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Solar Battery Charger with Hybrid Inverter

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Abstract-— **A solar battery charger with hybrid inverter is proposed that helps in reduction of the electricity bill i.e., reduction in consumption of electricity from mains. And also decreases the usage of electricity from grids. This project could be switched up in 2 ways that is firstly from solar and secondly from mains. The main purpose of this project is to utilize renewable energy (solar energy) as much as possible. By using mains energy we get more electricity bill in order to reduce this problem this project has introducing solar panels. Load shall be driven by solar or directly from mains. To make decision to drive the load Arduino Uno is used.**

Keywords - Arduino Uno, Mains, Grid, Renewable energy.

INTRODUCTION

In recent days everyone is moving towards the use of uninterrupted power supply (UPS) devices as there is a need for continuous power supply on a 24×7 basis [1]. Suppose if there is an interruption in power supply to load where no chance of saving a work, then complete work has to be done again from the initial state and it consumes more power again and there are chances of damaging the load. The project is to overcome these disadvantages using solar energy and hybrid inverters to provide uninterrupted power supply. Hybrid inverters are used not only to provide backup for loads, but also to reduce the consumption of electricity from main power supply point. Most are skeptical on how the consumption of electricity will be reduced. The answer for the above question is by usage of hybrid inverter. The input for inverter is either from solar or from battery. Arduino uno is used in order to choose the input for inverter. Always consider solar as first priority because it extracts as much as possible solar renewable energy. If solar is not available then inverter takes input from battery. If both solar and battery are not available then load can be driven directly from mains.

On earth there are many types of renewable energy in that solar energy was widely used now a day. Solar energy can be absorbed or extracted using photovoltaic cell. Solar cells convert sunlight in to DC electrical energy. This energy can be used for many devices such as small home application devices, battery charger etc. This project has level of battery charge indicators to display for users about the battery charge. Advantage of using solar powered battery charger was economical and cheapest form of rechargeable batteries [3].

Solar Hybrid inverters (Power Conditioning Unit) can help at homes in many ways. If power failure occurs then inverter will help to remain as unaffected in any events. There are different sizes of inverters are there. Inverter can be used for cutting the cost of daily energy consumption. Ideal usage of inverters in schools, homes, hospitals, shops, banks, industries and so on. Usually panels are larger in size in order to drive bigger loads. Inverter will act as backup if power failure happens and also drive the entire load whole night but battery contains enough charge. When battery gets fully charged then mains supply will be disconnected automatically then inverter drives the load hence electricity can be saved.

BLOCK DIAGRAM

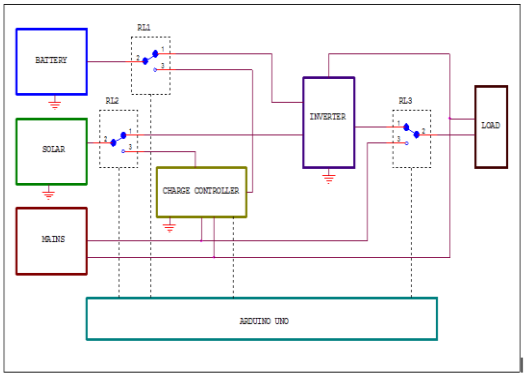

Figure 1: Block diagram of hybrid inverter with solar battery charger.

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In the above shown figure 1, input for inverter is either from battery or from solar. Choosing the input for inverter can be done using relays. Selection can be done based on voltages available in battery and solar. To know the voltages, voltage can be sensed by using arduino uno microcontroller. Charge controller will choose the highest voltage and make the relay to enable the highest voltage device. Inverter will take the highest dc voltage and convert in to ac voltage. Inverter used here is 12V DC to 220V AC. If both battery and solar voltages are not available to inverter then load can be directly driven from mains power supply.

CIRCUIT DIAGRAM

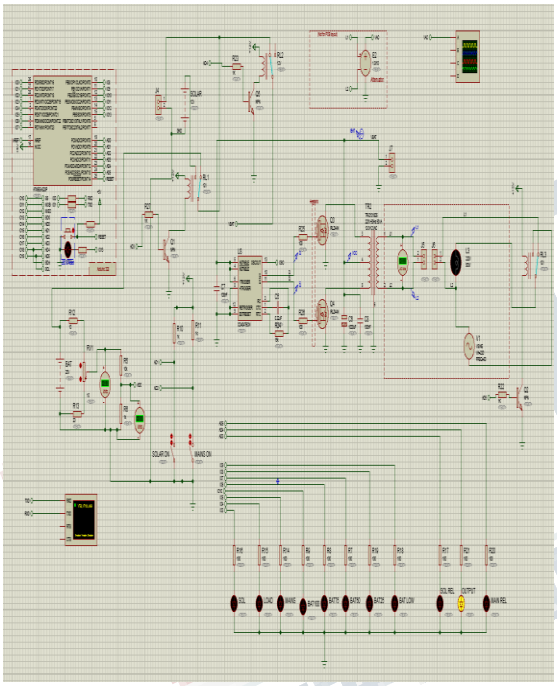

Figure 2: Circuit diagram of hybrid inverter with solar battery charger.

