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Design and Fabrication of Single Phase Grid Connected PV cells with Net-metering

Girijamma, Soujanya P Salimath, Hirematada Halaswamy, Omprakash J, Basavaraju S, Hadapad

U G Student, Department of Electrical And Electronics Engineering, Tontadarya College of Engineering, Gadag Karnataka, India.
U G Student, Department of Electrical And Electronics Engineering, Tontadarya College of Engineering, Gadag Karnataka, India
U G Student, Department of Electrical And Electronics Engineering, Tontadarya College of Engineering, Gadag Karnataka, India
U G Student, Department of Electrical And Electronics Engineering, Tontadarya College of Engineering, Gadag Karnataka, India
Assistant Professor , Department of Electrical And Electronics Engineering, Assistant Professor, Tontadarya College of Engineering, Gadag Karnataka, India.

ABSTRACT: Availability of power from conventional methods is not able to meet the requirements of consumers demand. Solar energy is a alternative source to create a standalone energy source. The conventional methods or solar energy alone can fluctuate. When they are used as combined sources of energy, can provide a reliable and uninterruptable power supply to the consumers. Excess power can sale to the grid utility system or can taken by the system when there is an inadequate energy supply from the PV cells.

KEYWORDS: Solar, Stand alone, Conventional methods.

I. INTRODUCTION

The gap between the energy demand and the supply adversely affects to the economical growth of the nation. As per the survey reviews India is a 3rd largest producer of electricity and 4th largest consumer of power. In order to fulfill the energy requirements of the consumes, the design of net-meter with solar PV cells has been carried out. In the summer season the availability of the solar power is in large quantity and one can meet the required load but when there is a non-availability of solar energy or excess of solar energy leads to the power interruption or power wastage. In order to avoid this problem, bidirectional energy meter concept is implemented here. Net-meter is used to analysis the energy transaction taking place between consumer and grid connection. This model includes the inverter design, transformer design and ADC implementation. It plays an important role at consumer level to know about energy consumption, excess power generation, energy transaction between grid and consumer and variations in current and voltage.Proposed model uses the solar energy as input and stores it in the battery. When there is a normal power drawn by PV cells, it draws only residential load. If there is an excessive amount of energy being produced by PV cells it can drive residential load and also energy can be sale to the grid utility system this may reduces the wastage of energy taking place in the system. Solar roof tops are well defined area for implementation of this model. This may reduces the dependency on conventional methods which are nonrenewable in nature. The proper utilization of energy source has been carried out without any wastage and interruptions. Bidirectional energy meter plays an important role in energy transaction and to count the units consumed by the consumer and taken by the grid utility system. Relay is used as source selector, depends on the solar power relay operates and switching action takes place.

II. BLOCK DIAGRAM

A. PV cells

Solar energy is abundant in nature and earth receives solar radiations in huge manner. The proper utilisation of solar energy is becoming a new trend because of its availability, clean form of energy and cost free. PV cells are designed to

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trap the solar radiations and these are connected in series parallel manner to increase its capacity. PV cells are usually made up of silicon crystals.

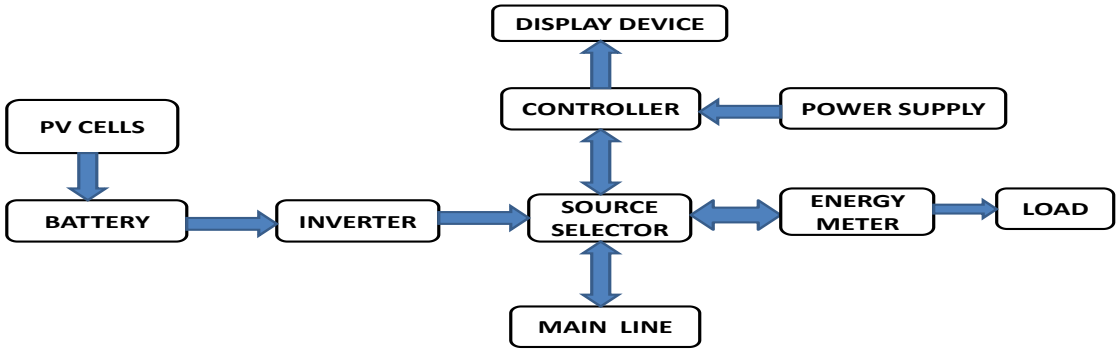

Fig. 2.1 Block diagram

A. Battery

Battery is a DC power storage device and its backup depends on the current rating. For prototype purpose 12 volts, 7.2 Ah battery has been used here. In order to charge this battery by solar panel takes approximately 4 hours, after this energy being sent to the grid if excess production.

