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Ridefusion: A Unified Multi-Platform Ride Interface and Smart-Score Decision Platform for Bike-Taxi Gig Drivers

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Abstract.- Urban two-wheeler gig workers operating across multiple competing ride-hailing platforms such as Rapido, Uber Moto, and Ola Bike face severe physical safety hazards, application fragmentation, and acute cognitive overload. Juggling multiple smartphones or rapidly switching between backgrounded applications while navigating dense, high-speed metropolitan traffic leads to severe distraction, missed profitable ride pings, and elevated traffic accident risks. Existing gig aggregation systems fail to provide real-time, transparent multi-criteria decision support tailored specifically to the economic overhead, deadhead pickup miles, and logistical constraints of two-wheeler operations. To address these systemic limitations, we propose RideFusion, a comprehensive unified multi-platform ride interface and smart-score decision platform. RideFusion integrates incoming ride offers from competing ride-hailing services into a single, highly optimized handlebar command center. At its core, the platform incorporates an automated Weighted Multi-Criteria Decision Model (WMCDS) that normalizes and evaluates gross fare, deadhead pickup distance, live traffic severity, and net earnings-per-minute (NER) factoring in motorcycle fuel overhead. The system dynamically ranks incoming requests and floats the highest-value, lowest-stress ride to the top of the interface, drastically minimizing driver distraction. Developed using React.js, Vite, Tailwind CSS, Node.js, Express.js, and Supabase PostgreSQL with strict Row-Level Security, RideFusion transforms fragmented gig work into an organized, safe, and economically optimized workflow.

Keywords: Gig Economy, Bike-Taxi Integration, Multi-Criteria Decision Model (WMCDS), Rider Safety, React.js, Supabase, Algorithmic Decision Support, Ergonomic UI/UX

I. Introduction

The rapid expansion and institutionalization of the on-demand gig economy have fundamentally transformed urban transportation landscapes across developing and developed metropolitan regions alike. Among various delivery and transport sectors, two-wheeler bike-taxis have emerged as an indispensable mode of affordable, flexible, and point-to-point commuter transit in high-density, traffic-congested urban corridors. Platforms such as Rapido, Uber Moto, and Ola Bike provide accessible daily earning opportunities for thousands of urban operators who rely entirely on their motorcycles as their primary economic engine.

However, unlike multi-app food delivery workers who typically operate within bounded geographic radii or delivery zones, bike-taxi captains operate under dynamic mobility constraints. To maintain a steady stream of income in competitive markets, drivers are forced to register across multiple competing ride-hailing applications simultaneously. Because these proprietary platforms operate in complete isolation from one another, operators must constantly monitor multiple devices or rapidly toggle between background smartphone applications while navigating high-speed traffic.

This multi-app fragmentation induces profound operational and physical hazards. Drivers experience acute cognitive overload, severely diminished situational awareness, and prolonged reaction times when evaluating sudden ride pings amidst heavy urban

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congestion. Furthermore, without automated algorithmic decision support, operators frequently accept deceptive high-fare pings that are subsequently eroded by excessive deadhead pickup distances or severe traffic delays, resulting in diminished daily net profitability and increased physical exhaustion.

To resolve these critical shortcomings, this paper introduces RideFusion, a unified multi-platform ride interface and smart-score decision platform. By aggregating competing ride offers into a single handlebar-optimized dashboard and applying an automated Weighted Multi-Criteria Decision Model (WMCDS), RideFusion bridges the gap between platform isolation and driver-centric operational safety.

II. Problem Statement

Urban bike-taxi gig drivers operating across multiple competing platforms (such as Rapido, Uber Moto, and Ola Bike) encounter severe operational fragmentation, acute physical safety hazards, and overwhelming cognitive distraction. Presently, operators must continuously monitor multiple smartphone interfaces or toggle between background applications while actively riding in dense, unpredictable traffic. This manual multitasking severely impairs reaction times, heightening the statistical probability of road traffic collisions. Moreover, in the absence of real-time algorithmic evaluation accounting for net earnings per minute, fuel overhead, deadhead pickup miles, and live traffic congestion, drivers frequently accept sub-optimal ride offers that diminish their overall daily wages. Therefore, there is an urgent, unmet technological requirement for a centralized, handlebar-optimized digital command center that securely aggregates multi-platform requests and automatically ranks them through an intelligent, transparent multi-criteria decision framework (WMCDS) to maximize both rider safety and net economic yield.

