Introduction:

This project emphasis on DC to AC power inverters aimed at simply and effectively transforming a DC power source into a high voltage AC output comparable to a power that would be accessible at an electrical wall outlet. Inverters are used for many applications as in circumstances where low voltage DC sources such as batteries, solar panels or fuel cells must be converted, so that devices can run off of AC power. A perfect example is the converting of electrical power in a battery to run a laptop, TV set or a cell phone.

Low voltage DC conversion is completed in two stages. The first being the conversion of the low voltage DC power to a high voltage DC source and consequently converting the high voltage DC source to an AC wave form using pulse-width modulation (PWM). Another method of completing the desired outcome would be to first convert a low voltage DC power to AC and then using a transformer to boost the voltage to 240V. This project concentrated on the second method described and specifically transforming a low DC source into an AC output.

They are different DC to AC inverters, but basically we have two different forms of DC output generated; modified and pure sine wave. A modified sine wave can be seen as more of square wave than a sine wave; it passes the high voltage DC for specified amount of time so that the average output power and Root Mean Square (RMS) voltage are the same as if it were a sine wave. These types of inverters are much cheaper than pure sine wave inverters and therefore are attractive alternatives.

Pure sine wave inverters on the other hand produce a sine wave output identical to the power coming out of an electrical outlet. These devices are able to run more sensitive devices such as laser printers, laptop, computers, digital clocks and medical equipment.

In this project work though we are building or contracting one of the dc/ac inverters on our own with reference to the already existed once, we would also like to write something small about those in the market .(Types of inverters ,applications, and operations).

AIMS OF THE PROJECT

This project aims is to design and construct a quite simple, efficient and low cost inverter with high output capabilities to power some selected domestic appliances such lighting system, small fan.

Our projects consists of three parts.

1) Converting and storing solar energy into a dc battery.
2) Converting the stored dc into ac in the output side.
3) Using this ac output to drive up to 30 watt ac load

EQUIPMENTS AND COMPONENTS USED FOR THE CONTSRUCTION

EQUIPMENTS

- Pair of pliers
- Soldering iron
- Multimeter
- Side cutter
- Soldering lead
- Connecting cables
- oscilloscope

COMPONENTS

- Resistor
- Mosfet (IRFP250)
- Opto coupler (TLP 250)
- Capacitors (100u/50v)
- Diode
- Fuse (2A)
- Transformer
- Arduino Uno R3
- Mail Rail
- Fuse Holder

Generating dc voltage from solar energy:

A solar cell converts light directly into electricity using the “Photovoltaic Effect”. There is no fuel, steam or thermodynamics involved. When light hits a solar cell, it instantly produces electricity. Solar cells today do not store electricity. In other words, when the light is taken away from the cell, it stops producing electricity. It is very common to store the electricity from a solar cell in a battery.

You can store electricity generated from a solar panel in a battery such as a typical car battery or you could use a Deep Cycle battery for more storage capacity. Typical car batteries are not recommended for use in solar power systems. They have a very small range of operating voltage and if discharged too deeply, the battery will be irreparably damaged.. If you are using a large solar panel to charge your battery, it would be wise to purchase a charge controller to regulate the current flow.

DC to AC conversion:

To drive the load we will need 240 V AC output.

There are two ways to invert a 20V DC input to a 220V AC output.

- One method is first creating a sine wave output of 24V amplitude and then stepping up the sinusoidal 20 V peak voltage to the desired output using an iron core transformer.

- The second method is first stepping up the DC voltage to $220 \times \sqrt{2} = 311\ V$ DC and then inverting this DC voltage to sinusoidal output voltage.

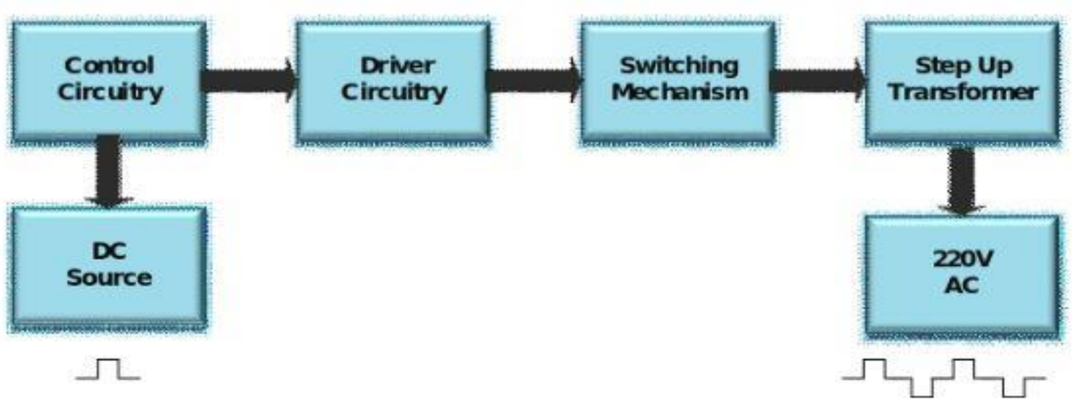
The power loss in iron core transformers is much larger than the power loss in ferrite core transformer (used in DC-DC converter). But if we chose the second method, we would need to make a boost converter and then an inverter. So, to avoid complexity we had chosen the first method.

