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Design and Development of a Speed Control of Single Phase Induction Motor by using Smart Phone

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***Abstract-** Induction motors due its various uses many industries use them. Different industries require different speed of induction motor according to their uses. So speed controlling of induction motors has a significance role in our life. Therefore in this project our main objective is to change the speed of single phase induction motor using a smart phone via Bluetooth technology. It is based on a microcontroller PIC16F73. A mobile app is use to send command which is detected by a HC05 Bluetooth module and the micro controller decodes the commands received from the mobile app and changes motor speed by the technique of pulse width modulation .The design is low cost motor control drive targeted for industrial as well as electrical appliances example compressors, air conditioners, washing machines electric water pumps and some simple industrial drives.*

Keywords- Micro controller PIC16F73, single phase induction motor, Speed control, Bluetooth, TRIAC

I.INTRODUCTION

Induction motors are widely used motors in different industries as well as in home appliances at our homes like fan, exhaust fan, etc. the requirement of speed change of these motors vary from place to place. At industries or home appliances a uniform speed is required whereas at some places an assorted motor speed output is needed. Earlier induction motors have been used without changing its speed due to non-availability of convenient methods. So, DC motors were used where a speed changing output was required but dc motors comes with a cost as these motors are equipped with commutators and brushes which require time to time maintenance, moreover induction motors have a capability of producing high torque with the help of high current.

To change the speed of induction motor there numerous ways which are as follows

(1)By changing the applied voltage

$$T = \frac{k_1 s E_2^2 R_2}{\sqrt{(R_2^2 + (s X_2)^2)}} = \frac{3}{2\pi N_S} \frac{s E_2^2 R_2}{\sqrt{(R_2^2 + (s X_2)^2)}}$$

Rotor resistance does not change and if the value of slip is small almost tending towards zero then, slip can be neglected, so torque will be directly proportional to SE_2^2 Thus, Torque is directly proportional to SV2 this implies that if the voltage provided from the supply is decreased, then the developed torque also decreases.

(2)By changing supply frequency

As we know, the equation mention below gives the synchronous speed of an induction motor

$$Ns = \frac{120 f}{P} \quad (RPM)$$

Where, f = frequency of the source(supply)and P = number of stator poles.

Henceforth, the synchronous speed alters with change in supply frequency.

(3)Constant v/f control of induction motor

The air flux transition will generally immerse on the off chance that if the frequency from the supply decreases while keeping up with the predefined voltage from the supply. This will bring about unreasonable the current of the stator and flux wave contortion. Accordingly, the stator voltage ought to be proportionate to the frequency which helps to keep the air-gap flux steady. The proportion of the stator voltage and frequency decides the number of flux in the stator. Subsequently, if the voltage-to-frequency proportion stays consistent, the flux also stays steady. If the V/F is kept consistent the torque is also kept near steady. This strategy is more productive as far as runtime. Therefore, for speed control, by far most of AC speed drives utilize the consistent V/F technique.

(4)Changing the number of stator pole

From the equation of synchronous speed,, The quantity of stator poles can be changed to adjust the synchronous speed (and subsequently the working velocity). Since the squirrel cage rotor changes with quite a few stator poles, this approach is ordinarily used for squirrel cage induction motor. At least two independent stator winding wound for various number of poles in similar spaces change the stator poles.

(5)Using microcontroller interface based

We can use a microcontroller interface module which can alter the voltage of the supply with the help of a TRIAC and our project is based on this.

Out of all the several methods of controlling speed of induction motors, with the advancement in technology and embedded systems a successful microcontroller interface based method is best because of its various reasons like fast control response, lower motor torque ripple, high motor efficiency, low cost.

