SINGLE PHASE INVERTER FOR INDUCTION MOTOR CONTROL- A PROPOSAL

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ABSTRACT: *Normally, speed control of induction motor is easier by the use of microcontroller and semiconductor devices. In this paper, we had designed a single phase inverter in which pulse width modulation (pwm) signals are given to it using Arduino controller. The firing pulses that are given to power semiconductor devices (i.e., MOSFETs here) are supplied by Arduino uno. The amplification of signals from Arduino is done by Driver board. This Single phase inverter can be used for many purposes like speed control of Induction motor and in some medical purposes (e.g. square wave therapy) by using its square wave output. The main advantages of this project are, it can be an energy efficient way of changing voltage, can step voltage up or down and can provide electrical isolation between input and output.*

Keywords: *Single-phase inverter, Induction motor speed control, Arduino uno, MOSFET (Metal Oxide Semiconductor Field Effect Transistor).*

1. INTRODUCTION

Technology advancement in both industrial and home appliances will not be separated from the use of AC power. AC power is the most important requirement to powerise all household electronic devices. The use of AC power is widely used by people in Indonesia. It happens because Alternating Current electricity is a type which firstly emerged in Indonesia at that time. To meet the needs of the AC electricity, the government made a program of built power plants throughout Indonesia. AC-type electricity can be generated through DC (Direct Current) power. The stages to obtain AC power from generating using DC electricity which use a reversing system of the pole of the DC electrical output which connected to the load is called as an inverter. Inverter is a device that can convert alternating voltages into direct voltages with adjustable frequency and level of voltage (Rashid, 1993). The inverter circuit consists of three parts, the first part of a circuit formed from the converter circuit which converts the alternating voltage source of the mesh into a direct voltage and eliminates the ripple at direct voltage output. The second part is a circuit of inverters that convert a direct voltage into a one-phase alternating voltage phase with the various frequencies. These two circuits are called the main circuit. The third part is a control circuit which functioned as the main circuit controller. The overall combination of the circuit is called an inverter unit. In Inverters, we have Single-phase and Three-phase in which three-phase inverters is generally used for many purposes. Since, Industries need more power and single phase inverters are not capable of supplying huge power they are used for small power applications such as speed control of induction motors etc. So, we had designed this project with the purpose of controlling the speed of an Induction motor by changing its output frequency. Output of our project is a square wave to which by adding a suitable filter pure AC wave is obtained which can be used for speed controlling. Square wave also has many other applications.

2. BASIC PRINCIPLE OF INVERTER

As we all know, Inverter is a power electronic device that converts Direct current (DC) to Alternating Current (AC). We have Single-phase inverters and three phase inverters in which single-phase inverters need four power electronic switches and three-phase needs six. Since ours is a single-phase inverter we have used four MOSFETs as switches. Here, we have used MOSFETs only as switches so as to control the frequency since MOSFETs hold good for frequency applications whereas IGBT (Insulated Gate Bipolar junction Transistor) holds good for high current applications. By taking pure DC from the rectifier, with the help of switches that perform switching action, Direct current is converted into Alternating current which is the function of an Inverter and working would be explained better in the further sections.

3. COMPONENTS USED

1. Transformer: As we cannot give 230V AC supply directly to the kit, Transformer can be used to step down the voltage here.

2. Bridge Rectifier: Converts stepped down AC voltage from the Transformer to DC which is fed to the inverter.

3. Capacitor: A 63V, 1000uf Capacitor is used in the circuit which filters the DC voltage from the rectifier.

4. MOSFET: The circuit consists of 4 IRF840B MOSFETs used for switching action. Drain current = 8A and Drain-Source voltage = 500V

5. Arduino Uno: Arduino Uno is an open source microcontroller board based on microchip ATmega328P microcontroller and developed by Arduino c.c. It is used to generate the PWM pulses for the Inverter circuit.

6. TLP250 Driver board: It is a 4 Opto-Isolated Gate drive used to isolate and amplify the input signals from the Arduino controller.

4. BLOCK DIAGRAM & CIRCUIT DIAGRAM

Block Diagram:

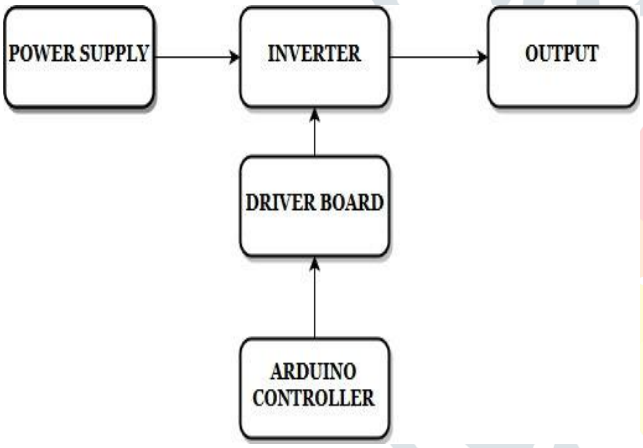

Fig1. block diagram of single-phase inverter

Circuit Diagram:

