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PORTABLE SENSORS FOR MONITORING PERSONAL EXPOSURE TO AIR POLLUTION USING IOT

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Abstract: This paper describes hardware developments in a portable air quality sensor assembly for analyzing personal exposure to air pollution. According to the World Health Organization, exposure to air pollution is now the largest single environmental health risk globally. Understanding personal exposure from traditional stationary and spatially disperse monitoring stations is challenging, particularly in urban environments with multiple pollutant sources and complex transport dynamics. Portable air quality sensors have the potential to fill in the gap left by traditional air pollution monitoring. Air pollution sensor technology is decreasing in cost and size, meaning it is now tenable to use low-cost portable air pollution sensors. The data collected by air quality sensor assembly will be stored in cloud using IOT and it can be accessed for future purposes.

Keywords :Air quality,Sensors, IOT, Cloud

I.INTRODUCTION

In our nature, Pollution is one of the biggest problems. The World Health Organization reported that exposure to air pollution has been linked to decreases in economic productivity, increases in healthcare cost [1], and premature deaths [2]. Pollutants in the air (e.g. particulate matter, carbon monoxide, carbon dioxide, ozone, sulfur, and black carbon) can cause health problems such as worsening of existing lung conditions, increase risk of heart attack, coughing, and chest tightness [3]. In order
to prevent health hazards and to keep safe our environment, we need to keep track the pollution level of air. When the pollution level crosses the safe limits, we need to purify air. As we, all know **"Prevention is better than cure"**, so we need to be alert before the pollution level cross safe limits. In this paper, we will show how to monitor the pollution level.
For air pollution control, we need to measure the humidity, temperature, Air quality, smoke, alcohol, methane and Carbon Monoxide in air. We need HIH-5030 humidity sensor and MQ2 gas sensor to check the air quality.
At the interval of 5 min, all the data will be uploaded to the cloud. The pollution control room will analysis the data to transform and remodel with a view to reach to a certain conclusion for a situation
Rest of the paper is organized as follows, Section II describes Related Works, Section III describes Hardware Architecture, Section IV describes Working of air pollution monitoring system and Section V describes conclusion.

II. RELATED WORKS

Traditionally the concentrations of air pollutants are measured using air quality monitoring (AQM) stations that are highly reliable, precise, accurate and are able to measure a wide spectrum of pollutants using standardized analysers. The existing monitoring system largely uses smart transducer interface module (STIM) with semiconductor gas sensors which uses the 1451.2 standard. STIM was found to an efficient monitoring system but for the power requirements and ability to expand for large deployment is difficult. These instruments provide fairly accurate and selective gas readings. A gas sensor that is compact, robust with versatile applications and low cost could be an equally effective alternative.One of the large scale sensor networks for monitoring and forecasting is Environment Observation and Forecasting System (EOFS). Air pollution monitoring system based on geo sensor network with control action and adaptive sampling rates proposed in also cannot be vast deployment due to high cost.

In this research, a real time monitoring of three gases are simulated in real environment. Gases that are monitored in this implementation are Carbon monoxide, carbon dioxide & Sulphur dioxide. In this simulation, these three gases are successfully tested in four areas. Then extended the simulated results to update in web.[1] The main aim of this paper was to design and implement an efficient monitoring system through which the required parameters are monitored remotely using internet and the data gathered from the sensors are stored in the cloud and to project the estimated trend on the web browser. A solution for monitoring the noise and CO levels i.e., any parameter value crossing its threshold value ranges, for example CO levels in air in an area exceeding the normal levels etc., inthe environment using wireless embedded computing system is proposed in this paper. The solution also provides an intelligent remote monitoring for an area of interest. In this paper, we also present a trending results of collected or sensed data with respect to the normal or specified ranges of parameters[2] e three main drawbacks are as follows:

- The significant infrastructure needed for installation due to their bulky size
- The complicated operational requirements, eg:access to grid power, heating/cooling, and secure shelters
- The prohibitive costs of acquiring,setting up, performing regular maintenance and calibration.

These drawbacks reduce the number of installations and results in sparsely distributed AQM networks with limited spatial resolution air pollution data

The proposed system includes the integration of IoT into the pollution monitoring system which could prove to be reliable for implementation and incredibly beneficial for both an individual and a society

III.HARDWARE ARCHITECTURE

A. *Sensors Module*

MQ-2 gas sensor is designed with sensitive material of sno2, which with lower conductivity in clean air. When the target combustible gas exists, the sensor's conductivity is higher. Signal conditioning circuit is used to convert the change of conductivity to correspond output signal with the input gas concentration. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

Features:

1. Analog and Digital output
2. Good sensitivity to Combustible gas in wide range
3. High sensitivity to LPG, Propane and Hydrogen
4. Operation voltage: 5VDC

Humidity sensor senses, measures both moisture and air temperature. Humidity measurement can be done using electronic hygrometers. Electronic type hygrometers or humidity sensors can be broadly divided into two categories namely capacitive sensing effects and resistive sensing effects.

