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"Zigbee Based Speed Control and Parameter Monitoring of Single Phase Induction Motor"

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Abstract: *In Global world the automatic system become most powerful and less time consuming things. Motion control of the systems is required in large number of industrial and domestic applications. The DC drives were widely used for the speed variation in various industries for different application. With a lot of development in technology has led to use of AC drives. Induction motor is being widely used in the Industrial processes. This paper is based on speed control and monitoring the various Parameters of the I.M. using Zigbee. In compare with other modules likes using Wi-Fi, Bluetooth, Zigbee is most portable. As wire connectivity is hazardous for human being, the wireless monitoring system preferred to avoid fault occur at the moment of operation. Thus the main Aim of this paper is the monitoring, speed control of motor with wireless technology which shows the values of Parameter on the LCD Display.*

Keywords: *Zigbee protocol, Ardiuno, LCD, Motor Drive, Microcontroller, Sensors.*

I. Introduction

In global competitive world wireless technology became a necessity. Induction motor is widely used in domestic, commercial and industrial areas. The advantages of using single phase induction motor is having low manufacturing cost, high efficiency and robust in construction. The speed of the single phase induction motor is controlled by various methods such as pole changing method, stator voltage control method, supply frequency control method and rotor resistance control method. The speed of induction motor can be controlled by varying the applied voltage to stator winding. Stator voltage control is method to control the speed of an induction motor. Initially, when the motor is started, heavy current flow through the field winding of the stator because back EMF has not yet been induced. This heavy current can damage the motor. To compensate this, voltage of the stator is reduced.

The torque produced by equation of three phase induction motor is given by

$$T \propto \frac{sE_2^2 R_2}{R_2^2 + (sX_2)^2}$$

In low slip region $(sX)^2$ is less than R_2. So, it can be neglected. So torque becomes

$$T \propto \frac{sE_2^2}{R_2}$$

Since rotor resistance, R_2 is constant so the equation of torque further reduced to

$$T \propto sE_2^2$$

We know that rotor induced EMF $E^2 \propto V$. So, $T \propto sV^2$.

From the above equation it is clear that if we decrease supply voltage torque will also decrease and hence speed will decrease.

The terminal voltage across the stator winding of the motor is varied for obtaining the desired speed by controlling firing angle of Power Semiconductor device such as a Triac. Monitoring the parameters of induction motor is a growing technology for the detection of fault initially. A module of transducer and sensors monitor the parameter of induction motor and transmit the data through Zigbee communication protocol leading to an efficient approach for getting continuous running of the induction motor Reduced Space, Energy saving, Greater life and reliability**.**

II. Zigbee Protocol

Zigbee is a basically communication protocol. Zigbee is a wireless technology which is abundantly used for sensor and control device. The cost of zigbee is very less as compared to other devices such as Bluetooth and Wi-Fi. The Zigbee is work on 2.4GHz frequency. In this project, the command is given to the transmitter side zigbee after sensing the signal then this signal is transferred to the receiver side zigbee.

III. Arduino kit

The Arduino Uno is an open source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The arduino kit is basically consist of number of sets digitaland analog input/output (I/O) pins which is further interface with the other circuits. In this project arduino kit is dedicatedly used for speed control of single phase induction motor.

IV. Methodology

The project proposed to "Zigbee based Speed Control and Parameter monitoring of Single phase I.M." The communication between transmitter and receiver can be made by using Zigbee which is a communication protocol. The Block diagram of the complete system is shown below:-

