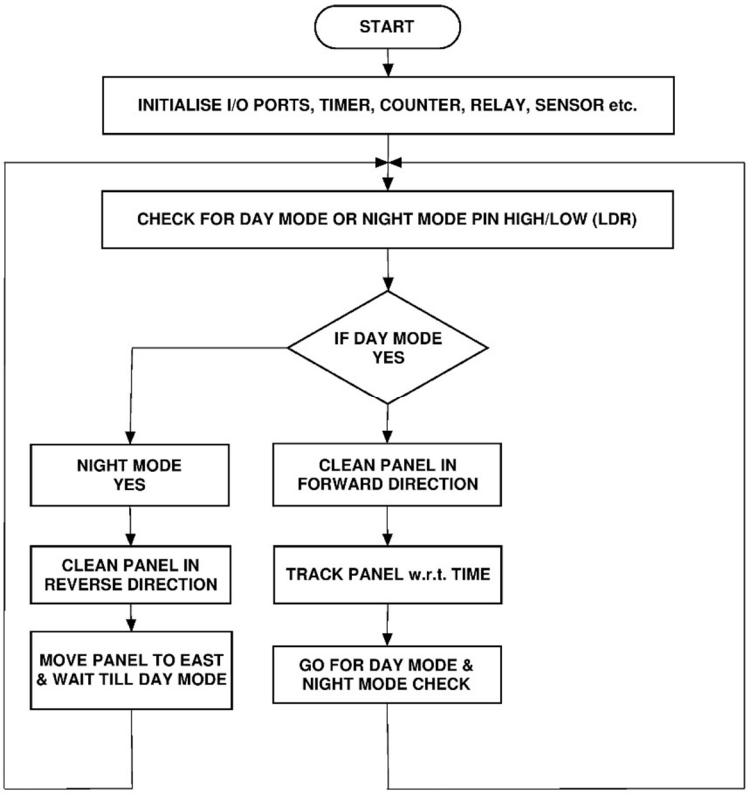

Figure 2. Flow chart of cleaning and solar tracking.

