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Blockchain Enabled Online Voting System

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ABSTRACT: Striving to keep electoral processes secure and honest is becoming more crucial in this age of lightning-fast technological advancement. Election procedures that are too old-fashioned to be convenient or easily accessible also lack security and transparency. The purpose of this research paper is to investigate whether integrating blockchain technology into online voting would be beneficial in light of the growing doubts about the legitimacy of election results in India. The paper opens with the existing electoral systems that is Electronic Voting Machine (EVM) overview. Thus, the present may define their major vulnerabilities and deficiencies. The next section clarifies blockchain technology's principles, including decentralization, cryptographic protection, and immutability, making it appropriate for electoral usage. Next, the analysis of remote electronic voting systems on a blockchain basis is provided, explaining the major features like authentication through electronic signatures, a possibility to cast a distributed ballot, and calculation of results. Finally, the paper covers Secure Hash Algorithm (SHA-256) to evaluate their effect on the electoral system's security and rapidity. Additionally, through the analysis of case studies and other projects of blockchain-based voting systems, it is possible to determine the successes, setbacks and other key takeaways. The appropriateness and scalability of blockchain technology in elections are ascertained by real-life examples. Theoretical evidences, examples and practical case studies were taken in to add to the body of knowledge on blockchain based online voting systems. It upholds support for acquiring new technologies to secure democratic processes, sustain electoral integrity and bring up public trust in India's democracy.

KEYWORDS: Electoral process, Blockchain technology, Decentralization, Cryptographic protection, Authentication, Distributed ballot, SHA-256, Electoral integrity

I. INTRODUCTION

Elections are the cornerstone of democratic governance; it allows citizens to exert their rights to opt representatives and make decisions that shape their society. An election, in its core is a fundamental process through which collective choices are expressed and political powers are allocated among candidates. Traditionally, elections were conducted in person at pre-designated polling places. But with time, range of procedures and modes have been added. Voters now has more ways to take part in elections with introduction of digital technology. They can cast their votes remotely using internet and electronic devices.

Despite the evolution of technologies, the integrity and rationality of electoral processes are not guaranteed, as they are vulnerable to challenges like voter fraud, security, accessibility and results manipulation. The drive for innovative and reformative voting practices has gained resistance to these challenges to improve election transparency, security and accessibility. One such technology that has gained a lot of attention with respect to this is Blockchain.

Blockchain--a decentralized, distributed ledger technology known for its secure, transparent and tamper proof capability offers never before known opportunities for transforming the conduct and management of elections. Blockchain, initially a chain of blocks, is a growing list of blocks combined with cryptographic connections. Each block contains a hash, timestamp, and transaction data from the previous block. The blockchain was created to be data-resistant. Voting is a new phase of blockchain technology; in this area, the researchers are trying to leverage benefits such as transparency, secrecy, and non-repudiation that are essential for voting applications [1]. Blockchain technology has emerged as a captivating stand for transforming online voting systems. Blockchain provides unique methods for improving the transparency and integrity of electoral process by utilizing its decentralized architecture, cryptographic

security features, and immutable ledger capabilities. Integrating blockchain technology into online voting systems boosts the public trust in democratic processes.

Several countries and organizations are experimenting on this blockchain based online voting systems, but are not adopted widely. Estonia was the first country to implement electronic voting systems with limited blockchain technology [2]. Other countries such as Switzerland also conducted various trials on blockchain based online voting systems [3]. In India, there have been discussions and surveys on the possible integration of blockchain into nation's electoral processes. Indian governments revealed their use of blockchain technologies in various sectors like healthcare, finance, land registry and supply chain managements. There have been calls for adoptions of blockchain into voting systems within quarters of India.

This paper examines feasibility and implications of implementing blockchain technology in Indian online voting systems. It aims to study how blockchain's key principles-decentralization, cryptographic security and immutability can be leveraged to lighten the challenges inherent in traditional voting processes. Through a comprehensive analysis of distant electronic voting systems built on blockchain foundations, this study investigates important aspects such as distributed balloting, result computation, and authentication methods.

Additionally, this paper examines various consensus mechanisms such as Proof of Work (PoW) and Proof of Stake (PoS) to evaluate their effects on security and efficiency of electoral systems. The objective of this study is to evaluate the scalability prospects, obstacles, and achievements of blockchain-enabled voting systems through an analysis of case studies and real-world deployments.

Outline: The rest of this paper is organized as follows. Section 2 describes the literature review. Section 3 briefs out existing system. This is followed by our blockchain-based voting system proposal in Section 4. Section 5 describes implementation details. This is followed by results and performance analysis in Section 6. Conclusion and Future scope in Section 7.

