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A Review on Zigbee Based Parameters Monitoring and Controlling System for Induction Motor

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ABSTRACT

Induction machines are very useful in many applications, such as suburban, commercial, engineering and utility applications due to its simple construction and low maintenance. They convert electrical energy into mechanical energy. Induction motor also used in household applications, such as pump, fan etc. It may be connected to some other form of mechanical equipment such as a winding machine, a conveyor belt or a mixer. Induction motors have existed before many years ago but were always limited in their application because it was difficult to control the speed of the motor. Monitoring of an Induction motor is a fast upcoming technology for the detection of initial faults. It avoids unexpected failure of an industrial process. Monitoring techniques are of two types as the conventional and the digital techniques. This paper proposes a wireless control and monitoring system for an induction motor based on ZigBee communication protocol. This system is safe and economic for data communication in industrial as well as in commercial fields. A module of transducers and sensors monitors the parameters of induction motor such as current, voltage, speed and temperature and transmits this data through wireless ZigBee Protocol. Microcontroller based system is used for collecting and storing the data. According to this data it will generate control signal to stop or start the induction motor through computer interface developed with Zigbee.

Keywords: Induction Motor, Monitoring System, Wireless control and ZigBee Module.

I. INTRODUCTION

In industries, Single Phase and Three Phase Induction machines are very popular because of their applications. It is necessary to protect them against faults to get uninterrupted output. Generally for various types of machines there are using various parameter controlling and monitoring systems, but in case of induction machine due to the high initial cost and physical conditions, the controlling and monitoring systems are not normally used. To overcome this, monitoring and controlling of induction motor based on Zigbee System is used which makes it more economic and simple. To start with, first we should know what is Zigbee. Zigbee is a wireless communication device as like WiFi and Bluetooth. Basic difference between Zigbee and other communication devices is that all Zigbee devices relay each other's traffic, bypassing the wired network entirely. While Bluetooth devices connect to another wireless that acts as a center and WiFi devices connect directly

to an access point, which is wired to the enterprise network using Ethernet. The Institute of Electrical and Electronics Engineers (IEEE) developed 802.15.4 standards and helped the production of Zigbee protocol and devices that support this protocol. The disadvantage of using traditional systems is that it increases the cost whereas digital systems reduce the cost of system. The basic structure of Zigbee based parameter monitoring and controlling system consists of microcontroller board and zigbee device, one set of microcontroller board and zigbee device are installed at the side of induction machine and acts as transmitter for the other microcontroller and zigbee device which is connected to the computer where the parameters are displayed on computer using software application. In addition to Zigbee Device various other sensors are used i.e. voltage sensor, current sensor, hall effect sensor and temperature sensor for measuring different parameters such as voltage, current, speed and temperature respectively. Wireless sensor network (WSN) system are pollution free, economic and reliable to operate.

II. WIRELESS ZIGBEE TECHNOLOGY

There are three network topologies of Zigbee device. They are Star Network, Cluster-Tree Network and Mesh Network. Different network topologies built up by Zigbee devices like star topology, cluster tree topology and mesh network. For all network topologies, there can be only one coordinator in each network. In star topology there is a coordinator which is responsible for all over the network. All other devices are back-end devices and directly communicate with the coordinator. This topology is suitable for networks with a centralized device and for time critical applications. Next is a cluster tree network where coordinators are still responsible for the Network initiating and maintenance. However, routers can be used to extend the network. Routers control data flow by using hierarchical routing strategies in the network. They also may imply beacon enabled network that is defined in IEEE 802.15.4 for periodical data transmission. In mesh network coordinator is seen as responsible for the network initiating and maintenance. Routers can be used to extend the network.

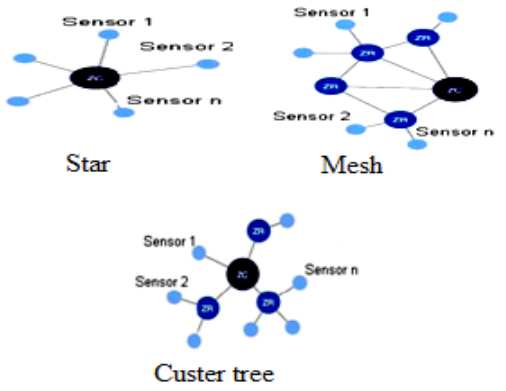

Figure 1. Structure of ZigBee

A mesh network allows full peer to peer communication. A mesh relies on this way self-healing technology so that if a node fails another route is used for the data delivery.

III. MONITORING AND CONTROLLING SCHEME

Monitoring and controlling of induction motor is an embedded system. An embedded system is a combination of software and hardware to perform a dedicated task and to make the system reliable. Fig. 3 shows the block diagram representation of the systems to be designed and implemented. The Block diagram consists of Microcontroller, LCD Display, ZigBee Module, Sensor, Power supply, Relay and Single Phase Induction Motor.

Parameters monitoring and controlling system for single phase induction motor by using ZigBee. A microcontroller is small computer on a single integrated circuit constructed of relatively simple CPU combined with support function such as crystal oscillators and timers. Microcontrollers are used automatically controlled products and devices such as automobile engine control system, office machine etc. The LCD give professional look to the embedded system. It also displays all the parameters of induction motor. The microcontroller stored the all data which collect form sensors according programming in microcontroller. Major role of this system is to collect data from sensor accordingly range of ZigBee adjusts.

