Implementation of Single Phase PWM Inverter using Arduino Uno

[1]Neeta Lamichaney, [2]Chitrangada Roy

[1,2]Department of Electrical and Electronics Engineering, Sikkim Manipal Institute of Technology, Majhitar 737132, East Sikkim

Email id:n.lamichaney91@gmail.com[1], roychitrangada@gmail.com[2]

Abstract: **The speed control of induction motor has been easier by the use of microcontroller and semiconductor. This paper shows the variable speed control of induction motor using v/f method. In this work, the speed of the induction motor can be adjusted. This is done by varying the PWM firing pulses of IGBTs. The system is designed and implemented in hardware& experimental results are recorded for variable speed. Here speed control of a single phase induction motor is implemented using Arduino Uno controller. Arduino Uno controller is connected to the PWM inverter.**

***Key words*: Arduino Uno, H-bridge Inverter, Opto-Coupler, PWM**

I. INTRODUCTION

Induction Motors are widely used in many industrial applications due to its simple construction and low maintenance cost. However IM motors are difficult to control over its speed characteristics as it is directly dependent on frequency of the supply, it can be done using voltage control system but however is not very convenient and finely controllable. The system designed in the project developed a voltage/frequency drive system that controls the speed of the motor by varying the speed of the ac supply. [1]

To control the speed of single phase induction motor we generally use V/F control strategy. The different methods available for the speed control of an induction are pole changing, frequency variation, variable rotor resistance, variable stator voltage, constant V/f control, slip recovery method etc, the constant V/f speed control method is the majority used. In this method, the V/f ratio is kept constant which in turn maintains the magnetizing flux constant so that the maximum torque remains the same. In constant V/f control with PWM method we can vary the supply voltage as well as the supply frequency such that the V/f ratio remains constant so that the flux remains constant too. So, we get different operating zone for various speeds and torques and also we get different synchronous speed with almost same maximum torque. Thus the motor is use full and we have a good variation of speed control. It is effortless, cost-effective to easier to design in open loop. But the drawbacks of open loop is it doesn't correct the change in output also it doesn't reach the steady state quickly. [6]

II. DESIGN OF THE AC DRIVE SYSTEM

The ac drive system consists of a supply unit, rectification block, gate driver unit, inverter block and the load.

The supply is given from 230V, IΦ. The step down transformer of (230V/12V) is used to step down the supply voltage to 12 V AC. Output of the transformer is given to the bridge rectifier which coverts it into 12 V DC.

12 V dc voltage is passed through a voltage regulator circuit (IC7812) and thus constant 12 V dc voltage is fed as input to the H-bridge inverter.

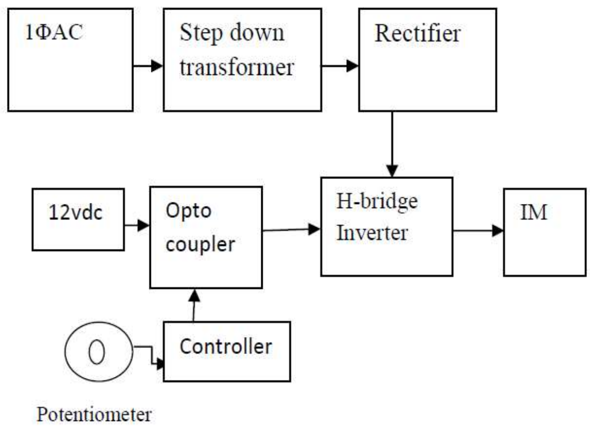

Fig. 1 Ac drive block diagram.

In order to drive the gate of the H-bridge inverter a gate driver circuit is required which provides isolation between the circuit and act as a protection unit. Thus it is made up using MCT2E (Opto coupler). The unit is supplied with separate 12v dc power supply.

An arduino Uno is programmed to give PWM pulses to the H-bridge inverter. The pulses are varied using a potentiometer. So, for the constructed system the frequency range from 14.85Hz to 60Hz for variable voltage to change the speed of induction motor. [1]

III. CIRCUIT DIAGRAM

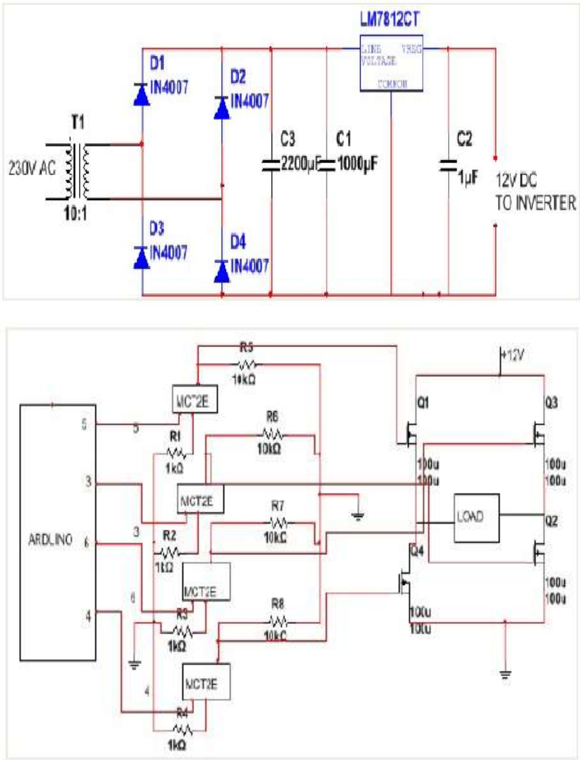

Fig. 2. Circuit diagram of the ac drive system

The H-Bridge inverter consists of 9540N P-channel MOSFET as a switching element. These MOSFET (four in number) are used in H-bridge configuration to form inverter to supply A.C. current to the motor. [3]

