# Indoor Air Quality Monitoring Using IoT

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**ABSTRACT:**

The system presented in this project is an advanced real time air quality reporting system supported with Internet Of things (IOT) architecture. Degrading air quality has been a matter of concern nowadays and real time monitoring of air quality helps us to keep a check on it. Greater air pollution indicates more dangerous air is for human health. The model presented here uses a combination of the ESP32 software and hardware along with a Gas sensor - MQ135, MQ7 sensors which help in detecting gases like NO2, CO, Ammonia, and Sulphide. The circuit finally displays the PPM values as well as Air Quality level of gases on an Android application which fetches data from sensor through IoT.

***Keywords:*** Internet of Things, Air quality, dependability, gas sensors, monitoring system

## I. INTRODUCTION

Nowadays, the air quality monitoring system has become a necessity as the air pollution level is increasing exceptionally. The rapid economic development over the past 25 years has resulted in increasingly frequent evolution; such as chemical industrial park construction. This venture has caused the increase of probability of an air pollution accident and severe issues to the earth. Over decades, air pollution is one of the monstrous issues occurring in South East Asia. A portion of the air toxins produce through human activities are carbon dioxide gas (CO_2), carbon monoxide (CO), Sulphur oxides (SO_2), nitrogen oxides (NO_2), volatile organic compounds (VOC), ammonia (NH_3) and methane gas (CH_4). At the point when a portion of these compound toxins is uncovered into the air and the environment, it will increase the occurrence of ailments for example, pneumonia, lung malignant growth, ceaseless bronchitis, asthma, constant respiratory infections, and coronary artery disease.

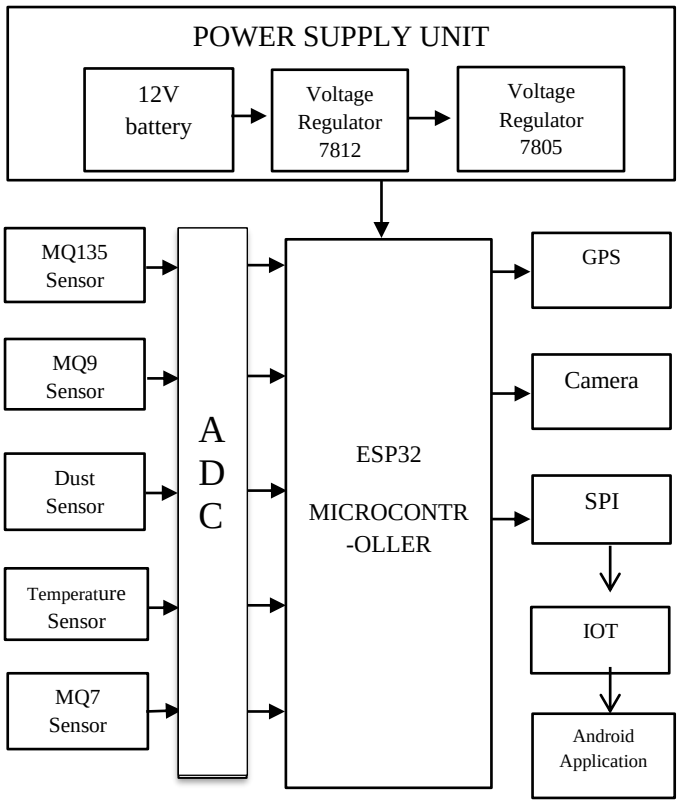
Towards environmental sustainability and social resilience in metropolitan areas, it is essential for residents to have clean air. In this regard, technical measures are needed for monitoring and improving air quality, whereby IoT-enabled wireless sensors networks are promising among available monitoring systems for healthy built environment and air quality management. While global smart city development can offer various dimensions and services covering all aspects of municipal activities, it should be people-centric, addressing directly citizens' well-being and quality of life.

Therefore, the needs and preferences of citizens should be considered in public-involved programs to implement of LWSN for environment monitoring. As reported in, residents may raise concerns on data quality, system reliability, operating sup-port, ownership, and the arrangement of power supply for monitoring systems installed at some locations in suburbs.

The indoor environment plays a critical role in our well-being due to the amount of time we spend indoors. Indoor environments can be two to five times more toxic than the outdoors. Monitoring systems of this nature are needed for everyday users to become engaged and proactive in participating in the management and improvement of the environmental quality at home. Combining multiple sensors into one unit means for more broadly assessing conditions relating to adverse health effects, such as hazardous gaseous substances, and conditions more affecting the comfort and well-being of residents or workers. The indoor air quality monitoring system thus helps companies to build a healthier working environment to keep the AQI under control. By comparing the real-time air quality data with ideal conditions, companies can facilitate adequate ventilation, control the production of pollutants in their facility, and keep temperature & humidity level in a comfortable range. The advantage of the AQI is that, it is created in handily comprehended ranges of quality in reporting the quality of air as opposed to utilizing the actual concentrations of air pollutants by the public. To overcome this problem, proposed work is one step forward towards the environment and pollution levels around the manufacturing industries needs to be monitored efficiently, reliably, and accurately. By monitoring harmful gases present around industry it also checks high pollution rate and compare it with standard levels and when quality goes down beyond a certain level it sends notification to human that it's not safe.

The main objective of IOT Air pollution Monitoring System is to monitor pollution levels, that is major issue these days. It's necessary to watch air quality and keep it in check for a far better future and healthy living for all. Due to flexibility and low-cost Internet of things (IoT) is getting popular day by day.

