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Novel Approach on Peer-to-Peer Carpooling Using Blockchain

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Abstract: ***Peer-to-peer (P2P) carpooling platforms have emerged as a promising solution to address transportation inefficiencies, reduce traffic congestion, and alleviate environmental impacts. However, existing P2P carpooling systems encounter challenges related to trust, security, and transparency.***
This work proposes a novel approach to enhance P2P carpooling through the integration of blockchain technology. Blockchain, a decentralized and immutable ledger, offers inherent advantages such as trust, transparency, and security. By leveraging blockchain, this proposed system aims to address key issues in P2P carpooling, including identity verification, payment settlement, and data integrity. Smart contracts, programmable self-executing agreements, enable automated transactions and enforce rules within the carpooling ecosystem.

I. INTRODUCTION

Peer-to-peer carpooling, often referred to as P2P carpooling or simply carpooling, is a transportation concept that enables individuals to share rides in their personal vehicles with others who have similar travel routes. It is a cost-effective and environmentally friendly way to reduce the number of vehicles on the road while providing a convenient and shared commuting experience. Peer-to-peer carpooling involves individuals sharing their car rides with others traveling in the same direction, whether it is for daily commutes, long-distance trips, or specific events. Carpooling allows participants to split the cost of fuel and other expenses, making it more affordable than driving alone or using public transportation.

Utilizing technological advancements, carpooling efficiently reduces the number of single-occupancy vehicles on the road. This reduction significantly diminishes air pollution and greenhouse gas emissions, thus advancing a greener and more sustainable transportation option.

Various carpooling platforms and apps have emerged, making it easier for people to find and connect with potential carpool partners. These platforms often include features like scheduling, route planning, and payment options. Many carpooling services offer safety measures such as driver and passenger verification, user reviews, and emergency contact features to enhance the sense of security for participants. Carpooling helps alleviate traffic congestion in urban areas, which can lead to shorter commute times and less stress for participants.

Carpooling can also provide an opportunity for social interaction and networking with fellow travellers during the ride. Carpooling may be subject to local regulations and insurance requirements, so participants should be aware of the legal aspects in their region. Overall, peer-to-peer carpooling offers a flexible and sustainable solution to the challenges of modern transportation, benefiting individuals, communities, and the environment. It's a concept that continues to gain popularity as people seek more efficient and eco-friendly ways to get around.

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II. LITRETURE SURVEY

SL. NO	PAPER TITLE	AUTHOR NAME AND PUBLISHED YEAR	TECHNOLOGY USED	OBSERVATIONS
1.	Peer to Peer Carpooling Using Blockchain	Ms. Feon Jaison, Suhas Chandra R **(2023)**	• Blockchain Network • Smart Contracts • Decentralized Storage	• Trust and Transparency • Efficiency and Automation • Security Enhancement
2.	Survey on Peer to Peer Car Sharing System using Blockchain	Pankaj Desai, Mahesh Kolte Patil, Tanmay Dandile, Shivam Shingare, Prof. K. S. Hangargi **(2022)**	• Reinforcement Learning • Route Planning Techniques • Privacy-Preserving Techniques	• Decentralised Solution • Blockchain Integration • Authentication Protocol
3.	A Systematic Literature Review of Ride-Sharing Platforms, User Factors and Barriers	Annie Kortsari and Georgia Ayfantopoulou, Lambros Mitropoullos **(2021)**	• Cloud Computing Platforms • Geospatial Analysis Software • Machine Learning Models	• User-Centred Design Emphasis • Focus on Barriers • Policy Implications
4.	A Survey on: Real Time Smart Car Pooling and Ride Sharing System using Android Application	Akshay Raut, Rushikesh Bhosale, Kalpesh Avhad, Mahesh Swati, Somesh Jadhav, A. S. Gaikwad **(2020)**	• Global Positioning System (GPS) • Cloud Computing	• Contraction, Insertion, and Dynamic Grid Methods • Smart Peer Car Pooling System

