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# Smartphone-Based Real-Time Bus Tracking System

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**ABSTRACT**

***Urban transportation systems face challenges such as unpredictability of bus arrivals and lack of passenger information. Traditional bus tracking systems rely on dedicated GPS modules, increasing hardware costs. This paper presents a smartphone-based bus tracking system using the driver's smartphone to transmit location, speed, and heading data to a central server. The server broadcasts location updates to passengers via WebSocket. ETA (Estimated Time of Arrival) and path visualization are computed on the client side. The system operates efficiently in the background, reducing battery consumption.***
***Keyword: - Bus Tracking, Real Time Tracking, Smartphone GPS, ETA, Battery Efficient***

## 1. INTRODUCTION

Urban commuters often face uncertainty regarding bus arrival times due to varying speeds and schedules. Real-time tracking systems improve passenger experience by providing location updates and ETA information. Traditional systems require dedicated GPS devices in buses, increasing cost and complexity.

This research proposes a smartphone based approach using the driver's smartphone to transmit GPS data to a server. The server broadcasts location updates to passengers via WebSocket, allowing real-time tracking on Android devices and web interfaces. Drivers log in to the system and can start or stop the background service, which determines whether a bus is active or inactive. Active buses are displayed with a green colored disc in the passenger app or website, while inactive buses appear with a grey colored disc. Users select a bus from a list to track; only active buses can be tracked. ETA and path visualization are computed entirely on the client side. Technologies used include Flutter for frontend, Spring Boot for backend, MySQL for data storage, and WebSocket for real-time updates.

## 2. SYSTEM DESIGN

### 2.1 System Architecture

The system has three main components:

**Driver Application (Flutter):** Allows driver login and start/stop of the background GPS tracking service. When active, GPS coordinates, speed, and heading are transmitted to the server; the bus is represented with a green colored disc for passengers. When inactive, no updates are sent, and the bus is displayed with a grey colored disc.

**Central Server (Spring Boot):**Receives bus location data, stores it in MySQL, and broadcasts updates via WebSocket to subscribed passengers.

**Passenger Application (Flutter & Web Interface):** Subscribes to WebSocket updates for selected bus IDs. Only buses with a green colored disc (active) broadcast updates and can be tracked. ETA and path visualization are computed entirely on the client side. The interface clearly distinguishes active and inactive buses using the green/grey colored disc indicators, as shown in the screenshot.

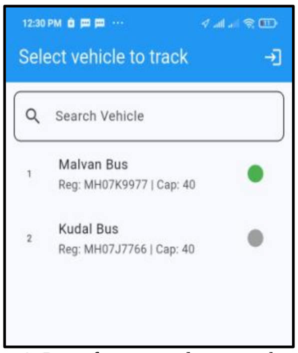



**Fig -1**: List of active and inactive buses

### 2.2 Offline Handling

When the driver's smartphone loses connectivity, passengers see the last known bus location and last update time based on which they can estimate the current location of the bus. Upon reconnection, the background service resumes automatic data transmission if active.

### 2.3 ETA and Path Visualization

ETA and path visualization are computed on the client side using bus location and average speed. The proposed system considers 50 samples of bus speed recorded after each 5 meter distance to calculate average speed. Based on the average speed and distance between user and bus, ETA is calculated and shown to the user. No traffic or congestion data is used. This ensures lightweight, efficient computation suitable for smartphone and web platforms.

### 2.4 Implementation

#### 2.4.1 Frontend:

Flutter-based apps for smartphone and web interface. In Flutter, a single codebase can be used to design apps that runs on multiple platforms. Flutter provides support for Android, IOS, Web, Windows, Macintosh and Linux platforms.

#### 2.4.2 Backend:

Spring Boot server handles GPS data reception and broadcasts updates via WebSocket. Spring Boot is the framework of Java Programming Language. Using Spring Boot, REST APIs are created which are to be consumed by frontend apps.

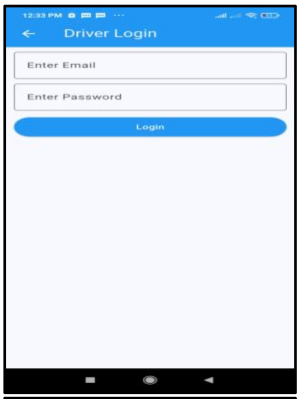
#### 2.4.3 Database:

MySQL stores bus location history and metadata. MySQL is Database Management System which is used to organize data in tabular form. MySQL is a widely used relational database management system (RDBMS).