II. LITERATURE REVIEW

The study [4] says, the blockchain protocol is a means of logging and verifying records that is transparent and distributed among users. Usually, the credentials are recorded, managed, and checked by a central authority. The implementation of blockchain technology would empower users to do these tasks themselves, by allowing them to hold a copy of the ledger.

Within [5] paper conveys significant risks faced by electronic voting such as if an electronic voting system is compromised, all cast votes can probably be manipulated and misused. Electronic voting has thus not yet been adopted on a national scale, considering all its possible advantages. Also conveys that today, there is a viable solution to overcome the risks and electronic voting, which is blockchain technology. In traditional voting systems, we have a central authority to cast a vote. If someone wants to modify or change the record, they can do it quickly; no one knows how to verify that record. One does not have the central authority; the data are stored in multiple nodes. It is not possible to hack all nodes and change the data. Thus, in this way, one cannot destroy the votes and efficiently verify the votes by tally with other nodes. Electronic voting based on blockchain will only work where the online voting system is fully controlled by no single body, not even the government.

In [6] the research explores that the blockchain consists of competitive and non-competitive types of consensus algorithms depending on how the blockchain is maintained. Competitive algorithms include proof-of-work (PoW), proof-of-stake (PoS), and delegated proof-of-stake (DPoS). Practical Byzantine fault tolerant (PBFT) algorithm, Paxos algorithm, and Raft algorithm are examples of non-competitive algorithms.

In this present time, Bitcoin, Blockchain, and Cryptocurrency are very hot topics nowadays. Moreover, each of the blocks in blockchain is identified by their hash value and this hash is generated using SHA 256 encryption algorithms says study [7].

[8] proposed Verify-your-Vote protocol which involves cryptographic primitives based on Elliptic-Curve Cryptography (ECC), pairings and Identity Based Encryption (IBE). Also, they formally proved the security of their protocol using ProVerif tool.

[9] put forth a BlockVote proposal in Thailand. This proposal used Blockchain to ensure that the voting process can be kept secure and trustable through the consensus handling mechanism of the Blockchain.

This paper [10] seeks to facilitate and protect the voting process by making an online voting system for elections and referendums connected with voting devices. The IoT and Blockchain have been used with this system to ensure that users' data are protected from theft and prevent eavesdropping or vote tampering to guarantee the integrity of the voting. The blockchain encrypts votes in order to protect every vote from forgery.

This paper [11] presents a secure blockchain based framework for an e-electronic voting in Iraq. And, paper [12] paper proposes a novel electronic voting system based on blockchain in USA.

[13] tried to combine the double envelope encryption technique and blockchain technology for their proposed electronic voting system in UK. [14] addresses open research, review and challenges on blockchain e-voting systems. Also gave comparisons of current blockchain-based electronic voting systems and scalability analysis of famous blockchain platforms. This survey paper [15] discusses the possible opportunity for applying blockchain technology in e-voting systems to improve the process of voting by tackling the issues of trust less, privacy, and security. This paper aims to evaluate different applications of blockchain as a service to implement distributed electronic voting systems.

III. EXISTING SYSTEM

The EVMs are called the Electronic Voting Machines, which are intelligent electronic devices used in the election processes to assist in accelerating and making voting efficient. The ECI, Election Commission of India is in charge of overseeing electoral processes. A cable connects the control and the balloting units in an EVM in India. Under the guidance of the presiding officer, the control monitors the voting process, while under their command, the voters use the balloting units. When pressing the button of their preferred candidate on the balloting unit, an electronic device sends a signal to the control unit, which is the vote. To counter tampering and unauthorized access, EVMs are equipped with several safeguards, including encryption, tampering detection systems, and locked compartments.

The use of EVMs in Indian elections has brought many successes, which include:

- Better Efficiency: Substantial reduction in voting time and acceleration of counting, election results can currently be announced more swiftly.
- Decreased Electoral Fraud: Electronic voting machines have cut the instance of electoral fraud by providing a safe and tamper-evident voting system.
- Voter Confidence: Decisions have been made to limit booth capturing and the ensuring of expanded voting and eliminate inflated voting through video surveillance.

