DETECTION OF AIR POLLUTANT USING ZIGBEE

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ABSTRACT

In this paper we describe use of ZigBee, sensor nodes, GPS to construct distributed system for urban air pollution monitoring and control. Zigbee module and pollution server is interfaced with GPS system to display real-time pollutants levels and there location on a 24h/7 days basis.

KEYWORDS

ZigBee, Sensor node, Air pollution, GPS

1. INTRODUCTION

With fast development of the industrialization and urbanization process in the world, environmental pollution problems become more common. At present environment contains air pollution, water pollution and soil pollution worldwide. Air pollution is the presence of contaminants or pollutant substances in the air that interfere with human health or welfare, or produce other harmful environmental effects. The World Health Organization states that 2.4 million people die each year because of polluted air. Based on the fact above mentioned, the human should focus on designing air pollution monitoring system.

Pure air and human health goes Hand in Hand. Air pollution is harmful for human health. It causes difficulty in breathing, wheezing, coughing and many respiratory problems. Currently there are two methods to monitor air pollution at present. First one is nonautomatic and other is automatic. The advantages of nonautomatic sampling method are monitoring devices is simple and inexpensive but it monitors the parameters for certain period. It does not provide the real time monitoring. While the nonautomatic sampling method provides the real time monitoring of harmful substances in the air. The nonautomatic sampling method uses the sensors to monitor the parameters, and send the data to central control center.

At present, for monitoring air pollution in wireless network the system includes the GSM, GPRS, etc. But these wireless nodes installation and maintenance are costly. That's why wireless sensor

network have been rapidly developed. The wireless sensor network has many advantages application in military and industries.

Many air pollution systems which monitor air pollution due to hazardous health problems of this the government of Tiwan use various air quality monitoring systems [1]. In this they use MAC medium access control protocol for monitoring air quality in wireless sensor network.

Khunarak et al. proposed E-nose electronic nose architecture for real time monitoring of indoor chemical polluted materials such as CO, NO2. These chemical materials are highly toxic and cause respiratory failure [2]. The ARIMA prediction model is used to monitor air quality in wireless sensor network. The ARIMA model predicts the carbon dioxide level in the air in [3]. A conceptual framework for the deployment of wireless sensor network for environment monitoring of Bangalore urban city is proposed in [4]. An outdoor air pollution monitoring system which uses ZigBee networks for monitoring air pollution in ubiquitous cities was reported in [5]. This system integrates wireless sensor board and CO2 sensors which also integrates with the dust, temperature and humidity and ZigBee module. In China, Zhang Qian et al. compared the advantages of ZigBee with Wi-Fi and Bluetooth and give a wireless solution based on ZigBee technology for greenhouse monitoring [6]. Although some authors use ZigBee to monitor air pollution, its application in air pollution monitoring stay little.

The exploitation of the technology of the wireless sensor network and ZigBee module, focusing on the air pollution monitoring system.

2. AIR QUALITY

The air pollution means presence of one or more contaminants for temporal duration that can become injurious to human life, vegetable, and animal. The air contaminants include smokes, gases, dusts, paper hashes, poisonous chemical products and many polluted materials.

Certain polluted materials react with each other and produces other pollutants. These pollutants called as secondary pollutants. Carbon monoxide and nitrogen dioxide produced by automobiles motors, lead to the development of ozone.

Air pollution has consequences for human health. It causes respiratory problems and even death. It also contributes the acid rain and reduction of ozone layer.

The proposed system is able to measuring the following gases in the environment.

- Carbon Monoxide (CO) – Carbon monoxide is a pale, flavorless, unscented nonirritating gas produced when sources of carbon, such as fuels or wood are burned. Common sources of human exposure include, smoke inhalation from fires automobile exhaustion, cigarette smoke. It causes respiratory problems.
- Sulphur Dioxide (SO2) – Sulphur Dioxide is pale gas, detectable by the different odor and flavor. It is due to fossil fuels burning. In high concentrations may cause respiratory problems, in sensitive groups, like asthmatics. It contributes to acid rains.

- Nitrogen Dioxide (NO2) – Nitrogen Dioxide is a brownish gas, easily noticeable for its smell, very acidic and highly oxidant. It is produced because of fossil fuels burning. It also contributes to acid rain.

3. ZIGBEE STANDARD

The ZigBee is the small range, low power, low data rate wireless networking technology for many wireless applications. It is present at the bottom three layers i.e. physical, data link, and network layer. This is the recently published IEEE 802.15.4 standards for personal area networks. ZigBee is embattled at radio-frequency (RF) applications that require a low data rate, extended battery life, and secure networking. ZigBee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power, wireless sensor networks.

