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Internet of Thing Based Air Pollution Analysis System Using Sensors

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***Abstract*- The level of pollution has increased with times by lot of things just like the increase in population, increased vehicle use, industrialization and urbanization which ends up in harmful effects on human wellbeing by directly affecting health of population exposed thereto. so as to watch during this project we are getting to make an IOT Based pollution Monitoring System during which we'll monitor the Air Quality over an internet server using internet and can trigger a alarm when the air quality goes down beyond a particular level, means when there are sufficient amount of harmful gases are present within air like CO2, smoke, alcohol, benzene and NH3. it'll show the air quality in PPM and also as on webpage so that we will monitor it very easily. During this IOT project, you can monitor the pollution level from anywhere using your computer or mobile.**

***Keywords* - Internet of things, air pollution, sound pollution, sensors, monitoring system, Arduino.**

I.INTRODUCTION

To provide adequate environmental and health protection, an efficient air quality monitoring system may be a necessary instrument. it's desirable that the system is straightforward , reliable, sensitive and cost-effective. additionally this technique must be high sensitive to low concentrations of gaseous air contaminants like hydrogen and carbon monoxide gas which exist in cigarette smoke. the present trend for air contaminants monitoring and alarm systems development is to extend the sensitivity and to scale back the reaction time , especially at low air contaminants concentrations.

Typical environmental sampling methods for these contaminants employ manual grab samples that are collected on site then transported to a laboratory for analysis. These sampling methods are often very costly and time consuming, and ongoing research has focused on the event of sensors which will replace traditional sampling methods to watch contaminants within the environment. Gas sensor supported semiconducting materials became of great interest to both sensor users and researchers. during this context, an enormous number of publications have appeared within the literature which deals with metal oxide gas sensors, generally , and with the prototype material tin dioxide, especially [3].

Drawn from industrial and commercial activities, the world's human population concentrates on specific regions. Such a phenomenon is understood as 'urbanization'. Although the urbanization brings a better economic development, the excessive population concentration will cause environmental damage and pollution like pollution , sound pollution , pollution , etc. Among various sorts of pollution, pollution features a direct impact on our lives, due to the rapid emission of pollutants. Over the past decades, governments of the many countries have imposed different regulations on air pollutants, therefore the severe damage delivered to human health is reduced considerably. Although there could also be no the immediate damage to human lives, however, pollution still causes some chronic diseases. consistent with epidemiological studies [1], for instance , the long-term exposure to pollutants may end in the harm to respiratory, nervous and cardiovascular systems. Therefore, the real-time monitoring of the air quality is especially important and necessary. High urbanization in a neighborhood may cause the absence of vegetation therein area. Air cleaning and temperature cooling become harder due to the shortage of vegetation, and therefore the area are going to be inevitably influenced by the urban heat island effect [2].

Moreover, the crowded tall buildings and heavy transportation also prevent air pollutants from dispersing. Thus, the govt in Taiwan built many air quality monitoring stations to watch the air quality in urban areas. However, the value of building the stations is extremely expensive, therefore the deployment density is quite low. Let's take the Taipei city as an example. There are approximately 2.6 million people living in a neighborhood of 271.8 square kilometer, but only eight air quality monitoring stations are deployed within the area. the space between the monitoring stations is quite dozens of kilometers. Such a technique for air quality monitoring doesn't provide a better spatiotemporal resolution.

The current pollution measurement methodology uses expensive equipment at fixed locations or dedicated mobile equipment. The data obtained during this way is

used to further extrapolate the extent and concentration of pollution through dispersion models. this is often a coarse-grained system where the pollution measurements are few and much in-between. Widespread deployment of this measurement paradigm is constrained by its prohibitive cost. additionally , it's desirable to possess access to real-time measurements to be able to quickly analyze and identify alarming levels of pollutants. Currently, access to such data is restricted [4] if not absent. it's available to and discernable by only a couple of who are well informed on the topic of pollution. As against a coarse-grained sensing system, a fine-grained approach would offer more frequent and spatially dense pollutant measurements.

A scalable sensing platform could effectively disseminate pollution information to users in need. Today, the scarcity of fine-grained air quality information is hindering public awareness of health issues arising from pollution. Studies suggest that the health effects among asthmatics from short-term changes in pollution levels are a crucial public ill health [5]. We anticipate that, with the assistance of fine-grained air quality measurements, people might be advised to require actions supported real time pollution levels to accommodate individual health needs. the supply of real-time air quality data could make drivers better educated about driving patterns and therefore the way it impacts the environment and increases pollution. Better driving habits will cause reduced pollution. Also, more health conscious citizens may choose alternate “healthy” routes supported the pollution information. it'll benefit them also as others by reducing pollution concentration in peak roadways so everybody breathes cleaner air.

II. LITERATURE SURVEY

Wireless Sensor Network (WSN) may be a lively field of research because of its emerging importance in many applications including environment and habitat monitoring, health care applications, control and military network systems. With the recent breakthrough of Micro-Electro-Mechanical Systems (MEMS) technology whereby sensors are becoming smaller and more versatile, WSN promises many new application areas within the near future.

