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Zigbee Based Parameter Monitoring System for Induction Motor

Annie.P.Oommen[1], Athira.K[2], Farsana.P.S[3], Merry Maria Abraham[4], Mithuna Anuraj[5]

Associate Professor, Dept. of EEE, Mar Athanasius Engineering College, Kothamangalam, Kerala, India [1]

UG Student, Dept. of EEE, Mar Athanasius Engineering College, Kothamangalam, Kerala, India[2,3,4,5]

ABSTRACT: Nowadays automation has become a basic need for the industries. Induction motors are the nerves of many industries. Hence industrial automation is required for precise and accurate operation. The project ZigBeebased parameter monitoring system for induction motor proposes a wireless control and monitoring system for induction motor based on ZigBee communication protocol for safe and economic data communication in industrial fields where the wired communication is more expensive or impossible due to physical conditions. Current, voltage, temperature and speed of the induction motors are very important parameters for its control system. The performance of an induction motor is directly affected by these fundamental quantities. However, during continuous operation it is difficult to control the machines. In such cases, remote control and monitoring techniques is a better solution to eliminate these hazards. Hence, wireless data communication is used in various industries. A module of transducers and sensors monitors the parameters of induction machine and transmit the data through ZigBee Protocol. A micro controller based system is used for collecting and storing data and generate control signal to start or stop the induction machine through ZigBee.This will provide the same type and quality of services to industrial users as the traditional, wired technologies do.

KEYWORDS: ZigBee, Induction Motor, Wireless Communication.

I.INTRODUCTION

In earlier days dc motors were frequently used for industrial applications. With the invention of AC induction motors that have higher performance attributes over DC motor, industrial automation are being widely done with it. An induction is an electric motor in which the electric current in the rotor, needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. The main advantages of the IM are its reliability, low cost, and simplicity of construction with respect to currently used high performance motors but it is much more difficult to control.

Single phase and three phase induction machines are very popular in the industries because of their vast applications. Hence it becomes necessary to protect them against faults so as to ensure uninterrupted operation and functioning. Various parameter controlling and monitoring systems are present for other types of machine, but in case the of induction machine the controlling and monitoring systems are not extensively used due to high cost of installation and physical constraints. So as to overcome the limitations in monitoring and controlling, ZigBee Based System is used which makes it cost-effective and simple. Monitoring of torque and speed by employing ZigBee based system was a radical step towards automation.

Different approaches have been developed [1]-[6], for induction motor control and parameter estimation, but only partial results were obtained. In [1] and [2] motor is monitored using ZigBee, while in [3] it is controlled by obtaining information regarding stator flux and motor speed. In [4] the control system uses unknown time varying rotor resistance and load torque and in [5] the data is obtained during normal operation. After going through all these papers it was concluded that the ZigBee based protection system of the induction motor is viable and can be safely implemented for the use of industrial automation.

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ZigBee is a wireless communication device like Bluetooth and Wireless Local Area Network (WLAN). Basic difference between ZigBee and other communication protocol is that all ZigBee devices relay on each other's traffic, bypassing the wired network entirely. Bluetooth devices connect to another wireless devices that acts as a hub and WLAN 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 micro controller board and ZigBee device. Micro controller and ZigBee transmitter are placed near induction machine and it acts as transmitter for the ZigBee receiver which is near the computer where the parameters are displayed. In addition to ZigBee device various other sensors are used for measuring different parameters. Wireless sensor network (WSN) system are autonomous operate unattended and adaptive to the environment.

II. ABOUT ZIGBEE TECHNOLOGY

2.1 WIRELESS SENSOR NETWORK

The wireless system for monitoring purpose will not only reduce the overall cost, but also provide flexibility in system in term of distance or location. So these systems are widely used in industries, military, hospitals, home and other commercial areas. According to these aspects the ZigBee becomes the new standard intended for low cost devices in automation, computer peripherals and home controls. ZigBee standard performs well at industrial environments. The developed platform is cost-effective and reduces the energy consumption.

2.2 ZIGBEE NETWORK STRUCTURES

There are three network topologies. They are Star Network, Cluster- Tree Network 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. A mesh network allows full peer to peer communication. A mesh relies on this self-healing technology so that if a node fails another route is used for the data delivery.

III.BLOCK DIAGRAM DESCRIPTION

The whole system is divided into two parts transmitter and receiver. In the transmitter part a network of sensor and transducers are used to monitor the risky parameters such as voltage, current, temperature of stator winding and speed of the induction machine .The monitoring data is simultaneously fed to the microcontroller. This data is transmitted efficiently and smoothly to receiver end through wireless Zigbee Communication Protocol (IEEE802.15.4 Standards). The micro-controller at the transmitter end is so programmed that if the monitoring parameters of induction machine come out of the desired or safety limit, a signal will be generated by the micro controller which will energize the relay circuit and the contactor cuts the mains supply to the induction machine. The data received at the receiver end is transferred to computer system through MAX232 interface. Thus a continuous monitoring of the parameters of induction machine can be done from a remote location far away from the actual working location.