Despite their successes, EVMs in Indian elections have faced several setbacks and challenges:

- Accessibility Challenges: For some voters, especially those with disabilities, using EVMs can be challenging. The design of EVMs may not cater to all needs.
- Allegations of Tampering: There have been allegations of EVM tampering by political parties and activists, raising concerns about the integrity and credibility of election outcomes.
- Technical Malfunctions: Instances of technical glitches and malfunctions in EVMs have been reported during elections, leading to disruptions in the voting process and delays in result declaration.
- Transparency and Accountability: Some critics argue that the lack of transparency in the functioning of EVMs and the absence of a paper trail make it difficult to verify the accuracy of election results, undermining the electoral integrity.
- Infrastructure and logistics: These are important for conducting elections in a country with the diversity and size of India, which might be difficult in remote locations.

Each of the above setbacks stems to implement online voting systems and making it secure by integrating blockchain to it.

IV. PROPOSED SYSTEM

We propose E-Voting system, which includes the following four phases:

- Secure Voter Registration: Users register by providing their Aadhar number, ensuring accurate voter data.

- Constituency-Based Candidate Listing: Based on voter's constituency, candidates from the respective party are presented.
- Encrypted Vote Verification: Votes are secured with blockchain encryption and verified by OTP, enhancing security.
- Real-time Admin Statistics: Administrators gain insights into voter turnout, candidate votes, and demographics.

The main objectives of our proposal are:

- To enable streamlined verification processes for voter registration, identification, and authentication.
- To enhance the security, transparency, and trustworthiness of the electoral process.
- To improve accessibility, convenience, and efficiency for voters, ensuring inclusive participation.
- To facilitate efficient auditing and verification, ensuring the accuracy and integrity of electoral results.

The system is designed with the following architecture:

1. Blockchain Infrastructure:
 - We choose Ethereum, a suitable blockchain platform that supports smart contracts and is scalable.
 - Implement smart contracts for user registration, authentication, voting, and result recording.
2. User Registration and Authentication:
 - Users register with their Aadhar number.
 - Upon registration, an OTP is sent to the registered mail-id for authentication.
 - Authenticated user information is stored on the blockchain.
3. Booth Assignment:
 - Based on the user's registered address, determine the corresponding booth number.
4. Voting Process:
 - Users log in and select their preferred candidates.
 - Votes are recorded on the blockchain with additional security measures such as OTP authentication.
5. Encrypted Data and Verification:
 - After voting, users receive an encrypted confirmation of their vote, which they can later use to verify their vote.
 - The encryption key and verification process should be secure to ensure privacy

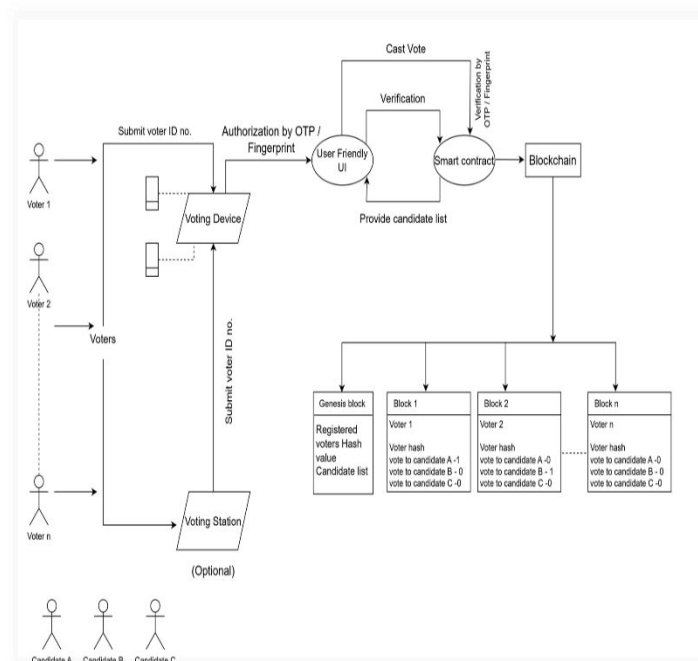


Fig 1 System Architecture



The advantages of our proposal over others are:

- Security: Blockchain technology eliminates tampering concerns, ensuring election integrity.
- Accessibility: The online platform accommodates all voters, including those with disabilities.
- Transparency: Real-time blockchain recording fosters transparency, preventing document forgery.
- Voter Confidence: Our system enhances voter confidence by securing each vote through blockchain technology, making it virtually immune to tampering or manipulation, there by instilling greater trust and confidence in the electoral process among all stakeholders, including voters and political entities.
- Anonymity: Blockchain allows for anonymity during voting. Having this ability might encourage more people to take part in elections.
- Processing time: Present systems take much time to collect and process results which costs issues. But in our system outcome can be instantaneously seen.
- Cost Savings: Online platform has the ability to reduce costs associated for the conduct and foresee of elections.

