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BLOCKCHAIN BASED E-VOTING SYSTEM

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Abstract - **Elections are a critical component of democracy, and their integrity is essential to ensuring a fair and just society. Traditional voting systems have a number of flaws, including a lack of transparency, vulnerability to tampering, and the possibility of human error. Blockchain technology has gained attention in recent years for its potential to address these issues while also improving election security and transparency.**
This research paper describes the design and implementation of a blockchain-based e-voting system. The proposed system uses a distributed ledger to record votes securely and transparently, making it difficult for anyone to manipulate or alter the results. The system safeguards voter anonymity and prevents double voting.
The system uses Ethereum, a popular blockchain platform, and smart contracts to automate the voting process. Smart contracts handle vote counting and tallying, which eliminates the need for centralised authority. By requiring a majority of network nodes to agree on the validity of each transaction, a consensus algorithm ensures the system's security.
The proposed blockchain-based electronic voting system outperforms traditional voting systems in terms of transparency, security, and efficiency. Because of the system's design, it is easy to integrate with existing election processes, making it a viable option for future adoption.
Both Simply Voting and Election Buddy provide secure and customizable online voting services for businesses, blockchain-based e-voting systems offer distinct advantages in terms of security, transparency, and decentralisation.[21][22]

Keywords-**Blockchain, Computing, Decentralised e-Voting, Peer-to-peer, Privacy, Security.**

I. INTRODUCTION

Voting in organizations can take various forms depending on the organization's size, structure, and governance model. A typical step in the process is a call to vote, eligibility determination, a voting method, ballot preparation, a voting period, vote counting, announcement of results, and implementation of the proposal or further action based on the outcome of the vote. The voting process must be fair, transparent, and accessible to all eligible voters.
Organizational voting can raise concerns about issues such as eligibility and voter identification, accessibility, security and privacy, transparency and fairness, and the accuracy and integrity of the results. Organizations must address these issues with careful planning, clear communication, and robust systems and processes to ensure that the voting process is fair, accessible, and trustworthy. Hence the main goals of this research are

- Validating the system to ensure that only legitimate voters are allowed to vote.
- To protect voter identity by disassociating the voterfrom the vote cast.

Voting shares, commonly known as ordinary shares and preferred shares, are two popular types of shares.

Pre-emptive rights, which enable shareholders to maintain their ownership position by enabling them to buy proportional interests in future issues of common stock, are another benefit of common shares. This implies that stockholders have the option to purchase additional shares before they are offered to the general public or to new investors.
In situations of bankruptcy or solvency, voting shares differ from preferred shares in a significant way. When corporate assets are sold under such circumstances, preferred shareholders are entitled to receive payment in advance. The rights of common shareholders to compensation in cases of solvency or bankruptcy are non-existent. Dividend pay-out is another area of distinction, when common shareholders are either paid less than preferred shareholders or are not promised a dividend pay-out.
Amongst voting rights, shareholders have the right to elect or remove company directors, examine corporate and financial records, and also appoint auditors to carry out company audits. Each shareholder in a company that is limited by shares and has equity share capital shall be entitled to one vote on each resolution affecting the company.
A corporation may acknowledge from each member all or a portion of the outstanding debt on any shares that member owns, even if no part of that debt has been called up. Before the amount paid by him relevant to sub-section (1) has been called up, the member of the company limited by shares will not have any voting rights with regard to that amount.

II. RELATED WORK

- BLOCKCHAIN

Blockchain, also known as a ledger, is a distributed database of records. The fundamental principle of blockchain is the immutability of the records already written in blocks.

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Advanced Cryptography is used to ensure data integrity and block chaining. Another distinguishing feature is the mode of network communication. To communicate between network nodes, a client method is used. There is no need for trustin this person because there is no third party to facilitate communication between clients. The network participant's true identity is unknown

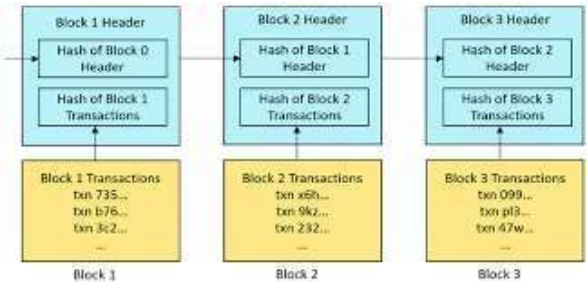

Figure.1 How a block is created in blockchain [24]

In order to provide a high level of trust and confidencein the voting process, blockchain is required in e-votingto create a transparent and auditable record of each vote.This can help to ensure the accuracy of the results whilealso increasing public trust in the electoral process. Furthermore, blockchain-based e-voting systems can boost voter participation, protect voters' anonymity andprivacy, and ensure that each vote is verified and counted only once.