B. Source Selector

Source selector is used for switching and selection of source according to the energy availability. 7 Amps ac, 250 volts source selectors are used here. 1N4007 diode is used for the reverse polarity protection. There are mainly three terminals in the relay normally connected, normally open and common. When relay in off condition the connection between common and normally connected established.

C. Inverter

Inverter is a DC to AC converter, used for the conversion of direct solar energy into alternating current. Inverter does not produce any power. The converted input voltage, output voltage and the frequency depends on the design of specific circuitry and required specifications. Here MOSFET is used for the reverse voltage block. To generate sinusoidal signal PWM technique has been implemented with the help of CD4047 IC. Resistors of various ratings are used to limit the current.

D. Energy Meter

Energy meter is a device used to determine the energy consumption by the electrical equipments. These are installed at residential, commercial, industrial etc to know the energy consumed by the consumers and for the proper billing purpose. Usually energy consumed is calculated in kWh. Bidirectional energy meters are useful to calculate the energy transaction between the consumers and grid utility system and named as Ne-meter. Single phase 1600 impulse/kWh, class 1, 240 volts and 50 Hz energy meter is used here. It gives the energy consumption in the form of units with the indication of blinking LED, net consumption will be displayed in the display board.

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B. Load

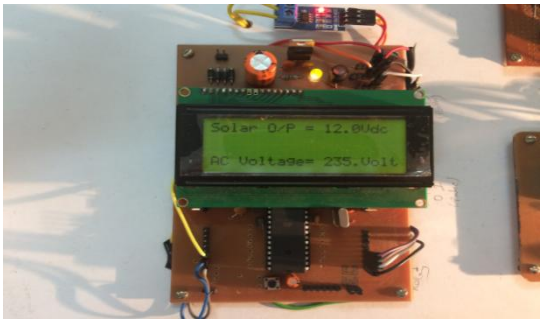
In the electrical field load means current, in other words the load is the one which consumes the electric power. Loads are energy consuming devices which may include residential, commercial, and industrial. There exist three types of loads resistive, capacitive and inductive loads. Resistive loads are having unity power factor but not used in practice. Inductive loads are enormously used because of various advantages.

C. Controller

ATMega32A controller is used here because of its flexible features such as built in ADC, 32 k byte flash memory, 1024 bytes of internal ROM and 3 interrupters. 40 pins are present and these may used for many applications. Controller plays an important role here, as per the program conditions it helps the system to flow in specific manner and display the task, which has been taking place in the system.

D. Display Board

The 16*2 display is used to show the status of the power. In terms of normal, excessive and low solar power. Display board is also used for the unit display, voltage and current values display.



III. HARDWARE DESIGN

The prototype model of project is as shown in the Figure 3.1. It consists of PV cells, battery, inverter, transformer, source selector, energy meter, loads and display device. When there is a normal power from the solar PV cells, only residential loads are able to drive the energy with the help of source selector circuitry, in which all LEDs corresponding to relay1, relay2 and relay3 are in off condition. Same manner when there is an excessive power from the PV cells, relay2 and 3 are in on condition at this stage, energy can be sale to the grid utility system with the help of bidirectional energy meter. Similarly when PV cells are producing inefficient energy and this can be indicated by turning on the relay1 operation, at this stage consumer can take the energy from the grid. When the system is in proper working condition, consumer can never feel interruption in the power supply due to automatic switching actions

