iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** I **Month of publication:** January 2025

DOI: https://doi.org/10.22214/ijraset.2025.66534

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue I Jan 2025- Available at www.ijraset.com

Building a Blockchain-Based Messaging Application on Ethereum

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Abstract: ***Decentralized application make use of peer-to-peer networks, this ensures that no network failure can occur due to central node failure. Blockchain serves as an immutable ledger which allows messaging to take place in a decentralized manner. A decentralized application for communication and resource sharing is need in today's world, where keeping data on a centralized server can be risky and costly experience. With the help of various consensus, we can implement different ways to share resources and communicate. Together with Blockchain and Decentralized Applications, we can create a secure and reliable messaging application that overcomes the drawbacks of traditional messaging applications.***
Keywords: blockchain, centralized, consensus, decentralization, immutability.

I. INTRODUCTION

Messaging applications are an important part of today's digital world, but the traditional platforms often rely on centralized servers, raising concerns about data privacy, security, and censorship. Blockchain technology offers a solution by enabling decentralized messaging applications, which address these issues. It presents blockchain-based messaging and how one can build this type of app on the Ethereum platform. We'll focus on Ethereum because of its smart contract functionality, so we will have code examples to explain how one can implement the concepts. By the nature of the distributed network where such blockchain-based messaging applications store messages, no one controlling these data increases the odds of breaches or unauthorized access to the information. Some primary components include 'user identities,' 'message transactions,' and encryption techniques. The users develop digital identities on the blockchain and securely communicate without involving third-party intermediaries. By decentralizing data storage and communication, blockchain messaging offers a more secure and private alternative to traditional messaging platforms.

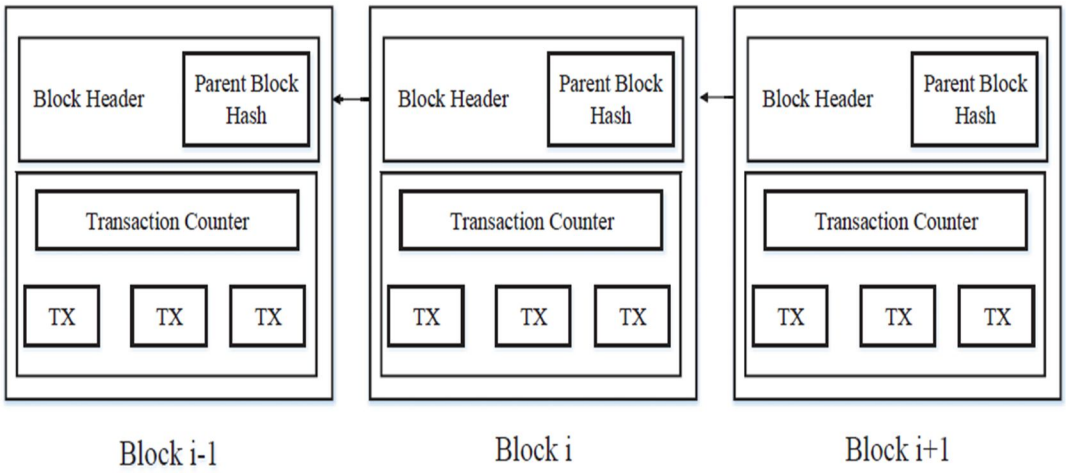

Figure: An example of blockchain which consists of a continuous sequence of blocks

The four main components of blockchain ecosystem are as follows:

- a node application
- a shared ledger
- a virtual machine

1) Node Application

Each Internet-connected computer needs to install and run a computer application specific to the ecosystem they wish to participate in. Using the case of Bitcoin as an example ecosystem, each computer must be running the Bitcoin wallet application.

2) Shared Ledger

This is a logical component. The distributed ledger is a data structure managed inside the node application. Once you have the node application running, you can view the respective ledger (or blockchain) contents for that ecosystem.

3) Virtual Machine

The virtual machine is the final logical component implemented as part of the node application that every participant in the ecosystem runs. To understand the capabilities added to an ecosystem by including a virtual machine let‘s take a quick look at what a virtual machine is.

Decentralized Application Structure Decentralized Application consists of multiple nodes connected to each other in a mesh topology type network. They are connected to each other in a Peer-to-Peer fashion. Blockchain is a sequence of blocks, which holds a complete list of transaction records like conventional public ledger.