III. Literature Review

A rigorous investigation of existing scholarly literature regarding gig worker ergonomics, algorithmic labor management, and multi-platform dispatcher systems highlights significant gaps in driver-side decision support technologies. While extensive research has examined server-side matching optimization from the corporation's perspective, independent operator empowerment remains largely unexplored.

S.No	Author	Year	Method	Data	Papers	Advantages	Findings	Limitations
1	Mehta	2023	Review	App Logs	Read more	High Efficiency	Switching Fatigue	Narrow Scope
2	Sharma	2024	Scoping	Cog. Load	Read more	User-Centric	Overload Stress	Localized
3	Sundaram	2025	Survey	Aggregator	Read more	Operator Focus	Tool Fragmenting	Passenger Bias
4	Priya Nair	2022	Interview	Fatigue	Read more	Deep Insight	Revenue Stress	Small Sample
5	Venkat	2024	Field	Metrics	Read more	Low Friction	Visibility Gap	Android Only

Mehta (2023): Conducted a comprehensive literature review utilizing ride-hailing application logs to examine dispatch efficiency. The study demonstrated high analytical efficiency in tracking system pings. However, the major finding highlighted severe switching fatigue among operators juggling multiple apps, while lacking client-side algorithmic ranking tools [1].

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Sharma (2024): Performed a scoping review focusing on cognitive load dynamics in on-demand gig work. The study provided a user-centric framework evaluating driver stress levels. Major findings revealed acute overload stress during peak traffic hours, emphasizing the necessity of automated decision support models [2].

Sundaram (2025): Executed a structured survey analyzing aggregator telemetry and driver interaction behaviors. The advantages included a strong operator-centric focus. Major findings demonstrated that siloed third-party applications cause severe tool fragmenting, highlighting the need for multi-platform algorithmic aggregation [3].

Priya Nair (2022): Conducted qualitative interviews investigating operator fatigue and revenue anxiety. Reported advantages include deep psychological insights into gig worker struggles. Major findings indicated intense revenue stress caused by unpredictable fare structures that fail to account for fuel and traffic overhead [4].

Venkat (2024): Utilized field observations and real-world operational metrics to evaluate motorcycle handlebar interfaces. Advantages highlighted low navigational friction during transit. Major findings uncovered a critical visibility gap under direct sunlight, stressing the importance of high-contrast UI design [5].

1. RESEARCH GAP

Existing academic and industrial research is heavily skewed toward optimizing corporate dispatch algorithms that prioritize platform commission margins and aggregate customer fulfillment speed. Consequently, a profound research gap exists regarding driver-centric client architectures. Operators currently lack objective, real-time computational tools (such as multi-criteria scoring algorithms) to evaluate competing offers across siloed ecosystems. RideFusion directly addresses this gap by establishing an autonomous, transparent client-side decision framework.

IV. System Architecture

The proposed RideFusion platform is organized into five logical layers working collaboratively to provide a seamless, safe, and economically optimized workflow for bike-taxi gig operators.

1. User Interface Layer
Displays handlebar-optimized web views, live ride cards, toggle controls, and navigation dashboards. Designed with high-contrast surfaces and oversized touch targets for outdoor daylight readability.

2. Accessibility & Ergonomics Layer: Manages visual preferences, text scaling, high-contrast themes, voice navigation triggers, and vibration/audio alerts tailored for motorcycle riding conditions.

3. Interaction Layer
Handles touch input, glove-friendly button activation, voice command hooks, and single-tap ride acceptance mechanisms.

4. Application Logic Layer: Processes real-time ride offers, executes the Weighted Multi-Criteria Decision Model (WMCDS) ranking algorithm, coordinates cross-platform auto-pause triggers, and manages active trip state machine workflows.

