# IMPLEMENTATION OF INDUSTRIAL WIRELESS SENSOR NETWORK

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***Abstract*- Primary objective of this paper is "Industrial parameter monitoring" through serial communication and to develop an embedded system which will monitor all the devices through Zigbee enabled wireless technologies. Since the monitoring application have been developed in medicine, agriculture, military, building, motion tracking and many other fields which involves the measurement of voltage, current, temperature, etc., These can be done by using sensor which are configured to measure internal temperature, remote temperature, remote current, remote voltage.**

***Keywords: Zigbee, Automation, Sensors, Wireless Sensor Networks, Monitoring & Control***

## I. INTRODUCTION

Industrial Automation Networks involves Programmable Logic Controller (PLC) or Distributed control system (DCS) that communicate with the sensors to collect the data related to the process. To provide the control PLC or DCS act on the physical variables measured by issuing the commands or signals that activate relays, solenoid, motors and actuators. Developments in Wireless Sensor Network domain plays an important role in the implementation of an Industrial monitoring and Controlling Network, which contains number of sensor nodes that measures the value of physical parameters such as Temperature, Pressure, Flow, level, Density etc., and transmit them to the centralized control room through intermediate nodes or remote control panels present in field.

Generally this can be achieved through wired networks by involving standard 4-20mA Electrical System. Wired Industrial monitoring and Controlling Network increase the implementation cost because the cost of cabling and structural support arrangement may be sometimes higher than the cost of Transmitter itself and also leads to increase the maintenance cost.

Wireless Sensor Technology has been effectively is an open standard. This paper proposes an Intelligent Industrial Automation system based on Wireless Sensor Network which may be implemented in Home Automation, Environmental monitoring, Health monitoring and so on. Bluetooth, X-10, Wi-Fi and Zigbee are the suitable wireless technologies to be employed in above mentioned areas. The wireless technology like Wi-Fi and X-10 are not suitable for Industrial automation applications because Wi-Fi is most suitable for high data rate application and X-10 is most suitable for very low data rate applications only.Hence Bluetooth and Zigbee may be the suitable wireless technologies for low data rate application like monitoring and control.Zigbee is capable of establishing two way communications between multiple devices over a simple networks using low power and with low cost. It uses license free 2.4 GHz band and IEEE defined 802.15.4 standard.

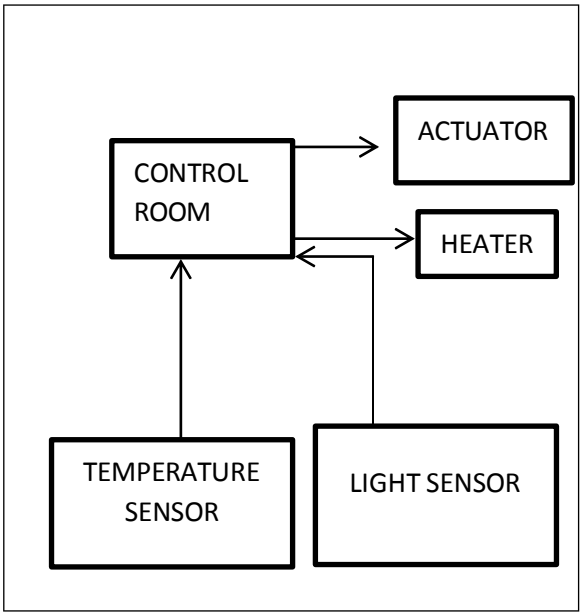



**Fig 1. Traditional Industrial Monitoring System**

## II. Traditional Method

In wired Industrial Automation Network (Fig 1) closed and open loop control is achieved by passing the values of physical variables measured in the process to the base station through signal cables. The control action performed by the controller present in the control Room.

As a result the controllers will send signal to the final control element, which in turn cause the changes in the process to maintain the physical parameters at desired value to perform closed loop control. In the above method in case of melting of cable it may either leads to shut down or reinstallation it may further leads to production loss as well as large reconfiguration cost.

## III. Proposed Method

Wireless sensor networks (WSNs) provide one potential solution to tackle the above listed challenges. Compared with a wired system,WSNs have many inherent advantages, such as relatively low cost, convenience of installation, and ease of relocation. These merits make a low-cost condition monitoring system for noncritical equipment possible.

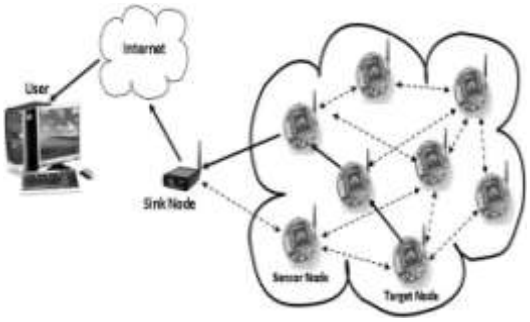



**Fig2. Proposed Monitoring Method**

However, industrial processes and devices have unique characteristics that make further demands on industrial WSNs (IWSNs), such as processing heterogeneous sensor signals, higher sampling rates, faster data transmission rates, and higher reliability.In our proposed method radio module is either electrically powered or battery powered data transmission or reception must occur through wireless.

a. Sensor Network Architecture

Wireless sensor network (Figure 2)is thenetwork of tiny low power devices capable of performing Sensing,Processing,

and Communication within the single chip**.** Wireless sensor network [6] classified into two types. First one consists of hundreds or thousands of node operate in large geographical areas. This network used in communication, military, and environmental monitoring. Second one consists of ten of sensors which used in remote measurement applications.

