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Blockchain Use in Healthcare Data Storage

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Abstract: ***Healthcare is an industry which needs to maintain a large amount of critical medical Data. Which may include the patient's historical data, medical record, and patient's private Information, etc. this information is very critical and needs to be stored and maintained securely. Whenever people hear about blockchain their mind might typically think about banking and financial markets. But we can use blockchain technology for decentralized Healthcare data storage. Blockchain used in healthcare is called as health blockchain. The proposed system increases data security and removes the cost, time, and resources required to manage the healthcare data records.***

Keywords: Healthcare Blockchain Technology, Healthcare Data Storage, Transaction Verification, Data Security.

I. INTRODUCTION

It is a very exciting time for health care and information technology (IT). Due to improvements in genetic research and the advancement of precision medicine, health care is witnessing an innovative approach to disease prevention and treatment that incorporates an individual patient's genetic makeup, lifestyle and environment. Simultaneously, IT advancement has produced large databases of health information, provided tools to track health data and engaged individuals more in their own health care.

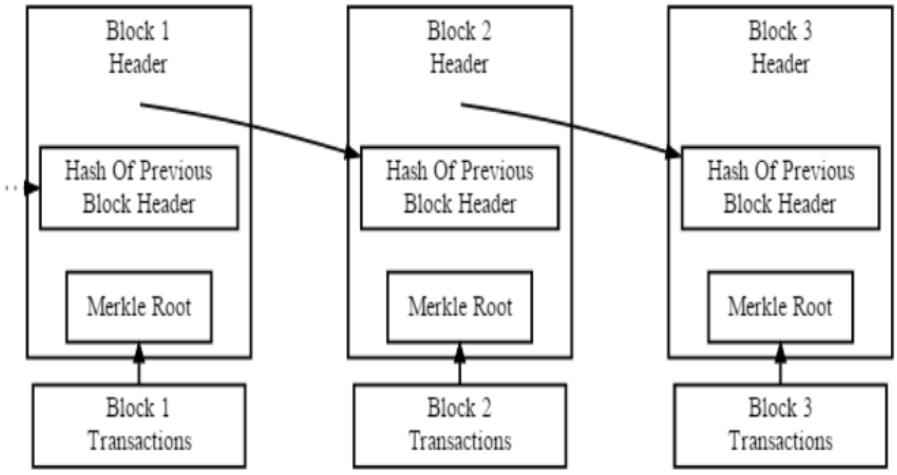


Figure: - Blockchain consensus sequence of blocks

Blockchain technology has the potential to address the interoperability challenges currently present in health IT systems and to be the technical standard that enables individuals, health care providers, health care entities and medical researchers to securely share electronic health data.

A. Blockchain Model for Health Care

Any blockchain for health care would need to be public and would also need to include technological solutions for three key elements: scalability, access security and data privacy.

B. Scalability

For health care to realize benefits from blockchain, the blockchain would need to function as an access-control manager for health records and data. The health blockchain would contain a complete indexed history of all medical data, including formal medical records as well as health data from mobile applications and wearable sensors, and would follow an individual user throughout his life.

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C. Access Security and Data Privacy

The user would have full access to his data and control over how his data would be shared. The user would setup specific, detailed transactions about who has access, the allotted time frame for access and the particular types of data that can be accessed. Access control policies would also be securely stored on a blockchain and only the user would be allowed to change them. This provides an environment of transparency and allows the user to make all decisions about what data is collected and how the data can be shared.

Technical Advantages of a Health Care Blockchain

1) The health blockchain would be developed as open-source software.
2) Blockchain would run on widely used and reliable commodity hardware.
3) Blockchain technology also addresses the interoperability challenges within the health IT ecosystem.
4) Blockchain would allow patients, the health care community and researchers to access one shared data source to obtain timely, accurate and comprehensive patient health data.
5) Blockchain works with standard algorithms and protocols for cryptography and data encryption.
6) No single point of failure with blockchain distributed architecture
7) Blockchain would ensure continuous availability and access to real-time data.

II. LITERATURE REVIEW

The author of [1] paper discusses how to improve the supply chain quality management by adopting the blockchain technology and propose a framework for blockchain-based supply chain quality management. This framework will provide a theoretical basis to the intelligent quality management of supply chain based on the blockchain technology. Also, it provides a foundation to develop theories about information resource management in distributed, virtual organizations, especially distributed, cross-organizational and decentralized management theory.

