Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 5, July, 2021: 4540 - 4547

Research Article

IoT-Enabled air pollution monitoring system with digital dashboard on smartphone

Mrs.D.Gowdhami[1,a)] Akshay Kumar N[2,b)] Dhanush Kumar N[3,c)]

Abstract

Air pollution is considered to be one of the major problems in India. The major reason for the deaths are that people are not aware of the air which they are breathing daily. People should be always aware of the AQI (Air Quality Index) value around them and also should be cautious about the air quality around them. The air quality level should be intimated regularly to the people. Our model consist of a Arduino UNO which is a microcontroller integrated with the PM2.5 sensor which is the optical dust sensor and MQ135 which is a gas sensor used to indicate various harmful gases like CO, NO2. The DHT11 which gives us the temperature and humidity is integrated along with this model. Further this readings are monitored using the open source IoT analytics application using the internet connected using hardware via the ESP8266 module. If any harmful gases or when the AQI value exceeds above certain value or if any harmful gasses detected along with the increase in AQI value the application will notify the user about the harmfulness of the air around. The model is implemented successfully and this will bring awareness among the people.

INTRODUCTION

Deaths due to air pollution. are one of the major factor in the developing countries like India. As per sources more than one lakh people died in India due to air pollution in the year 2020 and over 1.7million deaths occurred in India in 2019 due to air pollution. Some of the major diseases like asthma, pneumonia, lung cancer, obstructive chronic pulmonary diseases and others are caused due to air pollution. Researchers say that air pollution is the deadliest pollution, around the globe the most number of deaths are caused due to air pollution. It is sad and devastating that people are not aware of the purity of air around. Every individual person should be aware of the quality of air they breathe. Continuous monitoring of air quality level and immediate indication of the poor air is needed. The main motive of the project is to provide accurate purity level of air seamlessly to the application in the smart phone through the wireless network (Wi-Fi). Many other devices can also be connected to this Wi-Fimodule. The main aim is not only to provide data to the users but also to notify when poor air is detected. Higher the AQI and ppm value poorer the air is detected. There is a particular threshold value for each

[1][1]Asst. Professor Vel Tech High tech D. Rangarajan Dr Sakunthala Engineering College, Avadi, Chennai.
[2],[3] Student, Vel Tech High tech Dr Rangarajan Dr Sakunthala Engineering College, Avadi, Chennai,
[a)]Mrs.D.Gowdhami: gowthami@velhightech.com
[b)] Akshay Kumar N: akshay19499@gmail.com
[c)] Dhansuh Kumar N: dhanushk824@gmail.com

sensor. If the readings crosses the threshold value an indication comes through the notification in the mobile application.

Related Works

Air purity monitoring is considered as one of the important matter of concern for many scientist and environmental activist around the world. Many research is carried on and many new technologies is being developed to surpass the exactness of air quality level using various sensor networks. Some of the works are mentioned below

Carratu.M, A. Pieprosanto; P. Somella, ; M. Ferro V.Paciellomade[1] "A Smart Wireless Sensor Network For PM10 Measurement" made a air using PM10 sensor for detecting the dust particles and transferring the data through the wireless sensor network.

Temesegan Walelign Avele: Mehta designed a[2]Air pollution monitoring and prediction using IoT which consist of microcontrollers and sensors connected to the Wi-Fi network.

Colin Flanagan, Sean McGranth, LiaoyuanZeng, ConorO'Leary "IoT-Personal Air Quality Monitor" which [3]tracks the air purity level and transmits the obtained data rfrequently through a low power wide area network, and the data are analyzed and stored in the cloud platform in real time.

Swati Dhingra; Rajasekhara Babu Madda; Amir H. Gandomi "IoT – Air pollution Monitoring System(IoT-Mobair)" This system is consists of [4]Arduino IDE, gas sensors and WiFi chip and kit will be placed in various cities to monitor air pollution. All the data's are stored in the cloud. These data can be accessed through mobile application. wherever the user is travelling to a destination he/she can monitor the current location air quality.

Ravi Kishore Kodali; Saisri Pathuri; Sasweth C. Rajnarayanan designed aSmart Indoor Air-Pollution Monitoring System where the system is implemented for monitor the pollution of the air in indoor. The data which are collected from the sensors is transmitted via the internet and these data are obtained by [5]the mobile user from any area irrespective of the distance and must be connected to the internet.

