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Ir TV Remote Based Speed Control of Single Phase Ac Motor

P. S. Jadhav[1], G. B. Jirage[2], P. R. Bagade[2] C. B. Patil[2]
[1,2] Vivekanand College, Kolhapur (Autonomous)
Email : psj.eln@gmail.com

Abstract:

This article outlines the development and implementation of a speed control system for a single-phase AC motor using an infrared receiver module based on PIC microcontroller. The proposed speed control method allows users to remotely operate the AC motor. In this system, volume (+ /-) button on the remote control can e utilized to adjust the speed of the AC motor. When a push button on the remote controller is pressed, the infrared light-emitting diode transmits the signal that is received by the receiver in the infrared sensor module interfaced with micro-controller. Subsequently, the micro-controller interprets this signal, enabling control over the firing angle of the AC voltage controller. As a result, the AC motor operates at the desired speed as commanded by the remote controller.

Keywords: *PIC microcontroller, IR sensor, Triac, AC motor, zero crossing detector.*

Introduction

Now days, electronic components play a crucial role in various household devices, including the regulation of motor speed in washing machines, the control mechanisms of vacuum cleaners, the dimming functionality of lamps, and the heating systems in coffee vending machines. This trend is on the rise due to the growing demand for advanced features, coupled with the affordability and increasing sophistication of electronics-based solutions [1]. Induction motor speed can be controlled by using scalar control that is V/F converter, vector control, direct torque control, space vector control modulation and fuzzy logic controller method [2].As reported in[3] Altera FLEX 10K100A CPLD device has been used to control ac motor speed by using PWM technique. P. Kiran Kumar et.al controlled the speed of ac motor by using GSM technique [4]. Bhardwaj, S. et.al controls the speed of ac motor by applying varying voltage to the motor by using triac [5]. This paper presents the design and development of a system for speed control of a single-phase AC motor using an infrared receiver module.

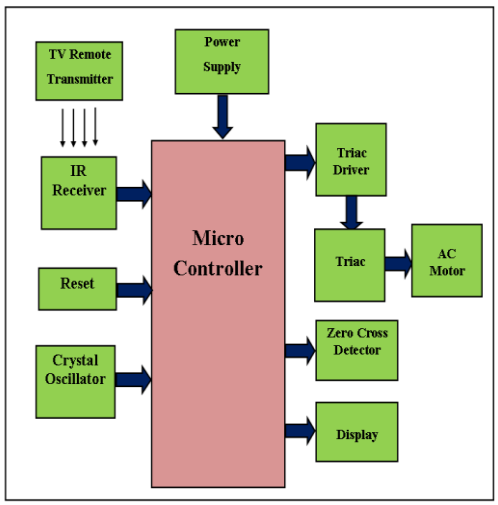

Fig1. Block diagram of IR remote based speed control of single phase ac motor

Fig. 1 illustrates the proposed method's block diagram, comprising an IR transmitter, receiver, a microcontroller, and a driver circuit for an AC motor. In the present system Philips IR remote is used. It operates on RC5 protocol. The IR sensor module is responsible for receiving IR pulses transmitted from a remote location and converting them into electric pulses, which are then supplied to the microcontroller. The microcontroller processes the input signals and produces control output, which is subsequently applied to the driver circuit responsible for operating the AC motor speed.

The current system utilizes a Philips IR remote operating on the RC5 protocol. In Fig.2, the RC5 protocol is depicted with two initial logical "1" start pulses. It's crucial to highlight that half a bit time elapses before the receiver detects the actual beginning of the message. Extended RC-5 introduces a modification, adopting a single start bit and reassigning bit S2 to command bit 6, resulting in a total of 7 command bits. To ensure compatibility with the original RC-5 protocol, the value of S2 must be inverted to obtain the 7^{th} command bit, preserving the initial 64 commands. The 3rd bit functions as a toggle bit, inverting each time a key is released. This feature enables the receiver to differentiate between a continuously pressed key and one that is repeatedly pressed. Following the toggle bit, the subsequent 5 bits represent the IR device address, transmitted with the Most Significant Bit (MSB) first. Subsequently, a 6-bit command follows, also sent with the MSB first. A complete message comprises 14 bits, resulting in a total duration of 25 ms. Occasionally, a message may seem shorter due to idle time in the first half of start bit S1. Additionally, if the last bit of the message is logic "0," the last half bit of the message remains idle.