VI. CIRCUIT DIAGRAM

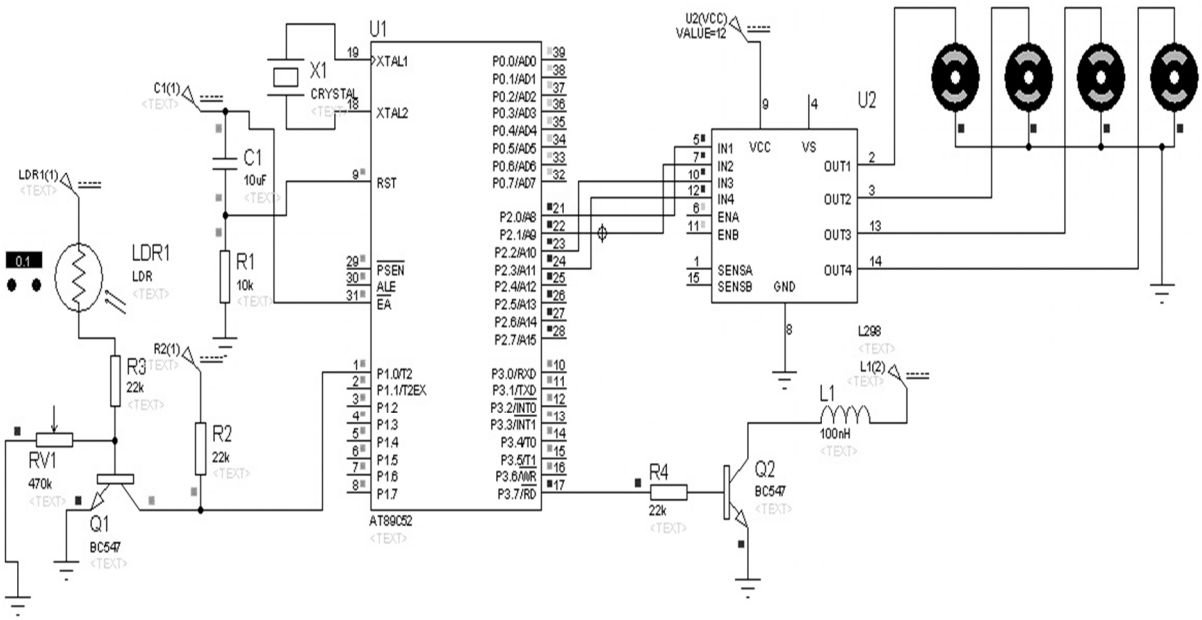

Figure.3. Schematic diagram of the Circuit

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VII. PROPOSED SYSTEM DESIGN

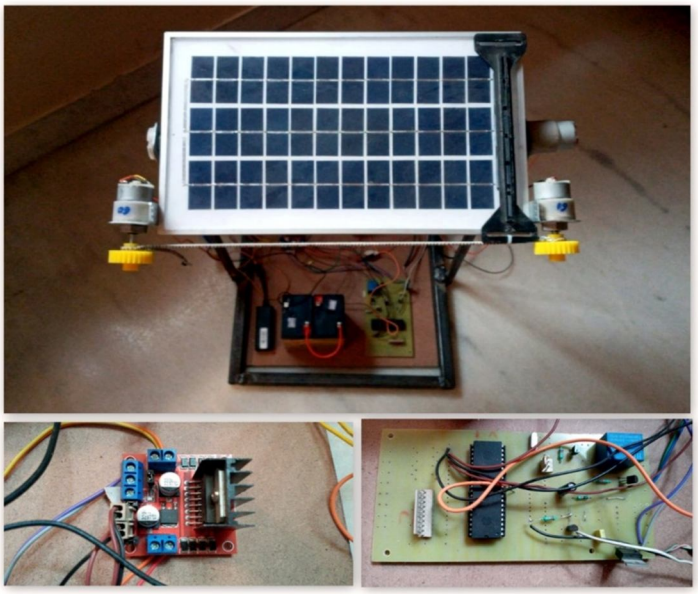

Figure 4. Solar Cleaning Model

VIII. RESULT OF THE ANALYSIS

Time	Without Track		With Tracking & Clean	
	Voltage (V)	Current (mA)	Voltage (V)	Current (mA)
8:00 AM	11.0 V	400 mA	12.0 V	500 mA
9:00 AM	12.0 V	0.4 A	12.5 V	600 mA
10:00 AM	12.5 V	500 mA	13.0 V	800 mA
11:00 AM	12.4 V	600 mA	13.1 V	800 mA
12:00 PM	13.0 V	700 mA	13.5 V	950 mA
1:00 PM	31.1 V	600 mA	14.0 V	950 mA
2:00 PM	13.0 V	650 mA	13.8 V	800 mA
3:00 PM	12.5 V	500 mA	13.5 V	800 mA
4:00 PM	12.3 V	400 mA	13.5 V	800 mA
5:00 PM	11.5 V	300 mA	12.0 V	500 mA
6:00 PM	10.5 V	100 mA	11.5 V	100 mA

Table 1. Max out voltage from solar panel with and without solar tracker and cleaning.

IX. ADVANTAGES

A. Due to regular cleaning no dust will accumulate on panel so that it will increases solar energy output efficiently.
B. Gain as much as 5 to 30% in output from your solar panel.
C. Eliminate build-up of dirt, debris and potential damage to solar panel system.
D. On the other hand an MPPT controller allows maximum power to be harvested from the panels.
E. The basics of time operated maximum power point tracker is to optimize the efficiency of the charge controller employed in a solar photovoltaic system.

X. CONCLUSION

The primary purpose of this paper is to build an efficient Solar Time Operated Maximum Power Point Tracker (MPPT) and Solar Dust Cleaning System. The Solar Panel Time Based MPPT improves maximum power output of the solar module. The Automatic Dust Cleaning System is attached to solar panel and can be operated without any human operation. This two features will increase the overall efficiency of solar panel which will recharge the battery properly with minimum loss of voltage verification in solar panel module.

