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Real Time Air Pollution Monitoring Using GSM Based System

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***Abstract* - Air pollution monitoring is a growing concern in the field of environmental engineering. With able support from others streams of engineering such as embedded system; it is easier to find appropriate solutions to any problems regarding the same. By air pollution monitoring we mean that detection and communication of various pollutant concentrations such as nitrogen dioxide, sulphur dioxide, carbon monoxide, carbon dioxide in real time. Pollution monitoring system consists of a single chip microcontroller, air pollution sensor array and GPS module which are integrated and communicated through GSM Transceiver. Finally it display through PC for real-time monitoring.**

***Keywords* - Sensor node, microcontroller, GPS, GSM Transreceiver.**

I. INTRODUCTION

Many forms of atmospheric pollution affect human health and the environment at levels from local to global. These contaminants are emitted from diverse sources and some of them react together to form new compounds in the air. Industrialized nations have made important progress toward controlling some pollutants in recent decades, but air quality is much worse in many developing countries, and global circulation patterns can transport some types of pollution rapidly around the world. Toxic gases play essential role in air pollution, in which NO_2, SO_2 & CO makes an environment as pollutant than other gases [1]. Such gases can be monitor using sensors [2]. With the continued expansion of production scale, the disadvantages of traditional wire monitoring system are more and more prominent, such as complicated arrangement, difficult maintenance and so on. Then the wireless monitoring system is developed, which based on wireless communication technology, does not need cables, adds or reduces configuration at random, possess simple system construction [3,4]. The proposed system is an optimum solution considering low power factor.

II. STRUCTURE OF THE SYSTEM

The diagram of air pollution monitoring system is shown in figure 1.

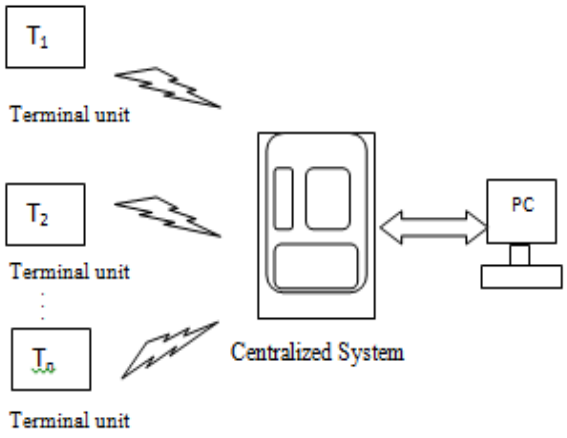

Fig. 1. General System

It is a multipoint wireless system, which includes number of terminals, centralized monitoring system, serial communication circuits and PC. The centralized monitoring system is a master node controlled by microcontroller with a wireless GSM module connected to a PC, which communicates with the sensor nodes through wireless channel. This system is responsible for sending the control frame, receiving and processing data from the terminal node sensors, and displaying and storing the processing results [5].

III. HARDWARE DESIGN OF THE SYSTEM

The block diagram of hardware system is shown in figure 2.

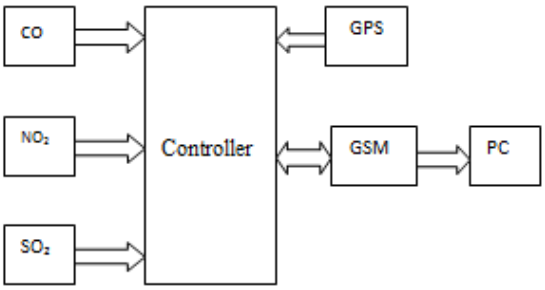

Fig. 2.Hardware design of system

3.1 Sensor Module

Sensor module consists of sensor and amplifying circuit [6,7]. Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) are sensing by its corresponding sensors. These sensors give the current output in ranges from 4 mA to 20 mA which will further be converted into voltage (0-5V) by using amplifying circuit.

3.2 Centralized Monitoring Module

Centralized monitoring module consists of PIC microcontroller, GPS and GSM module [8].

PIC microcontroller which has only 35 single-word instructions and all are single-cycle instructions. Analog-to-Digital (A/D) converter module has eight I/O pins. The conversion of analog input by taking high and low-voltage reference input with the combination of VDD, VSS, RA2 or RA3.

GPS consists of smart antenna receiver, an embedded antenna and GPS receiver circuits. It has 2 channel GPS SMD type receivers. The GPS smart antenna will tracks 32 satellites at a time while providing fast time-to-first-fix, one second navigation update and low power consumption [9].

Fig. 3. GPS Module

It can provide with high sensitivity and performance even in urban and dense greenery environment. Its extensive capability meets the sensitivity requirements of car navigation as well as other location based applications. It has in built micro battery to reserve system data for rapid satellite acquisition.

