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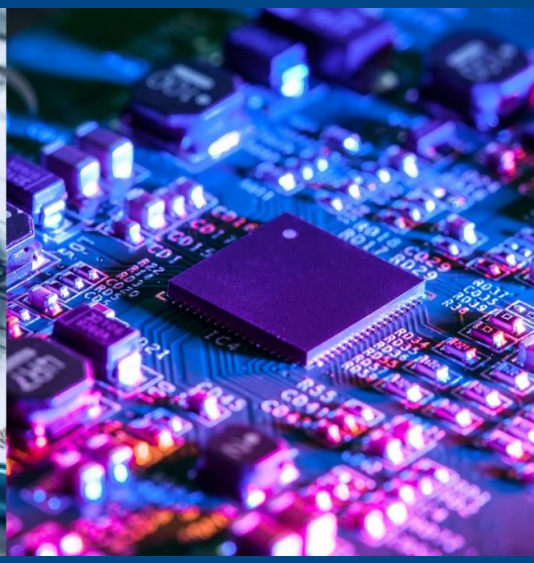

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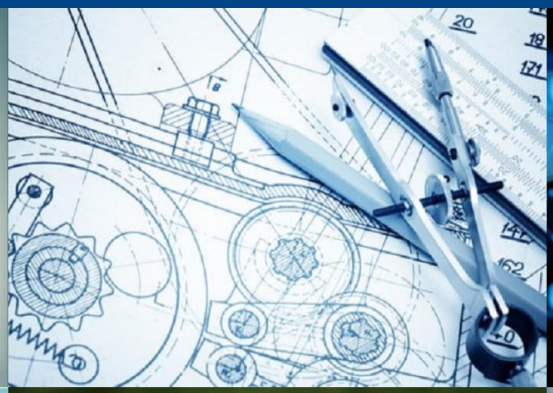

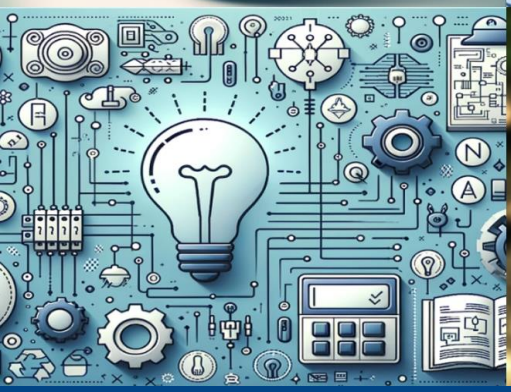

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LALPARII Real Time Bus Tracking App

