LoRaFireNet:

A LoRaWAN Based Wildfire Early Prediction and Detection System

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Problem Definition

Wildfires in high risk areas can quickly become uncontrollable if not detected in a timely manner. The current solutions for wildfire detection primarily rely on satellite imagery and human surveyors stationed in watchtowers.

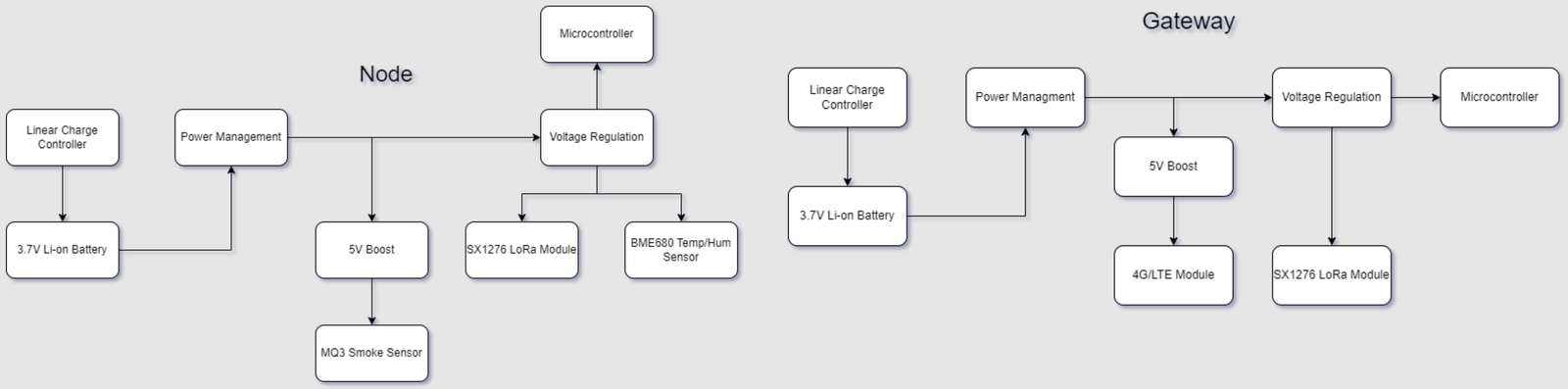
While satellite imagery can cover a wide area, it often takes time to identify fires and may detect them when it is too late to take action. Additionally, human surveyors face limitations in terms of cost and scalability; largely due to wildfires frequently occurring in hard to reach remote areas, and the potential reluctance to operate in such challenging conditions.

Solution and Implementation

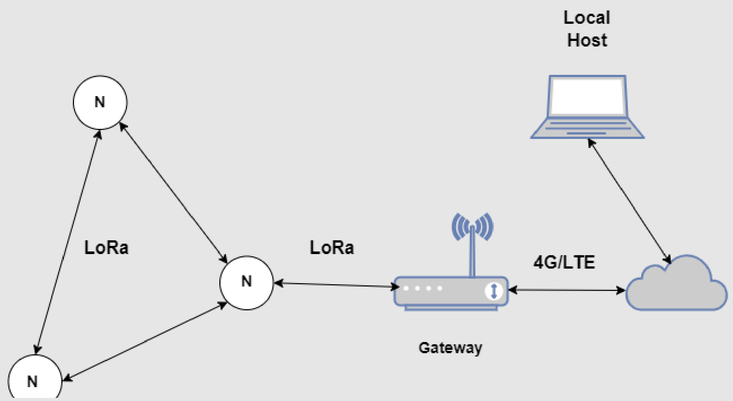
Solution: A wireless sensor network for real-time wildfire detection and prediction.
Aim: Swift wildfire detection and prediction, enabling timely response and mitigation efforts.

- Sensing: Sensors detect environmental parameters (temperature, smoke, humidity).
- Detection: Data from sensors analyzed in real-time to detect wildfire.
- Communication: Detected information transmitted via low-power, long-range (LoRa) mesh network to a cellular communications device (4G/LTE)
- Energy: Powered by renewable sources (lithium-ion batteries charged by mini solar panels) with a power management system for efficiency.
- Prediction: Machine learning model predicts wildfire behavior based on gathered data.

System Block Diagram



Network Topology



Specifications

- Temperature accuracy of ± 1°C
- Relative humidity accuracy of ± 3% accuracy.
- Smoke calibration accuracy of 0.4 mg/L or approximately 200 ppm of concentration in air
- Maximum current draw of 12 mA/h ± 5%
- Maximum response time of 2 minutes when fire is detected and/or predicted.
- Prediction accuracy of 97.2%.
- End node device should sleep and wake up periodically within the hour
- Maximum LoRa transmission range of 2 km in line of sight
- LoRa specific specs:
  - BW: 125 kHz
  - SF: 7
  - Power: 17 dBm

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