



## **Environmental Monitoring System With Wireless Mesh Network Using Zigbee**

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**Abstract :** Communication has become easier via many wireless technologies. With the advancement in sensor technology a wireless environmental monitoring system in mesh network has been built to monitor the temperature, humidity and the gas present in the observed environment. The sensor system is developed using Zigbee module with the competence of mesh networking. The sensors are distributed in the different nodes that constitute a wireless sensor network, which is capable of monitoring, processing and communicating the continuously sensed data as packets in regular intervals to the overall controller. The processes that are taking place in the system are data acquisition, data processing and filtering, data storage and sending. The system consists of a PIC 16F877A microcontroller based measuring units that collects the value of temperature, humidity and the pollution causing gases and finally the results are sent to PC where data is stored and displayed in numeric form. The system contains four nodes connected in mesh network. The main advantage is data routing, that is, the collected data will be routed to the other node and then transmitted without any interruption even any one of the nodes in between gets failed. The system is combined with high reliability and performance. The system is also helpful in the implementation of monitoring applications without the technical hitches of complex wireless networking.

**Keywords :** Zigbee, wireless sensor network, data routing, mesh network, PIC 16F877A microcontroller.

### **Introduction**

Environmental issues are the major crisis in the fast moving world. These environmental issues may cause adverse effect in the social life of the people. It may have great impact on the health of the people. Thus to monitor the parameters of the environment such as temperature, humidity, pressure, pollution causing gases and many more which vary according to the observed environment, a wireless environmental monitoring system is developed. The system is also very useful in industries where some sections cannot be monitored manually.

A Wireless Mesh Network (WMN) is the very important in environmental monitoring system. It may have more than one node which is wirelessly connected in mesh topology. To transmit and receive the data from the nodes Zigbee module is used which is reliable in delivering the data between the sensor nodes. The Zigbee module is based on the IEEE standard 802.15.4.

A wireless sensor network consists of spatially scattered self-directed devices which use sensors to communally scrutinize physical environmental state of affairs such as temperature, humidity, water level,

pollution causing gases and pass their data through the network to a main location. When compared to wired systems, the relocation of the measurement points when required is faster and easier by immediate moving sensor nodes from one locality to another within a communication range in Wireless Sensor Network (WSN). The self-organizing competence is a great deal provided by distributed cluster mechanism. This system is more valuable in the environment where manual movement is not possible.

### **Methodology**

Most of the existing methodologies are based on the ARM architecture and it is dependent on base station. The existing system consists of sensor nodes, gateway and a base station. The sensor nodes are wired and not wireless due to cost problem. The data collected by the sensor network is forwarded to the gateway and then the gateway then forwards it to the base station. The control systems are either a centralized or a distributed one. The major difference between the centralized and distributed system is that, in centralized system the data collection is accounted to a single constituent whereas in distributed system it is distributed in the course of the system components. The shortcoming of these control systems is that they are not developed for WSN and they do not exhibit an energy proficient system.

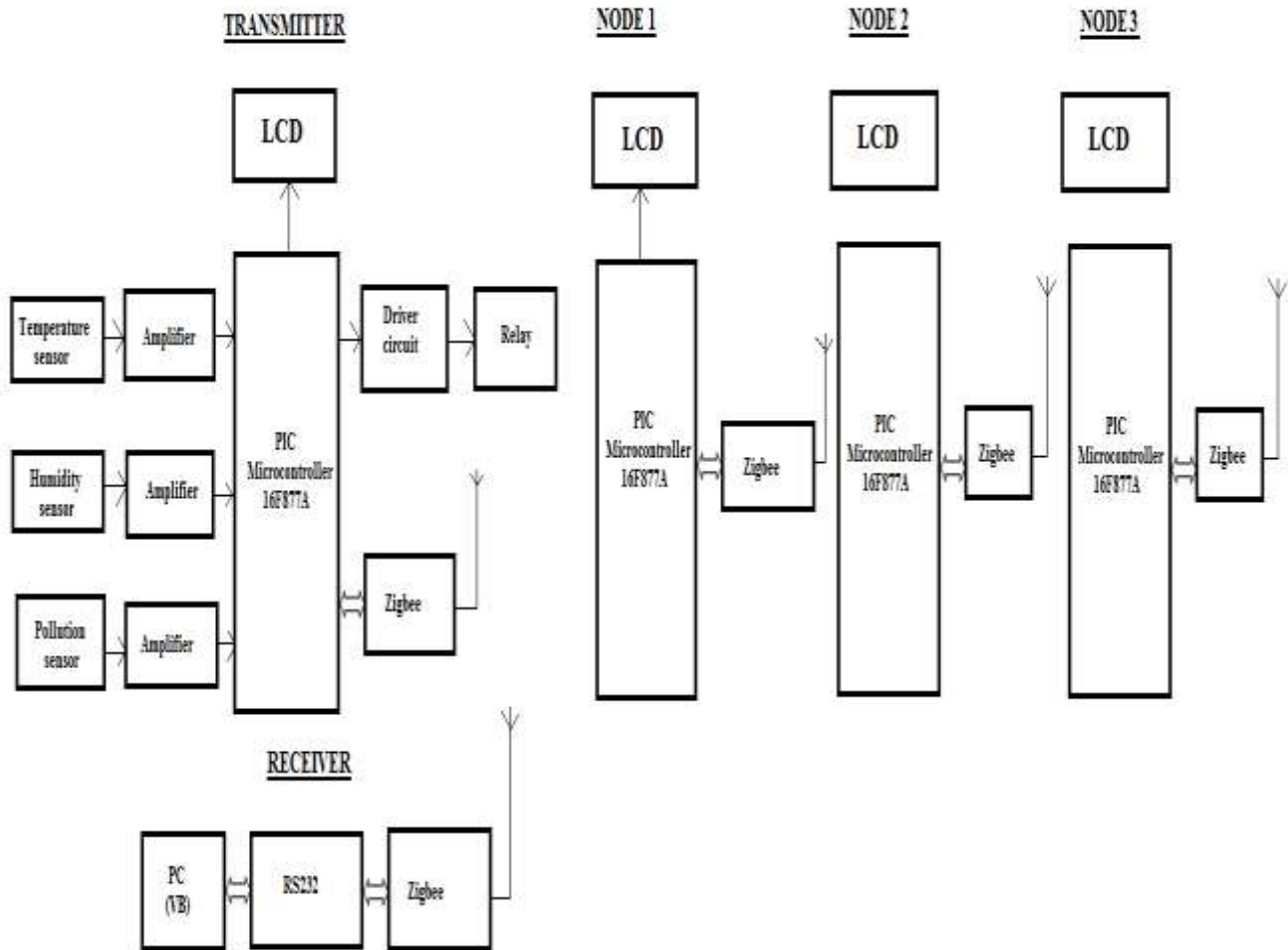
The exercise of sensors in the environmental monitoring system authorizes a real-time monitoring and an improved analysis all the way through expedient distribution. The gateway normally uses Ethernet communication. The operating systems for wireless sensor network are similar to embedded system. The requirements of wireless sensor networks include responsiveness, mobility, reliability, flexibility and cost. The complications in applying WSN in environmental monitoring applications incorporate higher costs and short of standardization on WSN communication protocol.