Muthukumar.S, W.SherineMary, R.Kiruthiga, Mahalakshmi.M Jayanthi.S created an Air Pollution Monitoring And Control System using IoT. This kit collects the data of air pollution occurred due to the automobile's and it's also provide the real time solution by using a sensor connected to a microcontroller which is positioned along the roads and also in street lamp posts and they forward the readings about air quality through wireless medium to [6]remote server. And the statistics is used to control the traffic. This helps the road users to take up the routes where quality of air is good.

PROPOSED SYSTEM

Our proposed system gets the input from three sensors namely MQ135 gas sensor, PM2.5GP2Y1010AU0F which is the optical dust sensor and DHT-11 sensor which is the [6]temperature-humidity sensor. Inputs obtained in the form of analog signal.

These signals are turned into digital or binary signals by the ADC converter in the Arduino UNO board. The in-built algorithm in the control processing unit of the Arduino UNO calculates the values from the particular sensors. The board was programmed using an open

source software Arduino IDE. The values are transmitted from the transmitter pin(Tx)of the Arduino UNO and sends to the receiving node(Rx) of the ESP8266 which is a WiFi chip. This Wi-Fi module transfers the signal to the Blynk cloud which then sends the data to the mobile app. The mobile app(Blynk) shows obtained data from Arduino UNO.

Complete report of the data can be monitored through the mobile application. If the data exceeds the particular threshold value the mobile application notifies the particular user about the harmfulness of the air around so that the user can stay away or take necessary steps to avoid the pollution in his or her locality.

Table

SENSOR VALUE	GOOD	MODERATE	DANGEROUS
GAS SENSOR VALUE	200-300 (ug\m^3)	300-600 (ug\m^3)	600 and Above (ug\m^3)
PM SENSOR VALUE	0-100 (AQI)	100-180 (AQI)	180 and Above (AQI)

COMPONENTS AND ITS SPECIFICATIONS

Arduino-UNO

Arduino-UNO is an [8]easily available micro-controller board based on a microchip called ATmega328P microcontroller which is developed in early 20`s. It has14 digital inputpins out of which 6 provide the PWM(Pulse wave modulation) output and 6 analog pins.

Figure :1 Arduino UNO

ESP8266-01 WiFi chip

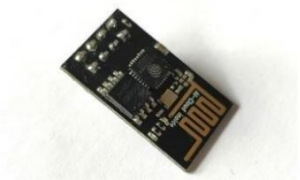

Figure: 2 ESP8266 module

WiFi Module is a self contained SOC(Security operating Centre) which is integrated with TCP/IP protocol stack which can be easily accessed by any microcontroller. Maximum voltage consumed is 3.6V. It can work both as an access point and station

PM2.5 sensor

Figure:3 PM2.5 Dust sensor

It is the optical dust sensor works on the principle of scattering of light. This sensor uses [1] scattering of lasers to identify the suspended particles in the air and then collects the scattered light that changes in time. The microcontroller calculates the particles with equal diameter and then the number of particles with variable diameterperunit volume. Particles that are 2.5microns and smaller are detected using this sensor. In this project PM2.5GP2Y1010AU0F sensor model is used.

MQ135 Gas Sensor

Figure :4 MQ135 gas sensor

It is a low cost gas sensor works on 5V DC supply which have some sensitive material called SnO_2 that has very low conductivity in pure air. The MQ135 gas sensor has sensitivity to harmful gases like Ammonia, benzene, Sulphide and Smoke.

DHT11 Temperature and humidity sensor

Figure:5 DHT11 temperature sensor

It is a low cost digital sensor. It calculates the relative humidity of the air by calculating the electrical resistance between two charged electrodes. This change in resistance between the two electrodes is directly proportional to the relative humidity and that transfers the digital values to the microcontroller

