IoT Based Air Pollution Monitoring System

A Project report submitted in partial fulfilment of the requirements for the degree of B.E in

Computer Science Engineering

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# Air quality monitoring system

**PHASE 5 : PROJECT DOCUMENTATION AND SUBMISSION**

## **ABSTRACT**

Air pollution is one of the biggest threats to the present-day environment. Everyone is being affected by air pollution day by day including humans, animals, crops, cities, forests and aquatic ecosystems. Besides that, it should be controlled at a certain level to prevent the increasing rate of global warming. This project aims to design an IOT-based air pollution monitoring system using the internet from anywhere using a computer or mobile to monitor the air quality of the surroundings and environment. There are various methods and instruments available for the measurement and monitoring quality of air.

## **INTRODUCTION**

Air is getting polluted because of the release of toxic gases by industries, vehicle emissions and increased concentration of harmful gases and particulate matter in the atmosphere.

The level of pollution is increasing rapidly due to factors like industries, urbanization, increase in population, vehicle use which can affect human health. Particulate matter is one of the most important parameters having a significant contribution to the increase in air pollution. This creates a need for measurement and analysis of real-time air quality monitoring so that appropriate decisions can be taken in a timely period.

### PROBLEM STATEMENT

* It refers to the contamination of the atmosphere by harmful chemicals or biological materials. It may cause diseases, allergies, and severe health problems in humans and other living organisms and may damage the natural environment.
* The problem statement is your opportunity to explain why you care and what you propose to do in the way of researching the problem. A problem statement is an explanation in research that describes the issue that is in need of study.
* Here's an example of a basic problem statement: Voter turnout in the southwest region of Florida has been significantly decreasing over the past decade, while other areas of the state continue to see increasing numbers of voters at the polls.

# UNDERSTANDING THE PROBLEM

* The starting point of air quality monitoring is to first study if an area has an air pollution problem.
* Monitoring helps in assessing the level of pollution in relation to the ambient air quality standards.
* Standards are a regulatory measure to set the target for pollution reduction and achieve clean air.

# DESIGN THINKING APPROACH

* Detailed concentration distributions and temporal variations of H2S for pollution detection and source identification were given by the Gaussian puff model, referring to the guideline models for environmental risk assessment. provides an approach to obtain the source area by means of meteorological data and
* The source area analysis method was employed to perform the source identification. It concentration measurements.

# PROPOSED SOLUTIONS

* An IoT-based air quality monitoring platform comprises two components, namely a smart air monitor and the web server.• The air monitoring solution has a set of IoT sensing devices that collect the data to precisely detect and analyze air quality.
* and wood stove use. Avoid burning leaves, trash, and other materials Reduce the number of trips you take in your car.

Reduce or eliminate fireplace.