A. This paper focuses the various opportunities of blockchain for usage in the healthcare sector, for eg. In public health management, user-oriented medical research based on personal patient data as well as drug counterfeiting. This paper proposed an Ethereum blockchain technology for decentralized healthcare database. Through this shared network infrastructure, different healthcare specialists can access the same information.

B. The current paper describes how the blockchain is important for storing healthcare data on cloud. It also proposed a data security and privacy while data storing. When new healthcare data for a particular patient is created (e.g. from a consultation, and medical operation such as a surgery), a new block is instantiated and distributed to all peers in the patient network. After a majority of the peers have approved the new block, the system will insert it in the chain.

C. This paper described a set of evaluation metrics, from both the technical and domain perspectives, to assess healthcare DApps using blockchain technology and serve as an initial guide for creating future apps in this domain. Blockchain offer properties of decentralization, transparency, and immutability that can potentially be leveraged to improve healthcare interoperability.

D. In this paper, they have conducted a comprehensive survey on blockchain technologies. It laid out four underpinning concepts behind blockchain and analyzed the state of the art using these concepts. They presented our benchmarking framework, BLOCKBENCH which is designed to evaluate performance of blockchain as data processing platforms. Finally, This paper also discussed four potential research directions, inspired by database design principles, for improving blockchain performance.

E. This white paper presents several promising use cases for applying blockchain technology in health care, especially related to interoperability, claims adjudication, supply chain and longitudinal patient care records. The most important takeaway to keep in mind is that blockchain, while progressing quickly, is still very much an emerging technology.

However, if support for blockchain from the ONC continues, we may see national or regional ONC-sponsored experimental implementations that may soon lead to meaningful advances in new solutions that lower overall health care costs and contribute toward improved patient participation, and even contributions toward health care research. Given the speed of advancement in blockchain technology, health care professionals would be wise to closely track new blockchain-related health care applications.

III. PROPOSED SYSTEM

Nowadays, majority of the people buy the counterfeits product, because they not aware or track the product ownership, the manufacturer of the product. So our main motivation to implement this system is to maintain the product ownership in SCM and provide the anti-counterfeits products to end users/consumers.

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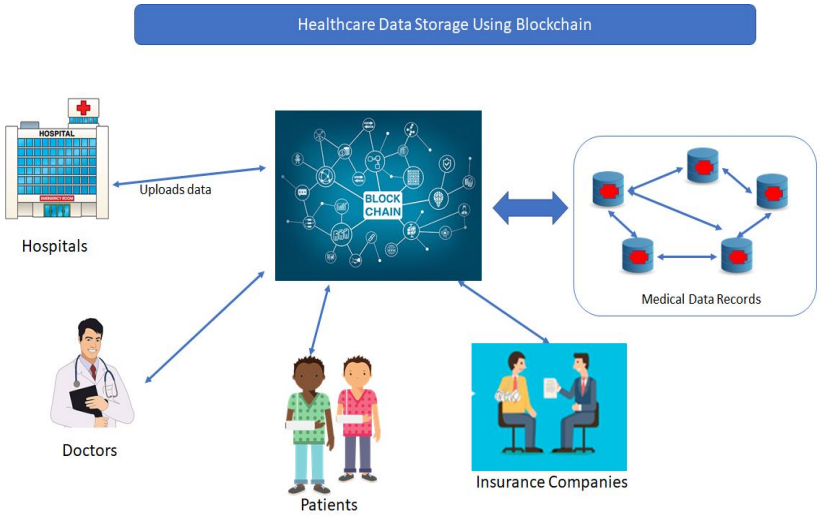


Figure: - System Architecture.

A. Patient Account

The user will add their personal information for creating their new account. It also contains their health records and medical history.

B. Report Submission

Hospital authority will submit the patient medical report. Submitted report will append with the patient existing history. Submission of one report generates one transaction.

C. Generate Transaction

From report submission to the billing process activity generates a number of transactions. All transactions are connected sequentially to each other like linked list.

D. Block Generation

A block contains more than 500 transactions on average. In this phase the generated block contains all transaction of the particular user/patients. The newly generated block is added into the existing blockchain. A block is composed of a header and a long list of transactions.

