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Solar Panel Cleaning System

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Abstract: ***The goal of Project SPACE is to create an automated solar panel cleaner that will address the adverse impact of soiling on commercial photovoltaic cells.***
Specifically, we hoped to create a device that increases the maximum power output of a soiled panel by 10% (recovering the amount of power lost) while still costing under $500 and operating for up to 7.0 years. A successful design should operate without the use of water.
This will help solar panel arrays achieve a production output closer to their maximum potential and save companies on costs associated energy generation. The current apparatus utilizes a brush cleaning system that cleans on set cleaning cycles. The device uses the combination of a gear train (with 48 pitch Delin gears) and a 12V DC motor to spin both a 5.00 foot long, 0.25 inch diameter vacuum brush shaft and drive two sets of two wheels. The power source for the drive train is a 12V deep cycle lead-acid battery.
Our light weight design eliminates water usage during cleaning and reduces the potential dangers stemming from manual labor. Our design's retail price was estimated to be around $700 with a payback period of less than 3.5 years. To date, we have created a device that improves the efficiency of soiled solar panels by 3.5% after two runs over the solar panel. We hope that our final design will continue .
Keywords: Solar, cleaning, brush, automatic, electricity

I. INTRODUCTION

There is more than enough solar radiation available around the world to satisfy the demand for solar power systems. The proportion of the sun's rays that reach the earth's surface is enough to provide for global energy consumption 10,000 times over. On average, each square meter of land is exposed to enough sunlight to produce 1,700 kWh of power every year. Solar Panel has a huge effect on our world.
It can helps our environment to be better without using other power generation plants that can harm the environment, but solar power plant needs to be cleaned at least every 3 days. It generally depends on the country for example in the Middle East, it needs to be cleaned every day so it will cost so much.
There are a lot of techniques for cleaning the solar panels; our idea is to design a smart solar panel that cleans itself automatically and remotely in order to maintain a high level of efficiency of the solar panel.

II. NEED OF PROJECT

A solar panel is a device that converts sunlight into electricity by using photovoltaic cells. PV cells are made of materials that produce excited electrons when exposed to light. The electrons flow through a circuit and produce direct current (DC) electricity, which can be used to power various devices or be stored in batteries. Solar panels are also known as solar cell panels, solar electric panels, or PV modules.
Solar panels are usually arranged in groups called arrays or systems. A photovoltaic system consists of one or more solar panels, an inverter that converts DC electricity to alternating current (AC) electricity, and sometimes other components such as controllers, meters, and trackers.
A photovoltaic system can be used to provide electricity for off-grid applications, such as remote homes or cabins, or to feed electricity into the grid and earn credits or payments from the utility company. This is called a grid-connected photovoltaic system. Some advantages of solar panels are that they use a renewable and clean source of energy, reduce greenhouse gas emissions, and lower electricity bills.
Some disadvantages are that they depend on the availability and intensity of sunlight, require cleaning, and have high initial costs. Solar panels are widely used for residential, commercial, and industrial purposes, as well as for space and transportation applications.

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III.RESEARCH METHODOLOGY

A. *Product Architecture and Components*

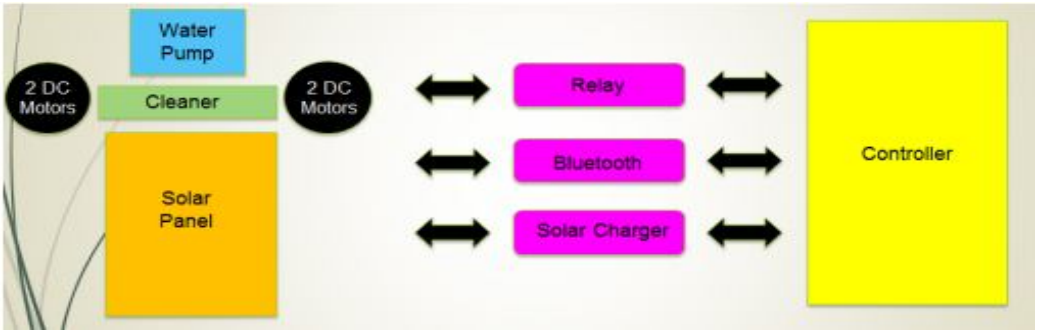


Figure shows the subsystems that we are going to implement in our project. We have two main subsystems which are Mechanical subsystem that is in the left of the block diagram, and the Control subsystem that is shown in the middle and the right of the block diagram. The Mechanical subsystem contains the cleaner along with the DC motors and the stand that holds the solar panel along with the rechargeable battery and the water pump. The Control subsystem contains the relay, solar charger, Bluetooth module and the microcontroller.

Solar cleaning robot uses a slightly different technique to clean the solar panel. In this system, a guiding railing is attached over the solar panels as shown in Figure 3. The guiding railing frame work can move horizontally over the surface of the array of panel. For top to down movement, the robot moves on the railing frame work. By sweeping its microfiber brushes connected to the head, Ecopia solar panel cleaning project cleans the surface of the solar array. The system has its own battery which is charged through its own solar cell. This energy storage features allows the system to clean the panels in the night. Furthermore, the system can also be controlled through internet.



