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Go Ride: A Safety-Aware Route-Corridor Matching Framework for Peer-to-Peer Car and Bike Ride Sharing with Real-Time Tracking

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Abstract
The rising cost of fuel, traffic congestion, and empty seats in private vehicles require a rethinking of peer-to-peer mobility options beyond casual carpooling. This paper proposes Go Ride – a cross-platform ride sharing system, which enables car and bike owners to connect with passengers heading to compatible destinations. Go Ride uses route-corridors as the basis for matching transportation means with potential passengers. The owner's route is represented as an ordered polyline covered with a configurable corridor. A ride is granted if the passenger pickup point and destination are within the corridor, follow the route direction, do not exceed the available seats, and the owner's vehicle and personal details are verified. Each ride is scored using a weighted scoring system that ranks route similarity, temporal proximity, fare, driver reputation, and verification level. The scoring function is applied only to the set of rides that satisfy hard constraints, so safety requirements are prioritized over optimization. The architecture decouples client applications, application services, matching engine, and safety services from persistent and secure storage. The system introduces one-time-password (OTP) based onboarding, document verification, transactional seat booking, sandboxed payment processing with refund guarantees, real-time GPS tracking with emergency SOS management, privacy-preserving communication channels, and post-ride-only reviews. The paper evaluates the precision of matching, invalid-sequence rejections, search latency, SOS delivery, and task-based usability on a test dataset and a prototype implementation. The paper expects Go Ride to offer better recommendation and trust-building mechanisms at the community and campus levels compared to existing location-based carpooling platforms.

Keywords: *Emergency SOS response; Peer-to-peer mobility; Real-time GPS tracking; Ride-sharing; Route-corridor matching*

1. Introduction
The rapid growth of cities, soaring fuel prices, and intensifying traffic congestion make it urgent to utilize the capacity of existing vehicles better. Each day numerous private cars and bikes come with empty seats while other commuters seek cheap transportation on the same route. Ridesharing can cut costs, reduce congestion, and lower pollution, but several factors have limited large-scale use of it [1]. At the time of an extensive North American review, it represented around 8 to 11% of the transportation modal share in Canada and the United States respectively [2]. A reliable online platform can connect travellers going the same way and turn single trips into shared ones. This paper proposes Go Ride, a mobile-based service in which a vehicle owner posts their intended route and passengers are invited to join based on safety credentials, overlapping routes, and time constraints. It is not a substitute for commercial ride-hailing services but an organized alternative to informal carpooling arrangements made through calls or chats. The principal motivations for this work are to reduce the cost of both daily and intercity travel by enabling cost sharing, to increase utilization of typically unutilized space in private vehicles through carsharing, to shift from an informal coordination mechanism to one that

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is auditable, verifiable, and secure via digital means, to reduce unnecessary and thus polluting transportation by reducing trips which otherwise would have been taken, and to increase consumer confidence by enabling verification of documents and reservations made. The rest of this paper is organized as follows. Section 2 reviews the related work. Section 3 states the problem. Sections 4 and 5 describe the proposed system and its architecture. Section 6 presents the route-corridor matching methodology. Sections 7 and 8 cover the implementation stack and the evaluation plan. Section 9 discusses the limitations, and the final section concludes the paper.

2. Related Work

2.1.Surveys and foundations

Furuhata et al. [1] classify the key aspects of the existing works on ridesharing system, and also point out the challenges that hinder their adoption. Agatz et al. [3] define the optimization challenges of dynamic matching of drivers with passengers, and review related operations research models. Chan and Shaheen [2] present the history of ridesharing in the North America, in five phases concluding with technology enabled ridematching. Shaheen and Cohen [4] review the shared ride service models, definitions and the existing impact studies related to it. Mourad et al. [5] review optimization models and algorithms used in shared mobility, and Wang and Yang [6] propose a framework for ridesourcing systems. Seng et al. [7] review the ridesharing and crowdsourcing for smart cities, including the architectures, matching strategies, AI based techniques, security issues, pricing and so on.

