12V TO 220V SOLAR INVERTER WITH GSM BASED PUMP CONTROLLER

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Abstract: Now a day's many people using solar inverters these days which proves that its necessity has been increased in the current years. A Solar inverter is similar to a normal electric inverter but uses the energy of the Sun i.e. solar energy. A solar inverter helps in converting the direct current into alternate current with the help of solar power. Direct power is that power which runs in one direction inside the circuit and helps in supplying current when there is no electricity. Direct currents are used for small appliance like mobile e phones, MP3 players, IPod etc. where there is power stored in the form of battery. In case of alternative current it is the power that runs back and forth inside the circuit. The alternate power is generally used for house hold appliances. A solar inverter helps devices that run on DC power to run in AC power so that the user makes use of the AC power. If you are thinking why to use solar inverter instead of the normal electric one then it is because the solar one makes use of the solar energy which is available in abundant from the Sun and is clean and pollution free. Solar inverters are also called as photovoltaic solar inverters. These devices can help you save lot of money. The small-scale grid one have just two components i.e. the panels and inverter while the off grid systems are complicated and consists of batteries which allows users to use appliances during the night when there is no Sunlight available.

***Index Terms* – LCD, GSM Modem, MOS FETs, Arduino Uno.**

I. INTRODUCTION

A solar inverter is one of the most important elements of the solar electric power system. It converts the variable direct current (DC) output of a photovoltaic (PV) solar panel into alternating 240V current (AC). This AC electricity then can be fed into your home to operate your appliances. The electricity that is not used in your home is then either fed into the grid (electrical power lines) or into home battery storage. New hybrid inverters include an integrated battery management system. Long lasting solar power systems require a high quality inverter with a robust convection cooling system. Low quality inverters have unfortunately failed in the Australian climate.

A **micro-inverter** is a very small inverter that is attached to the back of a solar panel. A micro-inverter only converts the power of one or two solar panels to AC so generally many micro inverters are required in a single system. Micro-inverters have several advantages over string inverters including performance, safety and monitoring, however the upfront cost can be significantly greater. For more details about micro-inverters, check out our micro-inverters article. A new type of solar and battery inverter is now also available, known as an **all-in-one hybrid inverter**. It combines a solar inverter and inverter/charger into one simple unit. These inverters are a very economical way to enable what is known as 'self-use' or 'load shifting' of energy. Allowing you to store solar or off-peak energy to be used during peak times. Although it is important to know that some all-in-one inverters cannot function during a power outage such as when there is a blackout. They can also have limited functionality and monitoring capabilities.

Now a days there are many solar inverters which runs with the power provided by electricity. These inverters will runs with the power that is stored in he form of battery .Whenever the power or the current turns off then these batteries provide the current that was earlier stored in them. There will be many inverters exist in today's technology like stand alone inverters, grid tie inverters, battery backup inverters, and hybrid inverters.

A battery is a vital part of an inverter. The performance of an inverter largely depends on its battery. Regular care and maintenance of batteries keep them in good shape for a longer time period. An inverter unit has 3 components: a charger, a battery and an inverter. The charger is connected to the power supply and it charges the battery when the electricity is coming from the utility. A poor quality charger can destroy the battery faster than anything else. Use good quality chargers to increase life of battery. Based on these several factors the electrical inverter will work .The problem with these inverters is that they will work effectively until the power in the battery completely used. Once power that is stored in battery runs down then the inverter will not work properly.

II. LITERATURE SURVEY

From the late nineteenth century through the middle of the twentieth century, DC-to-AC power conversion was accomplished using rotary converters or motor-generator sets (M-G sets). In the early twentieth century, vacuum tubes and gas-filled tubes began to be used as switches in inverter circuits. The most widely used type of tube was the thyratron. The origins of electromechanical inverters explain the source of the term inverter. Early AC-to-DC converters used an induction or synchronous AC motor direct-connected to a generator (dynamo) so that the generator's commutates reversed its connections at exactly the right moments to produce DC. A later development is the synchronous converter, in which the motor and generator windings are combined into one armature, with slip rings at one end and a commutated at the other and only one field frame. The result with either is AC-in, DC-out. With an M-G set, the DC can be considered to be separately generated from the AC; with a synchronous converter, in a certain sense it can be considered to be "mechanically rectified AC". Given the right auxiliary and control equipment, an M-G set or rotary converter can be "run backwards", converting DC to AC. Hence an inverter is an inverted converter.

