International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

Control Strategy of Induction Motor Drive By Using Universal Controller And It's An Analysis In MATLAB

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Abstract - *Induction motors are widely utilized in many industrial processes because of their rigid nature, robustness, and reliability. However, induction motors have fixed speed limiting them from getting used in other processes. Available speed control techniques like as variation of supply voltage, variation of number of poles, variation of motor resistance, constant V/F ratio control and slip recovery method are a number of the methods of speed control characterized by low efficiency and high maintenance cost. Development of variable frequency motor drive, an device wont to control the speed of an induction motor with increased efficiency, reliability and low cost. Control of speed of induction motor was successfully achieved from zero to nominal speed by varying the frequency of applied AC voltage using pulse width modulation method.*

Key Words: **Induction Motor, PWM Inverter, ArduinoMega2560 Microcontroller, Speed Control Sensor.**

1. INTRODUCTION

Induction motors are fixed speed motors utilized in most industrial processes because of their reliability, rugged nature, low maintenance and reduced cost. However, induction motors are nonlinear and complicated systems due to their characteristic which require complex control, circuitry and inverter over sizing. Motion is required in any industrial application be it domestic or an industrial. Induction motor use is restricted in many industrial applications requiring variable speed because of high costs incurred in methods of speed control and inefficiency of the methods used. A variable frequency drive (VFD) also referred to as a variable speed drive could also be a kind of system through which speed of an induction motor can be varied. A VFD produces the use of electrical motor hence preferred to as electric drives. This controls the speed of the electric machine by converting frequency of grid to adjustable value on machine side hence allowing electrical motors to quickly and easily adjust its speed.

In these, various sensors and control algorithms is completed to manage speed using suitable speed control techniques and through this case varying the frequency using the pulse width modulation (PWM) inverter. Control of Induction Motor is run with the hardware and software simulation by the Microcontroller in MATLAB.

2. SOFTWARE PART

The circuit simulated by using MATLAB Simulink's Sim Power grid program. The absolute circuit consists of a DC Voltage Source, Asynchronous machine, universal bridge, PWM generator, and a Scope which will show the signals generate throughout the simulation.

3. HARDWARE PART

There are many tools which may use for the effective implementation of this project.

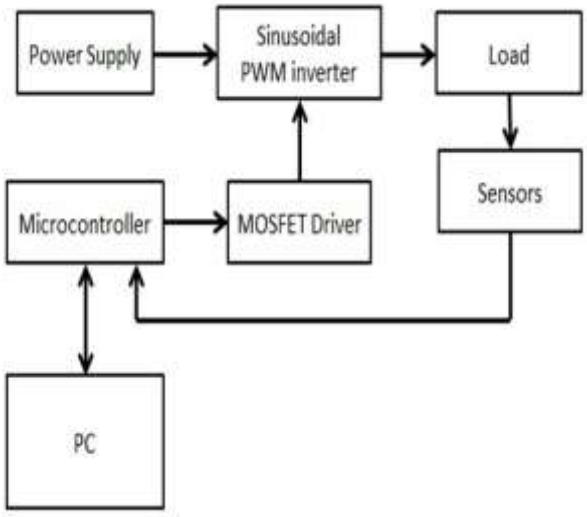

Figure 1: Block Diagram of Drive Circuit.

A. POWER SUPPLY

The power supply circuit will have step down transformer 230/12V which will passes through single phase bridge rectifier. The rectifier converts the alternating current (AC to DC) and capacitor filters are used for smoothing out the DC.

B. MICROCONTROLLER

AurduinoMega2560 Controller

Arduino Mega 2560 is a Microcontroller based on Atmega2560. It comes with more I/O pins and memory space as compared to other boards available in the market. There are 16 analog pins and 54 digital I/O pins incorporated on the board that make this device different

and stand out from others. 15 pins are used for PWM (Pulse Width Modulation). The ATmega2560 is also a Microcontroller. The recommended Input Voltage will range from 7volts to 12volts. The operating voltage of this microcontroller is 5volts. The digital input/output pins are 54 where 15 of these pins will supply PWM o/p. The input voltage will range from 6volts to 20volts. Analog Input Pins are 16. DC Current used at 50 mA for 3.3V Pin. DC Current for each input/output pin is 40 mA [2]

C. MOSFET Driver

Driver for the MOSFET also very important for development in this circuit because it's used to interface between control circuits (low voltage part) and inverter (high voltage part).