MOSFETS are used as switching device. The operations of this inverter are;

1. Q1-Q4 ON: Both create short circuits across the DC source and are invalid.
2. Q3-Q2 ON: Both create short circuits across the DC source and are invalid.
3. Q1-Q2 ON: Applies positive voltage (Vs.) to the load. The positive current passes through Q1-Q2.
4. Q4-Q3 ON: Applies negative voltage (-Vs.) across the load. The negative current (-IL) flows through Q3-Q4 and draws energy from the supply.
5. Q1-Q3ON: Applies zero volts across the load.
6. Q4- Q2ON: Applies zero volts across the Load. [2]
7. To trigger the switches i.e. Mosfets pulses are required. To generate pulses PWM technique is used.

IV. RESULTS AND WAVEFORMS

The output is captured in the CRO.

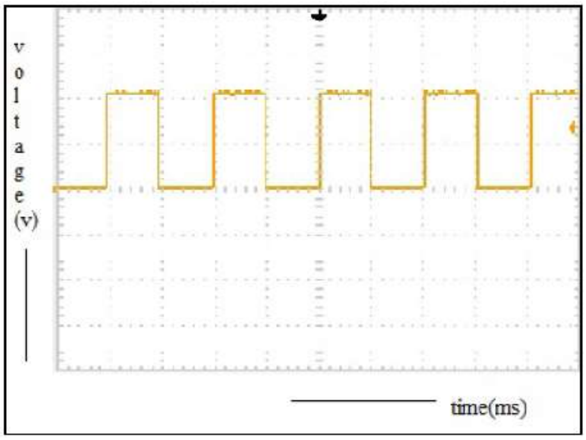

Fig. 3. Pulse across Arduino pin 5 without PWM.

Fig3 shows the waveform of pulses across Arduino pin 5 which is the input pulse to the driver circuit without PWM. Similar pulses are observed across pin 6, pin 4 and pin3.

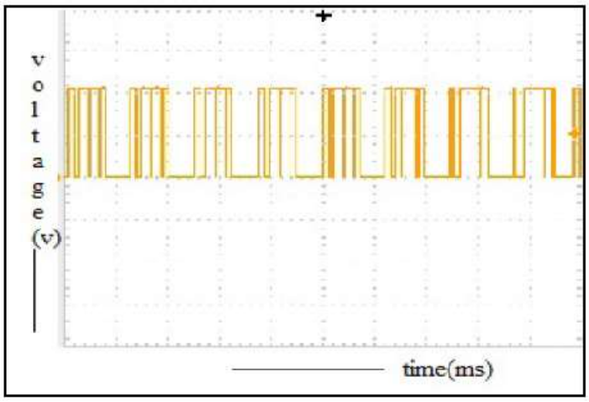

Fig. 4. Pulse across Arduino pin 5 with PWM.

Fig4 shows the waveform of pulses across arduino pin 5 which is the input pulse to the driver circuit with PWM. Similar pulses are observed across pin 6, pin 4 and pin3.

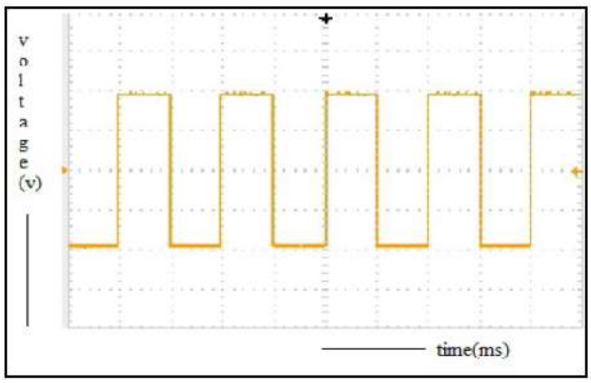

Fig. 5. H bridge inverter output without PWM.

Fig5 shows the output waveform across the H-bridge load of the inverter circuit without PWM.

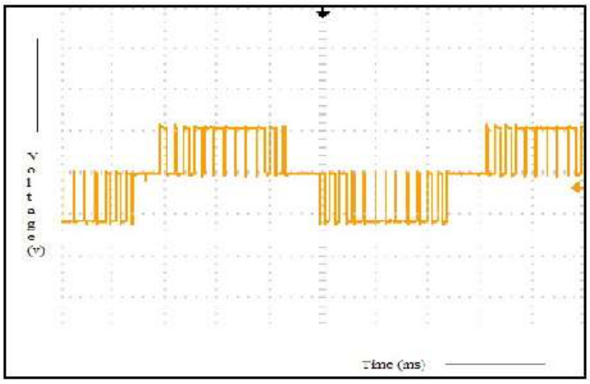

Fig. 6. H bridge inverter output with PWM.

Fig6 shows the output waveform across the H-bridge load of the inverter circuit without PWM.

On varying the pulse of the waveform the speed of the induction motor is varied.

V. CONCLUSION

With the help of Variable Speed Drive for a speed control application usually gives an energy efficient and environment friendly solution. Simple and straight forward VFD's, such as the PWM inverter drives, are available for applications where the speed control accuracy is not critical. The use of H-bridge inverter has made the inverter compact.

The variable speed drive with variable frequency control and voltage control method will give new, low-cost solutions for light commercial and consumer applications. The frequency range of the constructed circuit is 14.85 Hz to 60 Hz which can easily control the speed of an ac drive. [2] The V_{pk-pk} voltage is23.6Volt.

REFRENCES

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