III. EXISTING SYSTEMS

3.1 STAND ALONE SOLAR INVERTER:

Used in isolated systems where the inverter draws its DC energy from batteries charged by photovoltaic arrays. Many stand-alone inverters also incorporate integral battery chargers to replenish the battery from an AC source, when available. Normally these do not interface in any way with the utility grid, and as such, are not required to have anti-islanding protection.

3.2 GRID TIE INVERTERS:

Which match phase with a utility-supplied sine wave. Grid-tie inverters are designed to shut down automatically upon loss of utility supply, for safety reasons. They do not provide backup power during utility outages.

Grid-tie inverters that are available on the market today use a number of different technologies. The inverters may use the newer high-frequency transformers, conventional low-frequency transformers, or no transformer. Instead of converting direct current directly to 120 or 240 volts AC, high-frequency transformers employ a computerized multi-step process that involves converting the power to high-frequency AC and then back to DC and then to the final AC output voltage.

Historically, there have been concerns about having transformer less electrical systems feed into the public utility grid. The concerns stem from the fact that there is a lack of galvanic isolation between the DC and AC circuits, which could allow the passage of dangerous DC faults to be transmitted to the AC side.[10] Since 2005, the NFPA's NEC allows transformer less (or non-galvanic ally) inverters. The VDE 0126-1-1 and IEC 6210 also have been amended to allow and define the safety mechanisms needed for such systems. Primarily, residual or ground current detection is used to detect possible fault conditions. Also isolation tests are performed to insure DC to AC separation.

3.3 BATTERY BACKUP INVERTERS:

Are special inverters which are designed to draw energy from a battery, manage the battery charge via an on board charger, and export excess energy to the utility grid? These inverters are capable of supplying AC energy to selected loads during a utility outage, and are required to have anti-islanding protection

3.4 INTELLIGENT HYBRID INVERTERS:

Manage photovoltaic array, battery storage and utility grid, which are all coupled directly to the unit. These modern all-in-one systems are usually highly versatile and can be used for grid-tie, stand-alone or backup applications but their primary function is self-consumption with the use of storage.

IV. PROPOSED SOLAR SYSTEM

The block diagram consists of LCD Module, GSM Modem, Arduino Uno, Relay Module, DC Pump, and Solar panel, charging circuit, voltage regulators and filter capacitors, 12v/7AH battery, oscillator circuit, mosfets, step up transformer, AC load. A solar inverter helps in converting the Direct current into batteries or alternative current. This helps people who use limited amount of electricity. The inverter circuit is built around IC CD4047 which is wired as astable multivibrator. The operating frequency of astable multivibrator is set to 50Hz.The power MOSFETs IRF540 are directly driven by the Q and Q' output of CD4047.The power MOSFETs are connected in Push Pull configuration (Power amplifier). The MOSFETs will switch according to the pulse from CD4047 astable multivibrator. Thus an AC voltage is transferred to the primary of transformer; it is stepped up to 230V. The proposed solar system block diagram is shown in Fig. 1.

