International Journal of Mechanical and Thermal Engineering

E-ISSN: 2707-8051
P-ISSN: 2707-8043
IJMTE 2022; 3(1): 01-08
Received: 06-11-2021
Accepted: 09-12-2021

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Investigation and automatic rectification of fault in photovoltaic system using perturb and observe algorithm

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Abstract
Solar energy is a maximum ample form of Renewable Energy. The manufacturing of electricity using solar cells is mandatory to meet energy demand in the future. The electricity produced via solar cells is pollution-free and low cost, it performs a prime function for researchers. In our system, we are targeted to reduce the error that occurred in the solar cell to increase its efficiency. Though there is numerous equipment to be had, we're targeting low value and clever devices for fault locating the use of Lab View. This paper adduces a low-value PV characterization that's primarily based totally on Lab View. A simulation study of the fault in PV cell perturb and observe algorithm is carried out in Lab View. The data which can be with no trouble to be had from the cloud are acquired and the fault is recognized from GUI. We have modelled our device to take remedial motion while fault came about in the PV system to keep the efficiency.

Keywords: Fault classification, divination methodology, P&O algorithm, cloud automation

Introduction
The existence of inexhaustible energies is growing faster than fossil fuels. Nowadays. The energy from the land, water, Sun, Fire, Air are the most important abundant sources of energy, available in nature. The energy extracted from them is termed as Biomass, Hydro energy, Solar energy, Geothermal energy, Wind energy respectively.

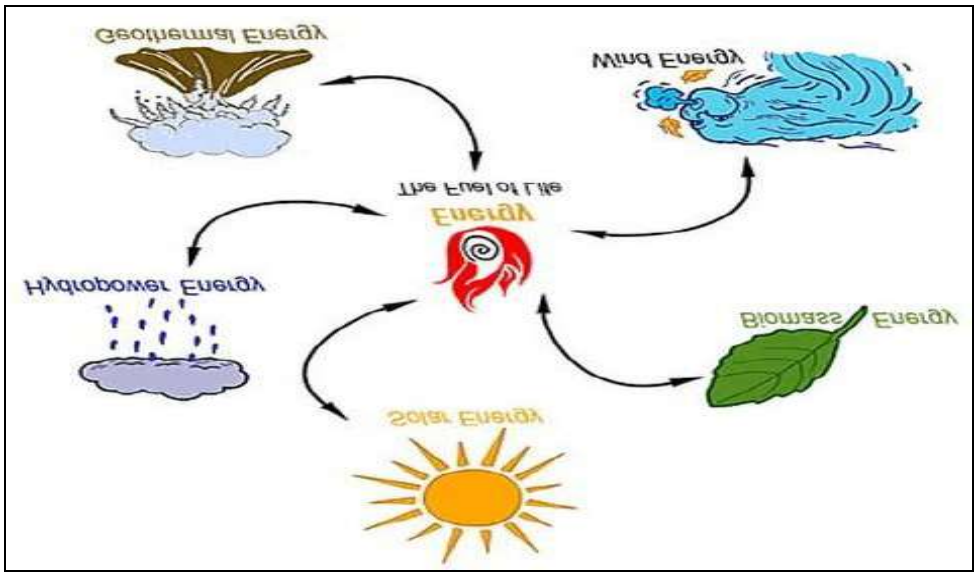


Fig 1: Various types of renewable Energy sources

The different types of renewable energy sources are sunlight, wind, tides, waves, and geothermal heat which are used for energy conversion. As our country exists under Tropical of Cancer, Energy Produced by Solar Energy can be easily applicable in India [1].

Solar energy is a globally approved energy, which has opened a new place for renewable energy development. Because it's cheaper and more environmentally friendly than conventional Energy. The photovoltaic system can be used as a dominant and promising alternative energy in the future. PV system that is applied to solar panels can be used to meet the household electricity needs or industries depending on the electricity needed. PV based on renewable energy resources could be a suitable alternative for rural electricity in the low power range [2]. The large scale of PV connected to the grid allows transferring power to the grid when PV has excess power [3]. Simulations using Lab VIEW for grid PV systems have been carried out and analyzed with weather variables in the same environment [4]. Under constant temperature and irradiance, PV module results showed similar parameters and characteristics, i.e I-V and P-V characteristics, both offline and with Lab VIEW simulations [5].

