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Design and Development of Solar Panel Cleaning Machine

Miss. K. V. Rajgure[1], Prof. D. A. Shahakar[2]

[1]PG Student, Department of Electrical Engineering, P. R. Pote College of Engineering, Amravati, Maharashtra, India

[2]Associate Professor, Department of Electrical Engineering, P. R. Pote College of Engineering, Amravati, Maharashtra, India

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ABSTRACT: *There are a lot of renewable energy sources available, solar energy is one of them. As the world is paying very much importance role toward increasing electrical energy demands. In recent trends various countries have established their policies regarding solar energy, and research hers are still working on how to make use of solar energy with maximum extraction, maximum efficiency. The energy which is extracted from sun is then converted into solar energy with the help of solar panel. Maximum energy extraction can reduces the overall cost increases the efficiency and hence meet the demands. Physical conditions like rain, mud, dust, snow etc can reduces the overall efficiency of solar panel. Hence it is very important to keep solar panel clean. In this the solar panel cleaning machine is designed and tested. The design consist of a dual motor which runs the brush over a rack as per the timing which covers the whole length of the panel and stops when the limit switches switch.*

Keywords— ***Photovoltic cells, solar panel efficiency, solar panel cleaning machine, arduino board***

1. INTRODUCTION

The sun provides more than enough energy to meet the whole world's energy needs, and unlike fossil fuels, it won't run out anytime soon. As a renewable energy source, the only limitation of solar power is our ability to turn it into electricity in an efficient and cost-effective way. Solar power is arguably the cleanest, most reliable form of renewable energy available, and it can be used in several forms to help power your home or business. Solar powered photovoltaic (PV) panels convert the sun's rays into electricity by exciting electrons in silicon cells using the photons of light from the sun. This electricity can then be used to supply renewable energy to your home or business. No greenhouse gas emissions are released into the atmosphere when you use solar panels to create electricity. And because the sun provides more energy than we'll ever need, electricity from solar power is a very important energy source in the move to clean energy production. Solar panels are made of solar cells integrated together in a matrix-like structure. After solar panels have been installed, operational costs are quite low compared to other forms of power generation. Fuel isn't required, and this means that solar power can create large amounts of electricity without the uncertainty and expense of securing a fuel supply.

As a renewable CO2-free power source, the environmental impact of solar power is significantly smaller than other power generation methods. The impact is mainly related to the production and supply of the special materials and metals that are required to produce solar panels. Electricity generated using solar photovoltaic (SPV) technology can only be economical if the PV modules operates reliably for 25–30 years under field conditions. The key limiting factors which reduce widespread use of PV applications comprise the high initial investment cost and the comparatively low conversion efficiency of PV cells due to heating of PV panels. Module temperature is always higher than the ambient temperature. Higher temperature of the module is because of the glass cover over it, which traps the infrared radiation.

Due to the cost of inequality, depletion and the natural effects of climate change and carbon offset fossil oil, Coal, gas and oil are no longer an option in energy production. Also, given the growing demand for energy on earth, solar energy, as an alternative to sustainable, renewable and easy-to-use energy sources, it has been expanding globally due to its benefits in both technical and economic aspects. In addition, it serves as an economic saviour in the most dependent countries in terms of power. There are two major ways to convert solar energy into solar energy: solar photovoltaic systems that directly use solar light
another way heat-supporting system. However, solar energy is usually generated by photovoltaic panels [2]. Solar panel efficiency which depending on the temperature and radiation of the sun is one of the most important factors in extracting the available energy from the sun.

Maximum power point tracking (MPPT) devices are one way to increase solar efficiency with equal switching burden. These devices are DC-DC converters controlled by MPPT algorithms. Among the MPPT algorithms, Perturb and Observe (P&O) method and method of behavioral supplementation (IC) is widely used [8].

Other physical conditions also cause loss of the efficiency of the solar system. One of these conditions is the shading effect caused by clouds weather, nearby tree or bulls. The small amount of shading from the solar panels makes a significant impact on the output power[10-11]. In [8], the authors they say that under shady conditions, PV curves

have high altitudes and existing MPPT systems remain inadequate.

Posting and disconnection of PV systems fitted with installed parts or various types of connection and suspension of PV panels a reit has been suggested in the literature to reduce the effect of blurring on the energy produced by PV [2].