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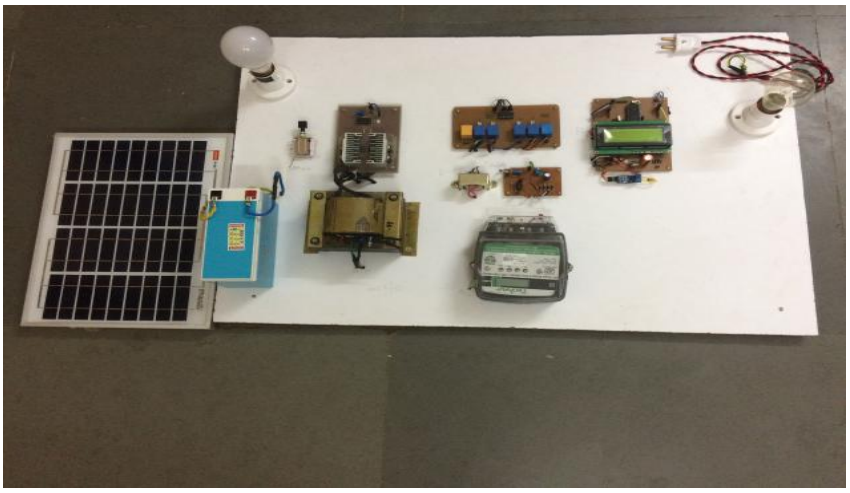

Fig. 3.1 Prototype model of a proposed system

IV. FLOW CHART

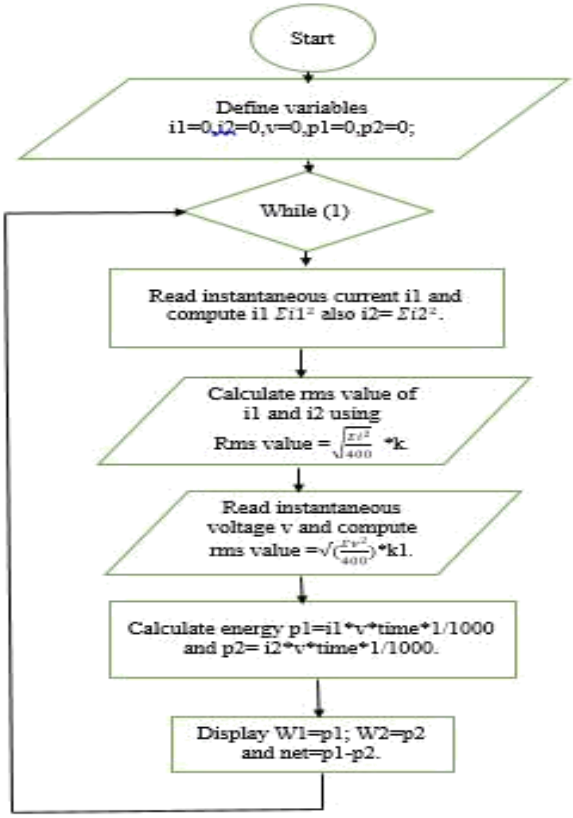

Fig. 4.1 Flow chart

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V. EXPERIMENTAL RESULT

The effective utilization of solar energy leads to the economical growth of the nation and also reduces the dependency on the fossil fuels. The designed model gave the expected outcome with respect to various parameters as mentioned earlier. The outcome of the model has been displayed as follows.