Blockchains are classified into three types: public, private, and hybrid. Private blockchains are operated by a single organization, are closed to the public, and have identified nodes, whereas public blockchains are open to the public, decentralized, and anonymous. Hybrid blockchains combine the benefits of both public and private blockchains, allowing organizations to retain control over information while still benefiting from decentralized features. Each type of blockchain has unique benefits and is best suited for specific use cases.

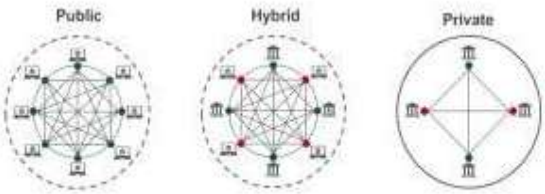

Figure.2 Different types of blockchain

Several key components of blockchain technology interact to form a secure and decentralized system. Among the components are the distributed ledger, blocks, nodes, consensus mechanism, cryptography, smart contracts, and mining. All network transactions are secured and transparently recorded by the distributed ledger, while blocks contain transaction data and other relevant information. Nodes are blockchain network nodes that maintain a copy of the blockchain and verify transactions. The consensus mechanism is the algorithm used to reach an agreement on the state of the ledger, ensuring that the network remains decentralized and secure. The blockchain's data is protected by cryptography, and smart contracts enable transaction automation and the development of decentralized applications. Mining is the process of adding new blocks to the blockchain by solving complex mathematical problems. These components work together to create a secure, transparent, and tamper-proof system.

- GANACHE

Ganache is a popular personal blockchain for Ethereum development and testing. It allows developers to test smart contracts, build decentralised applications, and debug code in a safe and secure environment. Ganache provides a local blockchain network with test Ether accounts, enabling developers to test and deploy smart contracts without incurring actual transaction costs.

Ganache comes in two flavours: CLI and GUI. GanacheCLI is a command-line tool that allows developers to quickly create a personal blockchain network, whereasGanache GUI is a graphical user interface that allows developers to interact with their blockchain network visually. Ganache is open source and free to use.
One of Ganache's key features is its ability to simulate various blockchain scenarios, such as different network conditions, transaction fees, and gas limits. Developers can now test their applications in a variety of environments and optimize their code accordingly. Ganache also works with a diverse set of development tools, including well-known frameworks like Truffle and Remix.
Ganache is a useful tool for anyone looking to build decentralised applications or smart contracts on the Ethereum network, and it is widely used by Ethereum developers and development teams.[18]

- METAMASK

To use Metamask, users must first install the browser extension and create a wallet. They can then connect to different Ethereum-based dApps and execute various blockchain transactions directly from their browser. Metamask provides a user-friendly interface for managing transactions, including the ability to set gas fees and confirmations.

Before they can use Metamask, users must first install the browser extension and create a wallet. They can then connect to various Ethereum-based dApps and execute various blockchain transactions using their browser. Metamask has an easy-to-use transaction management

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interface, which includes the ability to configure gas fees and confirmations.

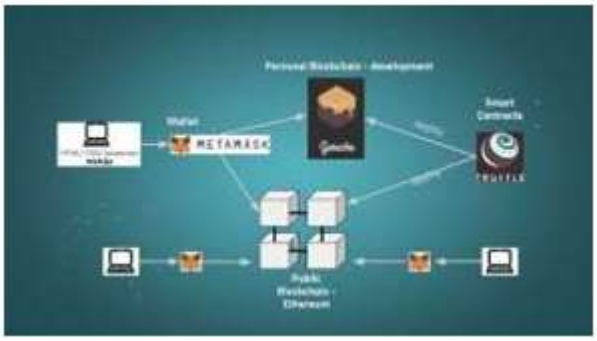

Figure.3 Use of Metamask

- SOLIDITY

Solidity is a programming language used to create smart contracts on the Ethereum blockchain. Smart contracts are agreements between two or more parties that are programmed to automatically enforce the terms of the agreement. Solidity is a high-level programming language designed to be easy to read and write.

