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Solar Panel Automation Cleaning System

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ABSTRACT: The purpose of this solar panel cleaning project is to research, develop, and implement an effective cleaning strategy to maintain the optimal performance of solar panels. The accumulation of dust, dirt, and debris on solar panels can reduce their efficiency and overall output, making regular cleaning essential for maximizing their energy production. To achieve this goal, we will conduct research into best practices for solar panel cleaning, including different cleaning methods and equipment. We will also perform testing to determine the most effective cleaning methods and equipment for different types of solar panels and environments. Based on our research and testing, we will develop a maintenance plan that outlines the frequency and method of cleaning for each solar panel installation. The plan will include recommendations for the use of eco-friendly cleaning products and will ensure that cleaning is carried out safely and effectively. Ultimately, the goal of this project is to improve the efficiency and effectiveness of solar panels, promoting the use of renewable energy sources and reducing our reliance on non-renewable energy sources. By implementing a regular cleaning strategy, we can ensure that solar panels are operating at peak efficiency and generating the maximum amount of electricity possible, saving money for individuals and businesses and contributing to a sustainable future.

KEYWORDS :- Solar Panel 40W, NodeMCU ESP8266, Water Pump, LDR, DC Gear Motor.

I. INTRODUCTION

Solar panels are a popular and environmentally-friendly way of generating electricity. They are low-maintenance and can provide power for decades with minimal upkeep. However, one issue that can impact their performance is the accumulation of dust, dirt, and debris on their surfaces. This buildup can reduce the amount of sunlight that reaches the solar cells, lowering their efficiency and overall output. Therefore, regular cleaning of solar panels is important to maintain their optimal performance. A solar panel cleaning project can help to ensure that solar panels are operating at peak efficiency and generating the maximum amount of electricity possible. This can not only save money for individuals or businesses that rely on solar power but also help to reduce our reliance on non-renewable energy sources. The purpose of this project is to develop and implement an effective solar panel cleaning strategy. This will involve researching best practices for solar panel cleaning, testing different cleaning methods and equipment, and developing a maintenance plan to ensure that the solar panels are cleaned on a regular basis. By undertaking this project, we can improve the efficiency and effectiveness of solar panels, and promote the use of renewable energy sources.

II. METHODOLOGY

The solar panel cleaning project will involve the following methodology:

1. Research: Conducting extensive research on best practices for solar panel cleaning, including different cleaning methods and equipment, eco-friendly cleaning products, and safety precautions.
2. Testing: Testing different cleaning methods and equipment to determine the most effective cleaning techniques for different types of solar panels and environments. Testing will involve measuring the energy output of solar panels before and after cleaning to determine the impact on efficiency.



3. **Developing a Maintenance Plan:** Based on our research and testing, we will develop a maintenance plan that outlines the frequency and method of cleaning for each solar panel installation. The plan will include recommendations for the use of eco-friendly cleaning products and will ensure that cleaning is carried out safely and effectively.
4. **Implementation:** Implementing the maintenance plan by regularly cleaning the solar panels using the recommended techniques and equipment. This will involve training personnel on proper cleaning techniques and ensuring that they have the necessary equipment and protective gear.
5. **Monitoring:** Monitoring the effectiveness of the cleaning strategy by regularly measuring the energy output of solar panels before and after cleaning. We will also monitor the performance of the cleaning equipment to ensure that it is functioning properly.
6. **Evaluation:** Evaluating the effectiveness of the cleaning strategy over time and making any necessary adjustments to the maintenance plan to ensure that it continues to meet our goals of improving the efficiency and effectiveness of solar panels. Overall, this methodology will allow us to develop and implement an effective solar panel cleaning strategy that maximizes the energy output of solar panels, promotes the use of renewable energy sources, and contributes to a sustainable future. Following is the Block Diagram.

