

Air Quality Monitoring System

Based on IoT

Introduction:

One of the most alarming issues in modern cities is the air quality level, where air pollution has caused 120 deaths out of 100,000 per year based on a worldwide study (Green Car Congress, 2019). The World Health Organization emphasized that 97% of cities in low- and middle- income countries with more than 100 000 inhabitants do not meet World Health Organization (WHO) air quality guidelines. Due to poor air quality, it will increase potential health risks such as risk of stroke, heart disease, lung cancer, asthma and others as well (citation). Hence, there is a need to install an air quality monitoring system in cities to ensure the air is not contaminated. This can be done by installing sensors to monitor dust particles, carbon dioxide, carbon monoxide, nitrogen dioxide and sulfur dioxide levels and this information can be shared with the public through smartphones, where the smartphone app allows people to monitor real-time data of the current air quality level in the area.

Project Definition:

IOT Based Air Pollution Monitoring System monitors the Air quality over a web server using Internet and will trigger an alarm when the air quality goes down beyond a certain threshold level, means when there are sufficient amount of harmful gases present in the air like CO₂, smoke, alcohol, benzene, NH₃, LPG and NO_x.

Objectives:

- To design an innovative air quality monitoring system that can cover one square kilometer of urban area
- To monitor the air quality index through smartphone applications from installed sensors on buildings with height ranges of 3 meters to 6 meter.

Problem Definition:

Protecting the atmospheric environment involves control of atmospheric emissions as well as an understanding of pollutant dispersion, monitoring emission levels, i.e. concentration in ambient air. To monitor these levels there are Air Quality Monitoring Networks.

1. Objective:

Clearly state the primary purpose of the air quality monitoring system. Is it for public health, environmental compliance, research, or some other purpose? For example, "The objective of this system is to continuously monitor and assess air quality to protect public health and support environmental management."

2. Scope:

Define the geographical area or locations where the system will be deployed. Specify if it's a local, regional, or national system. For instance, "This system will cover urban and industrial areas within the XYZ region."

3. Parameters:

List the specific air quality parameters to be monitored. This could include pollutants like PM_{2.5}, PM₁₀, ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, etc.

4. Data Collection:

Describe how data will be collected. Will it use sensors, monitoring stations, satellite data, or a combination of these? Mention the frequency and duration of data collection (e.g., real-time, hourly, daily).

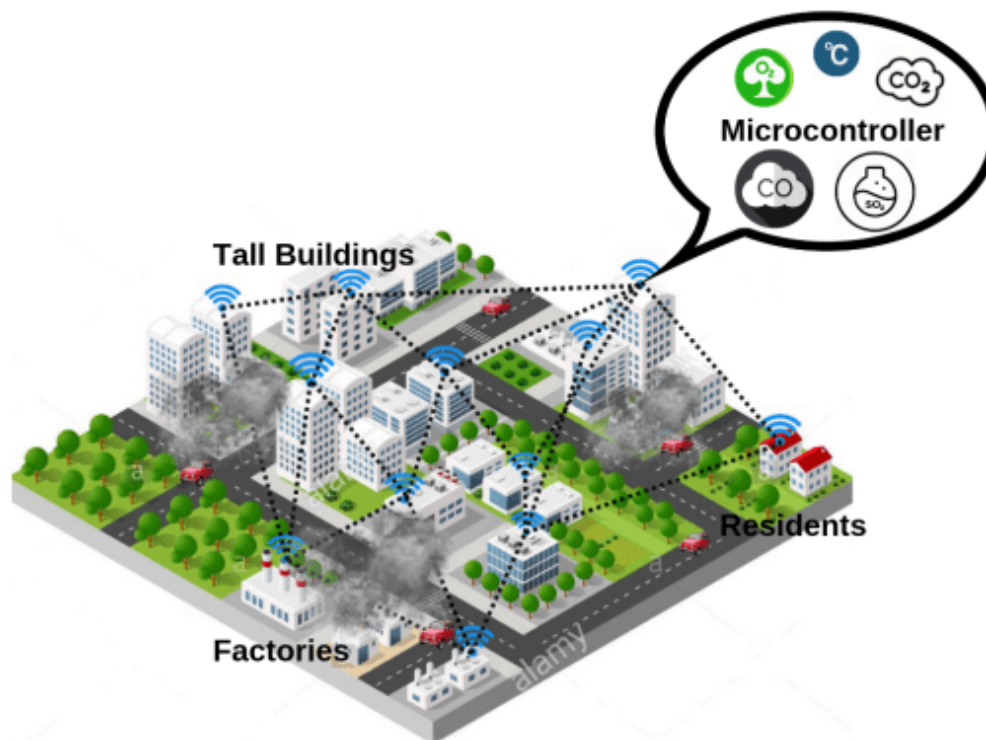
5. Data Analysis:

Outline how collected data will be analyzed and processed. Will there be data aggregation, trend analysis, or modeling to predict air quality?

