AC-PWM Speed Control System for Induction Motor Using AVR Microcontroller

BHAGYASHREE G[1], SHAILAJA[2], PRIYA[3], VIJAYLAXMI[4], PRASHANT G[5]
[1, 2, 3, 4, 5] *Guru Nanak Dev Engg. College, Bidar (KS)*

Abstract- ***ACPWM control for induction motor is a system, that enables the single-phase AC motor to run at different speeds. This project aims at controlling the AC power by using the concept of firing angle control of thyristor. This project uses a new speed control technique for the single-phase AC induction motor. It presents a low-cost design with high-efficiency drive capable of supplying a single-phase AC induction motor with a PWM modulated sinusoidal voltage. The circuit operation is controlled by an AVR family microcontroller. The circuit is capable of supplying a single-phase AC induction motor (or general AC inductive/resistive load) with varying AC voltage. The same as in triac control, the voltage applied to the load can be varied from zero to maximum value. On the other side, it uses a pulse width modulation technique (PWM circuit), and when compared with the phase angle control used for triac, produces much lower high order harmonics. It directly modulates the mains AC voltage. Compared with costly converter, it requires a lower number of active and passive power components. By the means of range, the speed of induction motor is been increased with the help of button. AC voltage is provided to the load. Once it reaches to the maximum voltage which is 230 volts, it starts decreasing. It helps to control the speed of induction motor.***

I. INTRODUCTION

Induction motor are widely used in industrial, commercial, utility application, residential application, in which the demand of induction motors are fed by static frequency inverters is growing fast. In this project microcontroller based to control speed of induction motor is developed using pulse width modulation. The circuit operation is controlled by an Alf's and Vegards RISC processor (AVR) family microcontroller. The circuit is capable of supplying a single phase AC induction motor with varying AC voltage. It directly modulates the mains AC voltage by using pulse width modulation technique. It helps to control the speed of the induction motor and is more efficient and has high level of performance.

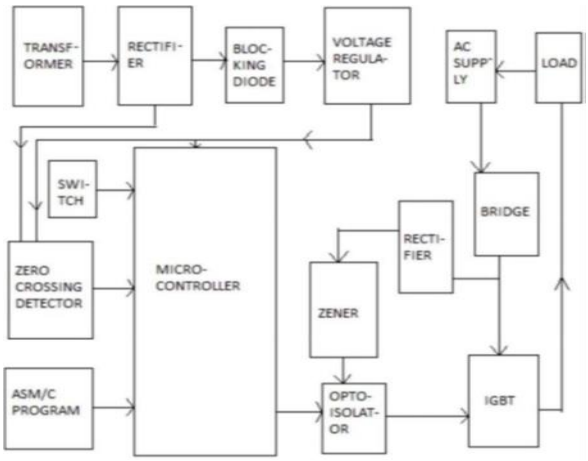
II. RELATED WORK

[1]. Khaled A. Madi Ali and Mohammad E. Salem Abozaed "AC PWM SPEED CONTROL SYSTEM" Proceedings of the International multiconference of Engineers 2010 vol. ll, March 17-19,2010
This paper deals with literature survey of applications of Induction motors which are being used in greater numbers throughout a wide variety of industrial and commercial applications because it provides many benefits and reliable device to convert the electrical energy into mechanical motion.

[2]. Hamid A. Toliyat, RahulKhopkar, Electric Machines & Power Electronics Laboratory Department of Electrical Engineering Texas A&M University 26 Feb. 2014
This paper deals with literature survey of various existing converter methods, which have been proposed for adjustable speed single phase induction motor drives. Included in the paper are several newly proposed converter methods. Various converter have been compared in this paper. Among these converter topologies, the adjustable frequency PWM inverter is the best choice for single-phase induction motor drives

[3]. P. Pawar, Chavan Neha Sarjerao and Shinde Ashwini Balaku "Speed Control of Induction Motor using PWM" Technique Published 4 September 2015 International journal of Harsha engineering research and technology
This paper deals with literature survey on advantages of Speed control of induction motor. It has high-efficiency which drives ac induction motor with PWM modulated sinusoidal voltage and design of a low cost. It requires a lower number of active and passive components which compared with costly converter.

III. BLOCK DIAGRAM



- MICROCONTROLLER ATmega328

The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core.

- Technical specifications

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, 3 flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and 5 software-selectable power-saving modes. The device operates between 1.8 and 5.5 volts. The device achieves throughput approaching 1 MIPS/MHz

- Opto-isolator

An opto-isolator (also called an optocoupler, photocoupler, or optical isolator) is 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. Commercially available opto-isolators withstand input-to-output voltages up to 10 kV and voltage transients with speeds up to 25 kV/μs.

A common type of opto-isolator consists of an LED and a phototransistor in the same opaque package. Other types of source-sensor combinations include LED-photodiode, LED-LASCR, and lamp-photoresistor pairs. Usually opto-isolators transfer digital (on-off) signals, but some techniques allow them to be used with analog signals.

- Zero crossing detector

A zero-crossing is a point where the sign of a mathematical function changes (e.g. from positive to negative), represented by an intercept of the axis (zero value) in the graph of the function. It is a commonly used term in electronics, mathematics, acoustics, and image processing. In alternating current, the zero-crossing is the instantaneous point at which there is no voltage present. In a sine wave or other simple waveform, this normally occurs twice during each cycle. It is a device for detecting the point where the voltage crosses zero in either direction.

- Rectifier

The three-phase rectifier convert alternating voltage into direct voltage and phase-controlled inverter converts direct voltage into alternating voltage. The AC supply is applied to the bridge rectifier, the bridge rectifier converts ac supply into dc supply. .....Three phase ac
voltage is connected to the three-phase induction motor. The PIC controller key functions are used to control the three-phase induction motor speed.

- IGBT

An insulated-gate bipolar transistor (IGBT) is a three-terminal power semiconductor device primarily used as an electronic switch, which, as it was developed, came to combine high efficiency and fast switching. It consists of four alternating layers (P–N–P–N) that are controlled by a metal–oxide–semiconductor (MOS) gate structure. One of the main important performance features of any semiconductor switching device is its switching characteristics.

Understanding the device switching characteristics greatly improves its utilization in the various applications. The main performance switching characteristics of power semiconductor switching devices are the turn-on and turn-off switching

transients in addition to the safe operating area (SOA) of the device.

IV. ADVANTAGES

- High efficiency
- Gives modulated sinusoidal voltage
- Requires a lower number of active and passive power components
- This system is more compact, more reliable and less costly as compared to other speed controls systems

V. APPLICATIONS

- The electric drive system used in many industrial applications require higher performance, reliability, variable speed can be operated.
- Fans and pumps as they have varying output requirements, and control of motor is more efficient
- Pumps, compressor drives and systems, mixers, high speed vacuum cleaners, hydraulic and irrigation pumps

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[3] Hamid A. Toliyat, RahulKhopkar, Electric Machines & Power Electronics Laboratory Department of Electrical Engineering Texas A&M University 26 Feb. 2014