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Track My Ride: Real-Time GPS Bus Tracking for Smarter Commutes using Mobile Application Development

A.Lakshmipathi Rao[1], Kelige Santosh [2], Mareddy Chaitanya[3], Mandhanapu Lakshmi Rajeswari[4]

Assistant Professor, Department of CSE, Guru Nanak Institute of Technology, Hyderabad, Telangana, India[1]

Student, Department of CSE, Guru Nanak Institute of Technology, Hyderabad, Telangana, India[2,3,4]

ABSTRACT: The Track My Ride application is an innovative real-time GPS-based bus tracking system developed to improve public transportation efficiency and commuter satisfaction. This mobile-based solution aims to bridge the communication gap between transportation providers and daily commuters by offering real-time bus location data, estimated time of arrivals (ETA), and dynamic route updates. Built on Android Studio and leveraging Google Maps API, the application ensures a user-friendly interface, scalability, and a seamless user experience for both passengers and bus drivers. Track My Ride addresses key challenges in public transport such as uncertainty in bus timings, inefficient route management, and prolonged waiting times. Through accurate GPS tracking, users can view the live location of buses on the map, making it easier to plan their journeys. Additionally, the system calculates ETAs by analysing current bus speed and traffic conditions, thereby enhancing commute predictability. The application not only benefits passengers by reducing waiting time and frustration but also helps drivers follow optimized routes, ensuring timely arrivals and improved resource utilization. The app architecture is well-structured and comprises several integral components: the user interface layer, application logic layer, database layer, and integration with third-party APIs. The user interface, designed using XML and developed with Java/Kotlin, enables smooth interaction for both passengers and drivers. The application logic handles GPS data processing, ETA calculations, and notification management. Data such as bus locations, user inputs, and route information are securely stored and retrieved using Firebase Realtime Database, which supports real-time updates and reliable data synchronization. Track My Ride also features notification alerts that inform users about delays, route changes, or other important updates, keeping them informed throughout their journey. The integration of Firebase and Google Maps API ensures real-time performance, scalability, and a visually rich experience, while the use of Android Studio as the development platform makes the app accessible to a large user base on Android devices.

KEYWORDS: Real-Time GPS Tracking, Mobile Application Development,Smart Transportation Systems,Public Transit ,Monitoring,GeolocationServices Fleet Management, Estimated Time of Arrival (ETA),Commuter Assistance System,Geo-fencing Technology IoTin,Transportation, AndroidApp,Smart Commute Solutions, Bus Location Tracking System, Urban Mobility Optimization, Live bus Monitoring, java,andorid studio

I. INTRODUCTION

Efficient public transportation is the backbone of any growing city, enabling millions of people to commute seamlessly every day. However, delays, inaccurate scheduling, and the absence of real-time bus tracking often hinder the experience for passengers. Without a reliable system to provide live updates, commuters struggle to plan their trips effectively, leading to wasted time and inconvenience.

With advancements in GPS and mobile technology, real-time tracking systems have become feasible solutions to enhance public transport efficiency. Many cities have started implementing bus tracking systems to improve transit reliability. However, a lack of widespread adoption and limited functionality in existing systems means that many passengers still suffer from uncertainty regarding their commute. Track My Ride is designed to bridge this gap by introducing a user-friendly, real-time bus tracking system that provides accurate location data and estimated arrival times. By integrating GPS technology with mobile applications, the system aims to revolutionize public transport experiences for both commuters and drivers.

The application works by continuously fetching real-time location data from GPS-equipped buses and updating passengers through an interactive mobile interface. This allows users to track bus movements, receive timely

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notifications about delays, and make informed travel decisions. The system is particularly beneficial in urban and suburban areas, where heavy traffic and route variations often disrupt travel schedules.

In addition to enhancing the commuting experience, Track My Ride also improves the operational efficiency of bus services. Bus drivers can receive optimized route suggestions based on traffic conditions, reducing unnecessary delays and improving service reliability. Transit authorities can also analyze the collected data to enhance overall route planning and fleet management.

