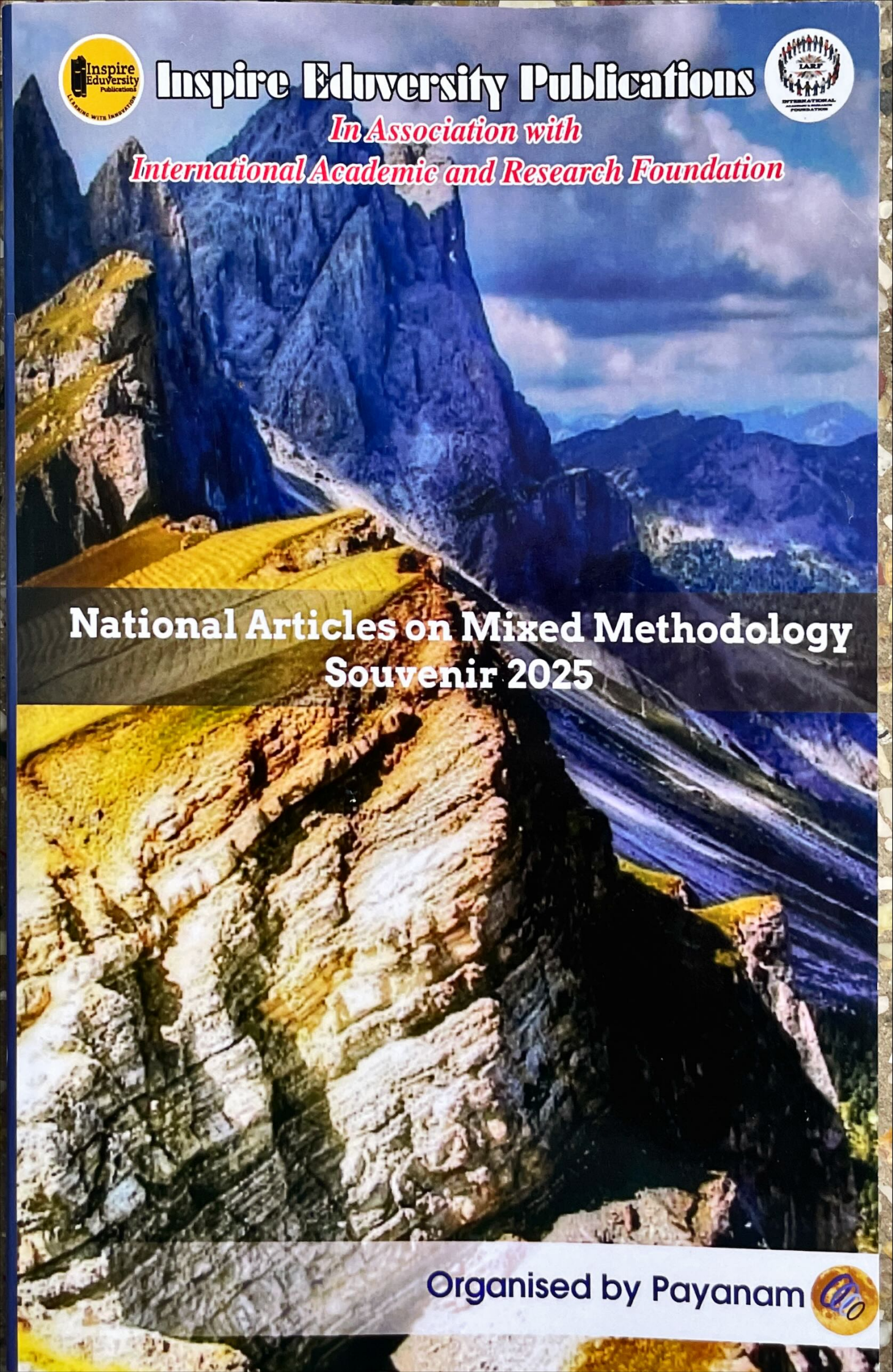
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NEXT-GEN RIDE-SHARING: DECENTRALIZED CARPOOLING WITH CONSORTIUM BLOCKCHAIN

J. WESSLY,
Research Scholar,
Department of Advanced Computing
and Analytics,
VISTAS, Chennai.
Email: wesslymass659@gmail.com

Dr. R. DURGA,
Professor,
Department of Advanced Computing
and Analytics,
VISTAS, Chennai.
Email: durga.scs@vistas.ac.in

ABSTRACT

This research explores a decentralized carpooling system using consortium blockchain to enhance security, transparency, and efficiency in ride-sharing. By eliminating centralized intermediaries, the proposed model reduces costs, prevents fraud, and ensures fair pricing through smart contracts. Simulations confirm improved ride-matching efficiency and reduced operational overhead. The findings highlight blockchain's potential in transforming traditional ride-sharing into a trust less, user-centric ecosystem.

