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SMART DOOR LOCK SYSTEM USING BLOCKCHAIN BASED ON SOLANA TECHNOLOGY

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Abstract— **Smart door lock system is based on blockchain technology which plays an important role in securing homes and properties. Blockchain technology improves security, trust, and privacy in smart door lock systems. This research paper presents an ideal approach to enhancing the security and efficiency of smart door lock systems by incorporating blockchain technology based on the Solana platform. It enhances security by using a decentralized consensus method to necessitate centralized authority. The system is resistant to single points of failure and unauthorized access attempts. In this study, we propose a blockchain-based smart door lock, specifically designed with the help of the Solana platform. The goal is to enhance the security and performance of traditional door lock systems by utilizing the decentralized, tamper-proof, and unchangeable properties offered by blockchain technology. Solana blockchain technology makes smart door lock systems safer and more efficient.**

Keywords— **Smart Door lock system, Blockchain, Solona, Security.**

I. INTRODUCTION

I. INTERNET OF THINGS

The Internet of Things (IoT) and blockchain technologies have transformed many parts of our lives, including home security systems. Traditional door lock systems have frequently depended on centralized authority and traditional procedures, which might pose risks and restrictions. Integration of blockchain technology with smart door lock systems has emerged as a possible answer to these difficulties. Decentralized, tamper-proof, and transparent aspects of blockchain can dramatically improve the security, reliability, and efficiency of door lock systems.

The blockchain is a shared public ledger of all completed transactions that is distributed among involved parties and functions as a distributed database of records. The consensus of a majority of the system's users verifies each transaction on the public ledger. Data Integrity is the concept that once input, information can never be removed [5]. A blockchain makes it possible to create apps quickly without the requirement for peer trust to be established. Due to its constant nature, capacity to guarantee non-denial of data, and duty of storing it, this form of invention has become increasingly popular on a global scale. The widespread availability of information on computer networks also brings with it difficulties in organizing and processing massive amounts of data with short latency.[6]

Solana is a high-performance blockchain platform that can process a huge number of transactions per second while charging cheap fees. The scalability and transaction speed of Solanas architecture is built to handle transactions rapidly and efficiently. This implies that access requests and authorization transactions may be completed quickly in a smart door lock system, allowing for near-instantaneous door unlocking. The scalability of Solanas guarantees that it can manage a high volume of access requests, making it suited for installations in big buildings or busy situations. Smart contract capability Solana enables smart contract execution, which is the execution of self-executing contracts with preset rules and circumstances.

II. BLOCKCHAIN

One of the most popular study topics in recent years is blockchain [7, 8]. A blockchain network consists of numerous members or nodes, which might be individuals, organizations, or computers. [10]. It offers a framework for trusted transactions (TXs) to be processed without the intervention of a third party. These nodes collaborate to keep a copy of the full blockchain and to participate in transaction verification and validation. Transactions are organized into blocks, each of which contains a list of valid and validated transactions as well as a reference to the previous block.[1] The blockchain is formed by connecting the blocks in a chain-like arrangement. Blockchain stores tamper-proof and unchangeable information in a safe and encrypted manner since the ledger is created and maintained by all system participants equally [9] and there is no central server to handle the activity. Peer-to-peer (P2P) networks are used by blockchain, and any node (network user or new user) is welcome to join safely. A new node or user who joins the blockchain network receives a complete copy of the blockchain. Each time a new request is made, a block is generated and transmitted to every node in the network for verification. After being confirmed by all the nodes as being

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unaltered, the block is then added to the chain of blocks. For the purpose of confirming the authenticity of the block, the network's nodes come to an agreement. Every node in the network compares a blockchain it receives for verification against its own blockchain, rejecting any blocks that have been altered.

Three strategies are being used to develop blockchain. The first type of blockchain is the public blockchain, also known as the permissionless blockchain, in which the ledger is completely distributed and available to users, miners, developers, or other members of the community [11]. The second option employs a private blockchain, which is a permissioned blockchain that only pre-selected members of a recognised organization may access. These organizations are chosen by the relevant authorities, who are blockchain developers or ecosystem members. The third way for implementing blockchain, consortial blockchain technology, borrows components from both public and private blockchains. Only a predetermined group of nodes are promised for block validation in a consortium blockchain [12]. Because the chain of blocks is shared by dissimilar nodes, it is referred to as a public blockchain. The private blockchain is only accessible by a limited number of nodes, hence this system might be referred to as partially centralized[13] . Claims that the consortium blockchain architecture is more suited to applications requiring internal system supervision, transaction agility, and privacy protection.Smart homes may now be guaranteed to be secure and private by utilizing blockchain technology.[3]

III. PROPOSED SYSTEM

Fig. 1 Architecture Diagram

Figure 1 depicts a block diagram of the proposed smart door lock. A RFID Card, RFID Reader,BlockchainSystem, a database, and a door OPEN/LOCK operator are included in the proposed smart door lock. The RFID Reader recognises the RFID Card within a 10-centimeter range. The RFID Reader reads all of the RFID Card's information. An access control module's verification module checks that the Card is an authorized Card. When the verification is finished, the system moves on to the blockchain module.The blockchain module consists of the blockchain integration, smart contract and blockchain verification The Blockchain module checks for the valid RFID Card with the help of serial number. If the serial number is present the Blockchain proceeds towards the smart contract.The smart door lock technology was integrated with the blockchain platform Solana for the transaction.[2] A smart contract is a computer software that can be saved and executed on a blockchain network. It is meant to automatically facilitate, verify, and enforce the terms of a contract or agreement between parties without the use of intermediaries or centralized authority.[12].The database stores the details of the opening and closing of the door with the timestamp and the serial number of the RFID Card Used at that time.Once all the process is done the blockchain sends the signal to the door OPEN/LOCK Operator.