III. METHODOLOGY

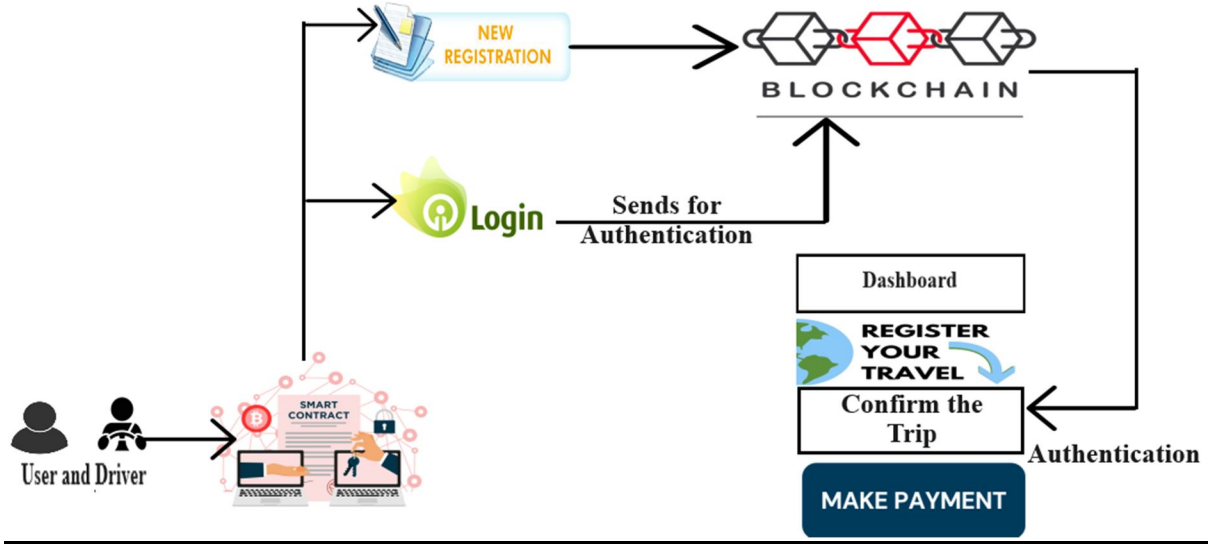
This work will follow an iterative and agile methodology, emphasizing continuous feedback and adaptation. The development process will start with comprehensive research and requirements gathering, analysing user needs and preferences for a decentralized carpooling platform. Prototyping and rapid iterations will be employed to quickly visualize and refine the user interfaces and system functionalities. The development team will leverage blockchain technologies such as Ethereum or Binance Smart Chain, implementing smart contracts for secure transactions and utilizing IPFS for decentralized data storage. Security audits and penetration testing will be conducted at various stages to identify and mitigate vulnerabilities. User feedback will be actively sought through surveys, usability testing, and community engagement to ensure that the platform meets user expectations. This work will also incorporate an ongoing monitoring and maintenance strategy, allowing for timely updates, bug fixes, and feature enhancements based on user experiences and emerging technologies. This iterative and user-centred approach ensures that the decentralized carpooling platform remains secure, user-friendly, and adaptable to evolving user needs and technological advancements.

In the surveyed paper 2023 [1], we have identified areas of lag and are currently in the process of implementing additional features to address these shortcomings. In addition to addressing the identified shortcomings, we are also incorporating new features to overcome the shortcomings.

1) *Identity Verification:* Leverage blockchain for secure and immutable identity verification, reducing the risk of fake profiles or identity theft within the platform.
2) *Tokenized Rewards:* Create a token-based reward system for users who consistently offer rides or exhibit good behaviour within the platform, encouraging more people to participate.

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3) *Emergency Response Integration:* Implement a feature that can automatically notify emergency services and share the user's location in case of accidents or emergencies during a carpooling trip.



[1], Fig 1 Block Diagram of Peer-to-Peer Carpooling.

The block diagram that is fig 1 outlines the workflow of a peer-to-peer carpooling system utilizing blockchain technology. The process begins with users choosing to either register as new participants or log in as existing ones. Upon logging in, authentication measures are employed to ensure secure access. Once authenticated, users gain access to a dashboard, which serves as the central hub for carpooling activities. Within the dashboard, users can register for a trip, initiating a series of interactions with the blockchain. The system confirms the trip details, and users proceed to make payments securely through blockchain transactions. Authentication mechanisms are continually utilized to maintain the integrity of the process. The involvement of riders and drivers is depicted, emphasizing the decentralized nature of the platform. Smart contracts, a fundamental component of blockchain technology, play a crucial role in automating and enforcing the agreed-upon terms for each carpooling transaction. This block diagram encapsulates the seamless integration of blockchain, authentication, and peer-to-peer interaction to facilitate a secure and transparent carpooling experience.