We converted the dc input to ac output using H bridge inverter. Then we used step up transformer to create 240 AC output.

H bridge inverter assembly and working principles:

The circuit used for the projects has to basic parts:

1. Driver circuit
2. Main circuit

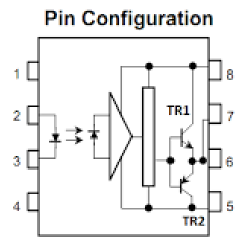


Driver circuit:

Driver circuit generates gate pulses for the h bridge. We use Arduino for creating 5V- 0V pulse. And then we used opto coupler to generate 12 V pulse and isolate gate of Arduino from main circuit. Components used in this circuit are,

1. **Opto coupler:**

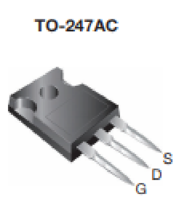
   an electronic component that transfers electrical signals between two isolated circuits by using light Opto-isolators prevent high voltages from affecting the system receiving the signal

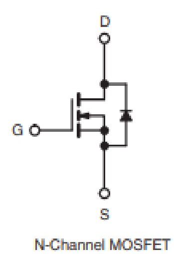


2. **resistor**: 200 Ω, 10 kΩ
3. **capacitors:** 100 uC (type: electrolyte), 10 nC (type: ceramic)
4. **Arduino Uno**:
   Arduino uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.
   Pin 13 of Arduino generates a square wave with 50% duty cycle.

5.IRFP 250 Mosfet:

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.





Bootstrap mechanism:

The figure 2 shows a pair of gate driver opto couplers driving the Mosfets. The bootstrap circuit consists of a capacitor, a diode, and a surge limiting resistor, and it is utilized to supply the necessary power to the gate drivers which in turn drives the high-side Mosfets.

When the high-side Mosfet is turned off and the low-side Mosfet is turned on, the power source, V_{SOURCE}, charges capacitor, through R and D. The C charge subsequently acts as a power source to the gate driver optocoupler, and drives the high-side Moafet via the discharge current path.