In Wireless Mesh Network (WMN) most of the traffic originates in the gateway. A wireless mesh network is a type of Mobile Ad-hoc Networks (MANETs). Only routing between nodes and gateways of the wireless mesh network is maintained by the routing protocol in many of the existing systems. Dedicated relay nodes and the information regarding the location in MANET protocols attempt to minimize the flooding overhead. The wireless links are unreliable and this makes the MANET protocol less competent. It is also incompatible for networks which lack centralized structure. But it is uncomplicated and easy to employ. It is also appropriate in wireless mesh network worn for internet access. The system is well suited for WMN circumstances in which there is a traffic flow between the nodes of the network and the centralized gateway.

### **Proposed system**

Environment monitoring system is used to monitor the environmental parameters like temperature, humidity, pollution. The proposed system is very much useful in the meteorological department. In the meteorological department, they have to monitor these environmental parameters in order to prevent drastic conditions. The environmental parameters should be kept under certain conditions, for that we need a testing system, that should monitor and it should give alarm for the critical conditions of those parameters. The system will have the following features like monitoring as well as for indication purpose.

The system is implemented with the help of ZIGBEE technology. The implementation of ZIGBEE will have the following features. The accuracy will be more. If multiple parameters are to be monitored, the software will support multitasking options. Any number of parameters can be monitored using the system. Here the parameters like temperature, humidity, pollution are monitored. All the three parameters are monitored with the wireless techniques.



**Fig 1. Block diagram of environmental monitoring system**

The Temperature can be measured with the help of thermistor sensor. The resistance variation in the sensor will be converted into voltage variation with the help of an amplifier circuit. Then the amplifier output will be amplified and that will be given to the PIC microcontroller.

The humidity can be measured with the help of humidity sensor. The value can be measured by using data acquisition configuration by accessing the analog port using the program, which acquires the value from the hardware unit. The pollution can be measured with the help of gas sensor. The value can be measured by using data acquisition configuration by accessing the analog port using the program, which acquires the value from the hardware unit. PIC microcontroller is connected with ZIGBEE through RS 232. This ZIGBEE transmit the signals from the PIC microcontroller to the PC. In receiver side ZIGBEE receives this signal and given to the PC through RS 232.

The advantages of the proposed system are the low power consumption, reliability and compatibility. Moreover the design cost of the circuit is low and maintenance is easy and good. By using microcontroller IC much more controlling action can be created.

### Experimental result and discussion

The environmental monitoring system consists of four nodes which are connected in mesh topology. A step down transformer is used because only 5 to 9V of power is required to run the circuit. Bridge rectifier is used in the circuit to convert alternating current to direct current. The sensors in the nodes senses the temperature, humidity and the pollution causing gases in the environment which is subjected to study. The data

collected in the sensor nodes are transmitted wirelessly through the Zigbee module to thereceiver via the nodes connected in mesh network. Each node in the network consists of a LCD to display the data collected in that node. If any of the nodes fail to transmit the collected data due to some interruption or malfunction in the node, the data gets transmitted through the other nodes to the receiver since they are connected in mesh network. Finally the data received are displayed in the personal computer using visual basic software. The personal computer is connected to the network by using RS232. Thus the data collected are transmitted at the required rate and received without any loss and eventually displayed in the personal computer for any actions to be taken if the data does not meet the required conditions and norms that the environment should possess.

**Table 1. Observed results of the environmental parameters**

Parameters	Node 1	Node 2
Temperature	38	35
Humidity	1	1
Gas	20	21

## Conclusion

Thus as per the above project the temperature, humidity and the gas present in the environment, that is, in the room has been detected by the sensors in the sensor node and the corresponding output is displayed using a Liquid Crystal Display(LCD) with a single node in the Wireless Mesh Network(WMN). The proposed system is demonstrated to have the advantages of low-cost combined with high reliability and performance, and can be useful in implementing monitoring applications without the complications of complex wireless networking issues. In the proposed system precautions can be when required if the parameters exceed the normal value.

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