Typical applications of WSNs include monitoring, tracking and controlling. a number of the precise applications are habitat monitoring, object tracking, reactor controlling, fire detection, traffic monitoring, etc. Initial development into WSN was mainly motivated by military applications. However, WSNs are now utilized in many civilian application areas for commercial and industrial use, including environment and habitat monitoring, healthcare applications, home automation, reactor controlling, fire detection and control.

This transition from the use of WSN solely in military applications has been motivated because of the character of WSNs which can be deployed in wilderness areas, where they might remain for several years, to observe some environmental variables, without the need to recharge/replace their power supplies. Such characteristics help to beat the difficulties and high costs involved in monitoring data using wired sensors. Below are some areas where WSN are successfully deployed to observe the environment.The air and sound pollution monitoring system is totally important for detecting big choice of gases, also sensors have long life time, easily available, less cost, easy to handle and are compact.

Quality of air are often checked indoor also as outdoor. this technique has simple drive circuit, works on real time and has visual output. the most objective of this paper is to make sure that the air and noise pollution is monitored and kept on top of things by taking measure accordingly. The proposed paper has certain limitations regarding humidity which should be but ninety-five percent and exact measurement of contaminating gases cannot be detected in ppm. This paper are often used for monitoring pollution level and also to prevent quite pollution which can cause huge problem in future. This paper gives an idea on how we'll give instant conscious of the authorities. the value effective IOT technology is employed .

Hence air and noise pollution is monitored by using this technology.[4] The automated Air & Sound management system may be a breakthrough to contribute an answer to the most important threat. The air & sound monitoring system overcomes the matter of the highly-polluted areas which may be a major issue. It supports the new technology and effectively supports the healthy life concept. this technique has features for the people to watch the amount of pollution on their mobile phones using the appliance . So, it becomes very reliable and efficient for the Municipal officials in conjunction with the Civilians to observe environment. Letting civilians also involved during this process adds an extra value thereto . As civilians are now equally aware and interested in their environment, this idea of IOT is useful for the welfare of the society. And it's implemented using the newest technology.[5]

This IOT based air and noise pollution monitor could also be an excellent step towards a healthy living. With the assistance of this device not only the municipal authorities but even the parents can participate within the tactic of controlling pollution and ensure safe environment. These automatic devices, once installed are capable of continuously tracking the pollution level and analyze the detected information. the foremost highlighting feature of this device is that the output is represented in digital also as analog format with the assistance of an easy mobile application which is usable on all android devices like smart phones, tablets, PDA’s etc. The device itself is extremely eco-friendly and doesn't harm the environment in any way.

Moreover, it's supported one of the fashionable technologies and also inexpensive as compared to other technologies developed so far and should be installed anywhere.For creating the system, first we did the research supported the system about IOT and various sensors. Sensors of air and sound supported availability and economical price were selected. For the interaction of internet with the system we are employing a Wi-Fi module which is connected to the microcontroller through the interface. So, the measured data is shipped from the module to any location with it range from the info are often fetched employing a laptop /mobile. we've tested this technique at various places. we've used it at the places where standard devices for the measurement of pollutants are installed to match those measured values with our system output values.

III. EXISTING SYSTEM

A portion of the current instruments for air contamination observing are Fourier change infrared (FTIR) instruments, gas chromatographs and mass spectrometers. These instruments give genuinely precise and particular gas readings. A gas sensor that is conservative, strong with adaptable applications and ease could be a similarly powerful other option. A portion of the gases checking advances are electrochemical, infrared, reactant globule, photograph ionization and strong state.

The current observing framework to a great extent utilizes savvy transducer interface module (STIM) with semiconductor gas sensors which utilizes the 1451.2 norm. STIM was found to a proficient observing framework yet for the force prerequisites and capacity to extend for enormous arrangement. One of the huge scope sensor networks for checking and determining is Environment Observation and Forecasting System (EOFS). Air contamination observing framework dependent on geo sensor network with control activity and versatile examining rates proposed in additionally can't be huge organization because of significant expense.

1. Pollution Monitoring System utilizing WSN in Visakhapatnam.
As the technology increases, the level of robotic work (cutting the labor) in the practically all parts are likewise incrementing. WSN are grabbing up the ground in all divisions of life; from homes to industrial facilities, from traffic control to natural checking. The air pollution monitoring system contains sensors to screen the intrigued pollution parameter with regards to condition. It reenacted the three air contaminations gases including CO, CO2 and SO2 in air in light of the fact that these gases chooses the level of pollution. It can additionally apply the methodology in dissimilar house hold activities like spilling culinary gas in our homes, to caution the laborers in oil and gas sedulity to recognize the spillage and so on. This repetition makes the awareness in individuals in urban communities.

2. An embedded system model for air quality monitoring.
Goal of the paper is to introduce a framework model which can encourage the evaluation of wellbeing impacts caused because of indoor air contamination just as open air and can suggest the human earlier about the hazard he/she going to have, here we are centering our work in setting to unfavorably susceptible patients as they will be educated by this instrument to such an extent that they can make sure about themselves without really encountering the hazard factors, here a detecting system based microcontroller outfitted with gas sensors, optical residue molecule sensor, mugginess and temperature sensor has been utilized for air quality checking. The plan included different units mostly: detecting unit, handling unit, power unit, show unit, correspondence unit. This work will apply the methods of electrical designing with the information on ecological building by utilizing sensor systems to quantify Air Quality Parameters.