Solar Cleaning System

The options for methods of cleaning were mostly different options of moving the cleaning material. The criteria for the cleaning method were the same as the criteria for the cleaning material. The options considered were an axle that lies across the panel and spins, a disk that moves side to side like a buffing machine, a lock that applies constant pressure across the panel and drags the cleaning material across it similar to a sweeping broom, and a drip system that leaks cleaning solution down the sides of the panel. A spinning axle that lies across the panel was chosen because of its proven effectiveness in operations like a car wash.



The Selected Brush Design Installed on Prototype

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IV. CONCLUSIONS

The Solar Panel Cleaning System project aimed to bring a better solution for maintaining solar efficiency. The main scope was to develop a machine that can clean a solar panel by a proper control system. This project is a developed prototype to expand on a new and increasing market. The project team hit many obstacles along the way. Designing the control system required learning Raspberry Pi configurations, python coding and its interference with the electrical components. Using soldering boards to implement the designed circuit, hardware wiring, relays and machinery were new experiences. This being said, the project fulfilled the desired design with the planned control and mechanism. The DC motors were controlled by both relays and drivers to accomplish speed and directions control. Also, control code for the DC motors and the water pump were written then implemented in the system. Finally, the MPPT charge controller was connected to the off grid system. However, the prototype was not completed because of the challenges and the limitations that were mentioned .

V. ACKNOWLEDGMENT

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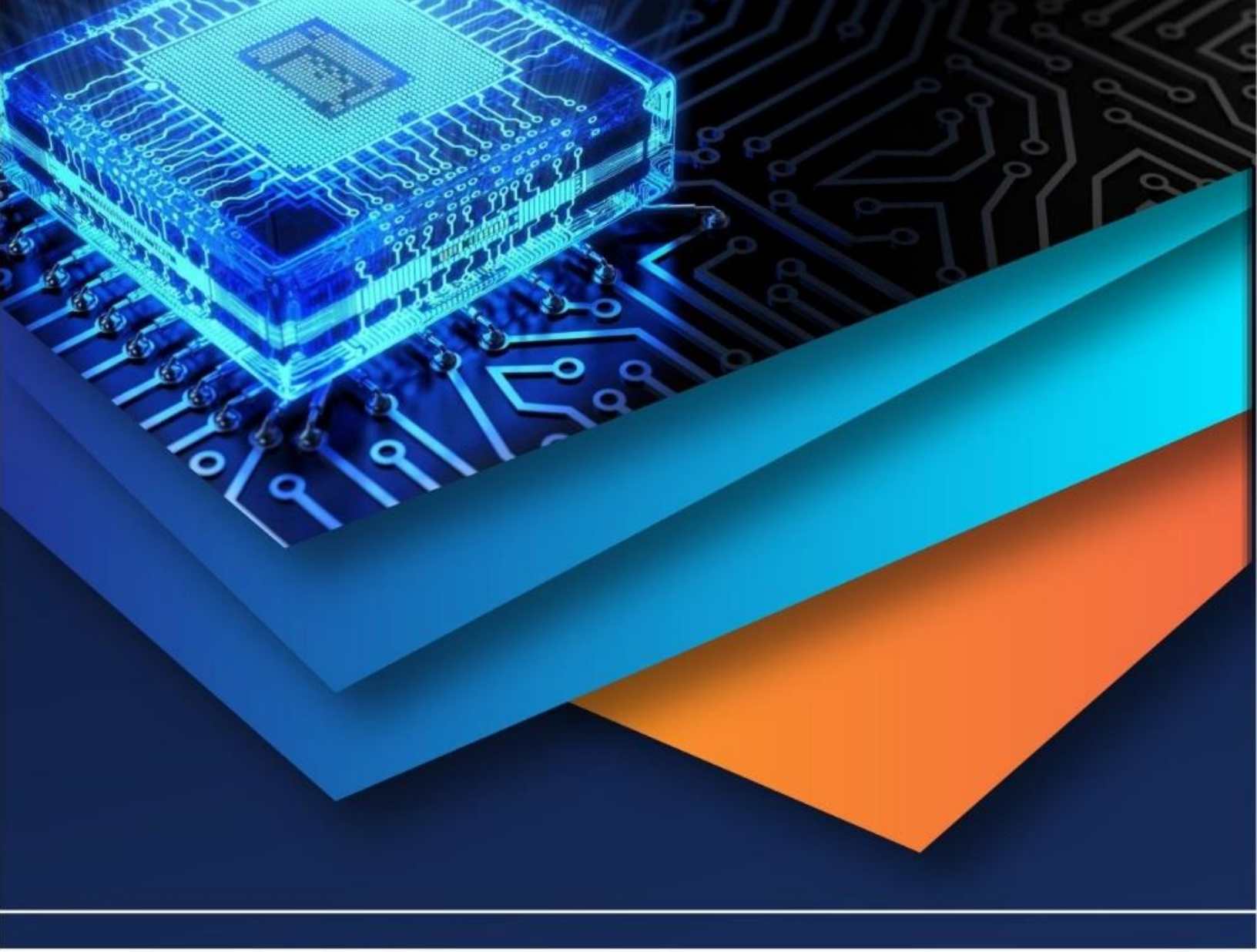
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