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Design of Cost Effective Single Phase Solar Inverter for Utilizing PV Energy

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ABSTRACT: We know that two types of sources for electrical power generation. One is conventional and other is non- conventional. Today to generate electrical power conventional sources like coal, gas, nuclear power generators are used. Some of conventional source are pollute the environment to generate the electricity. And nuclear energy is not used because of its dangerous radiation effect on the mankind. After some of ten years conventional sources will not sufficient enough to fulfil the requirements of the mankind. So some of the electrical power should be generated by non-conventional energy sources like solar, wind .With the continuously decreasing the cost of PV power generation and the further intensification of energy crisis, PV power generation technology has more and more application.

KEYWORDS: Solar tracking, single phase solar inverter, boost converter, Buck converter, utilization of solar energy.

I. INTRODUCTION

Energy is the basic need of human and with the rapid growth of population; its demand is increasing day by day in urban as well as in rural sectors of the country. Renewable energy is an indigenous resource available in notable quantities to all developing nations and capable in principle, of having a significant local, regional or national economic impact. The use of renewable energy could help to save foreign exchange and generate local employment if conservation technologies are designed, manufactures, and installed locally. Light gathering by solar panels is dependent on the angle of incidence of light rays to the solar cell's surface. If a flat solar panel is mounted on level ground, the sunlight will have an angle of incidence close to 90° in the morning as well as in the evening hours At such an angle, the light gathering ability of the cell is essentially zero, resulting in no output.

The people living in the remote rural area of Indian villages are still deprived of electrical supply from the conventional grid source. The Diesel Generator (DG) sets are being used by rural masses as an alternative source of power but its operation is limited due to high cost of fuel and high maintenance.

In this paper Sun tracking is a technique to constantly track the sun's direction throughout the day so as to increase the efficiency of the system. Two solar panels adjacent to each other are used and their output voltages are calculated. Output voltages are then compared and accordingly signal is given to the motor driver unit. And then both the panels moves in direction where the light intensity is more.

II. RELATED WORK

In [1], the concept of maximum power point tracking is best illustrated. MPPT is designed with AT89S52 MCU. Solar panel output is interfaced to Microcontroller through ADC. The controller continuously checks the voltage level of the panel and operates the stepper motor to attain maximum voltage. An LDR is used to sense the day night condition, to disable the tracking in night condition. The stepper motor is driven by a ULN driver. In [2] Solar cell/ PV cells convert solar energy into electrical energy. This electrical energy is in DC form. This dc voltage is boosted using dc to dc boost converter. This boosted dc voltage is fed to inverter. Inverter converts dc voltage into ac voltage. Here sine coded PWM push-pull inverter is used. The output of inverter is given to step-up transformer and low-pass filter which will give 220V 50Hz sine wave output Inverter topology is sine wave push pull inverter is selected. This topology is used to

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decrease the cost of solar inverter. In this topology only two MOSFETs are used. And the isolation requirement between control and power circuit is less. In [3] the single phase inverter using PIC16F73 microcontroller and MPPT Microcontroller based advanced technique of generating sine wave with lowest harmonics is designed and implemented in this paper. The main objective of our proposed technique is to design a low cost, low harmonics voltage source inverter. In this paper PIC16F73 microcontroller is used to generate 4 KHz pwm switching signal. The design is essentially focused upon low power electronic appliances such as light, fan, chargers, television etc. In this paper author used STP55NF06 NMOSFET, which is a depletion type N channel MOSFET. For driving the MOSFET used TLP250 and totem pole configuration as a MOSFET driver. The inverter input is 12VDC and its output is 220VAC across a transformer. In this paper a single phase PWM inverter has been implemented with PIC16F73 microcontroller and gated river's IC TLP250, totem-pole developed In [5] mechanical solar tracking system. Gear train operating system with the help of potential load is employed to rotate the solar concentrator with the movement of the sun. The comparison between the "Mechanical Solar Tracking System" and "Electro-Mechanical Solar Tracking System" shows that it consumes zero energy from the produced energy and thereby, increasing the overall efficiency by 5 to 8%.
In [7] authors design of an efficient solar tracking system based on Real Time Clock (RTC) using microcontroller. The time at which panel is tilted to certain angles in a particular direction either in clockwise or anti clockwise is called tilt time. Then the controller delivers an output, the corresponding PWM signals to drive the DC motor, so that panel position can be adjusted. this paper refers to the solar tracking system that automatically adjusts the PV panel position based on the given tilt times with respect to the natural position of the Sun at different times of the day by means of a DC motor controlled by a intelligent microcontroller (AT89S52) that equipped with an algorithm to provide the tracking position using RTC (DS1307) In [9] authors used Worm gear mechanism is used to tolerate any environmental forces including wind or any backlash forces, Two photo-voltaic (PV) cells are used to detect the illumination in east and west direction. Outputs of PV cells are compared and given to PIC microcontrollerPIC16F877A for tracking purpose In [10] authors designed solar tracker in which Solar panels give maximum output when the plane of the solar collector is normal to incident radiations . The system discussed in this paper uses a PSoC device to control a small model of solar tracker.