IV. RESULTS AND DISSCUSION

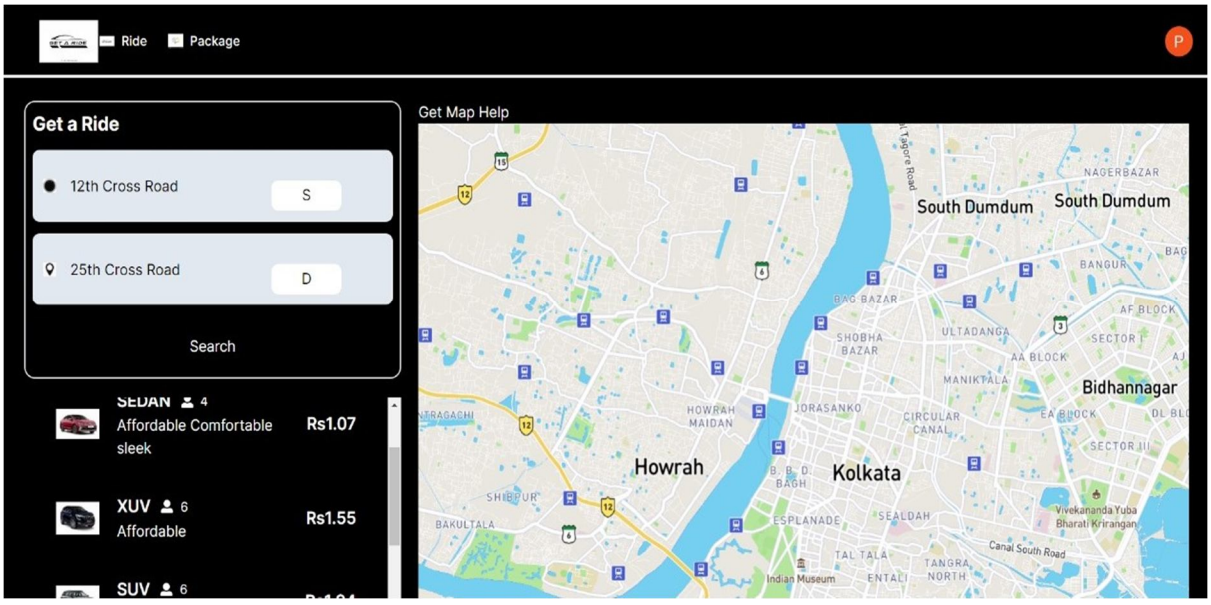


Figure 1 is a user-friendly platform designed for peer-to-peer carpooling, offering a seamless experience. Users simply input their start location and desired destination, and the output provides a route map showcasing the suggested journey. Alongside, it presents a curated list of available cars with respective prices, empowering users to select the most suitable option.

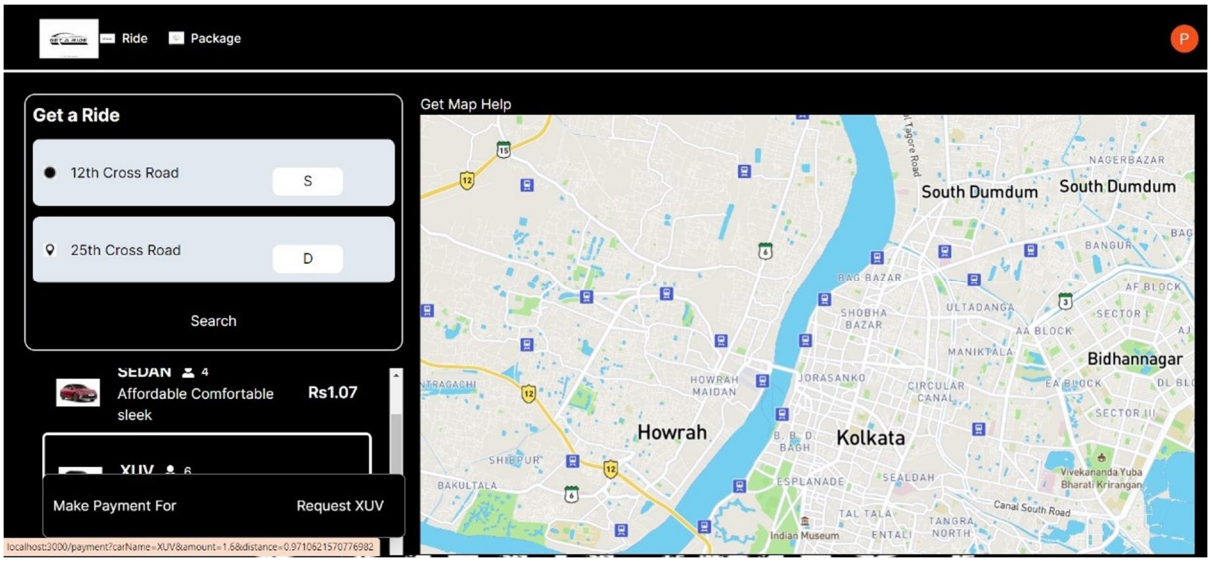


Figure 2 After selecting a car from the list provided, users encounter a pop-up message prompting them to proceed to payment. This message serves as a confirmation step, ensuring users are ready to finalize their carpooling booking. Upon clicking the pop-up, users are seamlessly directed to the payment section of the platform.