E. Block Header

It contains metadata about a block i.e. Previous block hash, mining competition, Merkle tree root etc.

1) Transaction List: It contains long transaction list.

E.g.

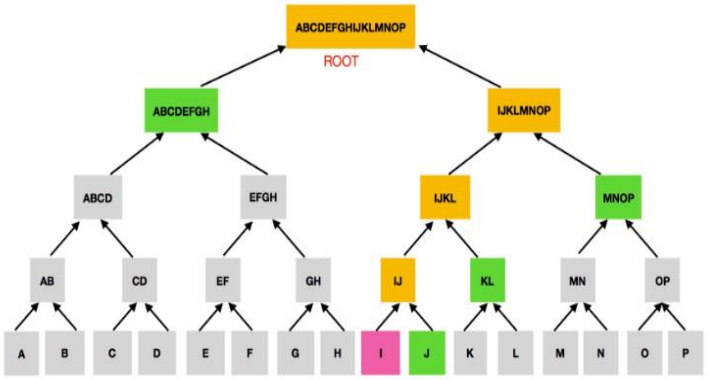


Figure: - Merkle Tree.

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F. Transaction Verification

Insurance Company Officer will act as a validator. After raising insurance claim to the insurance company, the office will validate the patient transaction history.

G. Final Outcome

After validating the patient transaction officer will approve or reject the claim. And transfer claim money to the patient account.

IV. TECHNOLOGY USED

A. The Inter-Planetary File System (IPFS)

1) Aims: Distributed application creation.The Inter-Planetary File System, IPFS is a decentralized file sharing platform that identifies files through their content.

a) When a file is uploaded to IPFS, it is split into chunks, each containing at most 256 kilobytes of data and/or links to other chunks.

b) Every chunk is identified by a cryptographic hash, also named content identifier that is computed from its content.

2) Identifier

a) Node IDs: Public Key Hash.

3) Routing in DHT, Based on

a) Other peer's network addresses.

b) Object names.

4) DHT: S/Kademlia: It stores two different types of information.

a) First, whenever a file is uploaded through a node, the latter registers itself as a provider of the file's chunks.

b) Second, the DHT contains information on how to connect to a node with a specific identifier, for example by providing an IP-address.

5) Block Exchange

a) Like BitTorrent, but not exchange not limited to blocks in a torrent.

b) Incentivizing cooperation (different strategies: tit-fortat, currency-based etc.).

c) Per-node ledger for accounting transfers that is exchanged when nodes "connect".

6) Object Merkle Directed Acyclic Graph (DAG)

a) Because of the Merkle DAG, an entire file can be identified by just using the root hash.

b) On top of DHT/block exchange.

c) Objects are immutable.

d) Generalization of Git data structure.

V. RESULTS AND DISCUSSION

A. Patient Details

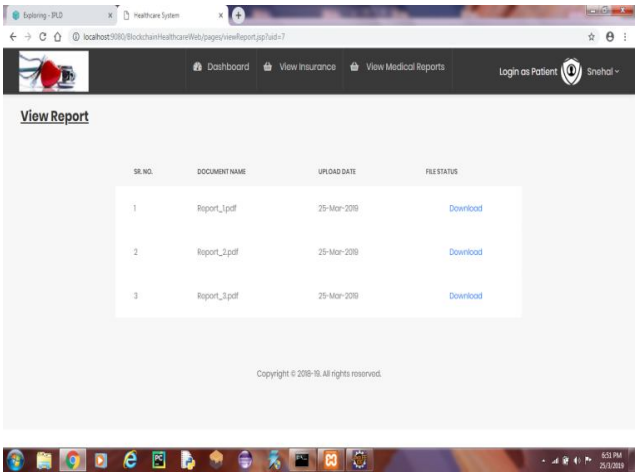


Figure: - View Patient Details.

