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AUTOMATIC SOLAR PANEL CLEANING SYSTEM

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Abstract — *The power output delivered by photovoltaic module highly depends on the amount of photovoltaic rays which reaches the solar cells. Solar power generation can be influenced by many factors. However, the major factors which reduce the generation of solar power are shadows, snow, dust, dirt, sea salt. When these particles accumulated on solar panel blocks the sunlight. The result shows that it affects the voltage provided by the module. A cleaning system has been developed that uses microfiber technology to remove dust particles from the surface of solar panels. A low DC voltage is applied to DC motors which are mounted on two different sides of solar panel and connected in anti-parallel connection. It has been demonstrated that more than 90% of dust particles are repelled from the solar panel after cleaning operation. It was demonstrated that the energy consumption by accessories of cleaning system is less. This technology is expected to increase the efficiency of mega solar power plants. The merits of using the automatic solar panel cleaning is that the cleaning system has light weight and compact structure.*

Keywords- *Arduino UNO, PWM Motor Driver Circuit, Jumper Wires, Real Time Clock, DC Motors, Aluminium Strip, Microfiber, Track Belts, Track wheels, Dead axels.*

I. INTRODUCTION

In recent years, photovoltaic technology has advanced fast for power generation from sunlight. Cleaning methods for solar panels are researched in order to keep solar panel efficient.
There are two types of cleaning system available manual and automatic cleaning systems. There is a risk of damaging AR coating of solar panels by manual cleaning and it is a tedious process. Therefore, we need to develop automatic solar panel cleaning system, which does not damage solar panel.
Water based cleaning system is expensive, incurs recurring cost, eco-unfriendly. Water based cleaning system leaves residues and causes scratches due to scrubbing of panels. We have used microfiber technology that effectively removes moisture and dust particles without scratching it. It is washable and re-useable. These merits make this type of cleaning system competitive in many applications than conventional manual cleaning system.
In this paper, I have proposed, microfiber based automatic solar panel cleaning system. The two DC motors are mounted on two sides of solar panel in anti-parallel connection and excited at the same voltage. Motors are connected with the help of track wheels. Aluminium strip with microfiber is connected between two sides of solar panel with the help of track belts. Speed of motor is controlled by program which is set in the Arduino UNO.

II. COMPONENTS OF DIGITAL LOCK SYSTEM

2.1 PROPOSED SYSTEM OF AUTOMATIC SOLAR PANEL CLEANING SYSTEM:

(a) **Power supply:** A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one from of electrical energy to another and, as a result, power supplies are sometimes referred to as electrical power converts.

(b) **Track wheels and Belt:** It is used in applications where it is desirable to control directions.

Figure 1: Track wheels and Belt

(c) **PWM Motor Driver Circuit:** There are many ways to control speed of the motor but simple way is PWM technique. PWM uses digital signals to control power applications as well as being fairly easy to convert back to analog with a minimum of hardware. In this IC555 is used in stable mode. In this mode circuit can be used as pulse width modulation. PWM generation is done using microcontroller. PWM is method for binary signals generations which has two signal periods high and low. Width of pulse varies from 0 to 1. Motor driver

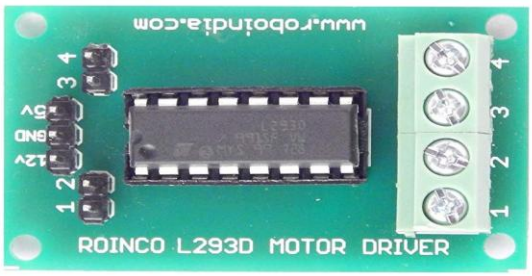

Figure 2: PWM Motor Driver Circuit

(d) **Arduino UNO:** Arduino UNO is an open-source prototyping platform based on easy-to-use hardware and software. Arduino consists of both physical programmable circuit board and piece of software, or IC that runs on computer, used to write and upload computer code to physical board. It has 14 digital I/O pins 6 for PWM output, 6 analog inputs. a 16 MHz ceramic resonator, a USB connection, a power jack, as ICSP header and a reset button. This signal from LDR is given to Arduino UNO which is already programmed. It works on DC power supply.

