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Utility of Non-conventional Energy Sources to Meet Increasing Power Demands by Solar Power Plant

Vijay Kandalkar, Prof P.P Jagtap

Integrated Power System, Electrical Department
G H Raisoni College of Engineering, Nagpur, MH-INDIA

Abstract- Solar is a green energy that consumes small streams to generate electricity without depends on any sources of non-renewable energy. Even though the power generated is less but the benefits gained from this energy is the ability to raise the standard living of residents in remote areas and it does not emit any pollution gas which is able to give an unfavorable effect in the local environment, get free from pollution and helps to maintain sound health. It is able to support the mission of protecting the environment particularly to the ecosystem. It is helpful to reduce the green house effect also. This paper presents a use of non-conventional sources such as solar power system for the fulfillment of power demand to some extent and gives remedial measures during extreme emergencies of electrical power.

Index Terms- Light sensor, Non-conventional, Solar collector, Power

I. INTRODUCTION

Utility of solar energy i.e. non-conventional energy is the only alternative solution to reduce the pollution created by fossil fuels. By thermonuclear processes the sun produces huge amount of energy. This process produced heat and electromagnetic radiations.

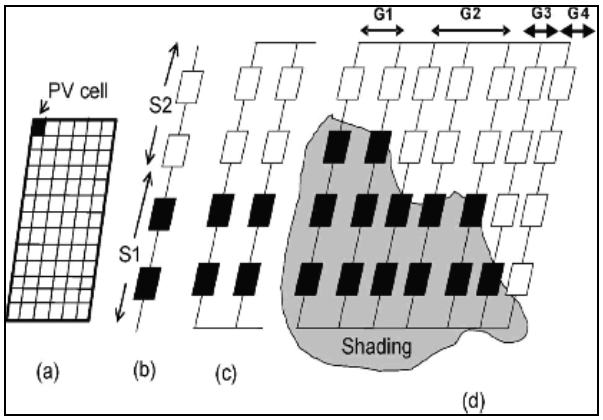
Since today, all countries around the world are concern about global climate changes and fuel sources that becoming less day after day. Green technology is intended to increase the employment of local resources and to contribute towards the national electricity supply security and sustainable socio-economic development.

Collector and storage units are two main components of solar power system. Collector collects the radiations which falls on it and convert it in other form of energy. Storage unit is required to store the heat because un-uniform radiation will be received throughout the year.

II. BACKGROUND THORY

PV Array Terminologies

Various components of a PV array are explained with the help of following Fig.



IMPLEMENTATION OF THE SUN TRACKING AND SELF-CLEANING OF SOLAR PV MODULES

Sun tracking systems are designed in a way to track the solar azimuth angle on a single axis. In single axis tracking system the collector is rotated around only one axis, the sun moves tracing an angle from the sunrise to the sunset. This angle traced by the sun is called the azimuth angle (γ) is defined as the angle between the lines due south and projection of normal to the collector as shown in Figure 1. Here we have used vertical axis with movement in the east-west (E-W) direction. The automated cleaning and tracking systems are implemented using a stepper motor, gear box (40:1), shaft, and sliding rod solar PV modules and circular metal rings for contacts as shown in Figure 3. The control of the stepper motor and the cleaning arrangement is done using a microcontroller.

A novel mechanism of sun tracking with automatic cleaning of PV modules is presented and cleaning mechanism of the PV modules consists of sliding brushes, which slides over module and cleans it twice a day, wherein PV panel makes a rotation of 360o in a day. It is observed that the daily energy generation of a flat PV module (kept stationary on ground) increases by about 30% and 15% for case of tracking-cum-cleaning and just single axis tracking, respectively. This demonstrated the effectiveness of tracking-cum-cleaning mechanism.

The mentioned tracking-cum-cleaning system is most suitable for today's industrial need. Above system can be kept inclined in the north or the south direction accordingly to achieve better energy generation from the PV modules of given wattage ratings. This system can extend to two axis tracking by rotating one axis manually and other axis automatically as rotated in this system. The other axis (north-south) can be rotated on daily or monthly

basis. This axis can also be implemented manually or automatically using motor, microcontroller etc.

`Figure 2. Schematic representation of Azimuth angle (γ) and Inclination angle (β)

A. Tracking mechanism A single axis tracking of the solar PV module is implemented along with the automated cleaning mechanism. For tracking the sun, the module is made to rotate 360o angle in a day, i.e. one rotation in 24 hours. The module starts its rotation from vertical position at the time of sunrise facing towards east (perpendicular to ground) and rotates at the rate of 15° per hour as shown in Figure 4.