Features:

1. Input voltage: 5v
2. Output: Analog (0-5v)
3. High Performance
4. Long Term Stability

B. *Microcontroller Unit – ARDUINO*

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default boot loader of the Arduino UNO is the optiboot bootloader. Boards are loaded with program code via a serial connection to another computer. It includes a code editor with features such as text cutting and
pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board.It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

Features:

1. Microcontroller Atmel ATmega328.
2. Operating Voltage : 5 V.
3. Input Voltage : 7-12 V.
4. Digital I/O Pins 14 (of which 6 provide PWM output)
5. Analog Input Pins 8.

C. *LCD Module*

Liquid Crystal Displays are the simplest man and machine interface giving spectacular visual data, displaying Icons, Symbols, Numerical, Alphabets and Characters. We've used ODM's 16x2 digital display.

This	systemconsists	ofMobile	Data-Acquisition
Unit	(Mobile-DAQ) and	stuck web	Enabled Pollution

observation Server (Pollution server).Mobile-DAQ consists of a 32-bit single- chip microcontroller integrated with a detector array using analog ports.

Features:

1. Input voltage: 5v
2. E-blocks compatible
3. Low cost
4. Compatible with most I/O ports in the E-Block range
5. Ease to develop programming code using Flow code icons.

D. *IOT Description Module – ESP8266 WIFI module*

Wi-Fi is a technology for wireless local area networking with devices based on the IEEE 802.11 standards. Wi-Fi is a trademark of the Wi-Fi Alliance, which restricts the use of the term Wi-Fi Certified to products that successfully complete interoperability certification testing. Wi-Fi most commonly uses the 2.4 gigahertz (12 cm) UHF and 5.8 gigahertz (5 cm) SHFISM radio bands. Anyone within range with a wireless modem can attempt to access the network; because of this, Wi-Fi is more vulnerable to attack than wired networks. Wi-Fi Protected Access is a family of technologies created to protect information moving across Wi-Fi networks and includes solutions for personal and enterprise networks. Security features of Wi-Fi Protected Access constantly evolve to include stronger protections and new security practices as the security landscape changes.IOT Provided with 3 links

- Data updating to a specific web site
- Device controlling web site
- Data updating to a social network

Features:

1. 802.11 b/g/n protocol
2. Wi-Fi Direct (P2P), soft-AP
3. Integrated TCP/IP protocol stack
4. Integrated PLL, regulators, and power management units
5. +19.5dBm output power in 802.11b mode
6. Wake up and transmit packets in < 2ms
7. Standby power consumption of < 1.0mW (DTIM3)

E. *Buzzer*

The buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, ousehold appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset

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time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

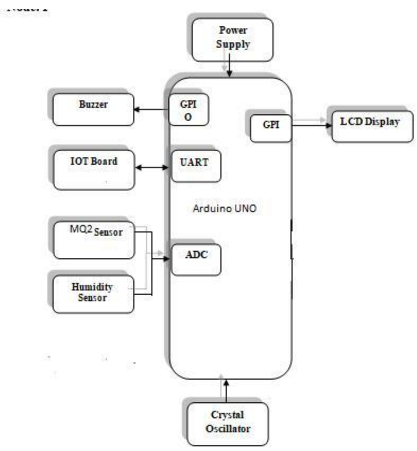

Figure 1 - NODE 1:

IV.EXPERIMENTAL OBSERVATIONS AND RESULTS

The system implementation and hardware connections are shown in Fig 1. In the working prototype model, the air quality is monitored and the pollution level is read as analog signals from the sensors where it is passed as an input to the Arduino microcontroller device. The data read is then compared with the threshold value i.e., the values which denotes the safety limits of the pollutants level in air.

NODE 2:

Once the value reaches the threshold level, the buzzer gets activated and alarms the authenticated person. Since the arduino is connected to the IOT module, the data can be transferred to the cloud using IOT. The data transfer to cloud is performed by wireless network using ESP8266 wifi module. The data in the cloud is stored using an open cloud storage platform called Thingspeak from where it can be accessed and analysed when needed. The data stored in cloud is then transferred to mysql database where it is displayed in a webpage.The pollution server contains all the data collected from sensors through cloud which can be accessed , processed and shared among clients to retrieve reliable informations. In this paper using MQ2 gas sensor and humidity sensor we mainly focus on detecting the carbonmonoxide and particulate matter level in air which are the major air pollutants causing harmful health hazards to human beings.Thus our prototype model prevents an individual from long term exposure to such pollutants in air.

V.CONCLUSION

Pollution is one the greatest headache of mankind. Due to pollution, the society is getting infected by diseases, viruses, bacteria etc... To keep safe ourselves, we need to take some actions. In this paper, we are dealing with how to detect the level of pollution in air .We are using some sensors, which can detect lpg , temperature, humidity, Air quality, Smoke, in air . The sensors provide continuous monitoring of the environmental pollutants and record data for air pollution continuously. Then these results are sent to the cloud where it is being analyzed using Internet of Things technology. If the pollutant level exceeds it will be notified to the authenticated person.

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