

AIR CHECK-For a Safe living Environment

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Abstract-

Air pollution has been a dead serious talk of the recent times all over the world. Air pollution refers to the release of pollutants into the air that leads to dangerous impacts on life. Air pollution has been increased due to industrialization and affects human health. Hence this paper proposes a system for checking and monitoring of air pollutants with the use of Global System for Mobile communication (GSM), Wi-Fi module (ESP8266 Olimex MOD-WIFI) and Wireless Sensor Network (WSN). This system makes use of hardware components like Arduino Uno, GSM module, Particulate Matter Sensor, Temperature and Humidity Sensor and software's include PHP (UI) and Firebase as the database. The functionalities include popup alerts when the pollutants exceed the mentioned threshold value, above which it causes serious issues.

Keywords— WSN, GSM, Wi-Fi module

I. INTRODUCTION

Air pollution is a major threat to all living being in the world and India is no exemption to this issue. Whether it may be a developed or developing nation this issue is a great threat. The levels of air pollution have increased due to population growth, development of more industries and the change of village to cities and town. As Air pollution is increasing health problems is also increasing at a faster rate and causing serious problems like heart diseases, bronchitis, etc. The serious pollutants are Sulphur dioxide (SO₂): Critical Pollutant, Nitrogen Oxides (NO₂): Killer Gas, Particulate Matter (P.I.), Carbon Monoxide (CO), Photochemical Oxidants, Organic in Ambient Air, Trace Metals in Ambient Air. Hence a digital surveillance system for air pollution monitoring shall be prepared using WSN, GSM, and GPRS. This air pollution monitoring system gives the real-time data on web page and sends alerts in dangerous situations. Esp8266 helps to connect the Arduino board to the internet. It makes use of TCP/IP protocol and thus it acts as Wi-Fi network.

The Wi-Fi module can be controlled via AT commands and esp8266 is available at low cost. Thus, with this Wi-Fi module, sensor data is displayed on web page. The warnings are sent through SMS and e-mail to the registered users so that necessary actions are taken in advance.

II. RELATED WORK

The Global System for Mobile Communication (GSM) a digital cellular network for mobile communication. The General Packet Radio Service (GPRS) is a packet-based wireless communications and is

the extension of GSM. Thus, GSM module helps the microcontroller to communicate over the network. The GSM module is operated using a Subscriber Identity Module (SIM) and the SIM card operates over the network provided by the service provider. The GSM module can be connected to a PC or laptop through USB or serial connection. Thus the GSM module helps to send information or data through SMS and the module has a unique number. GSM module helps to communicate anywhere with the help of services provided by the network providers.

The Wireless Sensor Network (WSN) is distributed to monitor the various conditions. In the Wireless Sensor Network, the node represents the various sensors and the sensors help to acquire the data related to the environmental or physical conditions.

The Wireless Sensor Network helps in monitoring and acquiring conditions at various locations. The network can be used to monitor various gasses, weather conditions, speed, light intensity etc. The sensors are light weight, small components and it is powered by the battery. The Wireless Sensor Network has a wide range of applications, which includes Traffic Monitoring, Robot control, Air traffic control, monitoring weather stations, automated systems, Medical device monitoring etc.

Wi-Fi module helps to connect microcontroller to the internet. Esp8266 is low-cost Wi-Fi module and can be controlled via AT commands. Thus Wi-Fi module helps to publish the data on a web page. The sensor data are periodically transferred to a PC through a Wi-Fi module and then data will be displayed on the dedicated website. Hence many people can be benefited with the air pollutant information. The reports are generated using the air quality index.

III. THE PRINCIPLE OF OPERATION

The air pollution monitoring system uses client-server architecture, in which the pollution detector sends the data of the sensor to the Arduino microcontroller and from the microcontroller the data is displayed on the web page.

A. The data acquisition process

The main component of the Pollution Detection System is the Arduino microcontroller. The data is collected from the gas sensors like mq2, mq6 etc. The measurement takes place at a specific interval say microseconds. And the values are displayed using the LCD display. The sensor data are then transferred to the Arduino board and from the microcontroller, the sensor values can be sent to the web page using the Wi-Fi module.

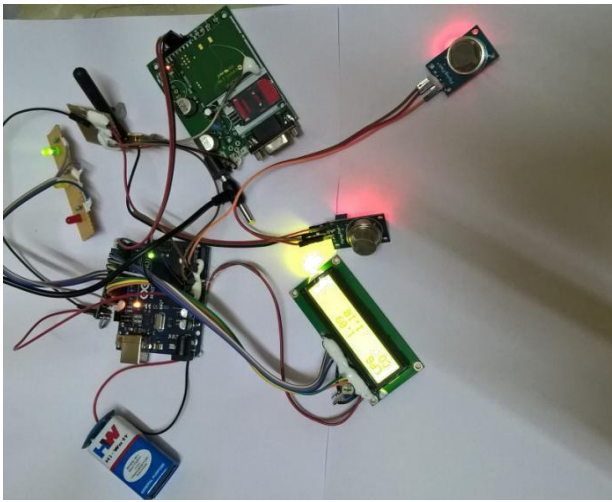


Fig 3.1 Data Acquisition from sensors

B. The user alert process

When the value of the air pollutants is greater than the given threshold value then the GSM module start sending SMS. After analyzing the alert message are sent to the subscribed users through SMS and e-mail if it is really an environmental issue otherwise the alert messages are not sent to the appropriate users. Air Quality Index is used to calculate the concentration of the air pollutants in the environment and it helps in generating reports and charts so that the subscribers can view the air pollutants level.

