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Track and Book – A Mobile-based Tracking and Booking System for Semi-Urban Public Transport

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Abstract: *Informal and rural shared transportation systems often lack proper tracking and booking mechanisms, causing uncertainty, long waiting times, and poor seat utilization. Most existing mobility applications are designed for urban, trip-based or fixed-route transport and do not address the needs of semi-structured rural services. This paper reviews and presents a service-based shared mobility approach through the proposed Track & Book system, focusing on continuous services, route-segment booking, and real-time tracking for informal transport. The study covers system design, service modeling, booking mechanisms, tracking methods, and basic performance evaluation. The key findings show that a service-oriented model with route-segment booking improves passenger planning, reduces waiting time, and increases seat utilization compared to traditional informal transport methods. The major conclusion is that service-based shared mobility is more suitable for rural and informal transport environments than conventional trip-based tracking and booking applications.*

Keywords – *Digital Public Services, GPS & Location Service, Real-time Systems, Smart Transportation*

I. INTRODUCTION

Informal and rural transportation plays a crucial role in connecting people in semi-urban and remote areas, where conventional public transport and modern ride-hailing services are often unavailable or unreliable. Such transport systems usually operate in an unstructured manner, without fixed schedules, proper tracking, or systematic booking mechanisms. Passengers depend on guesswork, local knowledge, or physical waiting at stops, which leads to long waiting times, uncertainty, and inefficient use of available vehicles. At the same time, most existing tracking and booking applications are designed mainly for urban environments, focusing on either fixed-route public transport or trip-based ride-hailing services.

The research area of shared mobility and transport digitization is important because transportation directly affects daily life. While significant technological progress has been made in urban mobility, rural and informal transport systems remain largely underserved by digital solutions. Developing simple, practical, and context-suitable systems for these areas can improve accessibility, reduce waiting time, increase seat utilization, and make transport more reliable for passengers. Therefore, studying service-based shared mobility models for informal and rural transport is both socially and technically significant.

The objective of this work is to review and present a service-based tracking and booking approach through the proposed Track & Book system. The study aims to analyze how continuous service modeling, route-segment booking, real-time tracking, and simple seat allocation can improve informal shared transport. It also seeks to highlight how this model differs from conventional trip-based or fixed-route systems and why it is more suitable for semi-structured, low-infrastructure environments.

II. RELATED WORKS

Yash Kadam, Suresh Pukale & Namrata Madvi – "Online Bus Reservation System" (IJARSCT,2025) [1], presents a web and mobile-based Online Bus Reservation System (OBRS) designed to automate ticket booking, payment, and management processes. The system provides real-time seat availability, route details, and secure payment options, eliminating manual inefficiencies. Developed using a three-tier architecture with technologies like HTML, JavaScript, PHP/Python, and MySQL, it supports features such as e-ticket generation, GPS tracking, notifications, and cancellation/refund handling. Testing confirmed improved efficiency, user convenience, and reduced booking errors. The paper highlights challenges like cybersecurity, system downtime, and refund delays while proposing AI, IoT, and blockchain integration for future scalability, security, and personalized services.

Sanjana Prabha et al. – "Smart Transit with GPS-Based Real-Time Bus Tracking" (SSRN,2024) [2], introduces a cloud and web-based real-time bus tracking system called *Smart Transit*, combining GPS, web sockets, and geospatial APIs to provide live updates with minimal latency. The architecture integrates GPS modules, Google Maps APIs, and WebSocket communication for continuous bidirectional data flow. Using PostgreSQL and Redis for geospatial indexing and caching, the system ensures scalability and low-latency performance. Testing results show GPS accuracy within ±5 m and average update latency of 1–2 s across 4G/5G networks. The paper also explores future integration with AI and quantum computing for predictive traffic analysis, anomaly detection, and autonomous fleet optimization, concluding that the system significantly enhances reliability, scalability, and commuter experience in smart cities.