IV. EXISTING SYSTEM VS PROPOSED SYSTEM

Sr. No	Existing Work	Proposed Work
1.	As per the base paper, in this concept there no any database used	In proposed work MYSQL database is used
2.	Costly cloud is used	Free of cost cloud used with all facilities
3.	No excel sheet generated	In this cloud excel sheet can be generated
4.	Totally mobile application based	Web based, also can view on mobile also
5.	Graphically representations are not shown properly	Well graphical representation shown
6.	No dashboard to represent all data	Well-designed dashboard
7.	Effects of pollution not shown	Effects of pollution shown properly
8.	User interface not shown	User interface designed and

		shown properly
9.	Microcontroller coding is too difficult	Microcontroller coding is easy to use and understand

V.PROPOSED SYSTEM

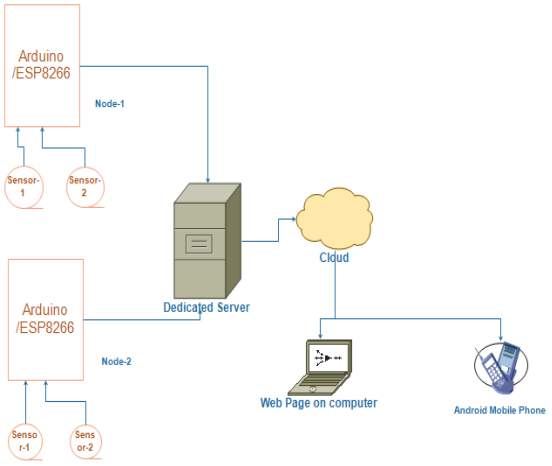


Fig 1. Proposed System.

Right now we are going to make an IOT Based Air Pollution Monitoring System in which we will screen the Air Quality over a webserver utilizing web and will trigger warning when the air quality goes down past a specific level, implies when there are adequate measure of unsafe gases are available noticeable all around like CO2, smoke, liquor, benzene, and NH3. It will show the air quality on the website page with the goal that we can screen it no problem at all.

- In this proposed system, two nodes will be used.
- The Arduino microcontroller used to access values of sensors and send to server using WiFi device.
- The server will store values in database, so user will get history of sensors values.
- The values can be processed and send to cloud to see current values of sensor.
- The output will be on computer and android mobile phone.
- The values of sensors can be accessed using web page also.
- The nodes are situation at different location and the pollution level can be detected and store on database.
- From that database the values can be fetched anytime and anywhere.
- The nodes are two only so here we are not using GPS for location, instead of it we will use the images of location.

VI. IMPLEMENTATION AND RESULT

Step 1

1. Interfacing Arduino DHT111 Humidity Sensor

This module consist of a DHT11 digital humidity and temperature sensor. The DHT11 uses an internal thermistor and a capacitive humidity sensor to determine environment conditions, an internal chip is responsible for converting readings to a serial digital signal.

Humidity

Humidity is the amount of water vapor in the air. Water vapor is the gaseous state of water and is invisible. Humidity indicates the likelihood of precipitation, dew, or fog. Higher humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin.

2. DHT11 Humidity Temperature Sensor

The DHT11 humidity and temperature sensor measures relative humidity (RH) and temperature. Relative humidity is the ratio of water vapor in air vs. the saturation point of water vapor in air. The saturation point of water vapor in air changes with temperature. Cold air can hold less water vapor before it is saturated, and hot air can hold more water vapor before it is saturated. The formula for relative humidity is as follows: Relative Humidity = (density of water vapor / density of water vapor at saturation) x 100%

Specifications

- Supply voltage: 3.3 ~ 5.5V DC
- Output: single-bus digital signal
- Measuring range: Humidity 20-90% RH, Temperature 0 ~ 50
- Accuracy: Humidity + -5% RH, temperature + -2
- Resolution: Humidity 1% RH, temperature 1

Long-term stability: <± 1% RH / Year

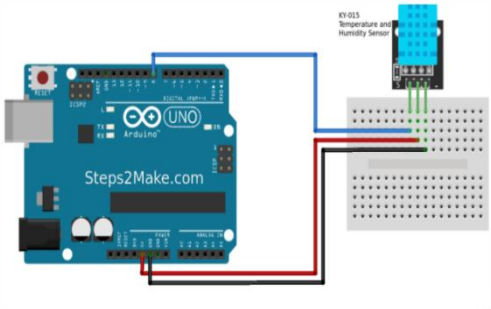


Figure 2 Arduino Connection With KY-015 Temperature And Humidity Sensor

Arduino pin 8 –> Pin S module
Arduino GND –> Pin – module
Arduino +5 –> Pin Middle

Figure 3 KY-015 Sensor Module

```
#include <dht.h>
dht DHT;
#define DHT11_PIN  8
void setup()
{
   Serial.begin(9600);
}
void loop()
{
int chk = DHT.read11(DHT11_PIN);
Serial.print ("Temperature = ");
Serial.print ln (DHT.temperature);
```

