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Android Based Car Pooling System

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ABSTRACT - The increasing demand for sustainable transportation solutions has led to the rise of carpooling systems that aim to reduce traffic congestion, travel costs, and environmental impact. This paper presents the design and development of an **Android-based Car Pooling System**, tailored to provide a seamless ride-sharing experience for users. The system enables drivers to offer available seats in their vehicles while allowing passengers to find and join rides based on real-time GPS data. A key feature of the application is the integration of a **Decision Tree algorithm** to efficiently match riders with drivers based on factors such as proximity, route similarity, and user preferences. Additionally, the system introduces driver-controlled fare settings, allowing flexibility and transparency in ride pricing. Special considerations for safety, including a female-only ride option and an SOS alert feature, are incorporated to enhance user trust and security. Designed with scalability and affordability in mind, this project offers an effective solution for everyday commuters, particularly within budget constraints. The proposed system demonstrates the potential of leveraging mobile technology to create smarter, safer, and more eco-friendly urban mobility options.

***Key Words*:** Android Application, Car Pooling, Ride Sharing, Decision Tree Algorithm, GPS Integration, Dynamic Fare Setting, Female-Only Ride Option, Ride Matching, Urban Mobility, Sustainable Transportation, User Safety, Real-Time Tracking.

1.INTRODUCTION

The rapid urbanization and exponential growth of vehicle ownership have contributed significantly to rising traffic congestion, longer commute times, increased fuel expenses, and alarming levels of environmental pollution. Traditional means of commuting, such as public transport and private vehicles, often fall short in addressing the dynamic needs of modern commuters who seek flexibility, affordability, and convenience. In this context, carpooling has emerged as a practical and sustainable solution by promoting shared vehicle usage among individuals traveling in similar directions. However, the absence of efficient, user-friendly, and secure carpooling platforms continues to hinder its mainstream adoption.

To bridge this gap, we propose an **Android-based Car Pooling System** that leverages mobile technology to offer a smarter, more accessible way to facilitate ride-sharing. The system allows drivers to post ride offers by specifying departure points, destinations, available seats, and pricing, while passengers can search for and book rides based on real-time availability. By incorporating **GPS integration**, the application ensures that users can view and select nearby rides accurately, enhancing both convenience and efficiency. Additionally, a **Decision Tree algorithm** is employed to intelligently match drivers and riders by considering factors such as location proximity, route alignment, user preferences, and seat availability, thereby optimizing the overall ride-sharing experience.

A standout feature of the proposed system is the flexibility it provides in **dynamic fare setting**, where drivers are empowered to determine the fare for their rides. This feature introduces transparency and fairness while catering to varying ride demands and distances. Moreover, acknowledging growing concerns about personal safety, especially for female commuters, the application includes a **female-only ride option** that enables women to opt for female drivers or co-passengers. An integrated **SOS alert feature** further strengthens the safety framework, allowing users to quickly signal for help during emergencies.

Designed with scalability, simplicity, and cost-effectiveness in mind, the Android Car Pooling System aims to address the major challenges faced by urban commuters today. By promoting shared transportation, the system contributes towards reducing the number of vehicles on roads, lowering carbon emissions, and fostering a sense of community travel. Through the use of mobile technology, intelligent algorithms, and strong safety mechanisms, the proposed solution aspires to make everyday commuting more affordable, efficient, and secure for a wide range of users.

2. LITERATURE SURVEY

[1] CARE-Share: A Cooperative and Adaptive Strategy for Distributed Taxi Ride Sharing (2017): Lu et al. proposed a distributed, cooperative ride-sharing system that dynamically matches ride requests and taxis using adaptive strategies. Their model significantly improved ride-sharing efficiency and reduced passenger waiting times in urban environments. [2] XGBoost-Based Dynamic Ride-Sharing Model (2019): Zhang et al. introduced an XGBoost machine learning model to predict and match dynamic ride-sharing opportunities. Their system achieved higher accuracy and faster matching speeds compared to traditional matching algorithms, demonstrating the potential of advanced machine learning in ride-sharing platforms.

[3] Development and Implementation of Bicata (2024): A team of developers created Bicata, an Android-based carpooling system designed for affordable ride-sharing with features like GPS tracking, dynamic fare settings, female-only rides, and a Decision Tree algorithm for intelligent ride matching, focusing on user safety and accessibility without relying on expensive cloud services.

[4] Dynamic Ride-Sharing: Exploration of Service Models (2011): Amey et al. discussed dynamic ride-sharing services that adjust in real-time to user needs and traffic conditions. Their study highlighted the benefits of real-time tracking but noted that limited smartphone access at the time restricted large-scale implementation.