One of the core strengths of the system is its scalability. Built using Android Studio, Firebase, and Google Maps API, the platform can be expanded to accommodate multiple routes, bus fleets, and additional user features over time. This ensures long-term usability and adaptability to different transport networks.

By offering a seamless, real-time tracking solution, Track My Ride not only enhances passenger convenience but also promotes greater trust in public transportation systems. A well-informed commuter base leads to increased public transit usage, reducing traffic congestion and environmental impact caused by private vehicles.

II. LITERATURE SURVEY

Title: Real-Time Bus Tracking System Based on IoT and GPS
Year: 2019
Author: R. Velu , S. Venkatesan
Description: Public transportation systems face significant challenges related to efficiency, reliability, and commuter satisfaction. One of the most common problems is the lack of real-time bus tracking, which leads to uncertainty and long waiting times for passengers. The conventional approach to bus tracking relies on static schedules that fail to consider traffic congestion, delays, or route deviations. This inefficiency results in passenger frustration and decreased reliance on public transport. The proposed system is based on a three-layer architecture that includes a GPS module, a cloud-based server, and a mobile/web-based application. The GPS module is installed in the bus to continuously capture real-time location data. This data is transmitted via IoT protocols to a cloud-based server, which processes and stores the information. One of the most critical aspects of this system is real-time location tracking. The GPS module installed in the bus continuously collects latitude and longitude coordinates and transmits this information via wireless communication technologies such as Wi-Fi, GSM, or LTE. The central server processes this data and integrates it with Google Maps API to provide a user-friendly map interface. The estimated time of arrival (ETA) is calculated using historical traffic data, real-time congestion analysis, and bus speed. The system ensures high accuracy in location tracking and reduces the chances of errors by using advanced filtering techniques to remove noise from GPS signals.

Title: Real-Time Bus Tracking System Using Mobile Technology
Year: 2020
Author: A. Nair, P. Sreenath ,A. Rajan
Description: The lack of real-time bus tracking remains a major issue in public transport, often resulting in commuter inconvenience and inefficient travel planning. Traditional bus schedules do not account for real-time traffic conditions, route diversions, or unexpected delays, making them unreliable. This research proposes a mobile technology-based bus tracking system that allows passengers to track live bus locations and receive timely travel

The system architecture comprises three key components:
GPS trackers installed in buses, a mobile network-enabled data transmission system, and a user-friendly mobile application for passengers. The GPS module continuously tracks bus locations and transmits the data through a cloud server. The mobile app provides an interactive user interface, allowing passengers to view real-time bus locations, estimated arrival times (ETA), and route details.

The system ensures real-time accuracy by integrating Google Maps API and cloud-based servers. The GPS tracker sends location data every few seconds, updating passenger mobile devices in real-time. The cloud server processes this data and applies traffic-based adjustments to enhance ETA predictions. Machine learning algorithms analyze historical data to improve route forecasting and delay predictions. The mobile app is designed with a simple, user-friendly interface. Commuters can search for their routes, select buses, and receive instant notifications regarding delays, detours, or alternative travel suggestions.

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The system also features an SOS button for emergency eporting and a feedback mechanism to improve efficiency..

Title: College Bus Tracking System Using Driver GPS
Year: 2022 **Author:** M. Magar and P. Patil
Description: Many educational institutions face challenges in managing transportation services efficiently. Students and faculty members rely on college buses, but the absence of real-time tracking leads to uncertainty regarding arrival times, delays, and route deviations. This research paper presents a driver GPS-based bus tracking system to provide real-time location updates of college buses to students, faculty, and administrators. The proposed system consists of a GPS module installed in the driver's smartphone, a cloud-based server for processing and storing location data, and a mobile/web application for students and staff. The driver's smartphone continuously tracks the bus's location and transmits it via the internet (Wi-Fi or mobile data) to the cloud server. The system updates real-time location data at regular intervals, ensuring high accuracy and minimal delays in tracking information. Once the bus location is sent to the cloud, Google Maps API is used to display live tracking on a user-friendly interface. The system also features an ETA (Estimated Time of Arrival) calculator, which considers real-time traffic conditions, road speed limits, and historical travel patterns to improve prediction accuracy. Additionally, route deviation alerts are included to notify administrators if a driver strays from the assigned path. The mobile application for students and faculty provides an interactive interface to view bus locations, estimated arrival times, and notifications about route changes and delays.