The Ethereum Foundation created Solidity, which has a syntax and structure similar to JavaScript. Because it is a statically typed language, variable types must be defined before they can be used. Inheritance, polymorphism, and other object-oriented programming concepts are also supported by Solidity.

The Solidity code is compiled into byte code and executed on the Ethereum Virtual Machine (EVM). The EVM is a decentralised virtual machine that runs on Ethereum network nodes. Solidity-based smart contracts can be deployed on the Ethereum blockchainand interact with other smart contracts and decentralised applications (dApps).

Developers can use Solidity to create a wide range of applications, including decentralised finance (DeFi) protocols, supply chain management systems, and tokenization platforms. However, it should be noted that Solidity is a new language, and smart contract vulnerabilities can cause significant losses for users. As a result, Solidity code must be thoroughly tested and audited before being deployed to the Ethereum blockchain. Overall, Metamask simplifies interactions with the Ethereum blockchain for users who may be unfamiliar with blockchain technology.

- ETHEREUM

Ethereum is a blockchain platform for developing decentralised applications (dApps) and smart contracts. It was created by Vitalik Buterin and first proposed in 2013. The Ethereum blockchain is designed to be more adaptable and programmable than the Bitcoin blockchain, which primarily serves as a value store.

Ethereum's native cryptocurrency, Ether (ETH), is used to pay transaction fees and to incentivize nodes to validate transactions on the network. Ether is also used as a medium of exchange in decentralised applications and is traded on crypto currency exchanges.

One of Ethereum's key features is smart contracts, which are self-executing agreements between parties that are programmed to automatically enforce the terms of the agreement. Smart contracts, which are written in programming languages such as Solidity, can be used to automate a wide range of processes, from financial transactions to supply chain management.

Ethereum has gained traction as a platform for developing DeFi protocols, which enable users to lend, borrow, and trade cryptocurrencies without the use of intermediaries. Non-fungible tokens (NFTs) are one-of-a-kind digital assets that can represent anything from artto music.

Ethereum's decentralisation and programmability make it an effective tool for developing new applications anddisrupting traditional industries. It is important to note, however, that the platform is still in its early stages, and there are risks associated with using decentralised applications and smart contracts. Before investing time or money in Ethereum, as with any cryptocurrency or blockchain technology, it is critical to thoroughly research and understand it.[17]

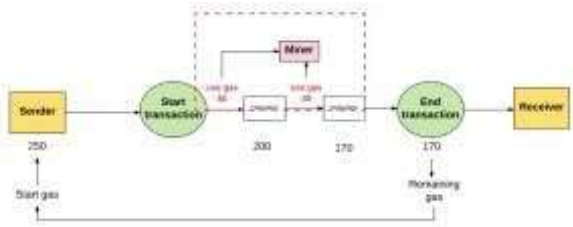

Figure.4 Working of ethereum [25]

- SMART CONTRACT

A smart contract is a self-executing contract in which the buyer-seller agreement is written directly into lines of code. Smart contracts are deployed using blockchain networks, which are decentralised digital ledgers that record and verify transactions. Smart contracts enable trust less transactions and automate the process of enforcing contractual obligations without the use of third-party intermediaries such as lawyers or banks.

Smart contracts operate based on predefined rules and conditions that are encoded in the blockchain network. Once the terms of the contract are met, the smart contract executes automatically, and the relevant parties receive their agreed-upon compensation. This process eliminates the need for intermediaries, lowering costs while increasing transaction speed and transparency.