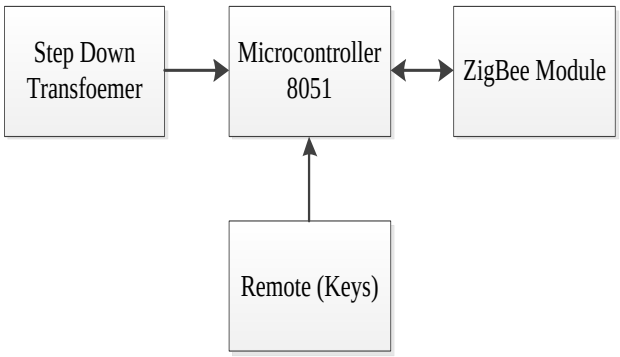

Fig.1:- Block diagram of Transmitter

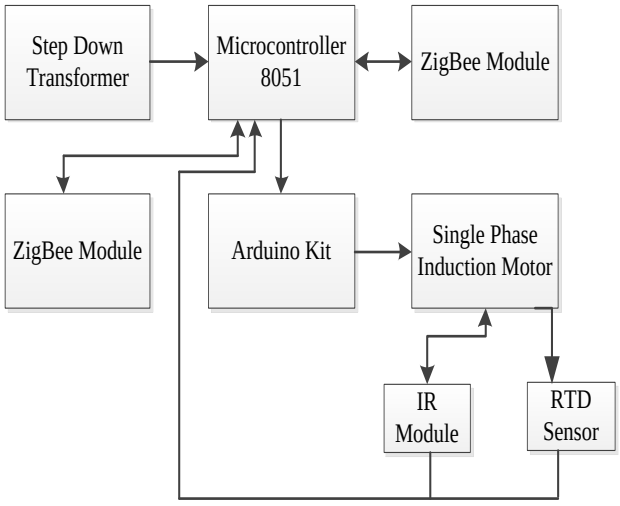

Fig.2:- Block diagram of Receiver

In order to control the speed of single phase I.M. the keys are assigned. As sooner we press key the resultant speed and temperature would be display on the screen. The command sends from transmitter is received by receiving side of zigbee. The single phase AC supply of 230V is step down to 12V and fed to the motor drive. The sensor like Resistance Temperature Detector (RTD) and Sensors for measuring speed i.e.IR sensor are installed on the body of the induction motor. These measured parameter will be shown on the receiving side consisting of the LCD Display. The block diagram for the Transmitter and Receiver section of Zigbee Protocol is shown below:-

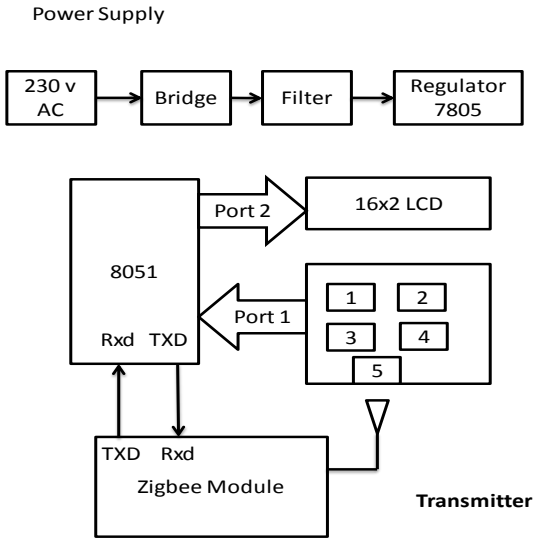

Fig.3:- Complete diagram of Transmitter

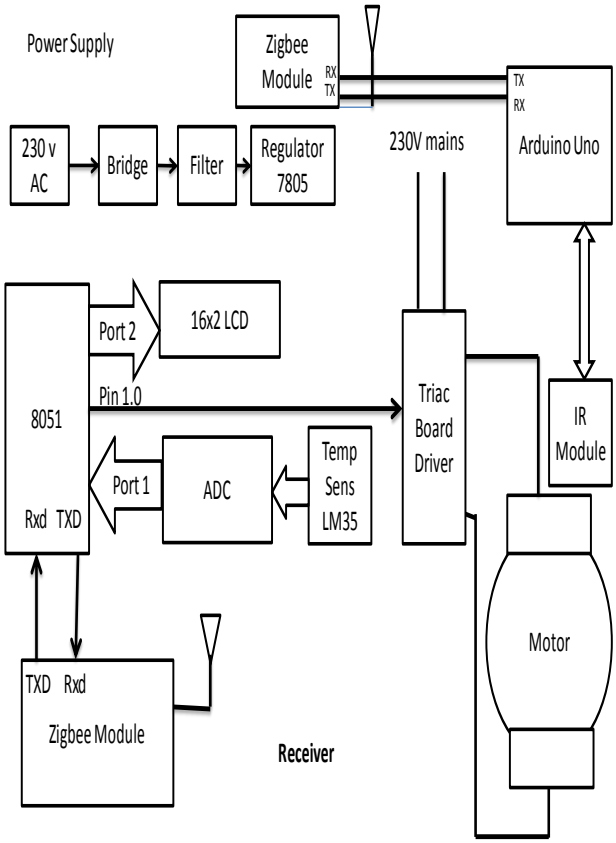

Fig.4:- Complete diagram of Receiver

V. Design and Implementation of Hardware

The single phase 230V AC supply is given to the transformer which is further step down to the 12V AC supply. The bridge rectifier is employed for 12V AC supply to converts the DC supply then pulsating DC supply can be filtered by using capacitor π-filter (1000µF-100µF). This DC supply used to circulate over the circuit. As the key press, the command is red by the microcontroller and further is sense by the zigbee. Then the received data from transmitter side zigbee is transfer to the receiving side of zigbee.

The command received from transmitter to receiver is given to the microcontroller. This command is given to the neighboured side arduino for the control of speed of single phase induction motor. The amount of speed of single phase induction motor is sense by the Infrared (IR) sensor. This speed is shown on the LCD

display. Meanwhile measuring the speed temperature also measure by using Resistance Temperature Detector (RTD). As the temperature is a analog quantity to make it digital we are going to use Analog to Digital Converter (ADC).