1. Sensor node consists of following components
Sensing sub system (Sensor which consists of Signal conditioning & A/D convertor)
2. Processing subsystem (Microcontroller with Small amount of data storage)
3. Communication subsystem (Radio module)
4. Power supply

b. Monitoring & Data logging

In particular, the following two functionalities are of great significance [1].

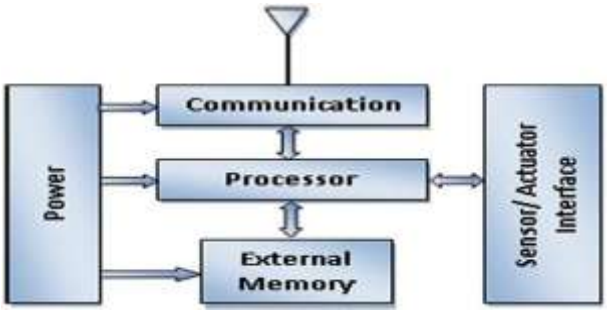



**Fig 3. Typical Sensor Node**

1. Graphic interface. The graphic interface allows representing the whole system display the status of all or part of the field. This allows the human operator to evaluate how the system is working and to recover quickly from critical conditions.
2. Historian module. The historian module Allows to record all significant parameters and to display them as suitable graphs. This can be useful to discover the reasons of some problems which occurred in the field.

Several IWSNs for industrial device monitoring have been developed. Most of these applications only use WSNs for data acquisition and transmission and complete the feature extraction and fault diagnosis functions on a central computer. On-sensor feature extraction and fault diagnosis is a promising alternative approach to raw data transmission, which can reduce the quantity of transmitted data, save node energy, and prolong node lifetime.

c. Communication Technologies
Commercially available wireless protocols (Table 1) for WSNs, including IEEE802.15.4,IEEE802.11(Wi-Fi), and IEEE802.15.1 Bluetooth). IEEE 802.15.4 was demonstrated IWSNs. Three protocols based on the IEEE802.15.4 physical layer, ZigBee, Wireless HART, and ISA 100.11a, will be explored.

| | Zigbee | Blueto oth | Wibree | Wi-Fi |
|---|---|---|---|---|
| **Frequenc yband (GHZ)** | 2.4 | 2.4 | 2.4 | 2.4 |
| **Range (ft.)** | -11.6 | 30–300 | Up to 10 | 100–150 |
| **Data rate (Mbps)** | 250 kbps | 1 | 1 | 11-54 |
| **Power** | Low | Mediu m | Low | High |
| **Cost** | Low | Low | Low | High |
| **Modulati on/proto col** | DSSS, CSMA /CA | FHSS | FHSS | DSS S |

**Table 1. Comparison of Communication Technologies**

d. ZigBEE


**Fig 4:ZigbeeNetwork**

Nowadays, Zigbee [4] a de facto standard for WSNs has become one of the most promising protocols for wireless home networking and automation due to its low power consumption, low cost, and support for various ad hoc network configurations. ZigBee is a radio frequency (RF) communications standard based on IEEE 802.15.4.

The Zigbee coordinator is responsible for creating and maintaining the network. Each electronic device (i.e. Washing Machine,Television, Lamp etc.) in the system is a Zigbee device managed by the coordinator. All communication between devices propagates through the coordinator to the destination device.

The ZigBee standard theoretically provides 250kbps data rate, and as 40kbps can meet the requirements of most control systems, it is sufficient for controlling most industrial automation whereas Wi-Fi provides 54 Mbps. Soit only suitable for high data rate applications.

e. ZIGBEE BASED MONITORING SYSTEM

The Zigbee network [5]Fig.5depicts the monitoring networks by a ZigBee network system. The networks include a master node connected with a server PC and a series of client nodes, which are classified into master, sensor, gatherer, actuator and, controller. The main functions of each element are described as follows.