Smart contracts have a wide range of applications, including supply chain management, real estate, and finance. In the supply chain management industry, smart contracts can help

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automate the process of verifying the authenticity of goods and tracking them through the supply chain. Smart contracts can be used in the real estate industry to automate the process of transferring property ownership. In the financial services industry, smart contracts can be used to automate the process of executing trades and settling transactions.
Overall, smart contracts are a novel application of blockchain technology that can aid in the automation of transactions and the elimination of the need for intermediaries.
In blockchain networks, consensus algorithms are used to reach an agreement among various distributed nodes. Consensus mechanisms based on proof of work (PoW) or proof of stake (PoS) protect the network by preventing unauthorized users from validating bad transactions.[23]

III. LITERATURE REVIEW

Gives a comprehensive analysis of the existing literature on scalable blockchain-based electronic voting systems. The authors describe electronic voting and go over the advantages and disadvantages of using blockchain technology to conduct it. In this paper, studies on the usability, scalability, and security of blockchain-based electronic voting systems are compiled. The authors also conduct a meta-analysis of the content they have assessed and provide information on the current state of research on scalable blockchain- based electronic voting systems. The essay may be useful to academics, professionals, and legislators who are thinking about adopting blockchain technology in electronic voting systems.[1]

Figure5. Architecture proposed by the paper [1]

with respect to this paper, we have made use interface to be quiet swift and user friendly and the web app is not only for technical experts to be used

The report recommends a distributed electronic voting system that makes use of blockchain technology to ensure the confidentiality, integrity, and transparency of the voting process. The voting process makes use of a network of nodes, each of which maintains a copy of the blockchain ledger used to anonymously and securely record votes. By limiting who can access the ballots, the strategy emphasises the need for voter anonymity and privacy in electronic voting. The paper provides a comprehensive examination of the potential benefits of integrating blockchain technology into electronic voting systems, with a focus on the requirement of safeguarding voters' anonymity and privacy in such systems.[2]

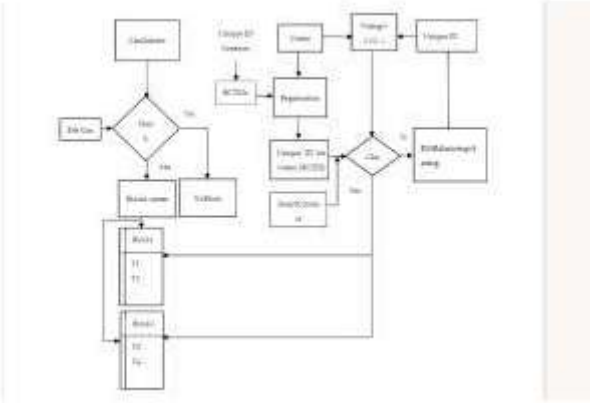

Figure6. Architecture proposed by the paper [2]

In order to provide secure and transparent electronic voting and bidding processes, the study suggests a decentralised system that makes use of a distributed network of nodes, smart contracts, and blockchain technology. Smart contracts make sure that transactions are only carried out when specific predetermined criteria are satisfied. They also ensure that the transactions are automatically verified and published on the blockchain ledger. The technology enables users to vote or bid safely and anonymously, and anyone on the network is able to audit and verify the results of the voting or bidding process. The paper provides a thorough analysis of the possible advantages of employing blockchain and smart contracts for electronic voting and bidding systems.[3]
The study proposes a description of how blockchain technology is being used in electronic voting systems, highlighting the benefits of increased effectiveness, security, and transparency. The authors evaluate the benefits and drawbacks of various proposed and implemented blockchain-based electronic voting systems. Additionally, they highlight other research problems that need to be solved, including the development of safe identity management systems, effective consensus processes, and safeguards for voters' anonymity and privacy. The paper emphasises the importance of user education and awareness in order to properly adopt electronic voting systems based on blockchains. Overall, the paper provides a comprehensive review of the use of blockchain technology in electronic voting systems as well as the challenges associated with performing related research.[4]

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Figure7. Architecture proposed by the paper [4]

The article proposes a reliable and secure blockchain- based electronic voting system that uses a distributed ledger and a consensus mechanism to provide transparency, immutability, and integrity in the voting process. The suggested method uses digital signatures and encryption to authenticate users and protect voter anonymity. Also, the authors provide a statistical analysis of the proposed method that demonstrates its dependability and effectiveness. The importance of voter anonymity and privacy in electronic voting systems is emphasised in the article, and the recommended solution allays these concerns by utilising encryption-based solutions. The study provides a comprehensive analysis of the proposed blockchain-based electronic voting system with a focus on its dependability, security, and transparency.[5]