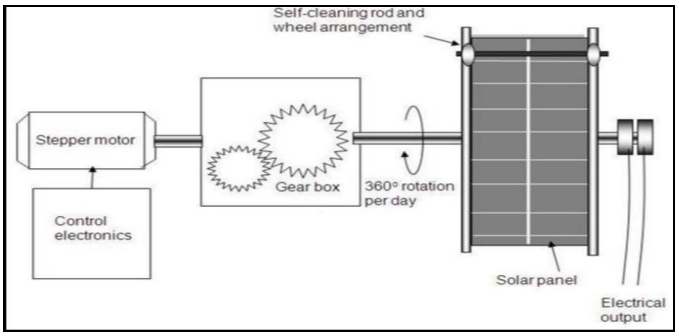


Figure 3 Schematic diagram of Sun tracking and automatic cleaning of solar PV modules

This tracking mechanism is based on the angle of rotation of earth around its own axis. The time for rotation of earth around its own axis is 24 hours which is equal to the tracking time of this system. This system is always in synchronization with the rotation of earth without any extra component because, this system starts at the time of

Figure 4. Rotation of panel throughout the day

sunrise and goes on and on as earth rotates on its own axis. That is the reason this tracking system does not require any sensor or extra component for synchronization like any other tracking system which usually comprised of.

B. Cleaning mechanism The automated cleaning mechanism is implemented using brush, rod & sliding wheels as shown in Figure 5. The brush is fitted in the rod. The rod is fitted with the wheels at both the ends, which are fitted in the channel in which they rotate. When panel comes in a vertical position at 6 am and 6 pm the brush fitted on the rod rotates on the panel from upwards direction due to gravity and cleans the panel two times in a day. In this way the cleaning mechanism works.

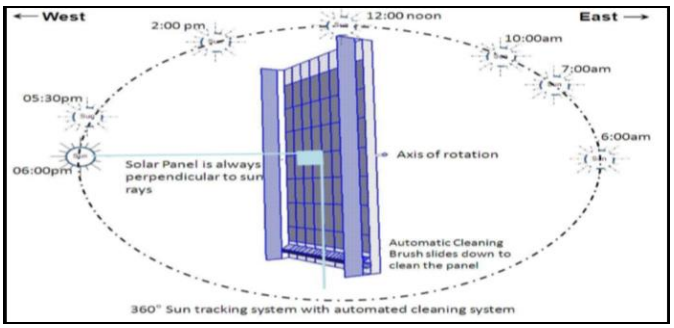


Figure 4: Rotation of panel throughout the day

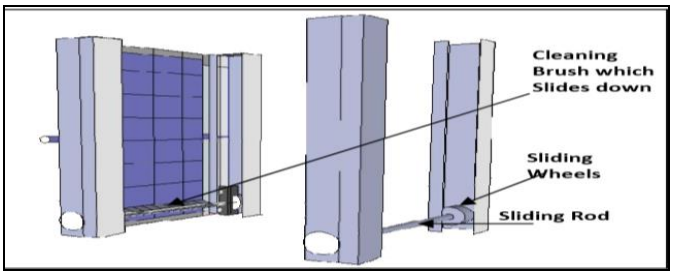


Figure 5 Sliding rod and wheels arrangement for cleaning mechanism

The proposed Sun tracking and self-cleaning of solar PV modules are a complete product and can be implemented with any existing solar PV system. This arrangement has capacity to enhance the energy output of the system and reduces the maintenance required for regular cleaning of

Sliding Wheels

Cleaning Brush which Slides down

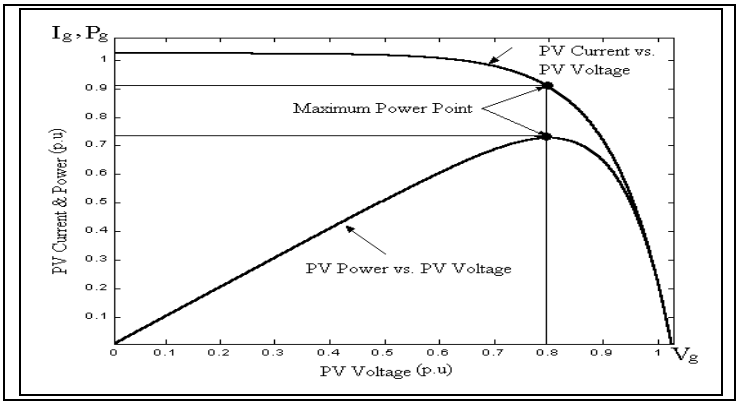
Sliding Rod the PV modules. This system cleans the modules twice in a day automatically.

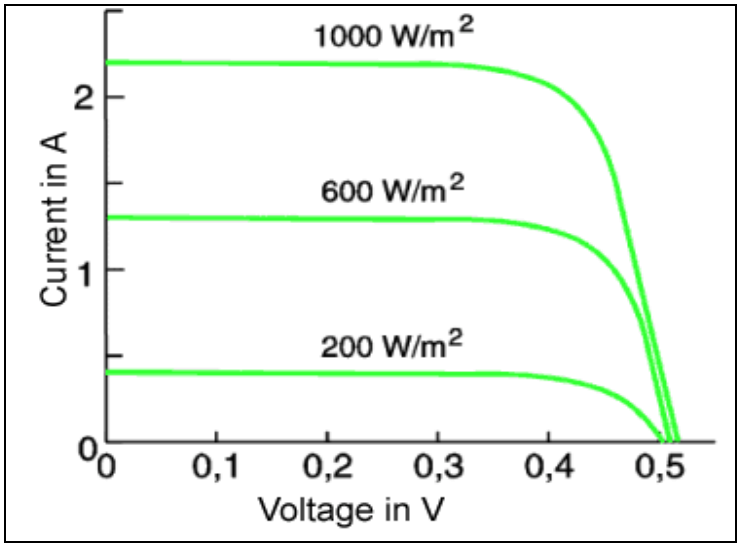
Maximum Power Point Tracking (MPPT)

The maximum power point tracking means to move the solar array voltage close to the maximum power point in order to draw the maximum power from the array under certain atmospheric conditions.

