An IoT Based Air Pollution Monitoring and Control System

GULSHAN GAIKWAD[1], ANKITA KAPSE[2], PRANAY MODI[3], NISHIGANDHA KADWE[4], AISHWARYA SHENDE[5], SHRUTIKA MANGATE[6], PROF. AMOL DHANKAR[7], PROF. GAYATRI PADOLE[8]

[1, 2, 3, 4, 5, 6, 7, 8] *Department of Electronics and Telecommunication, J D College of Engineering and Management, Nagpur, Maharashtra.*

Abstract*— An entire global nowadays is stricken by diverse varieties of pollutants, factors of nature are becoming polluted to a fantastic extent. Mainly air and water are laid low with non-stop artificial changes, interference and modernization. Air amongst all the factors of nature is getting its great poor. Carbon dioxide, carbon monoxide, nitrogen dioxide, sulfar dioxide particulate matter. The reassess of those gases are especially industries, cars use, infrastructural activities. High density of such varieties of gases debris are poisonous for dwelling beings. The air pollutants tracking and controlling machine has boosted sensors in it that could experience poisonous gases as properly because it may be monitored on Blank dashboard. And while move past its risky value, movements may be taken, via way of means of the users, coverage makers, and organization.

I. INTRODUCTION

An IoT-primarily based totally indoor air fine tracking platform primarily based totally on integration of cloud computing and IoT is supplied on this research. Also, a tool called ―Smart-Air‖ became advanced to exactly display indoor air fine and successfully transmit actual time records to a cloud computing-based internet server in the use of an IoT sensor network. The cloud computing primarily based totally internet server added on this platform analyzes actual-time records and provides visible results to demonstrate the situations of the indoor air fine. In addition, the internet server became designed to problem alert cellular software customers or facility managers of slight or terrible air fine in order that accountable events can take instantaneously remedial action.

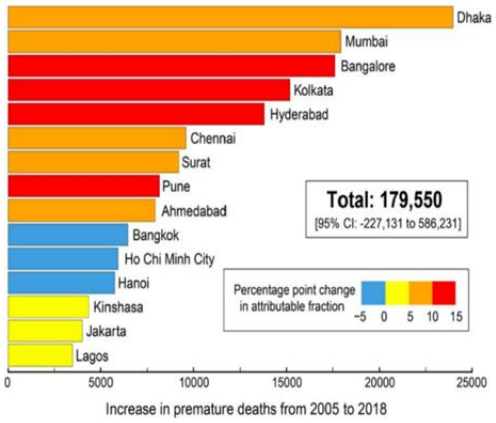
Real-time tracking and a speedy alert device produce a green platform for enhancing indoor air fine. Major contributions of the proposed observe are as follows

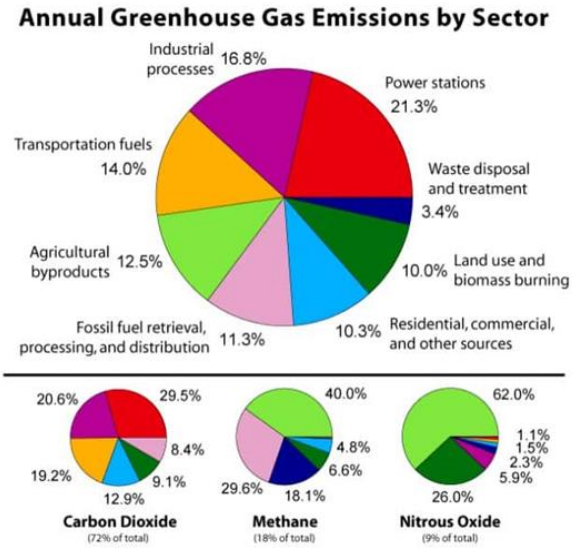
We suggest the usage of the Smart-Air for an appropriate tracking of indoor air fine. We suggest the usage of an IoT for green tracking of actual-time records. We suggest the adoption of cloud computing for actual-time evaluation of indoor air fine. We initially advanced a cellular software to make the proposed IoT device with functions of anytime, anywhere. The tool has been examined for reliability of the records and the platform has been applied in a constructing to check its feasibility.

The moto for organizing this kind of device is to add the statistics on a dashboard of blank or likewise programs in order that each man or woman may be privy to surroundings and his very own fitness. For this we've got we have proven the statistics of increasing stage of gases in air and the values over which it can be dangerous for human fitness are proven right here in table.

