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SMART SOLAR PANEL CLEANING SYSTEM BY USING IOT

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ABSTRACT

Photovoltaic energy is an accessible technology. It has become a popular investment for companies as well as for residential users. The solar panel efficiency may be reduced by up to 5% to 10% from the build-up of dust particles alone. Adding in other factors such as falling leaves, bird dropping, and water streaking, the efficiency of these panels can be further reduced to as much as 10 – 30%. The efficiency of the PV panel depends on the amount of light that falls on it. Due to the azimuth angle of the solar panel, the deposition of dust on the PV panel reduces the efficiency of the energy generated. To increase the efficiency of the PV panel, it has to be cleaned periodically. The panel detects the presence of an obstruction shading a cell and the concerned person can operate a cleaning mechanism that cleans off the obstruction and, therefore, restores the panel to normal capacity.

Keywords:Photovoltaic,Energy,Solar Panel Automatic cleaning system.

1. INTRODUCTION

Growing interest in renewable energy has resulted in significant expansion of the solar Photo-voltaic (PV) sector over the past decade. Because photovoltaic energy is a technology available. It has become a common investment for both businesses and residential consumers. This demand has therefore stimulated studies to increase the general output strength of PV systems. Any material that spreads through the atmosphere involves particles of soil and dust (suspended dust), smoke, fog, and particles called dust. Stabs are formed from terrestrial inorganic and organic substances. Dust is made up of substances such as storms of sand, bacteria, smoke from factories, pollen, forest fires and vapours from volcanoes. They also include the suspended solid particles of the atmosphere that stay that remain in the air for long periods. These particles can be transferred over lengthy distances by wind motions. The regions caused by elevated concentrations of dust experience considerable losses due to pollution from dust. Many previous studies have verified that the deposition of airborne dust on the photovoltaic indoor modules decreases the cell glazing transmission. It also results in a substantial degradation of PV modules ' solar conversion effectiveness. The dust deposition in the outdoor PV studies focused on the glazing transparency performance. However, it is not always as simple to clean solar panels.

2. LITRATURE SURVEY

Yuliya Zatsarinnaya, Denis Amirov and Maksim Elaev developed “Solar Panel Cleaning System Based on the Arduino Microcontroller” – 2020. The solution of the problem provides for the adoption of hydroelectric power plants, which are ubiquitous in Russia, and the construction of wind and solar power plants. One of the problems with the deep penetration of solar energy into the Russian energy system is the high cost of generating electricity at a renewable energy facility. Solar module layouts in open areas lead to the contamination of surfaces that receive emission. As a result, offering different designs for cleaning PV modules is still relevant. In this paper, both schemes of solar panel cleaning systems that have been considered are not only easy to assemble and, easy to control, but also adaptable to operating conditions. Changing or adding links allows you to apply the design at various scales, both in a private household and in a solar station.

Md. Rawshan Habib1, Md Shahnewaz Tanvir , Ahmed Yousuf Suhan, Abhishek Vadher , Sanim Alam, Tahsina Tashrif Shawmee, Koushik Ahmed, and Abdelrhman Alrashed describes the concept of "Automatic Solar Panel Cleaning System Based on Arduino for Dust Removal" – 2021.In this paper, an automatic solar panel cleaning system is proposed and built with easily available components. The proposed system is inexpensive and does not require any water to do the cleaning operation. Thus, wastage of water is avoided here. And this feauture makes this system applicable in the desert areas and where no water source is available. This proposed cleaning system is based on two steps mechanisim where exhuast fans do the first part which is remove dust from the surface though air blowing. The second part is done by wiper. This feature ensure the safety of the panel because any type of scratch is not seen duting the experimental tests. Experimentally the cleaning system is capable of serving its purpose.