Another condition for reducing PV system efficiency is dust accumulation in PV cells and PV cell contamination due to pollen, sand etc. This reduces the overall efficiency of the system by preventing solar radiation from reaching the solar panel. Bad the effect of talcum, sand and dust on the PV cell current-voltage element (V) is studied in [9] experimentally. According to [9], analyses the effect of dust collecting on solar energy output in Dhahran, Saudi Arabia, A 50% reduction in power output can be achieved if cleaning can be done in modules for a period not exceeding six. months. Based on author's research, they recommend a table designed to guide the appropriate identification time to clean and maintain PV systems regardless of normal and natural weather conditions. Also, in the lesson [9], an experimental study of the impact of airborne dust application on the operation of solar photovoltaic (PV) modules done. Experimental results show that the reduction in efficiency has a positive correlation with the amount of dust and dust deposits the placement and accumulation of solar panels results in a significant reduction in the current duration of the circuit. To solve the aforementioned problem, engineers are designing a variety of automation systems for solar panels. Some of them automatic cleaning systems: Gekko is a robot that utilizes the benefits of high cleaning, improved safety and ease of handling [12] and Gekko solar on the farm [12] with convincing product, wide range of cleaning, no additional installation and easy handling using a radio and a toy stick, Solar brush [13] for quality, cost and environmental benefits, Hector [14] includes more with small size, weight loss, completely independent cost and reduction, Sun1power-greenbotic's GB1 [15] wireless and rechargeable, automatic cleaning system Heilotex [16] cooler and PV module and PIC microcontroller and system-based cleaning systems (PLC) based [17-20]. Also, a comparison of installation costs with flexible cleaning types of PIC and PLC-based programs can be found at [21]. Find detailed descriptions of history, comparisons, shortcomings and advantages of the solar panel cleaning systems listed above, studies [22 - 24] can be analyzed. With this, we created an effective system for cleaning the solar panel. System software is used in Arduino development board. Charging station and park available the program runs on a PV module in both horizontal and vertical axis. In horizontal axis, the robot goes from one panel to another and the cleaner runs on a straight axis. The length of the solar panel list can be determined obtained by position change to keep SPCR in the limited line you want. Detailed descriptions of the cleaning program designed provided in the next section on computer hardware and software components.

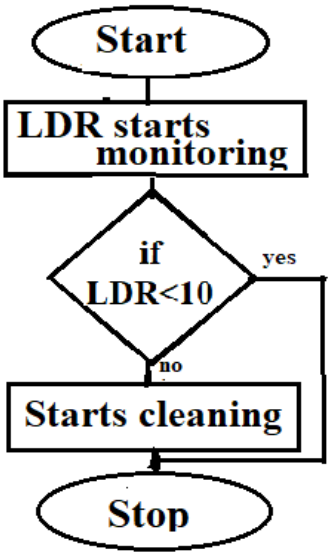
2. SYSTEM DESCRIPTION

In this project, it will facilitate the cleaning of dust collected and built up on the surface of the PV panel. Control of devices will be provided by a microprocessor described in detail in the software section. Designed device to complete cleaning automatically check with limited and distance sensors. It will be able to charge the battery in the parking lot so that it will be ready with the next washing process without extra effort. In the motion system, the pulley pallet system is specially designed for The PV panel provides a smooth transition from the spaces between the PV panels. Thanks to this pallet system, there is no need for anything an additional rail system for PV panels resulting in reduced both labour and labour costs. Aluminium sigma profiles used as frame no rail system provides the advantage of light to the device.

The parts used for metal connections are wire and the designs are produced with a 3D printer. Reduced weight and cost of a program designed for SPCR, cheap, lightweight, automatic and low maintenance cleaning will be available.

3. SOFTWARE IMPLEMENTATION

Software program is used to control hardware. Usually plcs and microcontrollers are used but in our project we use timer based sys with the help of arduino board. The ATmega328 microcontroller-based board with a clock speed of 16Mhz, has 8 input pins, 22 digital input pins While the operating voltage is 5V. The reason we use arduino is because of its size combined with easy operation. The board is then sorted by computer program.