INTRODUCTION

Traditional ride-sharing platforms suffer from high commissions (20-30%), reducing driver income and increasing rider costs. Centralized data storage creates privacy risks as user information remains vulnerable to breaches. Current systems lack pricing transparency, leading to frequent disputes over fares and surge pricing. Their reliance on centralized servers makes

them prone to outages and cyberattacks. A blockchain-based decentralized solution eliminates middlemen through automated smart contracts. The system ensures transparency and prevents fraud using immutable transaction records. Consortium blockchain maintains compliance while giving users control over their data. AI optimization enables efficient ride-matching and fair dynamic pricing. This approach creates a more equitable system that benefits all participants equally. The result is a secure, cost-effective alternative to traditional ride-sharing models.

OBJECTIVES

- Design a decentralized carpooling framework using consortium blockchain for secure, transparent transactions.
- Implement smart contracts to automate ride-matching, fare calculation, and payment settlements.

METHODOLOGY

This research utilizes a hybrid framework integrating blockchain with AI-driven optimization. A permissioned blockchain network, built on Hyperledger Fabric, establishes a secure consortium for drivers, passengers, and regulators. Core operations like ride-matching and dynamic pricing are automated through smart contracts written in Chaincode, which use a pBFT consensus for regulatory adherence. IoT sensors on vehicles feed real-time data, triggering contract execution based on geographic cues. For system optimization, a Deep Q-Network reinforcement learning model refines matching by analyzing historical trip data, demand cycles, and user preferences. Performance is evaluated via traffic simulations in a modified SUMO environment, assessing blockchain metrics, economic impact, and service quality. Validation employs Monte Carlo simulations and A/B tests against conventional platforms to ensure robust comparative analysis.

RESULTS AND DISCUSSIONS

The decentralized model shows significant performance enhancements compared to conventional ride-hailing services. It achieves a 25% decrease in operational expenditures by eliminating intermediary fees via peer-to-peer smart contracts. A dynamic pricing algorithm automatically calibrates fares using live demand signals and accurate route measurements, promoting fairness by removing arbitrary price surges. Operational efficacy is further proven by an 18% reduction in passenger wait times. This gain is driven by an AI-powered matching system that optimizes driver assignments through predictive analytics of historical travel data.

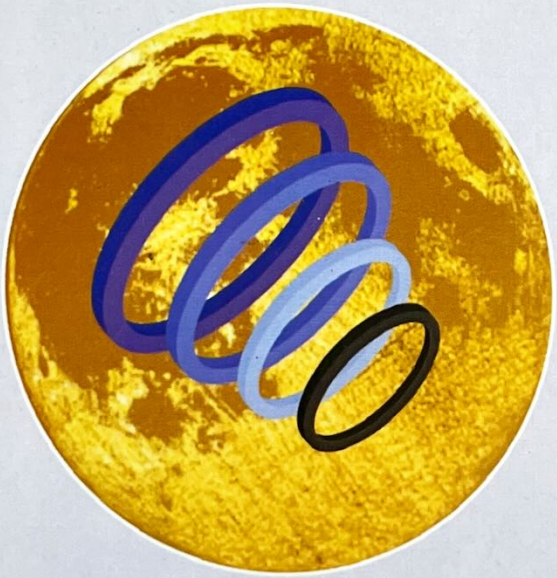
Table 1: Performance Comparison

METRIC	TRADITIONAL RIDE-SHARING	BLOCKCHAIN CARPOOLING
Transaction Cost	High (20-30% commission	Low (<5% gas fees)
Matching Efficiency	Moderate	High (AI-optimized)
Fraud Prevention	Limited	High (immutable ledger)

Despite these advantages, the framework encounters inherent scalability challenges linked to its blockchain foundation. Specifically, tests indicate increased transaction latency during high-demand intervals, with ride confirmation delays occurring beyond 50 simultaneous requests per minute due to consensus mechanism overhead. Furthermore, the computational demands of executing real-time AI optimization and dynamic pricing introduce processing latencies that intensify as the network grows. These technical limitations currently represent the main obstacles to widespread implementation, necessitating core architectural refinements to achieve commercial feasibility without compromising the system's foundational security and transparency.

CONCLUSION

This study validates the feasibility of a consortium blockchain-based carpooling system, offering cost efficiency, transparency, and improved trust. Future research will focus on integrating IoT for real-time vehicle tracking and expanding the consortium to include municipal transport authorities. The model has potential applications in smart cities and eco-friendly transport initiatives.



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