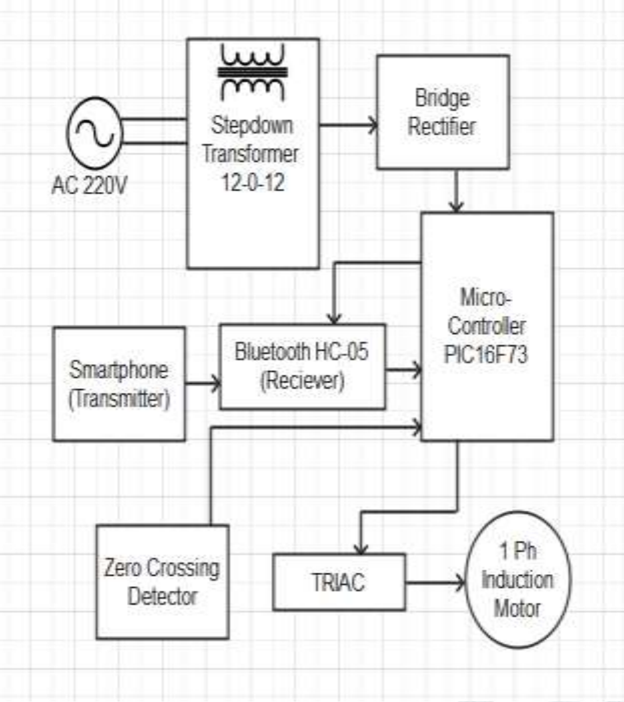


Figure 1. Block Diagram of Speed Control Of Induction Motor

II.METHODOLOGY

This task plans to control the speed of single phase induction motor with a microcontroller interface based method, This strategy have high proficiency driven capacity of providing single phase induction motor with pulse width modulation (PWM) sinusoidal voltage. This strategy have additionally minimal expense than different techniques for speed controlling. The circuit activity is constrained by a micro controller PIC16F73. Both inductive as well as resistive load with varying AC voltage can be provided. TRIAC is utilized to control the voltage across the load which fluctuates from 0 to the maximum value and it additionally utilizes PWM and it is contrasted and the stage point control of TRIAC so it creates a lot of lower harmonic pollution. It requires least number of active and passive components when contrasted with exorbitant converter. the load power is controlled by obligation patterns of PWM pulses taking signals from microcontroller PIC16F73. pulses from PWM are synchronized with the supply phase zero voltage detecting point implies extraordinary care is taken by the circuit.

.III.COMPONENTS

S.no	Component Name	No. of units used	Rating
1	Induction motor	1	1ph 50watt
2	Bluetooth module HC-05	1	3.6-6 V
3	Microcontroller PIC16F73	1	
4	Mini Bridge rectifier DB107	1	
5	Crystal Oscillator	1	
6	Voltage regulator L7805CV	1	
7	Diode 1N4007	8	
8	Transformer Step-down	1	Output 3amp 12 V
9	Optocoupler MOC3021	1	
10	Thyristor (Triac) BT136	1	
11	Transistor BC547	1	