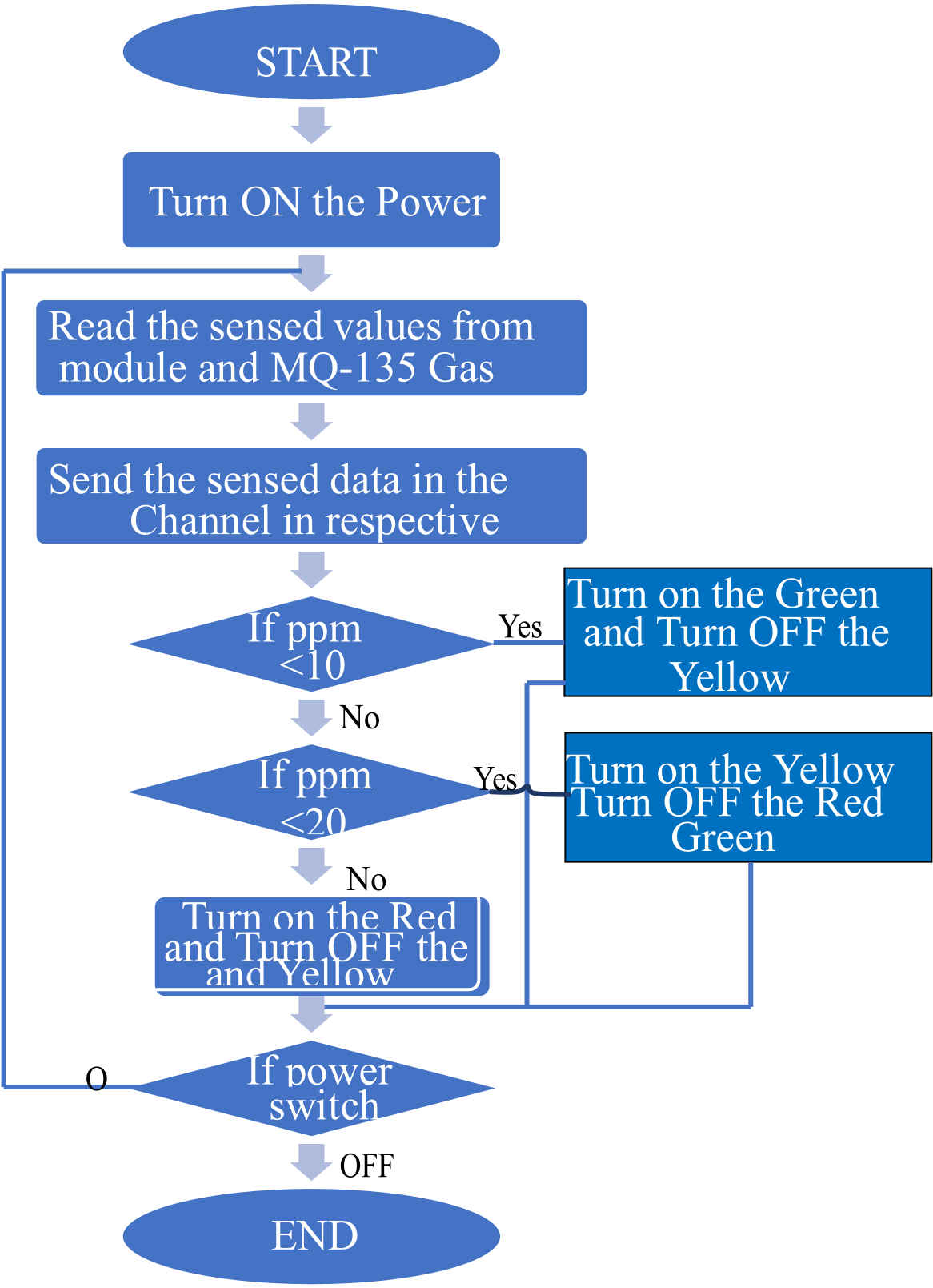
# DESIGN CONCEPT

• The most commonly selected air quality indicators for urban and industrial air pollution are:

− nitrogen dioxide (NO2),

− sulphur dioxide (SO2),

− carbon monoxide (CO),

− particles with aerodynamic diameter less than 10 µm (and 2,5 µm), PM10 (and PM2,5) .

# IMPLEMENTATION PLAN

• The completed document will provide insight on monitoring network design and operations, the implementation plan that aims to fulfill the air monitoring goals and objectives, and critical data management and quality assurance elements.

# CONCLUSION

* an IoT-based air pollution monitoring system is a revolutionary air quality in a particular area.

solution that can provide accurate and real-time data about the

* It can help identify the sources of pollution and take necessary health.

measures to reduce it, protecting the environment and human

* Air Quality Monitoring Networks allow the measurement, operation and predictive analysis of the evolution of air pollution in different areas (urban areas, industrial areas, special nature conservation areas, etc.)
* While the effects of air pollution on materials, vegetation, and animals can be measured, health effects on humans can only be estimated from epidemiological evidence.

*“Sensing technologies are the new eyes and ears for cities to understand air quality, as well as the sources and health risks from pollution. We have a unique opportunity to work with technology innovators, academia, private sector and civil society to connect health and technology to truly clean the air we breathe.”*

In some parts of the world, a lack of data makes understanding local pollution–and its impact on community health–nearly impossible.

New, lower-cost air pollution sensing technologies can change that. These new sensors are not only more accessible than traditional monitoring methods. They also show how pollution changes from neighborhood to neighborhood, or even block to block.

This kind of hyperlocal data can shine a light on previously invisible hotspots, helping officials and empowering communities to make a stronger case for changes that protect public health and the environment.

## Opportunities for Cities and Businesses

Cities can use hyperlocal pollution data to invest in clean transportation, create clean air zones, change land use rules and more efficiently set and enforce pollution and emissions rules.

This expanding field brings not only opportunities for cities and activists, but for companies with expertise in sensing technology, fleet management and data analysis.



### A Growing Market for Pollution Sensors

Tech entrepreneurs can help cities tackle their air pollution challenges by investing in the growing market for monitoring technology. Until now identifying funding opportunities has been challenging. Learn more about the report and key findings .

