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Wireless Speed Control of an Induction Motor Using Pwm Technique with Gsm

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Abstract : *This paper presents design and analysis of a three phase induction motor drive using IGBT''s at the inverter power stage with volts hertz control (V/F) in closed loop using a microcontroller. A 1HP, 3-phase, 415V, 50Hz induction motor is used as load for the inverter. Oscilloscope is used to record and analyze the various waveforms. The experimental results for V/F control of 3-Phase induction motor using GSM clearly shows constant volts per hertz and stable inverter line to line output voltage.*
Keywords - *Induction motor, IGBT, GSM,V/F,PWM technique*

I. Introduction

In the present time, in the most of the applications, AC machines are preferable over DC machines due to their simple and most robust construction without any mechanical commutators. Induction motors are the most widely used motors for appliances like industrial control, and automation; hence, they are often called the workhorse of the motion industry[6]. As far as the machine efficiency, robustness, reliability, durability, power factor, ripples, stable output voltage and torque are concerned, three- phase induction motor stands at the a top of the order. Motor control is a significant, but often ignored portion of embedded applications. Motor control applications span everything from residential washing machines, fans to hand-held power tools, and automotive window lift, traction control systems and various industrial drives. All most in all the applications there is a drastic move away from analog motor control to precision digital control of motors using different processors. Digital control of induction motors results in much more efficient operation of the motor, resulting in longer life, lower power dissipation. Although various induction motor control techniques are in practice today, the most popular control technique is by generating variable frequency supply, which has constant voltage to ratio frequency ratio. This technique is popularly known as V/F control [3]. This work describes the design of a 3-phase AC induction motor drive with volt per hertz control in closed loop (V/F) using High-Performance Controllers. tem as all its operations are controlled by intelligent software inside the microcontroller. The aim of this project is to control i.e. to ON/OFF and speed control of different motors, the electrical or electronic appliances connected to this system from anywhere in the world. For this purpose user can use any type of Mobile. This way it overcomes the limited range of infrared and radio remote controls. Using the convenience of SMS, this project lets you remotely control equipment by sending into the controller and easily remembered later. It can control up to eight external devices Short Message Service (SMS) is defined as a text-based service. control up to eight external devices Short Message Service (SMS) is defined as a text-based service. That enables up to 160 characters to be sent from one mobile phone to another. In a similar vein to email, messages are stored and forwarded at an SMS centre, allowing messages to be retrieved later if you are not immediately available to receive them. Unlike voice calls, SMS messages travel over the mobile network's low-speed control channel.

II. V/F Method for Motor Drive

V/Hz control is a basic control method, providing a variable frequency drive for applications like fan and pump. It provides fair speed and torque control, at a reasonable cost. Sensor less Vector control provides better speed regulation, and the ability to produce high starting torque. Flux Vector control provides more precise speed and torque control, with dynamic response. Field Oriented Control drives provide the best speed and torque control available for AC motors. It provides DC performance for AC motors, and is well suited for typical DC applications. Volt/Hertz control in its simplest form takes a speed reference command from an external source and varies the voltage and frequency applied to the motor. By maintaining a constant V/Hz ratio, the drive can control the speed of the connected motor [4].

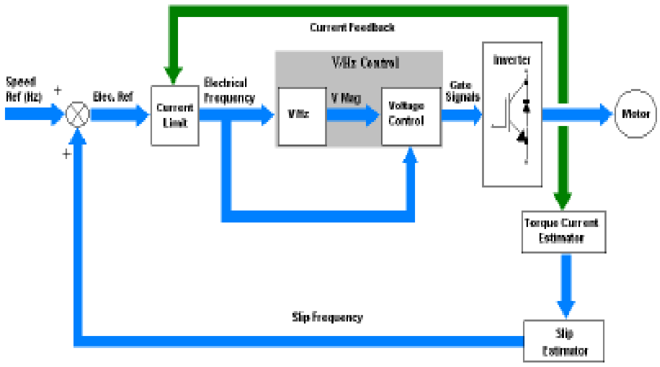

Fig 1.1: Block Diagram of V/F method speed control.

Typically, a current limit block monitors motor current and alters the frequency command when the motor current exceeds a predetermined value. The V/Hz block converts the current command to a V/Hz ratio. It supplies a voltage magnitude command to the voltage control block. The angle of this tells the voltage where it should be with respect to current. This determines flux current to the motor. If this angle is incorrect, the motor can operate unstable. Since the angle is not controlled in a V/Hz drive, low speeds and unsteady states may operate unsatisfactorily. An additional feature in newer drives, a "slip compensation" block, has improved the speed control. It alters the frequency reference when the load changes to keep the actual motor speed close to the desired.