III. PROPOSED SYSTEM

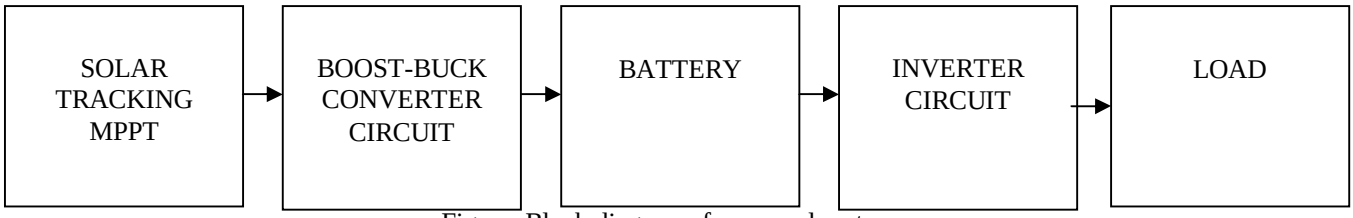

Figure. Block diagram of proposed system

IV. DESCRIPTION OF PROPOSED SYSTEM

Solar tracking system MPPT
Sun tracking is a technique to constantly track the sun's direction throughout the day so as to increase the efficiency of the system. Two solar panels adjacent to each other are used and their output voltages are calculated. Output voltages are then compared and accordingly signal is given to the motor driver unit. Comparator LM 358 is used and motor driver L298 is used And then both the panels moves in direction where the light intensity is more. Output of solar panel is then given to the boost and buck converter circuit.

Boost converter:
The boost stage is a popular non-isolated power stage topology, sometimes called a step-up power stage. Power supply designers select the boost power stage because the required output is always higher than the input voltage. The input current for a boost power stage is uninterrupted, or non-pulsating, because the output diode conducts only during a portion of the switching cycle. The output capacitor supplies the entire load current for the rest of the switching cycle Boost converters are basically a step-up power converter that takes in a low voltage input and provide an output at a much higher voltage.

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Buck converter:
A DC-DC converter in Buck stage has been used for this research. It simply scales down the output of the PV panel to the desired level power stage can operate in continuous or discontinuous inductor current mode. In Continuous inductor current mode, current flows continuously in the inductor during the entire switching cycle in steady-state operation. In discontinuous inductor current mode, inductor current is zero for a portion of the switching cycle. It starts at zero, reaches peak value, and again returns to zero during each switching cycle. It is desirable for power stage to remain in only one mode over its expected operating conditions because the power stage frequency response changes significantly between the two modes of operation.

Battery: A Battery is device having two or more electromechanical cells which store chemical energy and make it Available in an electrical form.Any required capacity can be obtained by serial or parallel connections of the batteries. The battery that provides the most effective operation in the solar and wind power systems are maintenance free dry type and utilizes the special electrolytes12 V-7.2AH battery is used. The charging current for the battery is 1.0 A.

Inverter:
Power inverter used here converts DC power or direct current to standard AC power which allows us to run the electrical appliances. MOSFET based circuit is used for inverter .To drive MOSFET based circuit Transistor are used. Input to inverter circuit 12V DC and output is 12 V AC.Output is then connected to step up transformer. The principal advantage of the MOSFET is that it is a voltage-controlled device which requires negligible power to hold it in the on state. The gate drive circuitry is thus not much complex and costly than the base-drive circuitry of an equivalent bipolar device

V. RESULTS.

In Sun tracking is a technique to constantly track the sun's direction throughout the day so as to increase the efficiency of the system. Two solar panels adjacent to each other are used and their output voltages are calculated. Complete practical set up is as shown in fig1

Fig.1 solar tracking system.

Initially absence of light,LCD display shows solar input 0V and also battery charging voltage is 0V as shown in figure.2

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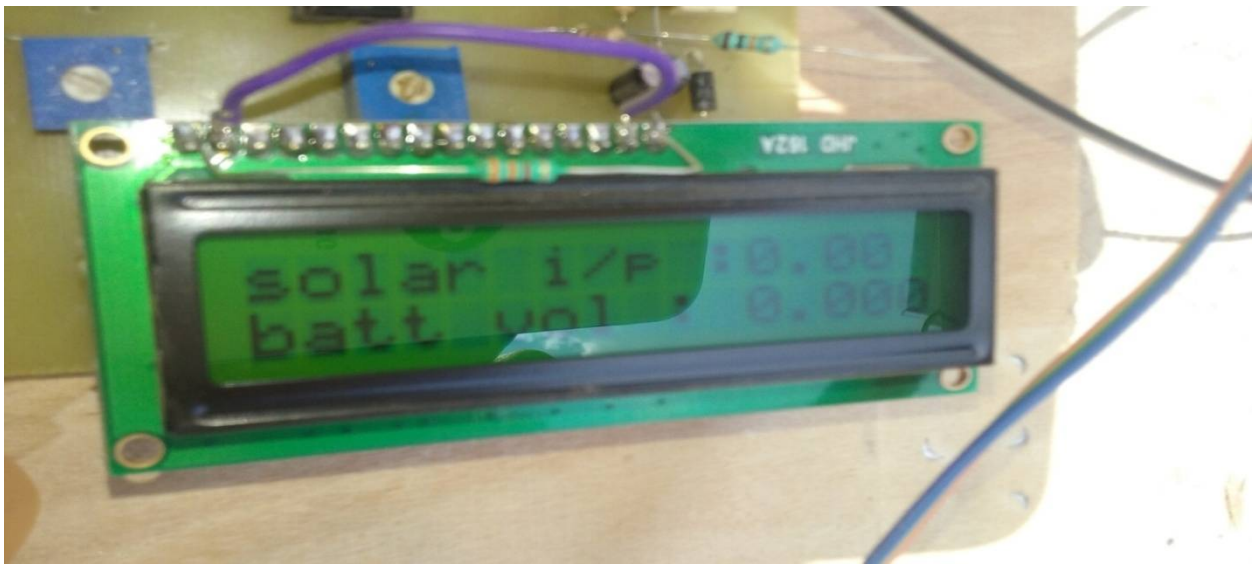

