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AUTOMATIC SOLAR PANEL CLEANINGUSING WIPER

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ABSTRACT

One of the key environmental elements that has a big impact on solar PV module efficiency is dust. India is one of the tropical nations where dust buildup on solar panels is a major issue. Due to the dust, the power outputs of some PV modules in India are lowered by 50–60% in a month. Therefore, a model of solar panel cleaning system has been suggested to lessen the efficiency loss caused by dust deposition. This technique uses wipers that are each positioned at the panel's diagonally opposite corners and are powered by a DC wiper motor via a mechanism. The power loss due to dust may be regulated and kept between 5 to 10% of such output power by cleaning the panels by using technology either daily or weekly, depending on the rate of dust collection. The usage of this proper cleaning with PV panels will shorten the solar PV system's total payback period in locations with substantial soiling losses because it is an affordable solution to the soiling issue.

I. INTRODUCTION

The usage of solar PV modules as a power source is growing. In response to the rising demand for solar PV modules, efforts are being made to increase their effectiveness and financial feasibility. Both off-grid and on-grid solar power systems have difficulties in making their use affordable for the general population. Due to research on the characteristics of the semiconductors used in solar cells, the efficiency of PV systems has been limited at 15% to 20%. There are several losses linked with the power generation using solar panel like shading loss, wiring loss, sun tracking loss and soiling loss. Among all these losses the most critical one for the tropical countries is the soiling loss. So, in these areas there is no option other than cleaning the PV modules to maintain the high power output, but as the PV modules are mounted at greater height on the roof for avoiding the shading in the off grid system, their access is difficult and risky. Also, the panel cleaning is required to be done once or twice a day in the dusty areas, which would be cumbersome if done manually. So, there is a necessity of developing a system to clean the solar panel automatically, to reduce the loss of power due to soiling.

II.LITERATURE SURVEY

1. Automatic Solar Panel Cleaning System Based on Arduino for Dust Removal

Author: Md. Rawshan Habib, Md Shahnewaz Tanvir, Ahmed Yousuf Suhan, Abhishek Vadher, Sanim Alam.

Solar panel is vulnerable to accumulated dust on its surface. The efficiency of the solar panel gradually decreases because of dust accumulation. In this paper, an Arduino based solar panel cleaning system is designed and implemented for dust removal. The proposed solar panel cleaner is waterless, economical and automatic. Two-step mechanism used in this system consists of an exhaust fan which works as an air blower and a wiper to swipe the dust from the panel surface. a dc motor is used to power the wiper. Since, the system does not need water to clean solar panel, it avoids the wastage of water and effective in desert areas. Experimental results show that the proposed cleaning system can operate with an efficiency of 87-96% for different types of sand.

2. Automatic solar panel cleaning system Design

Author: Ali Al Dahoud, Mohamed Fezari, Ahmad Al dahoud

This paper aims to develop an automatic [1] cleaning system for Photovoltaic (PV) solar panels installed on the roof of University Al-Zaytoonah faculty of IT in Jordan. The experiments were done at University Badji Mokhtar Annaba Algeria. We designed a dust detector and perform tests on it for calibration. The brain of the system is an Arduino Uno microcontroller, which gets data from the dust sensor then makes treatment and sends instructions to the system to perform the cleaning process. The cleaning process is based on-power circuit that controls the speed and direction of a motor to scan all surface of the PV panel. GUI was developed to monitor the system and sensor status. The collected data is transmitted to the central unit. Finally, the primary results obtained to meet our expatiations for optimizing the efficiency of the solar panels.

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3. Automatic Solar Panel Cleaning System
Author: Nagseh Maindad, Akshay Gadhave, Suraj Satpute, Babita Nanda

This paper is about the cleaning of a solar panel. In rural areas, most of the solar street lights are used. After the installation of the solar street light, it only works for two to three months. Because, that panels are installed at a height near about 15 to 20 feet, at this hight cleaning is not possible by using a ladder. If the solar panel is not cleaned regularly, then the dust in environment accumulates on the surface of the solar panel. This dust converts into a thick sticky layer due to morning dewdrops. Due to this dust solar panels not give a sufficient charging current that required for the charging of a battery. if the battery is not fully charged, then it does not gives the desired output and we have to replace that battery. It increases the cost of maintenance. In this paper, we design a cleaning system for a solar street light. which can be operated automatically and it helps us to clean solar panels without any efforts. This system reduces human efforts, it saves time, it works automatically at a specified time. Overall it increases the efficiency of the solar street light. This system is designed using an ATmega16A microcontroller due to it's advance features. It also uses GSM module, linear actuator, limit switches, DC gear motors, Roller brush, and DC submersible pump. Here, GSM Module is used for real-time operation, linear actuators for the movementof the brush. The gear motors are coupled with a brush for the rotation of brush, the pump is used to lift the water from ground surface to upper surface of a solar panel for water cleaning purpose.

