

# Wireless Machine Wear Condition Monitoring Using ZigBee Technology

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**Abstract:-** Advanced sensor technology has brought the automated real-time condition monitoring system. To decrease the rate of accidental failures, increase productivity, reduce time lags, Condition Monitoring has been increasingly used. It is a predictive maintenance technology and can greatly reduce time and efforts in detecting failures. The wide variety of condition monitoring techniques available make it possible to detect failures way before the machines actually fail. Condition monitoring is very prompt technology and avoids unnecessary and incessant manual checking which becomes quite cumbersome and has greater chances of negligence. In this paper, the emphasis is laid on the use of Condition Monitoring technology to prevent accidents due to failures and to make an advanced inventory preparedness.

**Keyword:** Mechanical wear, Wireless sensor, Server, ZigBee, Safety, High Productivity.

## 1. INTRODUCTION

The mechanical parts of a machine are subjected to mechanical wear and tear. The wear is greater in running parts of a machine. In order to ensure that the machine parts do not fail suddenly, monitoring is done. Before the concept of using sensors for monitoring was developed, a skilled inspector would have to monitor the parts. This required manual checking of various factors like deviation, cracks, bends and deformations, noise and temperature. Often, the machines would have to be stopped from running during an inspection. This greatly increased the idle time of machines. Secondly, detecting fatigue, creep, vibrations etc. on regular basis is not feasible. But, after the use of sensors for monitoring the problems associated with manual monitoring were greatly eliminated [1].

To estimate the wear condition of the mechanical parts several sensor systems were proposed. Hou and Bergmann [2] designed a wireless sensor system to log the operating signals of vibration and temperature, these formed the basis for condition monitoring using sensors. The early sensor-based monitoring systems used Bluetooth for transmitting data wirelessly and later, WiFi technology was also used. However, the data transmission is quite slow and unreliable and the technology is quite costly. H. C. Mohring and O. Bertram [3] installed ZigBee wireless module and sensing component of machinery parts. The ZigBee transfer system greatly enhances the performance and is supposed to be cheaper than WiFi and faster than Bluetooth technology. The aim of the paper is to emphasize the use of condition

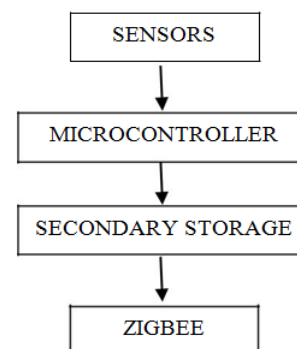
monitoring by using ZigBee wireless technology to increase productivity because of the following two reasons:

- 1) Reduce time in getting new machine parts after a machine fails. This is possible because monitoring helps us detect the condition of running parts and gives us an advanced warning about the failure of parts. The parts can be bought or inventory can be made available prior to the failure of parts.
- 2) If a machine part fails suddenly, it can cause accidents and can damage a machine considerably. By using condition monitoring, the life of operators, as well as machines, are kept safer.

## II. SYSTEM DESIGN AND ARCHITECTURE

The wireless condition monitoring setup, consists of the following three parts:

- 1) Sensor Node on machine tool
- 2) Server
- 3) ZigBee



**Fig. 1 SENSOR NODE**

**TABLE 1**  
**SERVER DETAILS**

RF TRANSCEIVER: ZIGBEE  
INTERNAL STORAGE: RAM  
SECONDARY STORAGE: SD CARDS

**ZIGBEE**

It is a low-cost as well as low-powered mesh network which is widely deployed for monitoring and controlling applications. Its coverage is 10-100 meters. This system is less expensive and simpler than Bluetooth and WiFi technology.

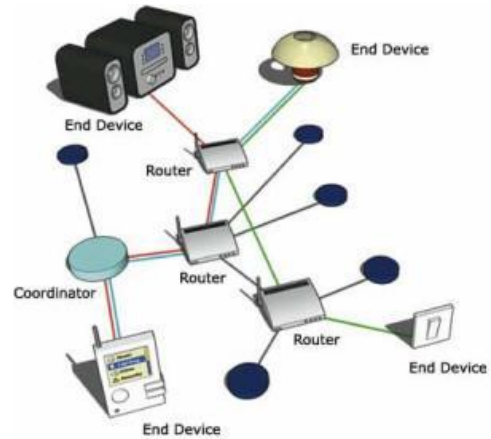


**Fig. 2: A ZigBee Modem**

ZigBee structure is made of the following three different types of devices

- 1) ZigBee coordinator
- 2) Router and
- 3) End device.

A ZigBee coordinator which coordinates and acts as a root and bridge of the network. The coordinator is responsible for handling and storing the information while transmitting and receiving data. ZigBee routers can be used to permit data to pass to-and-fro through them to other devices. End devices communicate with the parent nodes in such a way that the battery power is saved. The number of coordinators routers and end devices depends primarily on the type of network used.

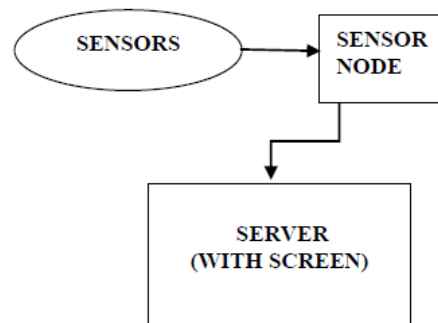


**Fig. 3 ZigBee Network Operation**

**III. PROCEDURE**

The procedure to acquire the aim of the paper is as follows:

- 1) Employ the sensor node setup on the machine under the working condition. The parameters like speed, Temperature, load, fatigue and vibration of the operating machine part are measured by tachometers (speed) radiation thermometers(temperature), load and Fatigue sensors and vibrometers (vibrations) respectively.
- 2) The data from the sensing elements enters the sensor node and is stored in the secondary storage of sensor node.
- 3) From sensor node data is transmitted wirelessly through ZigBee
- 4) The data from the ZigBee is received by the server.
- 5) The data is displayed on the screen attached to the server.
- 6) The data is analysed by the operator.
- 7) Action is taken according to the data analysis



**Fig. 4 Wireless System Setup**

#### IV. CONCLUSION

With the ever-increasing use of wireless technology, the systems are becoming better in performance, cheaper and more reliable. The wireless monitoring has also become cheaper because they are becoming inexpensive and work on less power [4][5]. This has a greater advantage and is thus being used in industries, automotive and aerospace. [6]

Use of Wireless Conditioning Monitoring system has incorporated considerable changes in the safety of production and reduction in maintenance and inspection costs. Condition Monitoring is aimed at minimising the need for human inspection which is time-consuming, costlier and inaccurate. This maximises machine productivity and quality by reducing the costs associated with repair and maintenances. Ultimately, the overall production costs are considerably reduced.

#### V. PROPOSAL

Mechanical wear condition monitoring in real time has been a popular issue. The sensor technology is continuously advancing and condition monitoring has never been accurate and easier before. With the help of the wireless technology, many problems due to data cables and expensive optical cable are now minimized and eliminated. Sensor and ZigBee module combined proved to be an excellent solution for short distance wireless data communication. The authors were able to compare the sensor outputs from wired and wireless sensors.

The authors want to put emphasis on the use of Condition Monitoring in every industry such that prompt decisions can be made. This will greatly reduce the equipment related failure accidents [7] and improve productivity.

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