Low-Cost Wireless self-healing sensor network (LoWSHAN)

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Overview

Low-Cost Wireless self-healing sensor network (LoWSHAN) system is a mesh network capable of monitoring and sensing uninhabited regions. LoWSHAN is flexible network capable of measuring a diverse set of physical properties and variables from temperature, soil moisture, humidity, and air content in areas uninhabited and adverse regions. LoWSHAN has three primary nodes:

- Sensor node
- Dynamic gateway node
- Static gateway node

LoWSHAN uses a low-powered wide-area radio frequency called LoRa to communicate between the nodes. The static gateway nodes use a raspberry zero as an IoT gateway device to connect to cloud storage. At the same time, the dynamic gateway nodes explore the region to find a connection between two or more range sensing nodes.

Introduction

One of the most challenging aspects of monitoring and remote sensing in deserted or harsh environments is sacrificing either the accuracy or cost. As seen recently in the Atmospheric Remote-sensing Infrared Exoplanet Large survey (ARIEL), which cost the European space agency 550 million dollars. Our LoWSHAN demonstrated the capabilities of creating a relatively low-cost monitoring and remote sensing network. Additionally, LoWSHAN can be used locally as an wildfire monitoring and prevention system in underdeveloped regions.

Wildfires have become one of the most destructive disasters in the last decade; from 2010 to 2020, an average of 13,934 fires annually, with 650,000 acres of land being damaged. Wildfires can fizzle out quickly or spread uncontrolled, consuming thousands of acres of land within hours. But the intensity and movement of a wildfire ultimately depend on fuel, weather, and topography. These factors are collectively known as the “fire behavior triangle.” Monitoring such conditions in a local environment is an excellent method to counteract the fire spread, which is one of the reasons LoWSHAN can be powerful weapon is fight against them.

Description of flow of data

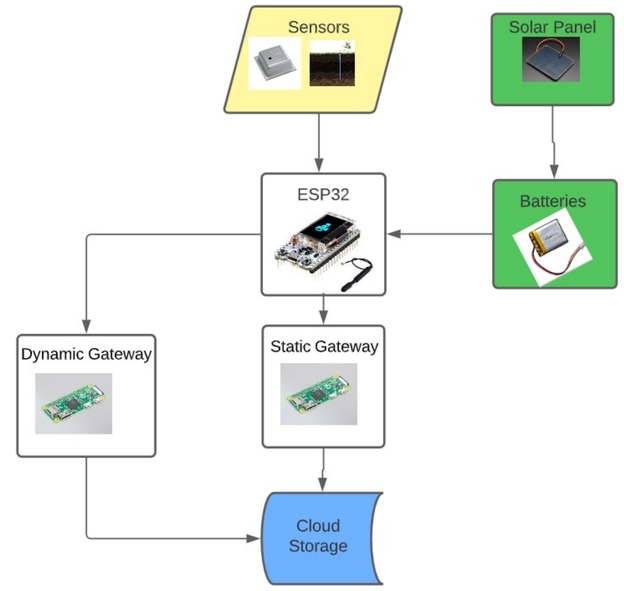

Figure 1

Network Architecture

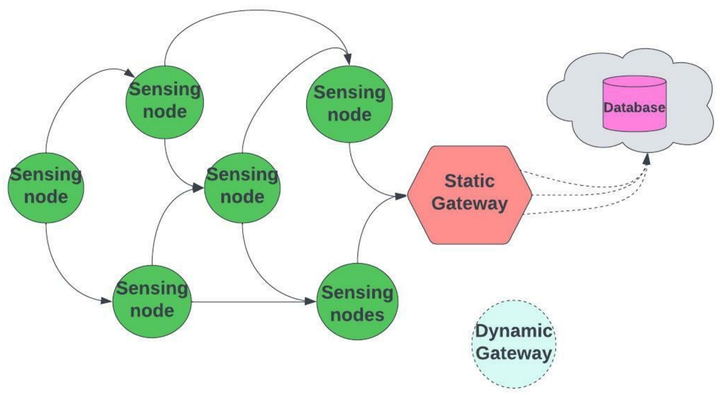

Figure 2

Results

The prototype testing of our Low-Cost Wireless self-healing sensor network (LoWSHAN) system demonstrated the system's potential to monitor and sense large areas of uninhabited regions. Using an ESP32 and a Raspberry Zero 2, as seen in figure 1, we created a wireless sensor network capable of monitoring the local temperature, soil moisture, humidity, and air content. The systems range was a surprise since we could connect two nodes below the range of 300m. This range notably played an essential part because radio frequencies are weakened within human urban areas. Expanding that range in an area not congested with existing human range radio frequencies, we would be able to extend it 1000 meters just using LoRa.

Conclusion and Future

Designing the Low-Cost Wireless self-healing sensor network (LoWSHAN) we believed that it will allow us to have a greater understanding of our solar system and the different planets and ecosystems that NASA will deal with. Additionally, LoWSHAN can also play an important part in NASA’s other missions such as monitoring the effects of climate change as seen in out prototype the network is also capable of monitoring and identifying wildfires. Outside of wildfires we identified that it can also be used to monitor local environments such as:

- Forest regions
- Lakes
- Wildlife habitats
- Deserts

In conclusion LoWSHAN is a great tool for the advancement of sensing in extreme and uninhabited areas. equipment, we would be able to protect them.

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