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IoT based Air Quality Monitoring System

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Abstract – *The air contamination rates now a days are radically expanding in all the nations which requires an financial effective solution. The proposed system includes the design for monitor Air Pollution parameter using the Arduino. The monitored values can be accessed from the IoT platform (Thingspeak). The air pollution parameters are taken from the gas sensors (DHT11, MQ7 and MQ135). The air pollution parameters include: Carbon Monoxide, and Nitrogen-Di-Oxide, Ammonia, Nitric Oxide. This acts as a warning to the authorities about the air pollution rate. A graph is plotted using the monitored values using Thing Speak platform. Rising amounts of toxic gases in the environment, it found that people are in need of a way to ensure the safety specifically to live those in cities. An approach is suggested in this project, that is economical yet affords good detection, and can give accurate readings that can be analyzed and manipulated. These necessities are found in the Arduino UNO when it snared to the sensors. This project is mainly focused on dangerous gases such as Carbon Monoxide(CO), Nitric Oxide(NOx), Ammonia(NH3), Benzene and sulphide. The success with the Arduino give the accurate results in graph values to manipulate the data's.*

KEYWORDS: Internet of Things

1. INTRODUCTION

Air is getting contaminated as a result of arrival of harmful gases by enterprises, vehicle discharges and expanded fixation of unsafe gases and particulate issue in the air. The degree of contamination is expanding quickly because of variables like enterprises, urbanization, expanding in populace, vehicle use which can influence human well being. Particulate issue is one of the most significant parameter having the critical commitment to the expansion in air contamination. This makes a requirement for estimation and investigation of continuous air quality observing so proper choices can be taken in an opportune period. This paper shows a constant independent air quality checking. Internet of Things (IoT) is these days finding significant use in every single part, assumes a key job in our air quality checking framework as well. The arrangement will show the air quality in PPM in page with the goal that we can screen it effectively. In this IoT venture, you can screen the contamination level from any place utilizing your PC or versatile.

2. LITERATURE SURVEY

Firstly, 0-50 PPM can be considered completely safe. 51-100 PPM can be considered as Moderate where this could be usually observed at traffic areas [8]. 100-150 PPM can be considered as Unhealthy but only for sensitive groups. Above 151 PPM [7]is completely unsafe or unhealthy where India capital New Delhi falls in this range. It's very rare to record 300 PPM and above which can be considered as Hazardous, possibly due to Coal gas in mines [6].

AIR QUALITY INDEX

RANGE (PPM)	STATUS
0-50	GOOD
51-100	MODERATE
101-150	UNHEALTHY FOR SENSITIVE GROUPS
151-200	UNHEALTHY
201-250	VERY UNHEALTHY
251-300	HAZARDOUS

TABLE 1

This paper referred the idea cited at [1] with less cost i.e., while pushing the data to the cloud, no need to see the output on LCD which adds more cost to the project. On targeting IoT as a platform, our intension should be to present the idea on internet using the platforms like thinger.io or Thingspeak or Cayenne website which are beautifully designed to present the output and even able to download the dataset. When doing an experiment air quality monitoring, no need to use LPG or methane detecting sensors as it is used for Home/office safety. This paper used Wi-Fi to push the data onto the cloud rather using GSM or GPRS module [2]. The problem in another paper that cited at [3] hasn't calibrated the sensor and not converted the sensor output value into PPM. As per the guidelines by UN Data, 0-50 PPM is SAFE value, 51100 is moderate as shown in Table 1. New Delhi, the capital of India is the most polluted city in the world recorded around 250PPM. As this paper uses two sensors, both of them have internal heater element, it draws more power(P=V*I), so though the both sensors are turned ON, its output voltage levels varies and shows unpredictable values due to insufficient power drive. So we used a 9Volts battery and a 7805 family LM7805 Regulator for the CO sensor MQ7 as power from Arduino alone is not sufficient to drive two sensors.