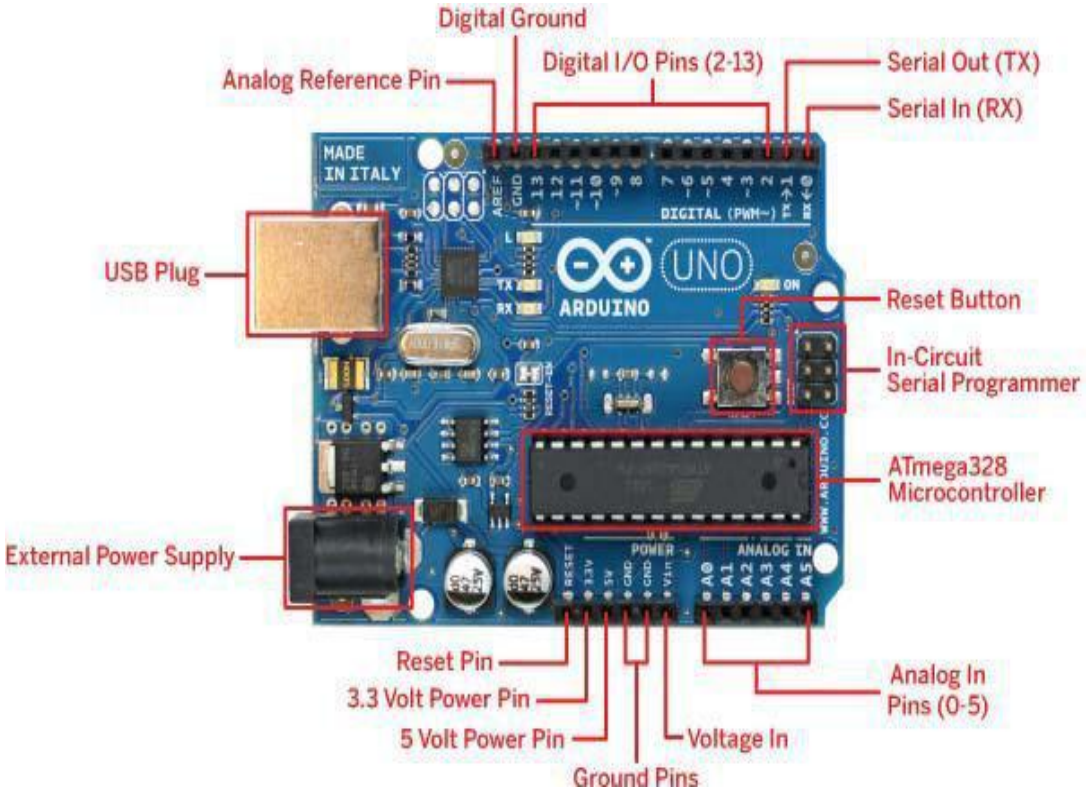

Figure 3: Arduino UNO with its parts

(e) **Microfiber:** Microfiber technology effectively removes moisture and dust particles without scratching it. It is washable and re-useable.

Figure 4: Microfiber

(f) **DC motor**: It is 12V and 30 rpm DC geared motor. Specifically designed for robotic applications offer a wide variety of options, key features – easy to use and mount, standard size, long durability and very affordable considering the features. It provides high torque.

Figure 5: DC Motor

(g) **RTC (DS1307)**: If you want to track time in embedded applications than Real Time Clock (RTC) required. This small breakout board uses the most popular DS1307 to keep track of the current year, month, day as well as the current time. The module comes fully assembled and includes a small Lithium coin cell battery that will run he RTC for minimum of 5 years without an external 5V supply.

