COMPARISON OF SOLAR TRACKING WITH FIXED PANEL POWER GENERATION (WITHOUT LOAD)

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ABSTRACT

Photovoltaic modules are devices that directly and cleanly convert the sunlight into electricity and offer a practical solution to the problem of power generation in remote areas. They are especially useful in situations where the demand for electrical power is relatively low. To maximize the power extraction as per demand, instead of installing a extra panels we can use tracking system, which enhances the power. The solar tracker that has been designed and constructed in this project optimizes the power output of PV modules by making sure that they are pointed towards the sun at all times during the day. The tracker could be implemented in any situation where solar modules are used. It would be especially effective in situations where only a small number of modules are required and where efficiency is of a great importance.

Keywords: Efficiency, Photovoltaic system, Power generation, solar array, Solar Tracking.

I INTRODUCTION

We know to get maximum efficiency, the solar panels must remain in front of sun during the whole day, but due to rotation of the earth the solar panels cannot maintain their position always in front of sun, and this problem results in decrease of their efficiency. Thus to get a constant and maximum possible output, an automated system is required which should be capable to constantly rotate the solar panel. The Sun Tracking System was made as a prototype to solve this problem; it is completely automatic and keeps the panel in front of sun. The important feature of this system is that instead of taking the earth as its reference, it takes the sun as a guiding source. It has active sensors which constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum.

1.1 Need of Tracking System

As the Global warming has increased by using fossil fuels for the electricity generation, the demand and request for energy produced by the renewable sources like solar power is more. The advantages of using a tracking system compared to that of fix ground system are:

- Increase in the power generation.
- The space required for installation is less.

- Tracking the sun from east in the morning to the west in the evening will increase the efficiency of the solar panel by 30-35%.

In the present designed system project geared D.C motor is used to rotate the solar panel from east to west and back to the original position in the evening. Open loop control is an active method of tracking that does not use direct sensing of the sun position and RTC is used to set the time, depending on this time the panel will be rotating and pointing directly towards the sun to extract maximum solar energy. The motion of the sun leads to variation in the solar energy incident on the SPV panel leading to lower energy gain. The provision of a tracking system can overcome this malady by maintaining a lower value for the incidence angle that ensures higher energy gain. The present system implements automatic single axis tracking of solar panel that can lead to savings up to 30% compared to the fixed panel.

II METHODOLOGY

The project is real time deployed using 8051 microcontroller, RTC (Real Time Clock), keypad, DC Geared motor and switch. The system is arranged in the fashion as shown in the block diagram. The function of main parts is as follows.

Key pad: The micro switches are interfaced the 8051 to the input port of 8051.In this project three keys are interfaced to controller.

RTC: As the tracking is time based, so we need to set the time for the movement of the solar panel according to the direction of the sunlight. This is done by using RTC DS1307.

Microcontroller: The 8051 microcontroller is employed and the program is down loaded in the ROM, the 8051 receives the signal from the input port and executes the instructions stored in the ROM and sends the signal through the output port to the encoder.

Solar Panel: For the present designed system two panels each 10Watts are used.

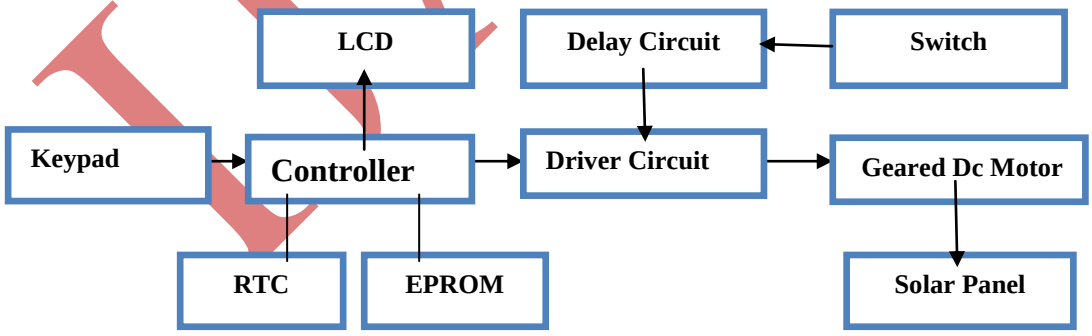

Fig.1: Block diagram of Solar Tracking System

Driver circuit: As we know the output of 8051 circuit is 5V, which cannot drive the motor. So the driver circuit is used to increase the signal. A driver circuit comprises of Darlington amplifier, which increases the DC level to a required value of 9V/12V. To drive the two DC motors motor of 3.5 rpm each we have used L293D, which has two inbuilt H-bridge driver circuits.