3. OVERALL SYSTEM ARCHITECTURE

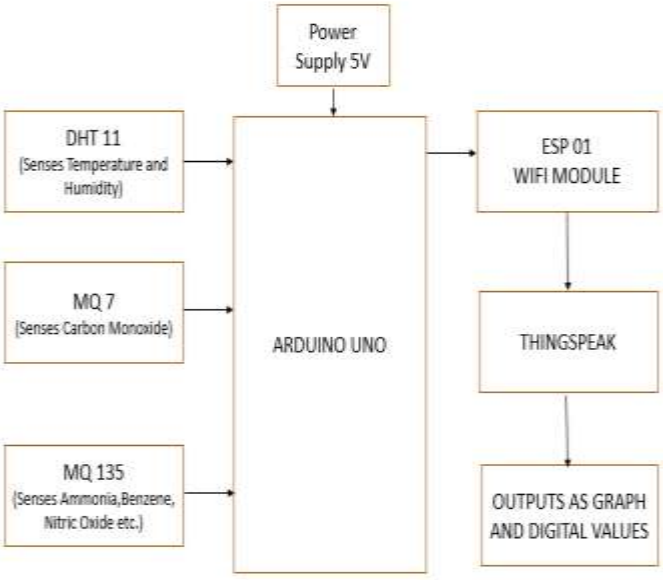

Fig-1 Block Diagram

The proposed air pollution monitoring is based on the block diagram as shown in the Fig.1 the data of air is recognized by the DHT 11, MQ 7 and MQ 135 gas sensors. When we will connect it to Arduino then it will sense all gases and it will processed by the ESP 01 Wi-Fi module to convert the analog values into PPM values and it will push the converted digital data's into IoT platform Thingspeak. where we can able to monitor the values in graph over a period.

A. ARDUINO UNO BOARD

Fig-3.1 Arduino UNO

Arduino is a microcontroller which can work with different sensors. Because of its effortlessness and accessibility of number of equipment expansions, the board can be utilized with most extreme effectiveness. It is the most adaptable hardware utilized on Arduino which can be programmed by the function where it is to be utilized. What's more, it is an open source microcontroller gadget with effectively available programming and is good with numerous sensors accessible. Likewise, it isn't costly and can be assessed with free authoring software for example IDE (incorporated advancement condition). With the accessibility of a huge no. of source codes over the web, the programming of Arduino turns out to be simple.

B. Gas Sensors

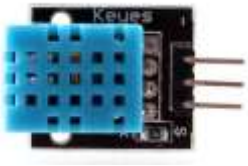

Fig-3.2 DHT 11

DHT 11 is utilized to detect the temperature and humidity which are the primary parameters of the air quality. The DHT 11 is a fundamental, ultra ease advanced temperature and humidity sensor. It utilizes a capacitive stickiness sensor and a thermistor to gauge the encompassing air and lets out an digital sign on the output data pin. It is genuinely easy to utilize.

Fig-3.3 MQ 7

MQ 7 is utilized to detect the carbon monoxide which is the fundamental agent of air contamination prompts numerous deadly illnesses to our body. MQ 7 Semiconductor sensor for Carbon Monoxide. Delicate material of MQ 7 gas sensor is SnO2, which with lower conductivity in clean air. This is extremely easy to utilize, fitting planned for recognizing CO focuses inside the airborne. This will sense CO-gas fixations somewhere in the range of 20 to 2000ppm.This detecting component SnO2 envelops a high sensitivity and fast response time.

Fig-3.4 MQ 135

MQ135 is used to sense the wide range of gases includes ammonia, benzene, nitric oxide, smoke gases and argon gases etc which affords to implement this system indoor as well as outdoor. It has high sensitivity to Ammonia, Sulphide

and Benzene steam, also sensitive to smoke and other harmful gases. Also offers low cost and long life.

C. ESP 01 Wi-Fi Module

Fig-3.5 ESP 01

The ESP 01 Wi-Fi Module is an independent SOC with incorporated IP convention stack that can give any microcontroller access to your Wi-Fi network. Wi-Fi module is prepared to do either facilitating an application or offloading all Wi-Fi organizing capacities from another application processor. Each ESP 01 module comes pre-programmed with an AT command set firmware, which means, we can just interface with the Arduino device. The ESP 01 Wi-Fi module is a very cost effective device.

D. Thingspeak

Fig-3.6 ESP 01

Thingspeak is a cloud platform for Internet of Things. It allows the users to store the data collected from sensors in different channels. It is also used for real-time data processing, visualizations, and plugins.

4. PROCEDURE

We have used Arduino Uno Development kit that comes with ATMega328P microcontroller. In order to provide Wi-Fi Support for it, we have used cost effective ESP-01 Wi-fi module which helps us to connect to the Thingspeak Platform. Figure 4 represents the connections between the components used like Arduino Uno, MQ135, MQ7, ESP-01 Wi-fi Module, 9Volts Battery, LM7805 Regulator. From Figure 4, ESP-01 is connected to 3.3Volts pin of Arduino Uno. MQ135 is connected to 5Volts pin of Arduino Uno. As power won't be sufficient to drive one more sensor, MQ7 is connected to 9Volts Battery via 5Volts LM7805 Regulator.

