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Air Impurity Measurement System

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***Abstract*—In the last decade pollution has increased at quite a tremendous rate. People are exposed to air toxins both indoors and outdoors depending on the activities of individuals. It is important to measure the exposure of people to different gas toxins, especially for the wellbeing sensitive or susceptible individuals such as children, aged people and persistently ill people. To evade adverse imbalances in the nature, an air contaminant monitoring system is utmost important. Recent enhancement in technology have made it conceivable to deploy cost-effective wireless sensor nodes for environmental monitoring, indoor climate control, scrutiny, structural monitoring, gathering sensing information in unreceptive locations and ambient air monitoring.**

We propose an online pollutants concentration monitoring system centered on the technologies of sensor networks. We will attempts to develop an effective solution for air pollution monitoring using WSN that is featured by its low-cost, renewable power source, simple to set up, without excessive maintenance etc., and it can achieve assortment of various regional low-cost unmanned continuous monitoring. This system helps us to monitor various air constituents eliminating need to visit distant sites for data collection. The data is collected to a central server and displayed automatically to a formed data base online.

***Keywords*—Sensor, Pollution, Monitor, AQI, WSN**

I. INTRODUCTION

Air pollution is the mixture of elements, particulate matter, or bioticconstituents that cause damage or discomfort to humans and other living organisms, or cause offence to the environment of the atmosphere. The atmosphere is a complex dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone layer depletion due to air pollution has been recognized as a threat to human health as well as to the Earth's ecosystems. Indoor air pollution and urban air quality are listed as two of the world's worst pollution problems in the 2008 Blacksmith Institute World's Worst Polluted Places report [1].

The air pollution caused by exhaust gases from automobiles has become a critical issue. In some regions, fossil fuel combustion is a problem as well. The dreadful conditions of air are affecting the health of more than 120 million people globally. In India the growing commercial progress and a rapidly mounting population from 300 million people to more than one billion people today is laying a stress on the environment, economical framework, and country's natural resources. India is among the world's worst troupes when it comes to the overall environment management. Environmental deprivation costs India about 80 billion dollar per year that is nearly 6 per cent of gross domestic product, stated on July 17th, 2013 in a report bid by the country's environment ministry. Additional inspections show that India has the world's nastiest air pollution, and has 13 most polluted cities out of the 20 among big world economies. Therefore monitoring Air Quality is essential for State & Central authorities like air pollution regulatory body, MNC's as well as major Public and Private industries to comprehend and take suitable steps to prevent air pollution and consider emission sources, in order to preserve health and help to the round against the greenhouse effect.

The first decade of the 21st century has been labelled by some as the Sensor Decade. Sensors represent part of the interface between the physical world and the world of electrical devices, such as computers. In recent years, sensors have received people's attention as one of the important devices in electronic systems and enormous capability for information processing has been developed within the electronics industry. Of all sensors, gas sensors and light sensors have been most actively studied. Gas sensors are defined as a device that can substitute for human olfaction, and there are many researches being conducted to monitor air pollution by using these gas sensors.These sensors can be deployed in WSN to monitor and collect air environmental parameters [2]. The information is then wirelessly transmitted to data center server where they are integrated and analyzed. In the India, all main cities have networks of observing stations providing real time measurements of the most important pollutants. However, the number of these posts is usually very limited [3].

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A. PROPOSED SYSTEM

Thus we have directed to form a system that is inexpensive, not only to manufacture but to operate and maintain as well. The system organization costs are intended to be minimal with the minimization of physical restraint such as space and external power supply requirements. The proposed system should overcome the limits of singular static monitoring sites by attaining efficient high resolution, air pollution recognition. Henceforth, our objective is to develop device able to monitor certain atmospheric components and transfer the data continuously for the display, to determine status and trends of ambient air quality and sharing certain details with agencies like Town and Country Planning Department, Thus we propose a real-time air quality monitoring system with wireless sensor networks which possess following feature:

- Compact and portable.
- Cost effective and efficient.
- Continuous online monitoring from remote location.
- Mobile
- Uses solar power.
- Consist of off-the-shelf devices, components, and standards.
- Can easily adapt to take in different kinds of sensors.
- Precise and continuous real-time data collection.

