**Progress Report**

|  |  |
| --- | --- |
| Project Name | Locating Earthquake Victims Using Bluetooth |
| Student Number | 2210356061, 2210356097 |
| Name Surname | İlker AVCI, Buğra Kağan ACAR |

**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 |