The performance of the PV system needs to be monitored in real-time to evaluate all related parameters such as voltage, current, power, irradiance, panel temperature, humidity, and ambient temperature. By making use of data acquisition, a battery array, a solar array simulator, the prototype of a standalone PV monitoring system has been developed. Moreover, the concept of Virtual Instrumentation was introduced in the performance of PV [6]. In another paper, to improve the performance and efficiency of PV, the maximum operating value or maximum power is traced using the MPPT algorithm implemented using Lab View [7]. PV monitoring with Lab VIEW has also been done to determine the effect of temperature and humidity relative to PV efficiency after five months. The maximum PV power output drops to 30% after being used in these conditions [8].

Data acquisition (DAQ) hardware system can help monitor and evaluate between PV system (external signals) nd computer [9]. Fault monitoring and divination is indispensable for photovoltaic systems assuring to drive in a safe and reliable status. Automatic fault detection and classification plays a vital remain a major challenge in the PV monitoring field. In this paper, a diagnosis methodology based on characteristics curve deviation analysis was presented. The divination of the fault cases was based on experimental measurement compared to a developed model of the PV system.

System Description

Basic circuit Diagram

The photo voltaic cell starts conducting when it is exposed to Sun Light. It converts heat energy in to Electricity. The characteristics of PV under Ideal Characteristic is shown below. The researchers are focusing on fault analysis technique.

We have developed a Low cost simulation result using Labiew.

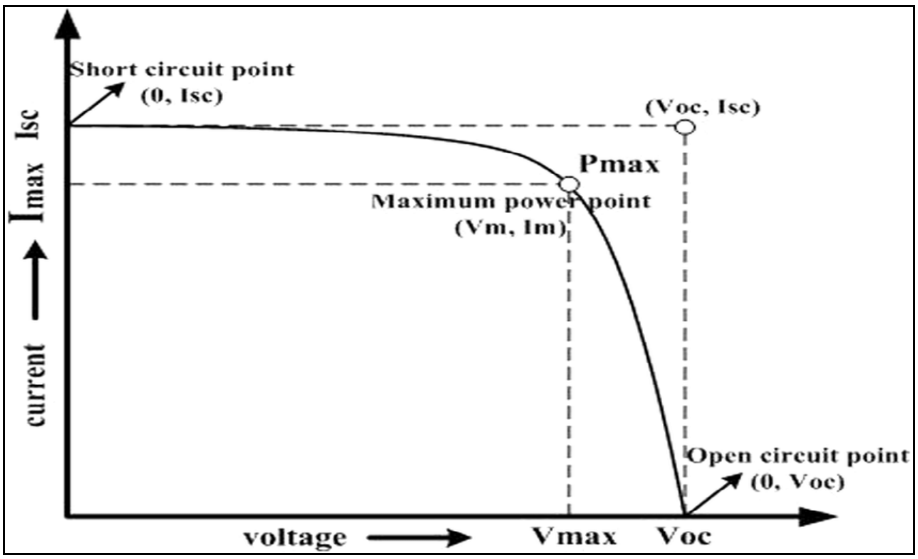


Fig 2: Ideal IV characteristics of PV

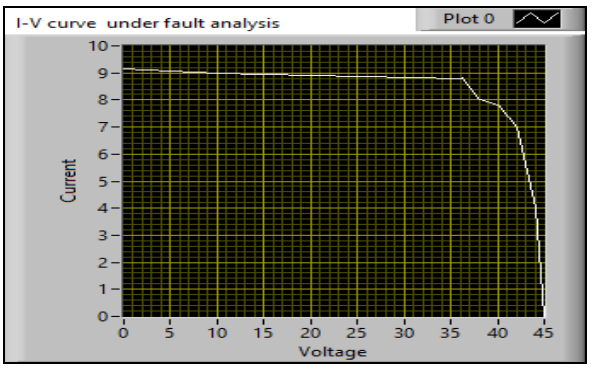


Fig 3: Ideal IV characteristics of PV using LabView

Abbreviations

Isc - Panel's short circuit current under normal condition
Isc' - Panel's short circuit current under faulty condition
Voc - Panel's open circuit voltage normal condition
Voc'- Panel's open circuit voltage under faulty condition
Max. Power - Panel's maximum power (system under test)
FF' – Measured fill factor
e = (Voc – Voc')/Uoc