III.BLOCK DIAGRAM

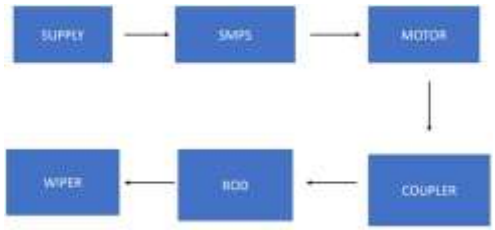

Figure1. Block Diagram

Supply: The system is powered by an electrical supply, typically from a battery or solar panel system. The supply provides the necessary power to run the various components of the system.

Switching Mode Power Supply (SMPS): An SMPS is used to convert the DC voltage from the supply to the required voltage level for the motor. The SMPS also helps regulate the voltage to ensure that the motor receives a stable and constant power supply.

Motor: The motor is the primary component responsible for driving the wiper. A DC motor is commonly used in these types of systems, as it can provide the necessary torque and speed to move the wiper across the solar panel surface. The motor is connected to the shaft rod througha coupling.

Shaft Rod: The shaft rod is a long cylindrical rod that connects the motor to the wiper. The shaft rod is typically made of metal and is designed to be durable andlong-lasting. The shaft rod rotates when the motor is activated, causing the wiper to move across the surface ofthe solar panel.

Bearing: The bearing is a component that helps support the weight of the shaft rod and wiper. The bearing is typically a ball bearing or roller bearing and is designed to reduce friction and wear on the shaft rod.

Wiper: The wiper is the component responsible for cleaning the solar panel surface. The wiper is typically made of rubber or another soft material that is gentle on the solar panel surface. The wiper is attached to the shaft rod and moves back and forth across the surface of the solar panel when the motor is activated.

Overall, the block diagram for an automatic solar panel cleaning system using a wiper includes a supply, SMPS, motor, shaft rod, bearing, and wiper. The components work together to provide a reliable and efficient cleaning solution for solar panel surfaces.

IV.MECHANISMS IMPLEMENTATION

The amount of degree of freedom that the linkage has is crucial when analysing a mechanism. The quantity of actuators required to operate the mechanism is referred to as the degree of freedom. Any actuator of the system could be used to manually move one link to a different position or attach a motor to one link's shaft. The sign for mobility, which represents a mechanism's degree of freedom, The degrees of freedom for planar connections coupled with common joints are calculated using M. Grumbler's equation, which is provided by:

$$M=3(n-1)-2jp-jh$$

Where:
M = degrees of freedom
n = total number of links in the mechanism
jp = total number of primary joints (pins or sliding joints) jh = total of higher-order joints (cam or gear joints)

The selection of the parts in this design is carefully scrutinised. The revolving wheel of the crank isconnected to the motor by means of gear mechanisms, and a DC electric motor is used to power it. The rotating wheel has gear teeth that mesh with the teeth in therotating shaft of the DC electric motor.

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Second, a four- bar mechanism with direct transmission of the action of the rocker system creating an arc to the two outside wiper frames is recommended as the primary mechanism. The connecting links are also constructed of steel to increase toughness so that they can endure the forces supplied by the crank wheel without breaking or deforming. The crank wheel is often made of steel material to withstand the motor forces. The four bar mechanism's casing is composed of iron rather than steel because it simply serves to house the parts and is subject to relatively low forces.

Additionally, steel is preferable for the wiper 34 frame construction so that it may move back and forth across the windscreen without warping or breaking. Rubbers are used as the rubbing surface of the wipers because they are effective surface wipers and can effectively clean the windscreen.

The crank slider mechanism on the outside- most wiper frame is built of steel for its moving parts, allowing it to withstand the forces applied to it as it swings up and down to cover the largest possible area while wiping. Rubber material is also installed on its wiping surface.

V.RESULT ANALYSIS

First of all before we start to test our new mechanism, it's clear from (Figure 2) below that the region cleaned by the wiper is limited. And using our new mechanism we can reach to the area which is inside the red box as shown in the figure..,

Figure2.Solar Cleaner Using Wiper

To provide a wiper that is new on the market and can be able to cover the maximum area of the windscreen when wiping in comparison to other designs manufactured earlier, the project design basically started from scratch and a desirable design had to be selected based on various factors depending on its use. A desired product is processed during the manufacturing process with a variety of factors and computations. The separate elements are fitted together throughout the assembly process, commencing with the motor being linked to the four-bar mechanism and ending with the connection of the exterior wiper components.

VI.CONCLUSION

After the conversations, it might be assumed that this work is intended to transform the auto industry by describing a modern vehicle wiper component that can handle visibility concerns during rainy conditions. Due to the standard wipers' limited ability to completely clear the windscreen, problems with water dribbling are unavoidable. This vehicle's windscreen can be completely cleaned by this windscreen wiper device. Thus, it will be useful in that it will improve driver visibility up to a comfortable distance and prevent unwarranted and unintended hits on streets. Regarding the aims, it might be noted that while creating a piece, it is important to establish a few points and goals that will guide you and provide a flowchart of what you should do. Following the completion of the job, these milestones and destinations are examined to determine whether they were attained.

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