- **Methodology:-**

RFID tag authentication is a process that uses radio waves to identify and authenticate users. The RFID tag is scanned by a reader, and its ID is encrypted using a secure algorithm. The encrypted ID is then checked against a database of authorized users. If the ID is found in the database, the user is authenticated and a request is sent to a smart contract to open a lock. The smart contract then executes the request and opens the lock.

- **Summary of Proposed System:-**

The smart door lock system verifies the RFID card with the help of an RFID reader and checks whether the card is a valid card or not. If the card is valid then the SOLANA blockchain system check of the card in the blockchain database. If the card is present in the database the smart contract is run and the verification is done. The request is sent to the DOOR LOCK to open/lock.

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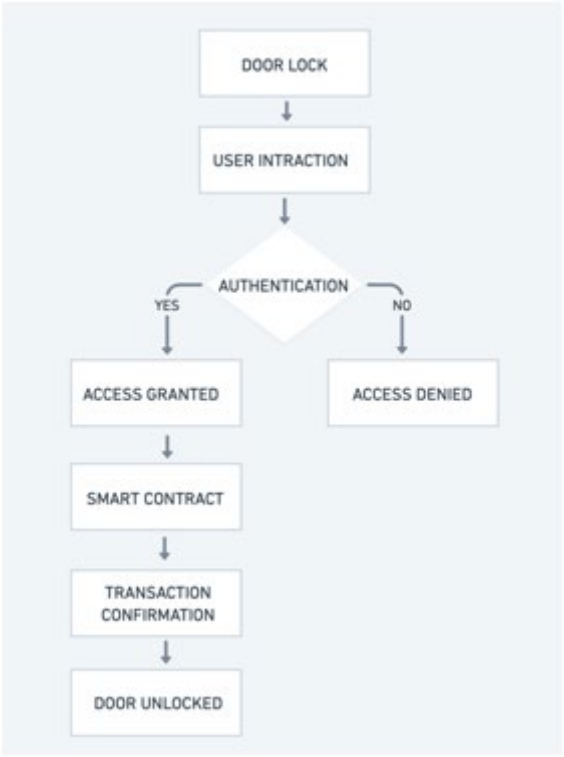

Fig. 2 Flowchart of door lock system

1. User Interaction: The user interacts with the smart door lock system through an interface, such as a mobile app or a physical keypad.
2. Authenticate: The system authenticates the user's identity through various means, such as a PIN code, biometrics, or RFID card.
3. Access Granted / Access Denied: Based on the authentication result, the system decides whether to grant access or deny it.
4. Record Access Event: If access is granted, the system records the access event, including user information and timestamp.
5. Smart Contract: The system updates the Solana blockchain with the access event data for transparency and immutability.
6. Transaction Confirmation: Solana blockchain confirms the transaction and adds it to the distributed ledger.
7. Door Unlocks (Access Granted): Upon successful transaction confirmation, the door unlocks, allowing the user to enter.

The RFID tag is scanned by the reader and its ID is authenticated. The tag's ID is encrypted using a secure algorithm. This is done to protect the RFID tag's ID from unauthorized users. The encrypted tag's ID is checked against the database of authorized users. This is done to check if the user is authorized to open the lock. A request to open the lock is made to the smart contract if the RFID tag is approved. And If the RFID tag is not authorized, the request to open the lock is declined. The smart contract executes the request to open the lock. This is done by updating the state of the blockchain to indicate that the lock has been opened. And then The solenoid lock is instructed to open.

IV. RESULT

Blockchain	**Ethereum**	**Solana**	**Polkadot**	**Bitcoin**
Transaction Fees	$0.867 ₹71.10	$0.000125 ₹0.010	$0.0914 ₹7.50	$2.26 ₹185.34
Speed(TPS)	27-30	50,000-65,000	1,000	10 to 20 minutes
Security	Not that Secured	More Secure than Ethereum	More Secure than Ethereum	More Secure than Ethereum

Table 1 Comparison of blockchains on the Blockchain Trilemma, highlighting decentralization, scalability, and security aspects.

The above table indicates that why Solana is better than other (popular) blockchain platforms. The results depict the outstanding outcomes of the Solana Blockchain in three different aspects. At first we can see the cost comparison i.e. the transaction fees which are charged for each transaction done on different blockchain platforms. Solana has the lowest transaction fees which makes it more cost efficient. Then the second aspect is the speed or maximum transaction that can be processed in a particular time span. Here we can clearly see that solana can process 50,000-65,000 transactions in a second which is the highest among the compared blockchain platforms. The third and the most important aspect is security. Solana stands out in secure transactions; each validator contributes to consensus and transaction processing, making

Solana the most censorship-resistant and efficient blockchain network in the world.

V. CONCLUSION

This research study's goal is to provide a thorough review of how blockchain technology has been incorporated into the door lock system. The blockchain trilemma has a workable answer, according to Solana. demonstrating its advantages in terms of energy efficiency, scalability, decentralization, quick transactions, low-cost infrastructure, and security. Future smart door lock systems can benefit from this connection, which ensures safer, more effective, and secure access control procedures.

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