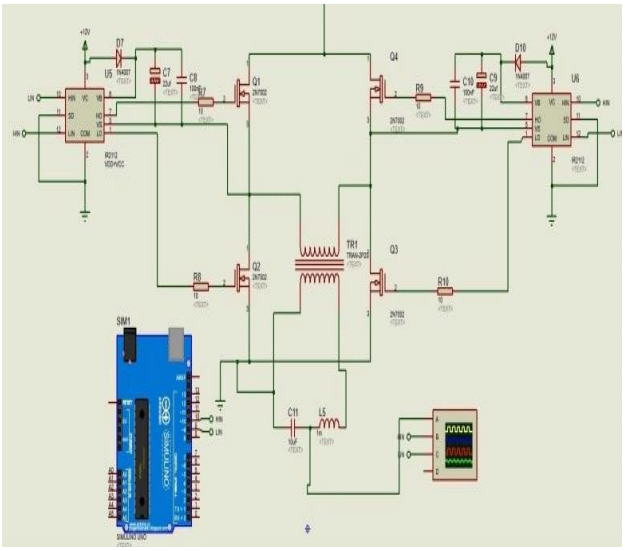

Fig.2 Circuit diagram of single phase inverter

5. WORKING

The AC drive system consists of a supply unit, rectification block, gate driver block and inverter unit. Single phase 230V AC supply from the mains is stepped down to 12VAC using a 5-tapping transformer. Now, using a Bridge Rectifier AC is converted to DC which is supplied to the Inverter circuit. Ripples are eliminated to obtain pure DC using capacitor as filter. The gate pulses are given to the Inverter circuit using a Microcontroller, Arduino UNO. The input signals of the Arduino are amplified and isolated by the Driver circuit. By the switching action of MOSFETs DC is converted to AC which is a square wave. The obtained square wave is used for many applications.

6. RESULTS AND ANALYSIS

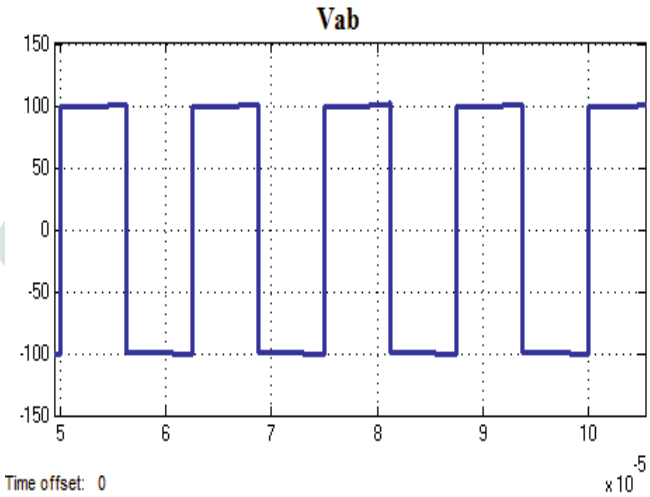

Fig.3 Output of single phase Inverter without filter

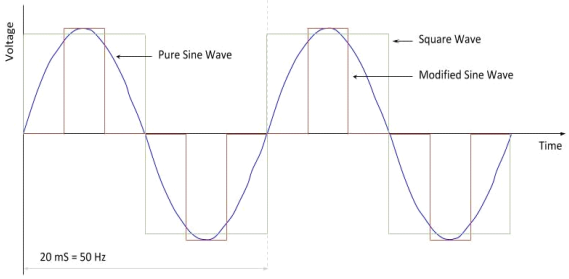

Fig.4 Output of single phase Inverter with filter

PICTURE OF THE PROJECT

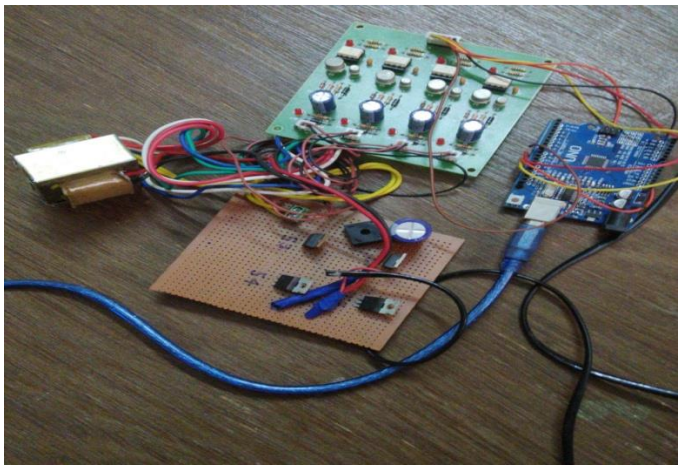

Fig.5 single phase inverter using Arduino

7. ADVANTAGES & APPLICATIONS

Advantages:

1. Simple circuit and low cost.
2. Can be an energy efficient way of changing voltage.
3. Can step voltage up or down.
4. Can provide electrical isolation between input and output.
5. Can provide an AC voltage from a DC source.
6. Can smooth out random variations in input voltage.
7. Can be used to produce 50 Hz from a 60 Hz supply or vice versa.

Applications:

1. It can be used to control the speed of an Induction motor using its output frequency.
2. It is used for Induction heating by varying its voltage.
3. It can be used in simple TRIAC applications.

8. FUTURE SCOPE

Along with the speed controlling of Induction motor, single phase inverter can be used to control the speed of electric vehicles in future. Due to the less number of resources available, usage of electric vehicles has already come into existence in foreign countries and that may be implemented in India also. So, designing large number of inverters is necessary. On the other end, square wave generated from the inverter has many applications in medical field (square wave therapy). For example**,** in methods and apparatuses for control of a wearable transdermal neurostimulator to apply ensemble waveforms and in Systems and devices for bilateral caloric vestibular stimulation.

CONCLUSION

Thus the single phase inverter using arduino control gives an energy efficient and environment friendly solution. The arduino pulse will be given to the H-bridge inverter and the switching speed will be controlled by using pulse width modulation (pwm). The speed of the motor will be varied by varying its output frequency.

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