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Speed Control of Single Phase Induction Motor Using Infrared Receiver Module

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ABSTRACT: In this paper the design and implementation of speed control of a single phase induction motor through infrared receiver module is presented. The proposed speed control method enables the user to operate an induction motor remotely. In this scheme any button on the remote can be used for the speed control of the induction motor. Whenever any push button switch of remote controller is pressed on the remote control, the infrared light emitting diode transmits the signal to the regulator's infrared sensor. Subsequently, this signal was decoded by the decoder and the firing angle of ac voltage controller can be controlled. Hence the induction motor operates at the reference speed in accordance with the action commanded by the remote controller.

KEYWORDS: IR decoder, AVR Microcontroller, Control, Display.

I.INTRODUCTION

Today, electronics are widely used in home appliances such as the motor speed regulation of a washing machine, the control of a vacuum cleaner, the light dimming of a lamp and the heating in a coffee vendor machine etc. This provision increases rapidly because appliances require enhanced features, easy to build and modify as electronics based solutions become cheaper and more sophisticated. With the evolution of VLSI technology, the microcontrollers replace analog controllers and discrete solutions are available in low cost applications. The design and development of a variable-speed controllerof AC motor drives, employing CPLD device is reported in [1]. The control of induction motor drives is a quite complex task. Usually the vector control algorithm is used to control induction motor. In vector control scheme, the rotor speed and the position of the magnetic flux inside the motor during the speed control process are required [2]. The measuring, modelling, and decoupling of saturation-induced saliencies in carrier signal injection based sensor less control is reported in [3]. AC drive system in conveyor applications can be very challenging. This scheme is suitable for a medium voltage AC drive system where electrical power can be supplied through a common AC Bus [4]. Stator flux estimation may be used to control the electromagnetic torque of the induction motor during soft starting. The inherent problems related to pure integration of the back electromagnetic force. To estimate the stator flux are minimized using the low pass filter [5]. A speed-estimation method may be used for controlling the induction-motor drive and it operates based on a special current-control scheme called integral sliding-mode current control. Classic current control for the induction motor drive is done by regulating the d-q synchronous reference frame currents using PI controllers with or without a decoupling compensator[6]. In this paper, the design and development of speed control of a single phase induction motor through infrared receiver module is presented. The proposed method enables the user to operate an induction motor remotely.

II.PROPOSED SPEED CONTROL SCHEME

The schematic block diagram of proposed speed control scheme is depicted in Figure 1. This block diagram consists of IR transmitter, IR receiver, microcontroller, and driver circuit. Generally IR sensor module receives the IR pulses which are sent from remote location and converts it to corresponding electric pulses. These electrical pulses are given to a microcontroller that decodes it to corresponding data byte using a zero crossing detector and on chip timer and interrupt. These data bytes are used to take further control decisions. The control output signals are given to driver circuit, which drives the actual device.



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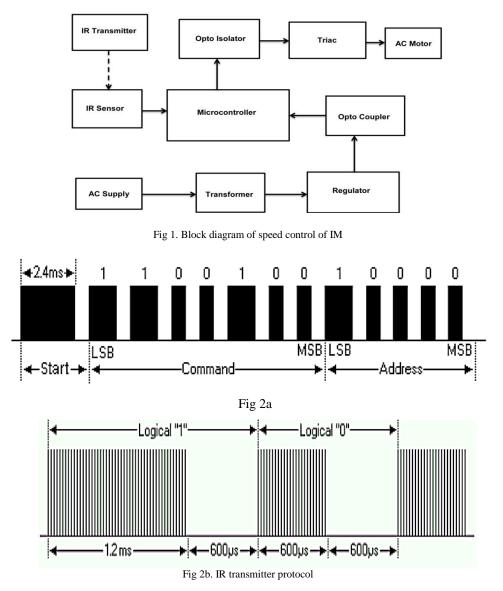
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In proposed speed control system, sony IR remote is used and it operates based on 12-bit SIRC protocol as illustrated in Figure 2a. The code starts with a header of 2.4ms followed by 7-bit command and 5-bit device address in which least significant bits (LSB) are transmitted first. Subsequently, the commands are repeated after 45ms as long as the switch is ON and the remote control is held down. The address and commands are exist for logical ones and zeros. A space of 600µs or 1T and a pulse of 1200µs or 2T form are used to represent logical one. A logical zero is formed by a space of 600µs and the pulse of 600µsis shown in Figure 2b. Usually, the zero crossing detectors generate pulses for each zero crossing of the input ac signal. After that these pulses are fed to the microcontroller interrupt pin through the optocoupler. The opto - coupler is used for the isolation of the high voltage ac to the low voltage dc supply at the microcontroller side. The microcontroller was interrupted at each zero crossing which triggers the triac as per requirement.





The system circuit diagram is depicted Figure 3. The proposed speed control scheme has been designed using the Atmega8 microcontroller. The microcontroller's on-chip peripherals like programmable I/O port, timer, oscillator, EEPROM, and power on reset etc. are being used to reduce the cost and to increase the efficiency and reliability of



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proposed system. This makes the AVR microcontroller a better choice for such embedded systems. This microcontroller uses calibrated 8 MHz internal RC oscillator. TSOP- 1740 receiver module is used to receive the IR signal from the transmitter. This sensor module demodulates the received IR signal that is compatible to the microcontroller. Microcontroller decodes the demodulated frame from the sensor module to corresponding command and address data byte. This decoded data bytes are then used to take an actual control decision. In the present system, in order to increase or decrease on decrease on the substant of the function keys 'volume +' and 'volume -' on IR remote transmitter are used respectively and to ON-OFF ac mains switch 'power' function key is used.