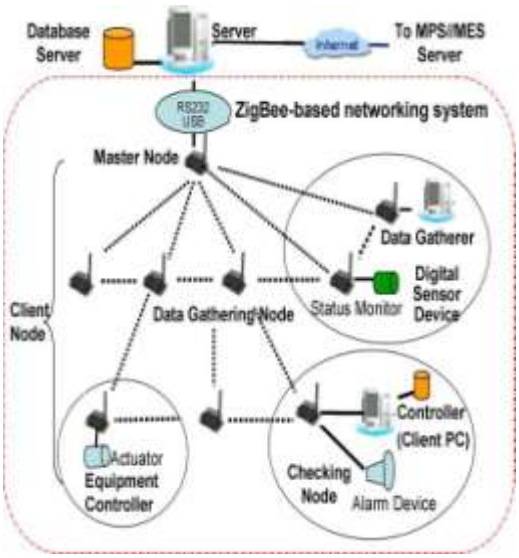


Fig 5.Zigbee Based Monitoring System Server: Issues commands to the networks and collects responding information from the sensor network. Database: Logs the system configuration data and monitoring data. Master Node:Collects original monitoring data and reports to management software; connects with the Server via a USB or a RS232 port. Gathering Node (Reader): Composes the backbone of data collecting and status monitoring network. Equipment Controller: Controls the actuator action to start or close the connected equipment/machine. Checking Node (controller):Acts as a checker a client PC can connect with a checking node used to display the real-time message of the system and issue control commands to the network when a specified event occurs. Alarm device:Functions as an emergency reporter used to notify the production controller.

## IV. IMPLEMENTATION:

Fig 6 shows the typical transmitter diagram. It consists of Sensor, Communication module, Processor& Power supply. Sensor usually deployed in the field, from where the sensed phenomenon is transferred via transmitter to the control station which has receiver from that received information controller will initiate corrective action to establish control.The above implementation setup capable to cover up to 30 meters in order to address the large area relay concept may be applied


**Fig 6.Typical Transmitter**

Fig7. shows typical receiver diagram. It also has the same components as above.

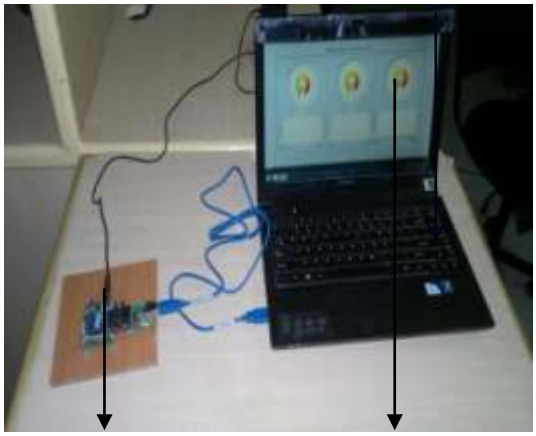



**Fig 7. Typical Receiver**

Fig 6 & 7 Shows the experimental setup for the data transmission and reception.

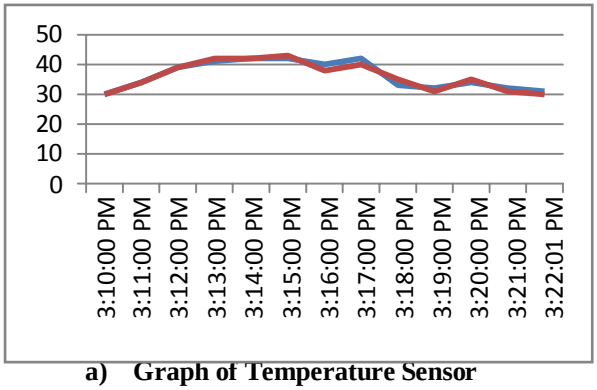
## V. RESULTS & CONCLUSION

The experiment conducted for 15 minutes by keeping TX and RX at the distance of 30mand observe the results. The table 5.1& 5.2 given below summarizes the TX and RX values at time distant.

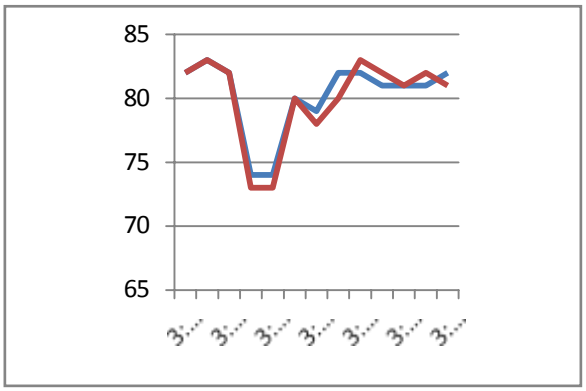
| TIME | TX TEMP | RX TEMP | TX LIGHT | RX LIGHT |
|---|---|---|---|---|
| 3.10 | 30 | 30 | 82 | 82 |
| 3.11 | 34 | 34 | 83 | 83 |
| 3.12 | 39 | 39 | 82 | 82 |
| 3.13 | 41 | 42 | 74 | 73 |
| 3.14 | 42 | 42 | 74 | 74 |
| 3.15 | 42 | 43 | 72 | 71 |
| 3.16 | 42 | 40 | 79 | 78 |
| 3.17 | 43 | 41 | 82 | 83 |
| 3.18 | 32 | 32 | 44 | 40 |
| 3.19 | 44 | 42 | 70 | 70 |
| 3.20 | 32 | 31 | 81 | 81 |

**Table 5.1.Tx& RX from temperature sensor& Light Sensor**

The following graphs(a,b) depicts the relationships between TX & RX value.




**a) Graph of Temperature Sensor**




**b) Graph of Light Sensor**

—— TX Value,_____RX Value

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