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Embedded System Based Air Pollution Monitoring System

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***Abstract*— Enhancement of technologies are boon to us, in today's scenario Air pollution monitoring system plays a vital role. It has a direct impact on human life. Air pollution is a major cause of concern as it causes various diseases and disorders such as cancer, lupus, allergic reaction, asthma etc. and also adverse imbalance in atmosphere, Air pollution can be controlled and prevented from its effects .Here we proposed an easy and handy system which is based on sensors and has been designed, performed and examined using GSM technology. This system consists of a Mobile Data acquisition unit and internet server. Transmitter part has DAQ unit consists of arduino, carbon mono oxide air pollution sensor and a Global Positioning System Module (GPS), That transmits pollutant level and pack them into frames and these frames are uploaded to GSM and transmission of data to pollution server is done by using mobile network. User can make wise decisions after getting air pollutant levels for different areas.**

***Keywords*-Mobile DAQ, Sensors, GSM, GPS, Pollution server.**

I. INTRODUCTION

Air pollution monitoring is very essential in this modern world. Increase in the industries, automations, change in life styles all these things increases the pollutant level of air such as CO_2 , NO_2, CO,SO_2 have adverse impact on human health. Also it causes global warming, acid rain, depletion of ozone layer. Therefore we necessarily require an Air pollution monitoring system to control the pollution level by regular monitoring of atmosphere especially in urban and industrial areas .In this paper we proposed a low cost, efficient wireless system that can help in air pollution monitoring. This device is basically based on an Arduino controller that controls all the operation of pollution monitoring system. We can mount this DAQ unit on any vehicle or we can fix it at different places from where we can get readings at different instances. Here we use a CO sensor to detect CO level in air and this sensed pollutant level and also physical location of the place using GPS are transfer to arduino controller in form of packet frames and by using GSM and public mobile network services all the details can be transferred to pollution server. From this server any client can get pollution level information of any place in the city. Here we set a threshold level for CO, if any time CO gas crosses that level LED attached to arduino will blink and also an alarm sends alert message to server. By collecting details from server we can also shoe it on google map to show the CO level at exact locations.

The rest part of the paper is framed as follows-section II gives the Literature survey and the work previously done in this field, section III System requirements describes hardware requirements. Software architecture is detailed in section IV and the result is shown in section V and section VI gives conclusion.

II. LITERATURE SURVEY

In this section we review different existing technologies. By using different approaches many systems are developed for air pollution monitoring. Many work have been done. Mobile GPRS sensors array used to detect different gas levels [1]. A wearable and wireless sensor system for real-time monitoring of toxic environmental volatile organic compounds was developed in [2]. An air pollution geo-sensor network consisting of 24 sensors and 10 routers was installed to monitor several air pollutants

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in [3]. The system provides alarm message depending on the detected pollution types in the field. A high-resolution surveillance Web-camera was used to monitor air quality via the Internet [4]. All these are basically used short ranges using wired modules, some used zigbee technology for indoor areas. Envirobat development also a new recent work which is based on the GPRS technology. By analyzing all these works we worked with GSM technology to make monitoring and transmission more fast and efficient.

III. SYSTEM REQUIREMENTS

To obtain the desired results we require a system which is reliable, secure and efficient also. The system's requirements are as follows. A system must-

- support real-time continuous and exact data collection.
- need to store the data and also to provide access to a location map interface.
- support mobility.
- minimum power consumption and 24/7 accessiblity.
- compact, fast and field configurable.
- use off-the-shelf components, devices, and standards.
- support two-way communication between the server and the client.
- easy to use and deploy.

Hardware Architecture- Our design uses basically 3 components as shown in fig 2.Sensor MQ-7 is used to sense Carbon mono oxide (CO) present in the atmosphere. This analog value is transferred to the ARDUINO UNO. And by connecting USB cable to the computer system we can get real time data of the sensors. These data are digitally transferred by GSM module to the receiver.