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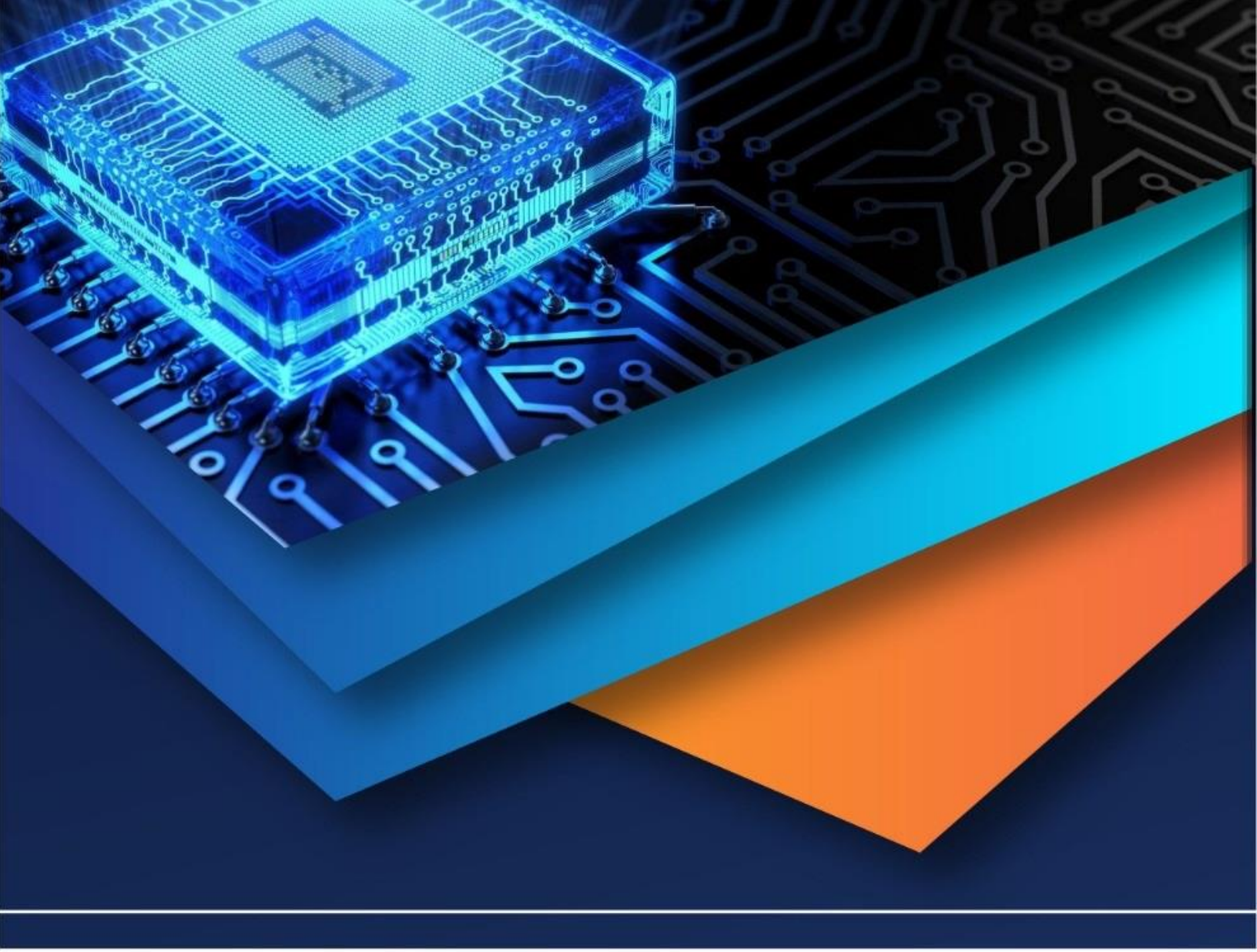

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