The common fault occurs in panels their Impact: The faults in PV are broadly classified into three types Environmental, Electrical, Physical. In our paper, we are concentrating on Open circuits and short circuit faults. Many researchers are working on Fault. The occurrence of a fault will lead to a decrease. So fault in PV is most common issue which should be monitored and controlled for increasing the efficiency of the panel. The most common issue soiling is taken for demonstration of fault under study.

Description Table with fault and its impact

The three most common falut occur in PV are taken for analysis, namely Aging, Shadow, Dust.

The occurrence of fault in Panel is identified from the values of Isc' and Voc'.

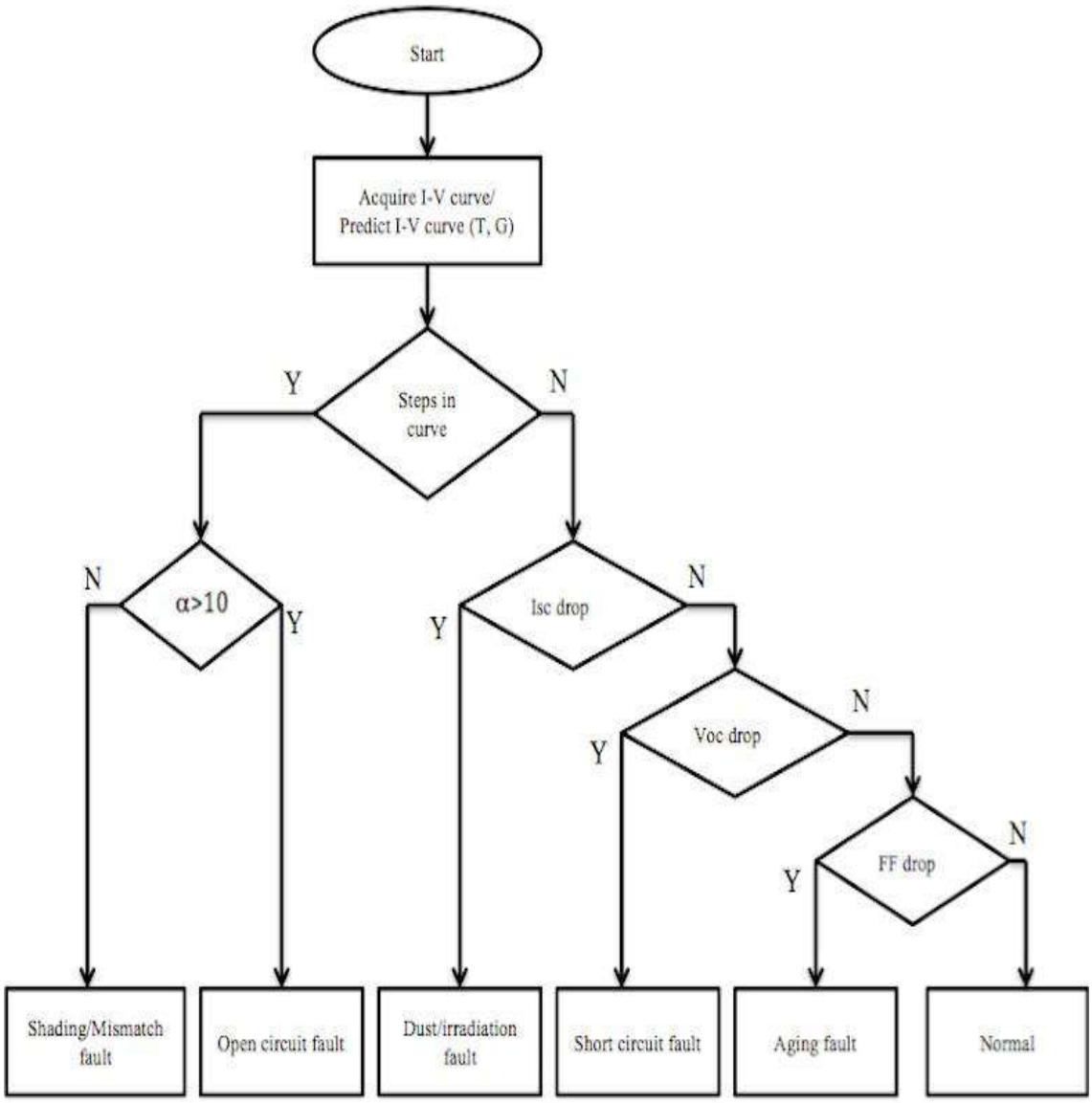
Table 1: Comparision of Fault with Voc' and Isc'