## II. SYSTEM OVERVIEW




**BLOCK DIAGRAM**

### A. Microcontroller – ESP32

ESP32 is a feature-rich MCU with integrated Wi-Fi and Bluetooth connectivity for a wide-range of applications. Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM. Supports 802.11 b/g/n Wi-Fi connectivity with Speeds up to 150 Mbps. Support for both Classic Bluetooth v4.2 and BLE specifications. 34 Programmable GPIOs. Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC.

### B. Global Positioning System

GPS is a space-based navigation system nominally consisting of a 24-satellite constellation that provides positioning and timing information.

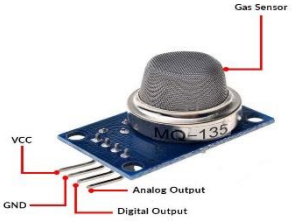
3m position accuracy. Jammer detection and reduction.
Data output Baud rate: 9600 bps (Default)
Low Power Consumption: 55mA at acquisition, 40mA at tracking.
High Sensitivity, -165 dBm

### C. Camera

A 360-degree security camera, also known as an omnidirectional or panoramic camera, captures video footage in a nearly complete sphere around the camera. An omnidirectional camera sees and records everything around it simultaneously. This captures a large visual field with just one camera. This camera is used to identify the object from which the gas is released.

### D. Sensors

- **MQ 135 Sensor**
  An MQ135 air quality sensor is one type of MQ gas sensor used to detect, measure, and monitor a wide range of gases present in air like ammonia, alcohol, benzene, smoke, carbon dioxide, etc.
  Size: 35mm x 22mm x 23mm (length x width x height)
  Working voltage: DC 5 V
  Signal output instruction. Dual signal output (analog output, and high/low digital output)
  0 ~ 4.2V analog output voltage, the higher the concentration the higher the voltage.

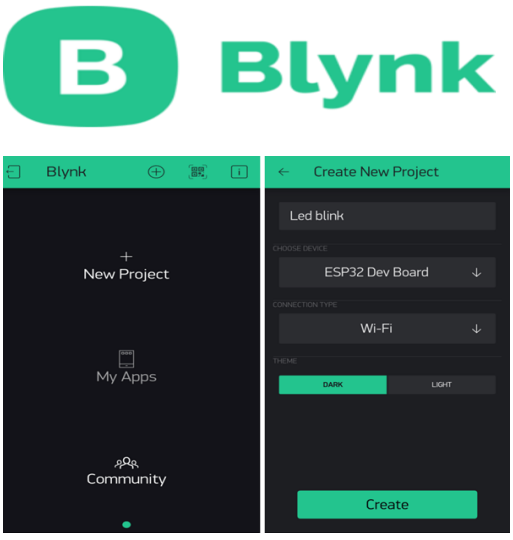



- **MQ 7 Sensor**
  The MQ-7 can detect CO-gas concentrations anywhere from 10 to 500ppm. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance.
  Vc circuit voltage 5V±0.1 Ac or Dc


- **Dust Sensor**
  Dust sensor detects the dust particle concentration in air by using optical sensing method. This sensor detects air quality. It is used in air monitors, air conditioners, and air purifiers.

### E. Blynk Application

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.



## III. WORKING

We have proposed a system for monitoring the real time air pollution using Internet of Things. The analog inputs are received from the analog input pins of the ESP32 from various gas sensors such as MQ135, dust sensor, MQ7. These data are converted into digital form by the ADC of the ESP32. These data received are first converted into ppm of the gases and then using this ppm of gases Air Quality is calculated. Here various MQ series sensors are used for different type of air detection. These data after calculations are send to ESP32 which will transmit that information to the required person's mobile using a mobile application called BLYNK through IOT.

With the help of IoT, real time data is sent to BLYNK APP, where this data can be accessed in a mobile phone application which uses past air quality data of places to calculate the condition of air in that area at that time and constitute an alert mechanism. The mobile application displays the condition of air into categories such as mq7, mq135, dust and temperature. In case if any hazardous gas detected then that will be shared to the concerned authority through IOT. And they can check the live status of the environment through a real-time camera connected with it. This camera is used to identify the object from which the gas is released. GPS will help to identify exact location of the device. All the sensor data will be displayed on the Blynk application.

### Software Design

The software used for the implementation of this project is the Arduino Integrated Development Environment (IDE) that is written in function from C and C++, one of the cross-platform applications. It is utilized to compose and transfer programs to Arduino boards. The below figure shows one of the programming codes to measure hazardous gases from the MQ-135 and MQ - 7 gas sensors.


### Results of Blynk Application

The results of good air quality environment from the air pollution monitoring system which were displayed and monitored through the Blynk application. There are five-gauge levels displayed which are humidity, gas 135, gas 7, dust and temperature. The data were displayed and updated after been detected by the sensors every one second.

## IV. CONCLUSION

Air quality monitoring is an important application of Internet of Things. In this paper we propose an air quality monitoring system using IoT. The main objective of this model is to monitor and analyze the quality of air in indoors. The hardware setup of the proposed system is detailed in this paper. An IoT-based air quality monitoring system is a revolutionary solution that can provide accurate and real-time data about the air quality in a particular area. It can help identify the sources of pollution and take necessary measures to reduce it, protecting the environment and human health. With its scalability and versatility, the IoT-based air pollution monitoring system can be used in various settings and integrated with existing air pollution monitoring systems, making it an ideal solution for air pollution monitoring. Real time deployment of the proposed model is to be carried out in the future.

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