The mobile DAQ unit consists of Arduino uno added with a CO sensor using analog ports, it is also interfaced to the GPS module and GSM module using RS-232. Each of components are as follows-

A. *Arduino*: The Arduino Uno kit is a microcontroller board based on the ATmega328. It contains14 digital input/output pins (6 pins can be used as PWM outputs), 6 analog inputs, a USB connection, an ICSP header, a 16 MHz crystal oscillator, a power jack and a reset button. Arduino has everything required to support the microcontroller; it simply needs to connect it to a computer using a USB cable or power it with AC-to-DC adapter or battery to get started. The Uno board is different from all other preceding boards in which it does not use the FTDI USB to serial driver chip.

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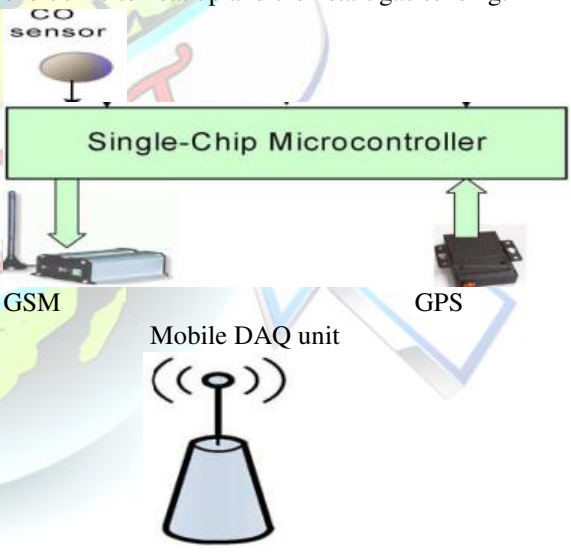
Fig 1. Arduino Uno Board

B. *Sensor*: MQ-7 carbon mono oxide sensor is used. It has a output range from 20ppm to 2000ppm CO. Analog to digital convertor is used to further processing sensor output. This sensor require a short time to heat up and then start gas sensing.



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Pollution Server

Fig.2 System hardware building blocks

C. *GPS Module*: Global positioning system is used to provide physical coordinates of the mobile DAQ. It is interfaced with Arduino using RS-232 cable.

Unit id	Pollution server IP address	Pollution server port#	time	date
Latitude	longitude	CO level	-	-

Fig3. Data Frame Payload

D. *GSM Module:* Global system for mobile communication service is used for transmission of the sensor and location value over a 2G or 3G cellular services of public network. Here we used SIM900 GSM module. It supports TCP/IP features such as FTP, E-mail, SMS, SMTP. It uses RS-232 to communicate with Arduino board.

E. *Pollution Server: A* personal computer is used with 24/7 internet accessibility. This server needs a private IP address for the GSM Modem and by using it server can communicates over a pre-configured port. This Pollution-Server connects to a MySQL database through a LAN. Pollution server runs a Wamp Server stack to provide the Apache Web Server in using the PHP Server-side scripting language.
Any client such as insurance company, tourist, municipalities, travel agencies can connect to this pollution server through the internet and they can get pollution level detail using browser on PC or mobile devices.

IV. SOFTWARE REQUIREMENTS

To run our devices we used Arduino IDE software that uses C programming. To transfer the data on server we used apache web server in addition with PHP language.

Basically Software architecture have two parts,

Physical Layer: This layer collect the data from sensor and location, date and time from GPS module and Arduino converts it into frames and send to GSM module through the RS-232 interface GSM makes it available for public.

Application Layer: It has two parts here first is Socket server that is a multithread java program which collects and stores the pollutant data in data base. Second is Air Quality Index, it converts row pollutant data into standard values.

The formula used to calculate AQI value is given below

AQI = (pollution level/pollution standard)*100

01	195.229.156.150	8000	11:13:00	01-04-09
25.311103	55.492365	04ppm	0.10ppm	0.05ppm