$$AQI = \frac{\text{pollutant concentration}}{\text{Pollutant nominal concentration}} \times 100$$

Thus using AQI, pollution levels are shown using the following color code:

- GREEN- good(AQI=[0-50])
- YELLOW - fair(AQI=[101-200])
- RED- poor(AQI=[301-400])

C. Protocols used for communication

The measured pollutant values are sent to the web page using the TCP/IP and HTTP protocol is used for communication. The air pollution monitoring system uses client-server model thus the client communicates to the server via HTTP protocol. Here the client is the web server which communicates with the server called Arduino. Thus the data's from Arduino are sent to the web server using the HTTP protocol. The PDS devices can be used along with GPS for getting the values of the air pollutants from various coordinates

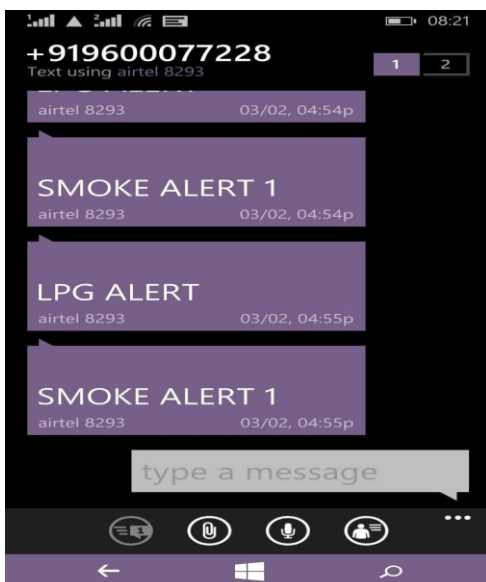


Fig 3.2 SMS Alert

D. User Interface

The real-time data from the pollution detection system is viewed the web page. The registered user or the user who wish to know the air pollutant data receives the alert if any pollutants exceed the threshold. If the user wants to monitor the particular location and to know about air pollutants levels they can register and get the information of various air pollutants.

IV. HARDWARE DESCRIPTION

The proposed air quality monitoring is based on the block diagram as shown in figure 3.1. CO, LPG in air is collected by corresponding sensors. Arduino processes the data received from the Coand LPG sensors. Controller changes it into more viable form accessed at the base station and by the user, GSM module is used to establish communication.

A. Arduino Uno R3 microcontroller

It is the most flexible hardware platform used based on ATmega328p which can be programmed according to the function to be used.



Fig 4.1 Arduino Uno R3 microcontroller

The Arduino microcontroller is not only for the technical audience but is intended for designers and artists as well because of its focus on usability based on its design which helps to achieve the intended goal. It is the primary component of the framework. Everything needed for its working is present on the board; we only require a USB cable to directly connect it to the computer or give power using battery source. Also, it is not expensive and can be accessed with free authoring software i.e. IDE (integrated development environment). With the availability of a large no of source codes over the internet, the programming of Arduino becomes easy.

B. CO Gas Sensor

The mq-6 gas sensor is a low-cost device that is very sensitive to CO and thus helps in the detection of this gas. The detection range is 10-10000 ppm. The sensor's output is an analog resistance. The CO measured is displayed on the LCD.



Fig 4.2 MQ6 Gas sensor

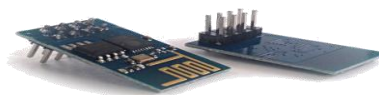


Fig 4.5 ESP8266 WiFi Module

C. Gas Leakage Detection Sensor

This sensor sense LPG, smoke, hydrogen and methane. Concentration of LPG gas detected will be 1000ppm.

The resistance value of MQ2 sensor varies for various kinds of gasses. The sensor is calibrated with a load resistance of about 20kΩ and the concentration of the gas to be detected is selected as 1000 ppm Liquefied Petroleum Gas(LPG).



