IOT BASED ATMOSPHERIC AIR QUALITY MONITORING AND ALARMING SYSTEM USING NODE MCU

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Abstract:

Quality of air is an important parameter for the normal well-being of all human beings in the world because human beings are mainly depending upon oxygen present in an atmosphere. Human beings make use of oxygen for their inspiration and carbon-di-oxide for their expiration for the normal functioning of metabolism. But in the present scenario the quality of atmospheric air concentration is keep on deteriorating in the past two decades. The major reason for decreasing the quality of air has been found to be increasing number of industries and thus contaminating the purity of atmospheric gases by amalgamating toxic gases with pure atmospheric gases. Now it is highly important for human beings to know about the quality of air which they respire. So, this paper mainly focuses on monitoring the air quality index of the environment and to provide notification or alarm messages to the vulnerable groups of people right in that environment as precautionary measure. It mainly uses node MCU, a microcontroller with Wi-Fi module which consumes low current, air quality sensor and an android application called telegram for instant intimation of the alarming message through handheld cell phones. A webpage can be maintained in order to provide real time monitoring of air quality index in that environment.

I. Introduction

In the modern world of technology everything has been changed which includes nature and natural resources. The present condition of the Earth has been degraded a lot because of pollution of the air, water and soil which are being a support system for the survival of human beings. The worst of all is contamination of atmospheric air. The atmosphere contains gases which contains 78% of Nitrogen, 21% of Oxygen and 1% of other gases. These quantities of gases are very much important for the normal well-being of human beings on Earth[1]. Contamination of atmospheric gases is a result of merciless activities of humans and also due to unforeseen disasters caused by nature which includes volcanic eruption, wildfires, etc., Because of the development of industries both in hardware and software, pollution caused by them also has been getting increased. Man-made disasters like wars, burning fossil fuels, etc., are resulted in increasing concentration of gases like methane (CH_4), carbon monoxide (CO) which leads to acid rain, increases the rate of aging of lungs, etc., This paper is majorly based on monitoring the contamination of atmospheric gases with toxic gases released by industries. By monitoring the gases, it will be easy to understand and analyse the air quality index of an environment in a better view. The important toxic gases which released by industries and contaminate the pure gases of atmosphere majorly consists of carbon monoxide (67%), nitrogen oxide (59%), sulphurdioxide (88%), etc., But the firstly mentioned three gases cause severe damage to the normal metabolism of human beings by causing severe malfunctioning of internal organs [2-4]. In addition to industries, pollution caused by vehicle exhaust also plays a vital role in contaminating atmospheric gases. The major reason for air pollution in Delhi is because of vehicle exhaust. The smoke and haze from the

factories are the major reason of air pollution in Visakhapatnam. Thus, it is high time to control air contamination and also to provide alert messages to public before its quality crosses its threshold level. [5-7] With this paper consists of air quality monitoring and alarming which is based on Internet Of Things (IOT) that means controlling things via internet, node MCU and an android app called telegram both monitoring and alarming public can be done with less effort and fairly low cost.

II. Comparing Existing Method and Proposed Method

In order to analyse the air quality of a given environment lot many methods which are existing can be used. Here for an instance, let us consider two methods. One is air quality monitoring using Arduino and GSM module and later is based on Arduino and WIFI module as discrete component. In the first method that is by using GSM module, the major disadvantage is that current consumption. It is found that GSM module for transmission of data from sender to receiver requires 2 amperes of current which is fairly high in the present situation. On the other hand, the second method which is based on the Arduino and WIFI module as a discrete component has a current consumption of 135mA which is tolerable but compared to proposed method which consumes current of 100mA it looks fairly high current [8-10]. The proposed method can provide real time monitoring through "Thingspeak" website which is free to create channel and to use whereas by using GSM module sending collected data to website is not possible. In addition, by using Telegram which is a cloud based android application can be installed from google play store which can be used to get time to time update. On contrast to telegram, WhatsApp has a limitation of 256 members per group whereas Telegram allows 200,000 people. There are several other parameters to

be compared which are listed in the table 1 shown.

Table 1. Comparison of Existing and Proposed Method

| Parameter	Arduino Uno and GSM Module (Method-1)	Arduino Uno and ESP8266W IFI module (Method-2)	Node MCU (Proposed Method)
Current Consumption.	350mA to 2000mA.	150mA to 1.5mA.	15µA to 400mA.
Memory Required	Only 250 contacts can be stored in sim of 256 KB.	Only 512 bytes of data can be stored in EEPROM of ESP8266.	Telegram cloud provides users with unlimited storage space.
Program	Quite big, as Arduino has to be interfaced with GPIO pins of GSM	Comparatively small, but Commands to interface Arduino with ESP8266 is needed.	No commands in code are necessary to interface Arduino with Node MCU.