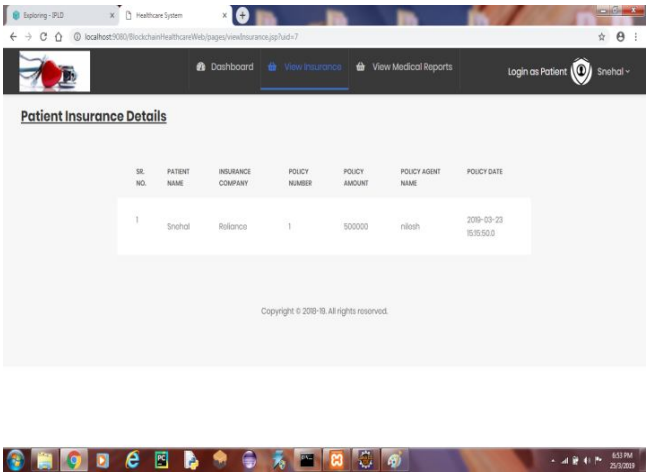


Figure: - Patient Insurance Details

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In Patient Details the doctor view the patient report with the document name, document uploaded date and file status. Also the in-patient insurance it has the details like patient name, insurance company, policy number, policy amount to be paid, policy date and policy agent name.

B. Doctor Details

In the dashboard of the doctor where it includes total test request, Pending test request and completed tasks.
Here the doctor can add the prescription of the patient and bill details of the patient to be paid.

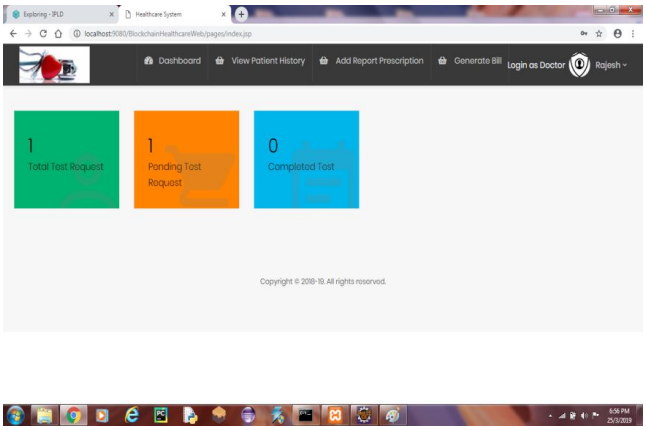


Figure: - Dashboard of Doctor.