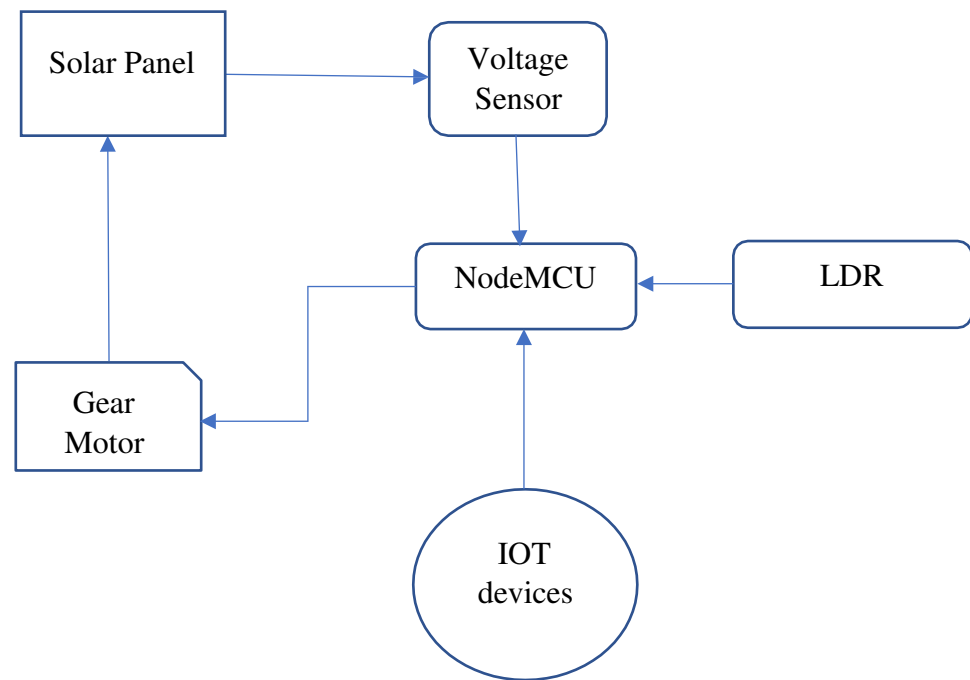


Fig 1 Block Diagram

Components Used :

Solar Panel: Photovoltaic modules consist of a large number of solar cells and use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer. Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells are usually connected electrically in series, one to another to the desired voltage, and then in parallel to increase current. The power (in watts) of the module is the



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mathematical product of the voltage (in volts) and the current (in amperes), and depends both on the amount of light and on the electrical load connected to the module. The manufacturing specifications on solar panels are obtained under standard conditions, which are usually not the true operating conditions the solar panels are exposed to on the installation site.



Fig 2 Solar Panel (40 w)

LDR: Photocells or LDR's are non linear devices. Their sensitivity varies with the wavelength of light incident on them. Some photocells might not at all response to a certain range of wavelengths. Based on the material used different cells have different spectral response curves. When light is incident on a photocell it usually takes about 8 to 12 MS for the change in resistance to take place, while it takes one or more seconds for the resistance to rise back again to its initial value after removal of light. This phenomenon is called as resistance recovery rate. This property is used in audio compressors. Also, LDR's are less sensitive than photo diodes and phototransistor. (A photo diode and a photocell (LDR) are not the same, a photo-diode is a pn junction semiconductor device that converts light to electricity, whereas a photocell is a passive device, there is no pn junction in this nor it "converts" light to electricity)

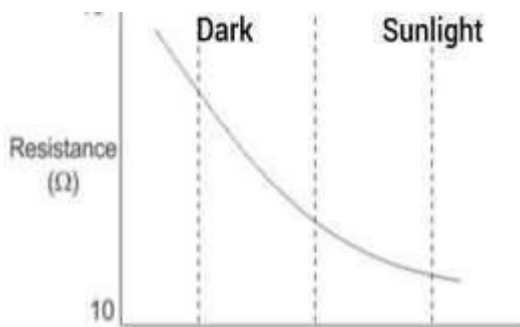


Fig 3 Characteristics

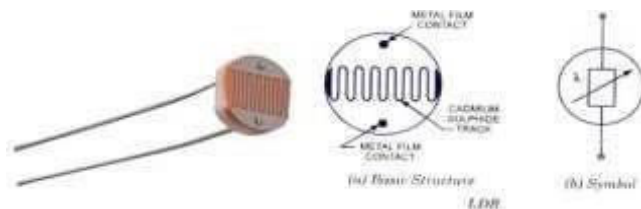


Fig 4 Symbol and construction of LDR



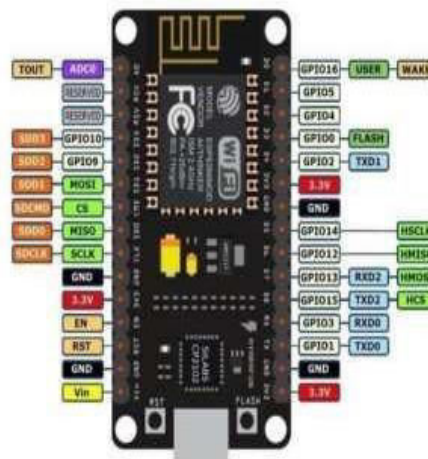
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NODEMCU ESP8266