B. SYSTEM DESIGN

Based on technologies of micro-sensors, GPRS, to meet the need of monitoring of air Pollutants, we developed a remote online monitoring system. The system mainly entails of monitoring equipment, data server and the clients, as shown in Figure 1. The design of monitoring equipment is the core task of the whole system. The equipment can be deployed in most polluted monitoring region. It can collect pollution gas concentration through sensors. GPRS network will send the assembled data to the data server, and then immediately data query, analysis and monitoring can be accomplished on various patrons [4-5].

The monitoring circuit consists of a microcontroller, air environment sensors array, power supply, solar panels, liquid crystal display (LCD) module, and GSM module as shown in Fig.1. The sensors array is used to collect data (CO and CO_2). The CPU displays them on the LCD module in real-time. Afterwards, the GSM module continuously wirelessly transfers the accumulated information to the dataserver [6].

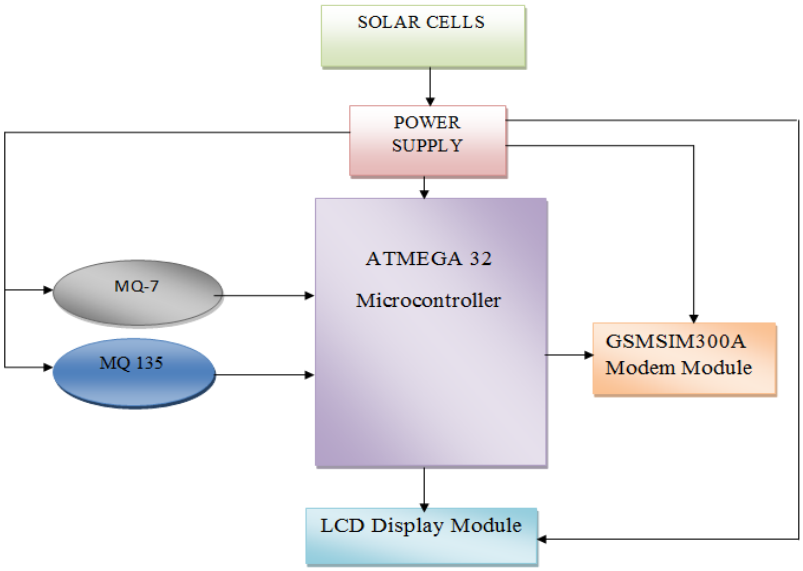

Fig 1: Hardware infrastructure diagram of Pollutant monitoring system

Main outlines of basic design consist of hardware and software. In designing hardware, the emphasis is on the electronic circuit design of monitoring device. On the other hand, the software design consists of how to envision the pollutant on Liquid Crystal Display (LCD) and computer programming using application of Microsoft Visual studio.

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C. Hardware Design

Hardware design consists of selecting and to classify the electronic components used in this model. The main components under hardware design is Atmega 32 microcontroller, air environment sensors array, power supply, solar panels, liquid crystal display(LCD) module and GPRS wireless transmission module.

Microcontroller Module

In this work, we are using the AVR microcontroller of Atmega32 for some reasons. The Atmel AVR Atmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. It usually execute instructions in a single clock cycle thus allowing us to improve power consumption versus processing speed.This microcontroller type has many facility, fast instruction process and reinforced by Code Vision AVR Evaluation software for simulation and compiler. In addition, the Microcontroller of ATMEGA has special feature, like analog to digital converter. This feature is very important for our system.

Sensors Chamber

The front end of air pollutant monitoring system is the sensor circuit detector of MQ-7 and MQ-135. The MQ series of gas sensors use a small heater inside with an electrochemical sensor. These sensors array are used to detect: CO sensor and CO2 sensor. These sensors, respectively, provide real-time collection of air data to the central processing unit [7]. Each sensor is described as following.