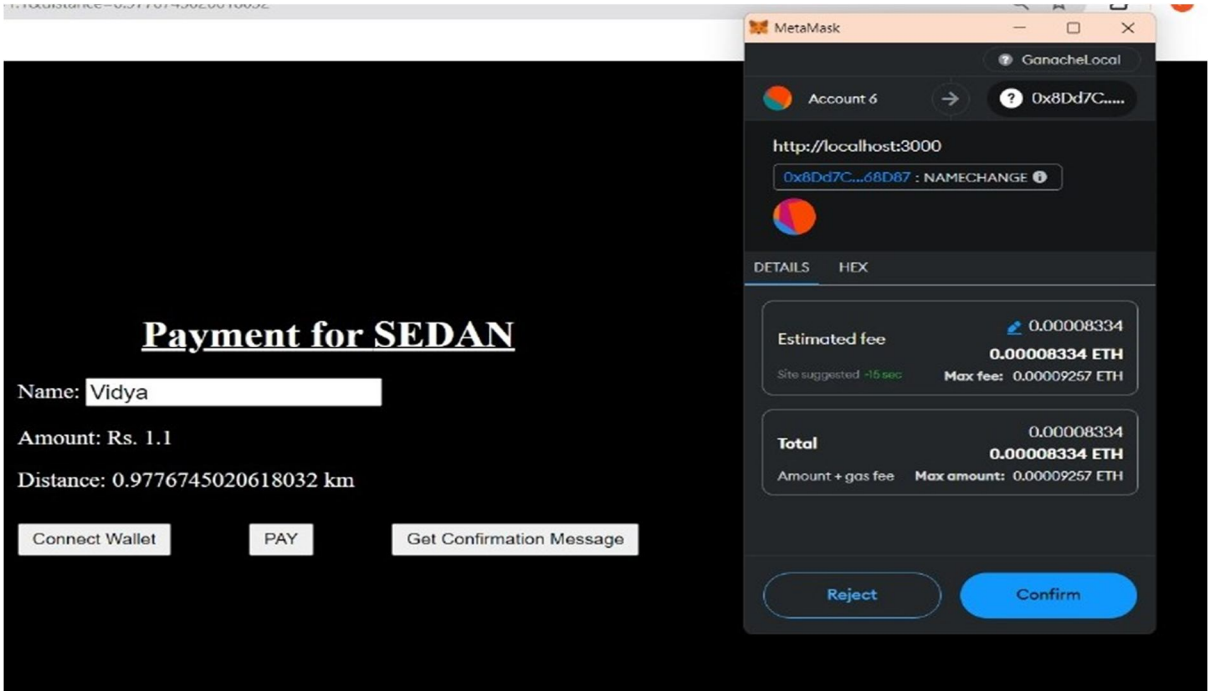


Figure 3 Following the car selection process, users are directed to the payment section where they can complete their transaction using ethers from their accounts. In this section, users are presented with a choice of accounts linked to their profile, each containing a balance of ethers. They can select the most suitable account from which to make the payment. Once the account is chosen, users are provided with options to confirm or cancel the payment. This additional confirmation step ensures that users have the opportunity to review their selection and make any necessary adjustments before finalizing the transaction.

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By offering flexibility in account selection and incorporating a confirmation prompt, prioritizes user control and security, enhancing trust and confidence in the payment process.



Figure 4 After the user successfully completes the payment, a confirmation message is displayed, reassuring them that the transaction has been processed. This confirmation message serves to provide peace of mind to the user and signals the completion of the booking process. Simultaneously, a message is automatically dispatched to the driver of the selected car, notifying them of the upcoming ride. This message contains essential details such as the user's name, pickup location, and destination, ensuring the driver is well-informed and prepared for the journey ahead. By promptly notifying the driver, fosters clear communication and coordination between both parties, facilitating a smooth and efficient carpooling experience for all involved.