III. Working of the Proposed Method

The following figure shows the working block diagram of the proposed method. The main part of analysing concentration of atmospheric gases is done using MQ-135 air quality sensor. It continuously senses the concentration of gases in atmosphere and gives the Air Quality Index i.e., AQI in parts per million (ppm) to the Node MCU. It also uses the barometric sensors (BMP 280) to measure the temperature, pressure, pressure inch in the atmospheric air of the environment which is considered. Both the sensors namely MQ-135 air quality sensor and BMP-280 barometric sensors which are monitoring the environmental conditions are giving it's output to the Node MCU. The microcontroller named

Node MCU used here compares the received AQI with its actual threshold value which is 1200 ppm. The Node MCU sends its data continuously to its serial monitor of Arduino IDE also to the webpage. The serial monitor displays the value of AQI in ppm, temperature in Fahrenheit, pressure in hPa, pressure inch and dew point. Now, the webpage used here has its domain from "Thingspeak" which is free to use and to create channels. Once the channel is created in a "Thingspeak" webpage, it has an access to the entire period of its working. The Node MCU which uses Arduino IDE can be interfaced to webpage through an API key generated upon creating a channel in a "Thingspeak" webpage. The webpage displays the routine graph for the values of AQI it obtained and also for the temperature, pressure, pressure inch and dew point obtained. The amount of CO_2 in atmosphere is sensed by gas sensor to analyse air quality[11-13]. As the ideal gas law states, temperature and pressure

determines the amount of substances present in the given quantity of gas and so their values are also measured at every interval and send to webpage.

Thus, the real time monitoring of AQI with temperature and pressure can be done through both webpage and also through serial port of Arduino IDE. If the received AQI is less than the threshold value which is 1200ppm, the Node MCU simply does the same work as earlier i.e., to send data to webpage and serial monitor. But whenever the value of AQI obtained by Node MCU from air quality sensor is greater than the threshold which here is 1200ppm, it sends intimation via a free android app called telegram in a broadcast manner [14-15]. This application is free to use and can also be installed easily. Since it sends data in broadcast through a group in telegram, everyone in that particular group can receive data at same speed and same time.
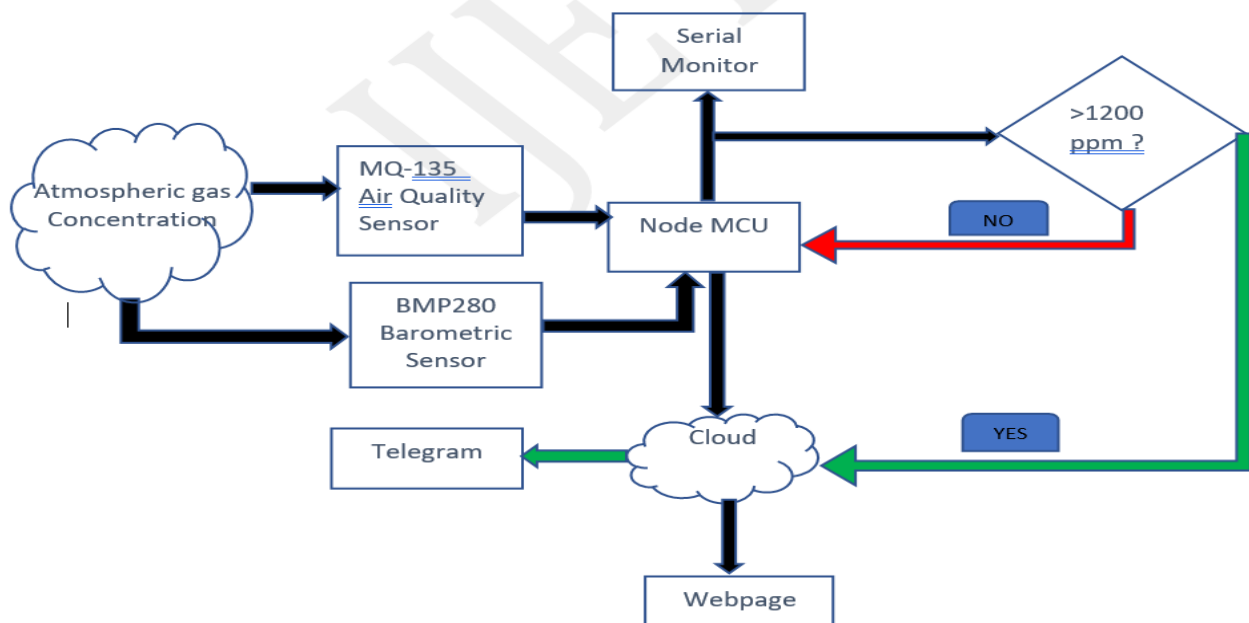
Fig 1. Block Diagram of Working of Proposed Method

