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Original Article

Echo Ride: A Carpooling App

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Abstract *- EcoRide is an app designed for Android Studio for the mobile app, providing a convenient, inexpensive, and much greener alternative to normal commuting by carpooling. The app matches drivers with passengers who have a similar destination, enabling users to share a ride, save money on travel, and lower their environmental impact. EcoRide is built on the premise that carpooling should be easy and is designed with an intuitive interface to create rides, match passengers, and track in real-time. Specific routes and corresponding timings will help users get together or join in carpools. EcoRide enhances the safety of these exchanges by providing user verification and in-app communication to ensure accountability and reliability for all participants.*

Keywords *- API, Authentication, Firebase, Google maps, Java, Location services.*

1. Introduction

Eco Ride is a mobile carpooling app that makes commuting easier, more affordable, and eco-friendly. Developed in Android Studio, Eco Ride connects drivers and passengers traveling in the same direction, enabling them to share rides, reduce costs, and minimize environmental impact. The app features an intuitive interface for creating and joining carpools, real-time ride tracking, and in-app communication to enhance user safety and convenience. EcoRide not only promotes sustainable travel practices but also helps reduce traffic congestion and greenhouse gas emissions, making it a practical and impactful solution for today's commuting challenges.

The carpooling application facilitates a great, intuitive, and user-friendly interface for users who can easily create or find carpools and create desired routes, destinations, and times. With the real-time tracking of rides built into the application, users can track the progress of their ride, which increases the perception of security and transparency throughout the ride. Also, the application's in-app communication features facilitate easy communication between drivers and passengers, while its user verification and safety measures help build trust and ensure a secure carpooling experience. In addition to serving individual convenience, EcoRide serves addresses an overarching mission: encouraging responsible travel behavior. It innovates mobility in urban spaces by reducing traffic flow, cutting carbon footprints, and increasing the economic use of road space through ridesharing, be it daily rides, long-distance commuting, or events, to name a few, EcoRide to the rescue with a touch of environmental saving grace :) and a modern commuting angst-soothing technology cornerstone. It also symbolizes sustainability and community health. The ride tracking in real-time is made possible by the integration of GPS and Google Maps API, with EcoRide helping all the parties to track the actual trip progress, the estimated time it will take to reach, and the live location during the trip.

It means increasing transparency and peace of mind for all parties and better coordination of everything. The app provides a user messaging feature for within-app communication targeted at clear and timely updates about the arrangement pertaining to rides. EcoRide also enhances safety through user verification systems like mobile number/email confirmation and optional identity checks to create an environment of trust and safety for all users.On the technical side, EcoRide employs a variety of modern developer tools, libraries, and frameworks: the backend service is based on Firebase, the local data storage utilizes Room Database, and the MVVM architecture allows for separating concerns and is easy to maintain. Some features like push notifications, user authentication, and Drivers and passengers going in the same direction are the foundation for EcoRide.

Through a sleek and responsive user interface, users can create or join carpools simply by entering their starting point, destination, desired route, and departure time. Users are automatically matched based on their location and their route similarity, which allows good ride planning and minimal deviation.This not only lowers the driver's fuel and maintenance costs significantly, but it also provides an economical and convenient replacement for public transport or ride-hailing services for passengers.

2. Literature Survey

Carpooling appears as a promising tool to optimize urban transportation, such as reducing traffic jams, environmental pollution, and increased travel expenses. A few efforts have been conducted to establish the advantages and obstacles associated with carpooling systems and to explore their potential to promote sustainability and commuting effectiveness.A study by Shaheen et al. (2016) highlights the importance of carpooling as one of the key contributors to VMT and GHG decreases in urban areas. The researchers say shared transport services, such as carpooling, can reduce single-occupancy vehicles, reducing traffic and pollution. This aligns with EcoRide's goal to encourage environment-friendly commuting by sharing rides. From a technological standpoint, Amey (2011) explores the efficacy of real-time, GPS-based dynamic carpooling systems.

The paper demonstrates the potential of mobile applications to perform efficient route matching and minimize travel time through linkages of drivers and passengers with similar itineraries. Thus, we also added the Google Maps API from this idea for the facility and efficiency of the user called EcoRide.The impact on the environment: We are encouraged in this by the work of Fellows and Pitfield (2000), which quantifies the amount by which fuel consumption and CO2 emissions are decreased from having more than one person in a car. They have found that carpooling can substantially reduce the carbon footprint per commuter in dense urban environments. EcoRide's function to calculate carbon emissions has been inspired by such studies and motivates users to participate in their journey towards sustainability. Lastly, Chan and Shaheen (2012) identify social and economic benefits, such as user cost savings and alleviating pressure on public transportation systems. Their study highlights the requirement for user-friendly interfaces and the motivation to promote uptake, especially in highly populated areas. EcoRide caters to these demands with its easy-to-use interface and intelligent matching algorithm that brings carpooling to the masses. They all point to the importance of carpooling in relation to the challenges of whole. It also emphasizes that when carpooling is combined with eco-driving and modern fuel-efficient vehicles, the reduction in greenhouse gases emitted can be even greater.