III. CONCLUSION

The implementation of a blockchain-based peer-to-peer carpooling platform represents a significant leap forward in the realm of transportation technology. By addressing the privacy concerns, security vulnerabilities, and lack of transparency inherent in centralized carpooling systems, this innovative solution not only ensures secure and efficient transactions but also empowers users and drivers by eliminating intermediaries and enhancing trust. Through the proposed approach, which leverages blockchain technology, user-friendly interfaces, rigorous security measures, and active community engagement, this work aims to revolutionize the way people commute, fostering a global network of secure, transparent, and user-centric carpooling experiences.

IV. ACKNOWLEDGEMENT

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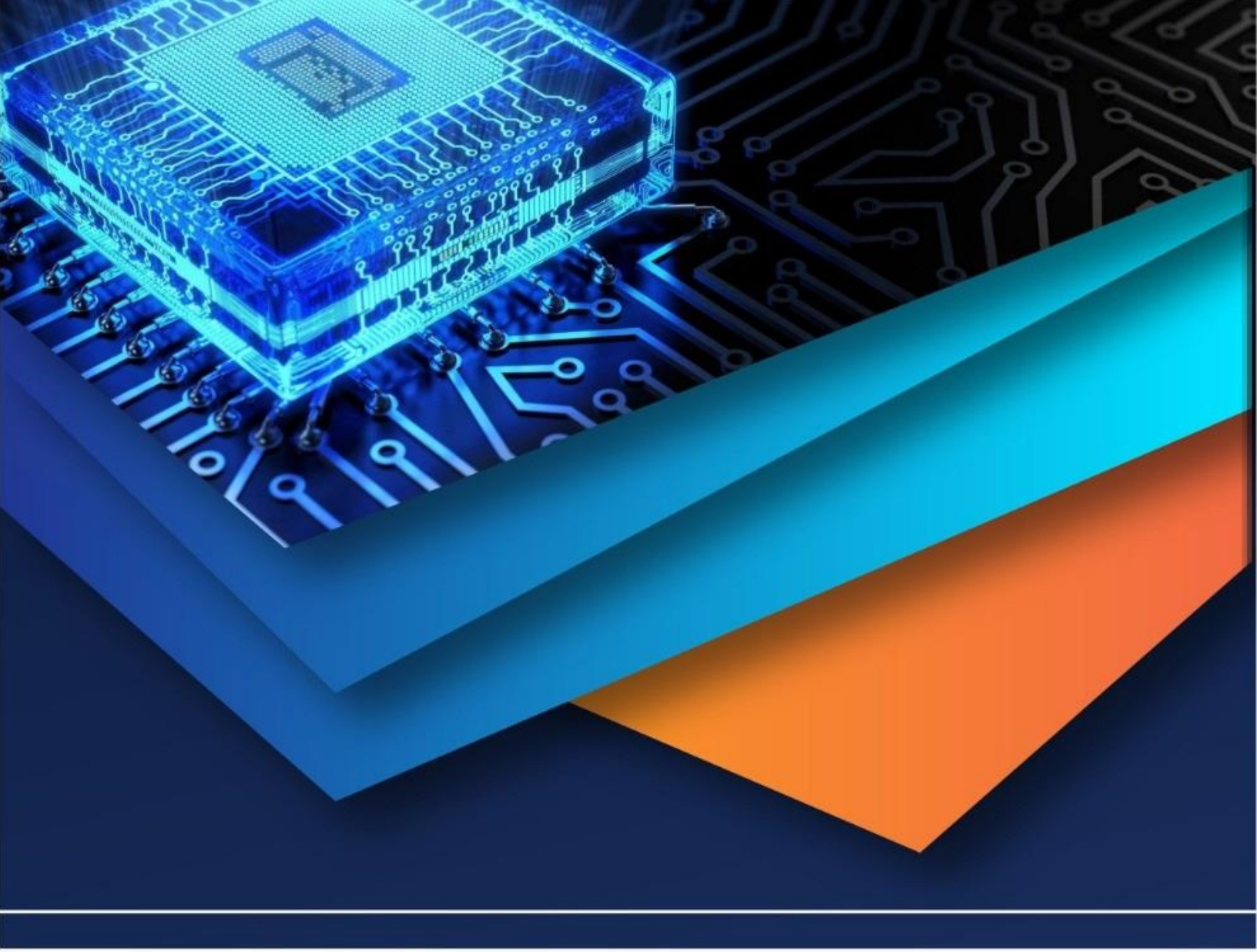
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