Title: Real-Time Bus Tracking and Management System for Public Transport using IoT.
Year: 2019
Author: R. Kaur and A. Arora.
Description: Public transportation faces significant operational challenges, including unreliable schedules, inefficient route planning, and a lack of real-time tracking. The unpredictability of bus arrivals leads to frustration among commuters, discouraging public transport usage. The proposed system consists of three main components: a GPS module installed in buses, an IoT-enabled cloud server, and a mobile/web-based application for commuters. The GPS module continuously tracks the bus location and transmits the data through IoT communication protocols (such as MQTT or HTTP requests). The cloud-based server processes and stores this data, ensuring smooth real-time tracking. The real-time location tracking system is designed for accuracy and reliability. The GPS module collects the latitude and longitude coordinates of moving buses and sends this information to the server via a wireless GSM network. The Google Maps API is integrated to visualize live bus locations and provide interactive mapping features. The mobile application and web interface provide commuters with an intuitive platform to track buses. Users can view real- time bus movements, estimated arrival times, and receive notifications about delays or route diversions. The system incorporates push notifications and SMS alerts to keep passengers informed at all times. Furthermore, an SOS button is included for passengers to report emergencies directly to the authorities, enhancing commuter safety.

III. EXISTING SYSTEM

Currently, several real-time GPS-based bus tracking systems are in use across cities, schools, and public transportation networks. These systems typically involve GPS-enabled buses transmitting their location data to a centralized server, which then displays the information to users via a mobile app or web interface.

EXISTING SYSTEM DISADVANTAGES

- Apps like Google Maps rely on data from transit agencies.If the data is outdated, incomplete, or incorrectly formatted, the app's tracking becomes inaccurate or unusable.
- Most systems require constant internet access for GPS tracking and updates.
- Existing systems rarely offer distinct interfaces for drivers, commuters, and administrators.

IV. PROPOSED SYSTEM

The Track My Ride system is designed using a layered architecture to ensure scalability, efficiency, and seamless communication between different components. Each layer in this architecture plays a distinct role in enabling real-time GPS tracking, user interaction, data management, and system integration. The system is divided into four main layers, each responsible for specific functionalities: User Interface Layer, Application Layer, Database Layer, and Integration Layer. These layers work together to deliver a smooth, real-time, and user-friendly experience for passengers and transit operators.

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PROPOSED SYSTEM ADVANTAGES

- The system is built using Android Studio, ensuring a scalable, robust, and user-friendly mobile application for both passengers and bus drivers. By integrating technologies such as Google Maps API, Firebase Realtime Database, and GPS tracking, the system delivers accurate and reliable updates about bus movements, estimated arrival times, and optimized routes
- A well-designed, intuitive user interface (UI) is critical for ensuring accessibility and ease of use for both passengers and bus drivers. The application is built using XML layouts for UI design and Java/Kotlin for applicationlogic, ensuring smooth performance. The user interface is clean and minimalistic, displaying bus locations, arrival times, and notifications in a visually appealing format
- The ETA feature of Track My Ride helps passengers plan their journeys better by providing accurate arrival times based on multiple real-world factors p.

