Air Quality Monitoring System

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Abstract – This paper develop an effective solution for pollution monitoring on a real time basis. To avoid such imbalances in the nature, an air pollution monitoring system is utmost important. The concentration of constituents in the atmosphere leading effects like global warming and acid rains. Available discrete gas sensors for sensing concentration of gases like CO2, NO2, CO and O2 are calibrated using calibration technologies. Other parameters like temperature and humidity were also sensed along with gas concentrations to enable data analysis. Experimentation carried out using the developed wireless air pollution monitoring system under different physical conditions show that the system collects reliable source of real time fine-grain pollution data.

Index Terms – Internet of Things, Buzzer, ESP8266 Wi-Fi Module, MQ-135 Gas sensor , Microcontroller.

1. INTRODUCTION

According to WHO (World Health Organization) every year around 7million people die all over world and 1.2million people die in India due to air pollution. Air pollution is caused due to the presence of particulate matter, harmful materials and biological molecules in earth atmosphere. It has adverse impact on living organisms such as humans, animals, food crops and can also damage built and natural environment. It may result in allergies, harmful diseases such as cardio vascular diseases, lungs diseases and can also cause death. For this project we applied IOT to develop wireless air pollution monitoring system on a real time basis. It carried out using developed wireless air pollution monitoring system under different physical conditions show that the system collects reliable source of real time fine-grain pollution data.

2. RELATED WORK

Some of the existing methodologies for the air pollution monitoring are described as below, In plug and sense device method, it Uses multiple sensors with location co-ordinate, AQI LED indicator is actuated as per pollution level and the Real time pollution level visualized using line graph [1].In distributed sensor data computing, it uses distributed intelligence for the sensor nodes and uses spatial database for locations [2]. In Arduino based method it uses sensor devices for data, Uses ESP8266 Wi-Fi module for connection to server, Uses Node.js and Node RED for displaying data on the server side [4].In personal assessment methods, Biochemical dose assessment methods are used Ex .Biomarkers [3].In ZigBee technology, ZigBee transmitters and receivers are used, GPS module is used for locations for pollution level on map. It includes Arduino based temperature, transmitting monitored data to cloud based server. In detail, the following environmental parameters are collected with the aim of measuring air pollution levels: Carbon Monoxide (CO), Carbon Dioxide (CO2), Nitrogen Dioxide (NO2), Methane (CH4), Hydrogen Sulfide (H2S), Ammonia (NH3), Particulate Matter (PM), Moreover, Other parameters like temperature, humidity are measured. In this section, the implementation of the proposed system is discussed. The use of database in this paper is to store the various sensor data into the online database. Xampp is a open source web server platform developed by Apache Friends. It consists of Apache HTTP server, MariaDB database, and an interpreter to decode the scripts written in PHP language. We can even create the database manually by starting the server and by using phpmyadmin in the localhost [4]. By localhost it means that the parent computer is treated as a web server. The various sensor values are collected and inserted into the database by using MYSQL query language. First a database is created in the localhost server named ‘MYDB’. Then a table ‘IOT’ is created to store the values of the sensors. Arduino is an open source micro-controller which is used with other communication and sensing technologies. This single-board development environment, which allows user to read uploaded data from sensors and allows to control different devices. ESP8266 is a low cost Wi-Fi module with an AT commands library. It allows the Arduino to connect to the Internet through a Wi-Fi connection. Moreover, ESP8266 has

a full TCP/IP protocol stack integrated on the chip. There are some constraints in terms of resolution. Indeed, the inputs uploading from analog sensors operate by default at 10-bit resolution. The on/off switching of the sensors can be operated remotely according to sensor-based data that are stored and maintained directly at the Cloud server. The Arduino collects all the data uploading from sensors and transmits it to the Cloud server by using the Wi-Fi module ESP8266, which is mounted on Arduino through an on-board serial port.

The data on the cloud server will be displayed location wise. The designed website will be hosted on the same cloud using python programming language. Website will contain the location wise separate dashboards and news, surveys related to air quality etc. will be updated on the website. The website link will be provided on the college website. The IOT allows for virtually endless connections and opportunities to take place, which we may not understand full impact of today. On a broader scale, the IOT can be applied to things like home appliances, internet, transportation networks: "smart cities" which can help us reduce waste and improve efficiency for things such as energy use; this helping us understand and improve how we work and live [5].

3. PORPOSED MODELLING

3.1. BLOCK DIAGRAM AND WORKING PRINCIPLE

The proposed system includes Arduino based temperature, transmitting monitored data to cloud based server. In detail, the following environmental parameters are collected with the aim of measuring air pollution levels: Carbon Monoxide (CO), Carbon Dioxide (CO2), Nitrogen Dioxide (NO2), Methane (CH4), Hydrogen Sulfide (H2S), Ammonia (NH3), Particulate Matter (PM), Moreover, Other parameters like temperature, humidity are measured. In this section, the implementation of the proposed system is discussed. Arduino is an open source micro-controller which is used with other communication and sensing technologies. This single-board development environment, which allows user to read uploaded data from sensors and allows to control different devices. ESP8266 is a low cost Wi-Fi module with an AT commands library. It allows the Arduino to connect to the Internet through a Wi-Fi connection. Moreover, ESP8266 has a full TCP/IP protocol stack integrated on the chip.