C. Saravanan et al. – "Real-Time Bus Tracking and Management System with IoT, Chatbot Integration, and Accident Zone Prediction" (African Journal of Biomedical Research,2025) [3], This research proposes an IoT- and AI-driven real-time bus management framework featuring GPS/GSM tracking, machine learning–based accident prediction, and chatbot-based user interaction. Each bus is equipped with IoT modules (NodeMCU + Neo-6M GPS) to transmit live location data to a central server, enabling real-time visualization via a mobile app. An SVM model trained on historical accident data identifies high-risk zones, which are displayed on digital maps for proactive route management. The chatbot, built using NLP, provides live bus updates via messaging apps. Experimental results show GPS accuracy within 2.5–5 m and strong model performance (F1 ≈ 0.9). The system enhances commuter safety, reduces delays, and improves accessibility, suggesting future AI-driven route optimization and congestion analysis for smarter urban transport.

Yuran Sun, James C. Spall, Wai Wong & Xilei Zhao – "Real-Time Bus Travel Time Prediction and Reliability Quantification: A Hybrid Markov Model" (University of Florida,2023) [4], introduces a hybrid Markovian framework for real-time bus travel time prediction with explicit reliability quantification. Unlike models that

only yield point estimates, this approach integrates Maximum Likelihood Estimation (MLE) with the Fisher Information Matrix (FIM) to provide 95% confidence bounds on predicted times. The model decomposes total travel time into three stochastic components — road segment travel, stop dwell time, and intersection delay — each modeled using conditional Markov chains. Data from Gainesville, Florida (GTFS static + real-time feeds) were used for training and validation. The system continuously updates predictions as new bus position data arrive, adjusting transition probabilities dynamically. Experimental results show improved accuracy and narrower uncertainty bounds compared to regression and neural-network baselines. The framework enhances interpretability, linking variability in predictions to traffic congestion, signal timing, and peak-hour effects. Overall, the study balances prediction precision, interpretability, and uncertainty quantification, offering a deployable solution for smart transit planning, reliability monitoring, and passenger information systems.

N. Shanthi, Sathishkumar V.E., K. Upendra Babu, P. Karthikeyan, Sukumar Rajendran & Shaikh Muhammad Allayear – "Analysis on the Bus Arrival Time Prediction Model for Human–Centric Services Using Data Mining Techniques" (Hindawi, 2022) [5], focuses on data–driven, human–centric bus arrival time prediction to improve passenger convenience and operational efficiency. The authors developed a real–time ETA prediction model using GPS– and GSM–enabled Raspberry Pi modules for data collection from city buses. The dataset, consisting of 3,360 trip records over 30 days, captures features like distance, average speed, traffic density, and weather conditions. Seven machine learning algorithms—SVR, Random Forest, Decision Tree, Gradient Boosting, AdaBoost, K–Nearest Neighbors, and XGBoost—were compared for prediction accuracy. After hyperparameter optimization via Grid Search, Support Vector Regression (SVR) achieved the best performance, with an R^2 score of 0.9148 and RMSE ≈ 20 seconds, outperforming ensemble and tree–based methods. The authors highlight limitations such as limited data volume and hardware constraints and propose future improvements including deep learning integration, IoT expansion, and real–time cloud analytics.

The proposed Track and Book system differs from existing works by focusing on a semi-urban transport environment and providing a lightweight, deployable solution without dedicated GPS hardware. Instead of relying on specialized devices, the system uses mobile phones as sensing units to transmit real-time location data. Additionally, the system integrates vehicle booking (e.g., local shared transport such as magic vehicles) along with bus tracking, which is not commonly addressed together in existing literature. The platform is designed as a web-based solution, making it accessible to both college students and local commuters while remaining scalable for future integration with municipal transport services.

Thus, the proposed system contributes by delivering a cost-effective, localized, and deployable transport tracking and booking platform tailored for semi-urban regions where advanced transport infrastructure is limited.