Working of solar tracking system: Key pad is used to set the time, date and durations. Keypad input is given to microcontroller. The controller is continuously monitoring the input port. Once it receives the signal, the controller will give the output to driver circuit to make the D.C motor on. Once the D.C motor is on, solar panel will move from east to west (signal is fed to L293 driver circuit to amplify the signal and fed to gear motor).At the end of time duration set, the solar panel will return back to its original position.

The circuit diagram of the designed system is shown as below

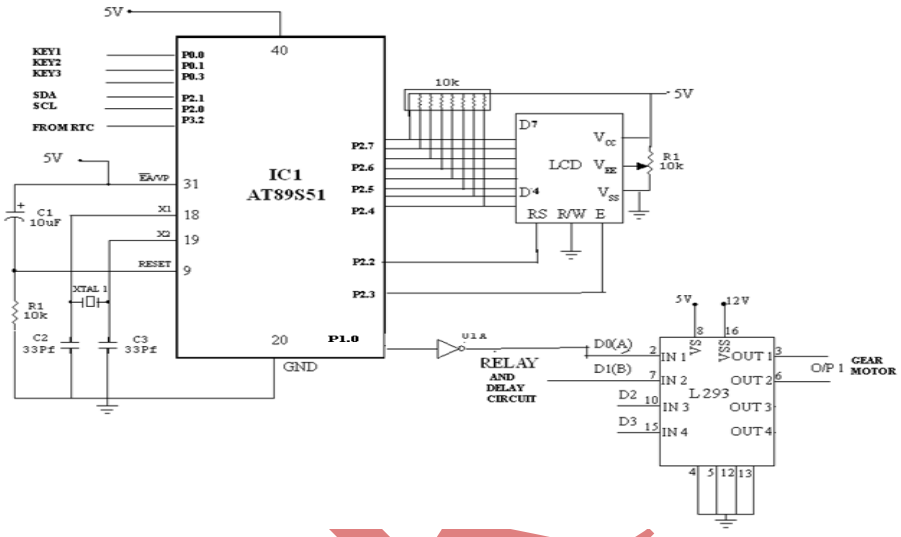

Fig.2: Circuit diagram of microcontroller connected with the RTC and display

The program execution of the microcontroller can be represented in the form of flow chart as below:

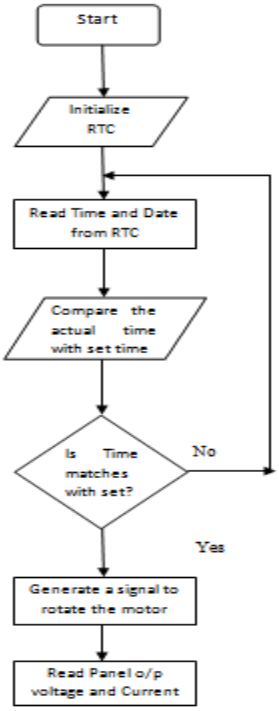

Fig.3: Program execution flow chart

III RESULTS AND DISCUSSIONS

The time is set in the RTC by using keypads, after setting the position of the solar panel. At the particular time i.e. from morning 8-30am to 3-30pm the voltage and corresponding current of the solar panel at No load conditions are noted down. Using these voltage and current values power, energy and efficiency are calculated for both fixed panel and automatic solar tracking.

3.1 Power Calculations for a Fixed Panel and Automatic tracking with load

From morning 8:30am till 3:30pm the load voltage (V_L) and short circuit current (I_L) are noted down. These readings are taken on the average sunny day without using tracking system and on no-load kept constantly throughout the day in the north south direction. By using these values power generated is calculated and solar panel efficiency is calculated.

The different parameters like voltage, current, power generation and panel efficiency of fixed and tracking system on no-load condition are compared and are graphed as below.