Isc'	Vco'	Max. Power'	Fill factor	Fault type	Real time image of Panel after fault
0.45	23.3	10.485	0.704	No-fault	
0.07	20.7	1.449	0.09	Shadow	
0.37	22.6	8.362	0.561	Dust	
0.45	23.3	10.485	0.231	Aging	

Fault divination methodology

The fault divination methodology used is model-based; basically, a model for the photovoltaic module under test is developed and calibrated with its current electrical parameters. The model is under Lab VIEW - Simulink and it simulates the behavior of a reference I-V curve regarding the values of irradiation and ambient temperature. Though there are several methods, Conventional method based on threshold values are most common methods of fault divination. Based on the comparison of the simulated curve with the measured curve of PV module, a deviation interpretation permits making conclusions about fault the may occur in the system, basically, shading, dusty cells are responsible for visualization for steps in the I-V curve.

Flow chart for fault Classification



Determination of fault using the computational technique

The current and voltage of the PV array sensed by current and voltage sensor respectively. Using DAQ the sensed values are interfaced with Lab View. The proposed computation technique are used to determine the type of fault. Due to fault any of the system parameters of the panel have been changed, resulting in deviation in the Ideal IV, PV characteristics of the panel. The different type of fault are identified using the flow chart and also there is automatic system generated message from the panel to the system in charge to give.