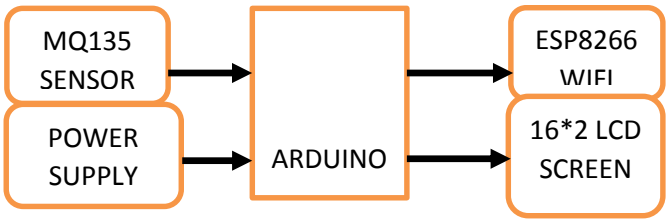

Fig.3.1 System Architecture

3.2. SENSORS

3.2.1. Microcontroller

Arduino Uno is one of the most popular prototyping boards. It is small in size and packed with rich features. The board comes with built-in Arduino boot loader. It is an at mega 328 based controller board which has 14 GPIO pins, 6 PWM pins, 6 Analog inputs and on board UART, SPI and TWI interfaces. In this IOT device, 9 pins of the board are utilized. There are six pins used to interface the character LCD. There are two pins utilized to interface the ESP8266 Wi-Fi Module and an analog input pin is used to connect the MQ-135 sensor.

Fig.3.2 Microcontroller

3.2.2. ESP8266

The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application networking functions from another application Each ESP8266 module comes pre-programmed with an AT command. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts. For connecting ESP8266 Module with Arduino Uno, you need 3.3 voltage regulator because Arduino is not capable of providing 3.3 v to ESP8266.

Fig.3.3 ESP8266 Wi-Fi Module

3.2.3. MQ-135

The MQ-135 gas sensor senses the gases like ammonia nitrogen, oxygen, alcohol, aromatic compounds, sulfide and smoke. The operating voltage of this gas sensor is from 2.5V to 5.0V.MQ-135 gas sensor can be implementation to detect the smoke, benzene, steam and other harmful gases.

Fig.3.4 MQ-135 Gas sensor

3.2.4. Buzzer

A buzzer is a mechanical and electromechanical, magnetic, electromagnetic or piezoelectric audio signaling device. A piezo-electric buzzer can be driven by an oscillating electronic circuit or other audio signal source. A click beep or ring can indicate that a button has been pressed.

Fig.3.5 Buzzer

3.2.5. LCD Display

LCD (liquid crystal display) screen is an electronic display module. A 16 X 2 LCD display is a very basic module an very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such line. In this LCD each character is display in 5x7 pixel matrix .LCD has two registers command and data the Command register store the command instructions given to the LCD .and data register store the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD..

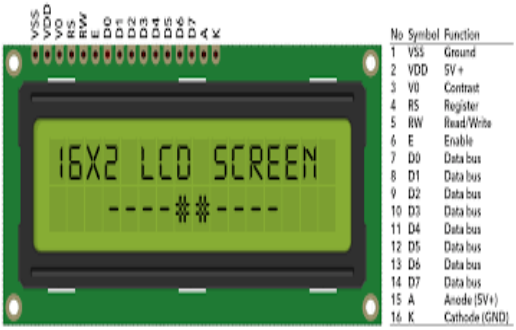

Fig.3.6 LCD

4. RESULTS AND DISCUSSIONS

4.1 Arduino IDE

Arduino IDE contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and genuine hardware to upload programs and communicate with them. It need two libraries (Software Serial and Liquid Crystal).It consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. It shows the air quality level in PPM(parts per million).

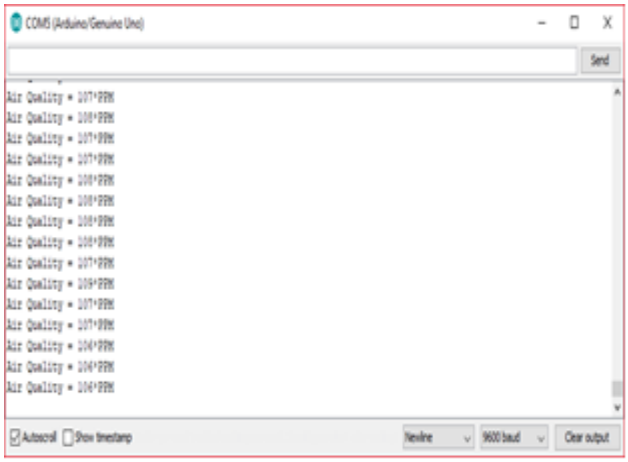

Fig.4.1 Air quality in ppm (IDE)

5. CONCLUSION

The IOT concept can be applied to a wide range of application. It uses in Industrial pollution monitoring and control. With this it can also prevent any disastrous hazards in the industries and provides a keen control over the environmental pollution. The implementation cost is very economical as the sensors and the microcontrollers are easily available. The online database system has increased the flexibility by updating all current parameters of the industries over a common server. This enables to generate automated control action in the absence of the authorized user. This project is also used for pollution monitoring purpose in cites. In future, this prototype can be extended in real time implementations in urban cities and it's price is very low compare to other air quality monitoring system.

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