IMPLEMENTATION

Block Diagram

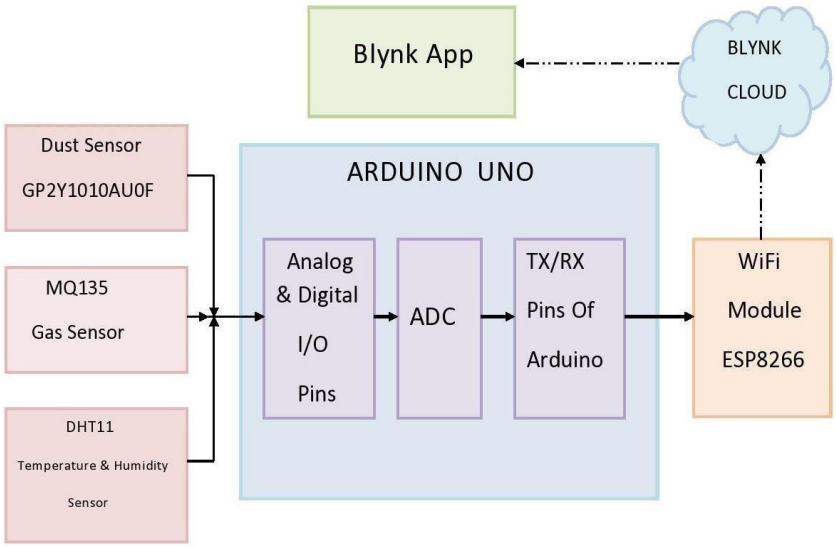

Figure:6 Block Diagram

The sensors which are used are linked to the analogue and digital pins of arduino. Inside microcontroller ADC is present. ADC, is a data [6]computing that converts digital circuits to integrate with originality by converting the analog signal into a digital code.
Analogue signals continuously changes its values which are obtained from various sensors which can measure different parameters [2]and many digital devices communicate with their surrounnding by obtaining the analog signals. From the analog to digital converter the data passes through the transmitter and [4]receiver(Tx/Rx) to transmit the data to the WiFi chip. From there it get stored to a private cloud platform. The values stored in the cloud can be monitored through the open source mobile application. Warnings and regular notifications are raised when the values crosses the threshold value.

Hardware Setup

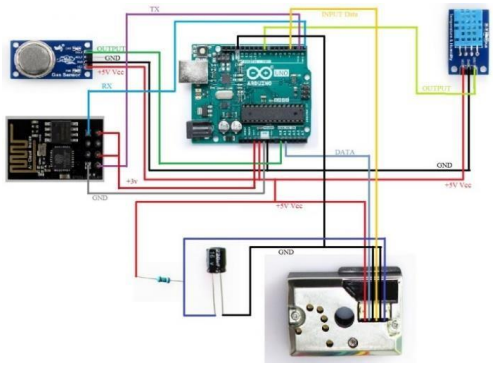

Figure:7 Circuit diagram

The Arduino-UNO board is integrated to desktop using USBport. The obtained values of the PM2.5 sensor and the[3] MQ135 sensor are attached to the analog pin of the Arduino UNO. Both the sensors[3] are attached to the 5V pin of the Arduino board for power supply and the ground pin is grounded for the respected sensors. The signal pin of the DHT11 sensor is fixed to the digital pin of the Arduino and power supply of 3.3V is given to the sensor through 5V pin with a 10K resistor in between them.

RESULT

The user can continuously monitor the values. When the values exceeds the threshold value a notification popups in the mobile phone. 201-300 AQI is very unhealthy and a serious health risk level for everyone. Gas above 300 means smoke is detected and above 600 means the smoke is very dangerous. Similar notifications are shown in the mobile using the above threshold value. The figure below is the screenshot of the obtained output

Figure:8 Output Result

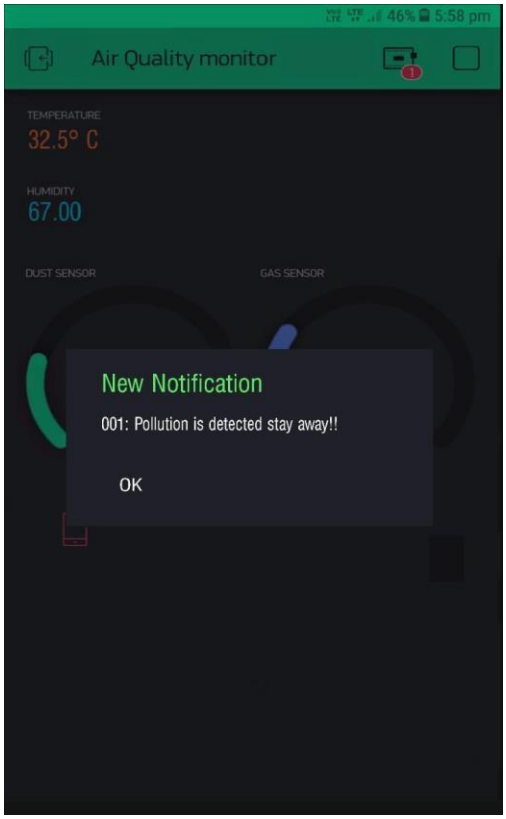

Figure:9 Notification

CONCLUSION

The suggested data is successfully tested and it accurately able to sense the respective values that are obtained from the sensor and it sends the value to the Blynk cloud and then to mobile application. By using the obtained wind quality values the condition of the air is predicted. It is used as a warning systemwhere the user gets a notification from the mobile application if the air gets highly polluted or became very harmful so that the user can take measures to prevent it.