AQI Category, Pollutants and Health Breakpoints								
AQI Category (Range)	PM_{10} 24-hr	$PM_{2.5}$ 24-hr	NO_2 24-hr	O_3 8-hr	CO 8-hr (mg/m^3)	SO_2 24-hr	NH_3 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5 – 1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1- 10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very poor (301-400)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800	3.1-3.5
Severe (401-500)	430 +	250+	400+	748+*	34+	1600+	1800+	3.5+

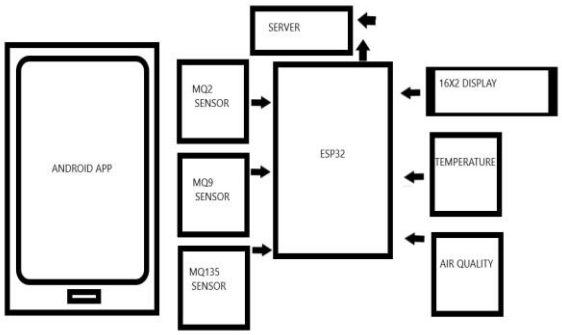
*One hourly monitoring (for mathematical calculations only)

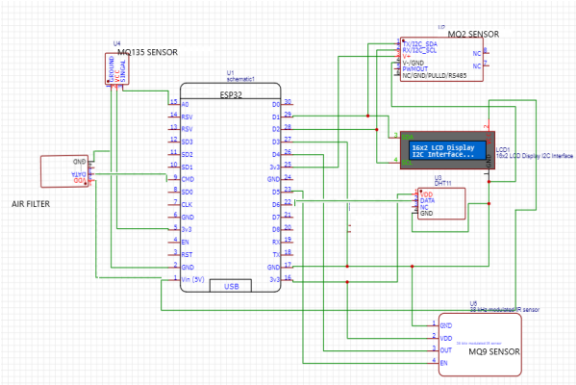




To observe approximately atmospheric circumstance of air and those fuelling debris additionally states that now no longer most effective the fitness can have an effect on because of sickness however additionally deaths everywhere in the international taking place. Thus, for the tracking and to enhance the surroundings at top level, we've got selected to set up this system, which number one feature is to feel the facts via sensors, then it's miles handed to the microcontroller ESP 32 to transform it in virtual form. These virtual facts are uploaded to the server and via the Blink dashboard it's miles to be hard to screen from any place.

Block diagram of the system has shown below.





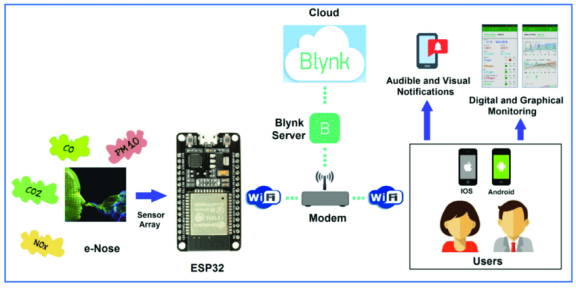
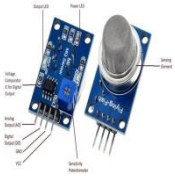
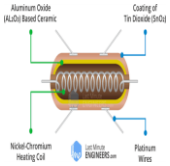
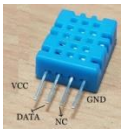
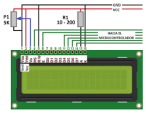
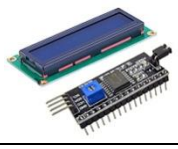
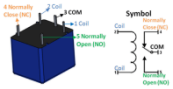


Fig. – Proposed system of air quality monitoring

- Hardware

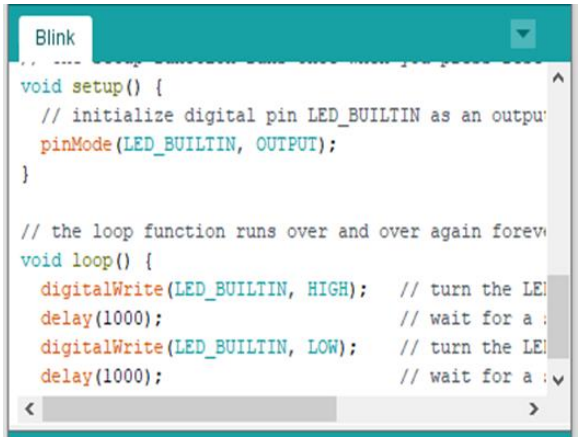
The data sensing elements are the primary function of the system, then conversion of data and data processing is done. The details about the hardware in the system are shown in the table.