Santosh Kumar S, Shivashankar, KeshavaMurthy has developed "Solar Powered PV Panel Cleaning Robot" – 2020. This paper proposes a solar panel cleaning robot which periodically cleans PV panel autonomously, the surface of the panel is cleaned by blowing air, spraying the liquid and wiping out the dust with wiper and drying the wet content on the panel using cylindrical brush. The proposed robot is controlled remotely by Internet of Things (IoT) which reduces the human effort in the solar plant and can be remotely monitored. The production of solar energy is reduced because of the deposition of the dust on the panel. The propose Solar PV panel cleaning robot aims to remove the dust on the panel by blowing the air. Using liquid to clean and wiped out by using the cylindrical brush. The movement of the robot is remotely monitored by using the Blynk app, robot is self-powered by solar Panel and battery. It has found that the power generation has increased in the solar plants and production is increased when compared the manual cleaning. The prevention of manual shifting of robot from one row to another will be avoided. The proposed system aim has to overcome these problems and increase the efficiency of the solar power generation

3. METHODOLOGY.

3.1 PROBLEM STATEMENT

The expense of fuel is rising every day, thus many are turning to electric and solar energy. Solar panels are installed on the roofs of many vehicles. For greater power generation efficiency, solar panels should be cleaned every couple of days or twice a week. It takesup to 2 litres of water to clean one solar panel plate, and they want to clean it manually on the roof, which is time-consuming and exhausting.

3.2 EXISTING SYSTEM

In the existing system, there is no proper system to clean the solar panels. Firstly, in the case of residential use, solar panels are usually placed on the roof or terrace to receive the maximum amount of sunlight. Because of this, cleaning these solar panels would result in the homeowner climbing up onto the roof to clean the panels, which can be hazardous. The other option would be to hire a company to do it for them. The dust collects on the module's front surface, blocking the incident light from the sun. It lowers the module's power-generating capacity. If the module is not cleaned for a month, the power output drops by as much as 50%.

3.3 DISADVANTAGES

1. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun.
2. The system reduces the power generation capacity of the module.

3.4 PROPOSED SYSTEM

The power output reduces by as much as by 50% if the module is not cleaned for a month. To regularly clean the dust, Fig.1 a solar panel cleaning chain system has been designed, which senses the dust on the solar panel and also cleans the module automatically. In terms of daily energy generation, the presented automatic cleaning scheme provides about 30% more energy output when compared to the dust- accumulated PV module. In this proposed system we have used a Dc fan and water spraying motor. Both of them are connected to a motor controller. This vacuum cleaner and water sprayer can be controlled using IoT. The concerned person can ON/OFF the vacuum and water sprayer using android mobile. This can be done with the help of IoT using a mobile application called Blynk. An indication switch is connected to this system to intimate the state of the water sprayer. When the water sprayer is on the Greenled will glow and when the sprayer is off the red led will glow

3.5 ADVANTAGES

1. The proposed system help to clean the solar panel effectively.
2. Human intervention can be reduced
3. The system helps to avoid manual work

4. BLYNK TECHNOLOGY

The blynk technology is encompassed with subsystems – an on- board subsystem and a ground subsystem, the ground subsystem comprises a computer, thereby enablingan efficient interaction with the on-board. A thermal camera is affixed on the blynk, which highly aids in detecting the hotspots, cracks, and the temporary shadowing defects such as dust and bird droppings on the panel. The difference in thetemperature between the cells of the panels is so accurate that it enables in observing the defects at an early stage. The connection between the thermal camera and the ground subsystem provides the coordinates of defects on the panel after which the panels can be cleansed.

The end effectors that are fastened to the blynk are blowers to blow the dust away, vacuum suction to remove the bird droppings, and brushes with sponge to scrub all the other soiled particles. The wire bristles are soft, very easy to clean and is also resistant to heat. A spray tank is attached on top of the blynk and is controlled by a spray block control system. Fig.1 represents the proposed System of solar panel cleaning by using chain system.