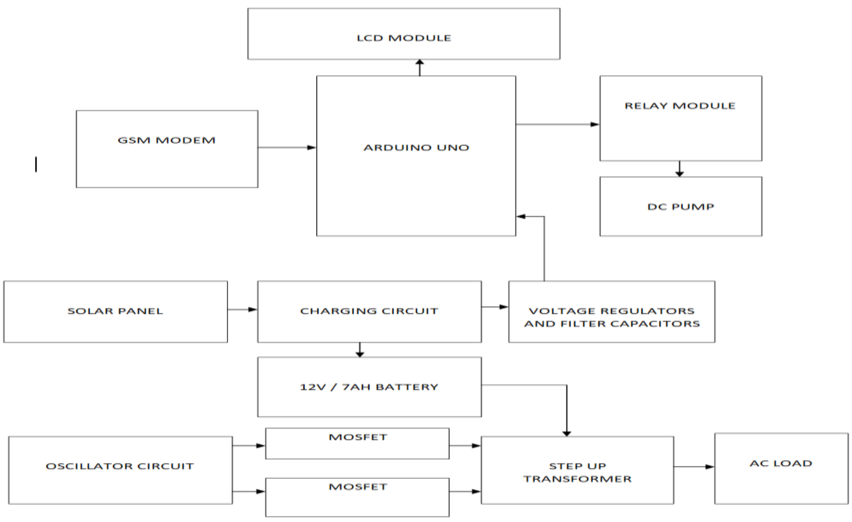

Fig. 1: Block diagram for solar inverter

The transformer used here is an ordinary step down transformer which is connected in inverted manner. That is, the primary of a 230V to 9V-0-9V step down transformer can be treated as secondary for this inverter project. If you would like to get 110V AC, choose 110V to 9V-0-9V step down transformer in reversed way. (That is primary as secondary and secondary as primary) Use suitable heat sinks for MOSFETs. This System is also Equipped with a GSM based Pump Control System. Arduino UNO Development board is used to design this System. GSM Modem 800 is used for GSM – SMS based Pump control System. LCD Module is used to Display the Status of Pump (On / off) action. To switch this pump on / OFF, user has to send a SMS to the control using. On receiving SMS from the User, Microcontroller unit validate the SMS and switches the Pump on/off according to predefined instructions. The power supply setup of the system contains a step down transformer of 230/12V, used to step down the voltage to 12VAC. To convert it to DC, a bridge rectifier is used. Capacitive filter is used to remove ripple from DC Supply. 7805 voltage regulator is used to regulate input voltage to +5V and 7812 is use to regulated input voltage to 12V DC.5V DC is used by LCD Module and 12V DC is used by Relay, Arduino UNO, DC Pump and Relay Module and Other Misc circuits.

Firstly, solar panels will extract the power from the sun and store it in dc current. To convert it to ac the stored power will be given to solar inverters, then this inverter will generate a square waveform. This will be given to IRF540 and the output of this will be given to setup transformer and thus the output of this setup transformer will be given to any load. Here a bulb is taken as load. This System is also Equipped with a GSM based Pump Control System. Arduino UNO Development board is used to design this System. GSM Modem 800 is used for GSM – SMS based Pump control System. LCD Module is used to Display the Status of Pump (On / off) action. To switch this pump on / OFF, user has to send a SMS to the control using. On receiving SMS from the User, Microcontroller unit validate the SMS and switches the Pump on/off according to predefined instructions.

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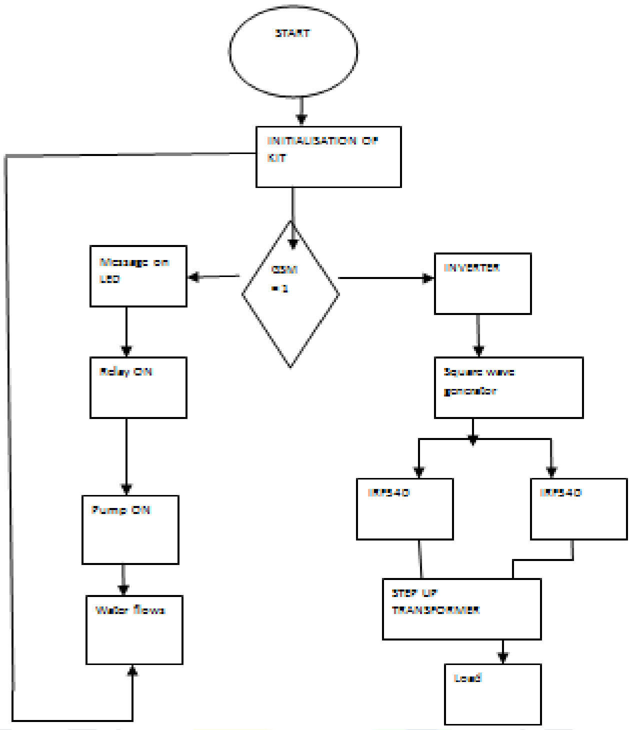

Fig. 2: Proposed solar system Flow chart

The Proposed solar system consists of different components is shown in Table 1.