This means carpooling is an available and scalable solution for solving environmental and economic problems in urban and suburban trips. Giving a broad sense of deep learning and its applications, for instance, used in image classification, EcoRide can indeed be everything.urban mobility: technology, safety, and attention to the environment, whose fundamental principles are advocated here. The research even showed that ride-sharing helps conserve energy as it reduces total fuel consumption as a whole. It also emphasizes that when carpooling is combined with eco-driving and modern fuel-efficient vehicles, the reduction in greenhouse gases emitted can be even greater. This means carpooling is an available and scalable solution for solving environmental and economic problems in urban and suburban trips. Giving a broad sense of deep learning and its applications, for instance, used in image classification, EcoRide can indeed be everything.

3. Existing System

Over the last 10 years, carpooling systems have evolved from niche travel solutions to becoming a popular urban travel mode, thanks to advances in mobile technology, environmental concerns, and the demand for cost-effective transportation in cities. The current systems are usually on mobile or web-based platforms that enable ride-hailing by matching drivers who pass on the same routes as their passengers. It also uses GPS tracking, map APIs, and matching algorithms commonly used by most existing systems to support competitiveness from a technical standpoint. Machine learning has enabled better matching, more accurate time predictions, and optimized routing. Some platforms have started adding user behaviour data, improving ride suggestions, and making the ride a safer experience. Although the technology has seen several upgrades, there are still limitations. In low-density scenarios, real-time matching in dynamic urban environments is especially difficult. Due to infrastructure gaps, existing systems in rural or semi-urban areas have low user adoption. Furthermore, due to privacy and security concerns, users are reluctant to share rides with strangers without proper safety measures in place.

4. Proposed System

The system proposes EcoRide, which is a mobile-based carpooling application that can offer smart, safe, and eco-friendly transportation options. While Cosmos offers Sustainability and holistic travel, EcoRide fills in the gaps with the existing working carpooling platforms by providing better UX, enhanced safety features, and smart matching of ridesharing. EcoRide is registered for drivers or passengers. Drivers can share details of their ride offer, including the departure location, destination, date and time of the ride, number of available seats, and preference for itinerary.

Travelers can match up with similar travel itineraries.The system uses the route-matching logic and location data to connect therewith, significantly minimizing the diversion om the initial itinerary for the passengers and the driver to therewith. Using Android Studio, this app will merge crucial features like real-time GPS tracking, the Google Maps API, and Firebase for authentication and database management, will allow user verification via mobile number/email, implement user rating and review features, and in-app chat to contact each other before a ride to ensure better safety and trust among users. EcoRide suggests smart matching of rides, taking into account user preferences, similarity of the routes, and time constraints. In contrast to the classical manner of

carpooling, where rides and ride seekers are matched at fixed time intervals, the system is mainly based on dynamically matching the rides with ride seekers so that the rides available get updated as soon as the rides become available. App users will be prompted to join suggestions at repeated rides according to their commuting history to fit the needs of their ride. To help facilitate sustainability, the app will calculate and track the number of carbon emissions saved from sharing a ride, encouraging health awareness. This data aggregate over the long term might serve as a foundation from which reports of the users collectively reducing their carbon footprint will be generated. In conclusion, although the existing systems offer an effective and advantageous solution to urban transportation problems, there is a great deal of potential for innovation in terms of optimal user matching, better trust mechanisms, and improved integration with public transport networks. It aims to overcome some of the limitations of today's carpooling services by providing a smarter and more responsive carpooling platform that can also cater to all potential users (even the non-tech-savvy).

5. Methodology

5.1. Requirement Analysis

There comes a situation to return to the world of the future. Then you realize certain ways need to be followed closely: some ways are strictly referred to as functional, say - ride creation, searching, route matching, in-app communication, and safety. More than that, though, what should be possible should be environmental. In other words, metrics for fuel savings and carbon emissions reduction allowed for a definition to be defined.