Air quality plays a crucial role in human health and the wellbeing of the environment. Unfortunately, air pollution has been on the rise due to various sources such as vehicle emissions, industrial activities, energy production, and natural disasters like wildfires. Understanding and assessing the quality of the air we breathe is of utmost importance. Air Quality Monitoring (AQM) systems, integrated with sensors and advanced technologies, are utilized to measure particulate matter and air pollutants like ozone, nitrogen oxides, and sulfur dioxide. The data collected by these systems helps formulate policies, monitor pollution reduction efforts, and empower the public to make informed decisions regarding their health and well-being. Currently, AQM stations are primarily used for calculating the Air Quality Index (AQI) and monitoring pollution. However, the infrastructure requirements, operational complexities, and ongoing expenses associated with these stations limit the expansion of AQM networks and the availability of air pollution data. To overcome these limitations, it is imperative to develop low-cost, efficient, and real-time data-sensing devices. IoT technology provides a promising solution, 2 with recent advancements allowing the use of IoT sensors in various domains, including smart cities, smart mobiles, smart refrigerators, and smartwatches. Leveraging IoT, air quality can be monitored remotely using sensors (e.g., temperature and pressure sensors, noise sensors), Arduino for data processing,

and cloud platforms for storage. Machine learning algorithms, such as Linear Regression, Random Forest, XGBoost, and ARIMA models, have also proven effective in forecasting and predicting air pollutant levels. The availability of affordable sensors and data processing tools has enabled the deployment of air quality monitoring systems on a large scale. However, maintaining the accuracy of these systems is crucial, as erroneous data can lead to flawed policy decisions and ineffective mitigation efforts. Regular calibration and validation are essential to ensure the accuracy of air quality monitoring systems.

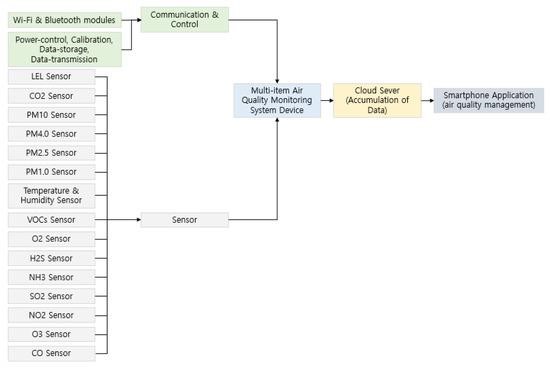
This paper presents several contributions:

* Development of a low-cost and user-friendly air pollution monitoring system.
* Real-time data gathering capabilities within the AQM system.
* Utilization of Blynk for real-time data visualization.
* Adoption of ThingSpeak, an open-source software, for day-to-day pollution visualization.

***Materials and Methods***

➢ Process of Multi-Item Air Quality Monitoring System

A multi-item air quality monitoring system component consists of a hardware part and a software part. The hardware part consists of a sensor unit and a communication control unit. The sensor unit consists of a total of 16 items: PM10, PM2.5, PM4.0, PM1.0, CO2, CH4, temperature, humidity, VOCs, O2, H2S, NH3, SO2, NO2, O3, and CO. The total number of installed sensors are eleven. The communication unit consists of a Wi-Fi module and a Bluetooth module. The software part consists of a web program and a smartphone application. The measurement process is that the sensor unit of the hardware part measures 16 air pollution items, the measured data are transmitted to the cloud server through the communication unit.



#### ➢ Hardware Process of Multi-Item Air Quality Monitoring System

The hardware part of the multi-item air quality monitoring system is divided into a sensor part and a communication part. The sensor unit includes nine sensors including a PM sensor, a temperature and humidity sensor, a VOC sensor, an oxygen sensor, a hydrogen sulfide sensor, an ammonia sensor, a sulfur dioxide sensor, a nitrogen dioxide sensor, an ozone sensor, and a carbon monoxide sensor. The carbon dioxide and methane sensors are attached to the separated probe rod and used in connection with the main device.

### IoT Monitoring System components

IoT-based air pollution monitoring systems comprise several components that work together to collect and analyze air quality data. The components include:

1. **Sensors**: Sensors are the primary components of IoT-based air pollution monitoring systems. They measure various air quality parameters such as particulate matter, carbon monoxide, sulfur dioxide, and nitrogen oxides. The sensors can be classified into two categories: physical and chemical sensors. Physical sensors measure parameters such as temperature, humidity, and pressure, while chemical sensors measure air pollutants.
2. **Microcontroller**: The microcontroller is the brain of IoT-based air pollution monitoring systems. It receives data from the sensors, processes it, and sends it to the cloud server. The microcontroller is usually a microprocessor such as Arduino, Raspberry Pi, or similar devices.
3. **Communication Module**: The communication module is responsible for transmitting data from the microcontroller to the cloud server. Communication modules can use various wireless technologies such as Wi-Fi, Bluetooth, or cellular networks.
4. **Cloud Server**: The cloud server is a centralized platform for storing, analyzing, and sharing air quality data. It collects data from the communication module and stores it in a database. The cloud server also provides web and mobile applications for users to access the data.
5. **Power Supply:** IoT-based air pollution monitoring systems require a power supply to operate. In case of permanent installations external power supply is provided and batteries are provided for portable devices.