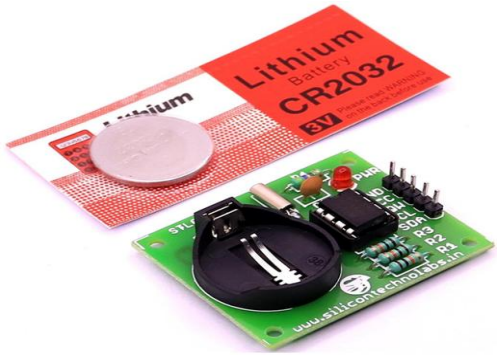

Figure 6: RTC (DS1307)

III. WORKING MECHANISAM

The block diagram of Arduino with RTC for automatic solar panel cleaning system is shown in figure 3.

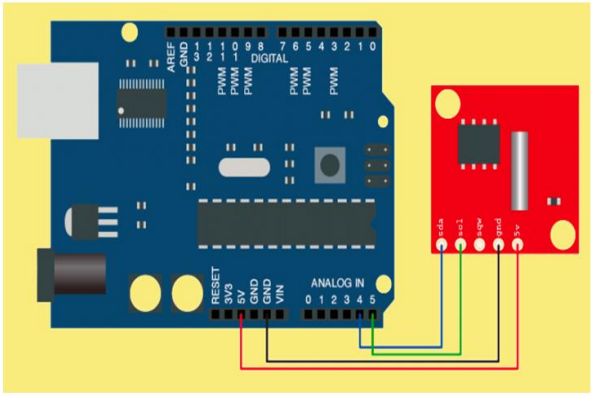

Figure 7 Interfacing Arduino UNO with RTC

The step by step working as given below,

Step 1: First of all, connect a two DC motors in the PVC pipe in anti-parallel directions as shown in figure 8.

Step 2: Connect track wheels with 6 mm shaft of DC motors. Connect dead axels at another part of solar panel and connect track wheels with dead axels. Measure vertical distance between two wheels and make track belt for both sides.

Step 3: Measure horizontal distance between two track belts and make one aluminium strip of 2 cm width, 0.5 cm thickness and 30 cm long.

Step 4: Take microfiber and cut it according to width of the strip (2 cm). Fix the aluminium strip on the track belt.

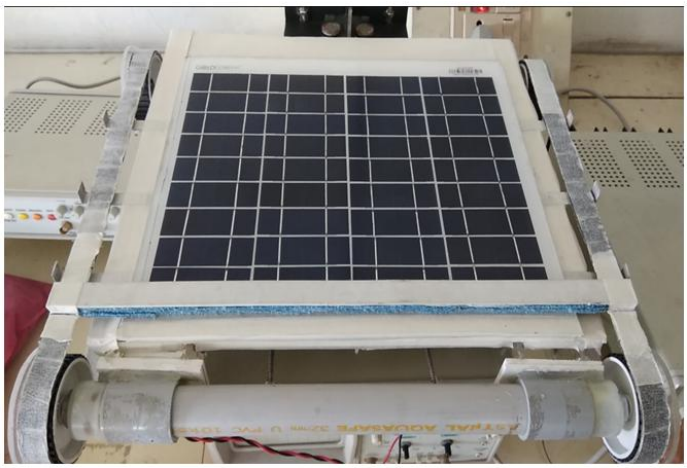

Figure 8: Automatic Solar Panel Cleaning System

Step 5: Interface PWM circuit with Arduino UNO board as shown in figure 9. As shown in figure connect geared DC motor at two output terminals out-1 and out-2.