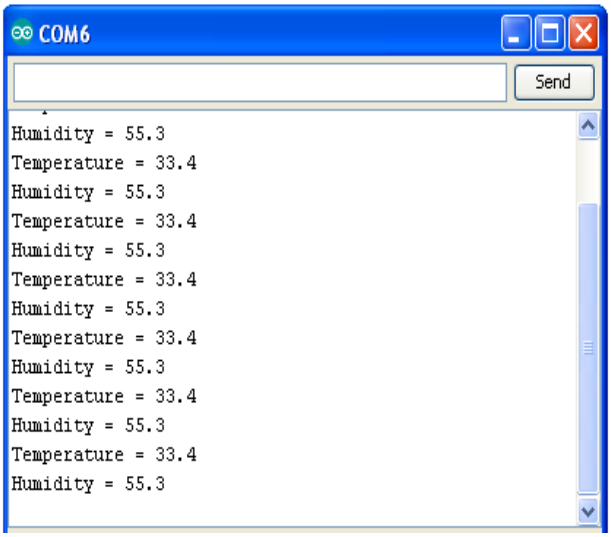


Figure 4 Open Serial Monitor And Observe The Readings. Blowing Air On Sensor Will Change The Humidity Readings.

Step 2

1. MQ-2 Smoke Sensor with an Arduino

The smoke sensor we will use is the MQ-2. This is a sensor that is not only sensitive to smoke, but also to flammable gas. This Gas Sensor mq2 Module features an MQ-2 sensor. The MQ-2 sensor is a versatile gas sensor capable of detecting a wide range of gases including: alcohol, carbon monoxide, hydrogen, isobutene, liquefied petroleum gas, methane, propane and smoke. This module is provided with male header interface and can be easily interfaced with Arduino/Mega using male to female type jumper wires.

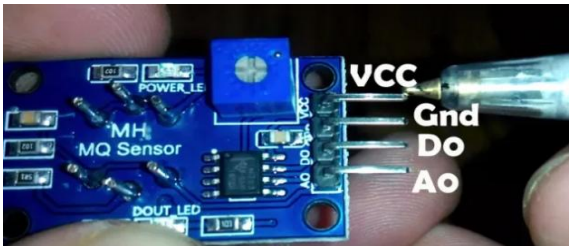


Figure 5 Pin Details Smoke Sensor

The MQ-2 smoke sensor reports smoke by the voltage level that it outputs. The more smoke there is, the greater the voltage that it outputs. Conversely, the less smoke that it is exposed to, the less voltage it outputs. The MQ-2 also has a built-in potentiometer to adjust the sensitivity to smoke. By adjusting the potentiometer, you can change how sensitive it is to smoke, so it's a form of calibrating it to adjust how much voltage it will put out in relation to the smoke it is exposed to.

We will wire the MQ-2 to an Arduino so that the Arduino can read the amount of voltage output by the sensor and sound a buzzer if the sensor outputs a voltage above a certain threshold. This way, we will know that the sensor is detecting smoke and we will sound a buzzer alerting a person such as a homeowner to this fact. The MQ-2 can be obtained very cheaply, just a few bucks. A good place to look for it is on ebay, which always has auctions on them for the $2-$3 range.

Important, it is recommended that you do not obtain the standalone sensor but the whole MQ-2 board. This is because if you buy the standalone sensor, you will have to finish building the whole schematic before you can connect it to the Arduino. So that less work is required for integrating this with the Arduino, it is recommended that you buy the complete MQ-2 sensor circuit. This you can see below. If you buy the complete board, there are 3 leads which need to be connected.

Setting up Thing Speak

- Create an account on Thing Speak https://thingspeak.com/
- Create a new channel with one field label
- Get the API Key
- Review the “Update a Channel Feed” Url

ThingSpeak is insanely easy to use. Once you have your channel and key you can simply make an HTTP request to https://api.thingspeak.com/update?api_key=YOUR_KEY_HERE&field1=4 to send the value 4 into field1. Try it in your browser, then review the data in the Private View of your channel.

Step 3

2. Testing the ESP8266 Directly

Here we can connect the reset pin on the Uno to GND to bypass the Arduino boot loader. This allows you to connect

to the Uno's TX and RX from the Module. Since the Uno's USB cable is properly hooked up to the Uno's TR and RX, any signals put on those lines will pass right on to the module. Here's the trick, in this case, we want the TX on the Uno to connect to the TX on the module and the RX from the Uno to the RX on the Module. Realize that all we're doing here is extending the TX line into the module. The crossover, in this case, is already managed in the USB adapter. We'll change this later. Only in this bridge model do you have TX to TX and RX to RX.

Wiring

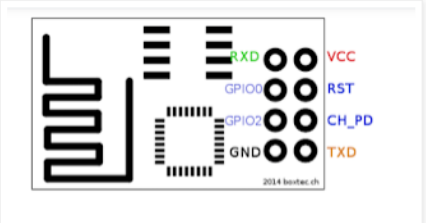
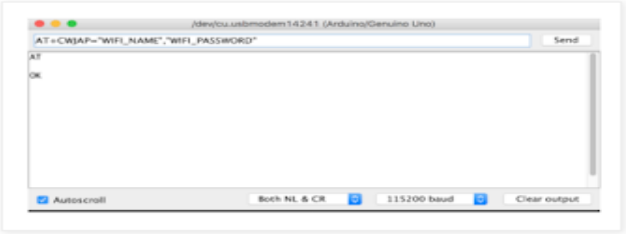


Figure 6 ESP8266 Wiring

Once you have it wired up you should be able to use the Arduino Serial Monitor in the Arduino IDE to access the Module. Remember you'll connect to the port the Arduino is on. Next, make sure you choose "Both NL & CL" then adjust the Baud rate. My module was talking on 115200 baud but I've heard other models on 9600. At this point, you should be able to send an "AT" command and get an "OK" response.