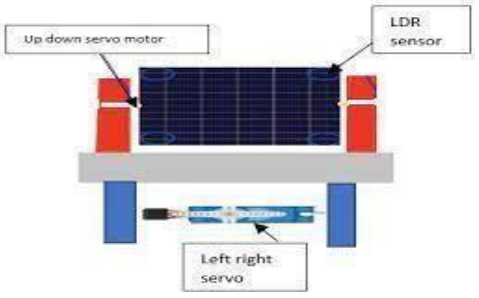

Fig.1.Proposed model Of Solar Panel Cleaning system

The chain system for the recommended purpose is expected to be highly resistant to various external factors which includes exposure to the ultra-violet rays, humidity, rain and heat and other similar conditions because the blynk works completely in the rough and harsh external environment. The features that has to be considered significantly for choosing a chain system includes the right selection of the payload, the wind resistance offered by the blynk, its operating temperature and its maximum transmitting distance. The payload has to be adopted in such a way that it is sufficient to hold the weight of the camera and the end effectors as well. The transmitting distance has to be chosen depending on the area to be covered by the blynk. It has to be high if the chain has to cover a large area and low in case of implementing it over a range of few kilometers. The battery capacity of the chain can be compromised as the chain is required to perform the cleaning action only when there is a drop in efficiency.

5. BLOCK DIAGRAM

5.1. TRANSMITTER UNIT

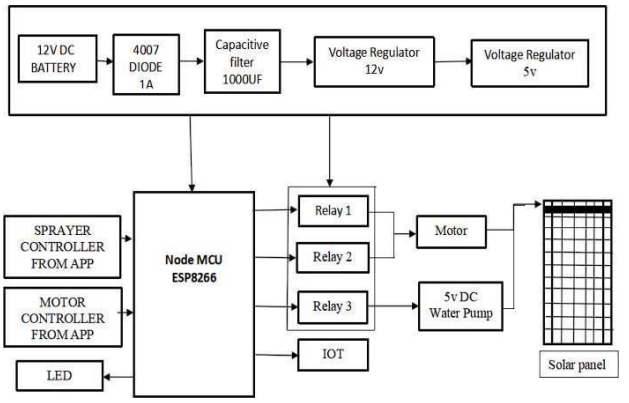

Fig.2.Transmitter Unit Block Diagram

5.2. RECEIVER UNIT

Fig.3.Receiver Unit Block Diagram

5.3 Working

The Figure 2 and 3 shows the block diagram of the project. Here it have connected a step-down transformer. The input voltage for this transformer is 230v ac supply. This will be applied to that transformer. The transformer will step down to 12 v AC. When a 12v step-down transformer generates the AC supply. The output from the step-down transformer will be given to the bridge rectifier. Among the rectifiers, the bridge rectifier is the most efficient rectifier circuit. We can define bridge rectifiers as a type of full-wave rectifier that uses four or more diodes in a bridge circuit configuration to efficiently convert alternating (AC) current to a direct (DC) current. The Bridge rectifier unit converts the AC supply into a DC supply. Here we have connected a 1000 uf capacitor which filters the DC supply. A capacitor-input filter is a filter circuit in which the first element is a capacitor connected in parallel with the output of the rectifier in a linear power supply. The capacitor increases the DC voltage and decreases the ripple voltage components of the output. Filtered output is given to voltage regulators 7805 and 7812.The motor driver is used to give a constant power supply to the dc fan and pumping motor. Both components will be connected

the output pin of the motor driver. The input pins of the motor driver will be connected to the Nodemcu microcontroller. These will be connected to the chain system to clean the solar panel. This system can be controlled through the internet using a mobile application called Blynk. Different widgets are created in the blynk application for controlling the ON/OFF states of the dc fan and pumping motor. When virtual switches are pressed using the mobile application then the dc fan and the pumping motor will be controlled. When connecting all these components with the chain system the concerned person can control the state of the dc fan and pumping motor to clean the solar panel. When water is pumping a Green LED will turn ON. And when water pumping is not active then a red LED will turn ON.