III. METHODOLOGY

The proposed Track & Book system adopts a service-based shared mobility approach for informal, rural, and semi-urban transportation. The methodology focuses on continuous service modeling, route-segment booking, real-time tracking, and simple seat management.

A. Service Modeling

Each vehicle is modeled as a continuous service rather than a single trip. A service operates within a defined time window and flexible route corridor. The system uses a Service-Based State Machine (SBSM) with states: Idle, Running, Partially Full, Full, and Unavailable. State transitions depend on service start time, booking activity, and seat availability.

B. Route-Segment Booking

Passengers book only the required part of an active service route instead of a full trip. This is implemented using a Route-Segment Booking (RSB) mechanism, which verifies seat availability for the selected segment before confirming the request. This allows passengers to join and leave a running service at different points.

C. Real-Time Tracking and ETA

Vehicle location is updated periodically using GPS from the driver's device. The system displays real-time positions to users. Estimated Time of Arrival (ETA) is calculated using a simple distance–time method based on current location, remaining route distance, and average vehicle speed.

D. Seat Allocation

Seat assignment follows a First-Come-First-Serve (FCFS) strategy. A booking is confirmed only if sufficient seats are available for the selected route segment.

E. System Architecture

The system uses a centralized backend to manage services, routes, bookings, users, and tracking data. A modular architecture is adopted to support scalability and future integration of advanced routing or prediction techniques.

This methodology provides a simple and practical solution for service-based shared transport in informal and rural environments.

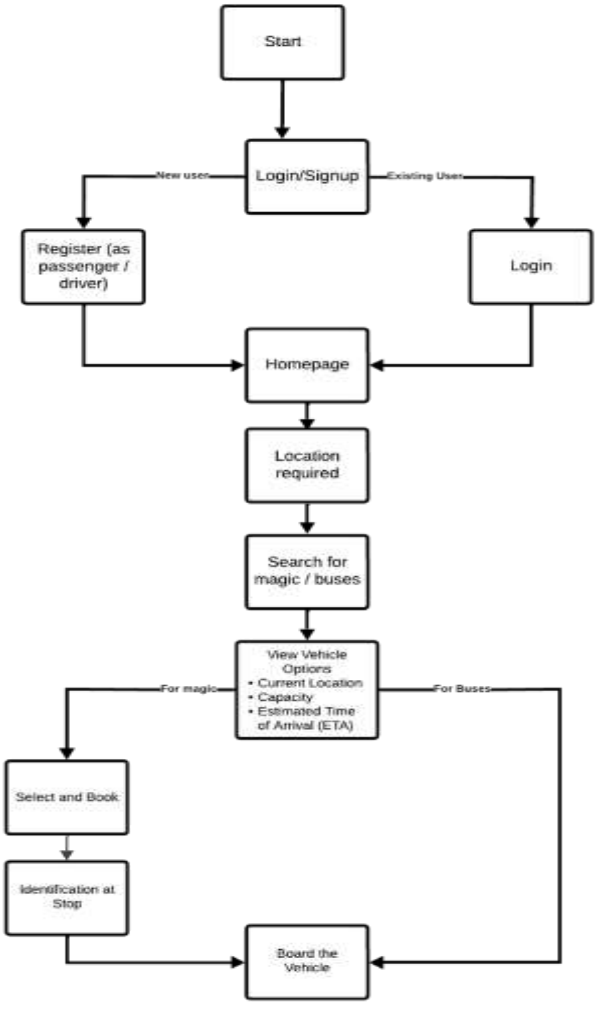

Figure 1: System Flow Diagram

IV. RESULT

A. System Design for College Students and Local Commuters

The "Track and Book" system has been designed for both college students and other daily commuters in the semi-urban region under Vasai–Virar Municipal Corporation (VVMC). A large number of students and local residents depend on VVMC buses and local shared vehicles such as "magic" for daily travel. However, there is currently no dynamic tracking system available for VVMC buses, which creates uncertainty in travel planning. The proposed system is specially designed to:

- Track VVMC buses dynamically.
- Provide booking for local vehicles like "magic." · Support daily travel needs of college students.
- Help other local commuters plan their journeys.
- Work as a local solution for a specific semi-urban area.

