

Review: Air Quality Monitoring System

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Abstract: Air Quality monitoring system monitors the environmental air quality. Now a days air pollution rates in developing and developed countries increase, so it requires more portable and cost effective air quality monitoring devices. Pollution measuring chambers are available in developed countries. The polluted air is harmful for health. In developing countries all services not available commonly. In this paper the review of various air quality monitoring systems is done. These systems measure the concentration of oxygen, carbon dioxide, carbon monoxide, nitrogen dioxide, sulfur dioxide, light intensity sensor, humidity, temperature respectively. All readings will be displayed on Android smart phone. According to threshold values of sensors alarm will be ring. GSM/GPRS Modem is used to send data wirelessly to the server pc. In some systems global positioning system is used for indication of location, date, time. Sensor data is automatically stored in SD card storage module for future use. Such systems prevent hazardous health problems as well as enhance air quality.

Keywords: Sensors; Air Quality; Air Pollution; Health.

I. INTRODUCTION

Air quality monitoring is a systematic process. The quality of air is monitor by measuring the quantity and types of pollutants. There are two types of pollutants primary and secondary. Primary pollutants are commonly produced from a process like volcanic eruption. Secondary pollutants are not emitted directly in the air. They generally formed by reaction or interaction of primary pollutants. These pollutants cause health hazards like sinusitis, asthma pneumonitis, allergic, organic dust toxic syndrome, nasal irritation, engionnaire’s central nervous system symptoms etc[1]. In the developed countries air pollution measuring devices are commonly available, people in the developed countries are more aware of health hazards caused due to polluted air as compare to developing countries. Ambient air pollution causes different diseases as shown in fig.1. Indoor air quality is also important fig.2 shows various diseases caused due to polluted indoor air quality[11]. To prevent health hazards air quality monitoring system is necessary.

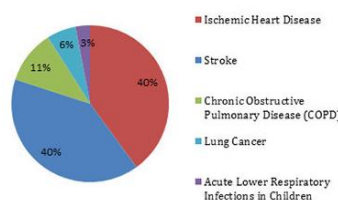


Fig. 2. Ambient air pollution causes different diseases [11].

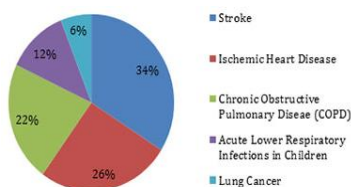


Fig. 2. Diseases caused due to Indoor air pollution[11].

II. RELATED WORK

The problem of real time processing of indoor environment air pollutants gases is tackled by using a DSP board (TMS320c6455) then implementing it to the proposed gas monitoring system. This system is low cost, low maintenance, fast response, ability to produce real time measurements. In this system DSP board is used which helps system to be used for real time application. This system measures the concentration of air pollutants gases carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen dioxide.

This system needs more field work to increase accuracy level, temperature sensor, humidity sensor could be added. Also this system can compliance to IEEE 1451 standard and will incorporate IEEE 1451.5 standard [1].

Wireless Sensor Network Air Pollution Monitoring System (WAMPS) is used to monitor air pollution in Mauritius. This system was implemented by use of wireless sensor network technology, wireless sensors were deployed in large numbers around the Island. Air Quality Index and Recursive Converging Quartiles (RCQ) algorithm used in this system helps to enhance the efficiency of Wireless Air Pollution Monitoring System. RCQ algorithm used for data aggregation and it eliminates duplicates, remove invalid readings ultimately helps to save energy. In addition to this hierarchical routing protocols were used in this system. Due to this mote went into sleep mode during idle time. This system can be effectively used to monitor high risk regions in any country. The advantage of this system is it produces high quality results. Results are more accurate and fine - grain at the level of sensors. [2].

