# ZigBee based Weather Station Monitoring System

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*Abstract*---Many significant weather events have affected our life over the years. Today, the temperature, wind and other weather parameters are of equal concern and can have an even greater impact on our high-tech life style. Weather affects a wide range of man's activities. This can cause the movement of gases through the atmosphere. Also, in an industry during certain mishap it is very difficult to monitor the parameters through wires and analog devices. So to overcome this problem we can use wireless device to monitor the parameters. By monitoring this parameters we can take certain steps in worst cases. In this weather station monitoring systems, different parameters like temperature, light, humidity, wind direction and speed, gas level are all sensed using sensors.

## I. INTRODUCTION

In spite of the improvement in advanced communication technologies, there are still very few functioning commercial wireless monitoring systems and there are still a number of issues to deal with. Therefore, there is a strong need to design and implement an interactive real-time wireless communication system. This paper provides simplistic, convenient, efficient and economic solution to overcome the problem of using analog devices and wires in hazardous conditions.

A data acquisition system is developed to design a wireless weather station monitoring system which enables to monitor the weather parameter in remote places by using ZigBee technology and display the parameters on the computer screen. This system is designed to monitor the temperature, light, humidity, gas level, wind direction and speed of a remote place. This system uses thermistor, light dependent resistor, HY- SS – 220 as humidity sensor, MQ – 6 as gas sensor and techogenerator to monitor wind parameters. It also uses AVR microcontroller and XBee module and TTL – USB for serial communication.

## II. ZIGBEE STANDARD

ZigBee is a standard that defines a set of communication protocols for short range wireless networking. The ZigBee standard is developed by the ZigBee Alliance, which has hundreds of member companies, from the semiconductor industry and software developers to original equipment manufacturers (OEMs) and installers. The ZigBee Alliance was formed in 2002 as a nonprofit organization open to everyone who wants to join. The ZigBee standard has adopted IEEE 802.15.4 as its Physical Layer (PHY) and Medium Access Control (MAC) protocols.

## III. XBEE

ZigBee-based wireless devices operate in 868 MHz, 915 MHz and 2.4 GHz frequency bands. Out of which 2.4 GHz is used worldwide. Interoperability is one of the key advantages of ZigBee devices. The network formation is managed by the ZigBee networking layer. The network must be in one of two networking topologies specified in IEEE 802.15.4: star and peer-to-peer. In the star topology, every device in the network can communicate only with the PAN coordinator. In a peer-to-peer topology each device can communicate directly with any other device if the devices are placed close enough together to establish a successful communication link. The maximum data rate of ZigBee is 250 K bits per second and its range is 10 – 100 m.

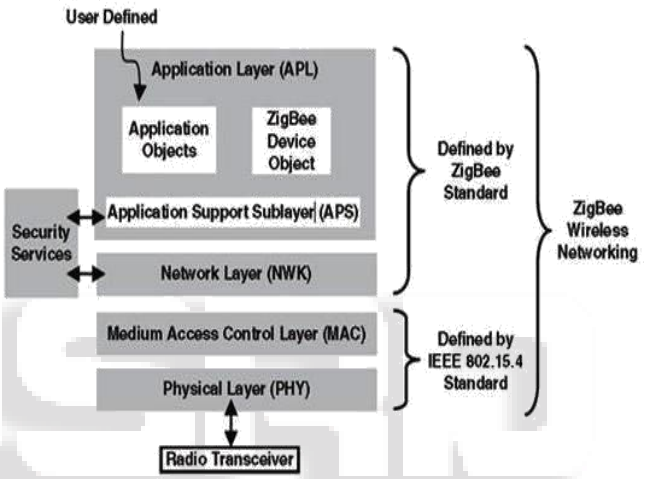


Fig. 1: Xbee Module

IEEE 802.15.4 implements Carrier Sense Multiple Access with Collision Avoidance (CSMA-CA) to use the same frequency channel for their communication medium. In CSMA-CA, anytime a device wants to transmit, it first performs a clear channel assessment (CCA) to ensure that the channel is not in use by any other device. Then the device starts transmitting its own signal. The decision to declare a channel clear or not can be based on measuring the spectral energy in the frequency channel of interest or detecting the type of the occupying signal.

A ZigBee network starts its formation as soon as devices become active as no additional supervision is required to establish a network, ZigBee networks are considered to be self-forming networks. When a mesh network is established, there is normally more than one way to relay a message from one device to another. Naturally, the most optimized way is selected to route the message. However, if one of the routers stops functioning due to the network can select an alternative route. This is an example of the self-healing characteristic of ZigBee mesh networking.

## IV. SYSTEM DESIGN

The wireless weather station monitoring system is divided into two sections: Transmitter section and Receiver section.