Fig 4.3. MQ2 Gas sensor

D. GSM SIM 300

Radio modem by SIMComm is used in the shield. Communication with the shield can be done easily with the shield by using AT commands. It supports features like Data, Voice, GPRS, SMS and integrated TCP/IP stack. The connections of GSM module are done directly to PC through serial port/to the microcontroller through the serial interface with the use of RS232. For different applications, particular specifications are required which are mentioned in the datasheet of GSM module as shown in fig. In this system, SMS application is used which is intended for the person who is monitoring the value of CO in a room or an industry whenever it exceeds a particular safe limit chosen according to a particular application



Fig 4.4 GSM SIM 300 Module

E. ESP8266 Wi-Fi Module

The ESP8266 Wi-Fi Module is integrated with TCP/IP protocol that helps the microcontroller to access Wi-Fi network. The ESP8266 is programmed with AT command firmware. The ESP8266 module operates at 3.3V and hence a voltage divider along with three resistors is used to convert 5V to 3.3V. The Wi-Fi module has a powerful processing and storage capability that allows it to be integrated with the sensors.

V. SOFTWARE DESCRIPTION

The initial page of the website consists of login credentials. Now the registered users can view the levels of various air pollutants in the environment. The data from Arduino IDE is transferred to the web page using ESP8266 Wi-Fi module. Embedded C is used to code in Arduino IDE. The serial monitor displays, to whom the alert message has to be sent when the threshold value is more than 2.0.

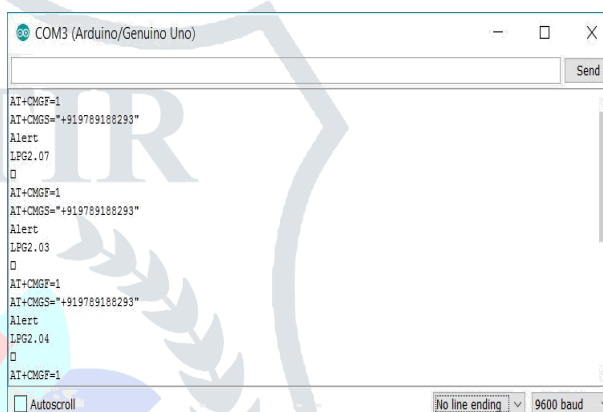


Fig 5.1 Arduino serial monitor

If the values of the air pollutants exceed the threshold then the alert messages are sent to the registered users through SMS and E-mail. The sensor data are stored in the cloud and analyzed. The sensor data on various days are carefully observed and averaged to compare the pollutant levels on various days and analysis takes place. The analyzed data is displayed as reports and the sensor data are compared for any drastic change. Thus air pollution monitoring system helps the authorities to take necessary steps in advance.

Air Quality Index is used to calculate concentration of the air pollutants in the environment and it helps in generating reports and charts so that the subscribers can view the air pollutants level. Arduino IDE serial plotter displays the sensor data as a graph in which the x-axis represents each tick for every microseconds (μs) and the y-axis auto adjusts to the incoming sensor values in volts (v).

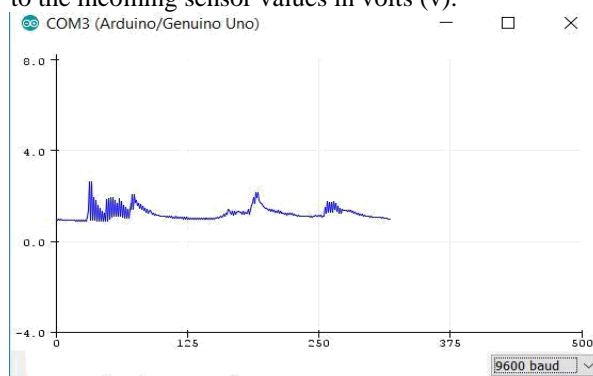


Fig 5.2 Graph of Air pollutant

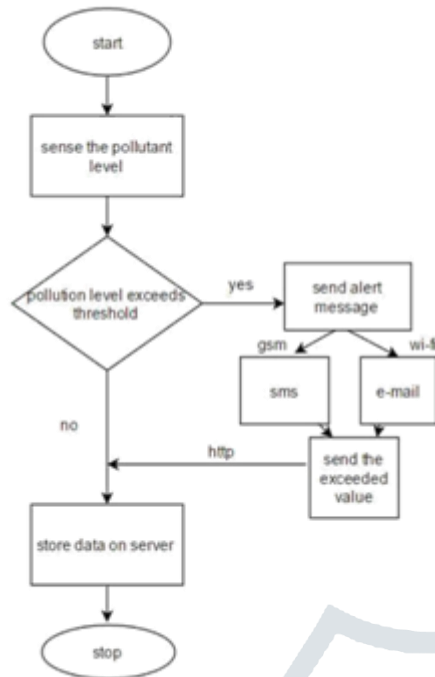


Fig 5.3 Flow of Operation

VI. CONCLUSION

The proposed digital surveillance system provides real-time information about the various pollutants in the atmosphere. The information can be viewed through the web page and alerts are sent through to the respective authority in case of any severe change in the levels of air pollutants. Thus necessary actions can be taken in advance of any environmental problem. Air quality index is used to show how polluted the air currently is and the sensor data are stored in the cloud and used for analysis. The analyzed data is displayed as reports to the users.

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