Table 1 components used in Proposed Solar System

S.NO	COMPONENTS USED
1	12v solar panel
2	12v battery
3	Arduino uno
4	Lcd
5	Gsm modem
6	Voltage regulators
7	Setup transformers
8	Mosfet
9	Relay module
10	Dc pump
11	LM317
12	CD4047

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V. RESULTS AND DISCUSSION

This Project is designed as a 12V Portable and Compact Solar Inverter that will key away from darkness. A solar inverter, or PV inverter, or Solar converter, converts the variable direct current (DC) output of a photovoltaic (PV) solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid or used by a local, off-grid electrical network. This System is also Equipped with a GSM based Pump Control System. Arduino UNO Development board is used to design this System. GSM Modem 800 is used for GSM – SMS based Pump control System. LCD Module is used to Display the Status of Pump (On / off) action. To switch this pump on / OFF, user has to send a SMS to the control using. On receiving SMS from the User, Microcontroller unit validate the SMS and switches the Pump on/off according to predefined instructions. Proposed solar system output is shown in Fig. 3.

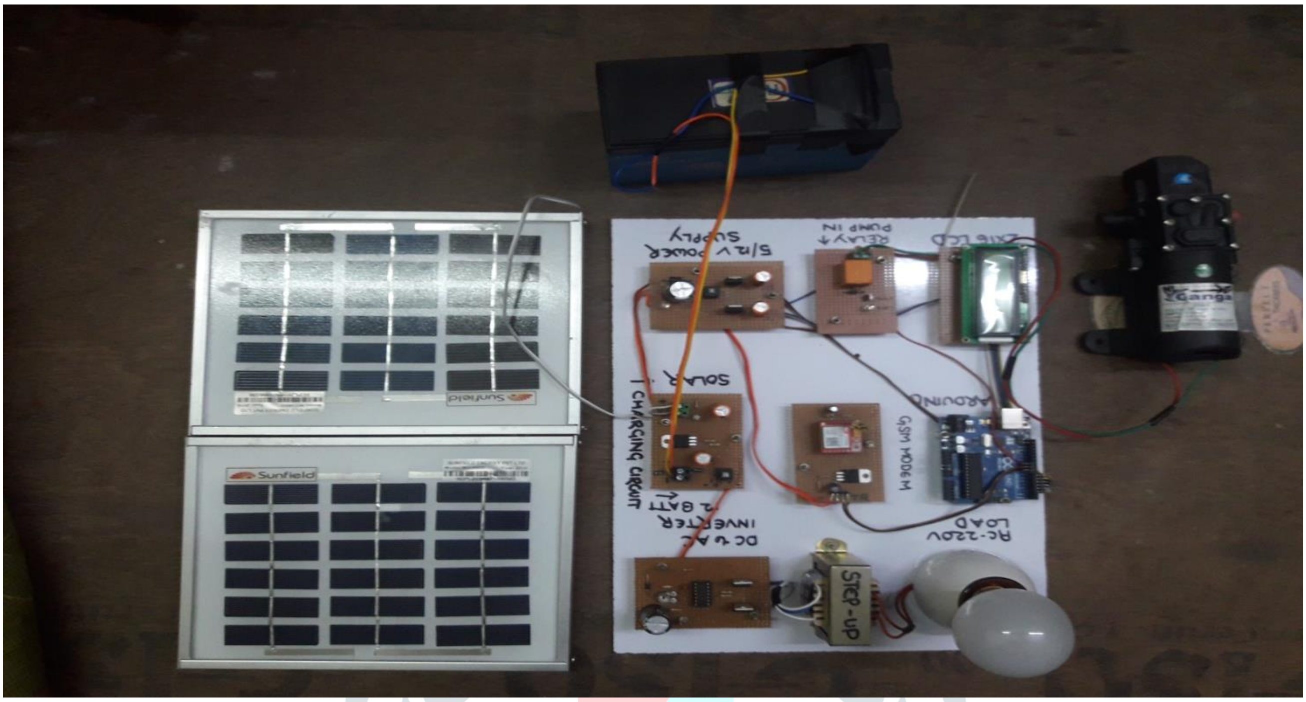

Fig. 3 Proposed solar system output

An inverter can produce a square wave, modified sine wave, pulsed sine wave, pulse width modulated wave (PWM) or sine wave depending on circuit design. The two dominant commercialized waveform types of inverters as of 2007 are modified sine wave and sine wave. There are two basic designs for producing household plug-in voltage from a lower-voltage DC source, the first of which uses a switching boost converter to produce a higher-voltage DC and then converts to AC. The second method converts DC to AC at battery level and uses a line-frequency transformer to create the output voltage.

This is one of the simplest waveforms an inverter design can produce and is useful for some applications. A power inverter device which produces a multiple step sinusoidal AC waveform is referred to as asine wave inverter. To more clearly distinguish the inverters with outputs of much less distortion than the "modified sine wave" (three step) inverter designs, the manufacturers often use the phrase pure sine wave inverter. Almost all consumer grade inverters that are sold as a "pure sine wave inverter" do not produce a smooth sine output at all, just a less choppy output than the square wave (one step) and modified sine wave (three step) inverters. In this sense, the phrases "Pure sine wave" or "sine wave inverter" are misleading to the consume However, this is not critical for most electronics as they deal with the output quite well. The AC output frequency of a power inverter device is usually the same as standard power line frequency, 50 or 60 hertz If the output of the device or circuit is to be further conditioned (for example stepped up) then the frequency may be much higher for good transformer efficiency.

