SCHEDULED SINGLE AXIS SOLAR TRACKER USING IOT AND MPPT SYSTEM

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Introduction:

Renewable sources of energy are cost effective, sustainable and do not cause any environmental degradation. India is the 3rd largest renewable energy producer in world with 42% electricity is being used for domestic purpose in 2021 from solar energy. One of the ways to generate electrical energy from solar radiation is the PV cells which converts the light rays to electric power. There are several disadvantages in the solar PV panel such as low conservation efficiency and the angle of solar panel is fixed. After a certain time, the light rays do not fall on the solar panel. To overcome these issues, the implementation of scheduled single axis solar tracker using IoT and MPPT will be used. In single axis solar tracker, sun coordinates will help in directing the solar panel towards the direction of the sun. This type of devices varies their orientation angle throughout the whole duration of the day, in order to follow the sun rays to harness maximum energy. They tried to minimize angle of incidence between incoming solar rays and the panel which will directly or indirectly increase the amount of energy captured by solar panel. Therefore, instead of using fixed solar panels, scheduled single axis solar trackers are being used those will continually adjust themselves towards the maximum solar radiation. The usage of mobile and internet which has led to newer technologies like the Internet of Things (IoT) that has enabled the communication and interaction between electronic devices. The energy obtained from the PV cells will be sent to the cloud server and displayed in the webpage using IoT. Single axis solar tracker efficiency can be improved by using Maximum power Point tracking (MPPT). Where MPPT is used to estimate the maximum power with varying the different loads connected to the system.

Objectives:

- The main objective of the project is to develop a Scheduled single axis solar tracker that produces maximum power as compared to fixed single axis solar tracker and that will reduce the usage of conventional energy resources.
- To develop a system such that solar panel aligns perpendicular to the sun radiation using

sun's polar coordinates by set of nonlinear equations which is dependent on time and place.

- To visualise the real time data such as voltage, current and power using IoT (Internet of things).
- To use efficient MPPT algorithm and maximise the generated power efficiency.

Methodology:

The Components used in project are

- Rasperry PI 3
- Solar Panel
- NodeMCU
- Batteries
- Servo Motor

Programming language's used

- C++
- Javascript

Software's Used

- Rasberry Pi OS
- Mosquitto
- Chrome
- Node Red
- Arduino IDE

The input parameters such as latitude, longitude, date and time are stored in the server. The server verifies whether the sun has risen or not and accordingly calculates the polar co-ordinates of sun using sun calculations and sends the calculated value of the azimuth angle to the microcontroller over the Wi-fi network. The microcontroller then rotates the solar panel using a servo motor according to the calculated azimuth angle and simultaneously measures the generated electrical power by the solar panel. The measured values are sent to the server for data storage and analysis. The same process repeats entire day.

Figure 1 shows the circuit diagram of scheduled line of symmetry solar tracker. ESP8266(Node-MCU) can be used as the Wi-fi microcontroller. The ESP8266 receives azimuthal angle at specific interval of time from the server and gives the PWM signal to servo motor, which is connected to the solar panel to rotate. The amount of energy generated from the solar panel will be around 10w. Raspberry Pie uses the Mosquitto server which is used for the data transfer. Raspberry Pie and Node MCU is connected to the local router. Arduino board is connected to Node MCU and then it is connected to the servo motor to rotate the solar panel.