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from EspressifSystems, and hardware which is based on the ESP-12 module. The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use. NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

Applications of NodeMCU * Prototyping of IoT devices * Low power battery operated applications * Network projects * Projects requiring multiple I/O interfaces with Wi-Fi and Bluetooth functionalities



Gear Motor : A gear motor is a type of electric motor that is designed to provide precise control over the position, velocity, and acceleration of a mechanical system. It consists of a motor, a feedback sensor, and a control circuit. Servo motors are commonly used in robotics, automation, and control applications where precise movement and positioning are required. They are often used to control the movement of robotic arms, CNC machines, and other industrial equipment.

Features: * Operates at a low volume. * For any project or to replace any old worn out brushless motors. * Solidly constructed. * It's ready to install in numerous applications to vehicles and wind turbines from agricultural and industrial equipment.

SPECIFICATIONS: DC supply: 4 to 12V RPM: 45 at 12V No Load Current: 50mA(max) at 12V Load Current = 300mA(max) at 12V Torque: 5kg-cm at 12V Total length: 46mm Motor diameter: 36mm Motor length: 25mm Brush type.



Fig 6:- DC Gear Motor

PUMP 5V: It is a micro submersible pump which works on dc 3-6v with cost efficient and portable. It is able to take around 120 liters for every hour with extremely low current utilization. Water level should be higher as if the motor is used without water it can harm the parts of this device due to overheating. There are many applications such as controlled fountain water flow, hydroponic systems, controlled garden watering system.

Specification: Input Voltage: DC 3V-5V Flow Rate: 1.2-1.6 L/min Operation Temperature: 80 Degree Celsius, Operating Current: 0.1-0.2A Suction Distance: 0.8 meter (Max) , Outside diameter of water outlet: 7.5mm Inside diameter of water outlet: 5.0 mm Diameter of water Inlet : 5.0 mm Wire Length: 200 mm Size: 45 x 30 x 25 mm Weight: 30g

How to Use: Firstly, simply connect the red wire (+) and black wire (-) to a 3V or 5V DC supply. Next, make sure the connection is right (+) wire to (+) terminal and (-) wire to (-) terminal. Submerge the water pump into the water according to your application preferences. When the supply is on, water will flow into the inlet of the pump and flow out through the outlet.



Fig 7 Water Pump 5v



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Working Model :-

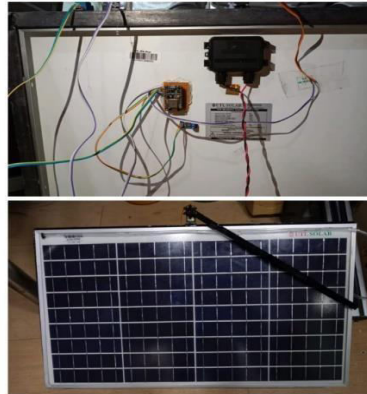


Fig 8 Overall Model

III. RESULT AND ANALYSIS

Comparison Of Before/After Cleaning Of Solar Panel :=>	Voltage	Voltage
Days	Before Cleaning	After Cleaning
Day 1	11.47	11.77
Day 2	10.67	11.56
Day 3	10.55	11.62

Considering the above results, we can conclude that cleaning process is not required on day today basic. On an average, cleaning the panel, helps increase efficiency by 10-15%.

IV. CONCLUSION

In conclusion, the solar panel cleaning project is a valuable initiative that can improve the efficiency and effectiveness of solar panel installations. Regular cleaning can remove dust, dirt, and debris that can reduce the amount of sunlight reaching solar cells, resulting in improved energy output and cost savings. The project also promotes the use of renewable energy sources and contributes to environmental sustainability by reducing the need for non-renewable energy sources. While there are potential disadvantages to consider, such as cost and safety risks, these can be mitigated through careful planning and implementation. Overall, the solar panel cleaning project has numerous advantages that make it a worthwhile investment for individuals and businesses that rely on solar power, ultimately contributing to a more sustainable future.

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