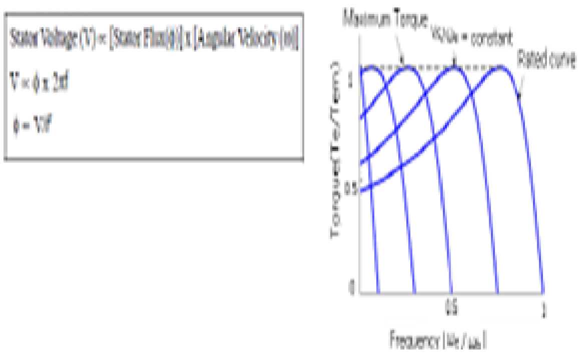

Fig. 1.2:Torque–speed characteristic of an Induction motor

The torque developed by the induction motor is directly proportional to the V/F ratio. If we vary the voltage and frequency, keeping their ratio constant, then the torque produced by induction motor will remain constant for all the speed range. Fig.2 shows the torque-speed characteristics of the induction motor with V/F control. The voltage and frequency reaches the maximum value at the base speed [1].We can drive the induction motor beyond the base speed. But by doing so only frequency varies but not voltage. Hence the ratio of V/F will no longer remain constant. Since the torque developed by the induction motor is directly proportional to the V/F ratio will not remain constant throughout the speed. Other than the variation in speed, the torque-speed characteristics of the V/F control reveal the following:

- The starting current is low.
- The stable operating region of the motor is increased. Instead of simply running at its base/ rated speed (NB), the motor can be run typically from 5% of the synchronous speed (N_S) up to the base speed. The torque generated by the motor can be kept constant throughout this region.
- Since almost constant rated torque is available over the entire operating range, the speed range of the motor becomes wider. User can set the speed as per the load requirement, thereby achieving the higher efficiency. Because of above reasons V/F control method is used in this work.

III. Implementation of Pulse Width Modulation

Figure 1.3 shows a block diagram of the power conversion unit in a PWM drive. In this type of drive, a diode bridge rectifier provides the intermediate DC circuit voltage. In the intermediate DC circuit, the DC voltage is filtered in a LC low-pass filter. Output frequency and voltage is controlled electronically by controlling the width of the pulses of voltage to the motor. Essentially, these techniques require switching the inverter power devices (transistors or IGBTs) on and off many times in order to generate the proper RMS voltage.

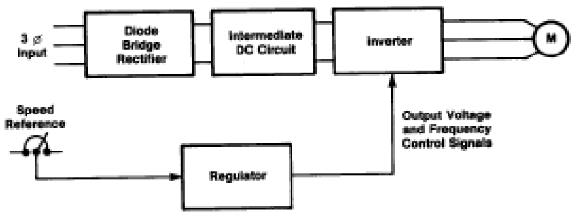

Fig. 1.3:Power conversion unit (PWM)

This switching scheme requires a more complex regulator than the VVI. With the use of a microprocessor, these complex regulator functions are effectively handled. Combining a triangle wave and a sine wave produces the output voltage waveform. AC drives that use a PWM type schemes have varying levels of performance based on control algorithms. There are 4 basic types of control for AC drives today. These are Volts per Hertz, Sensor less Vector Control, Flux Vector Control, and Field Oriented Control. V/Hz control is a basic control method, providing a variable frequency drive for applications like fan and pump. It provides fair speed and torque control, at a reasonable cost[6].