II. LITERATURE REVIEW

A. Decentralized Technology in Communication

Decentralized technology improves efficiency, streamlines processes, and fosters trust across industries. Peer-to-peer (P2P) chat systems replace centralized servers with distributed servers on user devices. Blockchain-based chat applications offer secure features like chat history access, smart contracts, encryption, and multifactor authentication.

B. Decentralized Systems and P2P Communication

Papers [2] and [4] highlight the scalability, privacy, and security of P2P systems. Paper [3] discusses blockchain architecture and consensus mechanisms.

Paper [6] explores applications like supply chain management, record-keeping, and secure communication for ACT and aircraft. Paper [5] focuses on P2P reference architecture for decentralized communication.

C. The Growing Adoption of Decentralized Technology and Its Applications

Decentralized technology provides innovative solutions to common problems and is rapidly growing in adoption. Applications like DUST and E-Chat lead with features like timed message deletion, cryptocurrency wallets, and Ethereum blockchain integration. Enterprise tools like Microsoft Teams and Skype for Business lack decentralized technology, indicating a gap in adoption.

D. Real-Time Applications of Decentralized Technology

Decentralized technology is revolutionizing industries through real-time applications like secure messaging, cryptocurrency transactions, and transparent supply chain management. These solutions offer enhanced privacy, efficiency, and automation, transforming sectors like finance, cloud storage, and energy trading.

E. Advancing Decentralized Technology

To advance decentralized technology, focus on improving blockchain scalability, smart contract optimization, and cross-chain interoperability while promoting adoption in mainstream enterprise solutions. Collaboration with industry leaders, policymakers, and education initiatives will be essential for accelerating real-world implementation and ensuring regulatory compliance.

F. Decentralized Technology Enhancing Scalability, Interoperability, and Regulatory Compliance

Decentralized technology aims to enhance scalability, interoperability, and smart contract optimization for broader industry adoption. Collaboration with policymakers and technology leaders is key to ensuring regulatory compliance and empowering users with secure, transparent systems.

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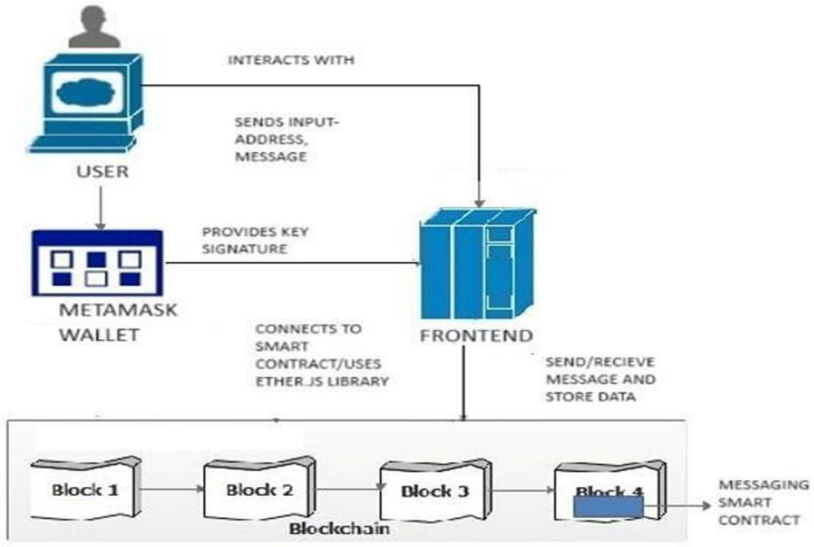
III. METHODOLOGY

Building a decentralized blockchain powered chat application involves multiple well-defined steps, each crucial to the success of the project. Below is a detailed description of the methodology followed in this project:



The proposed system shall be a decentralized messaging web application, bypassing the traditional bottleneck of centralizations through blockchain technology. In comparison with the apps having a dependency on centralized servers for operation, in our system, application services will be handled on a network of nodes while allowing for the scale through hosting from blockchain. Built in Solidity on smart contracts to manage data and React components talking to the contract through the library ethers.js; users connect directly to the contract using their public key, facilitating fluid communication within a decentralized framework but with enhanced security and privacy in comparison to any centralized alternatives.