The AC output voltage of a power inverter device is often the same as the standard power line voltage, such as household 120 VAC or 240 VAC. This allows the inverter to power numerous types of equipment designed to operate off the standard line power. The designed-for output voltage is often provided as a regulated output. That is, changes in the load the inverter is driving will not result in an output voltage change from the inverter. In a sophisticated inverter, the output voltage may be selectable or even continuously variable. A power inverter will often have an overall power rating expressed in watts or kilowatts. This describes the power that will be available to the device the inverter is driving and, indirectly, the power that will be needed from the DC source. Smaller popular consumer and commercial devices designed to mimic line power typically range from 150 to 3000 watts. Not all inverter applications are solely or primarily concerned with power delivery; in some cases the frequency and or waveform properties are used by the follow-on circuit or device. Mainly the proposed solar system used in:

1. DC/DC boost converter.
2. Module inverter.
3. String inverter.
4. used in solar heaters and solar coolers.

VI. CONCLUSION

Solar inverters are also called as photovoltaic solar inverters. These devices can help you save lot of money. The small-scale grid one have just two components i.e. the panels and inverter while the off grid systems are complicated and consists of batteries which allows users to use appliances during the night when there is no Sunlight available. This Project is designed as a 12V Portable and Compact Solar Inverter that will key away from darkness. A solar inverter, or PV inverter, or Solar converter, converts the variable direct current (DC) output of a photovoltaic (PV) solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid or used by a local, off-grid electrical network. In this proposed system, we have designed a Advance Solar Inverter using AVR Microcontroller and Inverter Circuit. This inverter Circuit converts 12V DC to 220V AC using Switching MOSFET and CD4047 IC. In this Project Variable voltage of DC is taken through 12V Solar Panel. This Voltage is given to the Charging Circuit using LM317; Output from LM317 is adjusted to 12V and given to 12V/7Ah Battery. Charged Battery Voltage is given to the Inverted Circuit. Inverter circuit consists of an Astable Oscillator (CD4047). This IC Produces a Complementary Square Wave at Pin 10 and 11. Power MOSFETs T1 and T2 are connected to output of CD4047 and it serve as drivers for the high-voltage generator, realized using step-up transformer. Here 9-0-9 Step down Transformer is connected in Reverse. Output from Transformer is 230V which is connected to any AC Load (Bulb).

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