Step 4

Step to Connect WIFI to ESP8266

AT
AT+RST
AT+CWMODE=1
AT+CWLAP
AT+CWJAP="SSID","PASSWORD"

Step 5

Connect to ThingSpeak

AT+CIPSTART="TCP","api.thingspeak.com",80
AT+CIPSEND=51
GET /update?key=2OAJ65WPLNXR7P6Q&field1=55 \r\n
AT+CIPCLOSE

This shows the response from ThingSpeak. Received a response after the GET command. Check your ThingSpeak channel to see the data.

AT+CIPSEND needs to be 2 more than the size of your GET line. this is related to the Serial Monitor sending NL & CR. There needs to be a space after the URL in your GET and the new line characters, that tripped me up.

Arduino and ESP8266 connection

Esp8266	Arduino
RX	11
TX	10
GND	GND (same)
VCC	5v (same)
CH_PD	5v (same)
GPIO 0	None (same)
GPIO 2	None (same)

Step 6

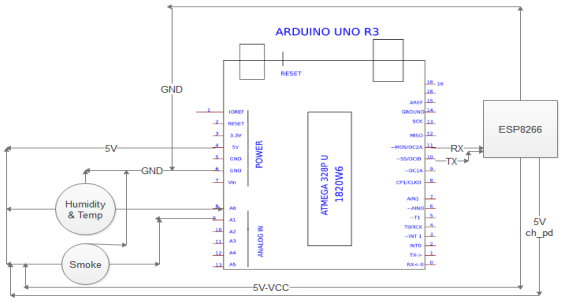


Figure 8 Node -1 Block Diagram.

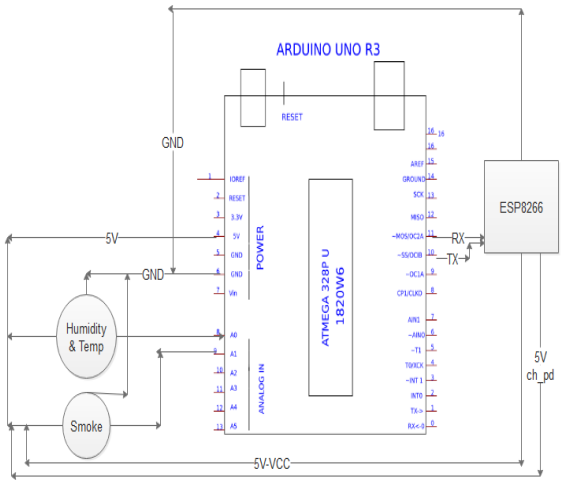


Figure 9 Node -1 Block Diagram

Connect all sensor to Arduino with ESP8266 Wi-Fi module

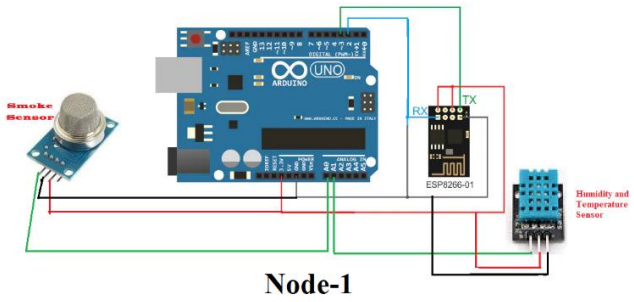


Figure 10 Node-1 Interfacing.

In above figure the humidity, temperature and smoke sensors are connected to Arduino sensor. The ESP8266 Wi-Fi module is used to transfer sensors values on cloud that is here we used ThinSpeak cloud. The data or values can be transfer with the help of this Wi-Fi module and this can be fetched by using its portal or by using the Php coding or any other coding.

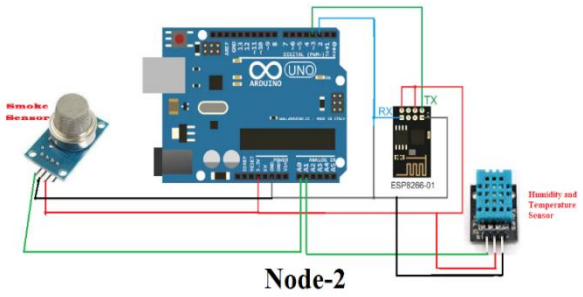


Figure 11 Node-2 Interfacing

In above figure the humidity, temperature and smoke sensors are connected to Arduino sensor Node-2. The ESP8266 Wi-Fi module is used to transfer sensors values on cloud that is here we used ThinSpeak cloud. The data or values can be transfer with the help of this Wi-Fi module and this can be fetched by using its portal or by using the Php coding or any other coding.

VII.RESULT

Figure 12 Dash Board

Above figure shows, the front page of project, which contains Graph of Node first, second. The node first and second sensors values inserted in database from cloud. Node first and second all values shows from database. The last 10 values shows of Node first and second. Last block shows the live data of Node first and second.