#### 2.4.4 WebSocket Integration:

Passenger apps subscribe to websocket by bus IDs to receive real-time updates. Driver login allows starting or stopping the background tracking service, controlling the bus's active/inactive status. Passengers easily identify active buses via green colored discs and inactive buses via grey colored discs. WebSocket sends realtime data related to angle, movement and speed of bus to subscribed client devices. As a result, users can have experience of live tracking.

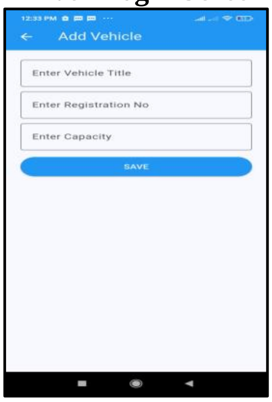
**2.5 Snapshots**



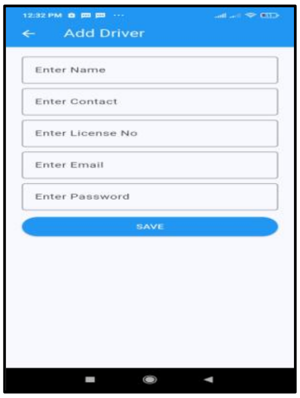


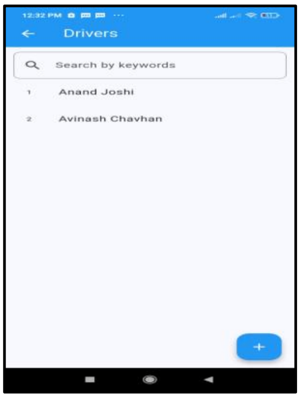


**Driver Login Screen** **Driver Dashboard** **Driver Online Mode** **Bus Status**

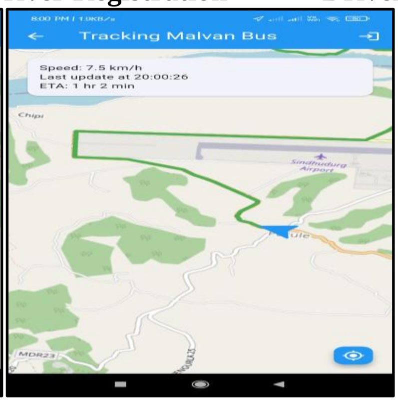







**Bus Registration** **Bus List** **Driver Registration** **Driver List**


**Bus Tracking** **ETA Calculation**

# 3. RESULTS AND DISCUSSION

## 3.1 Results

### 3.1.1 Observation Table

| Observation No | Predicted ETA (minutes) | Actual ETA (minutes) | Absolute Error (minutes) | Accuracy % |
|---|---|---|---|---|
| 1 | 29 | 31 | 3 | 90.32% |
| 2 | 69 | 67 | 3 | 95.45% |
| 3 | 17 | 16 | 1 | 93.75% |
| 4 | 7 | 6 | 1 | 83.33% |
| 5 | 3 | 3 | 0 | 100% |

It was observed that the predicted ETA closely follows the actual arrival time across all observations. Minor deviations are observed due to traffic and network latency. Overall, the system demonstrates high reliability, with accuracy reaching up to 100% for shorter travel durations.your research work