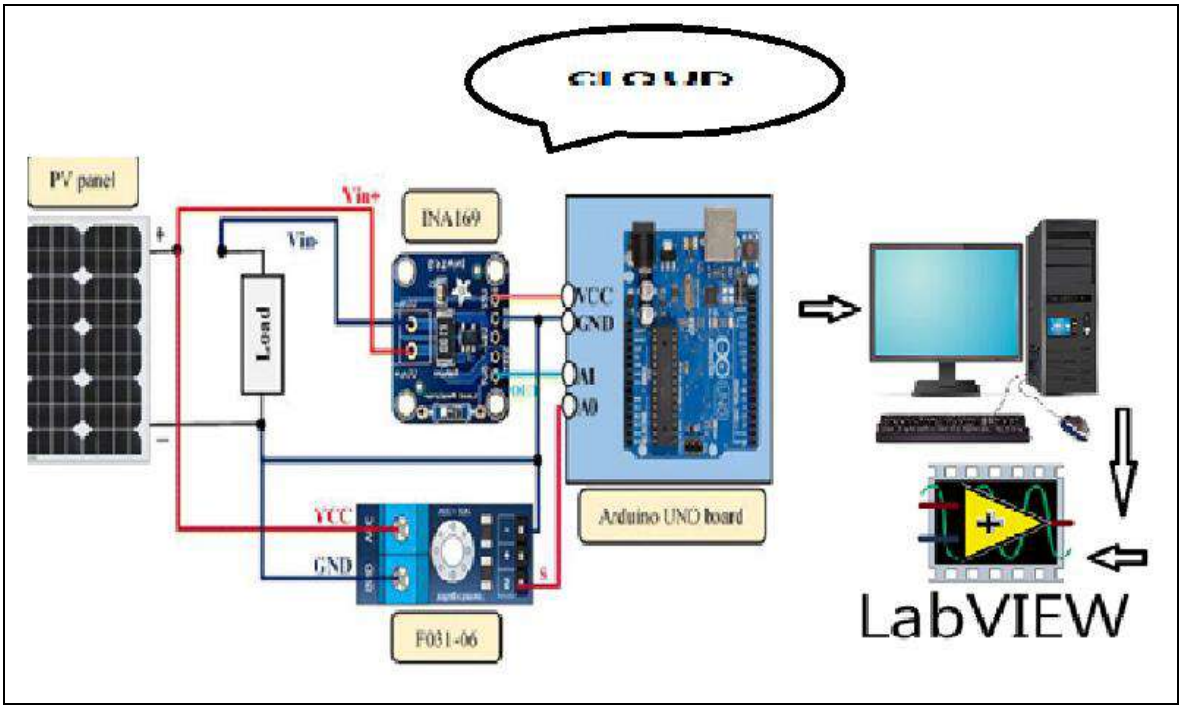
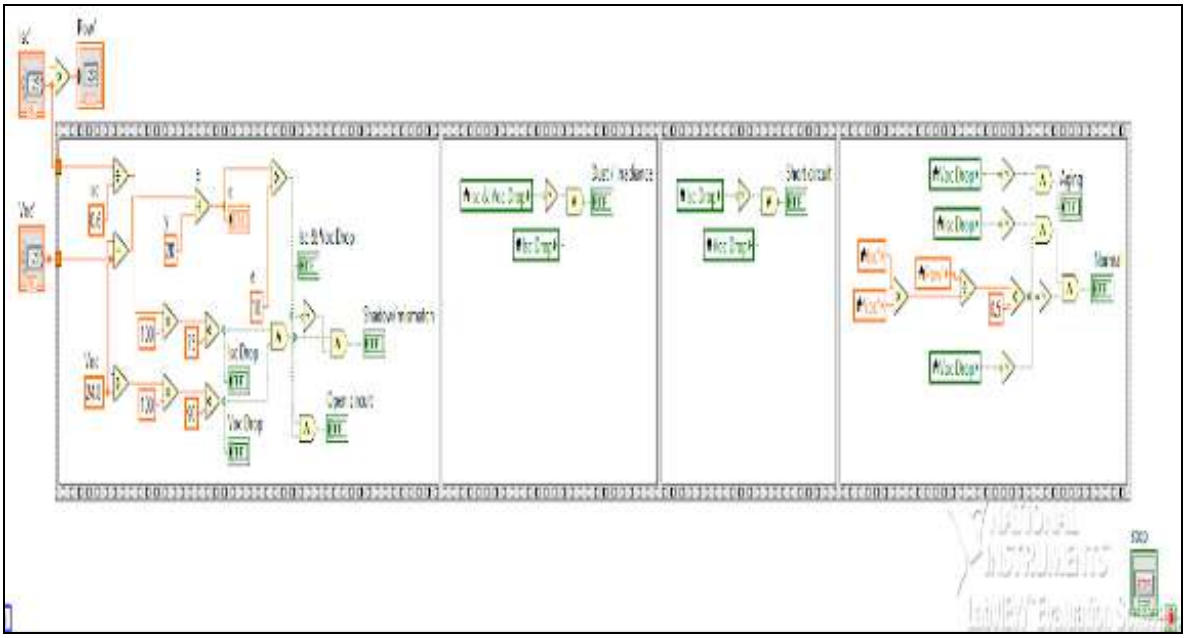