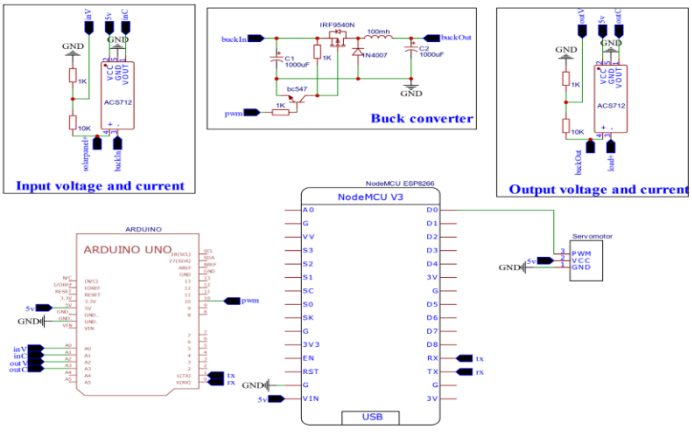
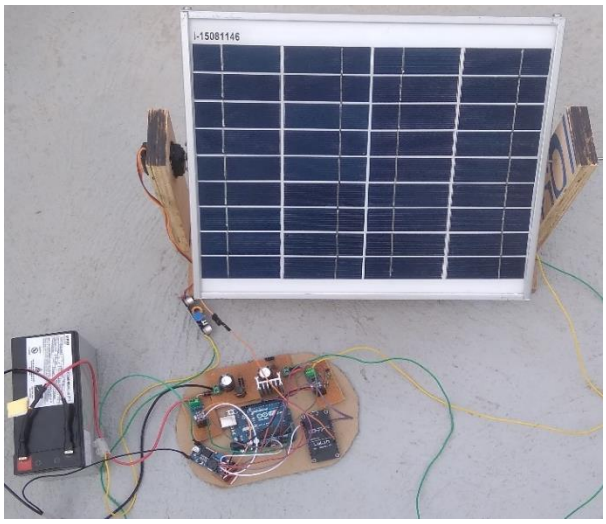


Figure 1 Circuit Diagram

Results and Conclusion:



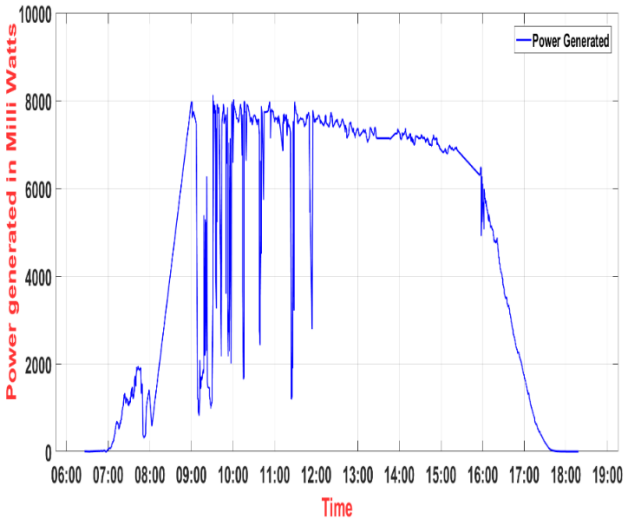


Figure 2 Generated Energy Graph

Figure 3 Project Prototype

Figure 2 shows prototype of scheduled single axis solar tracker which contain solar panel as well as solar panel stand which is used to capture the amount of solar power generated during 6am to 6pm from single axis rotating solar panel. The average maximum power generated is 8W. where the power generated by the solar panel will be stored in battery. From the above graph it is observed that constant power has generated over a time period of 9AM to 4PM. Using IoT the visualization of power generation becomes easier and the solar power data can be stored for future analysis. Hence, by using single axis rotating solar tracker the uniform energy can be generated.

In our project we are using solar energy for power generation. Which is not exhaustible. where we use solar panels to absorb the solar radiation emitted by the sun and hence the solar energy is converted to electric power. So, we designed a “scheduled single axis solar tracker using IoT and MPPT”, where the solar panel is rotated according to the azimuthal angle (which is calculated by Solar co-ordinates) using servo motor and hence the solar radiation will fall on the solar panel which will be exactly perpendicular to the sun.

We have analyzed different types of MPT algorithm which will be suitable for tracking and which has highest efficiency. So, we can conclude that incremental conductance algorithm suites to our project which may be more efficient and it is not so complex for hardware and software implementation. The incremental conductance algorithm depends on the P-V curve slope, which is dependent on solar radiation and load resistance.

Future Scope:

We have used 10W Solar panel it can be replaced with large capacity solar panel. The solar panel holding structure can be improved with iron material. In the proposed project Incremental conductance algorithm is used, it can be replaced with other algorithm which gives higher efficiency.