AIR QUALITY MONITORING SYSTEM

Dr. K. Deepa[1], V. Aadhithan[2], N.Balaji[3], P. Lokeshwaran[4]
[1]Professor, Department of Information Technology, Sri Ramakrishna Engineering College, Coimbatore.
[2,3,4]Student, Information Technology, Sri Ramakrishna Engineering College, Coimbatore.

Abstract
The level of pollution is increasing rapidly due to industries, urbanization, increase in population and vehicle use which affects human health. The aim of this project is to design and implement a system to measure the air quality using the Internet of Things (IoT) along with the android application. The system comprises of various sensors that can sense, compute and interpret data. The Air Quality Index (AQI) determines the pollution rate. As the AQI increases, an increasingly large percentage of population is likely to experience severe adverse health effects. The system measures the real time AQI values and when it exceeds the threshold level the system as well as the android application triggers the alarm. With the help of the Wi-Fi module the data gets transmitted and the AQI values along with the other values gets displayed on the application.
Keywords: IoT, Air Quality Index.

I. INTRODUCTION:

Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization and growing number of vehicles leads to release of lot of gaseous pollutants. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma.

The basic aspect of the Internet of Things is the integration with the cloud infrastructure, which hosts interfaces and web-based applications that enable the communication with sensors and external systems. The cloud computing infrastructure might provide the data to be stored and also to be retrieved.

The air pollutants should be monitored in real time so that the air quality can be checked periodically and therefore by checking periodically, adverse health effects can be prevented. The threshold level can be maintained only by continuous real time monitoring of outdoor pollutant levels. IoT might help health departments to take the most suitable and effective actions in case the environmental conditions become worse. Sensors such as MQ135 is used which used to sense the dust particles and also other such sensors are also used to find whether the air is polluted or not. In this IOT project, it can monitor the pollution level from anywhere using your mobile. This system can be installed anywhere and can also trigger when pollution goes beyond some level.

II. RELATED WORK:

The developed system is capable of real-time measurement of air polluted gases such as CO2, CO, NO2, and SO2. The machine-to-machine communication of the air quality monitoring station and PC with the sink node was successfully implemented. [1] Various gas sensor technologies were evaluated for the system and ultimately electrochemical and infrared sensors were used. The Air Quality Monitoring System uses an array of sensors to take measurements of the ambient air surrounding it and wirelessly transmits the data to the base station. A

graphical user interface (GUI), which makes it easy for end user(s) to interact with the system, was developed. Gas concentration values are plotted on the GUI. The defined calibration of the instruments at time interims assures that the desired accuracy is sustained.

Baralis, Elena et al [3] proposes a business intelligence engine (APA). The system is designed to aware the public about the quality of air being affected by different factors like pollutants, toxic gases etc. Analysis of air pollution from different perspectives like meteorological data, pollutants and traffic data using APA is done. The system helps the people to realize their activities impact on deteriorating air quality.

Shete., R. and Agrawal S. [2] provides the framework for monitoring the city environment. Low cost Raspberry pi is used for implanting the system. Parameters like carbon monoxide, carbon dioxide, temperature and pressure are measured but no emphasis is given on particulate matter which left the environment monitoring incomplete.

In [6], a remote carbon dioxide concentration monitoring system is developed. The system reports geological CO2, temperature, humidity and light intensity of the outdoor monitoring area. an urban CO2 monitoring system is presented.

In [7] an urban CO2 monitoring system is presented. The system operates outdoor at an urban area around 100 square kilometres

Ching-Biau Tzeng et al. [4] have described an indoor air quality (IAQ) monitoring system based on ZigBee wireless sensor network implemented with the TI CC2430 chip. In the system they propose, each sensor node measures temperature, relative humidity and carbon dioxide. The data was obtained by running a data logger program. The test results show that the proposed system can be used for detecting harmful gases too.

Jha, Mukesh et al [5] presented a system for monitoring the environmental parameters, modeling and manipulating microclimate of urban areas. The system is implemented for the adaption of efficient urban infrastructure after analyzing the urban micro-climate.

III. PROPOSED SYSTEM:

A.COMPONENTS

1) ARDUINO UNO

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB Connection, power jack, an ISP header and a reset button.

FIGURE 1. Arduino UNO

2) MQ135 SENSOR

The MQ135 sensor can sense NH3, NOx, alcohol, Benzene, smoke,CO2 and some other gases. It gives the output in form of voltage levels. MQ135 sensor senses ammonia, sulfide , benzene vapor high sensitivity of the smoke. Fig 2 shows the sensor MQ135.

FIGURE 2. MQ135 Sensor

3) WI-FI MODULE (ESP8266)

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability. It runs on 3.3V and gives our system access to Wi-Fi or internet. Fig 3 shows Wi-Fi Module (ESP8266).

FIGURE 3. WI-FI Module

4) TRANSFORMER

A transformer is a device that is used to either raise or lower voltages and currents in an electrical circuit. In modern electrical distribution systems, transformers are used to boost voltage levels so as to decrease line losses during transmission. The available power cannot change, but will slightly

decrease, depending on the efficiency of the transformer.

FIGURE 4. Transformer

5) DUST SENSOR (GPY2Y1010AU0F)

GP2Y1010AU0F is used to sense dust particles in air and also called as an optical air quality sensor. It is very much smaller in size. It detects the reflected light of dust in air.

FIGURE 5. DUST SENSOR

6) TEMPERATURE AND HUMIDITY SENSOR(DHT11)

This DHT11 temperature and humidity sensor features a calibrated digital signal output with the temperature and humidity sensor complex. It's technology ensures the high reliability and excellent long term stability.