The nature of GSM module allows the transmission of data to and from ISDN terminals, although the basic service support by GSM is telephony. Speech is inherently analog, and need to be digitized. At start, GSM wanted to ensure ISDN compatibility in services although the attainment of the standard ISDN bit rate of 64 Kbit/s was difficult to achieve, thereby belying.

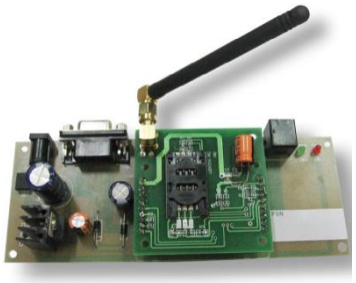

Fig. 4. GSM Module

Since inception, GSM employs digital rather than analog and operate at 900 MHz frequency band. Many GSM systems operate at 900 MHz and 1.8 GHz frequency bands.

IV. SOFTWARE DESIGN

4.1 Designing of main program

Using RS232, data can be transmitted in serial to PC. In main program, achieves data receiving, analysis and storage of every terminal. The main program sends control instruction to control electrical apparatus of every terminal on or off.

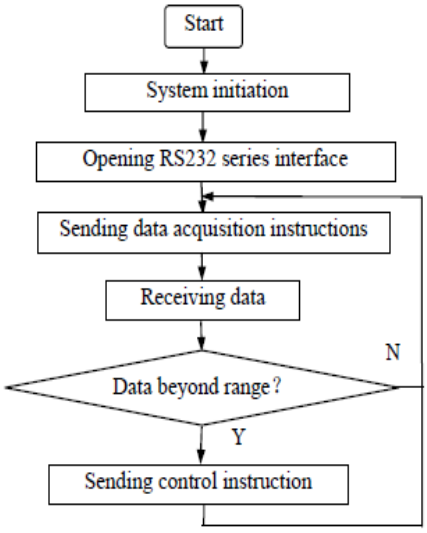

Fig. 5. Flowchart of main program

4.2 Designing of PIC subprogram

The microcontroller subprogram mainly achieves the receiving of data from every terminal and transmission of instruction from PC, it is the connective ligament of every terminal and the PC. The flowchart is followed as Figure 6.

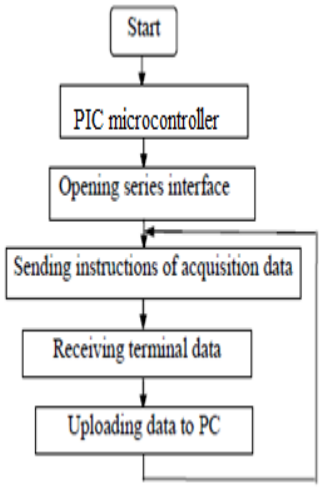

Fig. 6. Flowchart of PIC microcontroller

V. PROBLEM ANALYSIS

The quality of data measured and collected by the wireless sensor networks may get affected by its stringent resource constraint, internal and external factors of sensor nodes deployed in harsh and unattended environment, because of which real world data are often dirty. Especially when the sensor node calibration fails, power failure, malicious attacks, noise and other environmental effects which further influence quality of the collected raw data and aggregated results. For a given database *D*, one needs automated methods to evaluate the quality and dependability of data.

VI. TESTING

The data sampling interval of the system is of 20 minutes. The acquisition data are sent to central control unit by each terminal controller, and then also sent to the PC by the central unit. The data can be stored, displayed, analyzed, inquired and printed by the software of the PC. Table I shows the pollutant levels of CO, NO_2, and SO_2.

Table I
Experimental Results

S.No	CO Level (ppm)	NO_2 Level (ppm)	SO_2 Level (ppm)
1.	1141	1009	1174
2.	1108	1227	1424
3.	1116	1335	1248

VII. CONCLUSION

An air pollution monitoring system was designed, implemented and tested. The system utilizes city buses to collect pollutant gases such as CO, NO_2, and SO_2. The pollution data from various sensor arrays is transmitted to a central server that makes this data available on the Internet through a Google Maps interface. The data shows the pollutant levels and their conformance to local air quality standards. It is worth mentioning that much more work is required to commercialize the system and to bring the system to be used for the general and specialized works. Data is collected and can be applied at all levels of organization for creating awareness, performing scientific studies and to forecast remediation policies by the authorities to individuals and organization in controlling global warming. We have defined application specific consistency models for evaluating

the data quality. This is our initial step in building efficient embedded system for monitoring and computing greenhouse gases parameters.

VIII. REFERENCES

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