PROJECT ABSTRACT

BLE Indoor Asset Tracker with Floor-Map Dashboard

A BLE indoor asset tracker with ESP32 beacons, RSSI trilateration and a live floor-map dashboard. Delivered built-to-order with floor model, firmware, dashboard, report, PPT and viva kit.

01. Title

BLE Indoor Asset Tracker with Floor-Map Dashboard — zone-level indoor positioning with Bluetooth Low Energy.

02. Introduction / Background

GPS stops at the front door: inside workshops, hospitals and warehouses, equipment goes missing because nobody knows which room it is in. This project brings positioning indoors with Bluetooth Low Energy: ESP32 beacons fixed at known points on a scaled floor model, BLE tags on the assets, and a gateway ESP32 that scans advertisements, converts RSSI to distance estimates and trilaterates each tag's position. A web dashboard renders the floor map with live asset dots, zone assignments, out-of-zone alerts and tag battery warnings.

03. Problem Statement

The project addresses indoor asset blindness by demonstrating RSSI-based positioning with rigorous honesty: signal strength is noisy and multipath-prone, so the report documents the filtering (moving averages, outlier rejection), states zone-level accuracy (approximately 2-3 m, expected) plainly, and frames the system as asset-zone tracking — not centimetre surveying.

04. Objectives

- Deploy eight ESP32 beacons at surveyed positions broadcasting BLE advertisements.
- Track BLE asset tags with battery-level reporting.
- Filter RSSI and trilaterate tag positions via the log-distance path-loss model.
- Publish positions over Wi-Fi via MQTT with a 5-second design-target refresh.
- Render live asset dots on a floor-map dashboard with zone assignments.
- Raise out-of-zone and low-battery alerts with event logging.

05. Proposed Methodology

Beacons broadcast at fixed positions; tags advertise at intervals. The gateway scans continuously, recording RSSI per tag per beacon, applies moving-average filtering with outlier rejection, converts to distance via the log-distance path-loss model, and trilaterates from three or more beacons. Positions publish as JSON over MQTT; the dashboard plots the floor map, checks zone assignments and logs zone-change events. Alerts fire on zone violations and low tag batteries. A beacon survey and path-loss calibration procedure validates the installation.

06. System Architecture / Working

Eight ESP32 beacons and coin-cell BLE tags form the radio layer; the ESP32 gateway is the positioning engine, publishing to an MQTT broker. The dashboard backend persists positions and serves the floor map, zones, alerts and movement analytics. The scaled floor model with four

zones provides the demonstration geography.

07. Hardware / Software Requirements

- Hardware: 8x ESP32 beacons, BLE asset tags (coin-cell), ESP32 gateway scanner, scaled floor model with zones, tag battery replacement kit.
- Software: Arduino IDE (C/C++ firmware: beacon, tag, gateway trilateration), MQTT broker, web dashboard (HTML/CSS/JS), path-loss calibration utility.

08. Expected Outcomes

- A working floor model with BLE-tracked assets.
- A live floor-map dashboard with zones, alerts and movement analytics.
- Demonstrated RSSI trilateration with documented filtering.
- An honest accuracy discussion with calibration procedure.
- Complete documentation: report, PPT, viva Q&A and setup guide.

09. Applications

Workshop tool tracking, hospital equipment location, warehouse asset zones — anywhere indoor asset visibility prevents loss and search time.

10. Future Scope

Angle-of-arrival BLE 5.1 for better accuracy, UWB anchors for centimetre tracking, building-wide multi-floor deployment, and CMMS integration.