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E-Voting System in Blockchain Using Different Platforms

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ABSTRACT—

Nowadays, people don't want to spare even a single minute in waiting in queue for voting, banking, and any other form filling type of work. Modern technologies even provide the opportunity to carry out these works from the comfort of our home via the internet. Therefore, e-voting is becoming more popular with every passing day. However, to ensure that the voting process is being carried out properly, e-voting system should be secured and safe. It should not allow duplicated votes and be transparent while protecting the privacy of the attendees. For making the system secure as well as transparent, blockchain is the best technology at the current time. It has become a powerful tool because of its various introductions to smart contracts like the Ethereum platform.

Keywords—Blockchain, Ethereum, smart contract, E-voting.

I. Introduction

In many decades, doubts and concerns have been raised about the voting process. People in the opposition and voters have expressed apprehensions, including concerns about the security of voting machines. During the voting process, voters often encounter various difficulties, such as limited flexibility, and the possibility of fraud. This has been the case from the days of paper voting to the present use of electronic voting machines. There have also been instances of theft of voting boxes or voting machines. Additionally, a significant amount of manpower and effort is required to execute a successful voting process, from preparing polling stations to ensuring a smooth election day. When it comes to electronic voting, concerns arise about the ownership and potential insecurity of the results among candidates and voters. Voting is a crucial event in any nation, and the miscalculation of votes by external sources could have detrimental consequences. To address these issues and enhance the voting process, blockchain technology can be employed. Blockchain technology offers several advantages, with one of the key benefits being its decentralized nature. This means that there is no central authority that can manipulate or tamper with the voting process, making it more secure and reliable.

II. Literature on e-voting and Ethereum

In the domain of blockchain-based e-voting systems, "Blockchain-based e-voting system" [1] discusses the operation of "The DAO" on Ethereum. Similarly, "Broncovote: Secure voting system using Ethereum's blockchain" [2] highlights the concept of secure voting systems with blockchain. "Online voting application using Ethereum blockchain" [3] demonstrates Ethereum's potential for enhancing autonomous transactions and settlements. Additionally, the paper titled "A comparative analysis on e-voting system using blockchain" [4] provides insights into e-voting systems built on blockchain technology. Moving towards decentralized file systems, "Digital voting: A blockchain-based e-voting system using biohash and smart contract" [5] explores blockchain's utility in voting systems, leveraging content-based addressing for file identification. Furthermore, this interest in decentralized file systems is driven by the potential benefits of blockchain technology, including safety and privacy enhancements. "A Manipulation Prevention Model For Blockchain-based E-voting Systems" [10] emphasizes blockchain's potential for enhanced e-voting security. For document sharing and version control, a "trustworthy, secure, and decentralized system and framework based on blockchain" [7] utilizes Ethereum smart contracts, orchestration of communications, and IPFS for file archiving. "Blockchain as a Service (BaaS)" [8] introduces NutBaaS, a platform offering blockchain services in cloud computing environments, enhancing the reliability and security of blockchain-based applications. The "InterPlanetary File System (IPFS)" has gained considerable interest in the creation of decentralized file systems. However, these systems present challenges such as scalability and usability, as highlighted in [3]. Decentralized file systems, exemplified by projects like Storj and Sia [17], offer safe and private alternatives to centralized cloud storage, giving users greater control over their data. Additionally, "A Conceptual Secure Blockchain-Based Electronic Voting System" [14] recognizes the decentralization, persistency, anonymity, and auditability of the Bitcoin-derived blockchain. Vehicular Ad-Hoc Networks (VANETs) face challenges like identity validity and message reliability. To address these issues, "A consortium blockchain-based data security sharing and storage system (DSSSB)" [6] employs digital signatures based on bilinear pairing for elliptic curves to ensure data integrity when transmitted to a node. The use of consortium blockchain technology maintains a decentralized, secure, and dependable database. These research papers contribute to the comprehensive

understanding of blockchain applications, ranging from e-voting systems to decentralized file storage, document sharing, and data security in various domains.

III. Approach

Requirements Gathering: The research paper's development commenced with the critical phase of Requirements Gathering. This step aimed to lay a strong foundation by explicitly defining the project's objectives and scope. The primary objective was to establish a secure, flexible voting system, while the scope encompassed enhancing accessibility, bolstering security, ensuring transparency, and reducing the need for extensive manpower in the voting process. This process played a pivotal role in shaping the subsequent stages of development, highlighting its essential contribution to the project's success.

Smart Contract Development**:** Once the requirements were identified, the next step was to develop the smart contract for E-voting system. Firstly, using metamask accounts were deployed to the system, during which ethers were reduced from the account.

User Interface Design**:** The user can view the list of political parties who have participated in the elections. User can view the vote button using which voting is done. The result was also updated on the voting interface.

User Education and Support: Recognizing the paramount importance of User Education and Support, the project was dedicated to empowering users with the requisite knowledge and comprehensive assistance to adeptly navigate the intricacies of the e-voting system. This multifaceted endeavor encompassed the meticulous provision of user manuals and comprehensive guides. The goal was to ensure that users were not only well-informed but also ably supported in every facet of their engagement with the system.