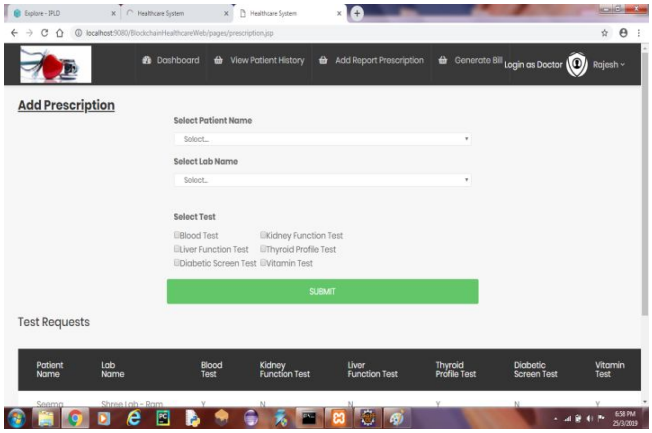


Figure: - Add Patient Prescription

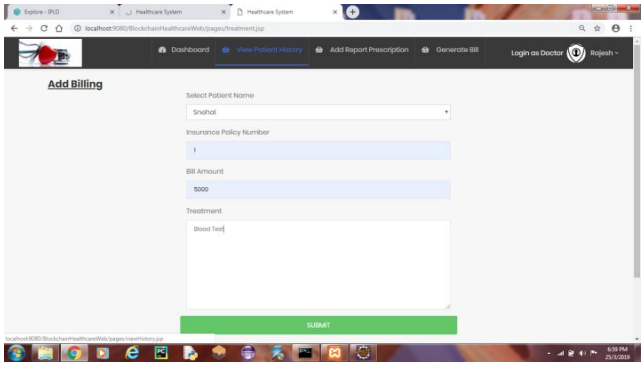


Figure: - Add Bill

C. Lab Assistant (Pathology)

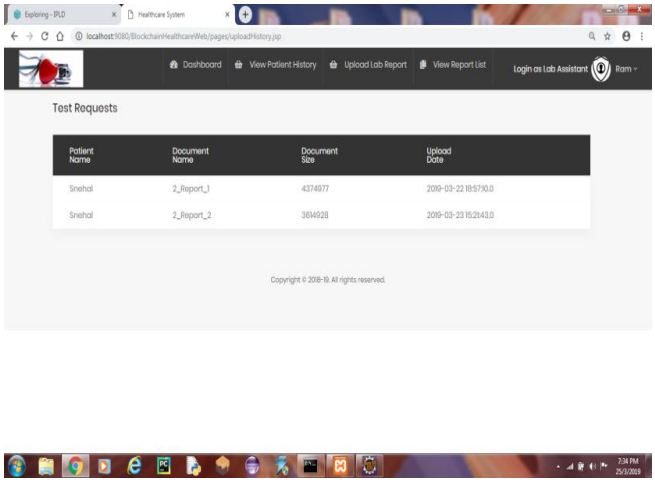


Figure: - Patient Test Request.

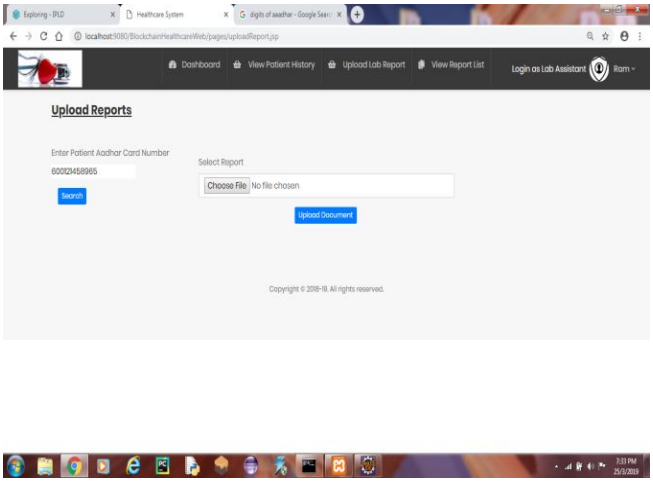


Figure: - Upload the report.

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The Above figure is Patient Test report that has been uploaded by lab assistant for examination of the doctor, with patient name, document name, size of the document and document upload date.
The Patient test reports are uploaded by the lab assistant using the patient Aadhar card number and then attach the respective report and upload it so that it can be accessible by doctors for the patient's examination.

D. Insurance Officer

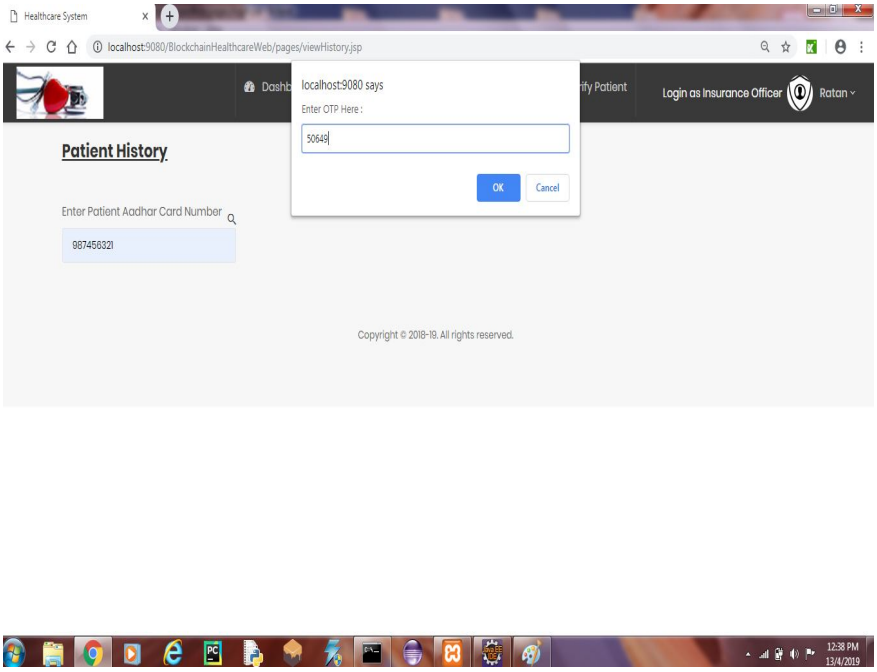


Figure: - Verify Patient.