B. Current Development and Deployment Status

The system has been designed, developed, and successfully deployed as a working website. The following features are implemented:

- User login for students and local commuters.
- Admin/driver module for adding and managing bus and vehicle details.
- Interface for updating bus and vehicle location using manual input or GPS.
- User interface to view live bus position and book vehicles like "magic."

Official integration with VVMC for real-time bus data is planned and will be completed in the coming days. After integration, real-time data from VVMC buses will be used directly in the system.

C. System Readiness

The system architecture is prepared for real-world use. All major functional modules are implemented, integrated, and running on the deployed platform. The website is accessible and functional, proving that the system is not only a design but a real deployed solution.

The platform is also designed in a scalable way so that more vehicle types can be added easily in the future.

D. Development Outcome

The main outcome of this phase is a complete system design and deployed platform that supports VVMC bus tracking and booking of local vehicles like "magic." The system shows that advanced transport features can be built even for semi-urban regions.

The platform is now ready for:

- Integration with VVMC.
- Pilot use for college students and local commuters. · Future integration of other vehicle types.

E. Discussion

This project focuses on building a practical solution for a real local problem. The absence of dynamic tracking for VVMC buses and organized booking for local vehicles has affected students and local commuters for a long time. By developing and deploying this system, a strong step is taken toward solving this issue.

The system proves that technology can improve transport experience in semi-urban areas. With upcoming integration with VVMC and future plans to include more vehicle types, Track and Book is expected to become a useful daily tool for college students and other commuters

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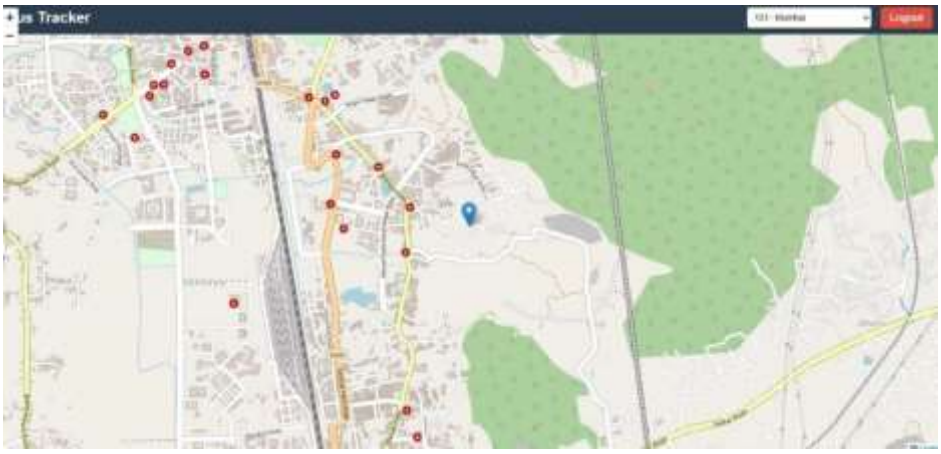

Figure 2 displays the live location of buses and magic vehicles on a map, helping passengers know where the vehicle is in real time.

Figure 3 shows seat availability using color-coded seats, allowing passengers to quickly select and book a seat easily.

V. CONCLUSION

In conclusion Track and Book, a comprehensive platform is designed to ease semi urban commuting by addressing the challenges of unreliable transport. In fast-growing semi urban areas, navigating through heavy traffic and lack of proper tracking and booking public transport system can be frustrating. Our system provides real-time tracking of buses, and shared rides, coupled with a seamless booking feature, helping users plan their journeys efficiently. Track and Book ensure you avoid delays and make informed travel decisions for daily commutes, our platform aims to offer a smarter, smoother travel experience.

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