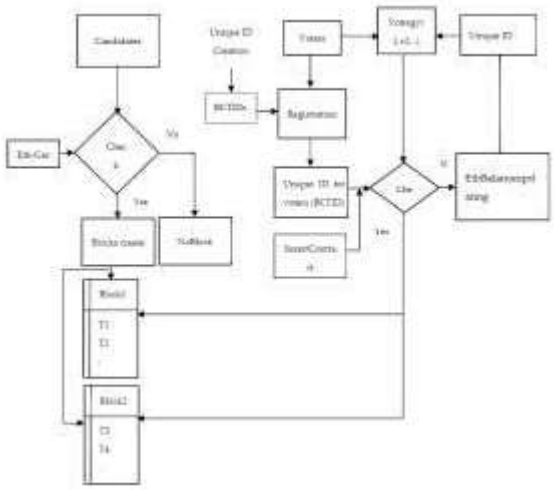

Figure8. Architecture proposed by the paper [5]

The study recommends an electronic voting system that uses an enterprise blockchain in order to ensure the integrity, transparency, and immutability of the voting process. By allowing only authorised parties to participate in the voting process, the proposed solution uses a permissioned blockchain to provide security and privacy. Any authorised user on the network may audit the system, and the authors employ a consensus process to ensure the validity of the vote results. According to the study, the application of blockchain technology in electronic voting systems may have benefits for improved efficiency, security, and transparency. The proposed blockchain-based electronic voting system is fully described in the paper, along with some of its potential benefits.[6]

Figure9. Architecture proposed by the paper [6]

Refrences of papers	[1]	[2]	[4]	[5]	[6]	
Parameters						
Non-repeatability	✓	✓	✗	✓	✓	✓
Security	✓	✓	✓	✓	✓	✓
Completeness	✗	✓	✓	✓	✓	✓
Fairness	✓	✗	✓	✓	✗	✓
Anonymity	✓	✓	✗	✗	✓	✓

Figure10. Comparison of different systems

IV. WORKING METHODOLOGY

Blockchain is a system in which rather than treating every entry as an individual we treat them as a block and connect all these blocks using an inter link hence the name Block-Chain. Every block consists of all the possible data of a single entity with a timestamp and sometimes preferably a nonce. Blockchain technology has emerged as a potential solution to address the challenges associated with traditional voting systems. By using a decentralized, tamper-proof ledger, blockchain-based e-voting systems offer several advantages, but also pose some challenges and risks. Here's a high-level overview of the working methodology:

User and admin signup/login: The user and admin provide their signup/login information using solidity asthe platform.

User registration and verification: Voters register to participate in the voting process by providing their personal information and verifying their identity through an authentication process using Aadhar number.

Voting process: - The user votes their respective party the blockchain network uses consensus mechanisms toverify the authenticity and accuracy of the vote. This process involves multiple nodes in the network validating the transaction to ensure that it has not been tampered with. Once the vote is

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verified, the block is added to the chain, making it a permanent record that cannot be altered.
Counting the votes: - After the voting period has ended, the votes are counted automatically by the blockchain network. The counting process is transparent and auditable, allowing anyone to verify the results independently. The blockchain-based e-voting system also ensures that no votes are lost, stolen, or altered in any way, providing a more secure and accurate voting process.
Declaration of Results: -Once the votes have been counted, the results are declared by the system automatically. The results are available for public viewing and can be audited by anyone. The blockchain-based e-voting system provides an accurate and transparent way of declaring election results, ensuring that the democratic process is upheld.

Admin Side working: -
User Interface: This is the front-end interface through which the administrator interacts with the system. It can be a web-based dashboard, a desktop application, or a mobile app.
Smart Contracts: Smart contracts are self-executing computer programs that run on the blockchain network. These contracts define the rules and conditions of the election, such as the eligible voters, the candidates, and the voting period.

Blockchain Network: The blockchain network is the underlying technology that powers the e-voting system.It is a decentralized, distributed ledger that records all the transactions in the system, including the votes cast by the voters.
Digital Identity Verification: To ensure the integrity of the voting process, the system must verify the digital identities of the voters. This is done using Aadharverification.