Working

- Initially Arduino sense the voltage in both battery and solar.
- After sensing both the voltages, arduino will decide the high voltage.
- To make this decision some program has written.
- That high voltage will be the input for inverter.
- And inverter converts the dc to ac voltage.
- By using this ac voltage we can drive the load.

A voltage sensor is a sensor is used to calculate and monitor the amount of voltage in an object. Voltage sensors can determine both AC and DC voltage level. In voltage sensors, the measurement is based on a voltage divider.

The Circuit Diagram shown above is the tested 12V DC to 220V AC Inverter Circuit. It uses 2 power IRLZ44N MOSFETs for driving the output power and the CD4047BCN IC as an astable multivibrator operating at a frequency of around 50 Hz.

The 10 and 11 pin outputs of the IC directly drive power MOSFETs that are used in push-pull configuration. Use suitable heat-sinks for MOSFETs as it will produce a huge amount of heat. The output transformer has a 12V-0-12V, 1 Amps on the secondary and 220V on the primary.

Below truth table will explain the complete working of the project.

Working of the project.

INPUT			OUTPUT		
SOLAR	MAINS	BATTERY	SOLREL	LOAD	MAINREL
1	1	>14.2	0	1	0
1	1	<14.2	0	0	1
0	1	>14.2	0	0	1
0	1	<14.2	0	0	1
1	0	>14.2	1	1	0
1	0	<14.2	1	0	0
0	0	>14.2	0	1	0
0	0	<14.2	0	1	0
0	0	<10.8	0	0	0

Table 3.1: Truth Table for Output.

Solar, mains and battery are the three power sources. Solar relay, mains relay and load are the output leds. These leds will indicate the output. In first case solar, mains and battery all are available then inverter will turn on the load by using battery voltage. Here battery voltage is greater than 14.2V. In this condition both solar relay and mains relay are off. In second case, both solar and mains are available but battery voltage is less than 14.2V. In this case inverter will is off but load is turned on by mains power supply. In third case, solar is not available means during night condition or cloudy condition and mains power supply is available. In this case load will be directly driven from mains and so on. In last condition both solar and mains are not available and also battery voltage is less than 10.8V. In this case only load cannot be turned on. Because to drive the load either battery has minimum voltage or mains is available. Battery is charged from solar panel but solar is not available because night or cloudy condition.

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SIMULATION RESULTS

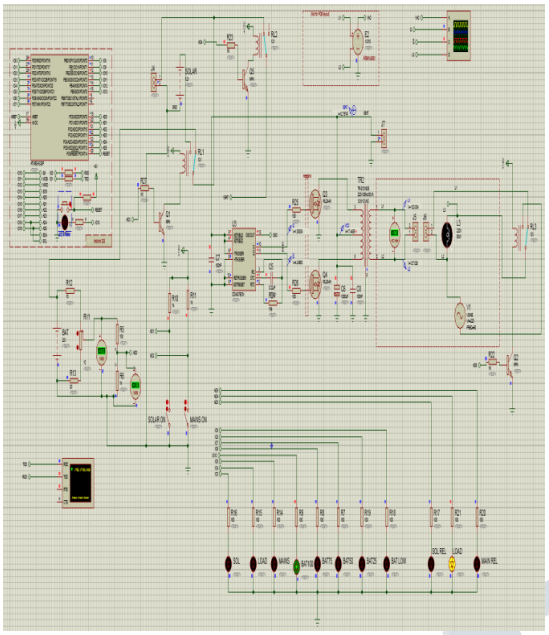

Figure 3: LED indication of battery voltage is 100%.

Figure 3a: 240V square wave output near the load.

In the above shown figure 3a, battery voltage is above 14.2V that is battery is in fully charged condition by using solar panels for charging purpose. So inverter will be turned on to drive the load using fully charged battery. Inverter is converting 12V dc to 220V ac. Here load is 220V 50W bulb and getting output voltage more than expected value. Expected output value is 220V but obtaining 245V near bulb.

Channel B and channel C represents the output from pin 10 and pin 11 from IC CD4047BCN that is Q and ~Q. Channel D is the output across the bulb. Not possible to get pure sine wave from inverter output and it is clearly visible in the above shown figure. This project drives the ac load using dc voltage.

In this project 12V lead acid battery is used so for this battery 14.2V is the charge cut off voltage. So considering 14.2V is the maximum voltage for writing the program in proteus.

