NIT Karnataka
IEEE Student Branch

ASSET TRACKER

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INTRODUCTION

In today's fast-paced business environment, efficient management and tracking of assets is crucial for both operational effectiveness and cost optimization.

To address the need for more accurate and reliable asset tracking, we propose a solution that integrates both indoor and outdoor tracking capabilities. Our system is designed to provide seamless tracking, whether assets are being used outdoors in open spaces or within the confines of indoor environments like homes, offices, or warehouses.

GOALS

Our asset tracking solution is designed with both indoor and outdoor capabilities to suit different environments:

OUTDOOR

Using GPS technology, the system provides accurate location data with an error margin of approximately 10 meters, making it perfect for tracking assets across larger areas, such as warehouses, fields, or open spaces.

INDOOR

For indoor environments, such as within a room, the system uses Bluetooth technology to track assets on a grid system. While it doesn't provide exact coordinates, it helps identify the grid zone where the asset is located, offering a practical and effective way to monitor asset movement in confined spaces with an accuracy margin of less than 1 meter.

PROBLEM STATEMENT

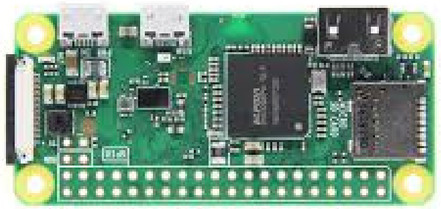
- Efficiently tracking and managing physical assets is a significant challenge for many businesses, leading to inefficiencies and potential asset loss.
- Traditional tracking systems often lack flexibility or are not suited for both indoor and outdoor environments. There is a need for a solution that can provide approximate but useful location data in real-time.

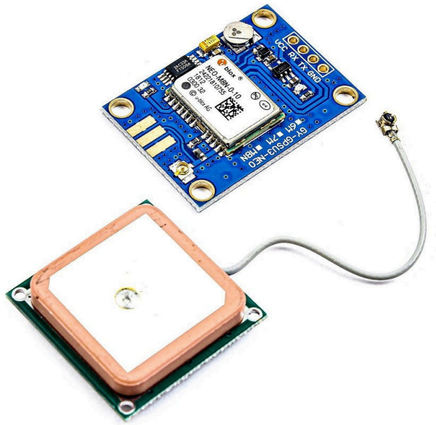
HYPOTHESIS

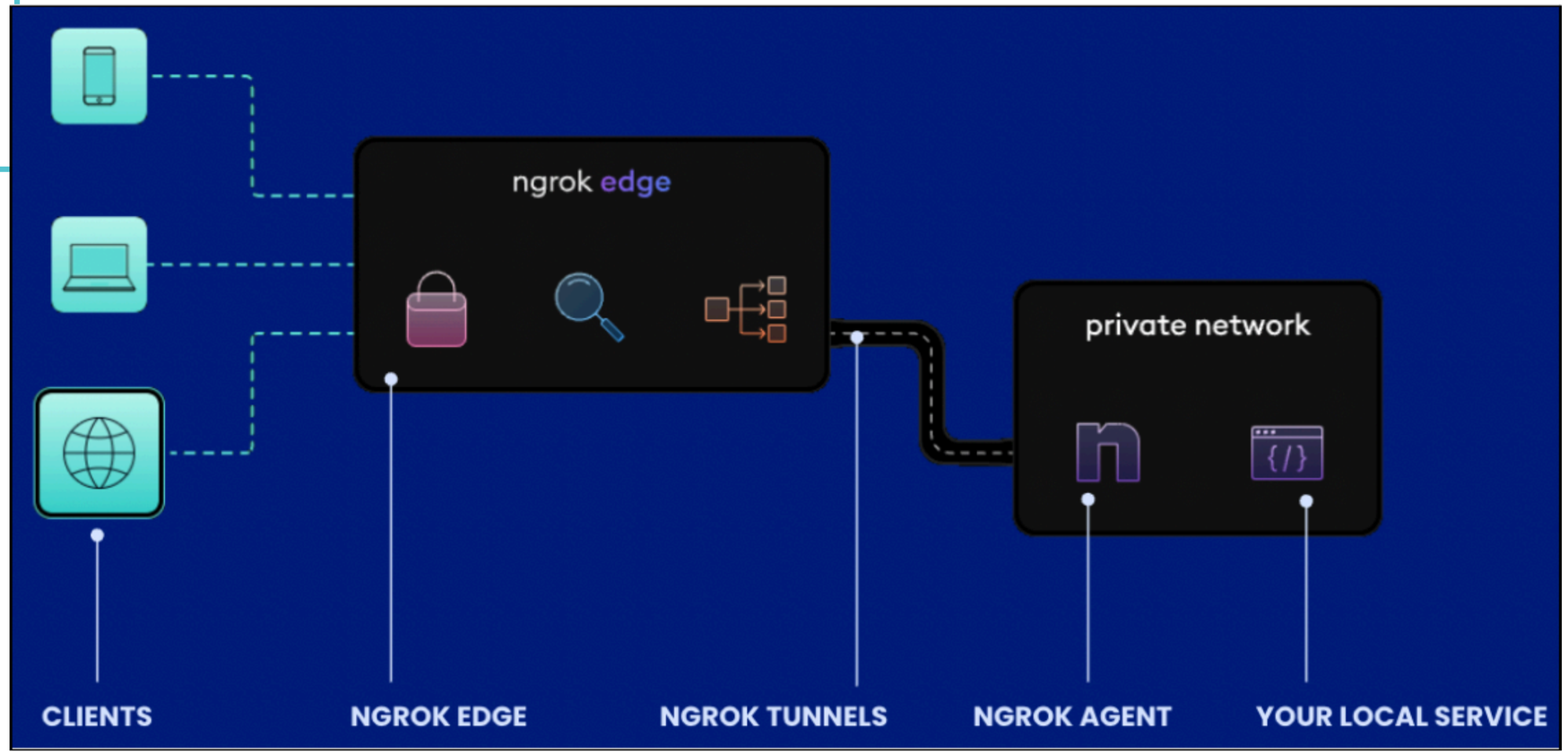
- By using two fixed Raspberry Pi devices (RPIl and RPI2) placed at the corners of a room, along with a third Raspberry Pi attached to the asset, the system can estimate the asset's location using the RSSI (Received Signal Strength Indicator) values.
- The fixed RPIs will send their RSSI data to a server laptop, where the distances between the asset and the two fixed RPIs are calculated.
- These distances will then be used to approximate the asset's coordinates within the room.
- While the system may not provide pinpoint accuracy, it is expected to give a reliable estimation of the asset's location with an error margin that supports effective tracking in confined indoor environments.