To find the percentage change in power maximum power point tracking offers by two methods:

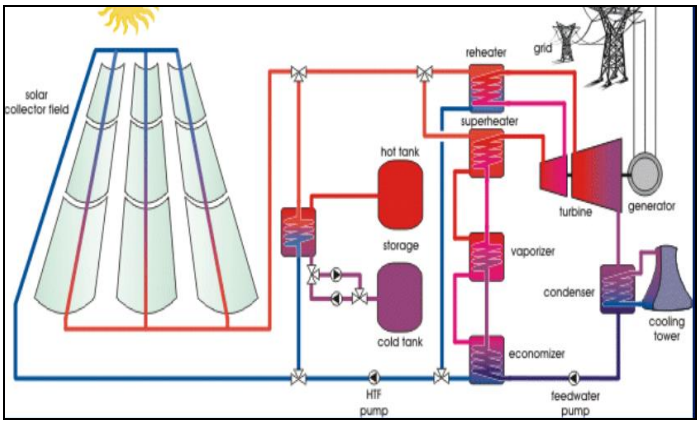
- Operating the stationary solar panel at constant load voltage and with MPPT.
- Operating the east west tacking solar panel at constant load voltage and with MPPT.
- Maximum power point tracking for improving the utilization ratio of photo voltaic cells, full of the conversion of energy is most important under the condition of changing temperature, under different sun light having the maximum power output increasingly and it is the basic principle of tracking





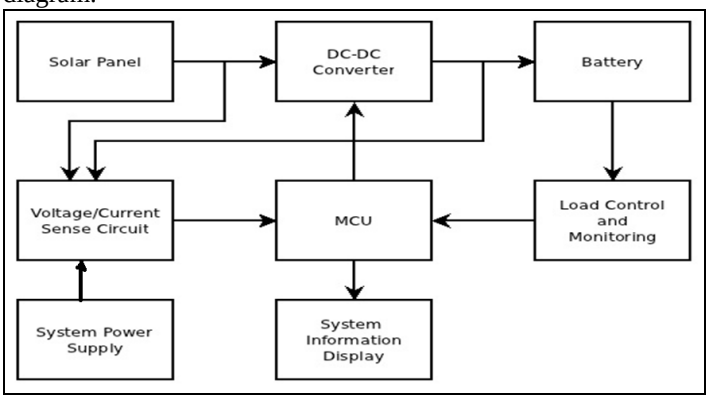
III. PROPOSED SYSTEM DESIGN

The overall design module of the pilot prototype is designed as below:



IV. CIRCUIT DESIGNING

The overall panel of solar will mainly consist of below circuit diagram:



- Solar panel - Output voltage - 9V, current - 3.5A , DIY 0.25m² solar panel built using 18 3"x6" solar cells.
- DC-DC converter, simple boost converter, solar panel voltage is lower than battery voltage
- Battery - 12V 10Ah SLA battery.
- For MPPT tracking accurate measurement is required
- Voltage and current sense circuit measures panel and battery voltage and current and disconnect the load if the battery is exhausted.
- 3.3V Power supply
- MPPT algorithm DC-DC converter MOSFET and system display is required
- System information display current, battery charge, Solar panel power, load power,etc

The main processor is microcontroller unit which provided linkages to DC-DC converter and system information display. The input to main processor is provided by Voltage/Current Sense circuit and load con and monitoring unit.

The solar panel is connected to DC-DC converter which is also connected to battery providing connection to Load control and monitoring unit. The system power supply is connected directly to Voltage/Current Sense circuit.

V CONCLUSION

As a conclusion, it should be noted that there are two input parameters in solar system which are very important in ensuing the efforts to harnessing solar power is successfully implemented, that are collectors and a storage unit. Based on the entire discussion in this paper, it is clear that the existence of solar system technology provide the peoples in remote areas a solution to the alternatives in generating electricity. Solar power system offers a technology which is small in size and less efficiency, low in cost and environmental friendly, pollution free, clean & green energy. It is recommended to all the researchers out there to explore and enhance the system of solar power for the purpose energy utilization for all the peoples in the world.

As such, use of non-conventional sources such as solar power system for the fulfillment of power demand to some extent and gives remedial measures during extreme emergencies of electrical power and to contribute towards the national electricity supply security and sustainable socio-economic development.

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AUTHOR

Prof. P.P Jagtap
G.H. Raisoni College of Engineering, Nagpur, Maharashtra, INDIA <ppjagtap@yhaoo.com> +91 95451 34265

Vijay Kandalkar
G.H. Raisoni College of Engineering, Nagpur, Maharashtra, INDIA <kandalkarvijay@yahoo.in>
+91 94228 04889