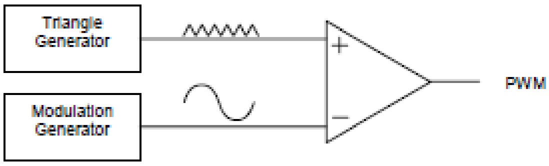

Fig 1.4:PWM generator

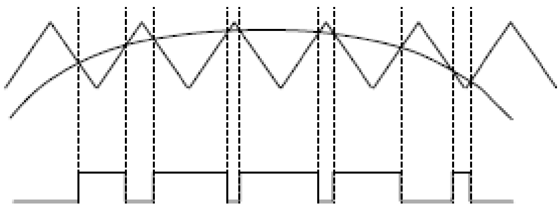

Fig 1.5: Output of PWM

IV. Wireless Monitoring And Control

The software program. Major role of this project is to receive the SMS to speed control of motor. As shown in Figure 1.6 the wireless transference of industrial monitoring messages discussed in this paper is built on the SMS of the GSM network. Data messages produced at one end of the monitoring system are encapsulated into a short message by the gateway and sent to remote monitoring devices at another end. When a short message is received, it can be restored to its original industrial form by removing the SMS PDU head. This is also conducted by the gateway of the monitoring system. If needed, the message content can be put into Gateway. In this project we are using the GSM technology. A micro controller (also micro controller unit, MCU or µC) is a small computer on a single integrated circuit consisting of a relatively simple CPU combined with support functions such as a crystal oscillator, timers and microcontroller control the Induction motor. The LCD will give displays the current operation of the system. The micro controller is used to control the relay drivers depending upon the software program. Major role of this project is to receive the SMS to speed control of dc motor and control of induction motor and control for circuit. Initially the SMS is received from the person authorized to use this setup (destination) by the GSM modem (SIM300 MODEM) & is transferred to the microcontroller[5].

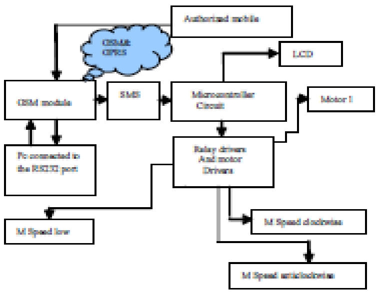

Fig 1.6: Wireless communication of IM

IV. Experimental Results

Software development: The software for the system is developed in Embedded C and Visual Basic. The flowcharts depicting the monitoring and the induction motor control of speed control of dc motor is shown in Flow chart for software implementation are as follows;

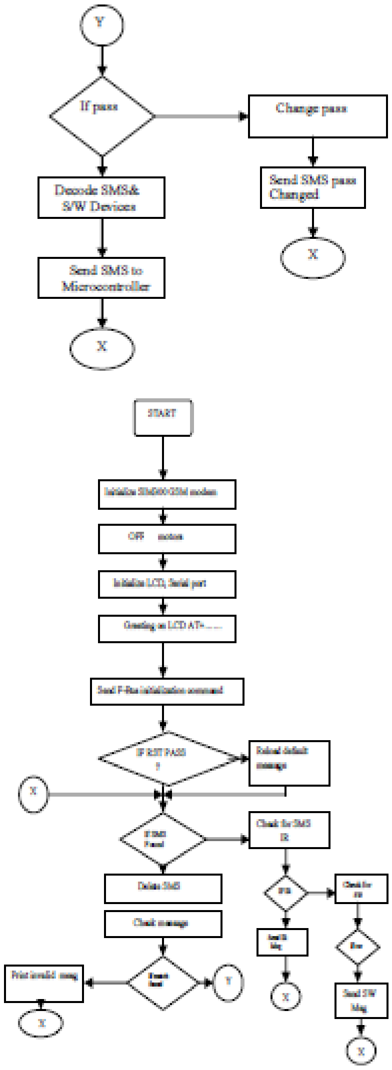

Table 1.1: Speed control of an Induction motor

Sl. No	Load In (Kg)	Actual Speed (RPM)	Frequency (Hz)	Max Torque (Nm)
1	0	810	26.88	7.10
2	0.5	810	26.88	7.10
3	1	825	27.05	7.11
4	1.5	810	26.88	7.10
5	2	795	26.50	7.06

Table 1.2 speed control using V/Hz

Sl no	Set speed RPM	Stator voltage volts	Stator current Amps	Gate pulse		
				Voltage	Frequency	V/F
1	810	314	1.42	3.53	26.88	0.13
2	855	328	1.40	3.60	27.74	0.13
3	915	342	1.38	3.96	30.12	0.13
4	1020	376	1.37	4.39	33.68	0.13
5	1080	398	1.33	4.78	36.76	0.13
6	1185	419	1.24	5.17	39.68	0.13
7	1230	440	1.19	5.12	41.67	0.13
8	1305	455	1.14	5.80	43.10	0.13
9	1350	471	1.10	6.01	44.64	0.13

V. Conclusion

In the paper low cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution for automation of different motors has been introduced. The approach discussed in the paper has achieved the target to control industrial appliances remotely using the GSM -based system satisfying user needs and requirements

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