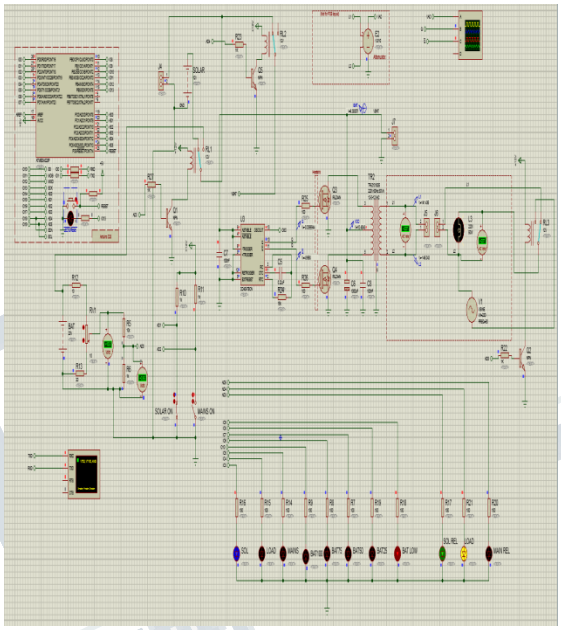

Figure 4: LED indication of battery voltage is low and solar switch is enable.

Figure 4a: 200V square wave output near the load.

In the above shown figure 4a, battery voltage is below 10.5V means battery is discharged. So to charge the battery solar switch should be ON. If this SOLAR ON switch is pressed, relay RL1 will change its path from

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battery to solar path. Nearly 200V AC is getting using 12V solar panel. Channel B and channel C are the outputs from pin 10 and pin 11 from IC CD4047BCN that is Q and ~Q. Channel D is the output across the bulb. Not possible to get pure sine wave from inverter output and it is clearly visible in the above shown figure.

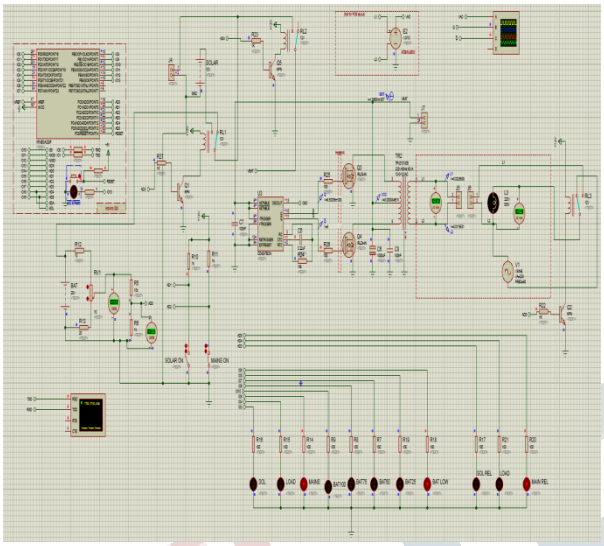

Figure 5: LED indication of battery voltage is low and mains switch is enable.

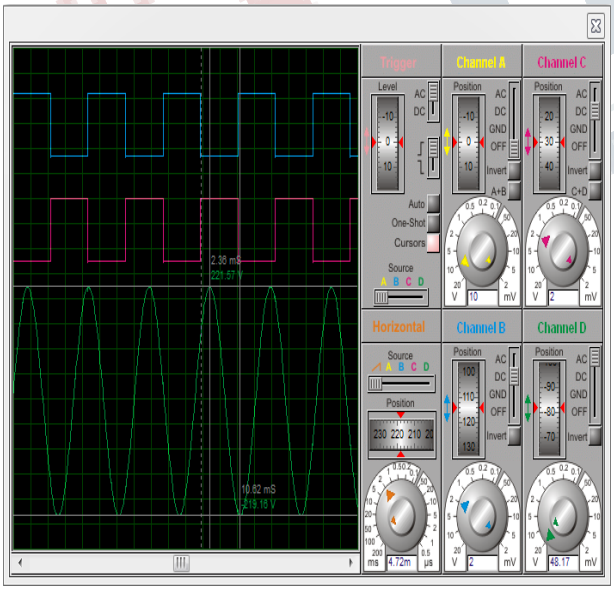

Figure 5a: 220V pure sine wave across the load.

In the above shown figure 5a, battery voltage is below 10.5V means battery is discharged. In this case solar energy also not available due to night or cloudy weather. During this condition mains switch will be turned on. If mains switch will be pressed then inverter will be in off state. This can be observe through relay RL2. And relay RL3 will change its path from inverter to mains. Channel B and channel C are the outputs from pin 10 and pin 11 from IC CD4047BCN that is Q and ~Q. Channel D is the output across the bulb. Here 220V AC is getting across the bulb as shown in channel D.

CONCLUSION

Solar battery charger with hybrid inverter is the emerging technology in industries. The main objective of this project is to reduce the electricity usage from mains. So that automatically electricity bill amount will be less. This can be done by using renewable sources. In this project there are three sources they are battery, solar and mains. If the input source for inverter is from battery, nearly 240V square wave output is obtaining near the load. If the input source for inverter is from solar, nearly 240V square wave output is obtaining near the load. If the input source is directly from mains, 220V sine wave output is obtaining near the load. The simulation of this project is done in proteus software. The future work includes switching the input sources can be done automatically. And also obtain the inverter output as pure sine wave.

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