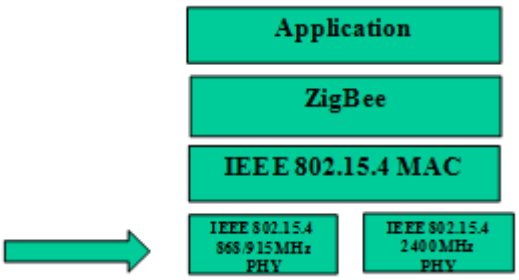

Figure 1. ZigBee Architecture

ZigBee network layer supports star, mesh and tree topologies. The ZigBee coordinator is responsible for initiating and maintaining the devices present in the network and other end devices directly communicate with the ZigBee coordinator.

The IEEE 802.15.4 (ZigBee) standard provides three frequency bands for operation: these are 868MHz, 916MHz, and 2.4GHz for ZigBee. 868MHz band used in only Europe and has the 20Kbps data rate of transmission and contain only one channel with BPSK modulation technique. 916MHz band is used in Americas having the 40Kbps data rate of transmission and contain 10 channels with BPSK modulation technique. 2.4GHz frequency bands used throughout the world because of ISM (Industrial, Scientific, Medical) band. It has 250Kbps data rate of transmission and 16 channels with O-QPSK modulation technique. Transmission distance is within the range from 30 meters in an indoor non-line of sight of environment and 100 meters in line of sight environment. The range problem can be solved by using various routing algorithms at the network layer.

4. HARDWARE ARCHITECTURE

The proposed system is designed by integrating the following hardware modules as shown in figure.

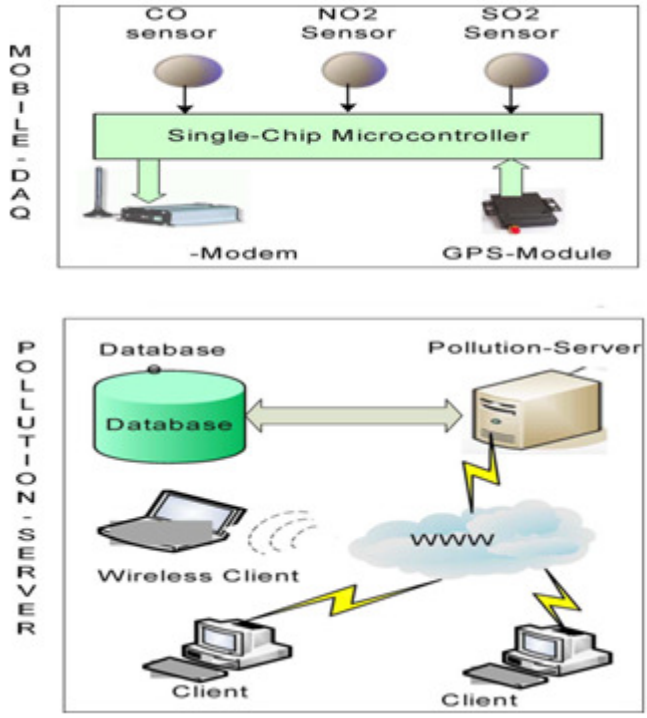

Figure 2. System H/W Basic Building Block

Here two communication protocols are used for wireless communication. One is UART and other is ZigBee. UART is nothing but Universal Asynchronous Receiver/Transmitter. UART used for wireless communication. UART supports serial communication which is required for wireless communication. In proposed system CO, NO2 and SO2 sensors are connected to the timer switching circuits which is later connected to the programmer logic circuits Microcontroller. Analog to digital ADC is connected to the Microcontroller circuit which converts analog signal coming from the sensors into digital form and send the digital data to client side.

ZigBee communication protocol has ZigBee coordinator and ZigBee end device. ZigBee coordinator is responsible for initiating and maintaining the the devices on the network and other end device nothing but the ZigBee end device is directly communicate with the ZigBee coordinator. The central server is a standard personal computer. The pollution sensors are conncted to to the ZigBee module via RS -232 communication standard. The pollution information send from each ZigBee end devices are collected to ZigBee coordinator module and then data are saved to the central server.

5. CONCLUSION

The main purpose of this paper is to provide an overview of urban air pollution monitoring application. Our work is enabled by ZigBee ,pollution sensors and database sensors i.e. attached to pollution server for storing the pollutants levels for future usage by various clients for measuring pollutants in air accurately at short intervals. The system measures air pollutant gases

such as CO, NO2, and SO2. This paper will give clear idea to move towards real time measuring in an urban area to ultimately improve quality of life on earth.

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