Progress Report

Project Name	Locating Earthquake Victims Using Bluetooth
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Summary

This project aims to develop a system for locating earthquake victims using Bluetooth signals emitted by their mobile devices. The system uses multiple ESP32 probes to detect signal strength, MQTT for data transmission, and a central system for multilateration. Currently, the project is on schedule. Key accomplishments include understanding Bluetooth Classic and BLE mechanisms, implementing discovery-based sniffing for Bluetooth Classic, active/passive sniffing for BLE, and creating a basic GUI for displaying locations. The next steps involve implementing probe-MQTT communication, potentially passive sniffing for Bluetooth Classic (though this faces challenges), finishing the multilateration algorithm, displaying gathered data in the GUI, and moving to the testing phase.

Accomplishments

- Learned how Bluetooth Classic and Bluetooth Low Energy works
- Implemented discovery-based sniffing for Bluetooth Classic
- Implemented active and passive sniffing for Bluetooth Low Energy
- Implemented a basic GUI for rendering device locations.

Expected Accomplishments

- Implementing the communication between the probes and the MQTT broker
- Passive sniffing for Bluetooth Classic
- Displaying the gathered data in a GUI
- Moving to the testing phase.

Issues/challenges:

The primary challenges encountered during the project relate to technical limitations and data handling. One significant issue was that the ESP-IDF's Bluetooth stack does not readily support passive sniffing in Bluetooth Classic mode. Given the complexity required to modify the stack, which was considered beyond the project's scope, this feature was removed, and the issue was effectively ignored. Another challenge involves achieving precise data synchronization across the multiple ESP32 probes, which is crucial for accurate location calculations. This was addressed by deciding to use NTP (Network Time Protocol) to synchronize the clocks. Additionally, real-world signal strength measurements can be imperfect due to various factors, potentially breaking exact sphere-based calculations for multilateration. The team plans to mitigate this by using a min-error formula rather than insisting on an exact calculation. Finally, signal reflections and multipath propagation can introduce false or inaccurate values; the strategy to counter this involves using more data samples and implementing methods to clean outlier data.

Status

Item	Current Status	Summary
Project Status	On Time	We have implemented the basics of packet sniffing and radar display. Everything goes as scheduled.
Scope	Changes Needed	We had to give up on the passive Bluetooth Classic packet sniffing since it would take too much time to reverse engineer the entire Bluetooth stack of ESP-IDF.
Schedule	On Time	Everything goes as scheduled.
Risk	No	There are no risks.

Tasks

Task	Status	Planned	Actual	Progress Complete
Understand the basics of Bluetooth	On Time	Early April	Early April	100%
Implement packet sniffing for Bluetooth Classic	On Time	Mid April	Late April	100%
Implement packet sniffing for Bluetooth Low Energy	On Time	Mid April	Late April	100%
Implement the multilateration	In Progress	Early May	Mid May	50%
Implement the probe ↔ server synchronization	Not Started	Mid May	Mid May	25%
Testing	Not Started	Late May	Late May	25%

Issues

Issue	Action or Ignore	Resolved
ESP-IDF not supporting promiscuous mode for Bluetooth Classic	Ignored.	Yes
Data synchronization between multiple probes	Use NTP to synchronize the clocks.	Yes
Imperfect measurements break sphere formula for multilateration	Use min-error formula rather than exact calculation.	Yes
Multi-path and reflections feed false values to the system	Use more samples / clean outliers.	Yes