For monitoring air pollution an online GPRS –Sensor Array has been designed, implemented and tested. In this system Mobile Data-Acquisition Unit(Mobile-DAQ) used for gathering air pollutants levels such as Carbon monoxide, Nitrogen dioxide, sulfur dioxide. Mobile-DAQ unit consists of Microcontroller and various gas sensors

array along with this system consists of GPRS-Modem and GPS-module. Data from sensor was packed in a frame with GPS physical location, time and date. The frame is transmitted by uploading to GPRS-Modem to the Pollution Server through the public mobile network. Also database server is attached to the Pollution Server for storing Pollutants levels for future use by clients such as tourist, vehicle registration authorities, environment protection agencies, insurance companies. The pollution Server is interface with Google Maps to display pollutants levels and locations in large area. The system reports Pollutants level and their locations in 24-h/ 7-day basis. This system can become more effective by adding sensors such as temperature sensor, humidity sensor[3].

In pollution monitoring system pervasive sensor technology is efficiently used. In this system Oxygen sensor, Carbon monoxide sensor, Carbon dioxide sensor were used. According to result electrochemical Carbon monoxide sensor exhibit linearity against the concentration range. In this work calibration results for different sensors were provided. Sensor such as carbon Monoxide sensor, Alphasense CO-BX, CO-AX, CO-D4 and Transducer technology RCO100F and 3CO1ET1500; Three galvanic Oxygen sensor KE-25; AND Five Figaro solid electrolytic Carbon Dioxide sensor TGS4161. Sensitivity of sensor is directly proportional to size of sensor. In case of Carbon Monoxide sensor as size increases sensitivity also become better than previous.

In future some changes can be made in this system such as, the sensors will be calibrated against a range of humidity and temperature mainly to the India and UK environments. The result of this system is used to develop correction or self calibration techniques to infer the real gas concentration in the actual deployment from the sensor measurement [4].

Wireless Sensor Network an important role in pollution monitoring system. Commercially available discrete gas sensors are used for sensing concentration of gases like Oxygen, Carbon Dioxide, Carbon Monoxide, Nitrogen Dioxide. Before implementing sensors, they were calibrated using appropriate calibration techniques. Integrated sensors along with wireless sensor mote deployed at the campus and the Hyderabad city by using multi hop data aggregation algorithm. Low weight middleware and web based interface was used to view pollution data online. Instead of WASP module different sensors can be used. WASP module is more expensive than sensors. By using this system humidity and temperature can be sensed [5].

Shashikant U. Suryawanshi et. al. proposed a system for monitoring air pollutant gases an Environmental Air quality monitoring system has been designed, developed and tested. This system used to measure concentration of Carbon Monoxide, Sulfur Dioxide, Nitrogen Dioxide. Here GSM-Modem was used to transmit frame which contains information about Location, date and time to the Central- Server. The Central-Server is interfaced with

Google Map to display location of Hardware unit. Signal conditioning unit connected in between sensors and Microcontroller. Signal conditioning unit consists of amplifier and analog to digital converter[6].

Now a days Air pollution rates increases in developed and developing countries. Air pollution monitoring chambers are available in developed countries developing countries need cost effective air pollution monitoring systems to aid the monitoring process. Mohammed A. Hussein et.al. designed a system which is useful for monitoring indoor and outdoor air pollution. Here two gases are considered Oxygen and Carbon Monoxide. Value of pollution decided by analyzing concentration of gases. The higher the amount of oxygen and less amount of Carbon Monoxide concentration indicated that least amount of air pollution. Low concentration of Oxygen and high concentration of Carbon Monoxide indicated that the value of air pollution is higher. Along with the sensors used in this system Oxygen sensor, Carbon dioxide sensor can be added to increase efficiency of this system[7].

Remote Carbon Dioxide monitoring system is developed to monitor concentration of Carbon Dioxide online. In this system Wireless Sensor Network technology used efficiently. It consists of monitoring equipment, a data center server and the clients. The monitoring equipment consists of Microcontroller unit, different sensors, global positioning module (GPS) receiver module, secure digital memory card i.e. SD card storage module, LCD display, general packet radio service (GPRS) wireless transmission module. This system consists of Carbon Dioxide sensor, temperature sensor, humidity sensor, light intensity sensor. Collected sensor data automatically stored in a SD card data storage module, simultaneously display them on LCD display. GPRS module is used for continuously transfer of collected data to the data center server. By using PHP programming language online monitoring WebGIS clients are developed, which runs on the Apache web server. For speed and reliability MySQL is used as database. By using the OpenLayer JavaScript web-mapping library the stunning cross-browser web maps are created. In this system more focus is on online Carbon dioxide monitoring, along with sensors used in this system different gas sensors can be added [8].