V. SYSTEM ARCHITECTURE

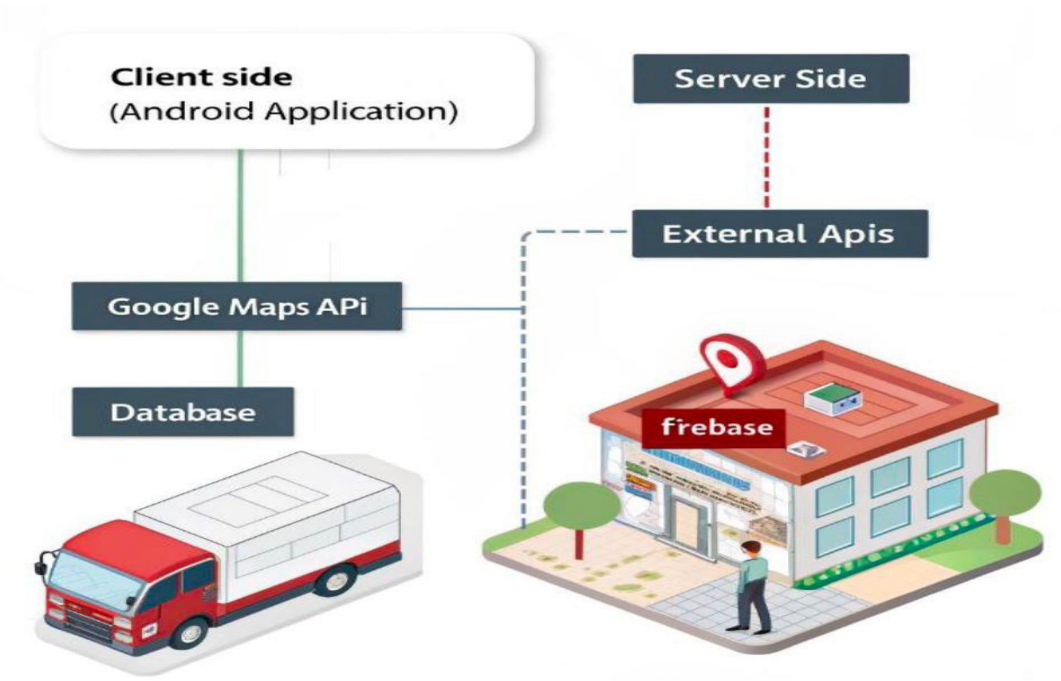

Fig:1 System Architecture

Client Side:
The client-side represents the front-end interface of the Track My Ride application, which is developed as an Android mobile app. It serves as the main access point for passengers and drivers who use the app to track vehicles, view routes, and get notifications.

The client side is built using Java/Kotlin for the application's logic and XML for the UI design. It fetches data from Firebase, integrates Google Maps for location tracking, and presents information in an intuitive and user-friendly interface.

The Google Maps API :
It is a critical component in the TrackMy Ride system. It is responsible for rendering maps, tracking vehicle locations, and optimizing routes.

By integrating Google Maps API, Track My Ride provides a smooth navigation experience, accurate location tracking, and optimized travel routes, enhancing user satisfaction.

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Database:
The Database in the system stores, manages, and synchronizes data between the client and the server. The image specifically highlights Firebase, which is a cloud-based NoSQL database designed for real-time applications.

Server Side:
The server-side is responsible for backend operations, which include data storage, processing, and communication with external APIs. This is where the application logic runs to ensure smooth functionality.

Role of Firebase in the Server Side
Firebase acts as both a database and a backend service, eliminating the need for a traditional server and It processes GPS data from drivers and sends updates to passengers in real-time.

External APIs:
Apart from Google Maps API, other APIs may be integrated into the system for enhanced functionality:
Traffic APIs: Fetch real-time traffic updates to optimize routes.
Weather APIs: Provide weather updates that could impact bus schedules.
Payment Gateway APIs: If ticket booking or fare payments are included in the system.

VI. TECHNICAL IMPLEMENTATION

The Track My Ride application is implemented using a combination of mobile development tools, cloud-based services, and real-time tracking technologies. Below is a detailed explanation of the technical implementation, including frontend, backend, database management, API integration, and deployment.