Carbon Monoxide (MQ-7) Sensor: The MQ7 is a simple-to-use Carbon Monoxide (CO) sensor suitable for sensing CO concentrations in the air. It can detect CO-gas concentrations anywhere from 20 to 2000ppm. The sensor can operate at temperatures from -10 to 50ºC and consumes less than 150mA at 5V.It has a brilliant long life, performance with constant sensing characteristics, Response Time is less than 150sec.

Carbon dioxide (MQ-135) Sensor: MQ135 are used in air quality control equipment for buildings/offices, are suitable for detecting various gases including CO2. Structure and configuration of MQ-135 gas sensor is composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. It possess following feature: detection range of 10-100 ppm, Fast response, long life and Simple drive circuit.

Wireless capability

We maintain wireless connectivity through a GSM modem. Any GSM network operator SIM card can be accepted by this modem. Benefit of using this modem is its RS-232 port to connect and develop embedded applications with baud rate of 9600 mbps. In GPRS mode it is used to connect to internet and for many applications like data recording and control. In this mode it also connects to any remote server and upload files for data charting [8]. Thus transfer of collected data is via GPRS wireless transmission module-SIM900A. It is a small chip, compact, have high reliability and low power consumption. Microcontroller uses RS-232 to connect to GPRS wireless transmission module.

Power supply

Various sensor in arrays, GPRS wireless transmission module, microcontroller and LCD display requires 5v for their operation. However heaters inside sensors draw a large current comparatively to heat up and also all these components are operating continuously for real time monitoring of pollution gases using external battery is not sufficient.Thus to make the architecture stand-alone solar panel has been incorporated. To make system more flexible we also designed 5v power supply to accommodate and utilize 230 V AC, power supply too.

LCD Display

In our system we are using a 16x2 LCD to display gas concentration on remote location. The gas concentrations are displayed on LCD.

II. SOFTWARE DESIGN

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The software design is divided into two parts, i.e. design of microcontroller program and design of interface computer application. The design of microcontroller program follows the flowchart related to the air pollution monitoring system shown in Fig. 2 below. It comprises two main fragments, real-time data collection and wireless transmission using GSM module [9]. First, the sensors array collect gas concentration, through GPRS wireless trans- mission module, continuous wireless transmission is conducted.