2.2.Matching and optimization

Santi et al. [8] introduced the concept of shareability networks and demonstrated, on taxi data from New York, that it is possible to reduce the cumulative length of all trips by 40% or more, with only minor inconvenience to the passengers. Alonso-Mora et al. [9] introduced a real-time algorithm for high capacity ride-sharing, where a single vehicle accommodates up to 10 passengers. Agatz et al. [10] showed on a metro Atlanta case study that optimization-based approach for matching outperforms simple greedy approaches. Masoud and Jayakrishnan modelled multi-hop peer-to-peer ride matching as a binary program, which they solved using a decomposition algorithm [11], and introduced a real-time algorithm for a flexible ridesharing system [12]. Stiglic et al. found that incorporating meeting points increases significantly the number of matched participants and the distance saved [13], and that small increases in the flexibility of the participants lead to significant gains in the expected matching rate [14]. Finally, Pan and Li address the problem of fast and scalable search for ridesharing opportunities [15].

2.3.Carpooling platforms and research gap

Qadir et al. [16] suggest a solution for carpooling that uses GPS, trip preferences, and multi-criteria recommendation logic. Koppala et al. [17] propose a ridesharing system named Carpool Connect that leverages artificial intelligence to offer ride posting, searching, matching, payments, and feedback. This is a solid set of functionalities to consider. However, none of the research above incorporates both ordered route-corridor validation, a safe-first ranking rule, and an integrated emergency workflow in a peer-to-peer framework. Table 1 below represents an overview of the studies closest to the present research. As shown in Table 1. Summary of related studies and their relevance to Go Ride.

Table 1 Summary of related studies and their relevance to Go Ride

Ref.	Main contribution	Relevance to Go Ride
[1]	Classification of ridesharing systems and adoption challenges	Frames the design requirements
[3]	Survey of real-time driver-rider matching optimization	Defines the matching problem
[8]	Shareability networks on taxi trip data	Shows the benefit of pooling
[9]	High-capacity dynamic trip-vehicle assignment	Scalable assignment concept
[11]	Multi-hop peer-to-peer matching as a binary program	Peer-to-peer matching formulation
[13]	Meeting points in ride-sharing	Pickup flexibility and deviation limits
[16]	Recommendation framework for carpooling	Multi-criteria ranking
[17]	AI-driven ridesharing platform	Functional baseline

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3. Problem Statement

Existing informal ride-sharing systems suffer from the inability to find reliable routes, verify identities, set fair prices, and respond to emergencies. The commercial ride-hailing apps are built for a commercial hire based on a demand-responsive transport mode. They are not designed to match the requesting passenger with the private traveller whose intended route is only partially compatible with the requested trip. The primary research problem is how the mobile service can match passenger's pickup and drop points with the ordered route of an identified car or bike owner while considering the route compatibility, time windows, money, seat occupancy, reputational score, and safety.

The objectives of this work are therefore:

- to match a passenger only with rides whose route contains both the pickup and the destination in the correct travel order
- to apply safety and verification rules as hard constraints before any ranking
- to rank eligible rides using route, time, fare, reputation, and verification factors
- to support booking, payment, live tracking, and emergency response in one workflow

4. Proposed System

4.1.User roles and workflow

Go Ride presents independent interaction processes for its ride owners, passengers, and administrators. In this case, a verified owner will publish a journey with details about the origin, destination, stops, schedule, seats availability, and cost. On the other hand, a passenger will perform a search using the pickup location, destination, date, time, and vehicle type. Consequently, the system's matching engine will search for all rides whose corridor includes the requested pickup and destination points in the specified order while considering the number of available seats, time-windows, and other constraints. Finally, it will sort the remaining options according to a composite measure and display the results to the user. Figure 1 below represents the end-to-end process. Once the owner accepts the booking request, the passenger confirms and pays the booking through the integrated gateway. During the ride, both the parties can track and share the real-time navigation and arrival location details. Post-ride, both the user and the owner can leave a verified review, and cancellation option is available according to the refund policy. As shown in Figure 1 End-to-end ride workflow.