Design Thinking:

a) Design Ideas

Air quality sensors are installed in the targeted area on top of buildings, industrial areas, traffic and residential areas. These sensors are connected to a microcontroller to control the sensors network. The data collected by the microcontroller is transmitted to the cloud for analysis. The analyzed data is shared to the public through a smartphone app

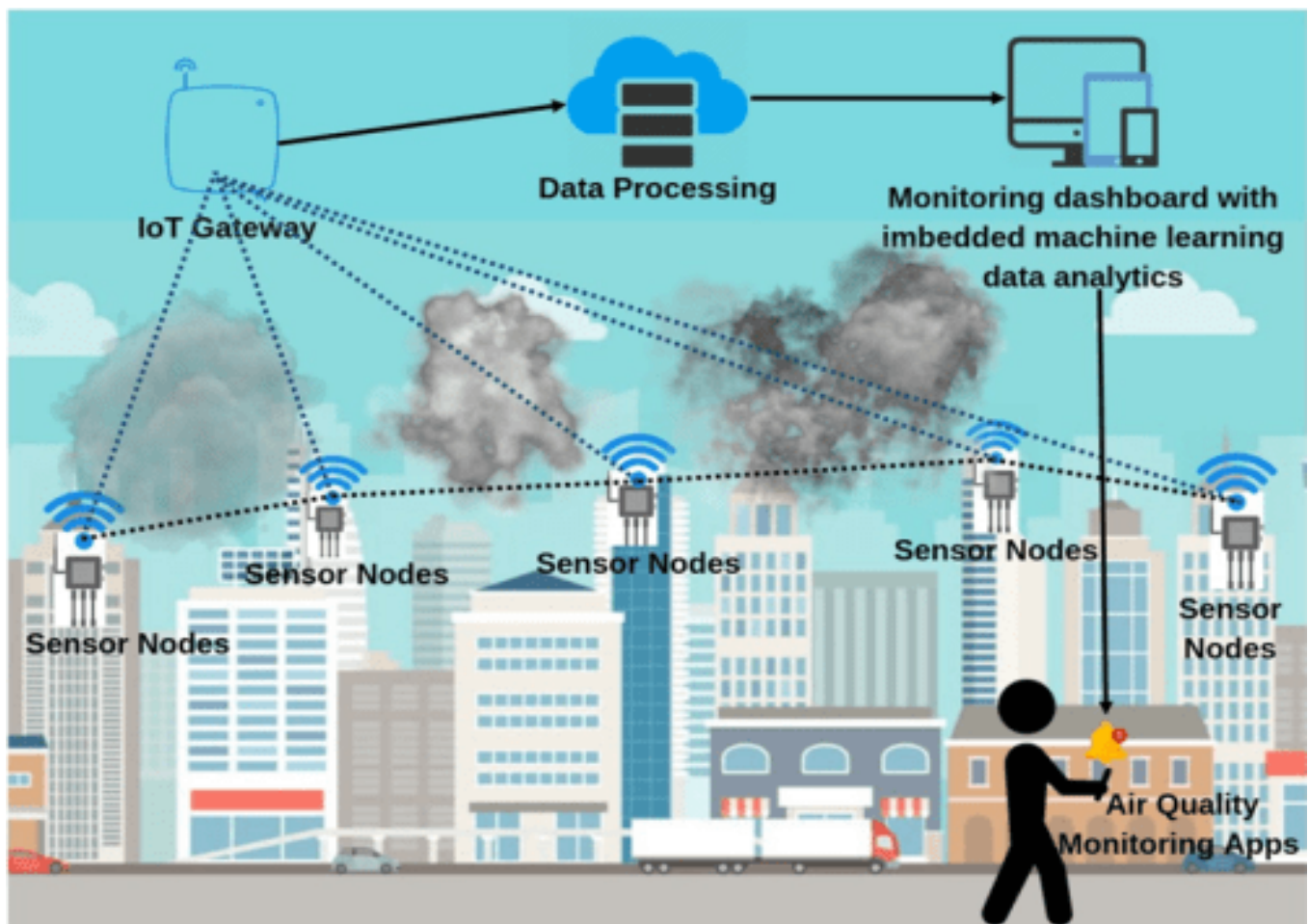


Module:

The DHT11 sensor module is used to measure the temperature and the humidity of the surroundings. With the help of the MQ-135 gas sensor module, air quality is measured in ppm. These data are fed to the ThinkSpeak cloud over the internet.

b) How it works?

Wireless sensors placed at strategic locations sense the level of dust particles, carbon dioxide, carbon monoxide, nitrogen dioxide and sulfur dioxide in the air. This information is transmitted to a gateway which forwards it to a cloud database by means of cellular or WiFi communication. In the cloud, the data are analyzed to provide information on the air quality. The information on the air quality is shared through a smartphone app. This allows the relevant authority to take remedial action and the community to take precautionary measures.



This project proposes an idea to install monitoring applications on smartphones. It is innovative because it provides easy access to the public to monitor real time air quality in their area. It uses low cost and readily available devices such as a dust sensor, carbon monoxide gas sensor, carbon dioxide gas sensor, and nitrogen dioxide gas sensor. For controlling these sensors, microcontrollers are used and the microcontrollers also act as transmitter to transmit the data to the cloud database.

The IoT based air pollution monitoring system can be produced by using sensors and microcontrollers available in the market. The microcontrollers are programmed to take the sensors as input and transmit the data to the cloud. An algorithm is developed to analyse the data and send it to the smartphones app.

c) Where would it be applied?

- i. Sensors will be installed on top of buildings, industrial areas, traffic and residential areas.
- ii. Smartphone app for monitoring is installed in individual smartphone.