 

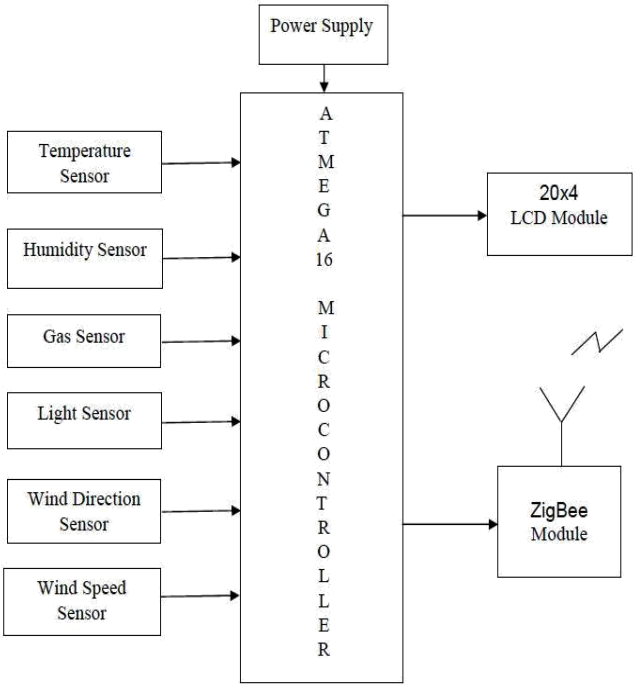


Fig. 2: Block diagram of transmitter

The block diagram of the transmitting section consists of four main parts: The sensors, microcontroller, ZigBee module & LCD. The sensors collect the parameters from the external environment. Mainly six sensors are used viz., temperature, humidity, light, wind direction, wind speed and gas sensor. The sensed data from the sensors is given to the microcontroller, controller has the inbuilt ADC. The data obtained from sensors is analog in nature which is converted into digital values using analog to digital converter within controller. The processed signal is now given to the LCD module, which displays the data collected by the sensors. At the same time the processed signal is transmitted to the ZigBee module, from where the data get transmitted wirelessly to the receiver section.

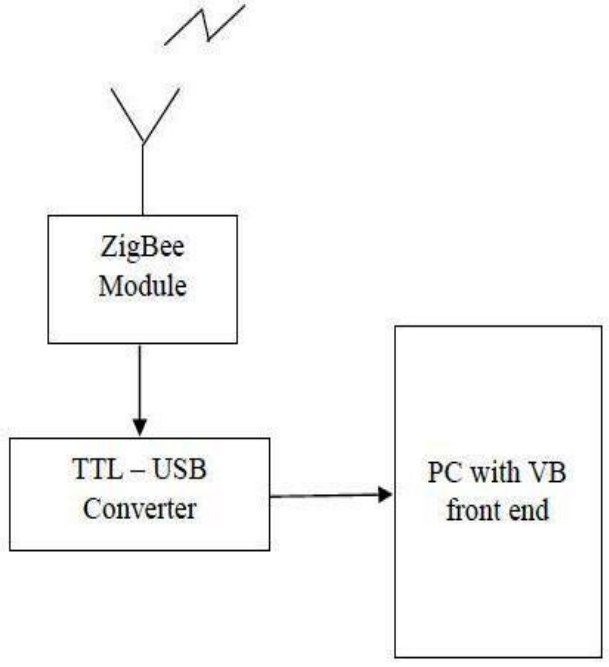


Fig. 3: Block diagram of receiver

The data which are transmitted from the transmitter side through the ZigBee module are received at the receiver circuit through another ZigBee module .The values thus collected are then send to the PC through the USB port .It will display on the computer with the help of Visual Basic.

## V. RESULTS

On implementing the designed system with Visual Basic 6.0 (VB6) on the PC, we get following output. It records each weather parameter and plot graph of variation of these parameters with respect to time as shown.


Fig.3: Results on LCD Screen

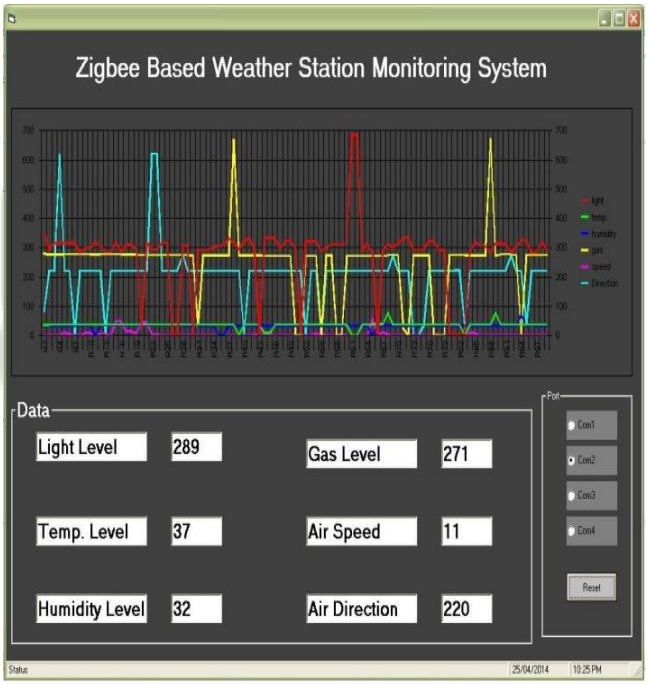


Fig.4: Results on PC with VB6

## VI. CONCLUSION

This paper focuses on developing devices and tools to manage, display and alert the weather/disaster warnings. The system uses AVR microcontroller and Xbee Wireless module based on the Zigbee/IEEE 802.15.4 standard. The developed system is very flexible and portable. The developed system has core competency including 1) display weather information, 2) alert when weather conditions goes beyond a certain limit and 3) Plot weather information statistics.

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