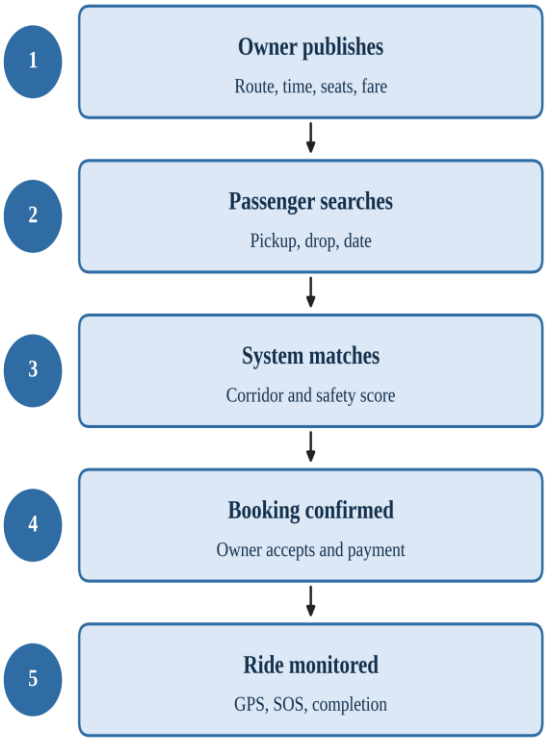


Figure 1 End-to-end ride workflow

4.2.Safety and trust mechanisms

Safety is a design requirement in all stages of the platform. The users need to register in the application with OTP-based onboarding. The owners, in turn, have to submit a driving license and vehicle documents, which are cross-verified before publishing any of the available rides. Seat reservations are transactional. The payment process is designed in a sandboxed gateway with cancellation and refund management. The in-app communication keeps the privacy of the contacting parties secure. The review system limits its features to any participant who has completed a ride, thus avoiding any form of unverified and even fraudulent feedback. An emergency SOS action records the active ride and the current location, then alerts the registered

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emergency contact and the platform support staff. Figure 2 shows this sequence.

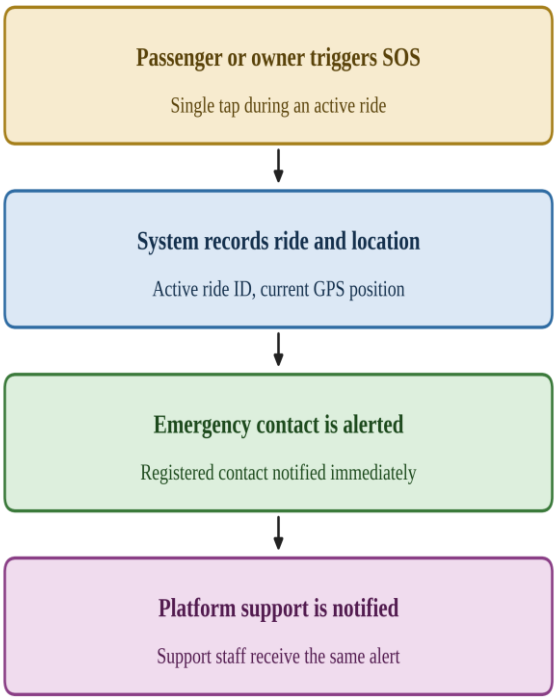


Figure 2 Emergency SOS workflow

4.3.Novel contribution

The most significant feature of this work is a novel safety-aware approach to route-corridor matching and ranking. It considers route ordered overlap, pickup deviation distances, temporal coincidence, seat availability, fare, verified identities, vehicle documents status, and accumulated user reputation, jointly, not simply matching the pair of coordinates distance-wise.