IV. PROPOSED SYSTEM

The proposed system aims to build upon the existing systems by focusing on more on all the user data is stored on a block which is connected to other blocks forming a chain. As the name suggests, a decentralized application does not have a centralized server. It is basically a peer-to-peer network. Also the data that is stored in block is almost impossible to view as a very secure encryption and hashing functions (256 bits) are used. Also is a hacker tries to make changes to the information in block then, he/she will have to make changes to all the copies of that block on whole blockchain network and that can be quite impossible. Though block are on all nodes, they cannot access the information in it, only the person for whom the information if can access it

V. RESULT

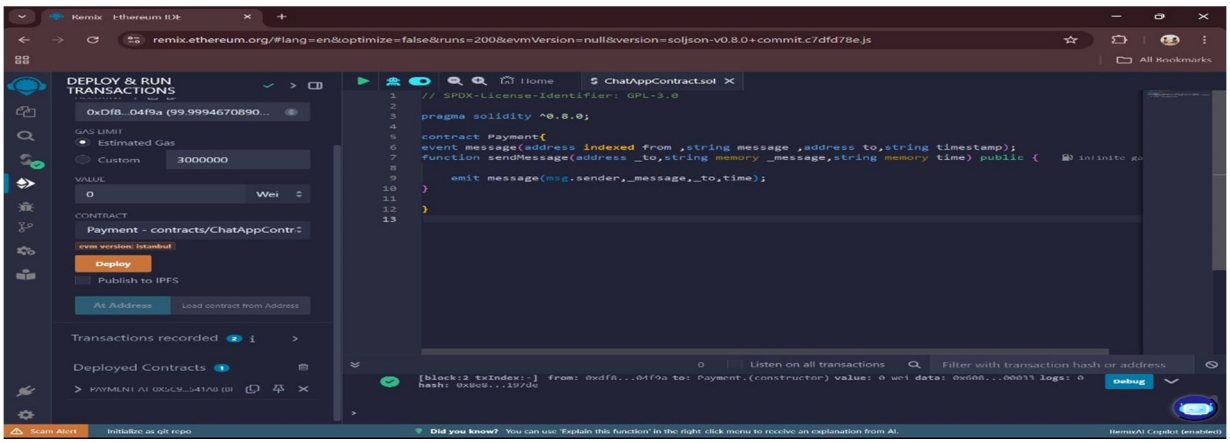


Fig: Remix - Ethereum IDE and community - remix-project.org

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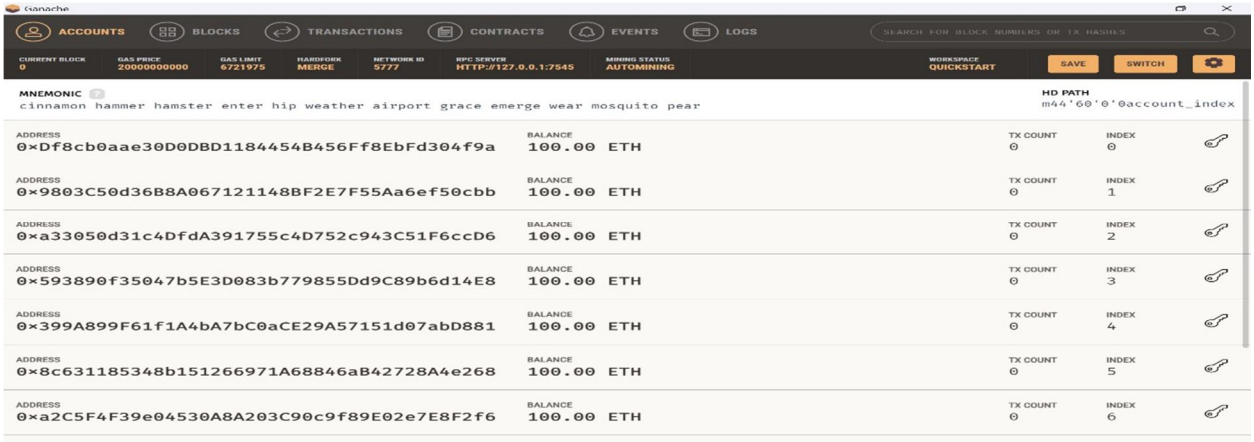