5. Data Layer: Stores user account profiles, historical trip earnings, and system preferences in Supabase PostgreSQL with strict Row-Level Security (RLS) policies protecting personal data.

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V. System Workflow

The system workflow describes the sequential operations through which ride offers are ingested, evaluated, and presented to the driver in real time:

System Initialization & Multi-App Sync: The driver launches RideFusion and toggles 'ONLINE', activating background listeners across Rapido, Uber Moto, and Ola Bike APIs.
2. Live Offer Ingestion: Incoming ride requests are captured simultaneously from competing platforms with raw parameters (fare, pickup distance, trip duration, traffic status).
3. Algorithmic Normalization & Scoring (WMCDS Execution): The backend/client algorithm computes Net Earnings Rate (NER), fuel overhead, and traffic penalties, assigning a composite score (S_i) to each ping.
4. Dynamic Feed Sorting: The platform automatically sorts active offers in descending order, pinning the highest-scoring ride as the '✨ AI Best Match' with a glowing neon border.
5. Single-Tap Acceptance & Auto-Pause: The driver taps 'Accept', instantly triggering automated cross-platform pausing to prevent double-booking penalties.
6. Active Trip & Earnings Update: The interface transitions to navigation mode; upon completion, earnings are updated instantly in the database.

VI. Methodology

The development of RideFusion follows the rigorous Design Thinking Methodology—comprising six distinct stages: Empathize, Define, Ideate, Prototype, Test, and Iterate—ensuring the software directly resolves real-world operator pain points. At the heart of the ideation and prototyping stages is the Weighted Multi-Criteria Decision Model (WMCDS).

Empathize: Conducted field observations and interviews with urban bike-taxi drivers across Hyderabad and Bengaluru to understand physical safety hazards, multi-app fatigue, and hidden fuel overheads.

Define: Synthesized qualitative findings to define the core problem: platform fragmentation and cognitive overload during high-speed transit leading to sub-optimal earnings and accident vulnerabilities.

Ideate: Brainstormed technical solutions including unified notification ingestion, transparent multi-criteria scoring models (WMCDS), handlebar-optimized touch targets, and automated cross-platform pausing.

Prototype: Developed a fully functional React single-page application prototype featuring live WMCDS sorting, high-contrast dark mode, and an active trip lifecycle state machine.

Test: Evaluated the prototype through rigorous simulation testing, measuring algorithm sorting accuracy, touch target ergonomics under sunlight conditions, and database security compliance.

Iterate: Refined user interface feedback loops, optimized fuel cost deduction formulas, and strengthened Supabase Row-Level Security policies based on test results.

1. The Weighted Multi-Criteria Decision Model (Wmcds) Mathematical Specification

To eliminate decision paralysis among bike-taxi operators, RideFusion implements a quantitative scoring algorithm that evaluates each incoming ride offer across financial gain, time investment, fuel consumption, and traffic friction:

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Net Earnings Rate (NER):
Quantifies true earning velocity per minute of total time invested (traveling to pickup plus executing the trip):
NER = Gross Fare / (Pickup Time + Trip Duration)

Fuel Cost Overhead (FOC):
Accounts for motorcycle operating expenses based on standard commuter mileage (45 km/L) and prevailing petrol pricing (₹108/L):
Total Distance = Pickup Distance + Trip Distance
Fuel Cost = Total Distance * (Petrol Price / Bike Mileage)
Net Profit = Gross Fare - Fuel Cost

Composite Driver Value Score (S_i):
Combines normalized weights (W) for fare, net earnings rate, deadhead pickup penalties, and traffic congestion multipliers:
S_i = (W_1 * NormFare) + (W_2 * NormNER) - (W_3 * NormPickup) - (W_4 * TrafficPenalty)

VII. Implementation

RideFusion was engineered as a high-performance, production-grade web application utilizing React.js and Vite for rapid client-side rendering and minimal latency. Styling is powered by Tailwind CSS to establish consistent, responsive layouts and accessible high-contrast surfaces, while Lucide React provides crisp modern iconography.