Frontend Development:
The Android mobile application serves as the user interface for passengers and drivers. It is developed using the following technologies

Programming Languages & Frameworks:
- Java/Kotlin: Used for writing the application logic and implementing UI interactions.
- XML: Used for designing layouts, buttons, input fields, and maps interface.
- Android Jetpack Components: Implement lifecycle management, navigation, and data persistence.

UI Design & User Interaction:
- Google Maps UI: Displays real-time vehicle locations.
- Material Design: Used for UI components such as buttons, menus, and notifications.
- Live Tracking UI: Continuously updates the vehicle's position on the map.
- Navigation Drawer & Bottom Navigation: Used for switching between features like live tracking, notifications, and settings.

Core Functionalities in Android App:
- Location Permissions: Uses Android's Location API to request GPS access.
- Background Location Services: Tracks vehicle movement even when the app is minimized.
- Push Notifications: Alerts passengers about delays, schedule changes, or route diversions using Firebase Cloud Messaging (FCM).

Backend Development:
Thebackendhandlesdataprocessing,real-timeupdates,authentication,and communication between clients.

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VIII. EXPERIMENTAL RESULTS:-

5.1 FIRST APP

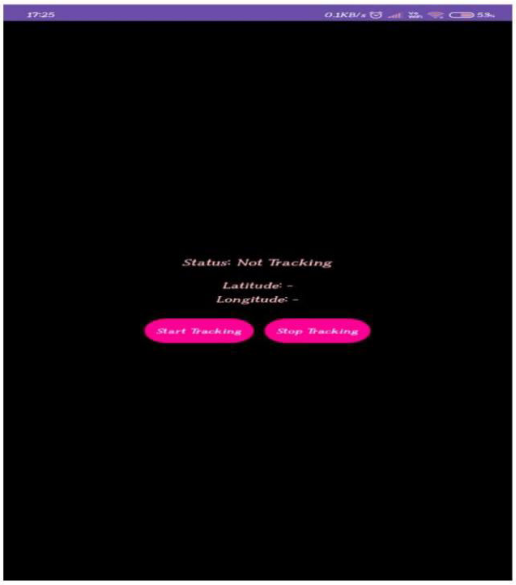

Fig 5.1 Before tracking

while tracking

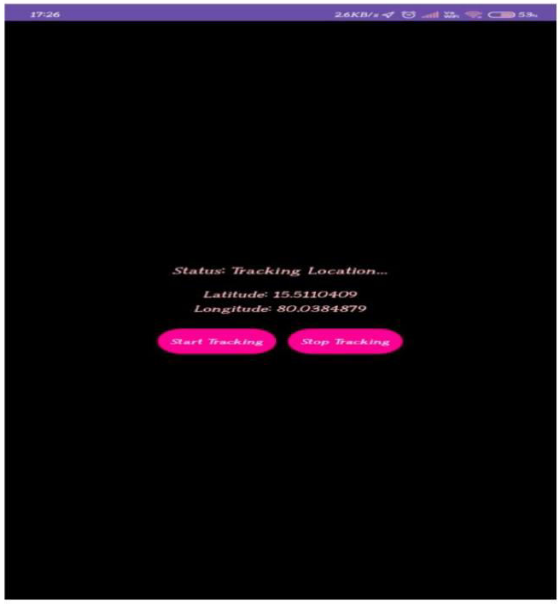

Fig 5.2

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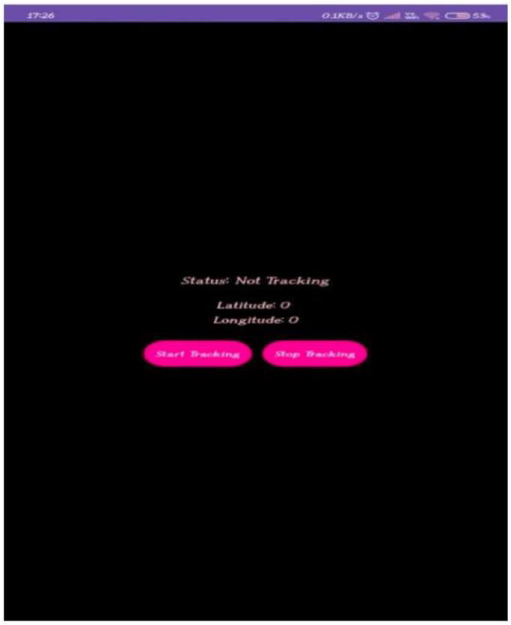