V. EXPERIMENTAL SETUP AND IMPLEMENTATION

Designing experimental setup for Blockchain based online voting system requires careful considerations of various components to ensure integrity, security and operation of the system.

- Blockchain Infrastructure: We setup blockchain network using Ethereum platform. We defined smart contracts to manage voting process, like voter registration, vote casting and counting.
- Ganache Tool: Using this tool, we can see each transaction details whenever any voting transaction is done by user, which means whenever user casts his vote then its transaction hash code can be seen in GANACHE. Thus, GANACHE tool is used to monitor transactions. We used SHA-256 algorithm to encrypt the vote casted by user. No one, including admin can decrypt the hash code.
- Truffle: Using this tool, we can deploy smart contracts solidity codes.
- User interface: We developed user friendly interface for voters and also implemented authentication mechanism, OTP here, to verify voter's identity.

Furthermore, proper hardware and software requirements setup also play a major role in setting up blockchain environment. Intel icore5 processor, 16 GB RAM, Compatible OS(Windows 10 or higher), SQL workbench for database, Visual studio IDE and Python3 for backend and HTML, CSS and JavaScript for backend.

In proposed E-Voting system, we are managing all voter details in Ethereum Blockchain tool as it supports immutable data storage and to implement this project we have designed following modules. See fig 2 & 3.

5.1 Admin Panel

Admin Login: Using this module, admin can login to system by using username as 'admin' and password as 'admin'

View Count: After login, admin can use this module to get count of vote for each candidate by entering his candidate ID