TECHNOLOGIES USED

- Raspberry Pi Zero 2 W
- Neo 7M
- Flask
- ngrock






ngrok edge
private network
CLIENTS
NGROK EDGE
NGROK TUNNELS
NGROK AGENT
YOUR LOCAL SERVICE

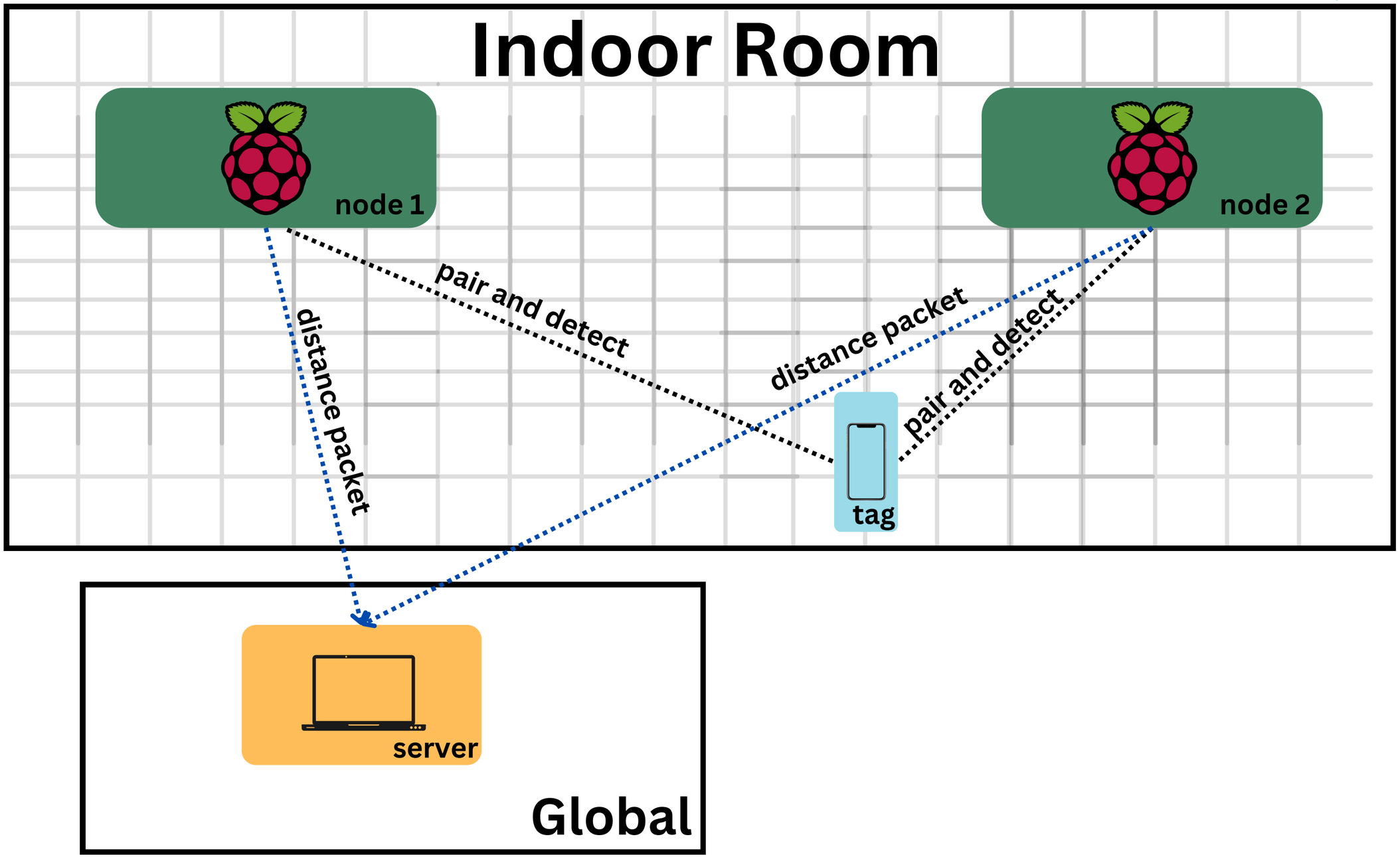
METHODOLOGY

Indoor Tracking

RPi-A and RPi-B → send BLE RSSI values

Laptop server → receives and prints them via Flask

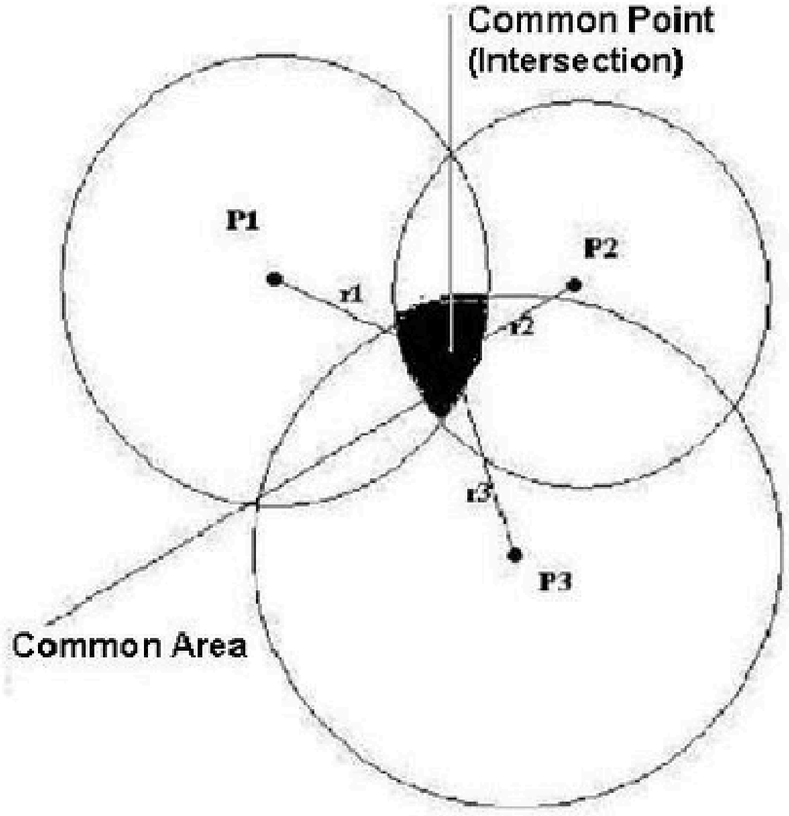
ngrok → makes the server reachable over the internet


Indoor Room
node 1
node 2
pair and detect
distance packet
distance packet
pair and detect
tag
server
Global