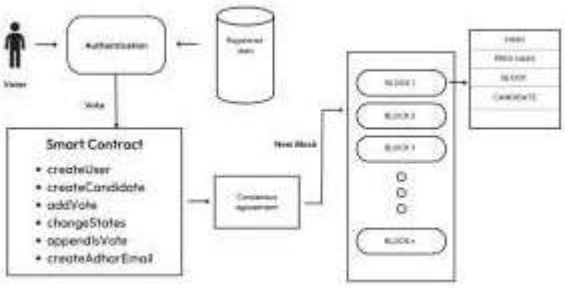

Figure11. Authentication architecture diagram

Software requirement in this methodology are asfollows:
OS: Windows 10
Code Editor: Visual Studio CodeServer: Localhost
Database: MS-SQL Server 2012/2014.

Hardware Requirements:
Processor: Intel Quad core 1.7 GHZ Processor or above.
Storage: Minimum 10 GB of Disk space.
RAM: Minimum 8 GB of RAM.

Testing Technologies that we have used are as follows: Ethereum Test Network-The Ethereum test network (also known as test net) is a separate network that runsalongside the Ethereum main network and is designedspecifically for testing and development. The test net isintended to simulate the functionality of the main Ethereum network without incurring any actual costs.
Ethereum Tester – An open-source testing libraryavailable in GitHub. The setup is relativelystraightforward, and it has very good API support for fork mining and other testing functions.

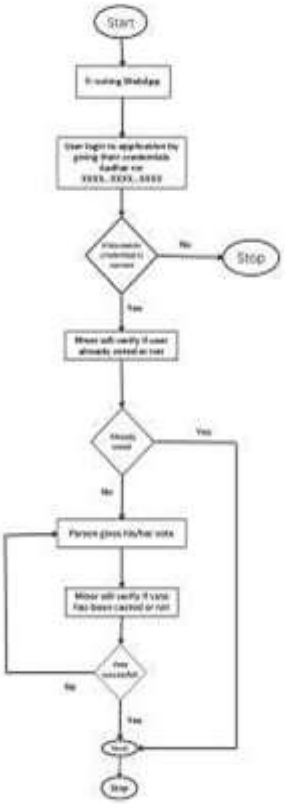

Figure12. Flow diagram of proposed system

V. INFERENCE

Some essential performance characteristics for ablockchain-based e-voting system to consider:
Security: To prevent unauthorised access and maintain the legitimacy and integrity of the votes, the system should have strong security measures.
Transparency: The blockchain-based e-voting system should be visible, which means that each voter should be able to view their vote and validate that it was successfully recorded.

Accessibility: The system should be available to all voters, regardless of where they live or their physical ability.
Rapidity: The blockchain-based e-voting system should be able to capture and process votes in real time.
Reliability: The system must be dependable and capable of dealing with any technological challenges that may develop during the voting process.
Privacy: The system should protect the identities and voting preferences of voters.
The system should be cost-effective, which means it should not be unreasonably expensive to implement andmaintain.
Usability: The system should be simple to use and navigate for all voters, regardless of technical talents or prior experience with blockchain technology.

Advantages of e-Voting using Blockchain:
E-voting with blockchain technology has various advantages, including:
Increased Security: Because each vote is recorded and encrypted on a tamper-proof and decentralised ledger, blockchain technology provides a very secure platformfor e-voting. It is practically impossible to tamper with or manipulate votes, ensuring that election results are accurate and reliable.

Transparency: Blockchain technology creates a transparent system in which each vote is recorded and accessible to all network participants. This can aid in the prevention of fraudulent actions and promote accountability, both of which are critical to the integrityof the electoral process.

Improved Accessibility: E-voting via blockchain technology can make voting more accessible to people
who may be unable to participate in traditional voting methods due to distance or disability. This can result inbetter voter turnout and general participation.

Reduce Costs: Blockchain-based e-voting systems can cut election expenses by eliminating the need for physical polling stations and shortening the time and resources required to count votes.

Faster Results: Because votes are automatically tallied and recorded in real-time, e-voting via blockchain technology can give faster and more accurate election results.