As telegram is also a cloud-based app it supports 200,000 members to be added in a single group. It also helps in such a way that their is no need of memory for storage of data. Sending information to telegram and receiving

information simply involves creation of "BOT" which will communicate with Node MCU by sending and receiving information from the sensors interfaced with Node MCU. Thus, this method of air quality monitoring and alarming

system is easy to implement, maintain, consumes low current, no storage is required and has fairly low cost compared to other existing method which are proposed so far. The figure 2. shows the serial monitor output of Air Quality Index, Temperature, Pressure, Pressure inch and Dew point obtained from

Arduino IDE interfaced with Node MCU, MQ-135 Smoke sensor and BMP 280 Barometric sensor. The serial monitor first displays the IP address of the WiFi where it is connected. Then it shows the retrieving time at which it is connected to WiFi and sends out its data for remote access.

IV. Results and Discussion

```
.......
WiFi connected. IP address: 192.168.43.179
Retrieving time: 1615990505
...........................................................................
Air Quality: 557.15  PPM
Temperature =  90.8
Pressure =  988.6
Pressure Inch = 29.19
Dew Point =  54.8
.........................................
Data Send to Thingspeak
Waiting...

got response
handleNewMessages 1
FOR CONDITION
got response
handleNewMessages 1
FOR CONDITION
AQI CONDITION
got response
handleNewMessages 1
FOR CONDITION
got response
handleNewMessages 1
FOR CONDITION
got response
handleNewMessages 1
FOR CONDITION
...........................................................................
Air Quality: 553.19  PPM
Temperature =  90.8
Pressure =  988.6
Pressure Inch = 29.19
Dew Point =  54.8
.........................................
Data Send to Thingspeak
Waiting...
```

Fig 2. Serial Monitor Output taken from Arduino IDE

Then it displays the Air Quality, Temperature, Pressure, Pressure inch and Dew point under the environment it is maintained. Then it displays the message called "got response" which means it has got response for any of the parameters obtained from sensors to the Telegram application. After that it shows a

message called "handle New Message" which means it has handled the response that is it has replied the required parameter to the Telegram application. At last, it sends the data to thing speak website to plot respective graph. The figure 3.shows the output graph of Air Quality Index, Temperature, Pressure and Dew point

obtained. This webpage is updated for every 10 seconds by the values obtained from the sensors.

The figure 4 shows the parameters obtained from Telegram bot by the user. Whenever the user enters the keyword "/start", the Telegram app responds it by a welcome message and other keywords to get required parameters.


Fig 3. Output of graphs taken from webpage created

Whatever the parameter needed by the user can simply click the keyword represented in a blue colour then the Telegram responds it automatically Creating bot in a telegram is very simple. By means of creating a bot in telegram, an API key that is Application Specific Interface key will be generated using which Node MCU can be able to communicate with Telegram app. Chat id is an another parameter necessary for sending and receiving messages through Telegram app.

Fig 4. Getting required parameters from Telegram bot
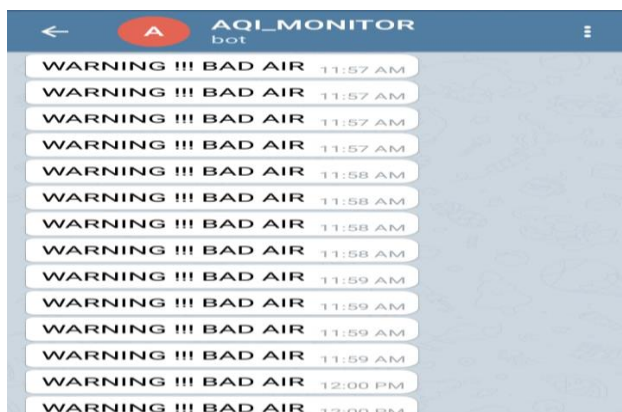
Fig 5. Telegram shows warning message

The figure 5. shows the warning message given the Telegram app to its users.

Whenever the Air Quality Index increases the threshold level of 1200 ppm it sends out message to Telegram which in turn informs its users through notifications.

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