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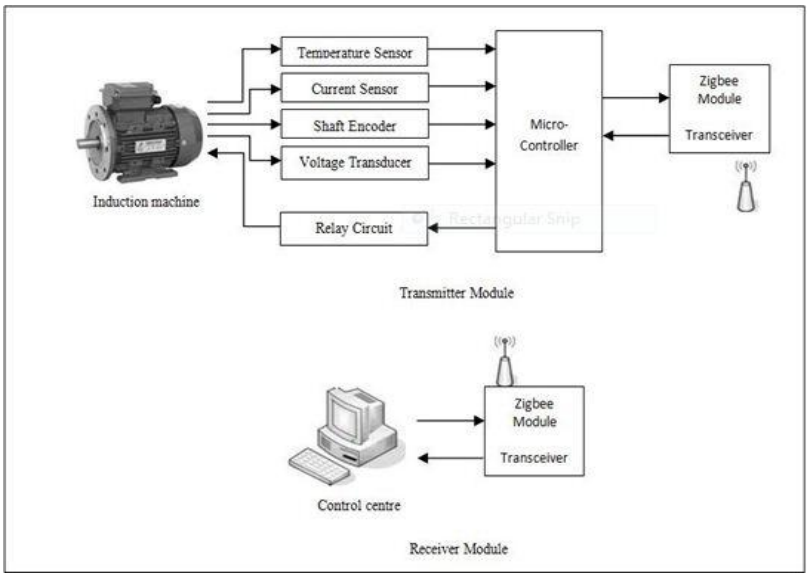

Figure 1: Functional block diagram

If the user anytime wants to start or stop the induction machine, a signal will be given from the computer system present at the receiver end, which is communicated at the transmitter end through ZigBee protocol.Then the micro-controller unit present at plant location generates a signal which energizes and de-energizes the relay circuitry to stop and start the induction machine respectively. Thus this system not only monitors the operation of induction machine but also protects it from the severe faults that commonly occur.

VI.RESULTS AND DISCUSSION

The parameters of induction motor were monitored and they are displayed on the LCD display. The voltage range is set between 200-250V.The current is set at 200mA, temperature at 40 ^{0} C, and speed at 1500 rpm. It was found that the motor will trip and stop operating if any of these parameters deviate from its predefined value. It was able to start and stop the induction machine from a remote location via wireless communication.

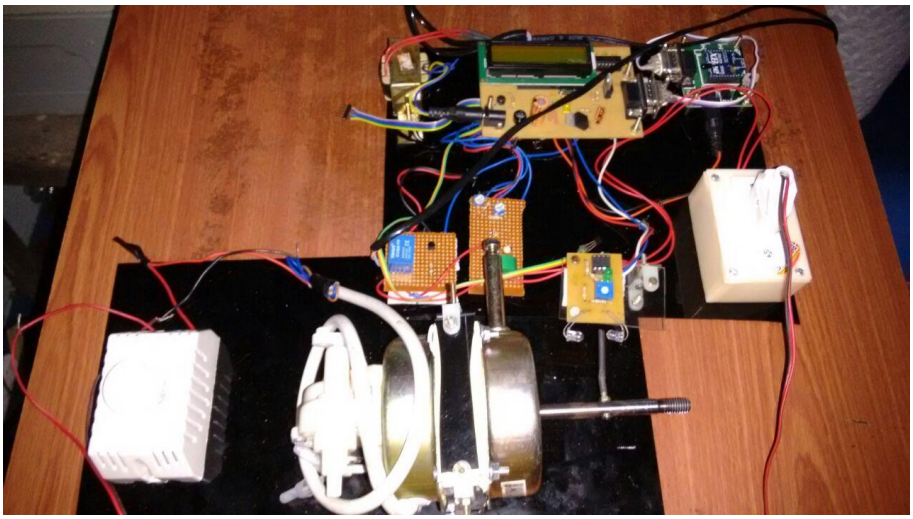

Figure 2: Working model

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V.CONCLUSION

This paper helps in the control and protection of the induction motor. It also put forward a cost effective model for controlling and monitoring of induction machine. Protection system initiates the tripping of the motor under abnormal conditions. The parameter set values are stored in the microcontroller. If the values shows any slight variations from these set values then the relay circuit energizes and the motor trips. It was also found that starting and stopping of the motor could be done from a remote location. Only when start permissive conditions are satisfied, the motor starts. Thus induction motor can be protected from the plant location as well as from the remote location.

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