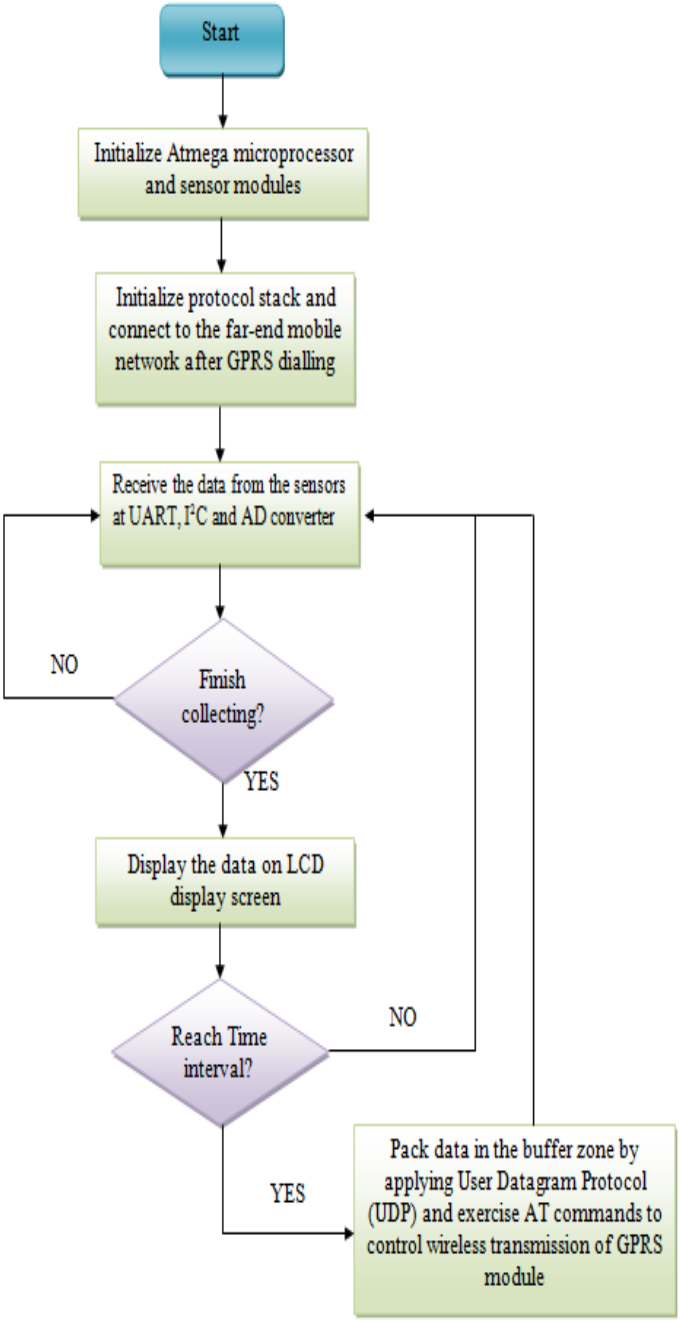

Fig 2: Firmware flow of remote real-time pollution monitoring equipment

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III. SIMULATION PERFORMANCE

In this section we have simulated our model in ISIS professional 7.8 to ensure correct functionality of our system. Here we have developed an approximate model of our system consisting of microcontroller Atmega 32, a temperature sensor LM 35, LCD display and virtual terminal. A proper TCP/IP connection is established virtually and temperature is displayed on LCD screen as shown in Fig. 3.