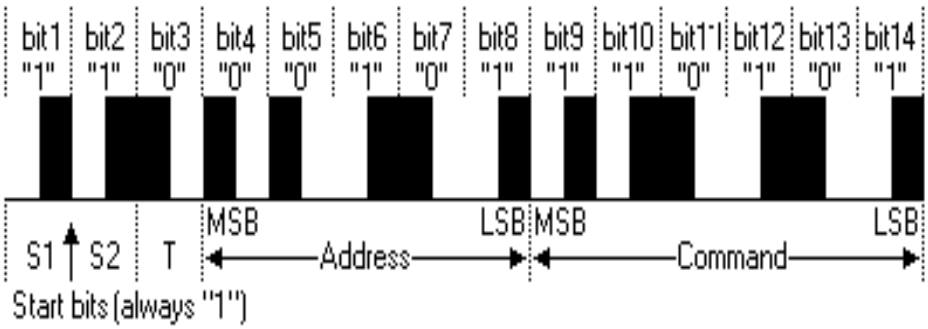

Fig. 2: RC5 Protocol

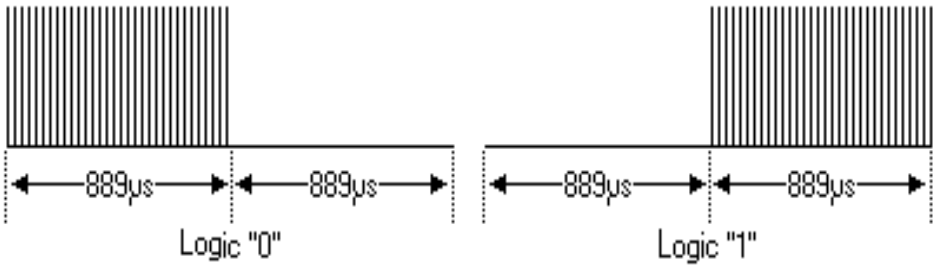

Fig 3. RC5 Protocol modulation

The protocol uses biphase modulation as in Fig.3 of a 36 kHz IR carrier frequency. All bits are of equal length of 1.778ms in this protocol, with half of the bit time filled with a burst of the 36 kHz carrier and the other half being idle. In the given encoding scheme, a logical '0' is denoted by a burst occurring during the initial half of the bit time, while a logical '1' is indicated by a burst taking place in the latter half of the bit time. The pulse/pause ratio for the carrier frequency of 36 kHz is either 1/3 or 1/4. This ratio has been chosen to minimize power consumption. [6].

2. Hardware Implementation of system

The schematic diagram is displayed in Fig.4.

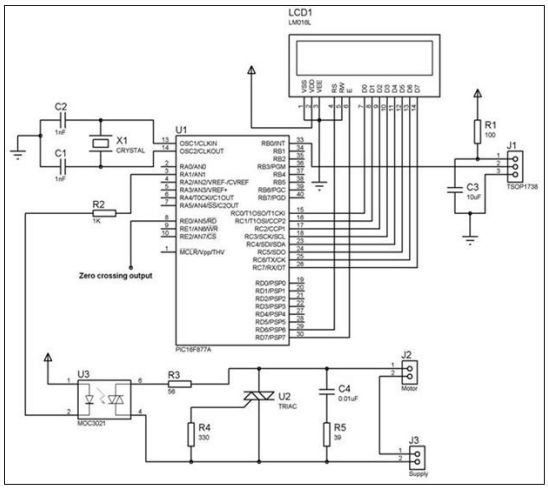

Fig.4. Schematic diagram of IR TV remote based speed control of single phase ac motor

In the current system, a PIC 16F877A microcontroller with an 8-bit architecture is employed, featuring five ports and operating at a clock frequency of 20MHz. The system utilizes a TSOP-1738 sensor module to receive infrared (IR) signals from a remote transmitter. This IR sensor module demodulates the received signals into a format compatible with the microcontroller, allowing it to process the data, decode input, and implement control actions.

The IR receiver is connected to pin B0 of the PIC, and when a key is pressed on the remote control, the sensor captures the corresponding data, which is then recorded by the PIC. The system employs a TRIAC-based circuit, utilizing a BT136 TRIAC, to control the speed of a motor. The firing pulses for the TRIAC are generated by the PIC through an optocoupler (MOC3021), providing electrical isolation. A zero-crossing detection circuit, implemented with another optocoupler, assists in determining the appropriate firing angles.

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Fig.5. Hardware of the IR TV remote based speed control of single phase AC motor

Software part: The software implementation is done through micro C.Fig.6 shows the flow chart of the system.