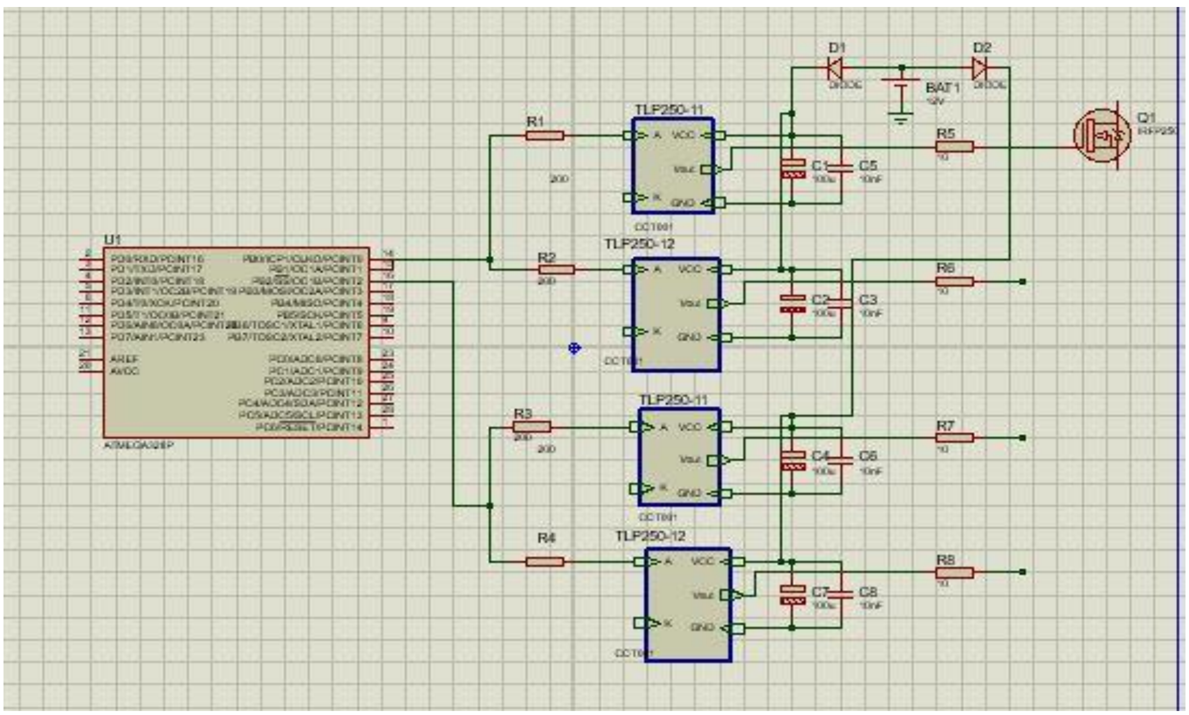


Figure: circuit diagram of driver circuit (proteus simulation)

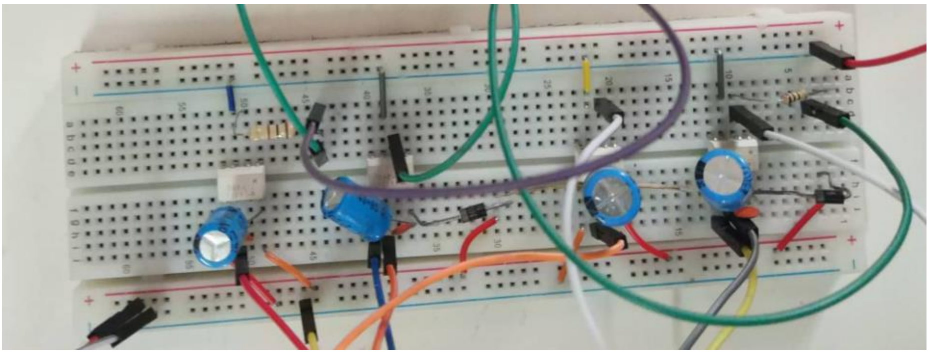


Figure: hardware implementation of driver circuit

1. ***Reason why R10 is used:***
   Here a resistance R10 is used for safety as 5 volt input square wave is act as a pulse to drive the opto coupler.It also reduce the noise as noise destruct the square wave.

2. ***Reason why Diode is used:***

D3 is used in high side opto coupler and the diode prevent from 12 volt input supply to get into the opto coupler circuit and ensures safety as output grounds are shorted from H bridge to opto coupler.

3. ***Reason why Capacitor is used:***

We used two capacitor

1.Ceremic capacitor

2.Polar capactor

- Ceramic capacitor is used for cancel the noise that is produced by the opto coupler.
- Ploar capacitor is used for ensure 12v pulse that is act as output signal of opto coupler.

// Arduino Code for generating pulse

```
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
  pinMode(11, OUTPUT);
  }
void loop() {
  digitalWrite(13,HIGH);
  digitalWrite(11,LOW);
  delay(9.5);
  digitalWrite(13,LOW);
  digitalWrite(11,LOW);
  delay(.5);
  digitalWrite(11,HIGH);
  digitalWrite(13,LOW);
  delay(9.5);
  digitalWrite(11,LOW);
  digitalWrite(13,LOW);
  delay(.5);
 }
```

H bridge inverter:

For the construction of H Bridge we used following components:

1. Mosfets (IRFP250)
2. P-N junction diode
3. Capacitors

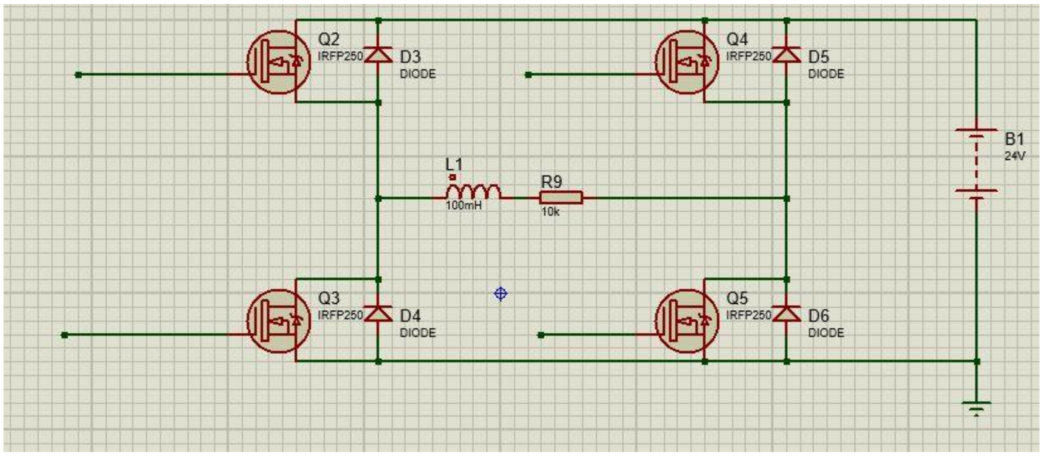


Figure: Circuit diagram of H bridge

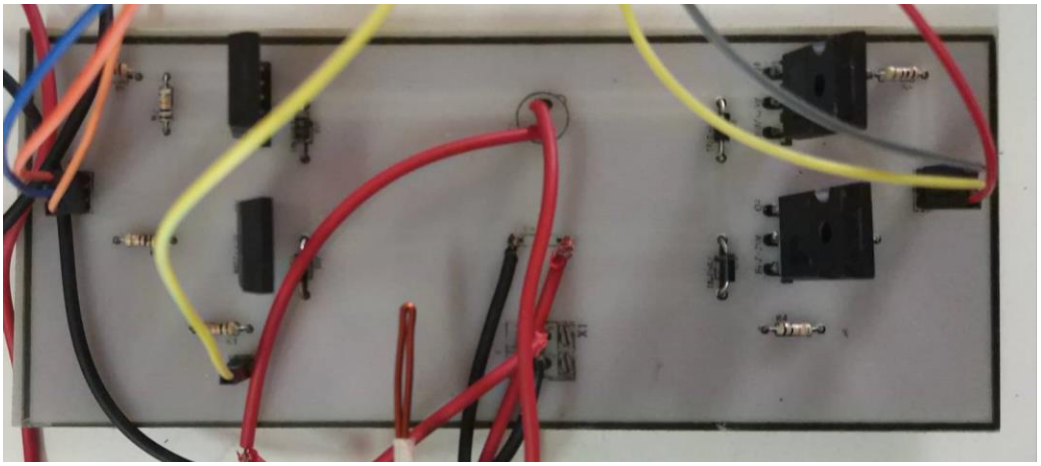
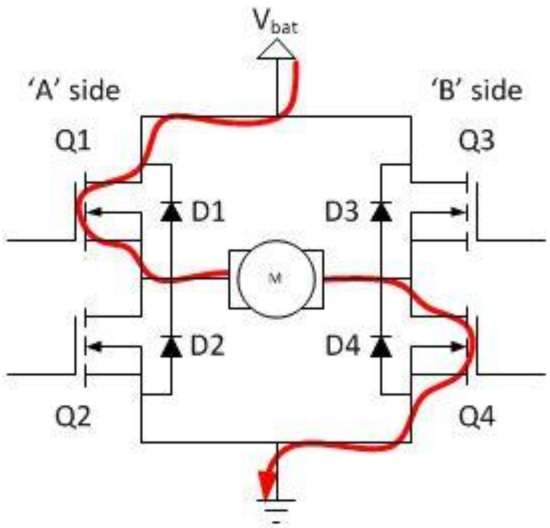


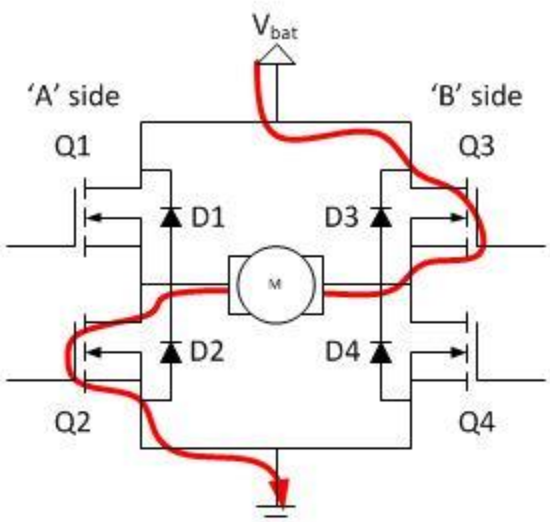
Figure: hardware implementation of the h bridge circuit