ACKNOWLEDGMENTS

We wish to convey our gratitude to the people who gave their help during the course of our project work.
We would like to record our sincere thanks to our honourable Head of the Department, Dr. N. Duraichi Ph.D., Associate Professor, for her constant support and encouragement.
We would like to extend our sincere thanks to our supervisor Mrs. D. Gowdhami B.E., M.E., Asst. Prof, Dept. of Electronics and communication, VelTech HighTech Dr. Rangarajan Dr. Sakunthala Engineering college for her consistant technical advice and valuable suggestions which motivated us to finish our project successfully.

Finally I would like to convey my word of thanks to our beloved PARENTS who supported us continuously and gave motivation through out for completing my project and pursuing my degree.

REFERENCES

1. M. Ferro; A. Pietroesanto; M. Caratu; P. Sommella; V. Paciello; “A Smart Wireless Sensor Network For PM10 Measurement” 2019 IEEE International Symposium on Measurements & Networking (M&N)
2. Temesgan Walelign Ayele, Rutvik Mehta “Air pollution monitoring and prediction using IoT” Proceedings of the 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018) IEEE Xplore Compliant - Part Number: CFP18BAC-ART; ISBN:978-1-5386-1974-2
3. Seam Mc Granth; Colin Flanagan; Liaoyuan Zeng; Conor O’Leary “IoT Personal Air Quality Monitor” 2020 31st Irish Signals and Systems Conference (ISSC)
4. Swathi Dhingra; Rajasekhara Babu Madda; Amir H. Gandomi;”Internet Of Things Mobile-Air Pollution Monitoring System (IoT-Mobair)”. IEEE INTERNET OF THINGS JOURNAL 2019
5. Ravi Kishore Kodali; Saisri Pathuri; Sasweth C. Rajnarayanan;”Smart Indoor Air Pollution Monitoring Station” 2019 IEEE International Symposium on Measurements & Networking (M&N)
6. S.Muthukumar; W. Sherine Mary; Jayanthi.S; Kiruthiga.R; Mahalakshmi.M;”IoT Based Air Pollution Monitoring And Control System” Proceedings of the International Conference on Inventive Research in Computing Applications (ICIRCA 2018) IEEE Xplore Compliant Part Number:CFP18N67-ART; ISBN:978-1- 5386-2456-2
7. Gagan Parmar; Sagar Lakhani; Manju K. Chattopadhyay;”An IOT Based Low Cost Air Quality Monitoring System”. 2017 International Conference on Recent Innovations in

Signal processing and Embedded Systems (RISE)

8. Ch. V. Saikumar; M. Reji; P. C. Kishoreraja;"IoT Based Air Quality Monitoring System" International Journal of Pure and Applied Mathematics Volume 117 No. 9 2017
9. Chenglong Jiang, Yongping Dan, Dongyun Wang "Design of air quality monitoring system using internet of things" 2016 10th International Conference on Software, Knowledge, Information Management & Applications (SKIMA)
10. Rahim, R., Murugan, S., Priya, S., Magesh, S., & Manikandan, R. Taylor Based Grey Wolf Optimization Algorithm (TGWOA) For Energy Aware Secure Routing Protocol.
11. Rahim, Robbi, S. Murugan, Reham R. Mostafa, Anil Kumar Dubey, R. Regin, Vikram Kulkarni, and K. S. Dhanalakshmi. "Detecting the Phishing Attack Using Collaborative Approach and Secure Login through Dynamic Virtual Passwords." Webology 17, no. 2 (2020).
12. UshaKiruthika,**S. Kanaga Suba Raja,** C.J. Raman ,V.Balaji. (2020) 'A Novel Fraud Detection Scheme for Credit Card Usage Employing Random Forest Algorithm Combined with Feedback Mechanism', IEEE Second International Conference on Power, Energy, Control and Transmission Systems (ICPECTS2020), Sairam Engineering College, Chennai ,Tamilnadu, India. **(Scopus Indexed)**
13. UshaKiruthika,**S. Kanaga Suba Raja,**V.Balaji ,C.J. Raman, (2020) 'E-Agriculture for Direct Marketing of Food Crops using Chatbots', IEEE Second International Conference on Power, Energy, Control and Transmission Systems (ICPECTS2020), Sairam Engineering College, Chennai Tamilnadu, India. **(Scopus Indexed)**
14. Amiri, I. S., Palai, G., Alzubi, J. A., & Nayak, S. R. (2020). Chip to chip communication through the photonic integrated circuit: A new paradigm to optical VLSI. Optik, 202, 163588.