Component	Specification	Quantity
Arduino	Uno	1
Potentiometer	10K	1
Motor Driver	L293D	1
Adapter	9V, 1A	1
Geared DC Motor	(6-12)V	1

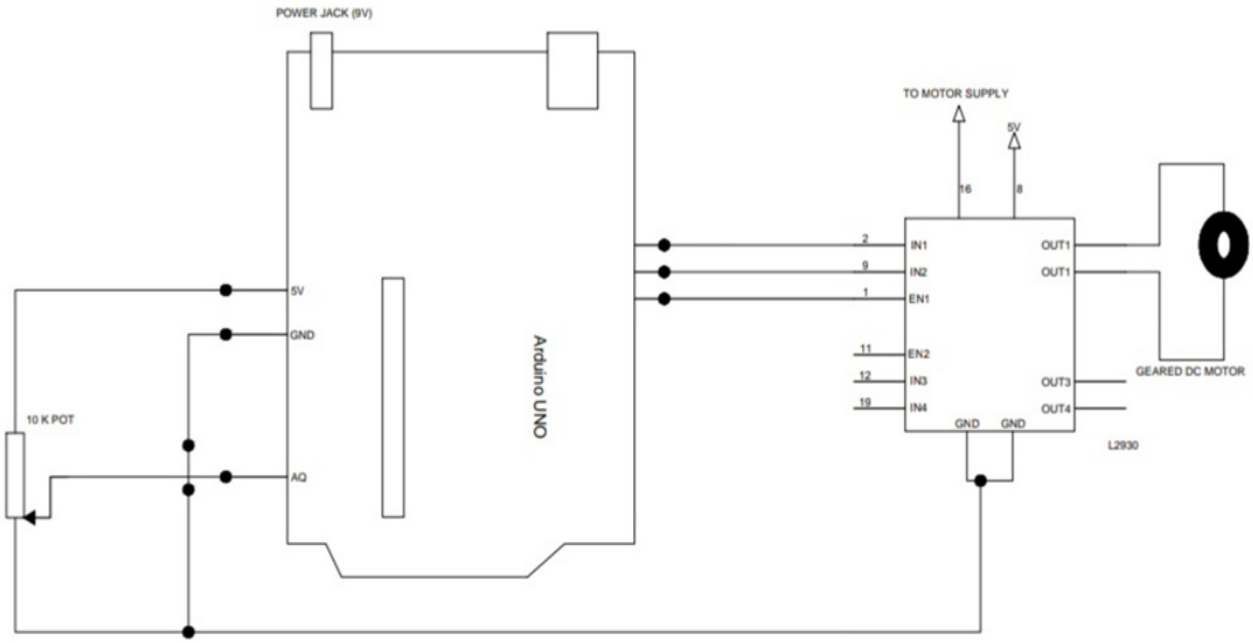

Figure 9: Interfacing Arduino UNO with L293D Motor Driver Circuit

Step 6: Interfacing of RTC with Arduino UNO as shown in figure 10.

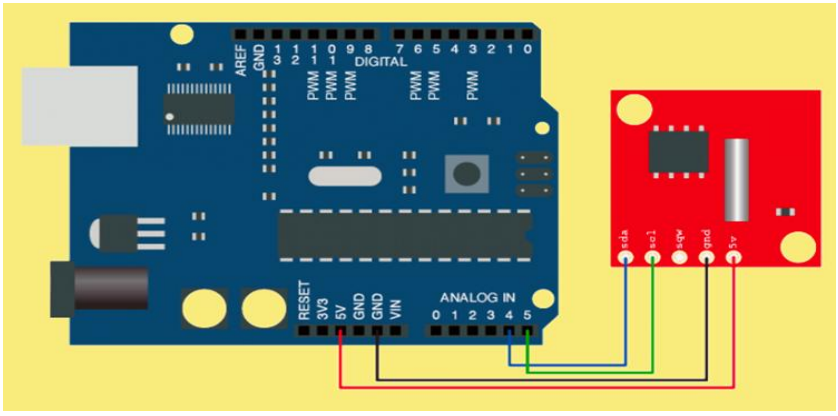

Figure 10: Interfacing Arduino UNO with RTC

Step 7: Connect power supply to the DC motors. Increase or Decrease voltage according to requirement. Speed of motor changes with respect to given voltage.