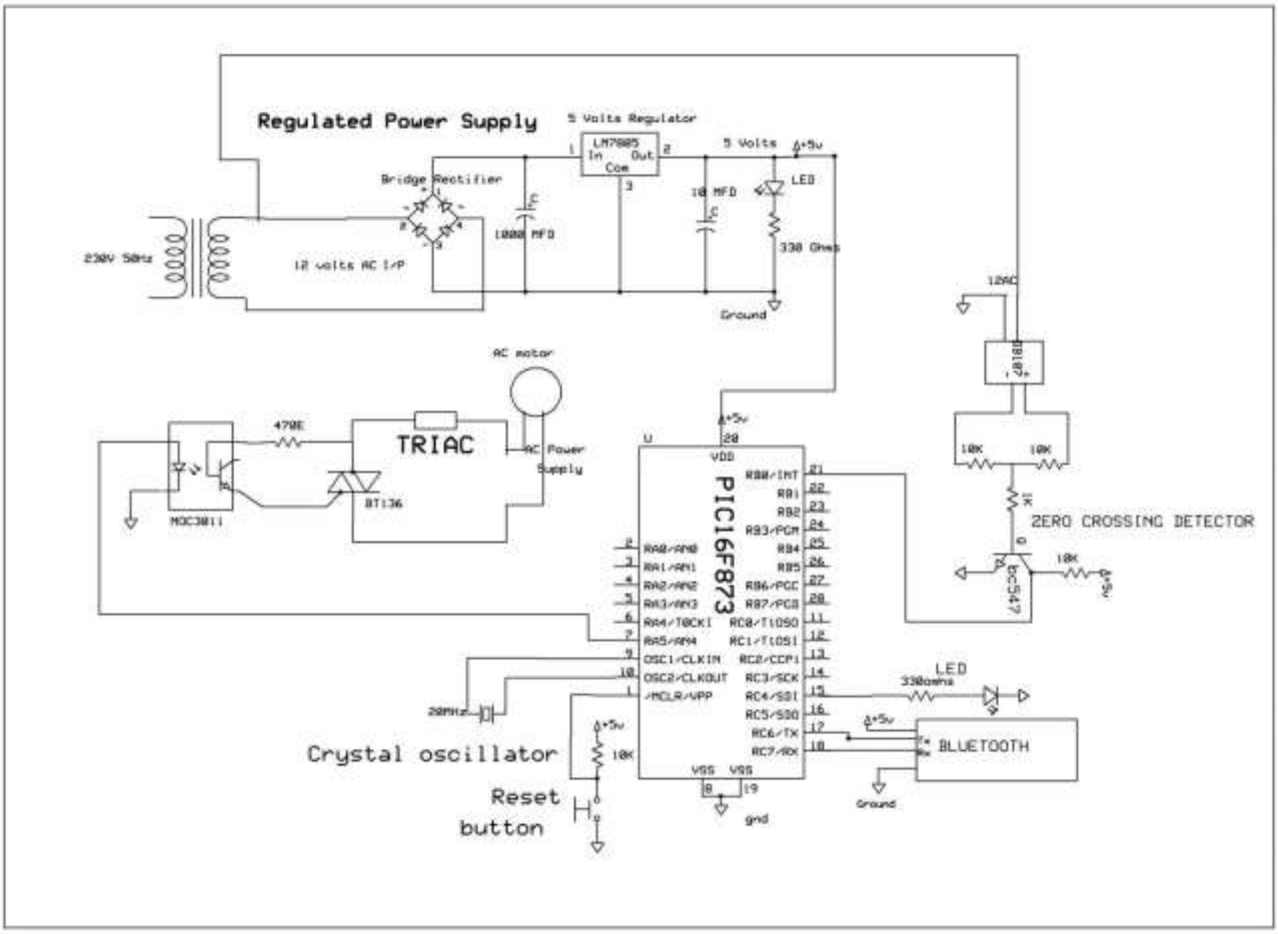
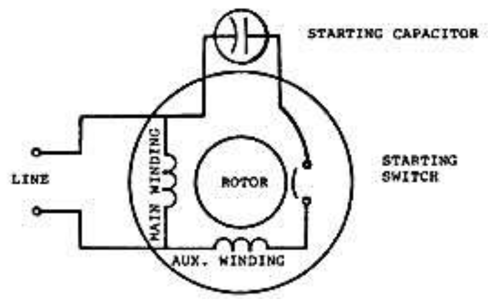


Figure 2. Circuit Diagram of Speed Control Of Induction Motor

(a) Induction motor

In induction motor the current in the rotor need a force and this force is gained by electromagnetic induction from the magnetic field present in the stator winding. There are two kinds of asynchronous motors which are wound type and squirrel cage type. The motor connection between current, time, speed, force and power element can be accomplished from analyze the Steinmetz comparable circuit (IEEE suggested identical circuit). This is a solitary stage portrayal of a multiphase acceptance motor that is substantial steady-state balanced-load conditions.



(b) Micro-controller PIC16F73

Micro-controller PIC16F37 is flash based CMOS micro-controller having 2 additional timers, 2 compare/capture/PWM functions,8 bit analogue digital converter. 3 wire serial peripheral interface is configured by serial port. It is high performance RISC CPU, it has power saving sleep mode, power on reset as well as power up timer and it can operate in the temperature ranges between -40 to +85.

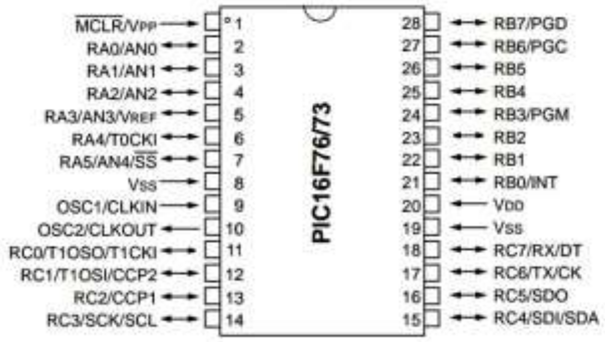


Figure 3. Pin Diagram of Micro Controller PIC16F73.