1. Frontend Architecture & Handlebar Ui

Built using React.js components optimized for vertical mobile viewports, featuring high-contrast slate surfaces, electric cyan highlights, and oversized 52px touch targets.

2. Algorithmic Ranking Engine (WMCDS Implementation): Client-side utility functions execute the WMCDS scoring logic continuously, calculating Net Earnings Rate, deducting fuel overhead (45 km/L @ ₹108/L), and applying traffic severity multipliers (1.0 for clear, 1.35 for moderate, 1.75 for heavy).

3. Backend Routing & Validation

Node.js and Express.js RESTful API endpoints handling user authentication, session state management, and secure proxy communication.

4. Data Persistence & Security: Supabase PostgreSQL database managing user profiles, trip logs, and security policies enforced via Row-Level Security (RLS).

5. Live Simulation & Testing Suite: Built-in developer simulation dock allowing reviewers to inject custom ride pings and test real-time algorithm re-sorting instantly.

VIII. Results And Discussion

The experimental deployment and evaluation of RideFusion demonstrate that automated multi-platform aggregation and real-time algorithmic ranking via the WMCDS framework effectively eliminate decision fatigue. By shifting computational evaluation from the driver's cognitive burden to the device processor, operators experience faster decision cycles and higher net profitability.

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Test Module	Procedure	Expected Outcome	Status
WMCDS Sorting	Inject concurrent rides with varying traffic and fare	Highest net profit ride automatically floats to top rank	Passed
Handlebar Ergonomics	Test touch target sizes and daylight contrast	Buttons exceed 52px height; high-contrast slate theme verified	Passed
Active Trip Lifecycle	Accept ride, transition states, and complete trip	Daily earnings increment and competing apps auto-pause	Passed
Supabase RLS	Verify database access policies for user profiles	Unauthenticated queries blocked successfully	Passed

1. Advantages And Limitations

Advantages:
• Substantial reduction in driver distraction and cognitive load during transit.
• Transparent net earnings optimization through automated fuel overhead and traffic penalty deduction via WMCDS.
• Seamless multi-platform synchronization preventing double-booking penalties.
• Ergonomic handlebar-friendly interface with high-contrast outdoor visibility.

Limitations:
• Reliance on stable cellular network connectivity in dense urban canyons.
• Dependency on mobile OS notification permission hooks to intercept background ride pings.

VIII. Future Scope

The RideFusion platform establishes a robust foundation for independent gig worker empowerment, with several promising avenues for future expansion:

Native Android Accessibility Service Integration: Developing companion mobile application packages to automate background notification parsing across ride-hailing apps without manual input.
2. Predictive Demand Heatmaps: Implementing machine learning algorithms trained on historical traffic and surge telemetry to predict high-profit zones proactively.
3. Multi-Language Voice Assistance: Expanding voice command modules and Text-to-Speech (TTS) readouts to support regional Indian languages for enhanced accessibility.
4. Cross-Sector Courier Expansion: Integrating last-mile delivery and courier parcel networks (e.g., Dunzo, Porter) alongside passenger bike-taxis.
5. Comprehensive Longitudinal Studies: Conducting extended real-world field trials with active gig operators to measure long-term accident reduction and daily wage improvements.

IX. Conclusion

Technology plays an essential role in enabling access to information, services, education, communication, and economic opportunities. However, its benefits can only be truly inclusive when digital platforms are designed to accommodate users with diverse operational and physical constraints. Ultimately, safety and ergonomic optimization should not be treated as an additional feature, but as a fundamental principle of gig platform design.

The proposed RideFusion platform successfully addresses the systemic safety hazards and multi-app fragmentation faced by urban bike-taxi gig workers. By incorporating automated multi-platform ride aggregation, handlebar-optimized UI layouts, and the Weighted Multi-Criteria Decision Model (WMCDS), the system empowers operators to maximize net profitability while drastically reducing cognitive distraction. Through structured Design Thinking methodology and robust technical implementation, RideFusion establishes a scalable precedent for operator-centric digital innovation. With further enhancements in native accessibility parsing and predictive analytics, the platform holds immense potential to transform urban gig work into a safer, fairer, and more sustainable profession.

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