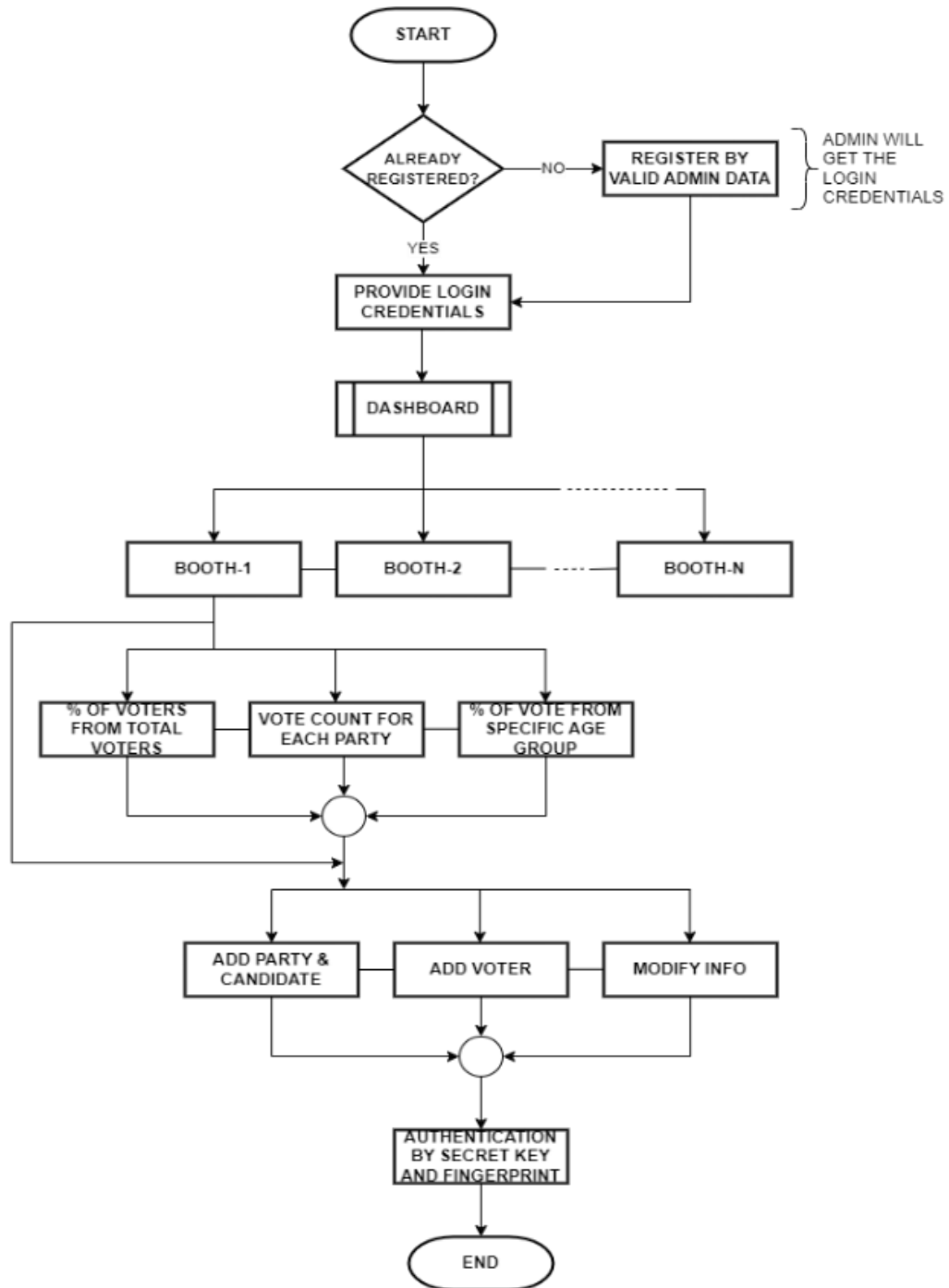


Fig 2 Workflow of Admin Panel



5.2 User Panel

Register Here: Using this module, user can sign up by providing details like, name, password, mobile no., mail-id, and constituency. Then, user can login by using username and password which is verified by OTP authentication.
 Cast Your Vote: Using this module, user will get list of candidates and then choose desired candidates to cast his vote
 Voter details: Using this module, user has to enter his name and AADHAR number. All details will be saved inside Ethereum Blockchain.

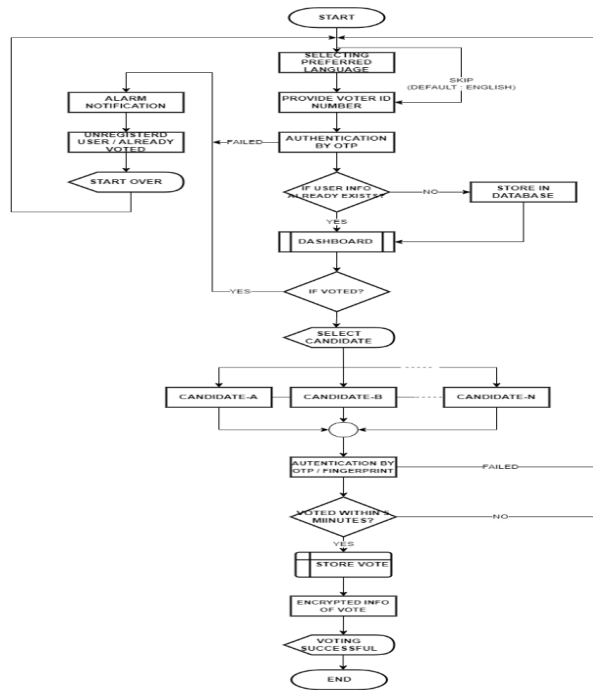


Fig 3 Workflow of user

VI. RESULTS AND PERFORMANCE ANALYSIS

We have written solidity code to add party details and mark vote function and get Count function to get count of votes for the party and we can deploy this contract using TRUFFLE Ethereum tool.
 Now we need to deploy smart contract code to store and access EVOTING data into Ethereum Tool. To deploy go inside 'hello-eth\node_modules\bin' folder and in this folder double click on 'runBlockchain.bat' file to get below screen:

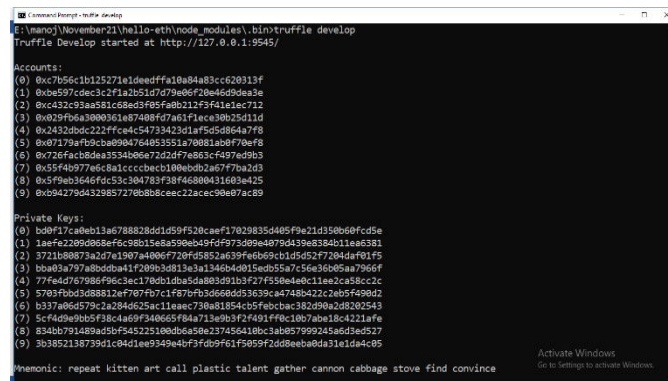


Fig 4 Truffle Develop



In above screen we can see some accounts and private keys that are generated and now press enter key in above black console to deploy solidity to Ethereum and to get a screen E Voting contract is deployed.

```

2_deploy_contracts.js
=====
Replacing 'EVoting'
-----
> transaction hash: 0x93584505bc5d7856e1bb3e9396f6b47057ea41b117c72e48b5d47badaaf3ba39
> Blocks: 0
> contract address: 0xB8c7cBe6C2412412583aB748679F2908D64eCF
> block number: 3
> block timestamp: 1644222596
> account: 0xd1eC18a9265b63621332fb89C963962B0D9F5aA4
> balance: 99.98064822
> gas used: 675234 (6xa518a)
> gas price: 20 gwei
> value sent: 0 ETH
> total cost: 0.01352468 ETH

> Saving migration to chain.
> Saving artifacts
-----
> Total cost: 0.01352468 ETH

Summary
-----
> Total deployments: 2
    
```

Fig 5 Truffle Develop

The contract address highlighted in above page can be seen even in GANACHE tool.

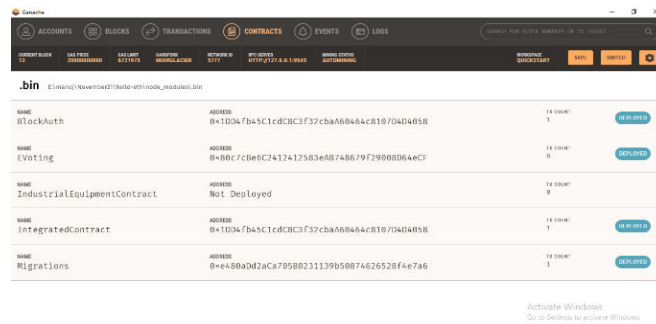


Fig 6 GANACHE screen

In above GANACHE screen, we can see EVoting solidity contract deployed. Now to see available blocks, click on Blocks.

BLOCK INDEX	MINED	DATE	TX INDEX	STATUS
13	MINED OK	2022-02-07 10:10:31	0451022	TRANSACTION
12	MINED OK	2022-02-07 10:08:12	0451003	TRANSACTION
11	MINED OK	2022-02-07 10:07:23	0451020	TRANSACTION
10	MINED OK	2022-02-07 10:05:148	0451022	TRANSACTION
9	MINED OK	2022-02-07 15:147:28	0451022	TRANSACTION
8	MINED OK	2022-02-07 15:145:28	0451022	TRANSACTION
7	MINED OK	2022-02-07 14:09:127	0451022	TRANSACTION
6	MINED OK	2022-02-07 14:09:106	0451022	TRANSACTION
5	MINED OK	2022-02-07 14:08:026	0451022	TRANSACTION

We can see total of 13 blocks are created and if anyone casts vote, then new block will be created and we can see 14th block.



To run project double click on 'run.bat' file to start python WEB DJANGO server.

```

C:\Users\jyoti\Desktop>
C:\Users\jyoti\Desktop>python manage.py runserver
Performing system checks...
System check identified no issues (0 silenced).
You have 15 unapplied migration(s). Your project may not work properly until you apply the migrations for app(s): admin, auth, contenttypes, sessions.
Run 'python manage.py migrate' to apply them.
[WARNING] A new release of Django is available: 4.2.1 (4.2.1)
Django version 4.2.1, using settings 'Voting.settings'
Starting development server at http://127.0.0.1:8000/
Hit the server with Ctrl-C.
    
```

In above screen DJANGO server started and now open browser and enter URL as <http://127.0.0.1:8000/index.html> and press enter key to get below page

