

Real-time Air Quality Monitoring Based on Internet of Things (IoT)



IOT Challenge – Smart Land

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. Hence, through these implementations, better quality of life can be achieved.

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 and smartwatch applications from installed sensors on buildings with height ranges of 3 meters to 6 meters
- To propose preventive actions through smartphones and smartwatch applications when the air quality level exceeds threshold values.

Proposed Concept

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.

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.

c) What makes it innovative?

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 information on air quality can be accessed through a smartphone app in real time.

d) How would it be produced?

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. Smartphone app will be developed for user to access the air quality information in real-time.

e) 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.

f) Potential impact around the globe?

There are many cities around the world facing air quality issues. The contaminated air results in death every year and decline in health conditions as people are exposed to unhealthy air quality. Awareness of the contaminated air enables the community to take precautionary steps. This will also enable the relevant authority to take remedial action. With this project the community can enjoy cleaner air and improved health conditions.

Inspiration (<250 words)

Our team has decided to propose this project because air pollution is among the most common problem faced by the entire globe. According to Climate & Clean Air Coalition (n.d), 92% of Asia and the Pacific population which is about 4 billion people are exposed to levels of air pollution that pose a significant risk to their health. Hence, with the implementation of real-time air quality monitoring system installed at targeted areas and monitoring applications in smartphone, sustainable clean air can be achieved which provide healthy environment to everybody affected by bad air quality.

Figures

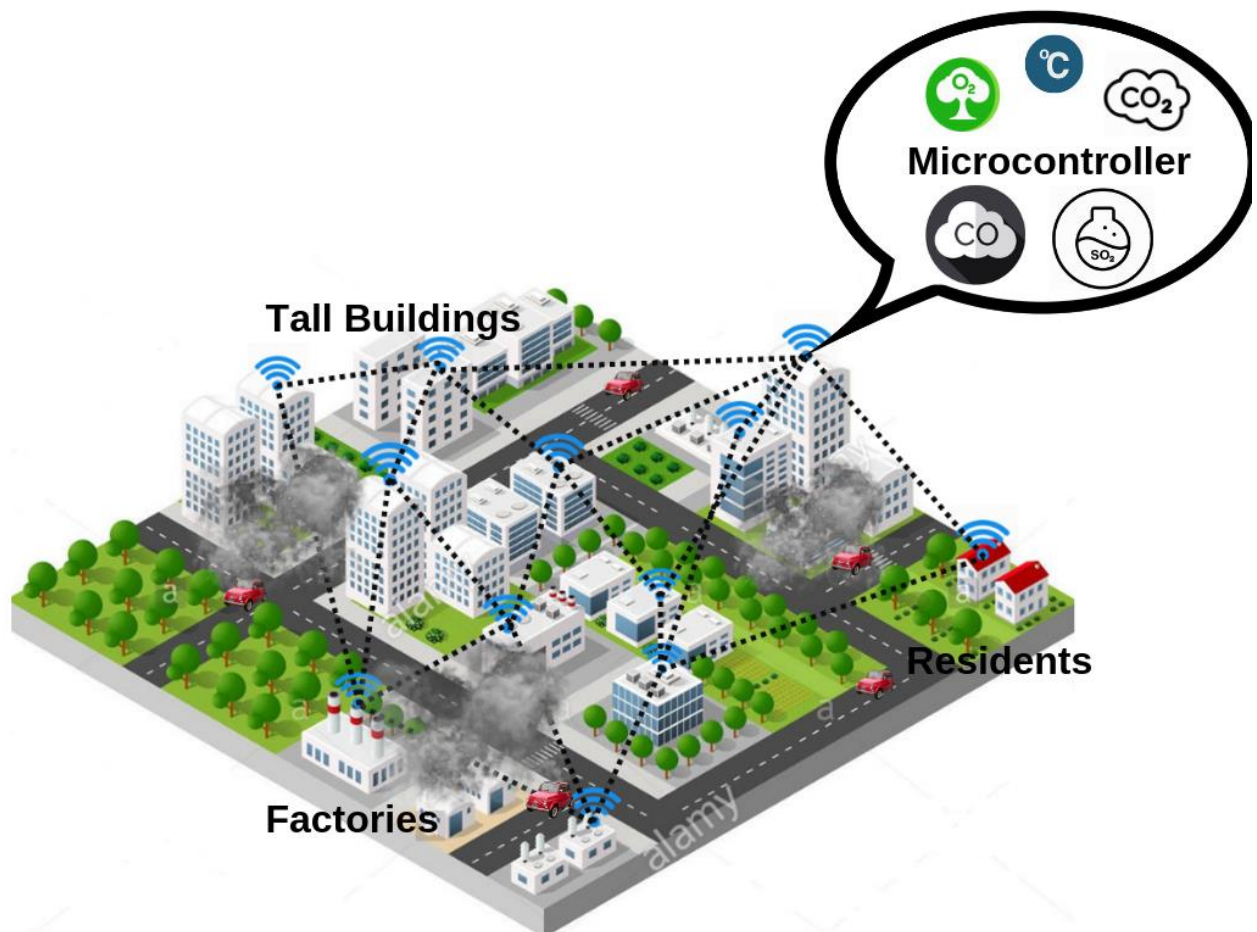


Figure 1. Air quality sensors installed in tall buildings, factories and residential houses (monitoring application)