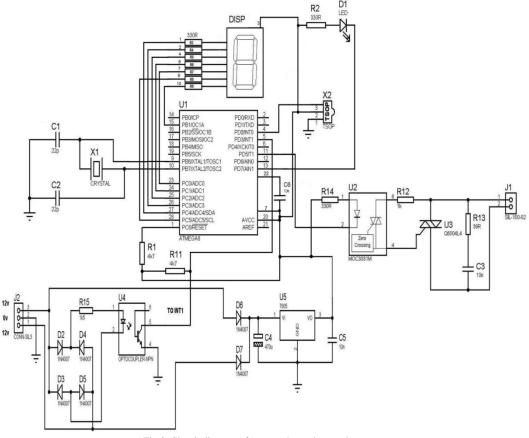


Fig 3. Circuit diagram of proposed speed control system

The corresponding decoded command bytes are 19, 20, and 21 respectively. The power control device used here is a triacwhich is least expensive power switch to operate directly on the 110/240V ac supply. Thus it is the optimal switch for most of the low-cost power appliances which are operating online. It can withstand a maximum load current typically 5A. The phase angle control technique is employed to control the load power. The output power is controlled by the phase delay of the triac. This delay refers to the zero crossing of the line voltage detected by zero crossing detector circuit. The control output from microcontroller port pin is given to opto-coupler for isolation between control circuit and power circuit. The output of opto-coupler is used to trigger the triac. Usually, the triac is driven in first and third quadrants with 60 mA gate current with 100 μ S pulse width. This pulse width is sufficiently long to ensure that the triac gets latched at the end of the pulse. Changing the operation from 50Hz to 60Hz can be achieved by making simple modifications to the microcontroller EPROM look-up table defining the triac conduction angle versus power level. The automatic selection of 50Hz or 60Hz look-up tables could be done by programming.



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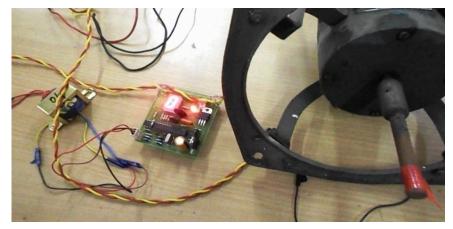


Fig 4. Hardware Circuit

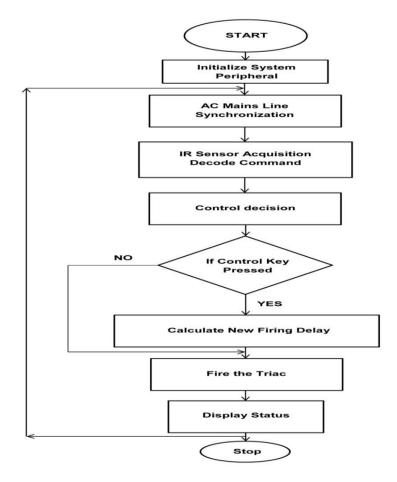


Fig 5. The basic flow chart of the device software



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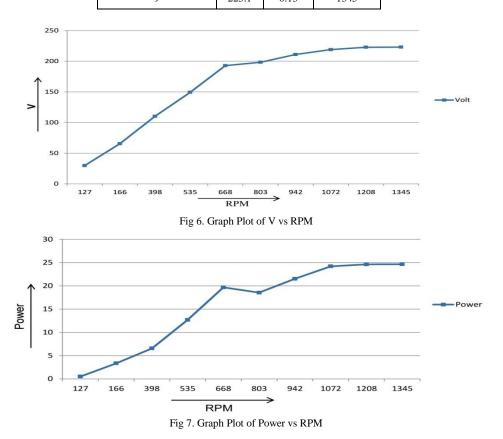
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IV.EXPERIMENTAL RESULTS

The concept of speed control of ac motors which are used in home appliances can be implemented using the proposed method. It can control the speed of induction motor effectively. The experimental results are illustrated in Table I. Relationship between speed vs voltage and speed vs Power are depicted in Figure 6 and Figure 7 respectively. Figure 8 and Figure 9 show the Output voltage across induction motor at remote switch position 2 and 9 respectively.

Remote Switch Position	Volt (V)	Amp (A)	Speed(RPM)
0	29.7	0.02	127
1	65.4	0.06	166
2	110.2	0.07	398
3	149.3	0.10	535
4	192.8	0.12	668
5	198.3	0.11	803
6	211.0	0.12	942
7	219.0	0.13	1072
8	222.8	0.13	1208
9	223.1	0.13	1345

TABLE I :	EXPERIMENTAL	RESULTS
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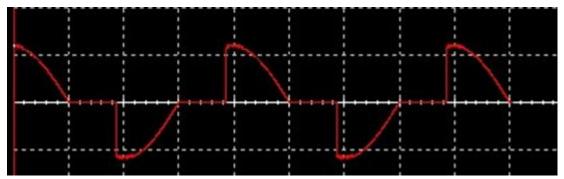


Fig 8.Output voltage across induction motor at α =85°

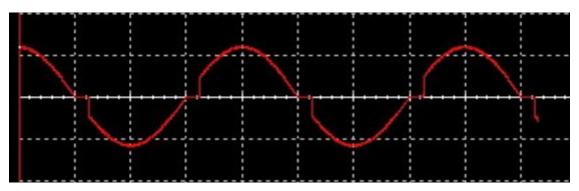


Fig 9.Output voltage across induction motor at α =30°

V. CONCLUSION

The proposed speed control system of single phase induction motor using inferred receiver module has been designed and implemented. The developed system has been tested and the experimental results are reported in this paper. The proposed speed to operate induction motor remotely. This variable speed drive with variable voltage control provides low-cost solutions for light commercial and consumer applications.

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