FIGURE 6. DHT11

B.PROPOSED METHODOLOGY

The aim of this project is to design and implement a system to measure the air quality using the Internet of Things along with the android application. The system comprises of various sensors that can sense, compute and interpret data. The system measures the real time values of Carbon Monooxide, Temperature, Humidity, PM2.5 and by using these values the Air Quality Index (AQI) is calculated. The AQI values ranges from 0 to 500 and when the AQI value exceeds the threshold level, the system will trigger an alert. The data that is being monitored is transferred to the cloud via Wi-Fi module.

The android application is used so that the values such as the gas composition levels, temperature, humidity can be viewed. With the help of this system, precaution can be given to the people regarding pollution and also preventive measures can also be taken.

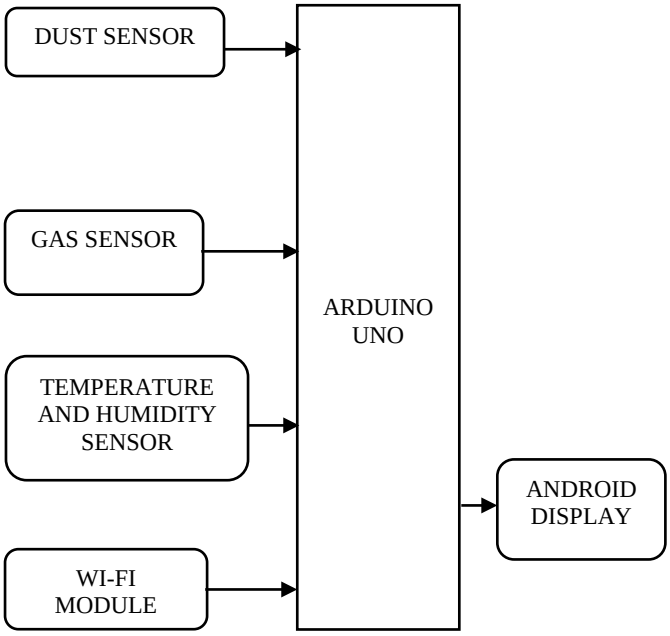

FIGURE 7. BLOCK DIAGRAM OF AIR QUALITY MONITORING SYSTEM

The GPY2Y1010AU0F (dust sensor), MQ135 (gas sensor), ESP8266 (Wi-Fi module) andTemperature and Humidity sensor are interfaced with the Arduino UNO. These sensors sense the dust particles and unwanted gas or pollutants that are present in the environment. The dust in air, Temperature and Humidity, Carbon Di-oxide and other such things are taken and the Air Quality Index is calculated. The AQI value ranges from 0 to 500 and there is a certain threshold level and if the Air Quality exceeds the certain threshold level, the system along with the android application will trigger an alert and the data that is being monitored is sent to the Wi-Fi module to cloud. The android application is used so that the values such as the gas

composition levels, temperature, humidity can be viewed. The cable along with the module is connected to the system and then the system is run. The module runs and the values are collected and then those values that are collected can be viewed in the android application. When the AQI value exceeds 150, serious health precautions should be taken for the welfare of the people.

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for sensitive groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

IV.CONCLUSION AND FUTURE ENHANCEMENT

The proposed system provides low cost, low power, compact and highly accurate system for monitoring the environment with the help of the sensors. The system to monitor the air in the environment using Arduino microcontroller, IOT Technology is proposed to improve quality of air. The MQ135 sensor senses the dangerous gas that is present in the environment. With the help of this system, when that Air Quality Index exceeds the threshold level, precautionary measures can be taken. Further, highly expensive industrial sensors can also be used for finding the accurate composition of gases and long term pollution patterns can be discovered and certain relationships between the air pollutants can also be found and then the system can also be setup in several areas for the welfare of the people.

REFERENCES

[1]Phala, Kgoputjo Simon Elvis, Anuj Kumar, and Gerhard P. Hancke. "Air quality monitoring system based on ISO/IEC/IEEE 21451 standards." IEEE Sensors Journal 16, no. 12, pp. 5037-5045, 2016.

[2]Shete, Rohini, and Sushma Agrawal. "IoT based urban climate monitoring using Raspberry Pi", IEEE International ConferenceIn Communication and SignalProcessing (ICCSP), pp. 20082012, 2016.

[3]Baralis, Elena, Tania Cerquitelli, Silvia Chiusano, Paolo Garza, and Mohammad Reza Kavoosifar, "Analyzing air pollution on the urbanenvironment", 39th IEEE International Convention In Information and Communication Technology, Electronics and Microelectronics (MIPRO), pp. 1464-1469, 2016.

[4] Chengbo Yu, Yanzhe Cui, Lian Zhang, Shuqiang Yang, “ZigBee Wireless Sensor Network in Environmental Monitoring Applications”, in Wireless Communications, Networking and Mobile Computing, 2009. WiCom '09. 5th International Conference on 24- 26 Sept. 2009, 2009.

[5]Jha, Mukesh, Prashanth Reddy Marpu, Chi-Kin Chau, and Peter Armstrong, "Design of sensor network for urban micro-climate monitoring", First IEEE International Conference In Smart Cities(ISC2), pp.1-4, 2015.

[6]H. Yang, Y. Qin, G. Feng, and H. Ci, “Online Monitoring of Geological CO2 Storage and Leakage Based on Wireless Sensor Networks,” Sensors Journal, IEEE, vol. 13, no. 2, pp. 556–562, Feb. 2013.

[7]X. Mao, X. Miao, Y. He, X.-Y. Li, and Y. Liu, “CitySee: Urban CO2 monitoring with sensors,” in INFOCOM, 2012 Proceedings IEEE, Mar. 2012, pp. 1611–1619.