Ying-Wen Bai et. al. presented a system which monitors Oxygen concentration. Lack of oxygen concentration leads either coma or dizziness or both in certain situation it might cause a heart attack, a stroke, etc. In this system concentration of oxygen is measured. Oxygen sensor is used to monitor oxygen in the ambient air. It generate equivalent voltage value with respect to oxygen level. An instrumentation amplifier is to amplify the voltage levels. When concentration lower than threshold value, alarm will ring, which inform user so that user come to know to take preventive action to prevent health hazard. On the screen of Smart phone. It In future work different gas sensors can be added and pollution server can be interface to store data collected from different sensors[9].

III. THE PROPOSED SYSTEM

The proposed system is developed to monitor air quality for home. Which is cost and energy efficient. Request and respond protocol is used to transmit sensor data wirelessly to remote computer combination address centric and data centric protocols is added. This combination of data aggregation protocols reduced power consumption to large extend.

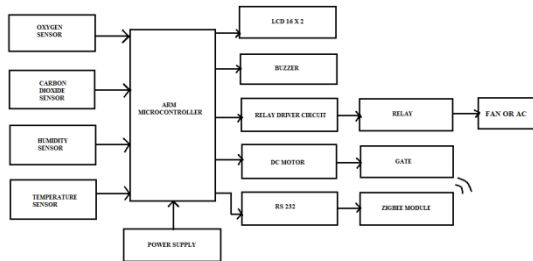


Fig. 3. Sensors data transmitting side.

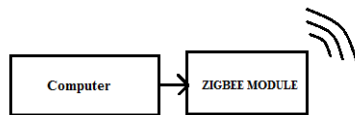


Fig. 4. Sensors data receiving side.

Figure 3 and figure 4 show the proposed system block diagrams.

At transmitting side of the proposed system oxygen sensor, carbon dioxide sensor, humidity sensor, temperature sensors are interfaced with ARM microcontroller. Sensors monitor indoor air quality of home. Readings of sensors are display on the LCD at transmitter side. For each sensor specific threshold value is set. When these threshold values are crossed, system gives notification by turning on buzzer. According to threshold values of oxygen sensor and carbon dioxide sensor gate (window) will get open or close to provide fresh air. Similarly , when threshold value of temperature sensor is crossed fan or AC will get on. Sensors data will transmit wirelessly by using ZigBee module to remote computer. At receiver side , there is a computer and a ZigBee module. Readings of sensors displayed on computer screen by using Visual Basic programming language.

IV. DISCUSSIONS

In above pollution monitoring system various gas sensors are used such as Oxygen Sensor , Carbon Dioxide sensor, Carbon Monoxide sensor, Sulfur Dioxide sensor, Nitrogen Dioxide sensor along with these sensors Humidity sensor, light intensity sensor, temperature sensor are used. The sensor data is send to central processing unit i.e. DSP or Microcontroller unit. In between sensors and CPU signal conditioning is used to amplify and sensor data into digital format. CPU is programmed and threshold values are set for each sensor. When limit of sensed value exceed or

reduced than that of threshold value, alarm will ring. GPS/GPRS modem is used to transmit sensor data wirelessly to the pc server, so that it can be monitor remotely. For storage of data SD card storage module is used to store sensor data[8]. Global positioning System is used for indication of location, time, date. Wireless Sensor Network technology is efficiently used.

V. CONCLUSION

Air quality monitoring systems are designed using different sensors for indoor and outdoor air quality monitoring in the previous works by using Bluetooth, GPS, GPRS wireless technologies. In a previous work WASP module is used which is costly. Instead of that different sensors can be used. The proposed system is developed for indoor air quality monitoring remotely. It is cost and energy efficient request and respond protocol is used along with combination of address and data centric protocols.

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