5. System Architecture

The architecture isolates client applications, core business services, matching and safety services, external integrations, and persistent storage. It enables independent testing of ride matching, booking, payment callbacks, and emergency workflows. Mobile clients communicate with the application services via an API gateway handling authentication and routing. The application services perform ride, booking, and payment logic and call a dedicated matching engine for route-corridor computation and ranking, safety services for SOS handling and live tracking, and external services for maps, OTP delivery, and payment processing. An operational database stores users, rides, and bookings. A separate secure layer stores KYC documents and system logs. A web-based administration portal manages verification, complaints, and analytics. Figure 3 depicts the layered design. As shown in Figure 3 Proposed Go Ride system architecture.

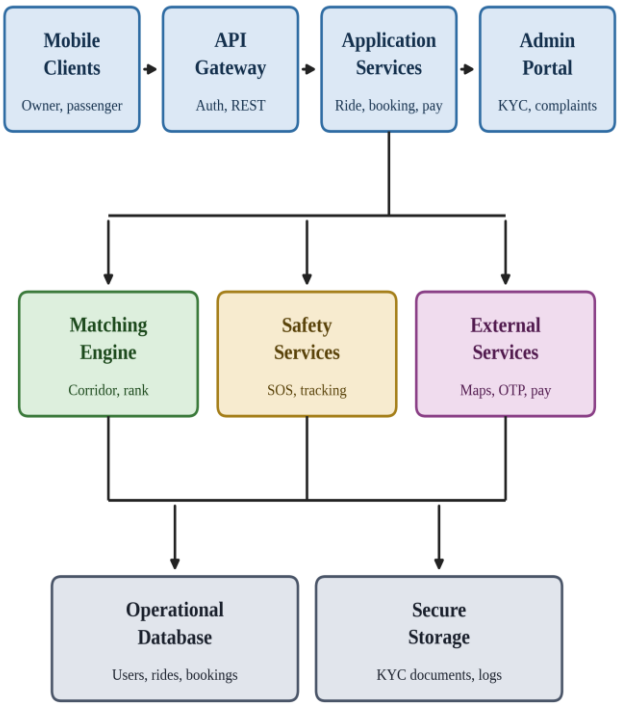


Figure 3 Proposed Go Ride system architecture

6. Route-Corridor Matching Methodology

6.1.Corridor and deviation

The owner's planned journey is represented as an ordered polyline L. A spatial corridor of half-width δ is constructed around L, as shown in Figure 4. For a point P, the deviation from the route is the distance to the nearest point of L:

$$d(P) = \min_{Q \in L} \|P - Q\| \quad (1)$$

A passenger request with pickup Pp and destination Pd is inside the corridor only when both deviations are within the configurable threshold δ:

$$d(P_p) \leq \delta \ \wedge \ d(P_d) \leq \delta \quad (2)$$

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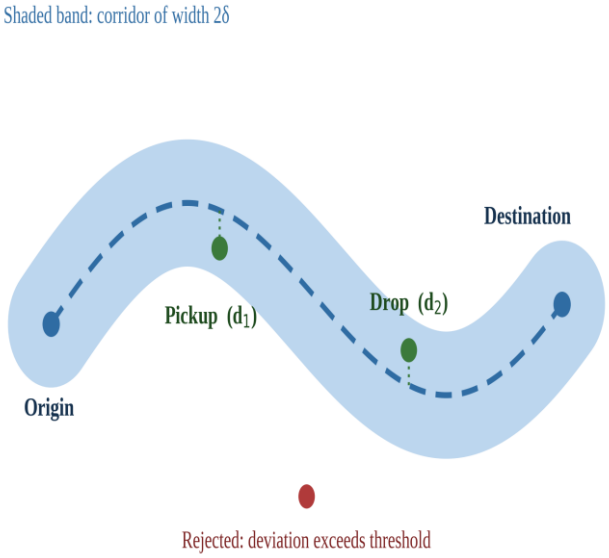


Figure 4 Route-corridor matching. Requests inside the corridor are accepted in sequence order. Requests outside the corridor are rejected

6.2.Sequence validation

A request must also respect the direction of travel. Let s(P) be the position of the projection of P along L, measured from the owner's origin. The pickup must come before the destination:

$$s(P_p) < s(P_d) \quad (3)$$

This rule rejects a request that distance-only matching would accept. For example, a passenger whose destination lies behind the pickup along the owner's route is near the corridor but cannot be served by that ride.