VI. Result

This paper is the experimental studies on speed control and parameter monitoring of using Zigbee technology**.** The Experiment is conducted by placing transmitter and receiver at about 25meter far away. The various speed is obtain by pressing the different keys as shows in below table:-

Sr. No.	No. Of Keys Pressed	Speed in (RPM)	Temperature in (^{0}c)
1	1	421	26
2	2	645	25
3	3	892	24
4	4	897	24
5	5	2617	25

Table 1:- Speed Control for Various Keys Selected in Key

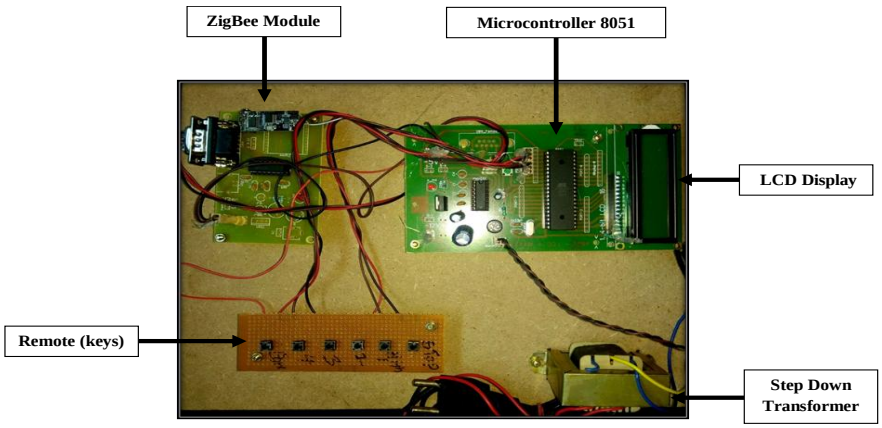

Fig.5:- Transmitter Section For Speed Control of Single Phase Induction Motor Using Wireless Zigbee Technology.

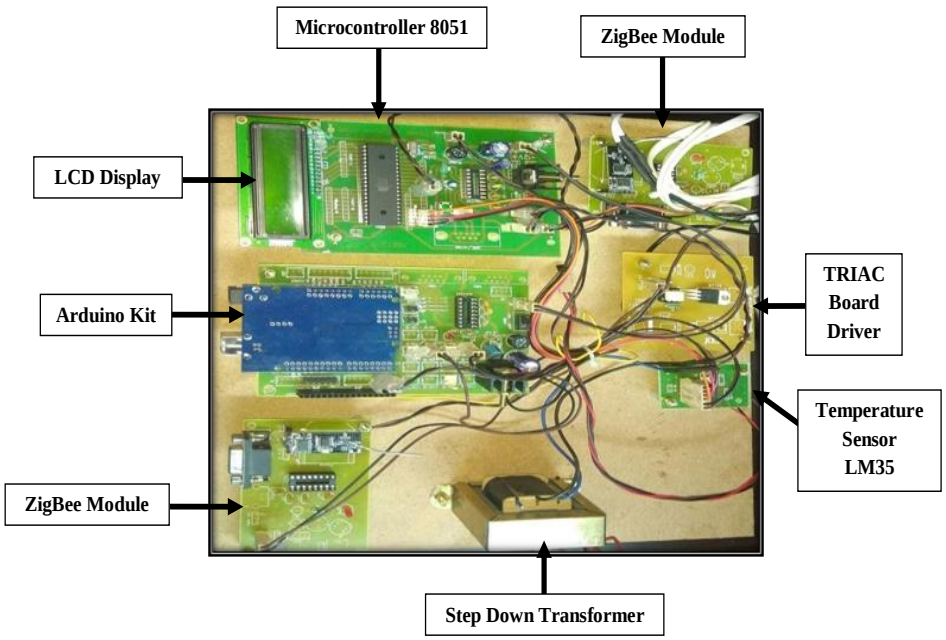

Fig.6:- Receiver Section For Speed Control of Single Phase Induction Motor Using Wireless Zigbee Technology.

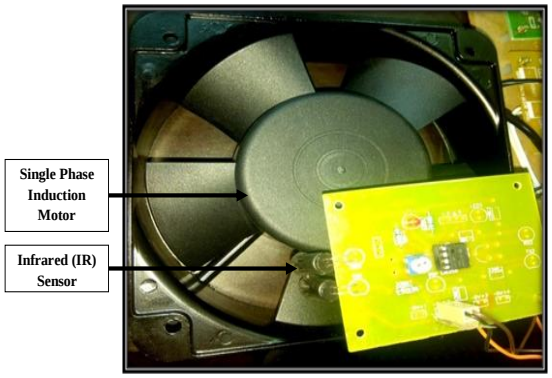

Fig.7: - Single Phase Induction Motor

Sr. No.	Parameters	Rating
1.	Power	100 W
2.	Voltage	220/240 V
3.	Current	0.22 A
4.	Frequency	50/60 Hz
5.	Speed	3000 RPM

Table 2:- Specification of Motor

Fig.8:- LCD Display

Fig.9:- Complete Experimental Setup of Hardware

VII. Conclusion

Among all the method of speed controlling, zigbee based speed control is one of the efficient method. The major reason being use zigbee is economical, reliable and has a long life for any industries and other sector. By analyzing the result we concluded that the speed of single phase induction motor can be control normally, step by step , step down and smoothly varried as per our requirement. Without interface any obstacle we can transfer the data in between transmitter and receiver side. The distance in between transmitter and receiver side wireless

technology keeping at about distance 25 meter. Wireless technology is applicable for square of speed, such as centrifugal pump drives, fan load.

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