D. SINUSOIDAL PWM INVERTER

Sinusoidal pulse width Modulation is widely used in power electronics inverter Circuit. In sinusoidal PWM the modulation signal is in sinusoidal. An inverter circuit by using Sinusoidal Pulse Width Modulation (SPWM) switching schemes is developed to manage the speed of single-phase AC motor and being verified experimentally. Inverter is a device that convert a DC source to an AC source. DC is one kind of energy found in batteries and AC could also be a kind of energy that is produced by the power company and found in electrical homes/offices appliances. Semiconductor device, (MOSFET) Metal Oxide Field Effect Transistor is employed as a switch within the full bridge (H-bridge) inverter configuration with unipolar voltage switching. A variable frequency output waveform is produced by the inverter to run a motor at variable speeds that are directly proportional to present frequency. The MOSFETs because of the inverter, driver for the MOSFET also vital during this circuit development because it's use to interface between control circuits (low voltage part) and inverter (high voltage part).

WORKING

The block diagram of the above simulation modeled and through a hardware. The diagram setup consists of a DC source power supply to a MOSFET based inverter in conjunction with an Arduino controller that generates the SPWM signal. The Arduino is employed to get the pulse of 5 V. The pulse generated is fed as input to the gate terminal of the MOSFET. The MOSFET is operated under 1800 conduction mode. Six MOSFETs were utilized during this inverter. The output of the inverter is used to manage the speed and thus the direction of the ac squirrel cage motor. The Arduino Uno R3 is an open source, low cost device used to interface the sensor output. It Consist of a Type B USB pin, a power port, Micro Controller Unit, Six Analog input pins (A0 to A5), Six Digital I/O pins, Six PWM pins and a Reset button.

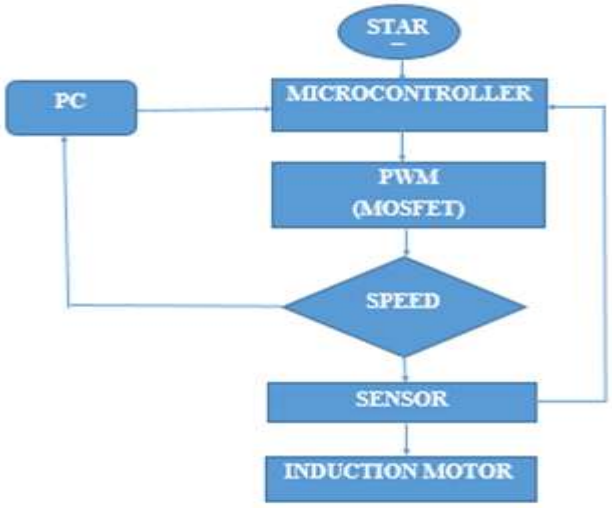

Figure 2: Flow Chart of Project Development

The MOSFET based inverter operates under 180o conduction mode the switching sequence of the inverter an induction motor is connected with the MOSFET based inverter the prototype and simulation are control to the speed of induction motor by using variable constant block.

In the simulation we'll made system for analog input block of arduino simulation library in matlab Simulink software and used that block to complete overall system.

ADVANTAGES

1. Wide range speed control of motor is possible.
2. Voltage/frequency based speed control of AC motor
3. Speed can be controlled smoothly down to the zero.
4. Multiple motors can be controlled at a time

CONCLUSION

The speed control on induction motors is made with a matlab Simulink software with interfacing of hardware of arduino and MOSFET based inverter and induction motor. The control offered to the inverter through an arduino board it holds a good performance change under variable loading conditions. Simulation results shows the performance change and thus effectiveness of the system is realized in hardware prototype model. As an extension of the work it will be applicable with the observation of power quality issues.

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