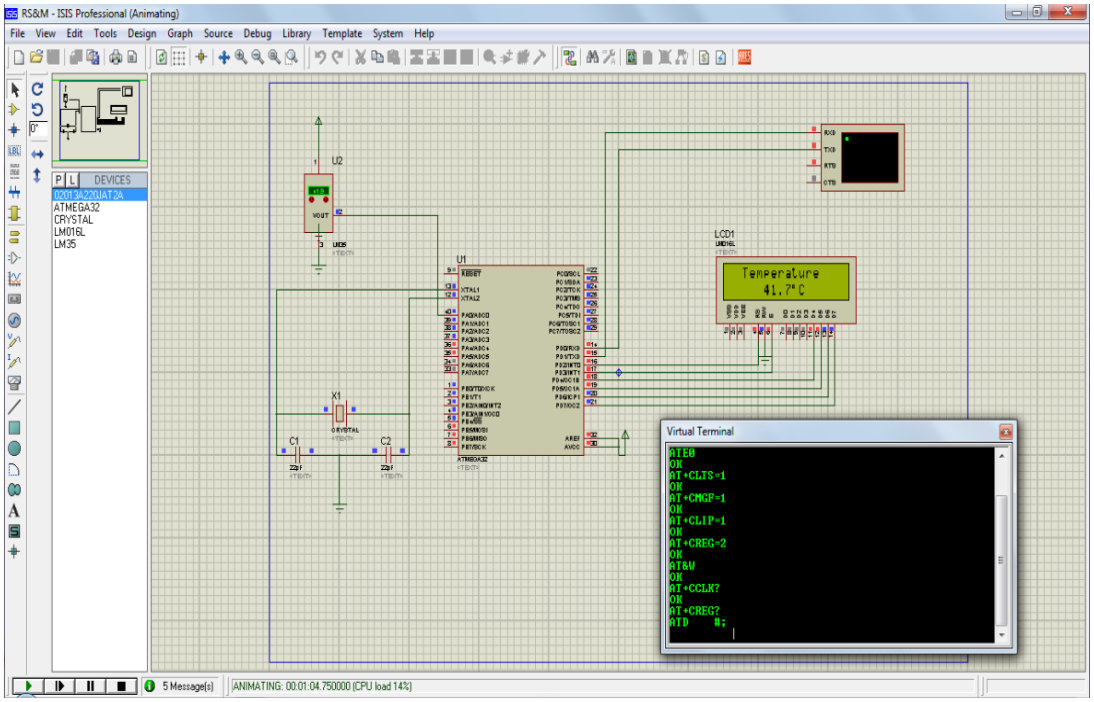

Fig 3: Simulation Result

IV. SYSTEM IMPLEMENTATION

Remote real-time monitoring equipment for measuring pollutant gases is successfully established which can realize real-time display and transmit the gas concentrations and temperature wirelessly. With compact size, the weight of monitoring equipment is 287 g. It can be easily placed in various experimental atmospheres as it is simple and movable. The implementation of circuit board is as shown in Fig. 4.

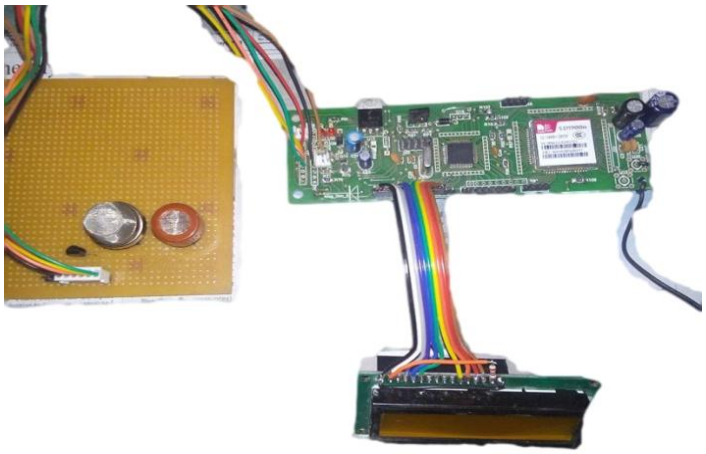

Fig 4: Implementation of basic circuit

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The circuit was tested sucessfully and it showed the result as shown below in Fig. 5.

Fig 5: Photograph of test results

We have tested the circuit under room conditions and produced some smoke for testing and its response in adverse environment condition is to be tested yet.Meanwhile, the design of interface computer application utilizes the Visual Basic studio which comprises of windowshowing gas monitoring system.The window shows gas concentration of CO, CO2 and temperature, time stamp LAC AND cell ID. The measurement results can be saved in PC in text file using application of Microsoft Access Database. Another feature is the menu setting to give information about the local area code of system.The example result about the application of interface system of air pollution monitoring in Microsoft Visual studio is shown in Fig.6.