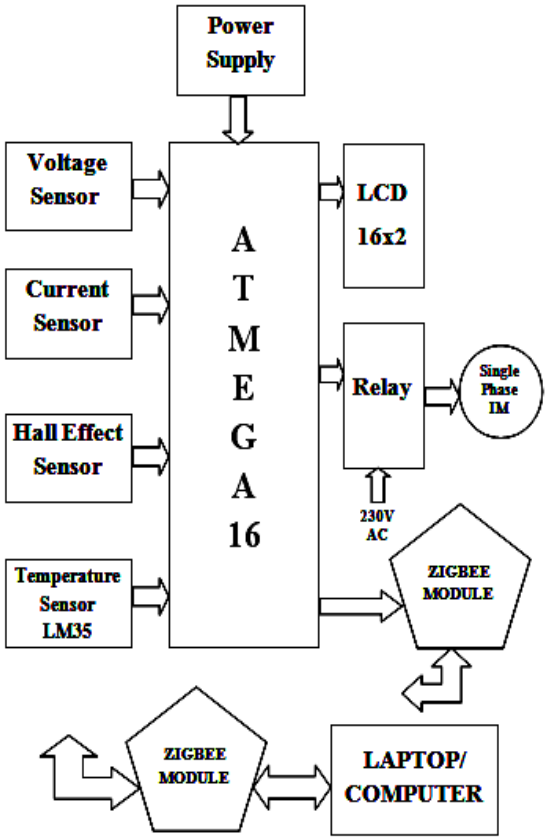

Figure 2. Block Diagram of Proposed System

The microcontroller transfer all the data to the ZigBee Coordinator which act as transmitter of wireless network. The parameters of the motor collected from the system transferred from the ZigBee End Device to the ZigBee Coordinator; and then, they have been transferred to the computer over the USB to TTL protocol. Graphical User Interface used to display received data on the screen to perform controlling commands and to storage data receive throughout the ZigBee system.

Block diagram of hardware system is shown in fig.3. The system consist of single phase induction motor, voltage sensor, current sensor, digital signal controller, a temperature sensor, a desktop computer. To design the interface program java programming used and finally ZigBee module for wireless communication.

The system consist of following component:

a) MICROCONTROLLER

Microcontroller can be termed as a single on chip computer which includes number of peripherals like RAM, EEPROM, Timers etc., required to perform some predefined task. There are number of popular families of microcontrollers which are used in different applications as per their capability and feasibility to perform the desired task, most common of these are 8051, AVR and PIC microcontrollers.

b) VOLTAGE SENSOR

The voltage sensor measures the instantaneous values. It allows for the measurement of direct or alternating voltages with electrical insulation between the primary and secondary circuits. This voltage is passed through an insulating amplifier and is then converted to a secondary output current. This secondary current is electrically insulated from the primary voltage to which it is exactly proportional.

c) CURRENT SENSORS

In proposed system, we used current sensors based on hall effect having Maximum Primary Current 25A, Secondary Voltage (Vo): 2.5 ± 0.625, frequency: DC- 25kHz, accuracy: 0.1%. The Hall Effect is the production of a voltage difference (the Hall voltage) across an electrical conductor, transverse to an electric current in the conductor and to an applied magnetic field perpendicular to the current

d) Hall Effect Sensor

A Hall Effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall Effect sensors are used for proximity switching, positioning, speed detection, and current sensing applications.

e) TEMPERATURE SENSOR LM35

Temperature sensor used in this work is the LM35 semiconductor sensor manufactured by National Semiconductor. The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

f) RELAYS

A relay switch is used for the controlling of induction motor. It performs the on and off operation of induction motor. It can be simply divided into two parts i.e. input part and output part. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section of relay switch consists of contactors which mechanically connect or disconnect. The contactors in a basic relay are of three types: normally open (NO), normally closed (NC) and common (COM). The COM is connected to NC, at no input state. The relay coil gets energized, when the operating voltage is applied to the relay and the COM changes contact to NO. There are Different relay configurations are available like SPST, SPDT, and DPDT etc, which have different number of changeover contacts. We can be switched on and off electrical circuit, by using proper combination of contactors.

g) LCD (LIQUID CRYSTAL DISPLAY)

LCD have a standard ASCII set of characters and mathematical symbols. For an 8-bit data bus, the display requires a +5V supply plus 11 I/O lines. For a 4-bit data bus it only requires the supply lines plus seven extra lines. When the LCD display is not enabled, data lines are tri-state and they do not interfere with the operation of the microcontroller. Data can be placed at any location on the LCD.

h) SOFTWARE DETAILS

The system software is used to build the Java Programming that works under the Windows Operating System. It has highly flexible programming structure. Motor parameters collected from the system transmitted through the ZigBee module to the computer over the RS232 protocol.

In the proposed system for monitoring & controlling of parameters of induction motor Flash Magic software is used. Flash Magic is a PC tool for programming flash based microcontrollers from **NXP** using a serial or Ethernet protocol while in the target hardware. Flash Magic works on Windows XP, Vista, 7, 8 and about 10. 10 Mb of disk space is required.

IV. ACKNOWLEDGEMENT

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