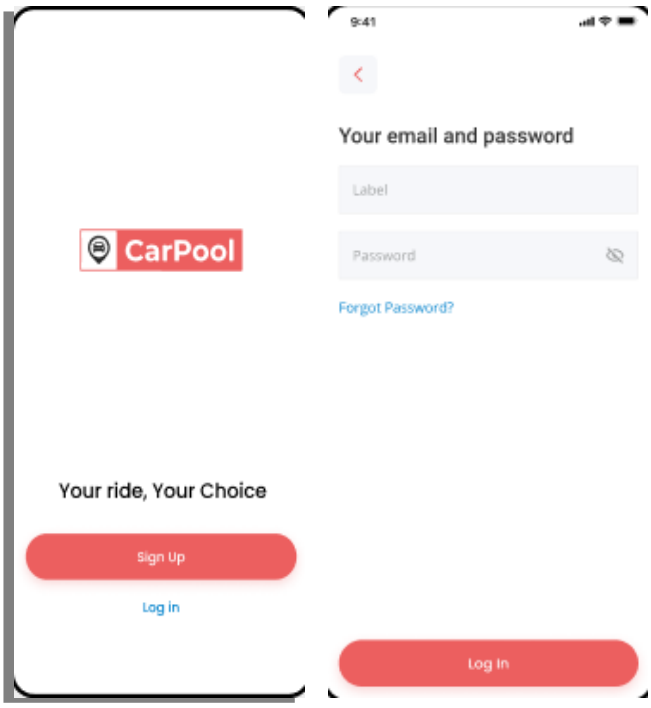

Fig. 1 Echo ride app login screen

5.2. System Design

- *Multiple User Interfaces:* Creating simple and intuitive user interfaces in Android Studio through XML Layouts.
- *Database Design:* A typical cloud-based data storage, like the Firebase Realtime Database, is selected to synchronize user data, ride details, and communication logs.
- *System Architecture:* Client-server architecture (app uses Firebase backend).

5.3. Implementation

- *User Authentication:* Signup/login securely by Firebase Authentication using email or OTP
- *Ride Matching Algorithm:* Match passenger-driver, ensuring similarity of | routes, closeness in distance, and time of travel
- *Safety Features:* Profile verification, user ratings, and ride history to ensure accountability and trust.

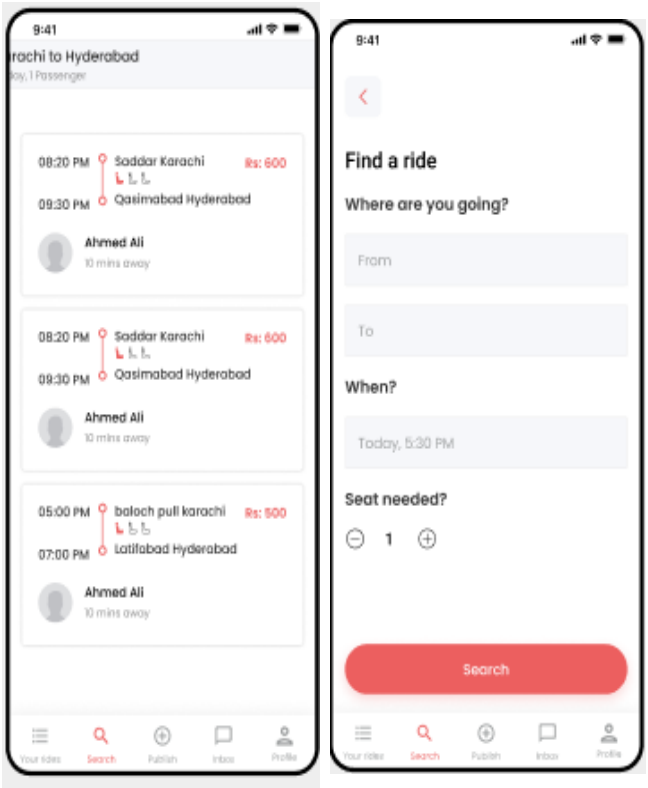

Fig. 2 Echo ride searching

5.4. Testing

- *Unit Testing:* Only single-function tests like login, ride posting, and matching.
- *Integration Testing:* Check if the modules, such as the database, location services, and UI components, would integrate.
- *User Testing:* A smaller audience of users used the application in the real world, providing feedback for improvement on usability and performance

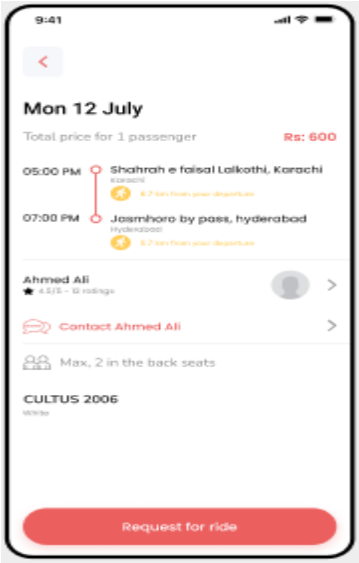

Fig. 3 Echo ride booking

5.5. Deployment

After testing was finalized and verified, it was ready to implement application deployment. Generation APK was anchored on a broad Android version by fixing and cross-comparative checking.