Basic Operation of H bridge:

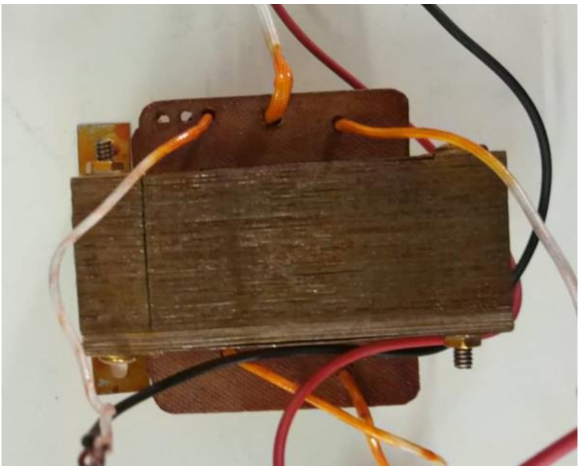
The basic operating mode of an H-bridge is fairly simple: if Q1 and Q4 are turned on, the left lead of the load will be connected to the power supply, while the right lead is connected to ground. Current starts flowing through the load.



If Q2 and Q3 are turned on, the reverse will happen Current starts flowing through the load reverse direction.



And finally we used 20:230 transformer to step up 20 V AC into 230 V AC. current at the input side had some had some dc component. So to avoid the saturation of the transformer we tried to keep the frequency as high as possible. Frequency used for this experiment is 10K hz.



24-230 volt ac-ac transformer (3 Amp)

Result analysis:

We have successfully operate a bulb of 30w with 230volt AC supply.

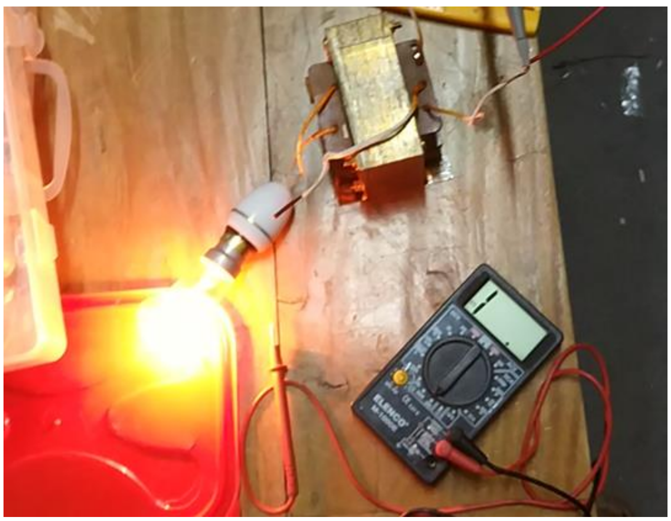


Figure1:*30 watt 230 volt Bulb at the end of our output*

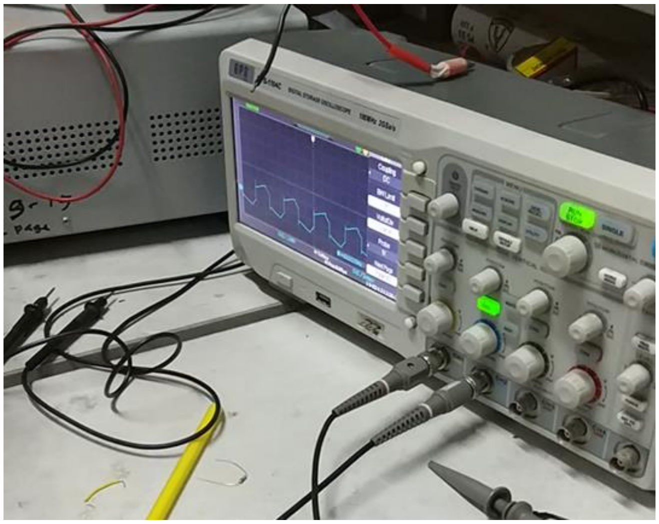


Figure2:*Wave shape we have got from our Project*.

Conclusion

In conclusion, the inverter was able to convert an input voltage of 24V DC source into an output voltage of 220V AC power supply and a frequency of 50Hz and it can now be use to power electrical appliances rated 30W depending on the capacity of the battery and can also reduce family spending on energy utilization because of its non-fuel consumption, low price and maintenance cost as compared to the other sources of power supply in the market but it cannot be used on three-phase machines, domestic appliances with voltages above 240V and below 220V, and devices with 60Hz frequency.