Fig.2 Initial stage of solar tracking system.

Finally in the presence of light the solar input the solar input voltage 23.81V and the battery charging voltage maintained to 12V constant. as shown in the figure.3

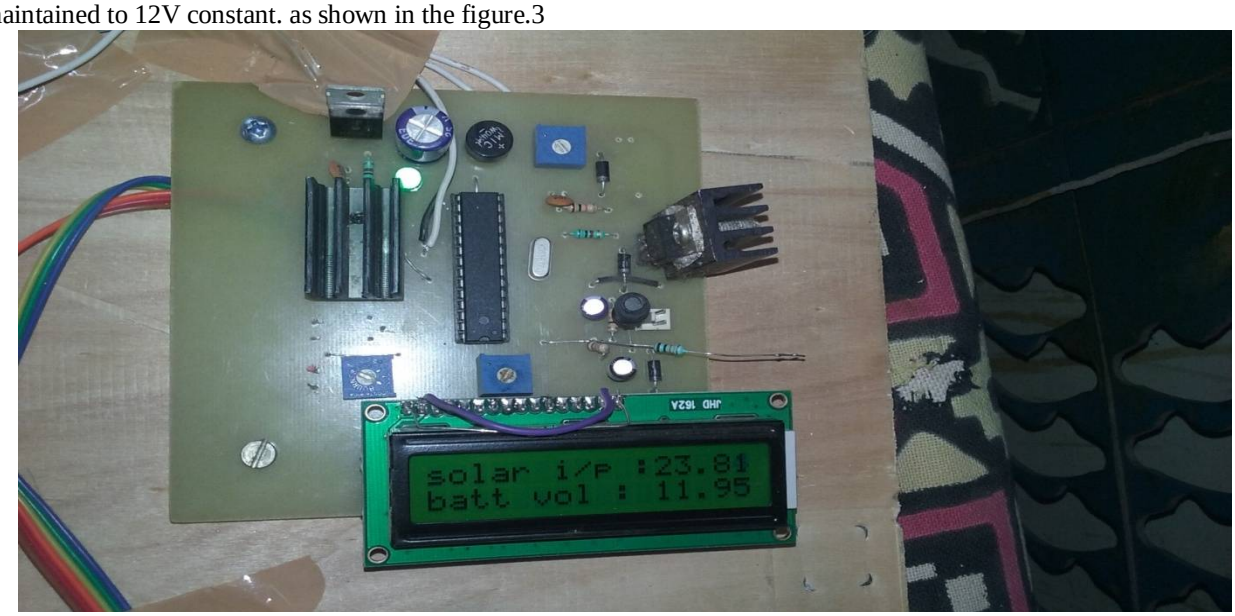

Fig.3 Final stage of solar tracking system.

Input and output of different stages:

Input from solar tracking system varies between 0-24V DC which is then applied to boost-buck converter circuit, boost-buck converter circuit is useful to maintain constant 12V DC supply for battery charging purpose, and output of battery is then applied to inverter circuit output of inverter circuit is 12V AC.output of inverter is then applied to step up transformer to get 230V AC.

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Sr. no	Circuit	Input voltage	Output voltage
1	Boost-buck converter	0-24V DC	12V DC
2	Inverter	12V DC	12V AC
3	Transformer	12V AC	230 V AC

VI. CONCLUSION AND FUTURE WORK

In this paper cost effective single phase solar inverter is implemented. Solar tracking system is implemented using two solar panel. Output of solar tracking is given to Boost-buck converter circuit for constant voltage which is required for battery charging purpose. MOSFET based circuit is used for inverter circuit.In this paper only two MOSFETs are used and the isolation need between control and power is less. Advantages of this system help to decrease the cost. Solar (PV) power system has a great use in future as one of renewable energy technologies for off-grid power generation. In this paper there is no work for power factor improvement. But in our regular uses power factor is vital factor. Low power factor causes great problem such as increase the reactive power, loss will increase, harmonics may generate, short circuit of line may appear and the total system may collapse. So there is a future scope for power factor correction.

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BIOGRAPHY

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