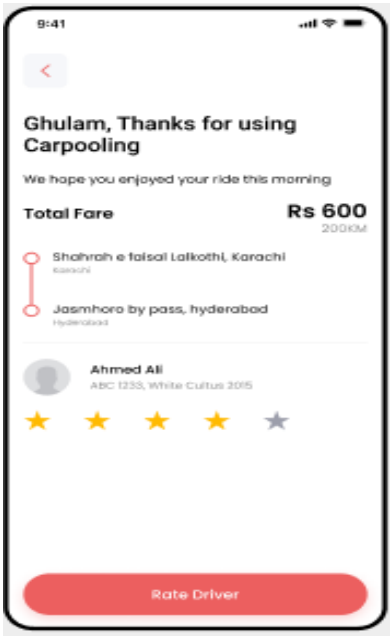

Fig. 4 Echo ride rating

6. Architecture

6.1. Algorithm

- Step 1 : Input: Users' current locations and their preferred time of departure are provided.
- Step 2: All active driver entries are pulled from the database, including their starting point, destination, departure time, number of empty seats, and route.
- Step 3: For each driver, the algorithm finds matches for the passengers along a similar travel path, similar to a map-guided resolution of route matching, by using the Google Maps API.
- Step 4: When a passenger orders a ride, the algorithm uses a map-guided route-matching solution (say Google Maps API) to find out passengers who have a similar travel path for every driver.
- Step 5: If the similarity of routes was matched with time compatibility and availability of seats, all matched in favor of the driver, then the driver is assigned to the list of matched-up drivers with a match score calculated based on route proximity and time compatibility.
- Step 6: The list of drivers that match is recorded and sorted by match score for the presentation to the passenger.
- Step 7: As a passenger selects a driver, a booking is made for that particular seat, and the count of available seats with that driver is updated in the database.
- Step 8: Both the driver and the passenger receive confirmation, with details about the route, user, and timing.
- Step 9:Real-time availability of GPS tracking during the ride and dynamic updates about the ride's status (e.g., the ride started, ongoing, completed) are shared.
- Step 10: The trip's history is stored for the purposes of reference and feedback, as well as building credibility with ratings and reviews.

7. Results

The EcoRide application was implemented and tested to demonstrate the following core capabilities: user registration and profile creation, ride creation, passenger-driver matching, and real-time tracking. The system was developed in Android Studio, using Firebase as a backend and Google Maps API for location services. The conducted tests provided several use-case scenarios for the application to evaluate its operation's reliability and usability. The ride-matching algorithm was accurate; a passenger would be matched to the right driver based on the input about the route and time preferences; it actually gave decent, relevant ride suggestions on time. Have created a threshold-based time filter (works on a 15-minute time window), which provides a flexible way of scheduling rides without losing accuracy. System performance was evaluated involving user interaction and simulated operation of the system. The statuses of the rides are updated dynamically from the booking to and even after the ride is completed. Passengers and drivers were well informed with timely notifications about ride bookings or completed rides, which helped to align communication and coordination into high efficiency. Testing found the user interface intuitive and responsive, and it was very well received in initial user testing. In-app messaging, seat reservation, and driver-passenger verification are but a few features that operated and reinforced a pool-focused, rider-friendly ecosystem. A measure of environmental effects was

a reduction of CO2 emissions, determined by how much reduction is possible for each shared ride. Each individual's reduction in carbon footprint was measured from the average successful carpool ride, thus signifying the sustainability achievements of the application.

In brief, the results showed that EcoRide actually reached its goals: cost-effective, convenient, and eco-conscious carpooling. It can be extended for any incremental feature in the line of AI-based ride prediction, payment integration, and enhanced user analytics.

