IoT Data Transmission System with LoRa Communication

Portable air quality monitoring

Objective:

The objective of this project is to collect air quality data with the assistance of a drone. I will establish a communication system between two LoRa devices for data transmission. The transmitted data will include air quality readings at the bare minimum and further expanding to get real-time GPS coordinates obtained from a GPS module, as well as temperature and humidity readings from a BME280 sensor. At minimum the air quality will be published to an MQTT server using the Adafruit dashboard and to exceed this will use Node-red. Additionally, a custom 3D-printed enclosure will be designed to house the circuitry.

Day 1-2: Setting up LoRa Communication **4/8/2024 – 4/9/2024**

* Acquire two LoRa devices and configure them for communication.
* Establish communication between the devices using LoRa protocols.

Day 3-4: Integrating GPS Module **4/10/2024 – 4/11/2024**

* Integrate a GPS module into the circuitry.
* C++ code to interface with the GPS module and retrieve real-time latitude and longitude coordinates.
* Implement data formatting to transmit GPS data over LoRa.

Day 5: Integrating BME280 Sensor **4/12/2024**

* Integrate a BME280 sensor into the circuitry.
* Develop C++ code to read temperature and humidity data from the sensor.
* Format the data and integrate it with the existing code for transmission over LoRa.

Day 6-7: Implementing MQTT with Node-RED **4/13/2024 – 4/14/2024**

* Set up a MQTT server (Mosquitto).
* Configure Node-RED for MQTT communication.
* Develop Node-RED flows to subscribe to the LoRa-transmitted data and publish it to the MQTT server.

Day 8-9: Designing and 3D Printing Enclosure **4/15/2024 – 4/16/2024**

* Design a suitable enclosure for the circuitry using CAD software.
* Ensure the enclosure design accommodates all components and provides adequate protection.
* 3D print the enclosure and assemble the circuitry within it.
* Test the assembled system for functionality, durability, and test flight.

Conclusion:

The project aims to achieve a fully functional IoT data transmission system utilizing LoRa communication. Real-time GPS coordinates, temperature, and humidity data will be transmitted between devices and published to an MQTT server. The custom-designed enclosure will provide physical protection and aesthetic appeal to the system.

USE CASES

Monitoring air quality is crucial for various purposes, ranging from public health protection to environmental conservation. Here are some key use cases for monitoring air quality:

1. **Public Health Protection**: Monitoring air quality helps identify harmful pollutants such as particulate matter (PM), nitrogen dioxide (NO2), sulfur dioxide (SO2), ozone (O3), carbon monoxide (CO), and volatile organic compounds (VOCs). By tracking these pollutants, authorities can issue health advisories and take preventive measures to protect people, especially those with respiratory conditions like asthma or COPD.
2. **Urban Planning and Infrastructure Development**: Understanding air quality trends helps urban planners make informed decisions about where to locate residential areas, schools, hospitals, and industrial zones. It also informs decisions on transportation infrastructure, such as road networks and public transit routes, to minimize pollution exposure.
3. **Industrial Compliance Monitoring**: Industries emitting pollutants are often subject to regulations that limit their emissions. Continuous air quality monitoring ensures that these industries comply with environmental standards and helps identify sources of pollution for corrective action.
4. **Environmental Conservation**: Monitoring air quality is essential for preserving ecosystems and biodiversity. Poor air quality can harm vegetation, aquatic ecosystems, and wildlife. By tracking pollutants, environmentalists can advocate for policies to reduce pollution and protect natural habitats.
5. **Early Warning Systems for Natural Disasters**: Certain natural events, such as wildfires and volcanic eruptions, can significantly degrade air quality by releasing smoke, ash, and gases into the atmosphere. Monitoring air quality allows authorities to issue early warnings to communities at risk and implement evacuation plans if necessary.
6. **Climate Change Research**: Some air pollutants, such as greenhouse gases (e.g., carbon dioxide), contribute to climate change by trapping heat in the atmosphere. Monitoring these gases, along with other indicators like aerosols, helps scientists understand climate trends and assess the effectiveness of mitigation strategies.
7. **Indoor Air Quality Management**: Poor indoor air quality can have adverse effects on occupants' health and comfort in homes, schools, offices, and other indoor environments. Monitoring indoor air quality helps identify sources of pollution (e.g., mold, volatile organic compounds from building materials) and implement measures to improve ventilation and filtration.
8. **Healthcare Facilities**: Hospitals and healthcare facilities benefit from air quality monitoring to maintain sterile environments in operating rooms and patient care areas. Monitoring helps prevent the spread of airborne infections and ensures compliance with regulatory standards for indoor air quality in healthcare settings.
9. **Public Awareness and Education**: Sharing air quality data with the public increases awareness of the importance of clean air and encourages individuals to take actions to reduce their contribution to pollution, such as using alternative transportation modes, conserving energy, and supporting policies that promote clean air.
10. **Economic Impact Assessment**: Poor air quality can have significant economic consequences, including healthcare costs, reduced worker productivity, and damage to crops and buildings. Monitoring air quality allows policymakers and economists to assess the economic impact of pollution and make informed decisions about resource allocation and investment in pollution control measures.

These use cases highlight the multifaceted importance of monitoring air quality for human health, environmental sustainability, and economic prosperity.

Top of Form