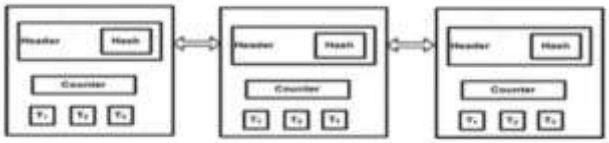

Fig 1. Basic Blockchain architecture

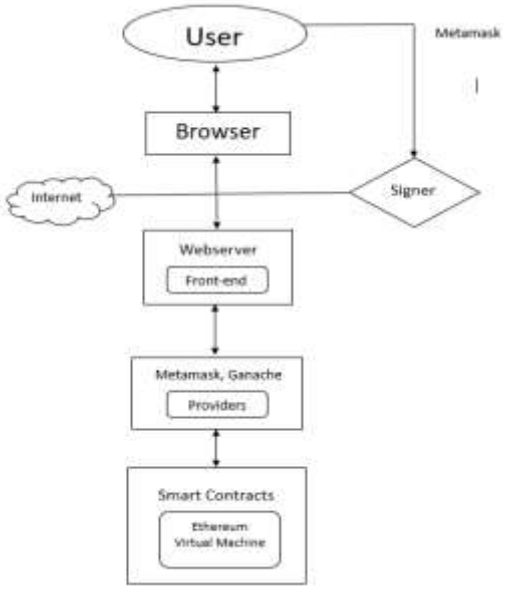

Fig 2. Architecture diagram of blockchain based E-Voting application

IV. Implementation

Voter Registration: Voters were allocated votes in the form of ethers (ETH) using metamask extension.

Ballot Creation: The process of ballot creation, facilitated by Ethereum smart contracts, is a pivotal step in the e-voting system. Here the accounts from ganache were added and deployed on the voting system using metamask extension.

Voting Process: The voting process, a fundamental component of the e-voting system, is made seamless and secure through a user-friendly interface. Users, after registering, interact with this interface to cast their votes. Here the voter can cast his vote to the political party he wants too.

Vote Counting and Verification**:** Each voter can cast a vote only once as his account was getting stored in the database which disabled it from revoting. The vote counts were updated immediately and accurately after a vote has been casted.

Tech Stack: Ethereum, ganache, metamask, solidity.

Smart Contract Language: Solidity is the language used for deploying smart contract.

Sr No.	Title	Methodology	Strengths	Weaknesses
1.	Blockchain-based e-voting system**.** (2018)	Proof of authority blockchain, district node connected to a boot node, admin gives permission to boot node, a transaction id is given to vote.	High authentication, provides more flexibility, useful for small scale elections.	Insufficient concerning high cost, gets effected due to high traffic.
2.	Bronco vote: Secure voting system using Ethereum's blockchain (2018)	Bronco Vote utilizes cryptographic techniques, like homomorphic encryption, to promote voter privacy.	Fraud occurring frequency becomes less due to less human intervention.	Improvement in individual ballot verifiability by generating a private, public key.
3.	Online voting application using Ethereum blockchain (2018)	Validated using Aadhar number and a OTP, Voter can vote only after giving OTP.	Once logged in cannot be logged in again, flexibility to voters.	Need of smartphone with internet connection with prior knowledge.
4.	A comparative analysis on e-voting system using blockchain (2019)	Encryption and decryption is used for security only disclosed information is total votes for each candidate.	Fraud resistance scalable, fast, one- time investment.	Concern on authentication of the voter.
5.	Digital Voting: A blockchain-based e-voting system using bio hash and smart contract (2020)	A hash algorithm is used for proof of membership authentication. Private and public key is generated for sending OTP.	Fingerprint is used for hash generation.	Awareness about registration and smartphones is needed.
6.	Secure large-scale E-voting system based on blockchain contract using a hybrid consensus model combined with sharding (2021)	Proof of Credibility works mutually with Proof of Stake. The sharding mechanism is used for splitting large databases into smaller parts.	Immutable, every vote can be traced without exposing the voter's identity.	Lack of actual system makes it difficult.
7.	On secure E-Voting over Blockchain. (2021)	Smart-contract of OV-network is used in decentralized. centralized remote they proposed a end-to-end verifiable e-voting schema.	Voters privacy is fulfilled and voting remains anonymous.	Each voter needs to have Ethereum account.
8.	E-voting System Using Blockchain Technology (2022)	The strategy makes use of a public blockchain, which is superior, and allows for additional voting rounds.	Public Blockchains are more transparent.	Public blockchains are slower than private.
9.	E-voting Using Blockchain (2021)	Two unique blockchains are housed in this architecture, one for voter information and the other for vote information.	Transparency and confidentiality.	Solution requires a lot of infrastructure.
10.	A Manipulation Prevention Model for Blockchain based E-voting Systems (2021)	To stop potential manipulations of the elections and the outcomes, a two-layer security model is designed and put to the test.	It talks about the improvement in security of the system.	difficulty of simulations with as many nodes as a real election system needs.