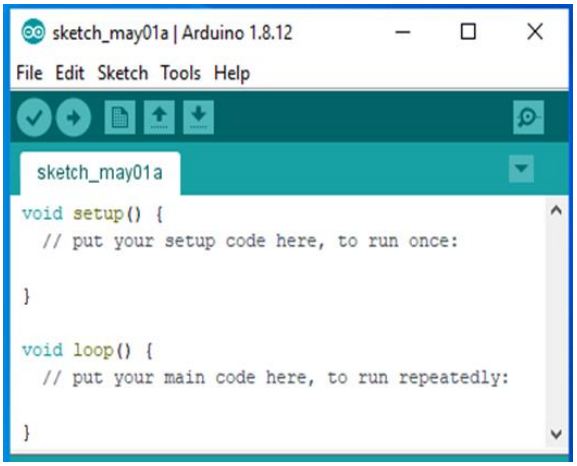
Sr no.	*Hardware component*	*Specification*
1.	*ESP 32 microcontroller* 	*It is a SOC microcontroller* *It has dual core,30 pins* *It runs 32 bit programs* *Built in Wi-Fi and Bluetooth*
2.	*MQ 135* 	*It is an Analog gas sensor.* *It works on DC 5V.* *Detects NH3,NOx,Benzene,Smoke,CO2*
3.	*MQ 9* 	*It is an analog gas sensor* *Its operating voltage is 5V DC.* *Detects LPG,Propane,CO, methane.*
4.	*MQ 2* 	*It is an analog gas sensor.* *Operating voltage is 5V DC.* *Detects Smoke,Alcohol, Propane.*
5.	*DHT 11* 	*DHT 11 is a digital sensor* *Operates on 3.3 to 5.5 volts.* *It is a humidity and temperature sensor.*
6.	*16 : 2 LCD DISPLAY* 	*Operating voltage is 4.7V to 5.3 V* *Desplay can work on 4-bit and 2-bit mode.* *Every character can built with 5*8 pixel box*
7.	*I2 C MODULE* 	*It is a protocol intended to allow multiple peripheral digital integrated cirquits to communicate one or more chip*
8.	*12 V RELAY* 	*12 V DC relay are the best for full voltage application and allows low current flow circuit to control high current flow circuit.*

- Software

Arduino IDE - is software which has been used to write the code in programming language C++.

- It makes to write a code and upload it on a board.
- Arduino serial plotter is another component of the Arduino IDE, which allows you to generate a real-time graph of your serial data.

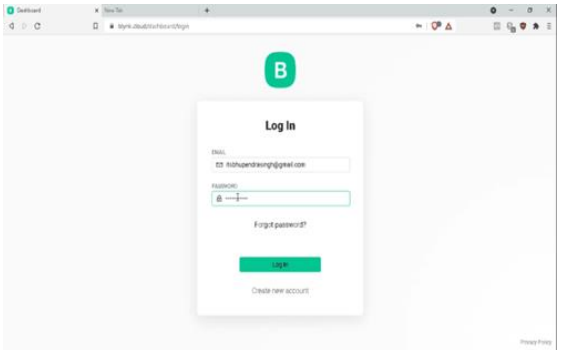


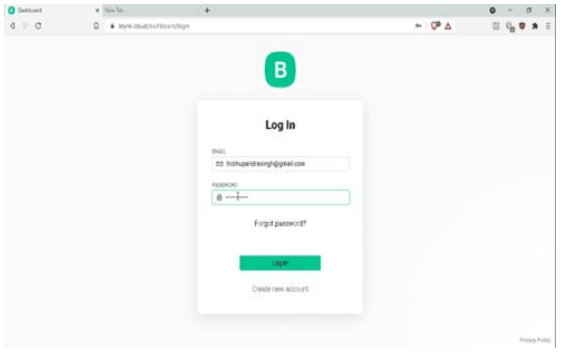


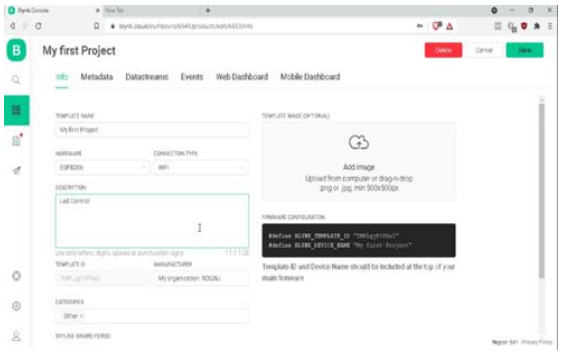
Blynk Dashboard – Blynk software remotely manage to connect electronics devices at any scale

This will connect hardware to the cloud and makes it ready for the end user. On the dashboard of Blynk users will be able to monitor the values from the sensors and the real time data. Enable Developer Mode:

- In the Blynk app or in Blynk.Console
- Navigate to My Profile / User profile in the left menu
- Check that Developer Mode switch is set to ON.