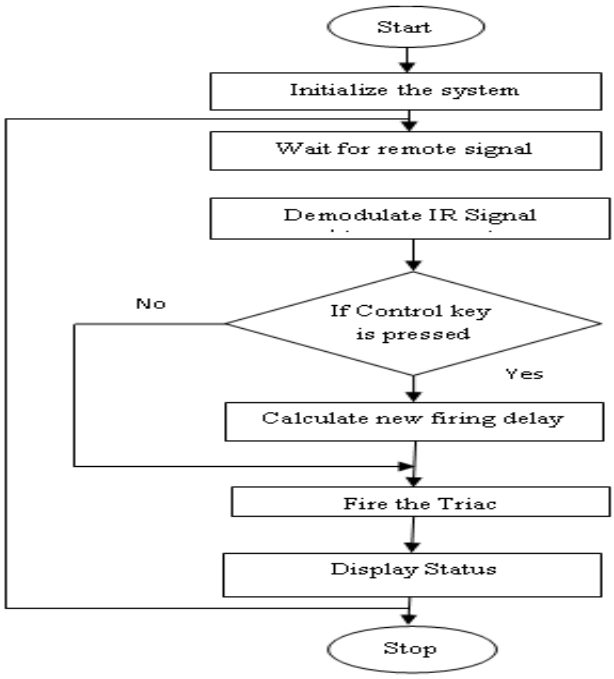

Fig.6. Flow chart of the software Implementation

3. Result

Speed control of single phase AC motor using IR remote is effectively implemented. The speed of AC motor and corresponding voltage drop across opto-coupler is exhibited in Table1.The speed of ac motor is measured with tachometer. Graph Plot of Speed% vs. RPM and Graph Plot of Speed% vs. V are shown in Fig.7 (a) and 7(b).

Table 1: Experimental Results

Sr. No.	Speed%	RPM	voltage across Opto coupler (V)
1	0%	0	0
2	20%	980	0.34
3	40%	1160	0.39
4	60%	1220	0.45
5	80%	1280	0.5
6	100%	1330	1.13

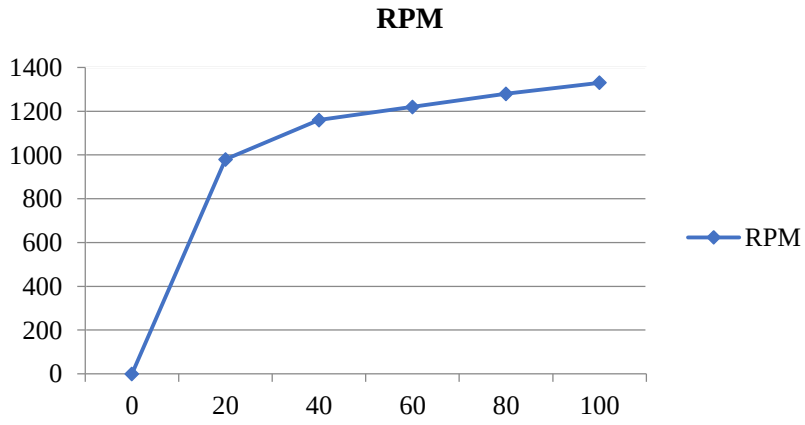

Fig 7(b). Graph Plot of Speed% vs RPM

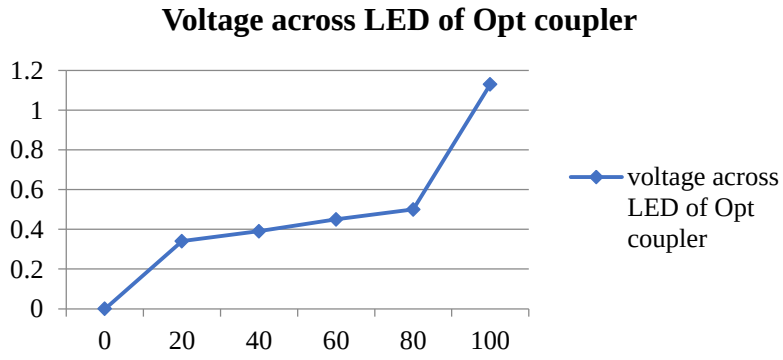

Fig. 7(b) .Graph Plot of Speed% vs V

4. Conclusion

The IR TV remote-based speed control system for a single-phase AC motor, implemented using a PIC 16F877A microcontroller and TSOP-1738 sensor module, offers an efficient and user-friendly solution. The integration of TRIAC-based speed control, zero-crossing detection, and an opto coupler ensures precise adjustments to the motor's speed with electrical isolation. By harnessing the capabilities of the PIC microcontroller and incorporating advanced control

features, this system presents a versatile and adaptable solution for applications requiring dynamic speed control of single-phase AC motors through the convenience of an IR TV remote. The successful integration of hardware components and software algorithms makes this system a robust and practical choice for various industrial and domestic settings.

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