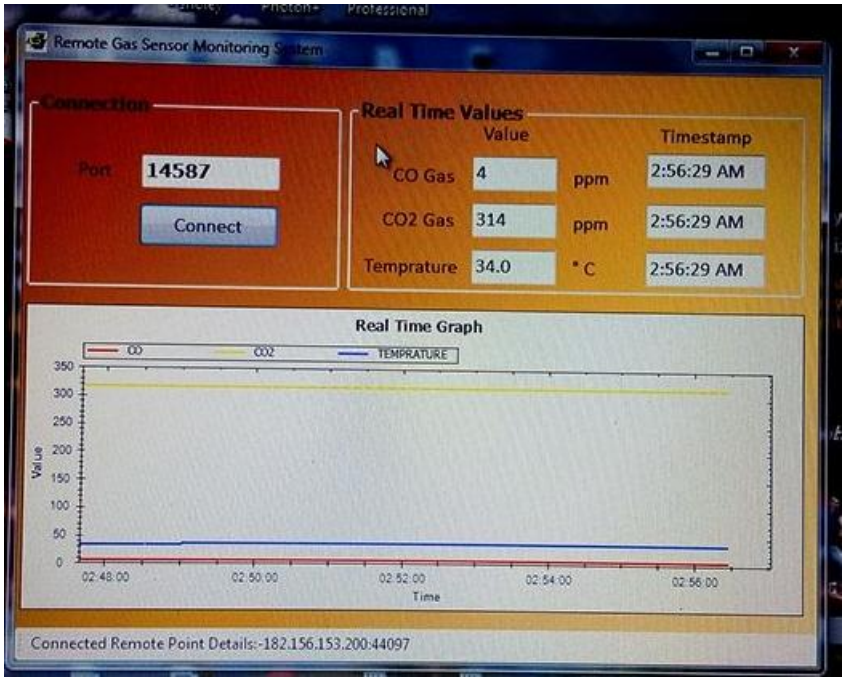

Fig 6: Interface system of air pollution monitoring in Microsoft Visual studio

V. RESULT

Thus here we have proposed and successfully realized a cost effective method of measuring air pollution constituents in an urban location. We have simulated our system successfully on ISIS Professional using LM 35 temperature sensor and achieved connectivity successfully on virtual terminal .Temperaturein degree Celsius and gas concentration in ppm are displayed on LCD screen and a proper TCP/IP connection is established and respective data are displayed on Desktop software. Also we have also measured and compared temperature and gas concentration in PUC center.

VI. CONCLUSION

Thus here we have proposed a cost effective system for measuring air pollution concentrations in an urban setting. We have limited our project cost up to 20k. The project is principally economical, compacted, energy saver and holds the ability to be installed in large numbers to overcome the limitations of traditionalenvironment

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monitoring systems. We have designed a system which aims at increasing attentiveness to the average citizen by displaying pollution level among them.

In near future, we plan to develop a successful online WSN air quality monitoring system with better dependability. We are also going to examine the practicability, reliability and precision of the project when mounted in an urban setting. For researchers in the field of environmental, our model could assist as a basis for a low cost air pollution monitoring system, which can be expanded with many new sensors, assessment algorithms and methodologies.

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REFERENCES

[1] KwangSooYoo, "Gas Sensors for Monitoring Air Pollution" Monitoring, Control and Effects of Air Pollution, ISBN 978-953-307-526-6, August, 2011.

[2] S. Edward Jero1, A. Balaji Ganesh and T.K. Radhakrishnan, "Implementation of a simple wireless sensor node for the detection of gaseous substances", International Journal On Smart Sensing And Intelligent Systems, Vol. 4, No. 3,pp 482-493,September 2011.

[3] S. Edward Jero1, A. Balaji Ganesh, "PIC18LF4620 Based Customizable Wireless Sensor Node to Detect Hazardous Gas Pipeline Leakage", Optoelectronics Sensor Research Laboratory, Chennai -66, INDIA, Proceedings Of ICETECT, pp-563-565, 2011

[4] Qi Liu, Member, IEEE, Nigel Linge and Vincent Lynch, Member, IEEE, "Implementation of Automatic Gas Monitoring in a Domestic Energy Management System", IEEE transaction on consumer electronics, Vol. 58, pp-781-786,2012

[5] Raja Vara Prasad, Rahul K. MishraRaja, "Real Time Wireless Air Pollution Monitoring System", ICRTET journals, Vol.2 ,pp 370-373,2012

[6] Hui Yang, Yong Qin, GefeiFeng and Hui Ci, "Online Monitoring of Geological CO2 Storage and Leakage Based on Wireless Sensor Networks", IEEE Sensors Journal, Vol. 13, No. 2, February 2013

[7] Xiao Liu, Sitian Cheng,Hong Liu, Sha Hu, Daqiang Zhang and HuanshengNing, "A Survey on Gas Sensing Technology", Sensors 2012,ISSN 1424-8220, Vol. 12, page 9635-9665

[8] Kavi K. Khedo, Rajiv Perseedoss and Avinash Mungur, "A Wireless Sensor Network Air Pollution Monitoring System", International Journal On Mobile & Wireless Network, Vol. 2,pp 31-43,2010

[9] Umesh M. Lanjewar, J. J. Shah, "Air Pollution Monitoring & Tracking System Using Mobile Sensors and Analysis of Data Using Data Mining", International Journal of Advanced Computer Research, Volume-2, pp19-22, Issue-6 December 2012.

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