Fig: Ganache Development Tool

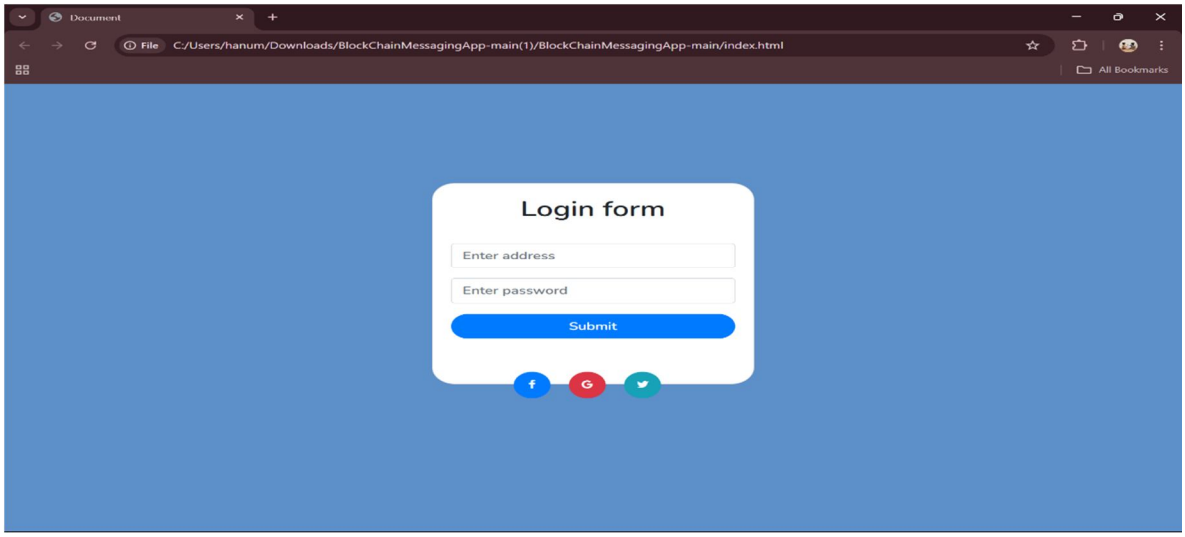

Fig: Login page

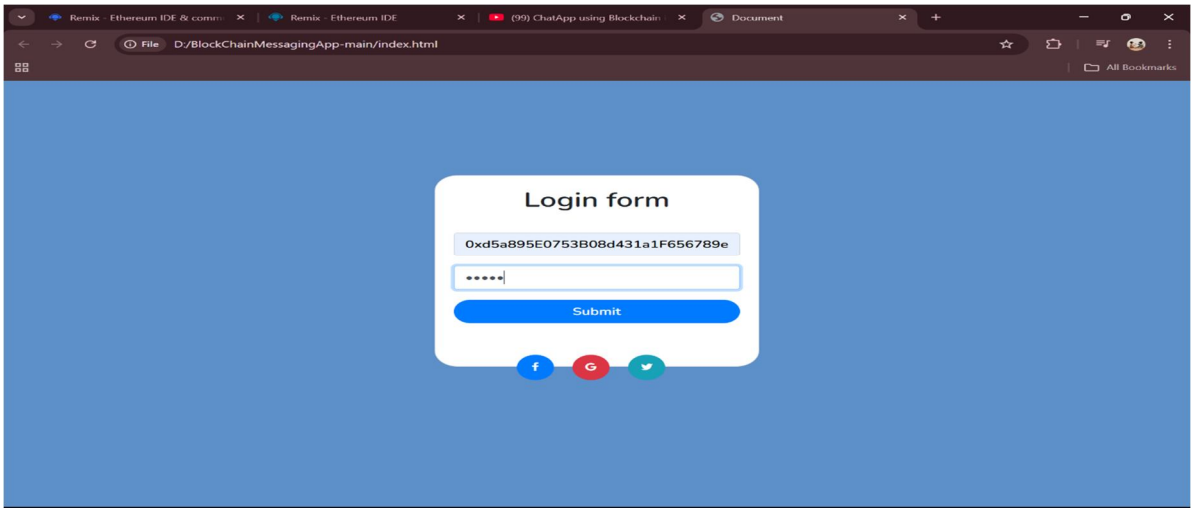

Fig: User Credentials

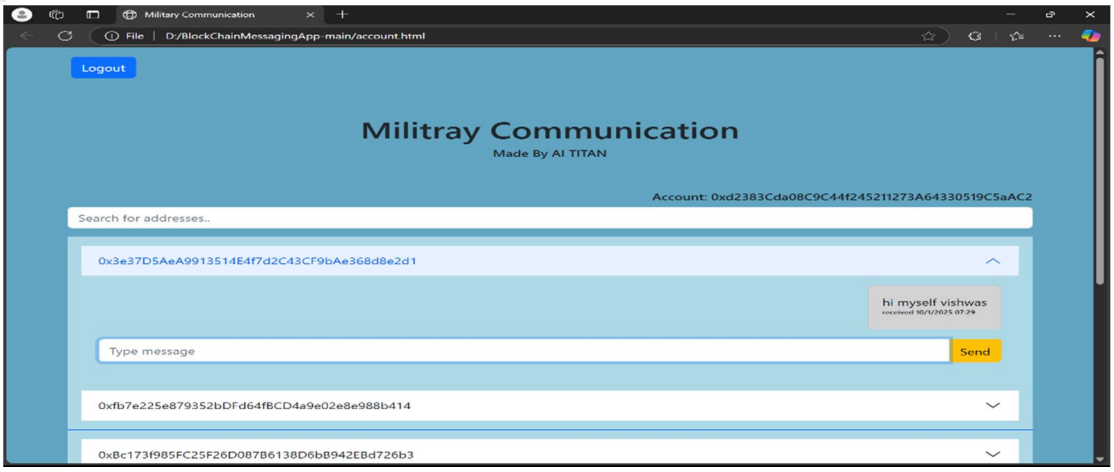

Fig: Page where user1 message will be displayed

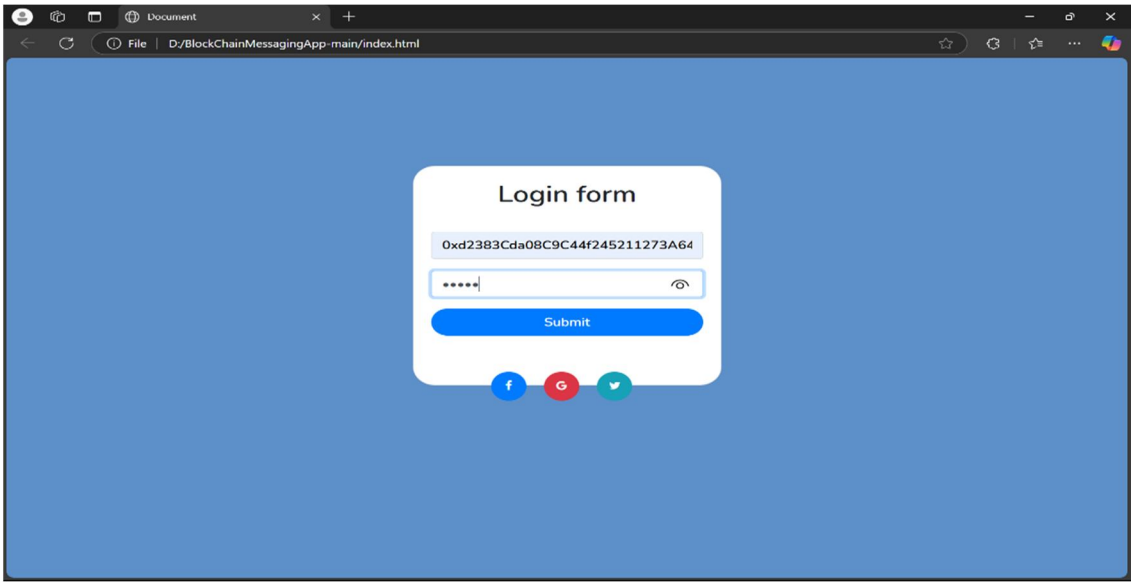

Fig: Another end user's credentials replying for user1

Fig: Page where user1 message is received and user2 has replied

VI. FUTURE SCOPE

In future iterations of the project, the focus will be on augmenting the exception handling mechanisms within the application to effectively manage anomalies in user behavior. This enhancement aims to fortify the application's resilience against unexpected scenarios, thereby bolstering its robustness and reliability in real-world usage scenarios. Furthermore, efforts will be directed towards expanding the maximum message size allowable within the application. Currently capped at 32 bytes, this limitation imposes constraints on the richness and complexity of communication that users can engage in. By exploring methods to increase this limit, the objective is to enable users to transmit more comprehensive and detailed messages, thus enhancing the overall user experience and utility of the application

VII. CONCLUSION

This project successfully demonstrates blockchain offers secure, transparent solutions for industries like healthcare, IoT, and finance, with applications such as fraud prevention in e- commerce. This study provides an overview of blockchain technology, covering its background, classification, architecture, and consensus types. his research paper has presented the development and implementation of a decentralized messaging web application leveraging blockchain technology. By addressing the limitations inherent in centralized messaging systems, such as privacy vulnerabilities and susceptibility to censorship, our decentralized application offers a promising alternative characterized by enhanced security, reliability ,and user autonomy.