Efficient Auditability: The blockchain-based e-voting system offers for efficient auditability because votes can be readily and rapidly audited.

Improved Trust: By creating a safe and transparent system that is highly resistant to tampering and manipulation, blockchain technology can increase public faith in the electoral process.

Ultimately, blockchain-enabled e-voting has the potential to alter the electoral process by providing a secure, transparent, and efficient system that can increase voter participation, lower costs, and improve the accuracy and dependability of election results.

Limitations of e-Voting using Blockchain:

Despite the fact that e-voting with blockchain technology offers numerous benefits, there are still limits to consider, such as:

Technical Complexity: Blockchain technology can be technical and difficult to grasp, creating barriers toadoption and limiting the use of blockchain for e- voting.

Limited Scalability: While blockchain technology can provide a secure and efficient platform for e-voting, itsscale is limited. The blockchain can only process a finite number of transactions, which can make large- scale elections difficult.

Lack of Standardization: A lack of standardisation in blockchain technology can lead to interoperability concerns between different blockchain platforms, making it difficult to construct a unified and consistente-voting system.

Security Risks: While blockchain technology provides a safe framework for electronic voting, there are still hazards involved with cyberattacks and hacking attempts. Bad actors could possibly compromise the blockchain network, jeopardising the voting process's integrity.

Digital Divide: E-voting through blockchain technology necessitates access to technology and the internet, which may exclude people who do not have these means. This has the potential to create a digital divide and impede the inclusiveness of the voting process.

Thus, while e-voting using blockchain technology has many potential benefits, it is critical to recognise and overcome these constraints in order to preserve the integrity and dependability of the electoral process.

VI. FUTURE WORK

Linking application with Government voting system data. Making the system more secure.
Enhancing the Graphical User Interface (GUI) of the application. Local languages can be included which will play a vital role for people living in rural areas as well as uneducated people. A Candidate's earlier social work and candidate qualification's can be added for a voter to have better choice. Also, adding a suggestion system for voters that enables the public to give suggestions to the current

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winner. A complaint system can be included, that allows the people to file complaintagainst a candidate

VII. RESULT

The proposed blockchain-based web application provides a safe voting system with the following features: privacy, convenience, free receipt and physical tally or count, as well as cost-free and fraud- free voting. The model uses the smart create User, create Candidate, add Vote, change States, append Is Vote, create Adhar Email. Figureure 18 below shows a Metamask-based eth balance that must be used to carry out the operations of the proposed system. In general, the regulatory authority needs gas to call the functions. The expense of gas consumption for each blockchain transaction is shown in