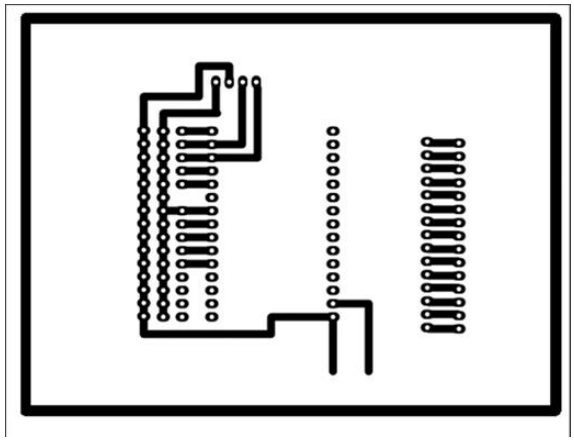


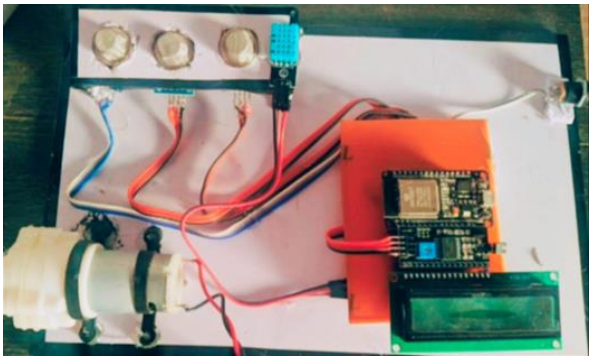




Methodology

An IoT based air quality monitoring system had its subsystem as hardware, software, and an IoT platform. This system has its primary function to sense the data via sensors. As the sensors are analog in nature, this real time data is converted by the microcontrollers in digital format, one through the I2 C module it is shown on 16 : 2 display. Another, via Wi-Fi micontroller is able to send this data to the Blynk server and hence it is available for monitoring at the user's end. The circuit diagram of the system is shown below.





Importance of air quality monitoring

The proposed system is preferred for not only the outdoor air quality but also the indoor air quality monitoring, industrial air quality monitoring, also for school, college, offices, governmental premises. The only system has unique to get the real time observations of environmental gases and to show the values and save it, to compare it in day to day schedule which can be used for future improvement of environmental aspects. The human and living beings today needs much such a system, because of adverse effect of some toxic gases, particles on human health and also sometimes cause of death.

Results Analysis

The analog output pins of the sensors are connected to the analog channel of the microcontroller unit. The analog output from the sensors can be assumed directly proportional to the concentration of gas. The digitized value (Vout) is related to the load resistance to find the resistance output value from the sensor(Rs).

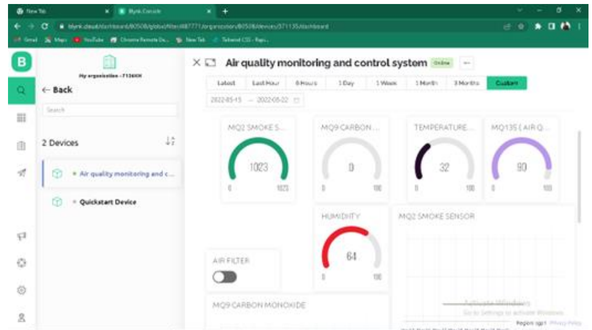
Rs = (Vc RL /V out) – RL where VC=5,

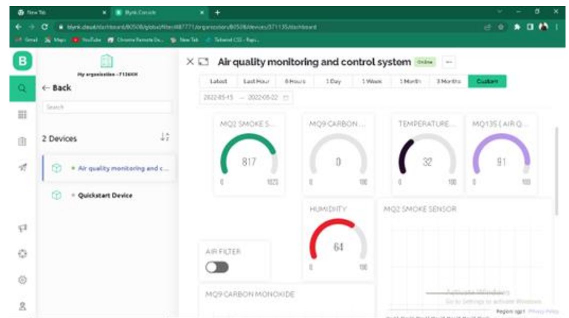
RL is load resistance and Rs is the sensor resistance (between 30Kohm and 200Kohm). It is possible to obtain values of CO2, CO levels in the air of the monitored environment using the following equations.

