EcoSenseNet - Smart Environment Prediction and Alert System

Pratiksha

Indian Institute of Information Technology Senapati, Manipur

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Outline

Introduction, Objective & Contribution

Introduction

EcoSenseNet is a smart environment prediction and alert system designed for localized areas like a college campus. It integrates IoT sensors, machine learning, and offline communication to deliver real-time environmental predictions and alerts, especially when the internet is unavailable.

Objectives

- To acquire real-time environmental data using various sensors.
- To process and predict environmental trends using a locally deployed LSTM model.
- To enable completely offline alert distribution using Reticulum MeshChat over LoRa and Wi-Fi.
- To provide an additional chat interface for administrators and students to communicate during outages.

Contribution

Background / Existing Work

Existing Work

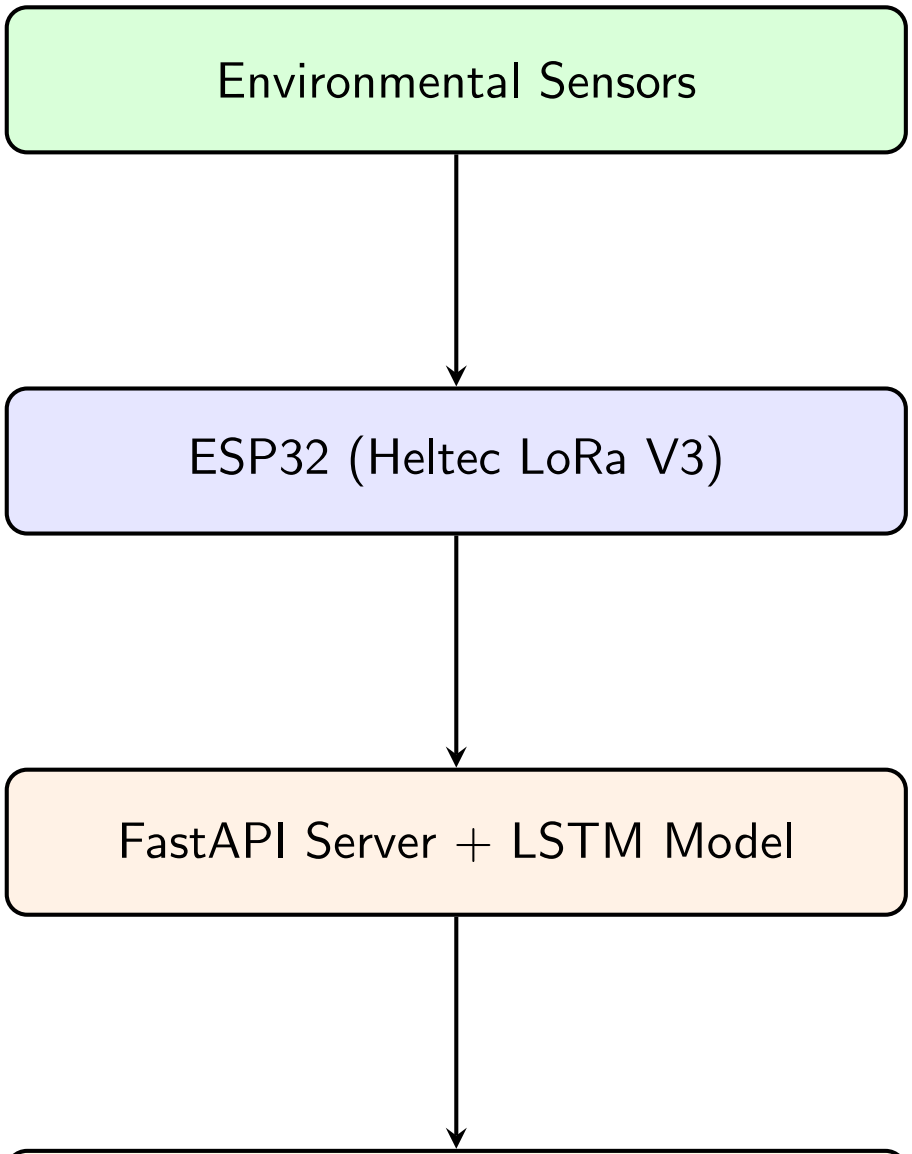
- Most environmental monitoring systems rely on constant internet connectivity and cloud-based analytics.
- Technologies like Wi-Fi and GSM have limitations in terms of range, power consumption, and reliability during disasters.
- Existing LoRa networks are often dependent on cloud-connected gateways.

Problems in Existing Work

- **Network Dependence:** Systems fail without internet access.
- **Centralized Architecture:** Single points of failure (gateways, cloud servers).
- **Lack of Edge Intelligence:** Few systems perform predictive ML locally.

How Our Project Overcomes These Problems

Proposed System / Architecture



Process

1. **Input:** Real-time environmental data is collected by sensors connected to an ESP32.
2. **Process:** The data is sent to a local FastAPI server, which uses an LSTM model to predict environmental trends for the next 3 hours.
3. **Output:** The predictions and any alerts are broadcasted over

Result & Analysis

Testing

The system was tested within the IIIT Manipur campus. Two laptops were used: one as a base station with sensors, and the other as a receiving node at various distances. The tests were conducted without any internet connectivity.

Key Results

Table: System Performance

Metric	**Result**
End-to-End Latency	4-7 seconds
LSTM Prediction Time	150-250 ms
LoRa Reliability (500m)	92-95%
LoRa Reliability (800m)	85%
False Alert Rate	8%

Conclusion

Summary

We have successfully developed EcoSenseNet, a decentralized and offline-first environmental monitoring and alert system. The system combines IoT, machine learning, and mesh networking to provide a resilient and low-cost solution for disaster-prone areas.

Achievements

- Achieved reliable end-to-end functionality, from data collection to alert delivery.
- The system operates with low latency (4-7 seconds) and high prediction accuracy (¿87%).
- Demonstrated the feasibility of a fully offline communication system for emergency scenarios.

Future Enhancements

- Replace laptops with Raspberry Pi for lower power consumption and a