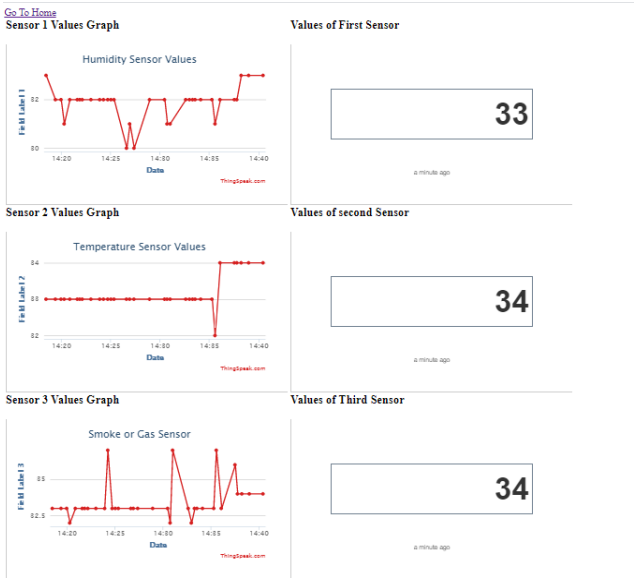


Figure 13 Graph And Values Of Node1

The above figure 13 shows the graph of node-1 and respective sensors values.

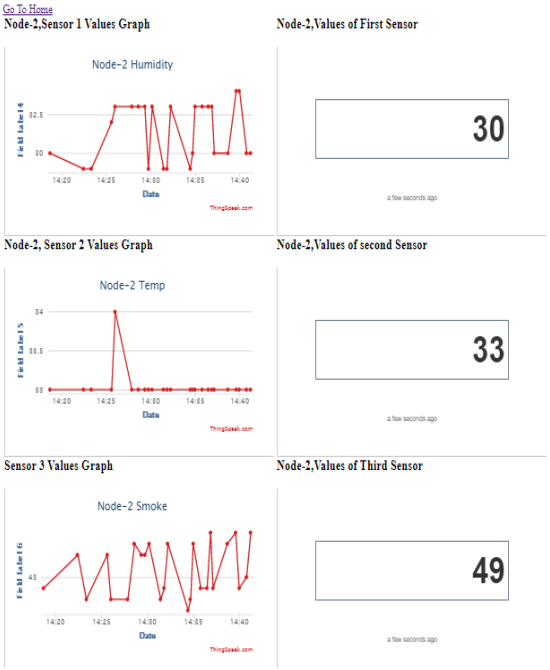


Figure 14 Graph And Values Of Node2

The above figure 14 shows the graph of node-2 and respective sensors values.

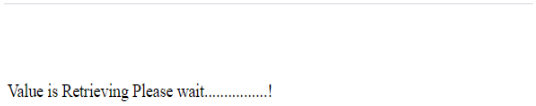


Figure 15 Retrieving Values From Cloud To Database.

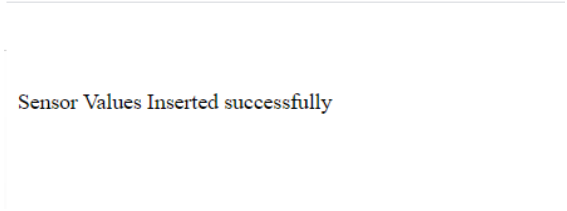
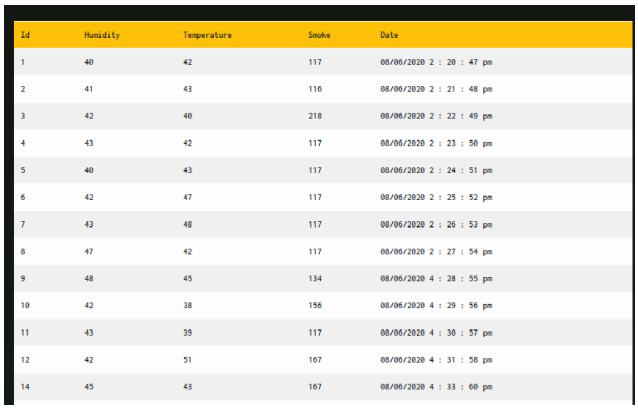


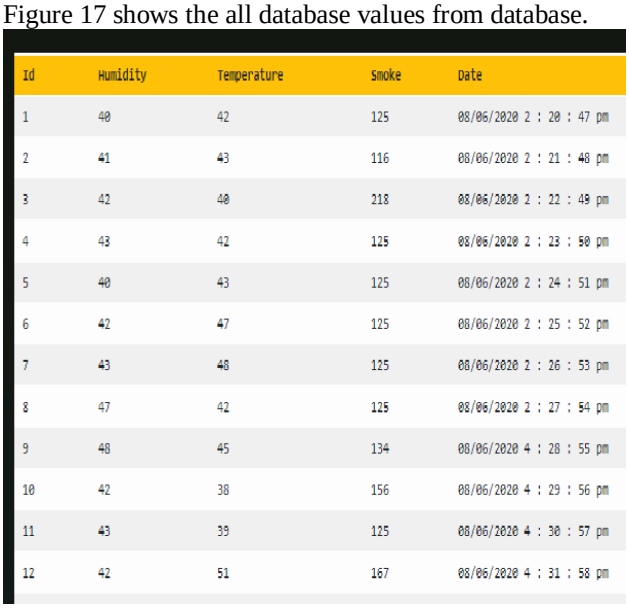
Figure 16 Data Inserted From Cloud To Database.