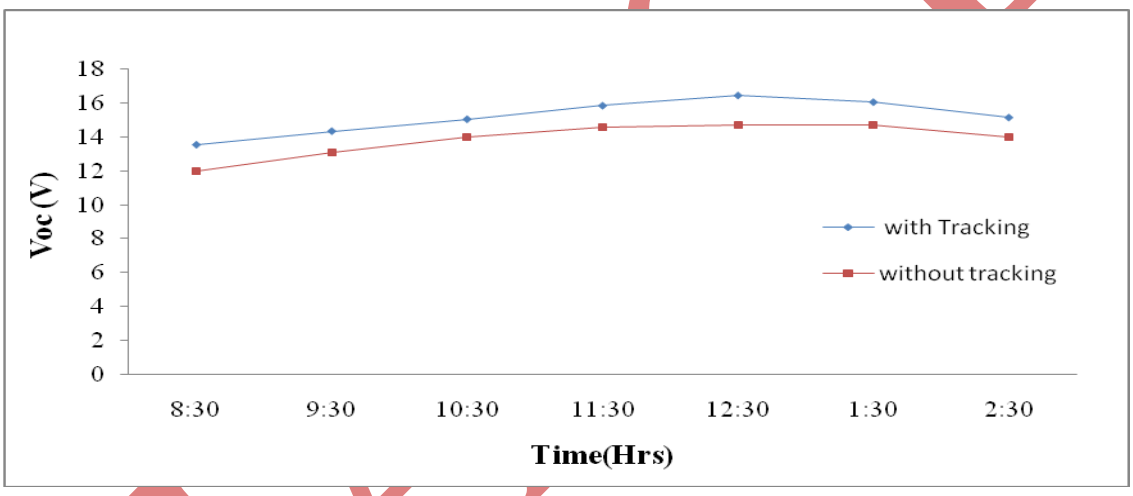

Fig.4: Comparison of voltage of fixed and tracking system

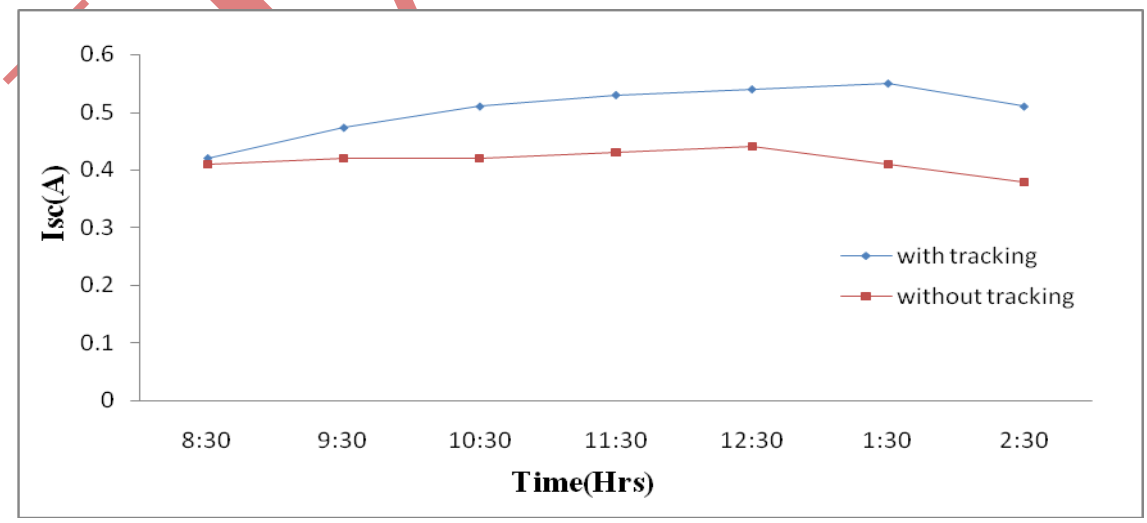

Fig.5: Comparison of current of fixed and tracking system

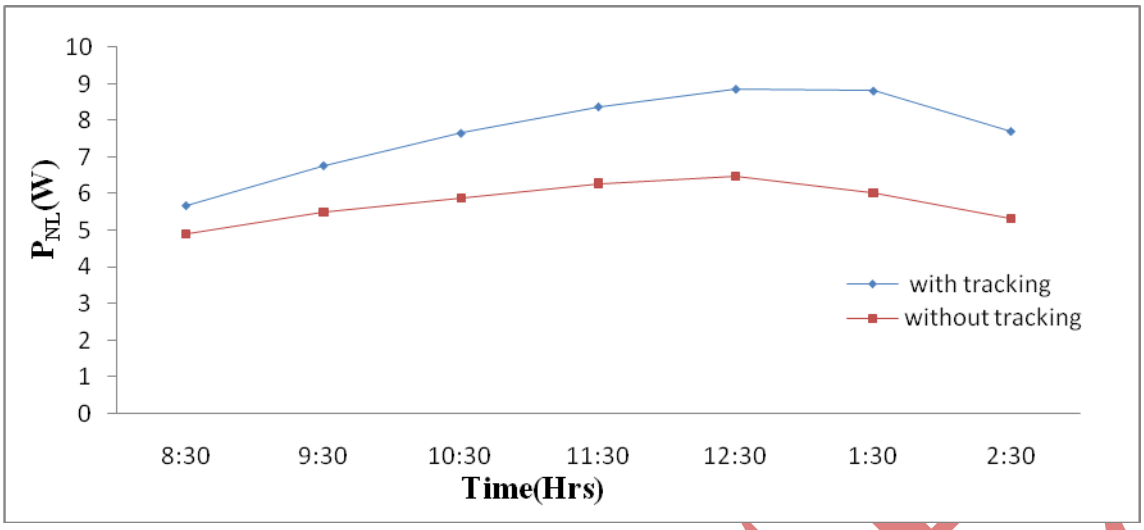

Fig.6: Comparison of generated power of fixed and tracking system

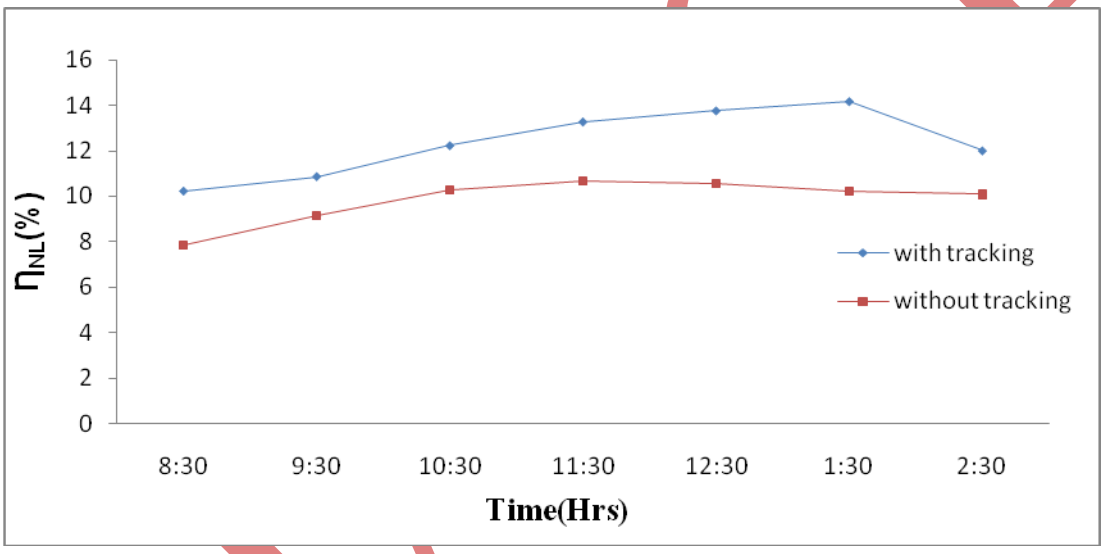

Fig.7: Comparison of panel efficiency of fixed and tracking system

From figures 4 and 5 it is clear that open circuit voltage and short circuit current measured with automatic solar tracking are more as compared to fixed panel. The current measured from a fixed panel is less as the panel is not directed in the direction of the sunlight and due to shading effect and clouds the current measured is less. The current measured from a tracking system is almost constant all the time with only slight variations due to clouds. And this improvement in current readings made to charge the battery easily, as the system uses automatic tracking the solar panel will be pointing towards the sun always and is set by using a RTC, which is interfaced with the microcontroller. The microcontroller gives the controlling signal to the DC geared motor to rotate in the direction of the sun. This way the absorbs maximum sunlight thereby producing more power as compared to the fixed panel.

Figures 6 and 7 indicates that the power and efficiency of the solar panel calculated by using V_{oc} and I_{sc} in case of automatic solar tracking are more as compared to fixed panel. It shows that solar tracking system is able to

receive more Sunlight and consequently generate more power as compared to static solar panel. The panel efficiency with tracking is always more as compared to the fixed panel efficiency.

IV CONCLUSIONS

The following conclusions have been derived from the experimental work on tracking system.

- It has been observed from the statistical analysis, that the sun tracking systems can collect about 31.66% more energy than what a fixed panel system collects and thus high efficiency is achieved through this tracker.
- The circuits developed are simple in nature and automatic, which avoids manual operation and flexibility in design.
- The constructed system model can be applied in the residential area for alternative electricity generation especially for non-critical and low power appliances.

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