Fig; 1 Flowchart

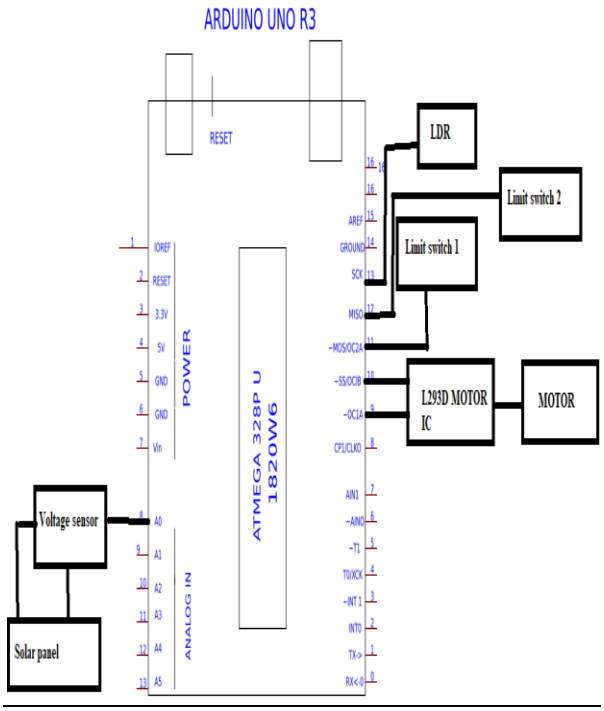
4. HARDWARE IMPLEMENTATION

In this project we will make an embedded system which move x axis or y axis for a plane here we will use PV grid to make it more efficient and remove dust from it using cleaning schedule and environment conditions.

For each a particular schedule system will start cleaning its solar panel as well as if any e obstacle comes between sun and solar panel for a short time then system will enhance its voltage with power storage Bank and provide continue constant power supply to our load . Solar panels absorb sunlight as a source of energy to generate electricity or heat.

A photovoltaic (PV) module is a packaged, connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. There are a few commercially available solar modules that exceed efficiency of 22% and reportedly also exceeding 24%.
A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).



Fig; 2 Arduino connections

5. WORKING PRINCIPLE

Solar panel works on the principle of photovoltaic effect. When certain material is exposed to light, they absorb photons and release free electrons. This phenomenon is called as photoelectric effect. Photovoltaic effect is the method of producing direct current electricity based on principle of photoelectric effect.

Based on principle of photovoltaic effect, solar cells are made. Photovoltaic cells convert solar energy into direct current electricity. But a single photovoltaic cell do not produce enough electricity. Therefore, a number of photovoltaic cells are mounted on a frame and are electrically connected to each other to form a photovoltaic module or solar panel. As of now it is clear that photovoltaic module produce DC electricity. But, for most of the times we require AC power and, hence, solar panel system consist of an inverter too.

In case between its working any E- shadow comes over the module, LDR will trigger the relay which further switch ON the boost circuit in order to maintain the required voltage.

6. PROPOSED METHODOLOGY

In this project we will make a embedded system which moves along X axis or Y axis along a plane here we will use PV GRID to make it more efficient and remove dust from it using scheduled cleaning in environmental conditions.

Here we use voltage sensor and light intensity detector in which we provide variable data in the form of analog which

will further use to analyse by controller. This data will give the condition for differentiation about dust and night.

As we cannot connect sun sensor directly to microcontroller we will go towards a concept of voltage divider circuit which will provide physical quantity in two variable voltage formed using analog sensor.

For each a particular schedule system will starts cleaning the solar panel as well as if an e-obstacle comes between sun and solar panel for a short time then system will enhance its voltage with the help of power storage bank and continue provide constant power to our load.

7. OUTCOME POSSIBLE RESULT

We can calculate the efficiency of our panel, by just multiplying the amount of sunlight that hits the earth's surface in our area (known as the "incident radiation flux") by the area of our panel (measured in square meters). Divide the maximum wattage on our panel by this number, then we can multiply it by 100 percent and we'll get an efficiency rating

8. CONCLUSION

This paper focused on improving solar panel efficiency by making it free from dust (by cleaning it at particular time or when LDR detect lower intensity than set value). The purpose of this Report is to address the need for essential consumer protection policies to govern the burgeoning markets for residential rooftop solar systems and community solar projects. The U.S. residential solar market has experienced explosive growth in the last five years, fueled by lower costs, state and federal incentives, and new financing options, including leases and purchased power agreements, also known as third-party ownership. Community solar, where a consumer subscribes to shares in a solar system that is located in a neighbourhood or community, is a relatively new and growing option. Consumers may be interested in solar power to help the environment, or simply to save money on their electric bills. Whatever the motivation, it is not easy to comparison shop for solar power. Consumers will be faced with comparing the costs of outright purchase, a purchase power agreement, a lease, or a loan.

As in future, we want to improve our project. Some of these developments provide brief information_time, minimum water and electricity storage requirements. Cleaning time can be reduced by changing the type of brush. And, next version of the device, the light detection circuit will be included in the day and night detection system. Avoid placing birds in PV panels, light bulbs and a moving structure will be considered. To wait for the bluetooth data used to run the program, the default time (three or two times a day) can be activated. Also we can use robotic turning table for the solar panel

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