[5] Optimization Models for Ride-Sharing (2012): Agatz et al. proposed mathematical models for route optimization and ride matching. Their work laid the foundation for intelligent matching systems, although they mainly focused on theoretical optimization without real-world mobile integration. [6] Mobile-Based Ride-Sharing System Using Shortest Path Algorithms (2013): Geisberger et al. developed a ride-sharing application using Dijkstra's algorithm for shortest route calculation. While effective in reducing travel distance, the system lacked dynamic fare adjustment and user-centric features like preference-based matching.

[7] Ride-Sharing: A Comprehensive Survey (2013): Furuhata et al. categorized ride-sharing systems based on scheduling (static and dynamic) and communication methods. They emphasized that dynamic ride-sharing, integrated with mobile technology, would become the dominant trend in urban mobility.

[8] Ensuring Women's Safety in Ride-Sharing Systems (2015): Saini and Madaan introduced the concept of female-only ride options within carpooling platforms. Their research addressed a critical gap in user safety, particularly for women, encouraging higher participation rates in ride-sharing services. [9] The Rise of App-Based Shared Mobility Services (2019): Shaheen and Cohen analyzed the impact of mobile applications like UberPool and LyftLine. They noted that while shared rides gained popularity, there was still a lack of affordable, commuter-focused solutions for small and medium urban areas. [10] Machine Learning for Ride Matching (2020): Chen et al. applied machine learning techniques such as Decision Trees for real-time ride matching. Their study demonstrated that lightweight models could achieve high accuracy in matching passengers with drivers without requiring heavy computational resources.

[11] Cost-Effective Carpooling Solutions Using Firebase and GPS (2021): Raval and Karani proposed budget-friendly mobile carpooling systems by using Firebase as a backend and Google Maps APIs for GPS integration. Their work supported the idea of developing scalable ride-sharing applications without heavy cloud infrastructure costs.

3. PROBLEM STATEMENT

Urban areas across the globe are witnessing rapid increases in vehicle density, leading to severe traffic congestion, extended commute times, increased fuel consumption, and higher levels of environmental pollution. Despite the potential benefits of carpooling, the lack of accessible, reliable, and user-friendly digital platforms has limited its widespread adoption. Existing solutions often fail to provide dynamic fare flexibility, personalized matching based on user preferences, or sufficient safety measures, especially for female commuters. There is a critical need for a cost-effective, mobile-based carpooling system that can intelligently connect drivers with passengers in real-time, optimize travel routes, ensure user safety, and provide fare-setting flexibility. Addressing these gaps would not only promote sustainable transportation but also make commuting more economical, efficient, and secure for everyday users.

4. OBJECTIVE

1. To create an Android application that simplifies the process of connecting drivers offering rides with passengers seeking transportation.
2. To build a secure login and registration process that manages user authentication and maintains accurate user profiles.
3. To allow ride providers to list their trips with detailed information including starting point, destination, date, time, number of available seats, and fare amount.
4. To enable ride seekers to search, filter, and join rides that best match their travel needs based on location, timing, and other preferences.
5. To implement a decision-making algorithm that recommends suitable ride matches by analyzing multiple ride and user parameters.
6. To integrate location-based services such as GPS for realtime tracking of rides and ensuring better communication between users.
7. To manage all ride data, user details, and booking statuses efficiently using a cloud-based real-time database.
8. To enhance user safety by offering features like gender specific ride preferences, allowing users to feel more secure during shared rides.
9. To optimize the application for smooth functionality across various Android devices, including those with lower system specifications.
10. To encourage environmentally responsible travel habits by promoting the concept of shared transportation and reducing the number of individual vehicles on the road.

5. SYSTEM ARCHITECTURE

In Figure no.1 information given,

1. User Management Module

This module handles the foundational features related to account control and authentication. It includes: - Registration: New users can sign up by providing personal and optionally vehicle details.

- Validation: Secure login and authentication mechanisms verify user credentials before granting access. This module communicates directly with Firebase Cloud to store and retrieve user data securely in real time.

2. Trip Management Module

This is the core of the system, where both ride seekers and ride providers interact. It includes: - Time Scheduling: Allows drivers to schedule rides based on departure time and route.

- Ride Posting: Enables drivers to list ride offers with route, fare, and seat availability.
- Finding Ride: Allows passengers to search for and request to join available rides based on filters such as location and time.

All trip-related information is synced with Firebase Cloud, ensuring immediate updates and availability for all users. **3. SOS and GeoLocation Services**

This service layer enhances safety and navigation: - SOS API: Provides users with an emergency alert system that can send notifications or location updates to predefined contacts or authorities in case of a critical situation. - GeoLocation API: Tracks the real-time position of both drivers and passengers to improve route guidance, safety, and transparency during rides.

These services also utilize Firebase to log or relay location and alert data when necessary.