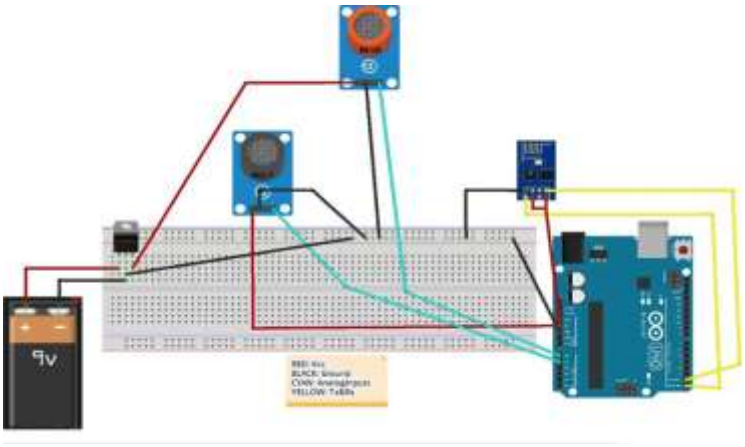

Fig-4 Connection Diagram

ESP 01 is connected to the Local Hotspot by giving corresponding SSID and Password. The reason for using LM7805 Regulator is that 9Volts supply should not be directly [9] given to MQ7 sensor where it needs only 5Volts input at maximum, so regulator does the job of stepping 9Volts to 5Volts [4][5]. The most important step is to calibrate the sensor in fresh air and then draws an equation that converts the sensor output voltage value into our convenient units PPM (parts per million).

5. RESULTS

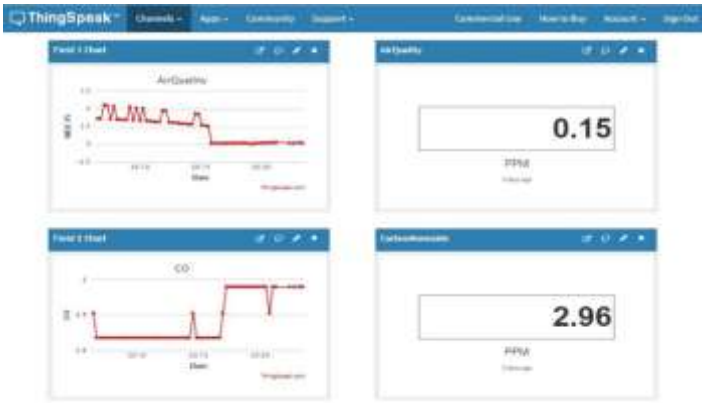

Fig-5.1 Output on Thingspeak

After connecting the ESP-01 successfully to the hotspot, it gets established with Thingspeak wesbite and the account API Key is written in Arduino Code which helps to save the data only to our account bearing the given API key. To push the data Thingspeak needs 15 seconds of refresh interval rate. Fig 3 shows the field charts of MQ135 and MQ7 sensor values for the location where the experiment is conducted in PPM (Parts per million). Also figure 5.1 shows the visualization charts for corresponding sensors. Fig 5.2 showing the graphical analysis of the values collected with timestamping on X axis and Air Quality PPM on Y axis.

Fig- 5.2 Graph showing AirQuality

6. Conclusion

This paper likewise rectifies the PPM counts referenced at Literature Survey. This project can be utilized both for indoor just as outside. For indoor, we can make this kit as a compact device to such an extent that if each home began utilizing the device, we can monitor the indoor air nature of a specific focused area. Because of expanding air contamination, there is need to watch out for Indoor air quality as well.For outdoor purpose, certainly one sensor is not enough because one sensor has a sensitivity range of around 1 meter, so a group of sensors has to be deployed to monitor the outdoor air quality.

7. Future Work

We can utilize one more sensor that tells the ozone layer status, be that as it may, it costs exceptionally high. Likewise we can utilize laser dust sensor accommodating for only for vehicle discharges detecting. Thingspeak has an impediment that it requires 15-20 seconds for each push of the values which is not a good one. We plan to utilize another IoT platform mydevices cayenne which is fast in demonstrating the qualities from the Arduino that makes a difference us to gather more values in the cloud which as dataset. Cayenne likewise comes with a prepared android/ios application.In any case, it doesn't work with Arduino Uno rather works with just Raspberry Pi and Node MCU only.

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