Fig 4: Schematic view of hardware



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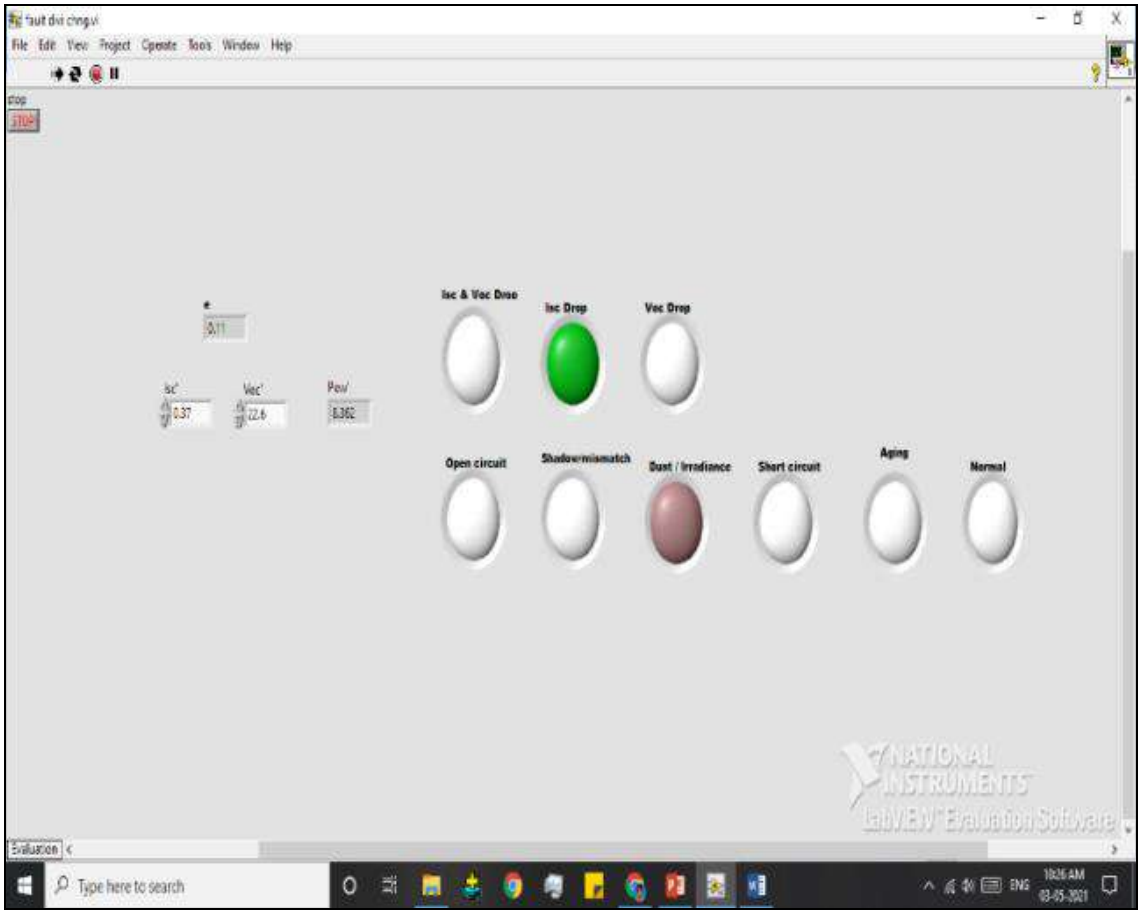

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Fig 5: Block diagram and front view of Fault using Lab VIEW