Id	Humidity	Temperature	Smoke	Date
1	40	42	117	08/06/2020 2 : 20 : 47 pm
2	41	43	116	08/06/2020 2 : 21 : 48 pm
3	42	40	218	08/06/2020 2 : 22 : 49 pm
4	43	42	117	08/06/2020 2 : 23 : 50 pm
5	40	43	117	08/06/2020 2 : 24 : 51 pm
6	42	47	117	08/06/2020 2 : 25 : 52 pm
7	43	48	117	08/06/2020 2 : 26 : 53 pm
8	47	42	117	08/06/2020 2 : 27 : 54 pm
9	48	45	134	08/06/2020 4 : 28 : 55 pm
10	42	38	156	08/06/2020 4 : 29 : 56 pm
11	43	39	117	08/06/2020 4 : 30 : 57 pm
12	42	51	167	08/06/2020 4 : 31 : 58 pm
14	45	43	167	08/06/2020 4 : 33 : 00 pm

Figure 17 Node1 Database Values

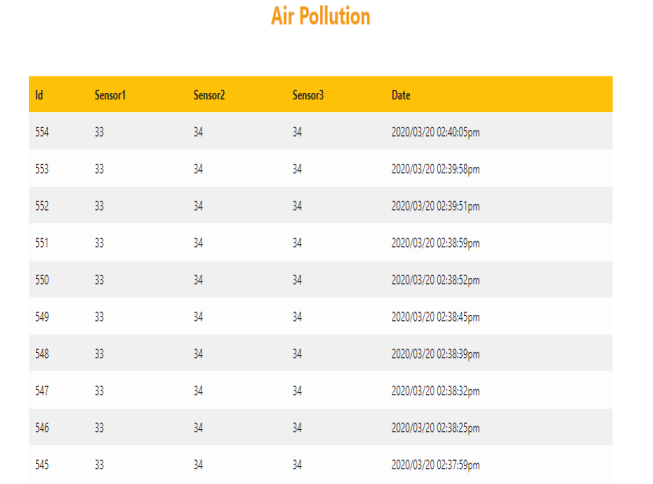
Figure 17 shows the all database values from database.



Id	Humidity	Temperature	Smoke	Date
1	40	42	125	08/06/2020 2 : 20 : 47 pm
2	41	43	116	08/06/2020 2 : 21 : 48 pm
3	42	40	218	08/06/2020 2 : 22 : 49 pm
4	43	42	125	08/06/2020 2 : 23 : 50 pm
5	40	43	125	08/06/2020 2 : 24 : 51 pm
6	42	47	125	08/06/2020 2 : 25 : 52 pm
7	43	48	125	08/06/2020 2 : 26 : 53 pm
8	47	42	125	08/06/2020 2 : 27 : 54 pm
9	48	45	134	08/06/2020 4 : 28 : 55 pm
10	42	38	156	08/06/2020 4 : 29 : 56 pm
11	43	39	125	08/06/2020 4 : 30 : 57 pm
12	42	51	167	08/06/2020 4 : 31 : 58 pm

Figure 18 Database Values

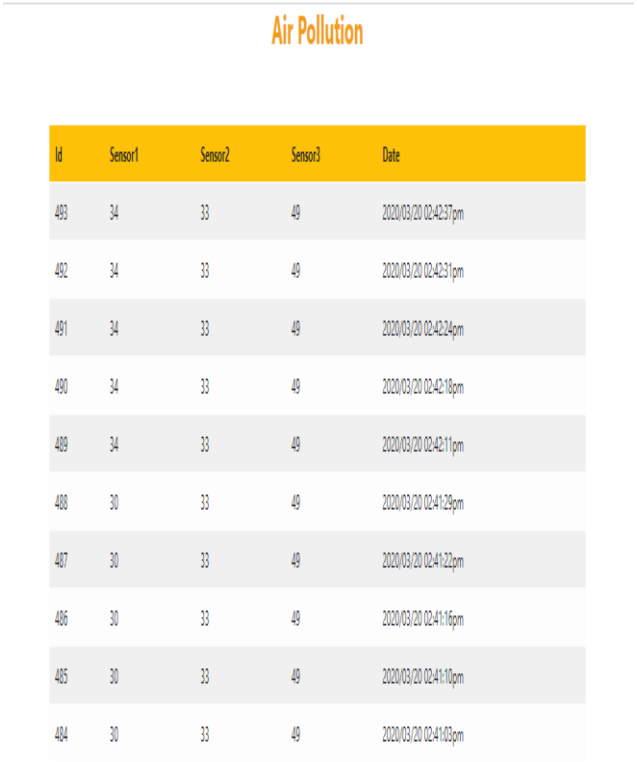
Figure 18 shows the all database values from database.



Id	Sensor1	Sensor2	Sensor3	Date
554	33	34	34	2020/03/20 02:40:05pm
553	33	34	34	2020/03/20 02:39:58pm
552	33	34	34	2020/03/20 02:39:51pm
551	33	34	34	2020/03/20 02:38:59pm
550	33	34	34	2020/03/20 02:38:52pm
549	33	34	34	2020/03/20 02:38:45pm
548	33	34	34	2020/03/20 02:38:39pm
547	33	34	34	2020/03/20 02:38:32pm
546	33	34	34	2020/03/20 02:38:25pm
545	33	34	34	2020/03/20 02:37:59pm

Figure 19 Last Ten Record of Node 1

Figure 19 shows the last ten values from database.