11.	E-voting System Using Homomorphic Encryption and Blockchain Technology to Encrypt Voter Data (2021)	Votes can indeed be tallied in their "encoded" state, which makes homomorphic encryption particularly well-suited for usage with e-voting systems.	ballot verifiability and result verifiability of votes, integrity and transparency	There is a concern about the authentication of the voters
12.	E-Voting System Using Hyperledger Fabric Blockchain and Smart Contracts (2021)	Replicated ledgers are used to store the nodes. SHA-256 algorithm enables chaining of nodes.	transparency, consistency and resiliency.	As Hyperledger is relatively new platform it has certain issues like concurrency management.
13.	Hyperledger frameworks with a special focus on Hyperledger Fabric (2020)	employed more and more in systems whose distribution, accessibility, security, and trust are among their key selling points.	compatible for business needs and evolving rapidly.	There are issues of scalability.

Sr No.	Title	Methodology	Strength	Weakness
14.	A conceptual secure blockchain based electronic voting system(2017)	System does not rely on trust and will publicly verify and distribute in way that no one will be able to corrupt it.	It provides security, reliability and anonymity	Even system is secure, hackers have ability to cast or alter vote using malicious software installed on voter's device.
15.	Blockchain based electronic recording system design(2018)	It works same as blockchain technology contained in Bitcoin system and focuses on database recording	Greater storage space and processing.	Inability to change vote in case of user's mistake
16.	E-voting protocol with decentralisation and voter privacy (2018)	It provides degree of decentralization and provides much control of process in hands of voters.	Greater transparency, security and immutability.	It uses software to register vote and is built by company, so vendors could twist software to work in their favor.
17.	Analysis of blockchain solutions for e-voting (2022)	It compares the Voting System methods in traditional Voting system and Online voting system.	Confidentiality, Fairness, Eligibility, Data Integrity.	Unpredictable attacks and lack of security for voter identification
18.	Third party verifiable voting systems	Third party verifiable Voting Systems: Addressing motivation and Incentives in E-Voting.	Provides greater security and transparency.	It requires greater number of nodes.
19.	Decentralized E-Voting Portal Using Blockchain (2019)	The e-voting system should verify the identity of voters and authenticate only eligible voters.	Votes are cryptographically secured, immutable, tamper-proof.	Continuous broadband access is required.
20.	Decentralized Voting: A Self-tallying Voting System Using a Smart Contract on the Ethereum Blockchain (2018)	In case of the vote not being verified as valid by the checks performed in the smart contract, the transaction reverts.	Checks for eligibility of voters. Multiple votes by single user are detected. No one can modify or duplicate submitted votes.	Large amount of computing power and time is required for encrypting the vote/transaction.
21.	Towards Secure E-Voting Using Ethereum Blockchain (2018)	In this work, they have implemented and tested a sample e-voting application as a smart contract for the Ethereum network using the	Votes cannot be modified after casting. Vote counting is faster.	Public cannot view or verify their vote.

		Ethereum wallets and the Solidity language.		
22.	Blockchain-Based E-Voting System (2018)	Proposed a blockchain-based e-voting system that uses "permissioned blockchain" Review of existing blockchain frameworks suited for constructing blockchain-based e-voting system.	Using an Ethereum private blockchain, it is possible to send hundreds of transactions per second onto the blockchain, utilizing every aspect of the smart contract to ease the load on the blockchain.	Access has to be given to people who want to store and verify the transactions.
23.	Votereum: An Ethereum-based E-voting system (2019)	In this paper, they have reviewed the requirements and then proposed Votereum, an E-voting system that utilizes the blockchain technology. They have implemented sharding for scaling.	A voter can verify that his/her voted is correctly counted.	Vote casting process is slow as the voters are verified by fingerprint or iris scan.

Conclusion

This paper studied multiple decentralized online voting systems for election using ethereum and hyperledeger blockchains. This paper has identified some common deficiencies in all the proposed systems. The current blockchain technology is not scalable.

The foremost issue in blockchain scalability refers to the limitations. In event of processing a new transaction, each node adds information regarding the transaction in the ledger. As a result, the increasing transaction history could topple the overall system. In addition, blockchain networks must maintain all data with accuracy to safeguard the levels of trust. Furthermore, blockchain also experiences issues of limitations in terms of hardware. Most of the issues in blockchain scalability problems arise due to hardware limitations. As the blockchain network expands further, it is difficult to set up and maintain the hardware required for operating nodes. The next critical factor which leads to major scalability challenges in blockchain refers to the high transaction fees. Block size is also a notable aspect for understanding why is scalability an issue for blockchain. All transactions in the blockchain network should pass a validation process. Generally, transactions have to wait for long periods of time for validation, considering the number of transactions in the queue. We seek to deliver a voting system that will overcome the problems in the referenced papers that will make the voting process much easier.

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