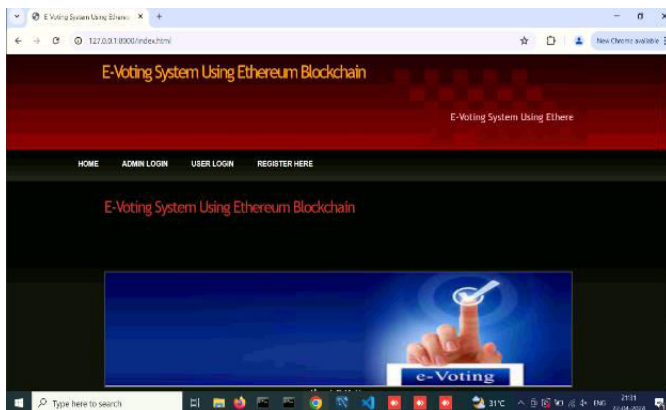


Fig 9 Home page

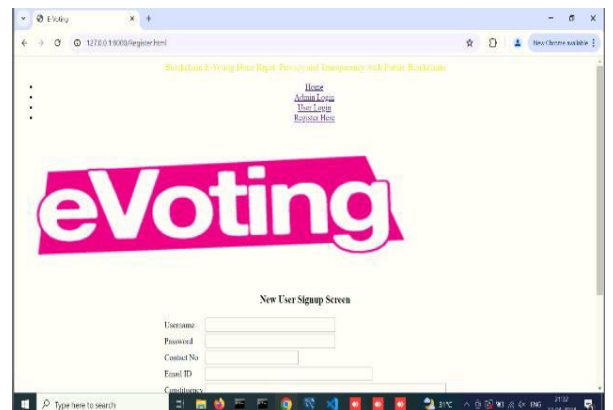


Fig 10 User Signup page

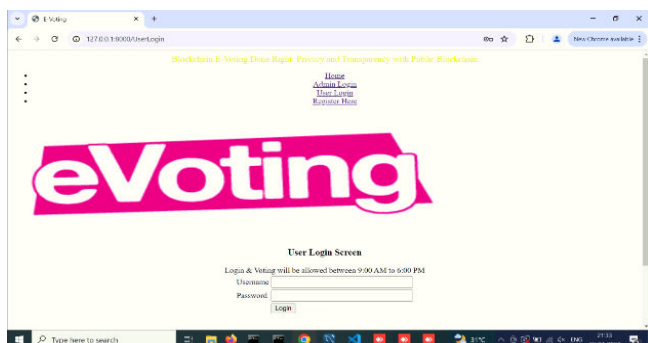


Fig 11 User Login Screen

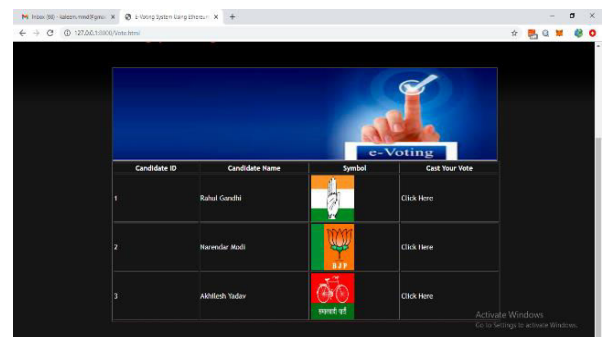


Fig 12 Cast your Vote Page

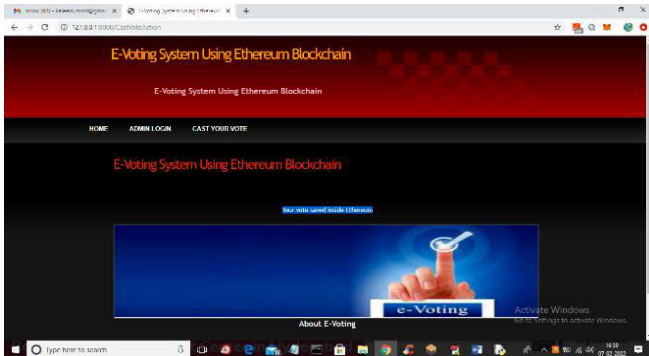


Fig 13 Successful Voting

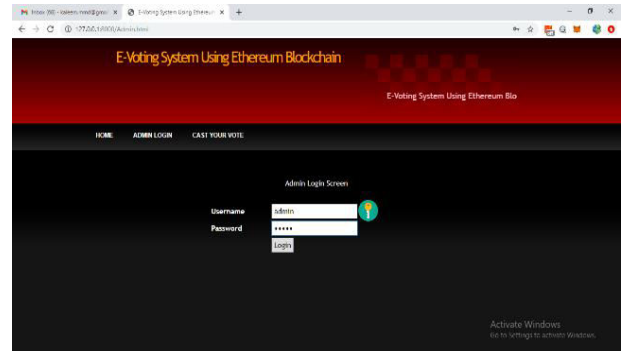


Fig 14 Admin Login

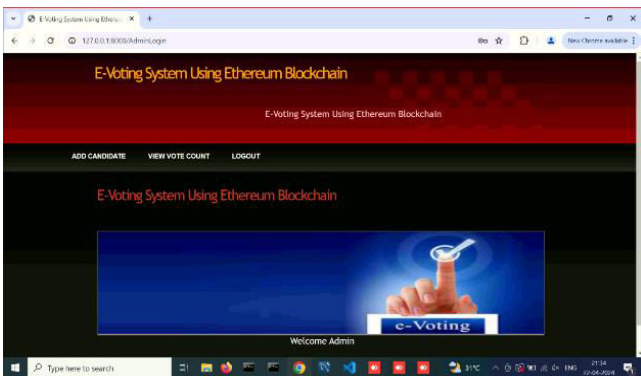


Fig 15 Admin Dashboard

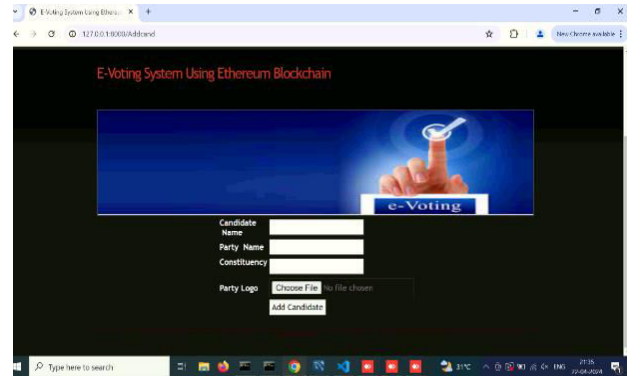


Fig 16 Add Candidate Page

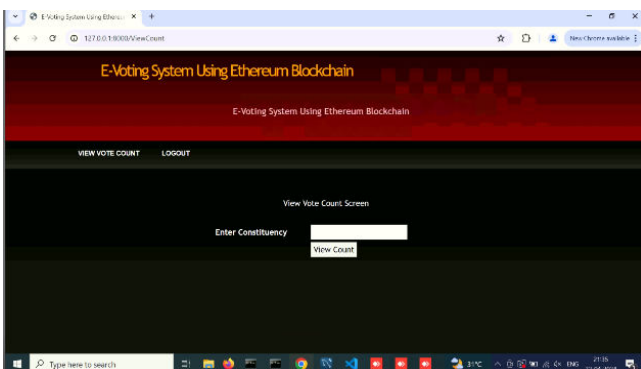


Fig 17 View Vote Count Page

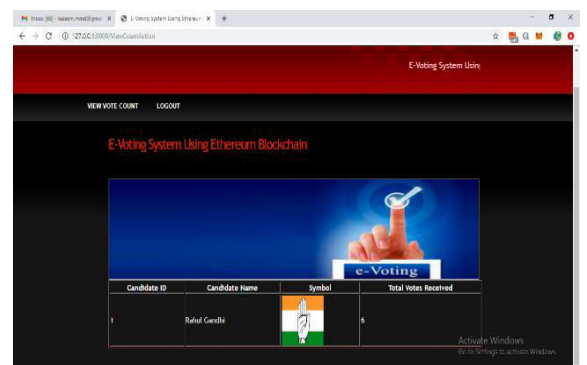


Fig 18 Vote Count

When it comes to performance, blockchain voting systems facilitated quick and accurate voting, with minimum time for casting and counting than EVMs that are being used so far. As blockchain uses cryptographic techniques, they ensure more security. EVMs require voters to physically visit the polls, but online systems made accessibility easier, even for disabled person and these are cost effective.

VII. CONCLUSION

The proposed blockchain-based online voting system provides an opportunity to simplify the registration process by utilizing Aadhar number and OTP authentication, ensuring convenience. It efficiently manages both voter information and booth number determination based on the address. The system values security above all with OTP authentication. Additionally, it provides voters based on secured data to authenticate their votes, which will give transparency element but will still preserve anonymity. The system's main aim is to reach as many as possible the different groups of voters. Moreover, it upholds the principle of one man, one vote to ensure a fair and efficient democratic process. They see in real time the number of voters, the candidates or parties that are ahead, and so on. It must pass through a set of strict security measures, extensive testing, and regulatory compliance in order to avoid fraud and safeguard integrity of the electoral process. To summarize, this online voting system based on blockchain technology can facilitate voter participation and inspire faith in the democratic process.

The introduction of Blockchain-Based online system for voting in India is a novel control mechanism which eliminates crucial shortcomings related to the electoral process. The technology behind blockchain that enables voter registry, constituency-based candidate listing, encryption of votes for verification, and live admin statistics is made possible. The future outlook involves making it accessible to more users with integrity and transparency through designing better interfaces, scaling up the technology, and establishing a regulatory framework. The collaboration of partner nations, public education and gentle design approach is the key to the overall acceptance. The system holds the promise of boosting voter turnout, safeguarding the taunt of the voting results and building a strong basis for democracy. Continuing to perform ground-breaking research and innovation should be of paramount importance for harnessing the full power of blockchain technology in transforming our electoral system.

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