Id	Sensor1	Sensor2	Sensor3	Date
493	34	33	49	2020/03/20 02:42:37pm
492	34	33	49	2020/03/20 02:42:31pm
491	34	33	49	2020/03/20 02:42:24pm
490	34	33	49	2020/03/20 02:42:18pm
489	34	33	49	2020/03/20 02:42:11pm
488	30	33	49	2020/03/20 02:41:29pm
487	30	33	49	2020/03/20 02:41:22pm
486	30	33	49	2020/03/20 02:41:16pm
485	30	33	49	2020/03/20 02:41:10pm
484	30	33	49	2020/03/20 02:41:03pm

Figure 20 Last Ten Record Of Node 2

Figure 20 shows the last ten values from database.

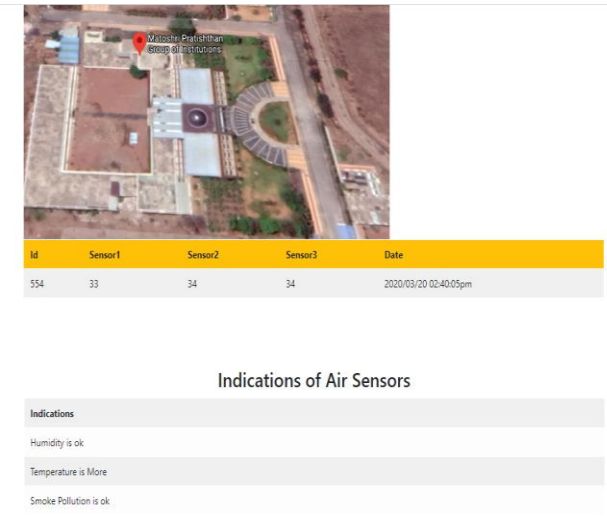


Figure 21 Live Values Of Node 1

Figure 21 shows the current values of all sensor's values of Node-1

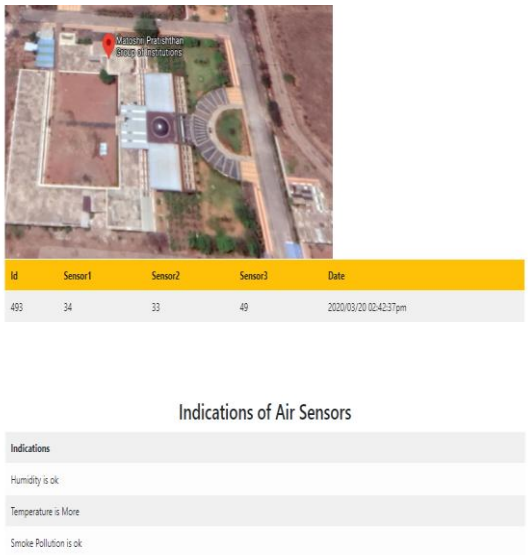


Figure 22 Live Values Of Node 2

Figure 22 shows the current values of all sensors values of Node-1

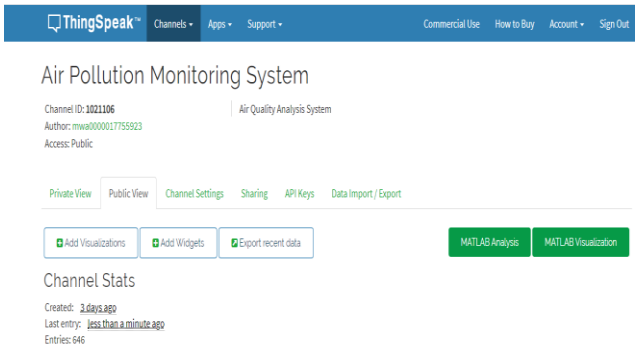


Figure 23 ThingSpeak Cloud Dashboard.

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VIII.CONCLUSION

Air Pollution is constantly increasing in the past few years. By this device, we cannot overcome the pollution in the open environment, but we can control it by avoiding the pollution causing elements. On the other hand, we can control it in the close environment like schools and offices by turning the exhaust on so that the pollutants will go out from it.

Future Scope
The developed air quality monitoring and visualization system accurately measured the concentration of pollutants carbon monoxide, carbon dioxide, smoke and dust in atmosphere. The sensor has been integrated with IoT framework which has efficiently been used to measure and monitor the pollutants in real–time. This system overcomes the problem of pollution monitoring, health monitoring, livelihood measurement, sustainability assessments and measurement related fields. The data's are automatically stored in the database; this information can be used by the authorities to take prompt actions. It also helps the normal people to know about the amount of pollutants in their area and to take control measures. This is a robust system which is very useful in industries because of the increasing pollution due to increase in industries. This system is user friendly and cost of the product is affordable. This system is monitoring only five parameters and hence can be expanded by considering more parameters that cause the pollution especially by the industries. Many pollutants do not have sensors that sense them if available they are very expensive and hence building sensors for different parameters might be a future and very challenging task. The developed system consumes too much power, so we can use solar power as an external source of energy in future and it will definitely improve the reliability of the system.

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