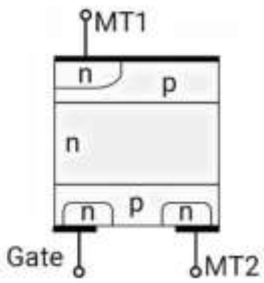
(c) TRIAC

TRIAC is TRIode for alternating current, it is 5 layers and 3 terminal semiconductor device. It's bidirectional device because it conducts the flow of current in two different directions. There are 3 pins in TRIAC.

Pin 1 : It's the mail terminal it can be connected to phase or neutral

Pin 2 : It can be connected to both phase or neutral like pin 1

Pin 3 : It's a gate terminal, it's used to activate the controlled rectifier (Silicon controlled rectifier.



(d)Bluetooth module HC-05

HC-05 is Serial Port Protocol and easy to use Bluetooth module, It communicates through serial communication which provides easy way to interface with micro-controller or PC. The switching mode of HC-05 Bluetooth module is between slave mode and master mode that means it can't use neither transmitting nor receiving data.

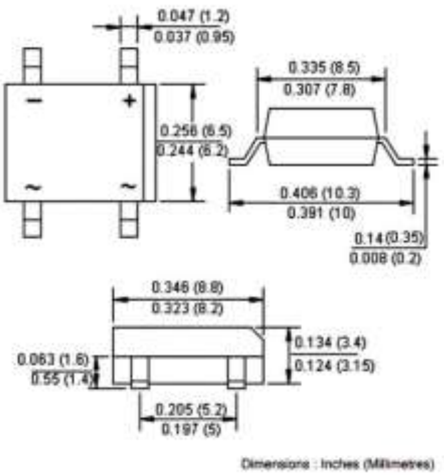
There are 5 pins in Bluetooth HC-05 module

1. VCC- Connected to +5v
2. GND- Connected to ground
3. TXD- Connected to RXD pin of micro-controller
4. RXD- Connected to TXD pin of micro-controller

(e)Mini Bridge rectifier DB10

Bridge rectifier is a small non-linear electronic gadget which converts alternating current to direct current. It is the most ingenious rectifier circuit when contrasted with others. It has higher efficiency then half wave rectifier. The moisture sensitivity level of DB10 is 1 the other characteristics of DB10 are as follows

1. Max forward current 1.0A
2. Max forward voltage 1.1V
3. Operating temperature -55 to 150 degrees C
4. Rating for +fusing 10 A 2sec+
5. Thermal resistance 110 degC
6. Junction Capistance 25.0pF



(f)12 MHz Crystal Oscillator

Crystal Oscillator is an electronic oscillator circuit. It utilizes the mechanical resonance of a vibrating crystal of piezoelectric material so it make an electrical sign that have a fix frequency. The characteristics and specifications of 12MHz Crystal Oscillator are as follows

1. The 12MHz MHz Crystal Oscillator is used as UART clock.
2.It allows integer division to common baud rates.
3.The 12MHz oscillator is a common clock for AVR micro controller.
4.The weight of 12 MHz Crystal Oscillator is 5 grams
5.It's dimensions are 10 x 4.4 x 3.3(mm)
6.The operating temperature is 263K to 333K

(g)Voltage regulator L7805CV

L7805CV is a linear voltage regulator. It gives local on-card regulation. It wipes out the distribution issues related with single point regulation. Mainly it's application is in power management. It ensures internal current limiting, thermal shutdown and safe area protection. It is delivering over 1A output current. The specifications Voltage regulator L7805CV are as follows

1. Fixed Output Voltage is 5V
2. Operating Temperature range 0 to 125°C
3. Input Voltage max is 35V
4. Number of pins are 3
5. Output Current is 1.5A

(h)Opto coupler MOC3021 (Opto-isolator) It is a Zero-Crossing TRIAC driven Opto-coupler. It's main feature is that it has Zero-Crossing capacity that is driven by a TRIAC.As the result is driven by a TRIAC so stacks up to 400V can be driven and the TRIAC can lead in the both the directions subsequently controlling AC loads won't be an issue. Likewise since it has zero-crossing capacity, when the AC load is turned on interestingly the TRIAC will begin leading solely after the AC wave arrives at 0V this way we can stay away from direct pinnacle voltages to the Load and accordingly keeping it from getting harmed. There are 6 pins in MOC3021 Optocoupler and the pin configuration is given as follows