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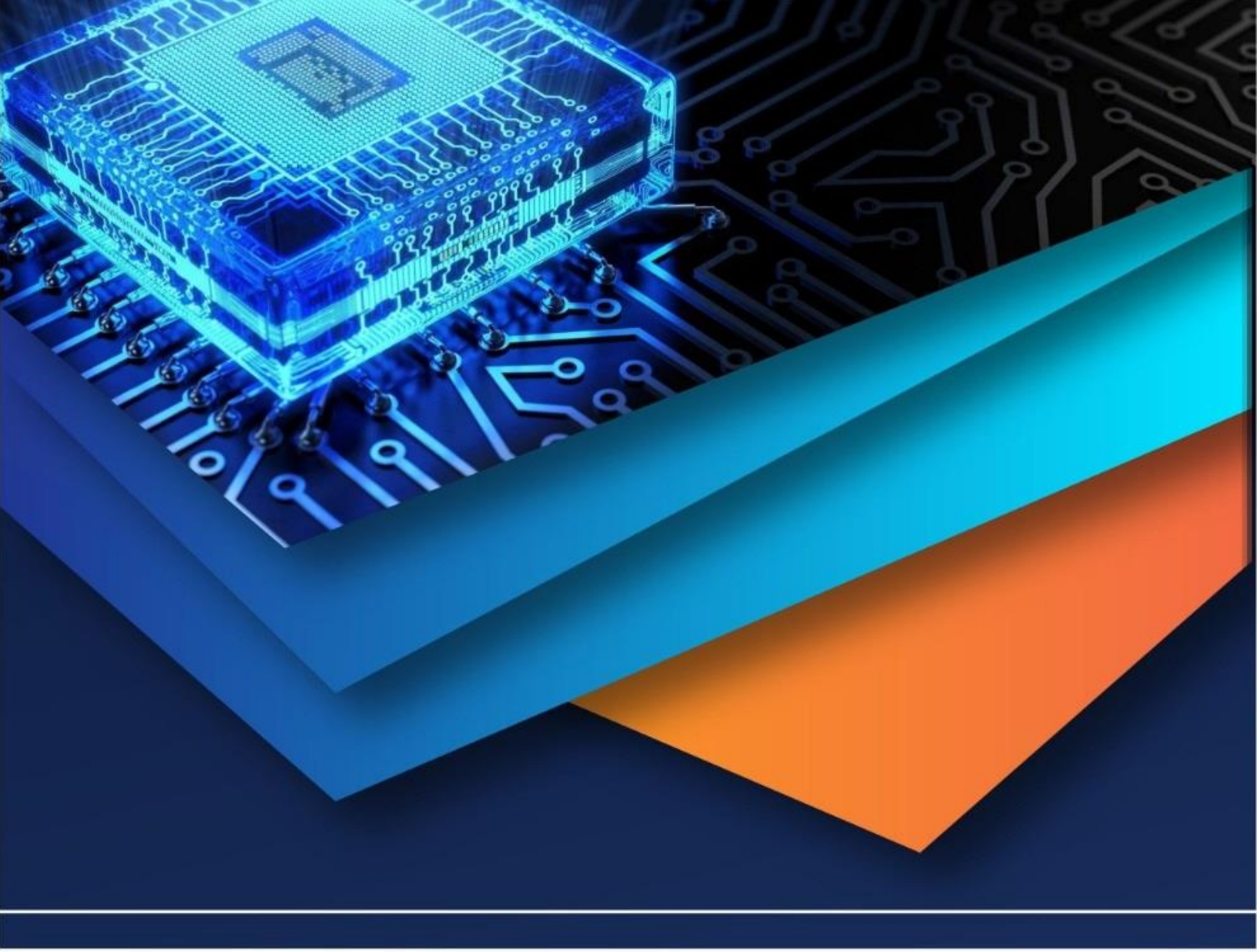

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