Fig 5.3 Tracking stopped

5.2 SECOND APP

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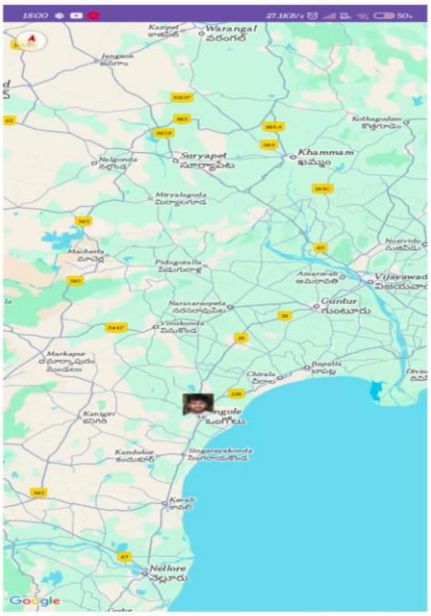

Fig 5.4 Locating in India
Locating in Andhra Pradesh

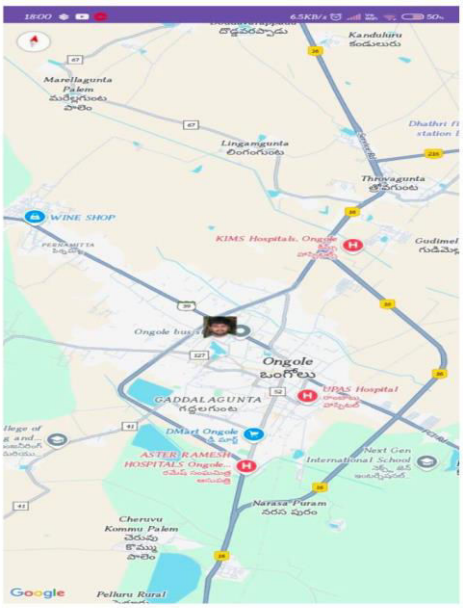

Fig 5.6 Locating exact position

IX. CONCLUSION

The Track My Ride application provides a smart, efficient, and real-time bus tracking system, addressing common challenges faced by public transport users. By integrating GPS tracking, Google Maps API, and Firebase Real-time Database, the app ensures that passengers have up-to-date information on bus locations, estimated arrival times, and route changes. This reduces uncertainty and enhances overall travel planning, making daily commutes more convenient and reliable.

One of the most significant advantages of the system is its ability to optimize routes dynamically based on traffic conditions and bus speed. This feature not only reduces travel time for passengers but also improves operational efficiency for transport providers. Additionally, the user-friendly interface ensures accessibility for a diverse range of

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users, from daily commuters to first-time travellers, making the app intuitive and easy to navigate. Further more,the real-time notification system keeps passengers informed about delays, diversions, and schedule changes, helping them avoid unnecessary waiting at bus stops.

X. FUTURE ENHANCEMENT

The Track My Ride application has successfully enhanced public transportation efficiency, but there are several areas for future improvement and expansion. One key focus is the integration of Artificial Intelligence (AI) and Machine Learning (ML) algorithms to predict bus delays, traffic patterns, and demand forecasting. By analysing historical and real-time data, AI can optimizeroutes dynamically, reducing congestion and ensuring faster travel times. Additionally, predictive analytics can help transport authorities manage fleet operations moreeffectively, improving overall service reliability.

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