6.3.Matching procedure

A candidate ride must satisfy spatial, temporal, sequence, seat, and verification constraints before it is eligible. Table 2 lists these hard constraints, and the procedure is as follows.

- Obtain the owner's encoded route and the passenger's pickup and destination coordinates.
- Compute the nearest point and perpendicular deviation from each passenger location to the route.
- Reject the candidate ride if either deviation exceeds the threshold.
- Determine the position of each projected point along the route to confirm that the pickup precedes the destination.
- Verify the ride date, permitted departure window, remaining seat count, and owner and vehicle approval status.
- Compute a weighted composite score and return the highest-ranked eligible rides to the passenger. As shown in Table 2 Hard eligibility constraints applied before ranking.

Table 2 Hard eligibility constraints applied before ranking

Constraint	Rule
Corridor	Pickup and destination deviation are within δ (Eq. 2)
Sequence	Pickup precedes destination along the route (Eq. 3)
Seats	At least one seat remains
Schedule	Ride date and departure window match the request
Approval	Owner and vehicle verification is approved

6.4.Composite ranking score

Rides that pass all hard constraints are ordered by the composite score M:

$$M = w_1R + w_2T + w_3S + w_4P + w_5V \quad (4)$$

The variables are defined in Table 3. The weighting coefficients w are tuned empirically during prototype evaluation. Because the hard constraints are enforced before ranking, a high composite score can never override an essential safety rule. As shown in Table 3. Components of the composite score.

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Table 3 Components of the composite score

Symbol	Component	Meaning
R	Route compatibility	Closeness of pickup and drop points to the owner route
T	Time compatibility	Match between requested time and the departure window
S	Safety and reputation	Accumulated driver reputation from verified reviews
P	Price suitability	Fit between the fare and the passenger expectation
V	Verification status	Level of identity and vehicle document verification

7. Discussion And Limitations

Corridor-based matching addresses two of the shortcomings of the distance-only approach. Firstly, it eliminates nearby requests that are in the opposite direction of the route and secondly, it limits the pickup deviation to a maximum value set by the owner/platform. Related works report that participant flexibility and pickup design are critical factors influencing the matching rate [13, 14]. As such, it is expected that the deviation threshold δ directly affects the trade-off between the number of matched trips and the detour cost incurred.

The work has several limitations. The evaluation uses a controlled prototype dataset; thus, the results at the city scale are yet to be seen. The weighting coefficients require empirical tuning. The system relies on third-party map, OTP, and payment services; the accuracy of the SOS workflow is GPS-dependent. Finally, the work leaves the door open for scalable search methods [15] and high-capacity assignment methods [9] if the platform is deployed at a scale beyond a community or a campus.

Conclusion And Future Work

Go Ride builds on the ride-posting, searching, matching, and feedback mechanisms of prior carpooling research [16, 17], with a focus on safety-aware, ordered route-corridor matching and integrated emergency-response procedures.

The combination of spatial matching, verified onboarding, transactional booking, tracking, and controlled post-ride reviews aims to provide cost-efficient and trustful community-based shared mobility. Future work includes machine learning algorithms for fare and demand prediction based on sufficient usage data with user consent, recurring ride groups for colleges and workplaces, multilingual and voice-activated accessibility, electric-vehicle categories with charging stop suggestions, and explainable fraud/suspicious activity detection with human reviews.

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