6. RESULT AND DISCUSSION

The proposed system is a microcontroller-based Solar panel cleaning chain system that is cost-effective active and lightweight. The proposed system reduces the effect of dusting on the output power of the PV panels. This system is designed in a short time period with high efficiency. The system is controlled using IoT techniques through Blynk IoT mobile application. The hardware setup and the results of the projects are shown in the figures.

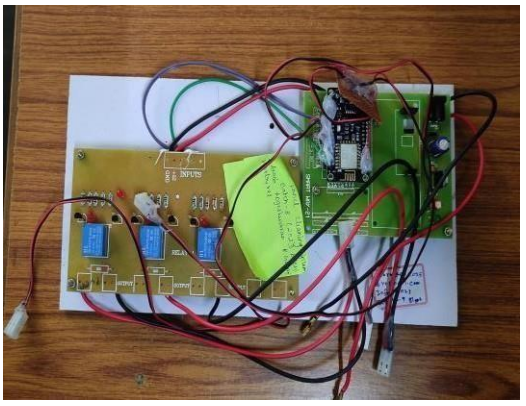

Fig.4.Control Circuit.

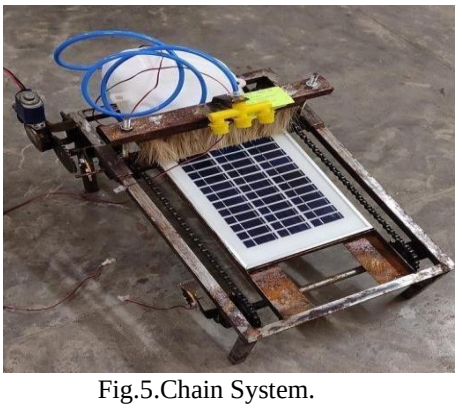

Fig.5.Chain System.

Blynk IoT mobile application.

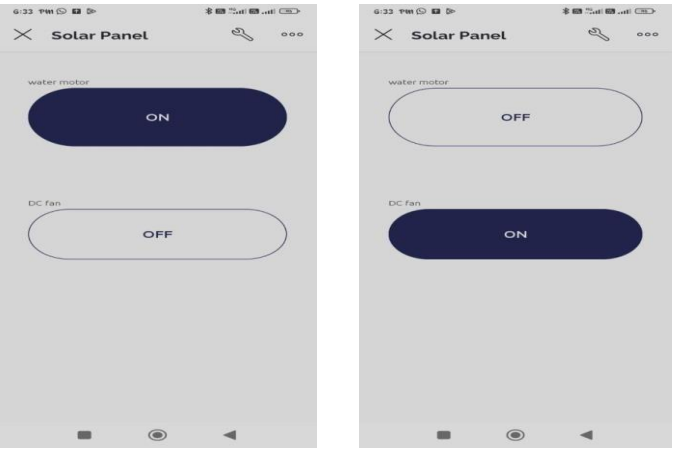

Fig.7.Water Sprayer and Air Pump Turned ON and OFF.

7. CONCLUSION AND FUTURE SCOPE

The purpose of introducing this system is for cleaning the solar panels so that the efficiency of energy generation can be improved. Initially, this work is done by humans but now they are mostly replaced by these automatic robots. This becomes an effective method for cleaning the panels because there is no fear of heights for robots. The Designed system successfully detects the presence of soiling or dust on the solar panel and cleans it with the help of a blynk. The chain can move along a PV module to clean it. The project's purpose is to develop a solar panel cleaning chain system to combat the negative effects of soiling on commercial photovoltaic cells. We aimed to develop a technology that would improve the efficiency of a dirty panel. The cleaning process such as water spraying and the vacuum cleaning process can be controlled using a Mobile application Blynk.

In future it can be provided as a permanent cleaning robot at time of installation along with panel frame, dust detection sensor, temperature sensor and camera surveillance, which is centrally connected.

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