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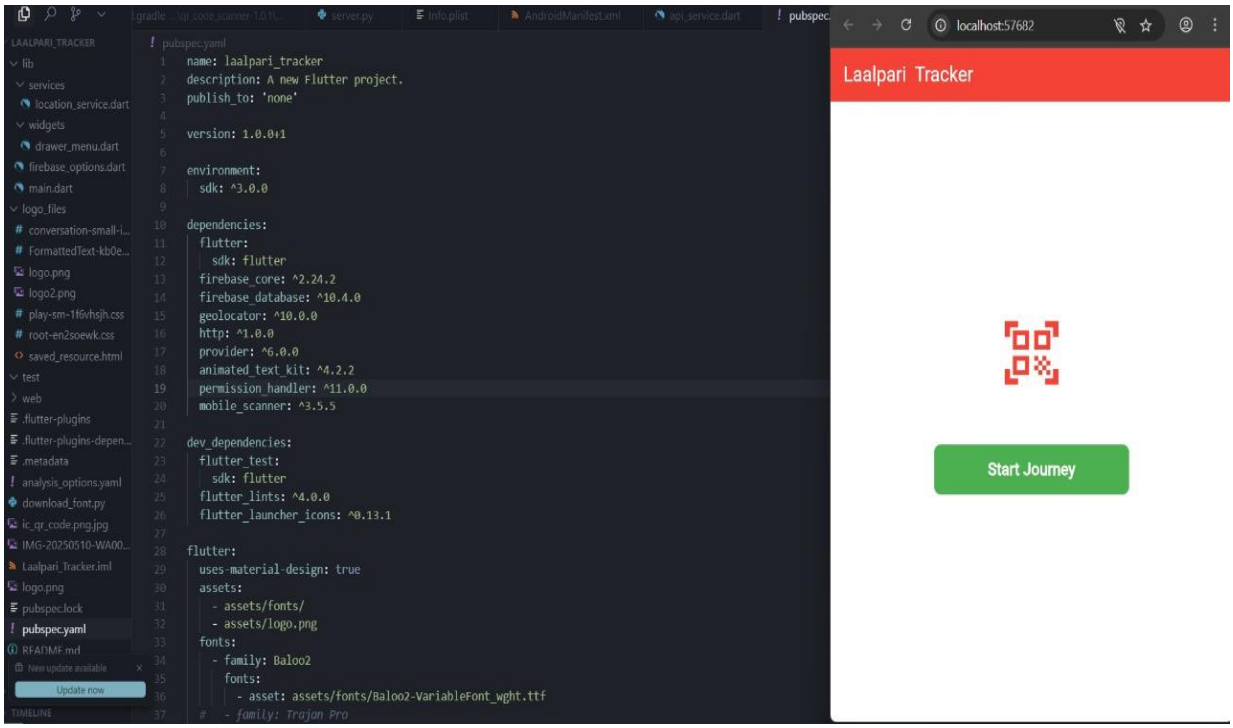
ABSTRACT: This paper details a real-time bus tracking system designed for MSRTC, utilizing QR codes for bus identification and two Android applications: Lalparii Tracker for drivers to transmit location data, and Lalparii for users to track buses, book tickets, and view schedules. The system architecture, featuring Firebase Realtime Database for real-time data synchronization, is presented along with implementation details and diagrams . The system comprises two mobile applications: a driver's app (Lalparii Tracker) for scanning QR codes and transmitting location data, and a user's app (Lalparii) for viewing bus locations, booking tickets, checking schedules, and optionally sharing the user's location.

I. INTRODUCTION

Efficient public transportation is crucial, and real-time tracking systems enhance its reliability and user experience. This paper describes a system designed for MSRTC (Maharashtra State Road Transport Corporation) bus tracking, incorporating QR codes for accurate bus identification and enabling users to monitor bus locations in real-time. The system aims to improve transparency, reduce uncertainty for passengers, and provide tools for better fleet management.

Lalparii Tracker
Code and Output-



The Tracker App, designed for the driver, uses either Python or Android (Kotlin) to retrieve the device's GPS location. Upon scanning the QR code, the app establishes a connection with Firebase to transmit location updates in real-time. This ensures accurate and continuous tracking of the bus.

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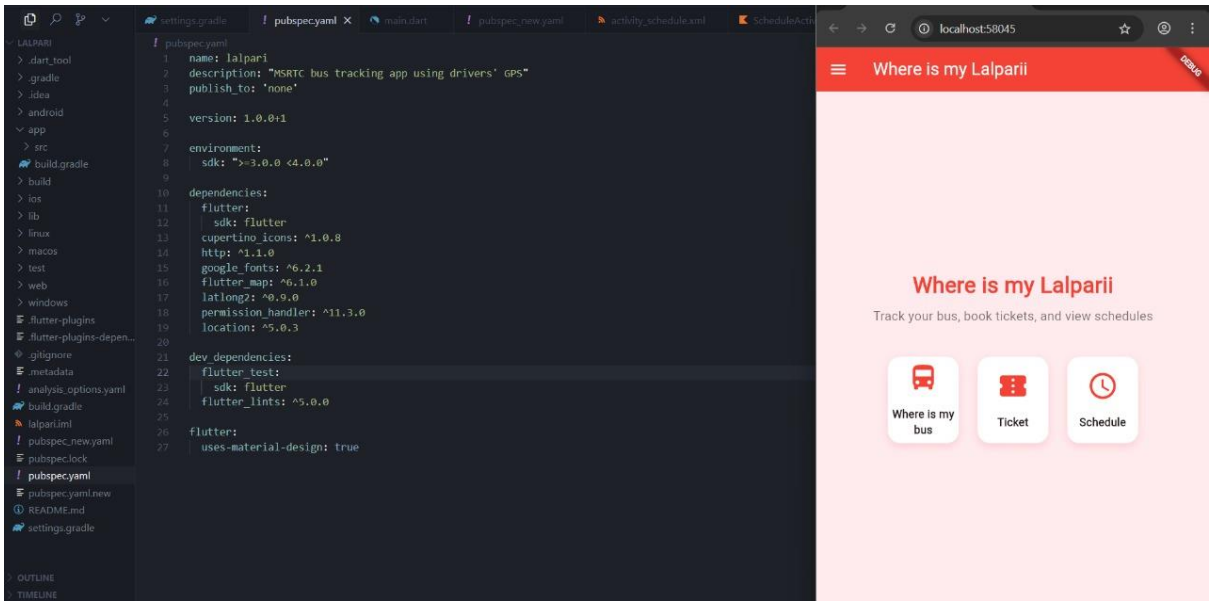
Lalparii

