WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design and Development of Solar Panel Cleaning Device

Omkar Jadhav[1], Vinay Dharme[2], Aniket Dalavi[3], Vishvjit Patil[4], Rohit Jagadale[5], Sanket Patil[6]

[1,2,3,4,5,6]Annasaheb Dange Collage of Engineering & Technology, Ashta, Dist. Sangli, Maharashtra, 416301, India

A B S T R A C T

Finding sustainable energy solutions is more crucial than ever before as both change in climate and temperature rise worry our planet's future. One of most effective ways to move to renewables and non-polluting sources of energy to generate power with solar panels. Because they have no moving components, solar panels are among the most affordable and minimally maintained ways of generation. Despite their numerous benefits, solar panels' performance might deteriorate if dust, filth, and grime accumulate. If maximum power generation efficiency is to be preserved, solar panels must be cleaned on a regular basis. This solar panel cleaning equipment intends to retain the effectiveness of solar power generation by guaranteeing that the solar panels continue to remain clean while posing no harm to people. As a result of increased interest in renewable energy, the solar pv sector has risen dramatically during the last ten years. Yet, maintaining clean panels is a significant challenge that is all too frequently disregarded. Panel cleaning is not worth the risk because it is frequently difficult and unsafe to access them. Additionally, installation expenses and the devices are requirement for specially built parts for the plant mean that autonomous cleaning robot are frequently only financially viable on a large scale. In order to lower the overall cost of the robot and make it lucrative on smaller scaled PV-plants, the goal of this project is to discover a more economically viable solution for the drive principle. The objective is to maintain an average family-sized plant and return on investment within two years (the warranty period in most Asian countries). A theory involving a robot using two cables fastened to the roof's edges was looked at. To replicate the performance of this driving principle, a virtual model was created. A proof of concept was then constructed to confirm the model. According to the study, using this drive mechanism on small plants is a promising alternative

Keywords: Energy Solution; Solar Panels; Autonomous Cleaning; Renewable Energy; PV Plants; Robot; Power Generation; PV Sector;

1. Introduction

1.1. Background

The use of solar energy as a source of energy has significantly increased in the United States during the past ten years. The annual electrical energy consumption of the United States is roughly 4,146 terawatt hours. Solar energy contributes to 30% of all the newest annual energy production capacity although accounting for just over one percent of total energy. According to the Department of Energy, California generated about half of all solar electricity produced in the US during that time period, making it not only a major generator of solar energy. Because of the growing demand for solar power, solar panel efficiency is more crucial than ever. Solar panels are ineffective., with an average peak efficiency of 11% to 15% for converting solar radiation to usable energy. The efficiency of PV panels is further reduced by soiling. It is generally known that the build-up of dirt on the panels can result in an annual efficiency loss of up to 27%. t is an automatic solar panel cleaner designed to cut down on efficiency losses in solar panel arrays that are already in place. To boost energy production, the technology cleans the surface of each panel. The system's goal is to increase each solar panel's energy output by an average of 10% once it has been installed on commercial solar panel arrays. The system can be used with any type of solar installation, even though it is intended to be installed on big commercial arrays. This technique will decrease demand for energy from fossil fuels, reducing the country's contribution to global warming., improve power output, and minimise potential hazards for human cleaners in addition to lowering maintenance expenses.

1.2. Problem Statement

Globally, there is more than enough solar radiation to meet the demand for solar power systems. The fraction of the sun's rays reaching the planet's surface is enough to supply the world's energy demands 10,000 times more. On average, each square metre of land receives enough sunlight each year to generate 1,700 kWh of electricity. Our planet is greatly impacted by solar panels. The environment can be improved without the use of other polluting power plants, however solar power plants must be cleaned at least three times every week. Generally speaking, it varies by country; for example, in the countries of the Middle East, since it has to be cleaned on a regular basis it will be prohibitively expensive. There are numerous ways of cleaning solar panels; however, in order to maintain the exceptionally high level of efficiency of the solar panel, our aim is to design a smart solar panel device who cleans itself autonomously and remotely.

1.3. Objectives

- To create a device for cleaning solar panels that will improve their performance.
- To simplify and automate the cleaning of solar panels.
- To limit human involvement.
- To develop cleaning method that doesn't degrade the original solar panel's quality
- To develop cleaning system that is environmentally friendly.