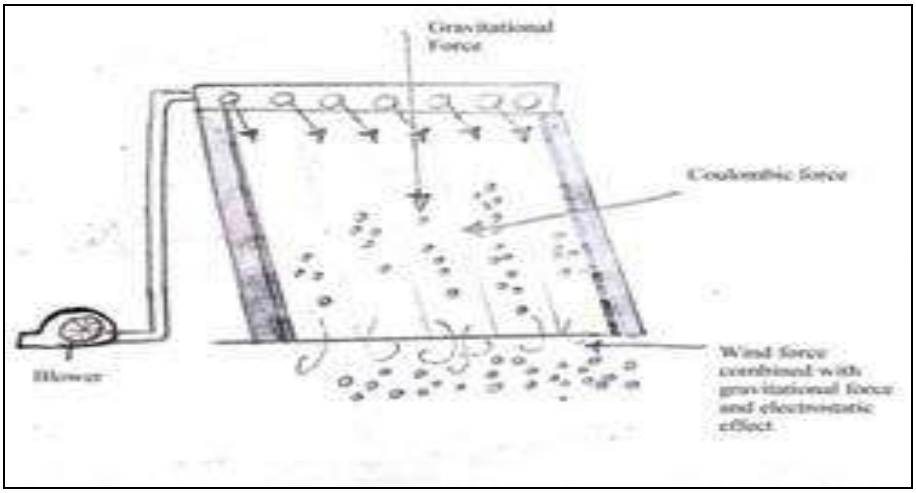
Proposed methodology

In the proposed model, a borosilicate glass substrate is adhered upon the solar panels using transparent and conducting adhesive. The adhesive is employed to stop insulation breakdown and accidental electric shock.

The glass substrate is embedded with copper wires of appropriate spacing. The copper wires are placed at a maximum spacing of 7mm so on avoid solar power wastage. When voltage is applied to copper wires, coulombic force is induced in it which repels away dust particles. This coulombic force is an electrostatic effect which tends to repel away charged particles. This repelled dust particles are acted upon by the travelling waves created thanks to the coulombic force.

When the solar panels are inclined at proper angles the gravitational force acts alongside coulombic force and pushes the dust particles in downward direction. The simplest angle of inclination was acknowledged to be nearly 20 to 22 degrees as studied in. However the dust particles accumulate at rock bottom portion of solar panels. Hence a blower setup is installed at upper segment of solar panels so on blow away the accumulated particles to enhance the performance of the above setup the thickness of glass substrate is preferred to be thin. Also to wash sticky dirt like bird poop, pressurized fluid pump could also be added soon get obviate the dirt with minimum usage of fluid.

Fig 6: Manual Cleaning of PV panel.



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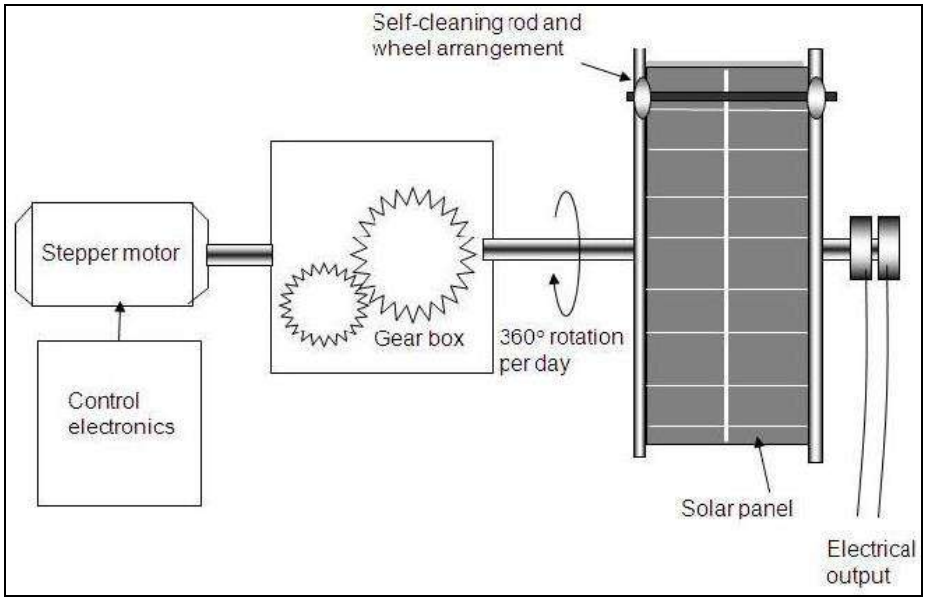

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Fig 7: Automatic Cleaning of PV panel when fault identified in PANEL.

Table 2: For Comparison of PV power at different conditions

Nature of Dust	Without Soiling	With Soiling	After cleaning
Sand	10	8.5	9.5
Paper	10	7.9	9.6
Others	10	7.2	9.3

Conclusion and future work

The system is automated for a only dust fault in PV array, which can be effectively increasing the efficiency of the Panel. In future as everything turn into IOT, any type of fault occur anywhere, the data can be collected from Cloud and the corresponding control action can be taken at any moment so as to increase the yield.

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