Code and Output-



Built with Flutter, the User App offers a user-friendly interface for real-time bus tracking, ticket booking, and schedule viewing.

Key features include:

– Displaying bus locations on a map using flutter_map and latlong2.
– Ticket booking and schedule viewing screens.
– The option for users to share their location for improved coordination and trust.

The app uses http to communicate with backend APIs for data retrieval.

II. LITERATURE REVIEW

The system integrates several technologies, including GPS tracking, QR codes, and real-time databases. A comprehensive literature review would typically explore existing research on:

- **GPS-based vehicle tracking systems:** GPS-based vehicle tracking systems play a vital role in modern transportation by enabling real-time monitoring of vehicles. These systems typically involve the integration of GPS modules within vehicles, which gather location data such as coordinates, speed, and direction. The data is transmitted to a central server using GSM or internet connectivity, allowing users to view and track the movement of vehicles through a web or mobile interface.
- **Applications of QR codes in transportation:** QR codes have become increasingly popular in the transportation sector due to their ease of use, cost-effectiveness, and ability to streamline passenger services. They are used extensively for mobile ticketing, where passengers scan QR codes to board buses, trains, or airplanes, eliminating the need for paper tickets. QR codes are also utilized for user authentication, accessing route or schedule information, and enabling contactless payments.
- **Mobile application development for real-time information systems:** Mobile applications are central to delivering real-time transportation information to users, offering features such as live vehicle tracking, estimated arrival times, and service alerts. These applications are developed using programming languages and frameworks like Kotlin for Android, Swift for iOS, and cross-platform tools like Flutter and React Native. Backend services, APIs, and real-time databases like Firebase or Firestore are employed to manage and synchronize data efficiently.
- **Database management for location-based services:** Effective database management is crucial for supporting location-based services such as vehicle tracking and route optimization. These services require the storage, retrieval, and processing of large volumes of geospatial data in real time. Depending on the application, databases

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such as MongoDB (NoSQL), PostgreSQL with PostGIS (spatial SQL), or InfluxDB (time-series) are used. These systems enable the implementation of spatial indexing, geofencing, and fast querying of location data.

III. METHODOLOGY

The development of the system followed a user-centered approach, with separate applications designed for drivers and users.

1. **Tracker App (Driver App):** This app was developed using Python or Android (Kotlin) for GPS data collection and transmission. It integrates QR code scanning functionality to identify the specific bus.
2. **User App (Customer App):** This app was built using the Flutter framework with Dart as the primary programming language. It utilizes various packages for map display, location services, and backend communication.
3. **Backend:** Firebase Realtime Database was chosen for real-time data storage and synchronization.

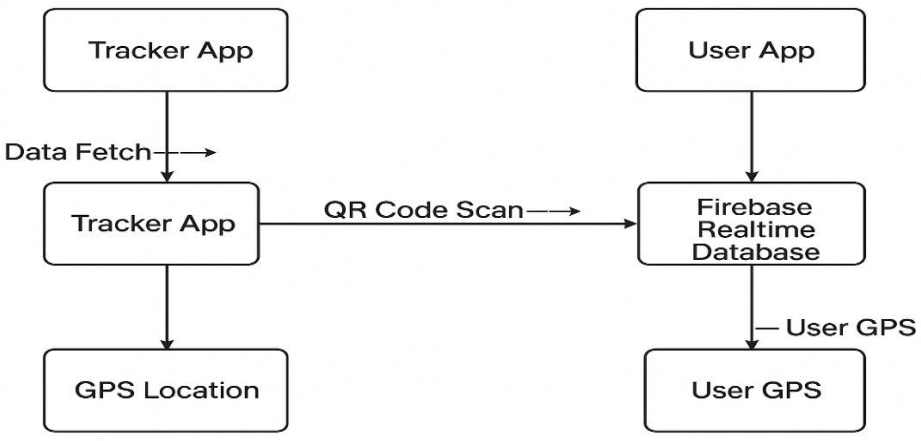
Features and Functionalities

The system offers the following key features:

- **Code Scanning:** The Tracker App uses QR codes for accurate bus identification The Tracker App incorporates QR code scanning functionality for efficient and error-free bus identification. Each bus is assigned a unique QR code, which is scanned by the app to authenticate and register the vehicle before starting its route.
- **Real-time Bus Tracking:** Both apps utilize Firebase to provide real-time updates of bus locations. Both the **Tracker App** and the **User App** rely on **Firebase Realtime Database** to provide accurate and continuously updated location data. The Tracker App sends periodic GPS coordinates (latitude and longitude) to Firebase, which are then retrieved by the User App to display the live location of the bus on a map.
- **User Interface:** The User App features a user-friendly interface with a splash screen, home screen, and navigation drawer.
- **Map Integration:** Bus locations are displayed on a map using flutter map and latlong2 in the User App. To provide geographical visualization of bus locations, the **User App** integrates interactive maps using the **Flutter Map** plugin along with the **latlong2** package. This integration enables the app to plot real-time bus coordinates directly onto a map interface, giving users a clear and dynamic view of vehicle movement.
- **Ticket Booking and Schedule Viewing:** The User App allows users to book tickets and view bus schedules
- **Location Permissions:** The User App requests location permissions to enhance tracking accuracy. To deliver precise tracking and nearby bus suggestions, the **User App** requests **location access permissions** from the user. These permissions are handled securely in accordance with Android and iOS privacy standards

Diagram

System Architecture Diagram-



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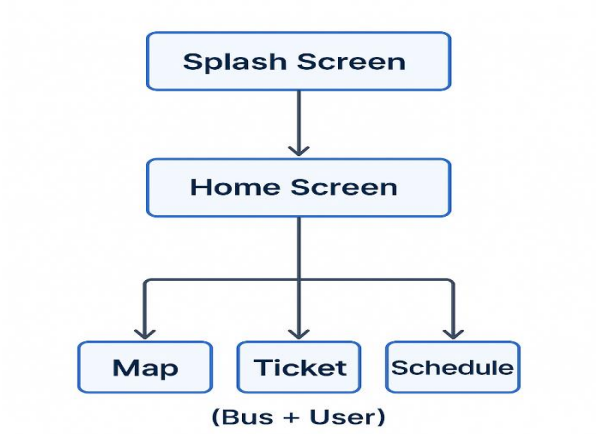
The system architecture diagram illustrates the flow of information between the components involved in a real-time bus tracking solution. At the core of the system is the **Tracker App**, which is operated by the bus driver or conductor. This app begins by fetching relevant data and scanning a unique QR code associated with the bus, thereby verifying the vehicle's identity before initiating location tracking. Once authenticated, the Tracker App continuously gathers GPS coordinates and transmits them to a **Firebase Realtime Database**, enabling real-time updates.

User App Flow Diagram-



The user app flow diagram represents the **User Interface (UI) flow** of the mobile application used in the bus tracking system, designed for both bus operators and passengers. The application begins with a **Splash Screen**, which acts as a loading or branding screen that appears when the app is launched. This screen transitions into the **Home Screen**, which serves as the main navigation hub for users.

From the Home Screen, users can access three primary features: **Map**, **Ticket**, and **Schedule**. The **Map** module allows users to view real-time bus locations through an integrated mapping interface. The **Ticket** section provides a platform for booking bus tickets digitally, enabling contactless and convenient travel.

IV. CONCLUSION

The real-time bus tracking system, leveraging QR codes and user location sharing, provides a comprehensive solution for enhancing public transportation. By improving accuracy, visibility, and user engagement, the system contributes to a more efficient, reliable, and user-friendly transportation experience.
Additionally, the inclusion of user location data allows the system to offer **personalized and context-aware features**, such as nearby bus suggestions and estimated arrival times. These improvements boost **user engagement** and **trust** in the public transport system. Overall, by combining advanced tracking mechanisms with a user-centric mobile application, the solution promotes a **more efficient, reliable, and user-friendly transportation experience**, ultimately supporting smarter and more connected urban mobility.

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