2. Process

- Research and design: Research different designs for solar panel cleaning devices and choose one that meets your needs. Create a design plan and gather materials.
- Build the device: Use the design plan to assemble the device, following all safety precautions. This may involve constructing a frame, attaching a motor and pump, and installing spray nozzles.
- Test the device: Before using the device on your solar panels, test it out to make sure it works properly. Check for leaks or other issues that may need to be fixed.
- Position the device: Choose a safe and stable location to position the device near your solar panels.
- Connect the water source: Connect a water source, such as a hose or reservoir, to the device.
- Turn on the device: Turn on the motor and adjust the spray settings so that the water is directed onto the solar panels.
- Clean the panels: Move the device over the surface of the solar panels, making sure that all areas are thoroughly cleaned.
- Rinse the panels: Once the cleaning is complete, rinse the panels with clean water to remove any remaining dirt or debris.

3. Methodology

Phase I: Data analysis

Understand previous work done on PV cleaning methods by referring IEEE research papers.

Phase II: Design and analysis

- The mechanism consisting of main frame, drive trail and rotating brush setup.
- Electronic system consists of motor drivers and limit switch interfaced with Microcontroller

Phase III: Manufacturing of component and experimentation

Drawing, testing and analysis of mechanism in 3d modelling software and manufacturing

Phase IV: Performance Testing

The mechanism will be tested on PV panel, after installing this cleaning mechanism the performance on PV will be tested with periodic power generation.

4. Actual setup

5. Test Results

The percentage increase was estimated using the data gathered. The outcomes demonstrated a direct correlation between the efficiency gain and the quantity of passes the gadget made over the panel. A slight rise of about 1% was discovered after device completed two passes along panel, it represents the run of system. Nonetheless, there was a 3.4% gain (approx.) in panel efficiency during the device's second run, which totaled four passes over the panel.

The team examined the panel that the system tested and saw a pattern in the dust it had left behind. The tested panel is shown in Figure. Large amounts of dirt were still present in the panel's center, indicating that the pressure applied by the Cleaning Subsystem to place the brush across the panel along its full length was insufficient. Also, slow rotation of the brushes leaves streaks of dirt behind that indicate the points of actual contact. The amount of dirt removed from the device per pass can be increased by raising the pressure along the cleaning subsystem and the RPM of the brushes. The test findings demonstrate that the device's number of passes performs on panel directly correlates with amount of dirt that is removed.

6. Conclusion

The Solar Panel Cleaning System project sought to develop a more effective means of preserving solar efficiency. The primary objective was to create a machine with an appropriate control system that can clean solar panels. This project is a prototype that has been built to tap into a growing market. Along the road, the project team encountered various challenges. With the anticipated control and mechanism, the project accomplished the desired design. Relays and drivers were used to control the speed and direction of the DC motors. Also, the system's water pump and DC motors' control codes were designed and installed.

7. References

Mondal, A. K., & Bansal, K. (2015). Structural analysis of solar panel cleaning robotic arm. Current Science, 108(6), 1047-1052.

Faranda, R., & Leva, S. (2008). Energy comparison of MPPT techniques for PV Systems. WSEAS transactions on power systems, 3(6), 446-455.

Elgendy, M. A., Zahawi, B., & Atkinson, D. J. (2011). Assessment of perturb and observe MPPT algorithm implementation techniques for PV pumping applications. IEEE transactions on sustainable energy, 3(1), 21-33.

Safari, A., & Mekhilef, S. (2010). Simulation and hardware implementation of incremental conductance MPPT with direct control method using cuk converter. IEEE transactions on industrial electronics, 58(4), 1154-1161.

Patel, H., & Agarwal, V. (2008). MATLAB-based modeling to study the effects of partial shading on PV array characteristics. IEEE transactions on energy conversion, 23(1), 302-310. [6] Ramabadran, R., & Mathur, B. (2009). Effect of shading on series and parallel connected solar PV modules. Modern Applied Science, 3(10), 32-41.

Rani, B. I., Ilango, G. S., & Nagamani, C. (2013). Enhanced power generation from PV array under partial shading conditions by shade dispersion using Su Do Ku configuration. IEEE Transactions on sustainable energy, 4(3), 594-601.

Adinoyi, M. J., & Said, S. A. (2013). Effect of dust accumulation on the power outputs of solar photovoltaic modules. Renewable energy, 60, 633-636.

Mani, M., & Pillai, R. (2010). Impact of dust on solar photovoltaic (PV) performance: Research status, challenges and recommendations. Renewable and sustainable energy reviews, 14(9), 31243131. [13] Jiang, H., Lu, L., & Sun, K. (2011). Experimental investigation of the impact of airborne dust deposition on the Project Report ADCET, Ashta Page 18 performance of solar photovoltaic (PV) modules. Atmospheric environment, 45(25), 4299-4304.

Al-Qubaisi E, Al-Ameri M, Al-Obaidi A, Rabia M, ElChaar L, Lamont LA. Microcontroller based dust cleaning system for a standalone photovoltaic system; 2009; Abu Dhabi. In: Proceedings of the 2009 Electric power and energy conversion systems.