Fig.4 Example frame containing sensor values and location

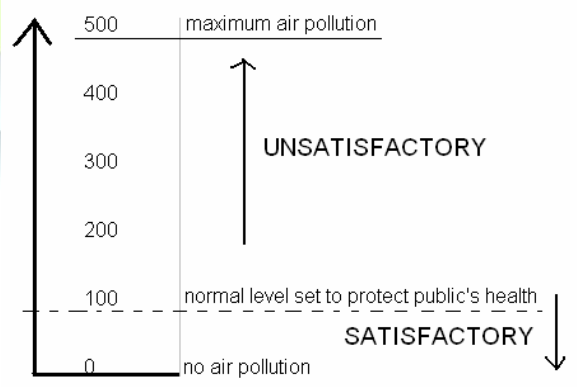

Fig.5 The range of AQI values

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V. RESULT

We have tested the device in on arduino kit, at different time instants it gave the different CO values. As sensor takes time to heat up and go to a threshold value final output fluctuated and we find variations in the readings at different time instants.Fig7.shows the lab examination results. There is a difference in readings of morning and evening because of atmospheric change in a day.

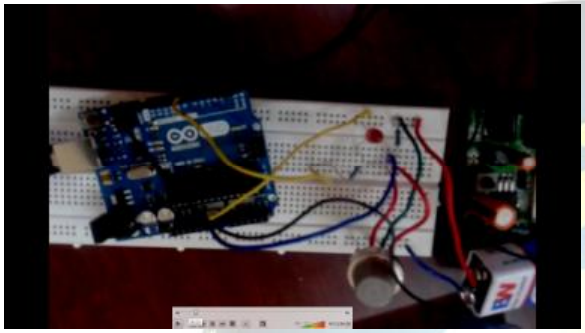

Fig.6 Basic circuit

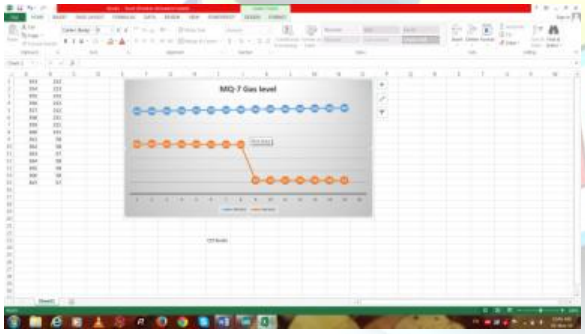

Fig.7 CO gas Level

VI. CONCLUSIONS AND FUTURE WORKS

A predictive system has been proposed. Experiment carried out using the developed Air pollution monitoring system. System is designed, implemented and tested using Arduino board, GSM and GPS modules. Many works have to be done to improve the performance such as power consumption during detection of pollutant sensing. Sensor takes time to heat up and takes time to reach a threshold level these things can be improve.

REFERENCES

[1.] A. R. Al-Ali, Imran Zualkernan, and Fadi Aloul,*"A Mobile GPRS-Sensors Array for Air Pollution Monitoring''* IEEE,2010

[2.] N. Kularatna and B. H. Sudantha, *"An environmental air pollutionmonitoring system based on the IEEE 1451 standard for low cost requirements,"IEEE Sensors J.*, vol. 8, pp. 415–422, Apr. 2008.

[3.] F. Tsow, E Forzani, A. Rai, R. Wang, R. Tsui, S. Mastroianni, C.Knobbe, A. J. Gandolfi, and N. J. Tao, "*A wearable and wireless sensor system for real-time monitoring of toxic environmental volatileorganic compounds,*" *IEEE Sensors J.*, vol. 9, pp. 1734–1740, Dec.2009.

[4.] Y. J. Jung, Y. K. Lee, D. G. Lee, K. H. Ryu, and S. Nittel, *"Air pollution monitoring system based on geosensor network,"* in *Proc. IEEE Int. Geoscience Remote Sensing Symp.*, 2008, vol. 3, pp. 1370–1373.

[5.] C. J. Wong, M. Z. MatJafri, K. Abdullah, H. S. Lim, and K. L. Low, *"Temporal air quality monitoring using surveillance camera,"* in *Proc. IEEE Int. Geoscience and Remote Sensing Symp.*, 2007,

[6.] Jen-Hao Liu, Yu-Fan Chen, Tzu-Shiang Lin, *Developed Urban Air Quality Monitoring System Based on Wireless Sensor Networks*(Fifth international sensing conference ,2011)

[7.] http://www.e2v.com/products-and services/instrumentation-solutions/gas-sensors/datasheets/''.