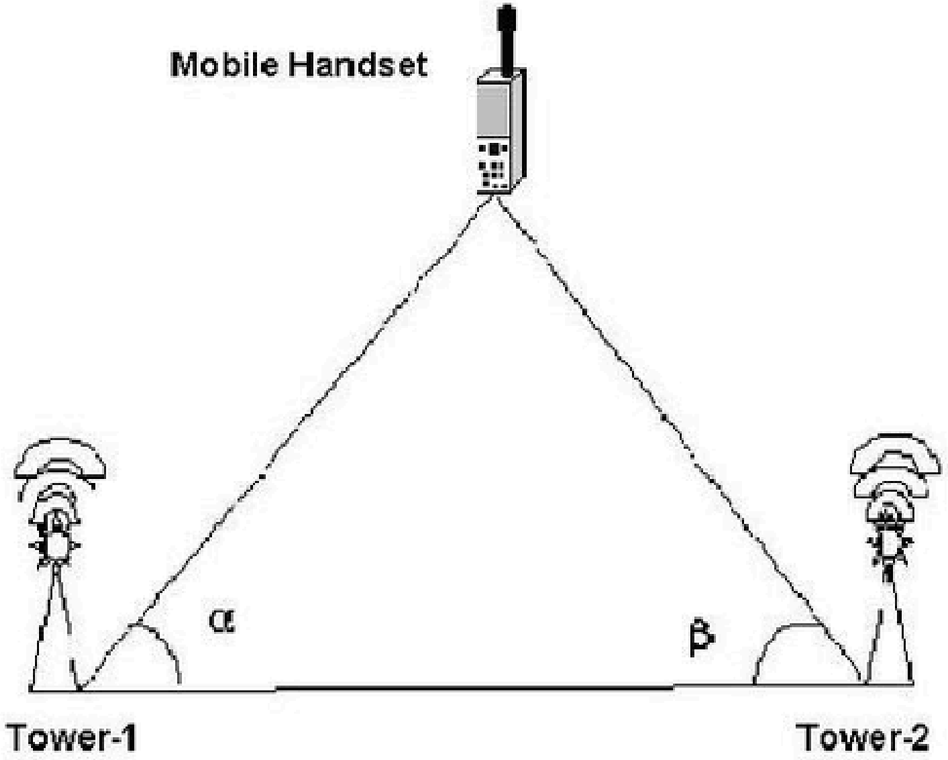
METHODOLOGY

Outdoor Tracking

- To ensure accurate asset positioning in outdoor environments, the system integrates a NEO-7M GPS module with the mobile Raspberry Pi.
- The NEO-7M is known for its high sensitivity and reliable performance, making it an ideal choice for outdoor tracking.



Trilateration



Triangulation

RESULTS

The asset-tracking system was tested in both indoor and outdoor environments. Indoors, RSSI values were successfully received from both RPi-A and RPi-B, and approximate position estimates were derived using trilateration. Outdoors, the GPS module interfaced with the mobile Raspberry Pi provided accurate latitude and longitude coordinates, enabling location tracking even in the absence of BLE receivers.

KEY OBSERVATIONS

- **Real-time RSSI Logging:** The central server received RSSI values from both RPis at ~2-second intervals. This confirmed stable communication between the RPis and the server

- **BLE Detection Range:** RSSI values showed a consistent inverse relationship with distance—stronger (less negative) RSSI values were observed when the asset was closer to the receiver.

- **RSSI Fluctuations:** Some fluctuation in RSSI values was observed due to environmental factors (e.g., obstacles, reflections). Smoothing techniques (e.g., moving average) can be applied to enhance accuracy.

KEY OBSERVATIONS

- **Position Estimation:** Although the current setup uses only two receivers (which gives approximate location via rough distance estimation), trilateration logic can be extended by adding a third fixed node to improve localization precision.

- **Outdoor Tracking Observations:** The GPS module provided coordinates with an average accuracy of 3–5 meters in open sky conditions.

REFERENCES

- Faragher, R., & Harle, R. (2015). Location Fingerprinting With Bluetooth Low Energy Beacons. IEEE Journal on Selected Areas in Communications, 33(11), 2418–2428.
- Zafari, F., Gkelias, A., & Leung, K. K. (2019). A Survey of Indoor Localization Systems and Technologies. IEEE Communications Surveys & Tutorials, 21(3), 2568–2599.
- Groves, P. D. (2013). Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems. Artech House.
- Misra, P., & Enge, P. (2006). Global Positioning System: Signals, Measurements, and Performance. Ganga-Jamuna Press.
- Patil, A., Desai, A., & Jadhav, R. (2021). BLE-based Indoor Positioning System Using Raspberry Pi. International Journal of Engineering Research & Technology (IJERT), 10(4).

THANK YOU