The entire system is managed via the Android client, which acts as the front-end interface. It connects all modules seamlessly and facilitates user interaction with the backend database through Firebase Cloud. This architecture ensures minimal latency, strong data integrity, and a user-centric experience across all devices.

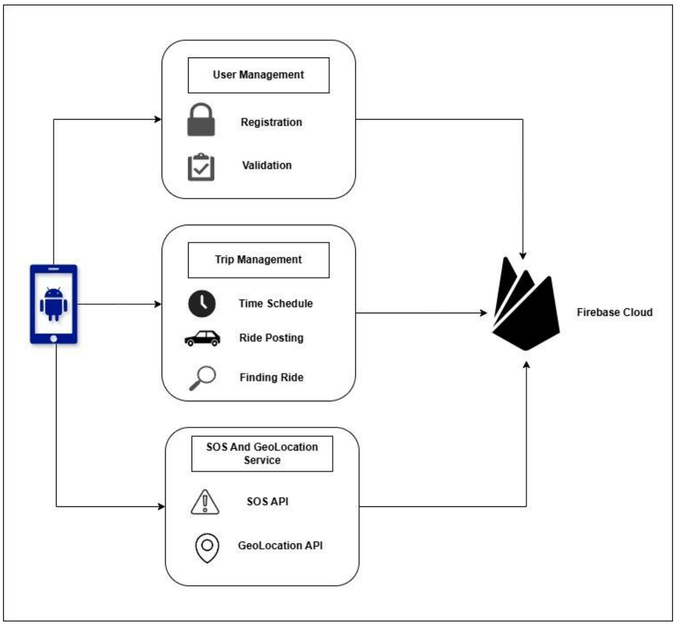


Fig1. System Architecture

6. METHODOLOGY

The development of the Android Car Pooling System followed a structured approach that focused on user-friendliness, efficient ride matching, and real-time tracking. The system was designed with modular components to ensure smooth operation and easy scalability.

Firstly, a user authentication system was implemented where new users can create accounts and existing users can log in securely. Profile management features were provided, allowing users to update personal information, vehicle details, and preferences such as opting for "female-only rides." Ride management functionality was developed where users could either offer a ride or search for available rides. When offering a ride, drivers could input parameters like source, destination, time, number of seats available, and fare amount.

Passengers, on the other hand, could search rides based on these criteria and request to join a ride.

The matching mechanism was powered by a Decision Tree algorithm, which helps in identifying the most suitable rides based on user preferences, proximity, timing, and ride availability. By analyzing multiple parameters, the system suggested the best possible matches to both drivers and passengers.

GPS integration was used for real-time location tracking and navigation assistance. Firebase Realtime Database served as the backend, storing and synchronizing user data, ride details, and booking statuses instantly across devices. Additionally, a simple but effective security feature was introduced to ensure safety during rides, particularly focusing on providing options for female travelers.

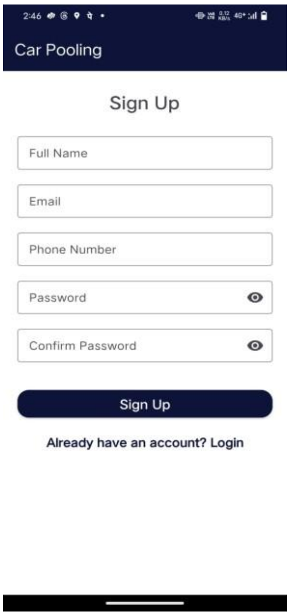
Throughout the system, optimization techniques were used to ensure that data retrieval and updates happened with minimal latency, keeping the overall app performance smooth even on low-budget Android devices.

7. RESULTS

The Android Car Pooling System was successfully developed and deployed on Android platforms using Java for the backend logic and XML for the user interface. Firebase Realtime Database was integrated as the cloud backend to handle data storage, authentication, and real-time updates efficiently.

The application was tested with a group of users acting as both drivers and passengers. The following results were observed during testing:

1. User registration and login functions operated reliably, allowing users to securely create accounts, authenticate, and manage personal details with minimal latency in fig. no. 1,2.
2. Drivers were able to post ride offers by selecting departure time, destination, available seats, and fare, all of which were stored in the Firebase database and displayed instantly to potential passengers in fig. no. 5.
3. Passengers could easily search for rides using parameters such as source, destination, and timing. The decision tree algorithm provided effective ride-matching by recommending the most relevant ride options in fig. no. 6.
4. Geo-Location integration allowed real-time tracking of both driver and passenger locations. Users were able to view the live position of the vehicle during the trip, enhancing route transparency in fig. no.8 .
5. The SOS feature functioned effectively, triggering location based emergency messages when activated, providing an added layer of safety.
6. Performance tests showed that the application performed smoothly on devices with limited hardware resources, and data syncing with Firebase was consistent and error-free.