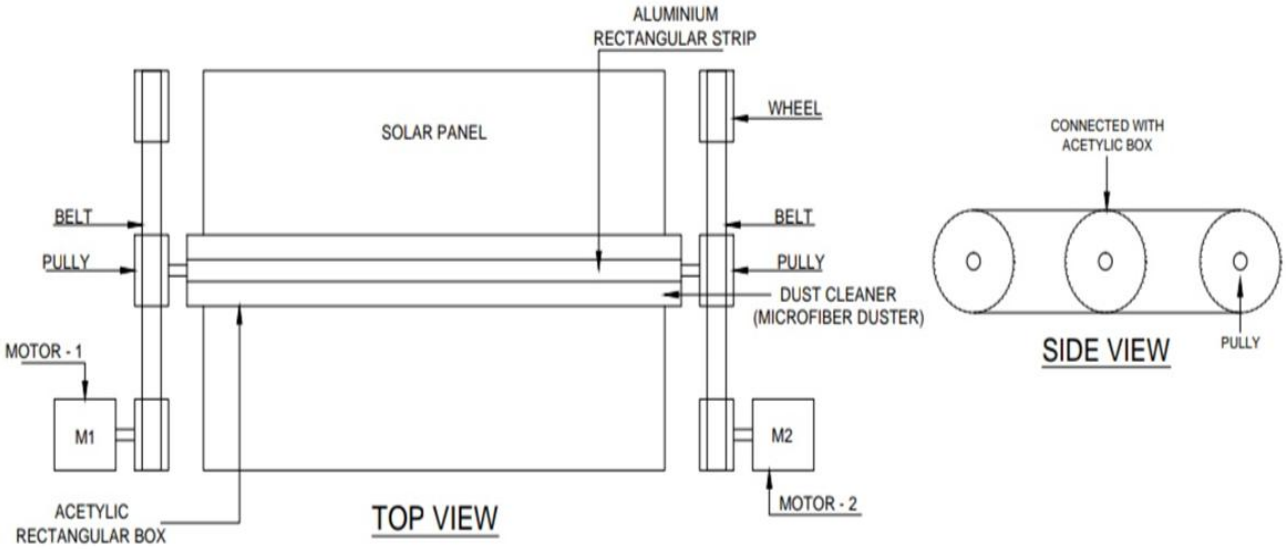

Figure 11: Diagram of Automatic Solar Panel Cleaner

IV. Comparison of Automatic Solar Panel Cleaning System with Manual Cleaning

- Automatic cleaning system is less time consuming process compared to manual cleaning.
- Manual cleaning is tedious process.
- Automatic cleaning system reduces cost of the system.
- It's easy to clean.
- It requires less power for its operation.
- Water-less, automatic, daily cleaning
- Maximum power generation with zero soiling losses.
- Uniform cleaning of panel.
- Remote operated on-demand cleaning
- Cleans dried particles and also dew condensation.
- Exerts no mechanical stress/load on the panels.
- Eliminates plumbing and recurring water related costs.
- Driven by high torque DC Motor.

Future Scope:

- Dust detector device will be designed which can detect the proportion and type of dust.
- A film will be put on Solar panel which will protect panel from scratches.

V.CONCLUSION

Dust accumulation on PV panels can dramatically alleviate their power output. While the Geographic district is sunlight based energy rich, the desert conditions are very dusty undermining the PV systems influence generation potential. The mechanical system proposed by me with the colleague is a basic method to handle this test successfully. Although promising outcomes will be achieved. Here we will set another benchmark by utilizing most recent innovation and replacing the regular techniques for cleaning the solar panels. We are saving water, time and money. Additionally, now a day there is increase in use of solar system in industries as well as at homes, thus giving a bright future scope for this system.

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