Pin 1 is anode associated with rationale input

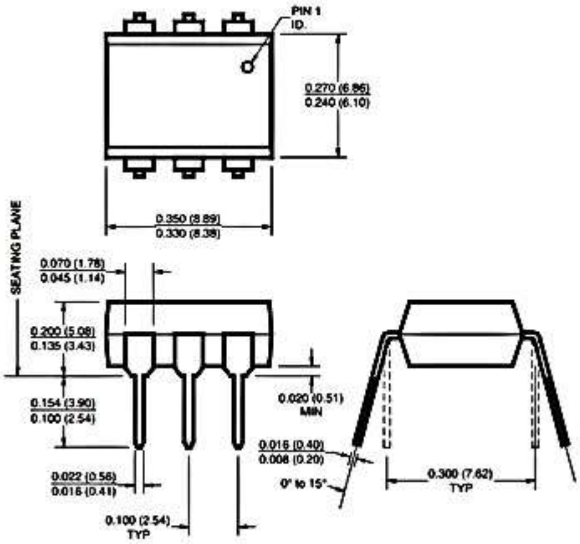
Pin 2 is Cathode pin of the IR LED

Pin 3 is No Connection it Can not be utilized

Pin 4 is Triac Main Terminal 1, One finish of the Triac which is available inside the IC

Pin 4 is No Connection it can not be utilized

Pin 5 is Triac Main Terminal 2 ,flip side of the Triac which is available inside the IC



IV.RESULTS

Levels	Voltage in Volts	Speed in RPM
0	0	Off condition
1	44	450
2	71	805
3	106	1157
4	128	1460
5	153	1710
6	179	2011
7	203	2301
8	221	2670
9	239	2868

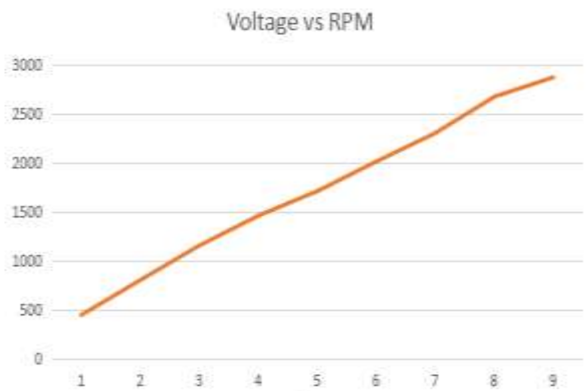
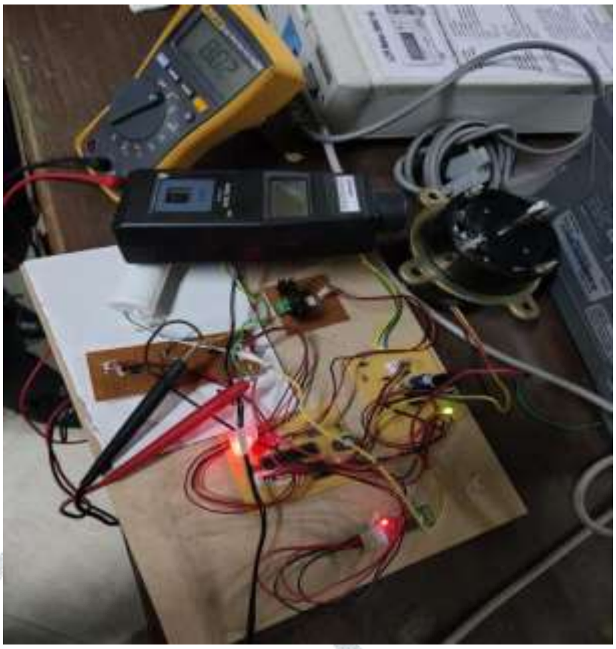


Figure 3. Graph between voltage and RPM

V.WORKING MODEL



VI.CONCLUSION

The main aim of this project has been achieved that is to design and development of a speed control of single phase induction motor by using smart phone. Keeping in mind the current trend of controlling everything wirelessly, we are controlling the speed of induction wirelessly using a smartphone and Bluetooth technology. Every hardware component responded properly including the Bluetooth module which operated successfully.

We have proposed this speed control of induction motor by smart phone keeping in mind the current scenario of people tending to use smart gadgets and control everything with just one tap on smart phone.Also one of the main objective of our project is to make a cost efficient so that everyone including the non-privilege people can also use .Different components were used and tested throughout our project work and finally we have come up with the best and cost effective components. We have learned and also this project has given us the chance to work hard and given us the experience and extra knowledge which will be very effective in future.

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