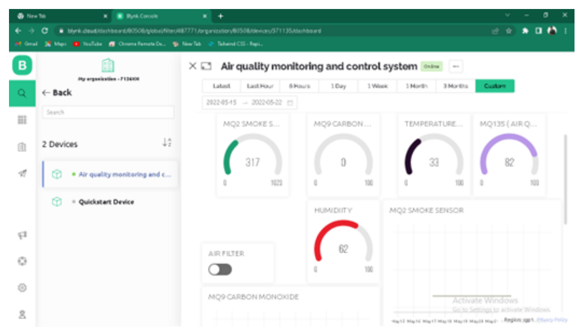
$$CO_2: \; ppm = 114.3544 \times \left(\frac{R_s}{R_0}\right)^{-2.93599}$$

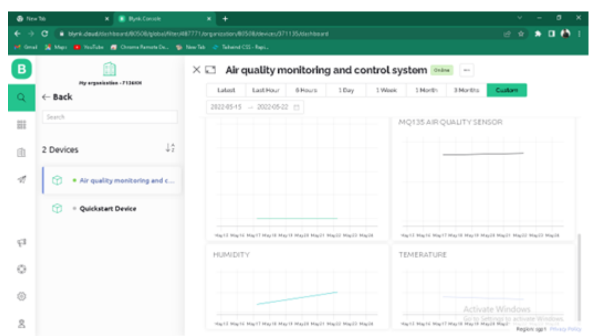
$$CO: \; ppm = 662.9382 \times \left(\frac{R_s}{R_0}\right)^{-4.0241}$$

$$NH_4: \; ppm = 102.694 \times \left(\frac{R_s}{R_0}\right)^{-2.48818}$$









CONCLUSION

The implementation and establishment of the system required to study the all aspects of the environment, particles in air its calculation, global effects of it as well as possibility of improvements done by the system. The system done well in the process of monitoring the air quality, the outputs acquired from

the different cites and places are satisfactory. As the system is less complex, easy to install anywhere, it is possible to apply nowadays.

System can further be increased by means of its range of sensors available today. Any organization, policymakers, can monitor the data updated over time to time, which makes easy to take further decision, as the system is an IOT based system.

REFERENCES

[1] Shreya Mahetaliya, Dipansh Makwana, Anchal Pujara, “IoT based Air Quality Index Monitoring using ESP32”[IRJET,Volume8,issue4,Apr2021].

[2] It is by Somnath Bera an “IoT based PM2.5 and PM10 Air Quality Monitoring System”

[3] Agiru Vasant,Ayush Agrawal,Aditya Bohara,Jagjeeta Bebarta,”Air pollution monitoring system using IoT.”[IJCRT,volume9,Issue7,July 2021].

[4] T. Veermanikandasamy, Gokul Raj,A Balamurugan, A.P.Ramesh, Y.A. Syed Khadar”IoT based Real Time Air Quality Monitoring and Control System to Improve the Health and Safety of Inustrial Workers’’ [IJITEE , Volume9 , Issue4,Feb2020].

[5] Asra Noorian F,Jibin Raju,Varsha V,”An IoT based Approach to Minimize and Monitor Air Pollution Using ESP32 and Blynk Platform”.[Journal of Xi’an University of Architecture and Technology,[Volume 12,Issue6,2020].

[6] Chaitra N, Bhavana S ,Vilas Reddu D N , Nikhil A S,”IoT based Air Quality Monitoring System”[European Journal of Molecular and Clinical Medicine”.[Volume 7,issue 8,2020].

[7] Prisma Megantoro, Shofa Aulia Aldhama, Gunawan Setia Prihandana, P.Vigneshwaran,”IoT based weather station with air quality measurement using ESP32 for environmental aerial condition study”[TELKOMNIKA Telecommunication, Computing Electronics and Control[vol.19,no.4,August2021]

[8] Poonam Pal,Ritik Gupta,Snjana Tiwari,Ashutosh Sharma,”IoT based Air Pollution Monitoring System Using arduino”[IRJET,Vol.4,issue10,Oct2017].

[9] Devahema,P.V. Sai Surya Vamsi,Archit Garg,Abhinav Anand,Desu Rajshekhar Gupta,”IoT based Air Pollutin Monitoring System”[Journal of Network Communication and Emerging Technology”[vol.8,issue4,April2018].

[10] Kennedy Okokpujie,Etinosa NomaOsaghae,Odusami Modupe, Samuel John and Oluga Oluwatosin,’’A smart Air Pollution Monitoring System”[Inernational Journal of Civil Engineering and Technology”,[vol.9,issue 9,sept 2018].