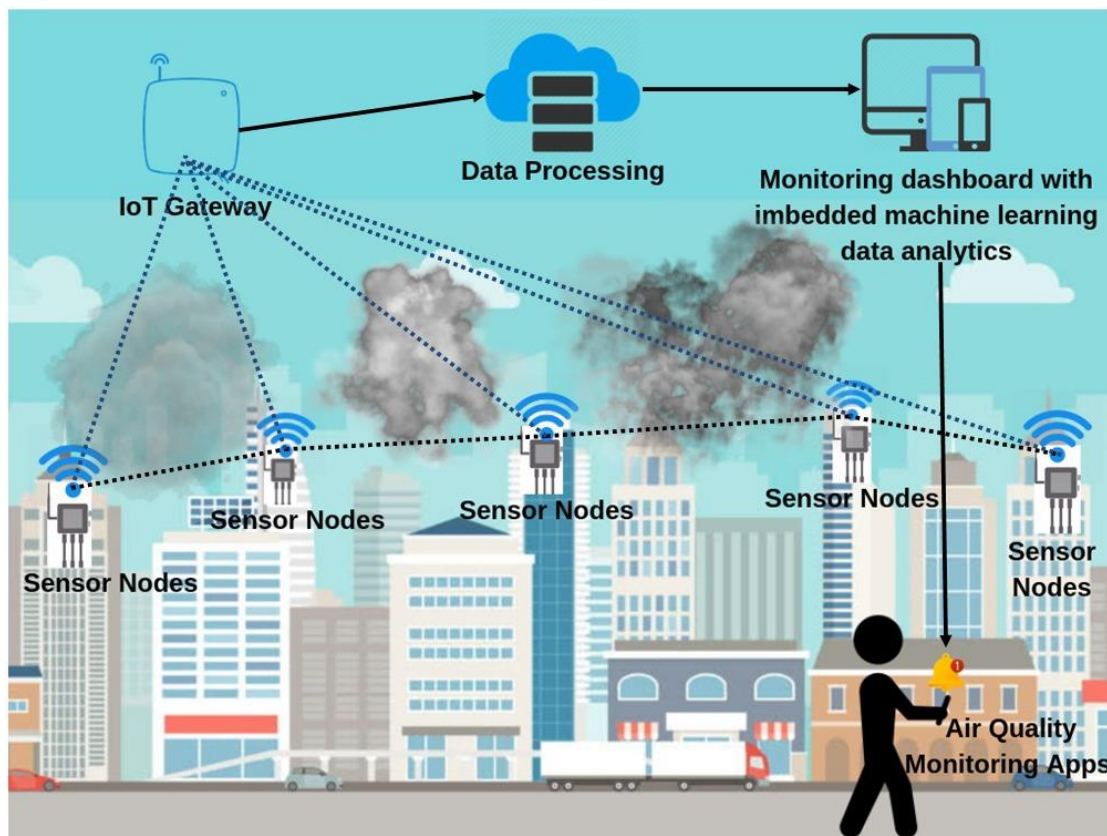


Figure 2. Clearer view on air quality monitoring networks

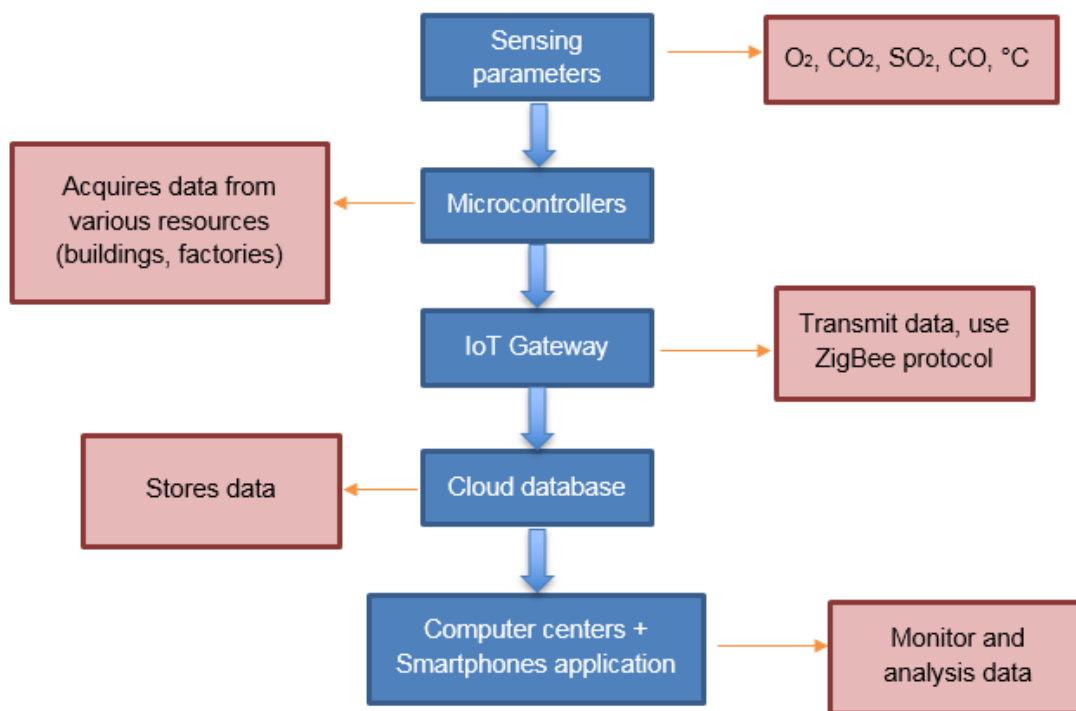


Figure 3. Block diagram of air quality monitoring system