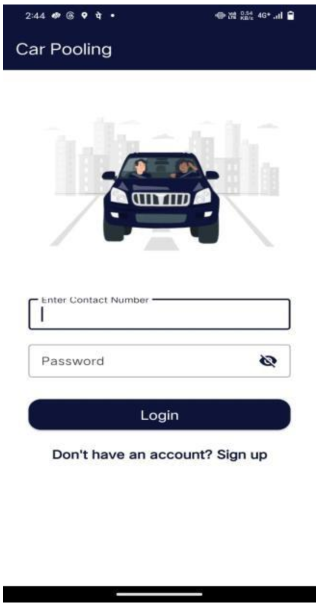


Fig. 1 - Create Account

Fig. 2 - Login

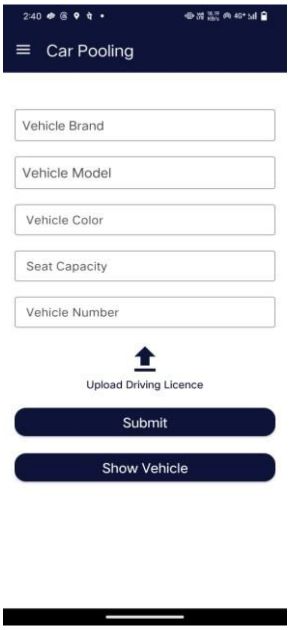
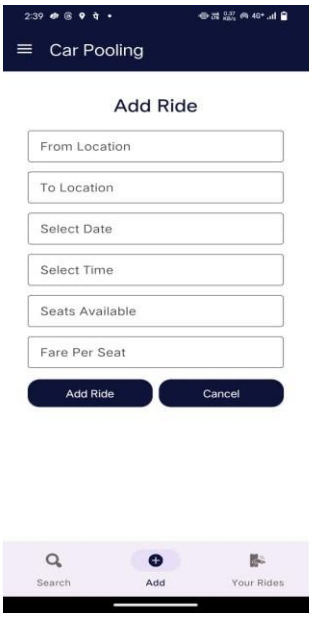


Fig. 3 – Car Details

Fig. 4 – Licence Details



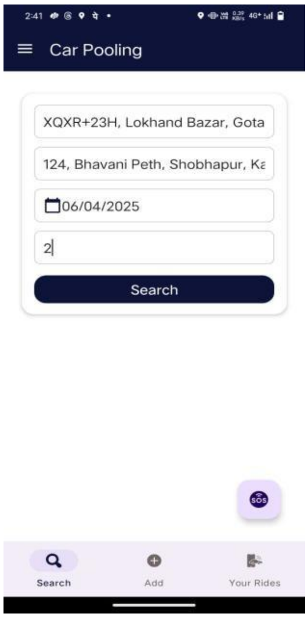


Fig. 5 – Add Ride

Fig. 6 – Search Ride

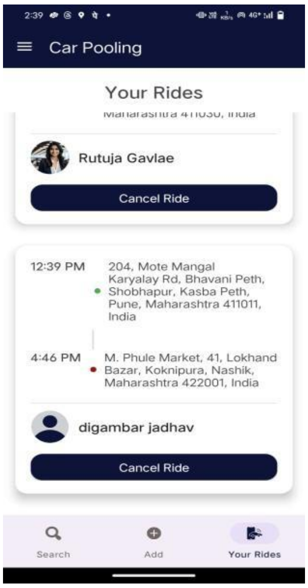


Fig. 7 – Ride Details

Fig. 8 – Location Details

8. CONCLUSIONS

The Android Car Pooling System developed in this project offers an efficient, affordable, and user-friendly solution to the challenges of urban transportation. By leveraging real-time GPS tracking, dynamic ride matching using the Decision Tree algorithm, and user-centered features like female-only rides and driver-controlled fare settings, the

system successfully addresses key issues such as high commuting costs, traffic congestion, and commuter safety.
Through the integration of Android Studio, Firebase, and Google Maps APIs, the system ensures seamless operation without requiring heavy cloud infrastructure, making it suitable for low-budget implementations. Rigorous testing and validation have confirmed the reliability of ride creation, searching, and matching functionalities. Additionally, safety measures such as gender-specific ride options and SOS features further enhance user trust and adoption.
This project not only builds upon existing research in dynamic ride-sharing and mobile transportation systems but also introduces practical improvements tailored for real-world needs. It demonstrates how thoughtful application of technology and machine learning techniques can create impactful, scalable solutions in the mobility sector. In the future, the system can be extended with features such as in-app digital payments, ride rating mechanisms.

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