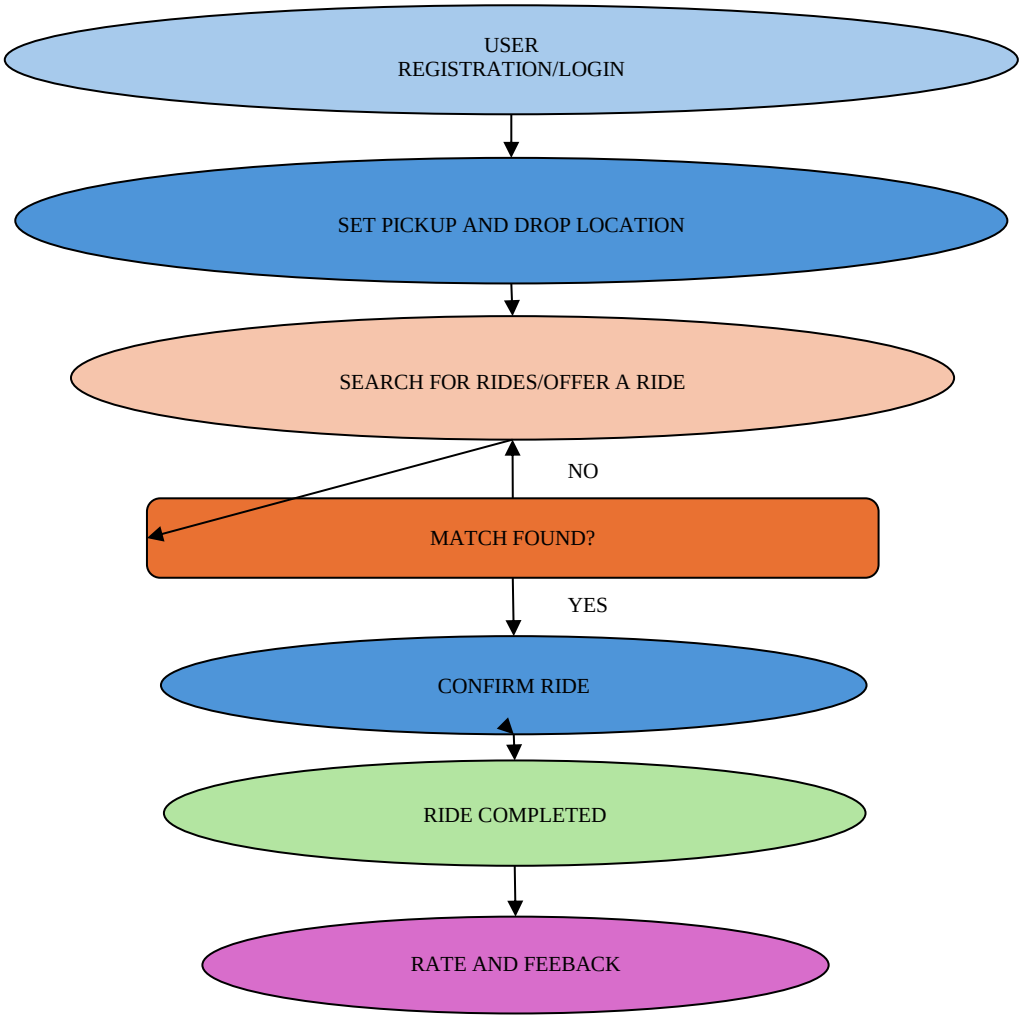

Fig. 5 Flow chart

8. Conclusion

The eco-friendly carpooling application, EcoRide, was deemed one of such effective remedies toward the situation, attributed to the increase in traveling expenditures, traffic, and environmental degradation due to increased individual sole vehicle utilization. EcoRide provides a simple and effective way for both drivers and passengers to avail and share rides through mobile tech, a centralized network lution powered by location services and cloud-based data management. This included user registration, generating rides, smart ride pairing, real-time route tracking, and in-app communication, which were all part of a single functioning application that used routes and time-based matching algorithms so that EcoRide could calculate a matching pair of users that were a good match for each other while ensuring flexibility and reliability.

Taking the system's design through usability and security, the application consists of user verification, ride history, and notifications. Testing and implementation proved that, yes, the application does work quite handily in real-time, giving the users an effortless experience with the perfect ride suggestions, compensating EcoRide's role in the echelons of environmental stability, endorsing shared portability while reducing group carbon footprints. EcoRide demonstrated that tech-oriented carpooling solutions can enable smarter, greener, and less expensive urban mobility at scale. So, it's a

flexible ecosystem with several potential additions in the future, like integrating digital payment, AI-powered route optimization, and scaling over a larger geographical area.EcoRide thus lays the groundwork for a culture of commuting that is responsible for society and the environment.

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