Figure13. Admin State change

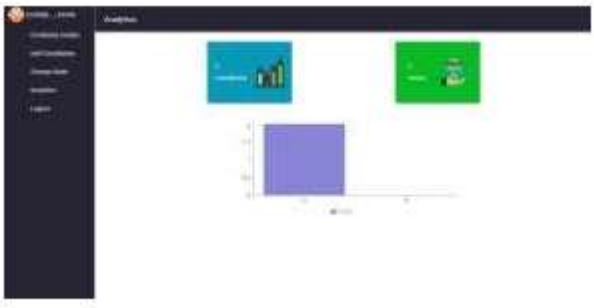

Figure14. Result Declaration

Figure15. Ganache transaction

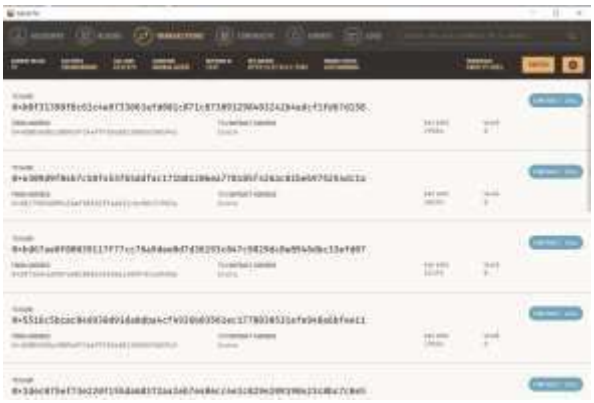

Figure16. Ganache Block

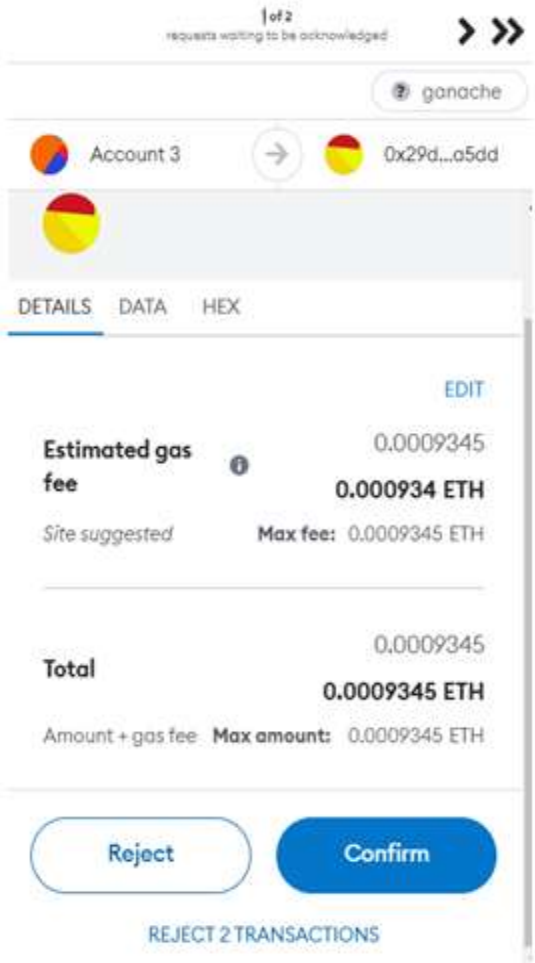

Figure17. Metamask

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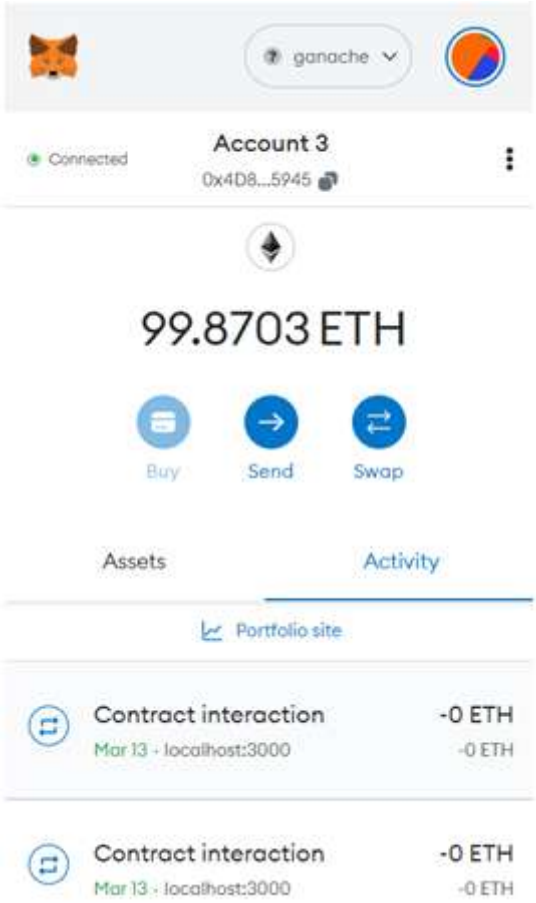

Figure18. Metamask Based Eth Balance

Figure19. Vote Casting Interface

VIII. CONCLUSION

This project introduces Ethereum's Blockchain based electronic voting system. This paper introduces Ethereum's Blockchain based electronic voting system. This application is able to overcome the limitations and security issues of the centralized voting system by using Blockchain technology. This study proved how a blockchain works to secure the data. The researchers developed a voting application in a decentralized method with a smart contract. Then deployed a smart contract to local blockchain for this application. The application is based on Ethereum Blockchain technology as a network and a decentralized database all in one for storing voter's accounts, votes, and candidates' details. Blockchain provides a decentralized model that makes the network reliable, safe, flexible and able to support real-time services. thevoter realizes his vote goes to his right candidate as wellas he has only one vote because the application does not allow for the duplicate vote by this method electronic voting could be highly reliable.

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