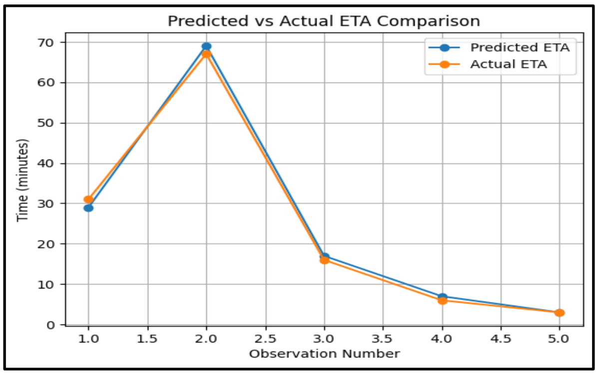



**Chart -1**: Predicted vs Actual ETA

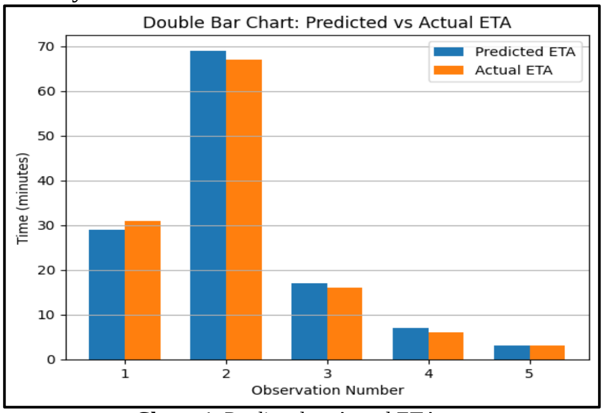



**Chart -1**: Predicted vs Actual ETA

Chart-1 & Chart-2 illustrate that the Comparison of predicted ETA and actual ETA for five observations, showing minimal deviation and high prediction accuracy. The graphical comparison indicates that the predicted ETA closely follows the actual arrival time across all observations. Minor deviations are observed due to traffic and network latency. Overall, the system demonstrates high reliability, with accuracy reaching up to 100% for shorter travel durations.

## 3.2 Discussion

Testing on urban bus routes demonstrated:

### 3.2.1. Real-Time Accuracy:

WebSocket updates ensure minimal latency for bus location tracking.

### 3.2.2 Offline Resilience:

Last known location and timestamp help passengers estimate arrival when connectivity is lost.

### 3.2.3 Battery Efficiency:

Background service consumes minimal additional power.

### 3.2.4 Cross-Platform Functionality:

Bus location and ETA are displayed accurately on Android app and web interface.

### 3.2.5 Active / Inactive Bus Visualization:

Only buses with active background services are trackable (green coloured discs); inactive buses appear grey, providing a clear user interface.

# 4. CONCLUSIONS

The smartphone-based bus tracking system eliminates the need for dedicated GPS modules, offering real-time location, client-side ETA computation, offline resilience, WebSocket-based updates, and driver-controlled bus activity. Active and inactive bus status is clearly represented with green and grey coloured discs, improving passenger experience. By leveraging Smartphone GPS, Flutter, Spring Boot, MySQL, WebSocket and

Background Service, the system is cost-effective, scalable, battery-efficient, and user-friendly alternative to hardware-based tracking systems.

## 5. FUTURE SCOPE

5.1 Integrate Weather API and Traffic API for more accuracy of ETA.
5.2 Integrate push notifications for expected arrival and bus status changes.
5.3 Implement energy-efficient location sampling to further enhance battery life.
5.4 Introduce analytics for bus activity patterns and service optimization.
5.5 More details in Driver Registration form.
5.6 More details in Bus Registration form.

## 6. REFERENCES

[1] Kumar, A., & Singh, R. (2020). Real-time public transport tracking using mobile GPS. International Journal of Transportation Science.
[2] Li, J., & Chen, H. (2019). Smartphone-based vehicle tracking systems: Design and evaluation. Journal of Mobile Computing.
[3] ISO 9241-210:2019. Ergonomics of human-system interaction — Human-centred design for interactive systems.
[4] Y. H. A. Abdelhafed, Improving Transportation Management by Real-Time Bus Tracking using GPS, IJRaset, 2025.
[5] S. B. Chikkabagewadi and M. A. Rane, Design of Bus Tracking System using GPS and Q-R Code attendance System, IJERT, 2021.
[6] J. Babu et al., GPS Based Bus Tracking System, IJERT, 2021.
[7] K. Irene Monica et al., Bus Tracking System using GPS on Smartphones, IJERT, 2019.
[8] J. C. Ogbonna et al., Real-Time Public Vehicle Mobile Tracking System Using GPS Technology, IJCTT, 2016
[9] Google, Flutter Documentation,
[10] F. Anjomshoaa et al., Beginning Flutter: A Hands-On Guide to App Development, Apress, 2020.
[11] Google Developers, Flutter API Reference,
[12] P. Sharma, Flutter Cookbook, Packt Publishing, 2019.
[13] P. Webb, J. Long, D. Syer, Spring Boot Reference Documentation
[14] C. Walls, Spring in Action, 6th ed., Manning Publications, 2022.
[15] Spring Framework Team, Spring Boot API Documentation, M. Heckel, Spring Boot Up & Running, O'Reilly Media, 2021.