1) Advantages

a) Avoid fraud in Insurance coverage policy.

b) Provide privacy and top-level security in storing healthcare data.

VI. CONCLUSION

Blockchain is based on open source software, Open API's, and commodity hardware. These components facilitate easier and faster interoperability between systems. It can efficiently scale to handle larger volumes of data and more blockchain users. This paper gives the survey the different techniques used by the researcher for implementing blockchain in various sectors. The proposed system can help to solve problems of security in supply chain management.

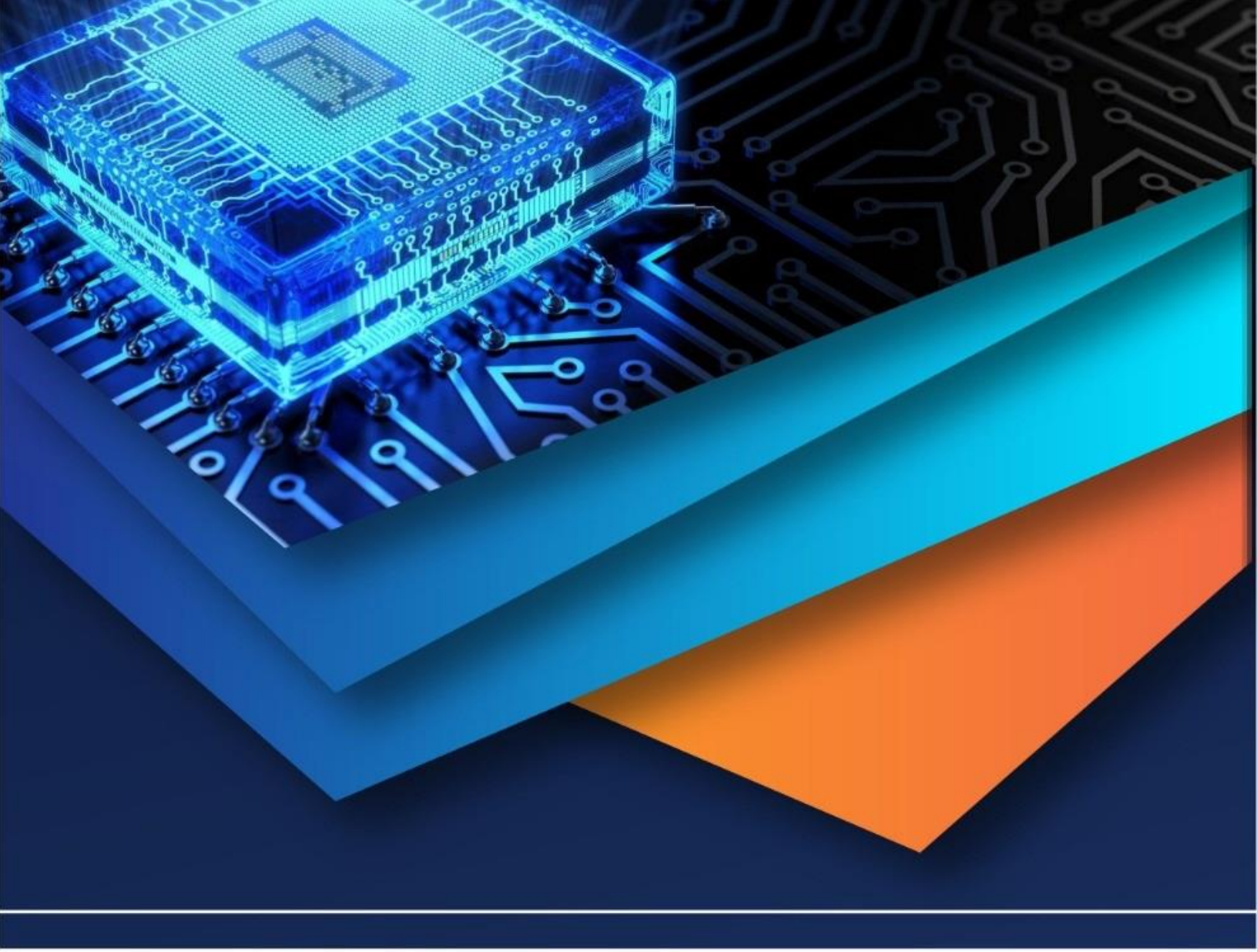
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