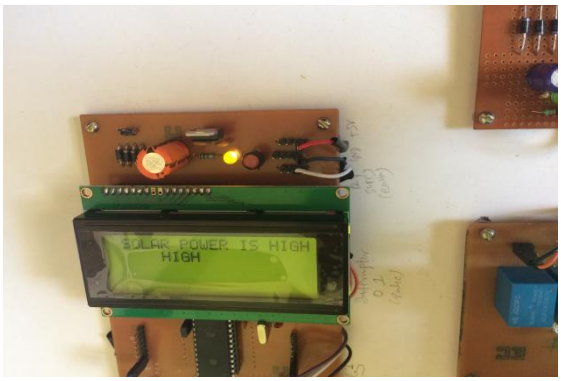

Fig. 5.1 Excessive Production

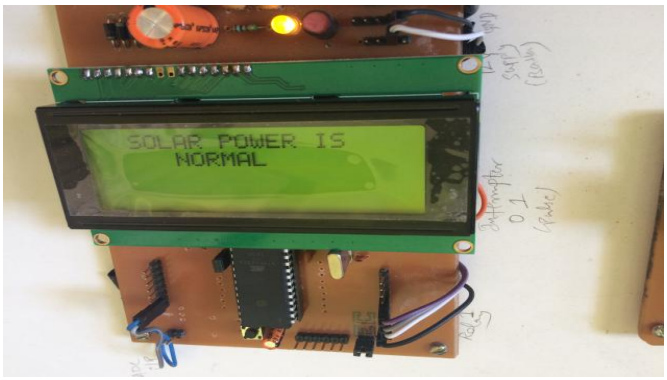

Fig : 5.2 Normal Production

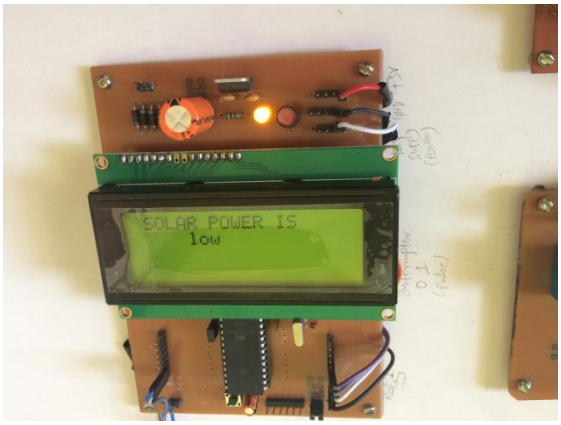

Fig. 5.3 Inadequate Production

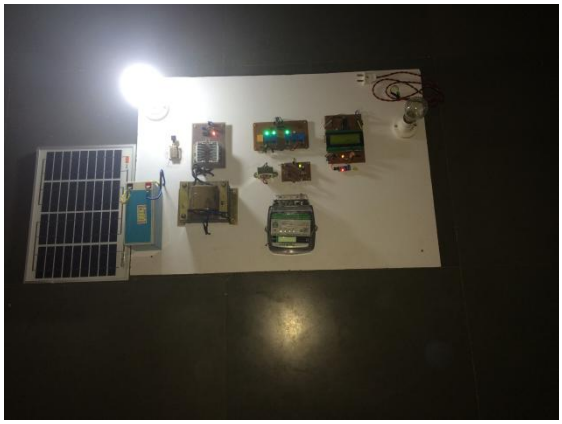

Fig. 5.4 PV cells driving an Residential Load

VI. CONCLUSION

The objective of our project is to design and fabricate the single phase grid connected PV cells with net metering. The objective of the project has been achieved with the help of Embedded C language, PCB express software, MATLAB simulation and Atmel studio 6.2. After debugging all the errors with respect to software part, team started analysis of hardware components and connectivity diagram. It has been analyzed that the net meter able to measure the power consumed by loads.

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AUTHOR'S BIOGRAPHY

BASAVARAJU S HADAPAD was born on 29th November 1991 in Bijapur district. He completed his engineering degree in electrical and Electronics Engineering at Shridevi Institute of Engg, and Technology, Tumkur in 2013 and his post graduation (Power and Energy Systems) at Basaveshwar Engineering College, Bagalkot in 2015. His interested field includes electric circuit analysis, transmission and distribution, Power system analysis. Currently he is working as Assistant Professor at Tontadarya College of Engineering, Gadag.

GIRIJAMMA was born on 24th November 1996 in Hutti Gold mines Raichur district. Presently pursuing Final year Electrical and Electronics Engineering in Tontadarya College of engineering Gadag Karnataka, India.

SOUJANYA P SALIMATH was born on 12th November 1994 in Gadag district.Presently pursuing Final year Electrical and Electronics Engineering in Tontadarya college of engineering Gadag Karnataka, India.

HIREMATADA HALASWAMY was born on 8th August 1994 in Bellary district U G Student, pursuing Final year Electrical and Electronics Engineering in Tontadarya college of engineering Gadag Karnataka, India.

OMPRAKASH JOGUR was born on 21st November 1990 in Bijapur district. Presently pursuing Final year Electrical and Electronics Engineering in Tontadarya college of engineering Gadag Karnataka, India