

BLOCKELECT: DECENTRALIZED E-VOTING SYSTEM ON BLOCKCHAIN

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Abstract - Ethereum blockchain can be used to do decentralized voting in a secure, transparent and tamper-proof way. It is a decentralized application that is built on Ethereum Blockchain network enabling participants to cast their votes and look at the results of the voting without any intermediaries. Votes are recorded on the blockchain, so no one can change or interfere with them. Through smart contracts, the voting process can be done automatically, transparently and securely. The blockchain technology has been used and implemented for decentralization so as to make it possible to carry out an election that is fair and trustworthy at a low cost.

Keywords – Blockchain, Ethereum, e-Voting, MetaMask.

1. INTRODUCTION

Blockchain is a type of digital bookkeeping that gets rid of middlemen. It lets network users share and check transactions in a safe and clear way. Because it is decentralized, data is stored on many computers rather than one central one. This makes the system secure and reliable as it's hard to hack or change data.

Blockchain became popular with the arrival of Bitcoin, the first decentralized virtual money. But now, many sectors use blockchain. Examples include voting, managing supply chains, healthcare, and finance.

Blockchain is a system that chains pieces of digital info together. Every part, or block, has a unique hash. This hash chains one block to the next.

No one can change a block after it's made unless everyone agrees. That's why it's really secure. The info on the blockchain stays true and clear for everyone to see.

Basically, blockchain could change how we keep and share info. It offers more safety, openness, and is easier for everyone to use.

Voting with blockchain could change how we vote. This kind of system uses the secure and see-through nature of blockchain to make voting better. It tackles a lot of the issues found in old-fashioned voting methods.

In this new voting system, when a person votes, the vote is registered in the blockchain making it unique to the individual who cast it thus preserving it from any manipulation.

Moreover, this program does not require supervision from entities such as the government for monitoring elections; therefore, it is less prone to manipulations and allows results to be released faster.

Another reason for creating decentralized voting systems is because they enable people to vote even if they are out of their countries. This makes the electoral process more democratic and comprehensive, engaging more electorate and thus realizing a high voter turnout. In general, a decentralized voting mechanism that is based on Ethereum technology has the capacity to deliver substantial advantages to the election process by increasing its safety, openness, and inclusivity.

2. LITERATURE REVIEW

Blockchain has simplified the voting system by making it transparent, user-friendly, and cheat-proof. It enhances the security of voting records and facilitates verification of votes. Several recent studies have raised concerns about e-voting on blockchain because it is prone to privacy issues and threats. They analyze varied e-voting platforms raised using a blockchain.

For instance, the Open Vote Network (OVN), which was introduced by [6], represents the initial implementation of an internet-based voting protocol which is both transparent and self-tallying in nature, while ensuring total user privacy and protection of profile, through the use of Ethereum. However, OVN does have limitations. It limits the number of voters or users to 50-60 with the framework and lacks various measures to prevent unauthorized people from intruding to the system.

Additionally, a fraud voter can indulge the voting process by submitting an invalid vote. The system does not provide resistance to coercion, necessitating trust in the electoral administrator [2,4]. Moreover, due to Solidity's inability to support elliptic curve cryptography technique, which is an external library was used for computation in the system[5,7]. The voting contract grew so big it couldn't fit on the blockchain. This made OVN vulnerable to a DoS attack, a devastating setback seen in the Bitcoin network's past [2,3,4]. A possible solution comes from Lai et al. [3], who put forth an idea for a decentralized secret but transparent electronic voting system (DATE) requiring trust among participants. They believe their DATE method can handle large scale e-voting. However, it lacks fortification against DoS

attacks, as they haven't assigned a third-party authority to review the vote post-election. Also, due to platform constraints, the system is better suited for small-scale applications [1,3].

While the use of Ring Signature ensures voter privacy, it presents challenges in managing and coordinating several signer entities. Furthermore, the system relies on PoW consensus, which has significant drawbacks, including high energy consumption, as miners' "supercomputers" perform millions of computations per second globally. Blockchain technology has the potential to bring about significant changes in the electronic democratic framework. It rectifies existing vulnerabilities in the electoral process, making voting transparent, accessible, and secure.

Using electronic voting with blockchain carries big risks. If hackers break in, they could change or misuse all votes. That's why many places still don't use electronic voting. Blockchain could fix these risks, though. In old-school voting, one main group could change vote records, and it's hard to check if they're true. But with blockchain, the votes spread out across many places. Hacking all these spots to change votes? Nearly impossible. It spreads the power, so we can trust the votes more, as lots of different spots agree on the vote count. Blockchain technology offers a powerful tool for digitizing and securing records. As a distributed ledger, it's both transparent and resistant to tampering. This makes it a good fit for e-voting, where maintaining trust is crucial[1].

For online voting, it's key that no single group controls the system. This includes governments. Elections should inspire wide trust, assuring citizens that leadership is valid. Finally, blockchain could make voting smoother and more secure. By studying past research and testing new methods, we can improve how we vote and participate in democracy.

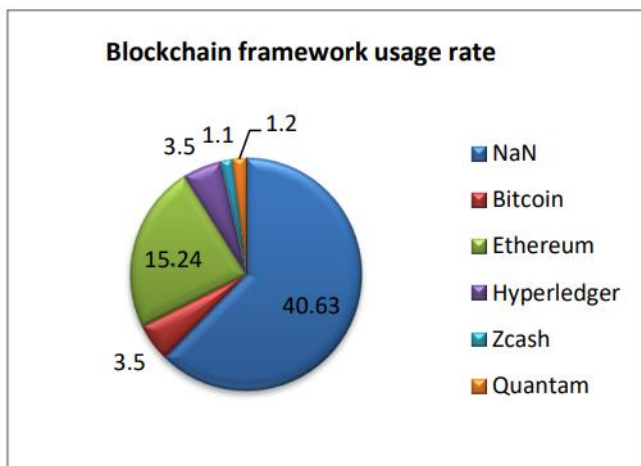


Fig. Blockchain Framework Usage Rate [8]

3. EXISTING SYSTEM

3.1 BRIEF ABOUT EXISTING SYSTEM

The existing voting system typically involves voters go to a polling station to vote with paper ballots. People count these votes by hand. Some places use machines or internet voting, but these methods can be risky because of security worries and can have potential vulnerabilities.

3.2 DISADVANTAGES OF EXISTING SYSTEM

- **Lack of transparency:** In many instances it is hard for an elector to ascertain whether their votes were correctly registered.
- **Vulnerability to fraud:** There is always a chance that these paper ballots or EVMs could be tampered, hacked or involved in other types of fraud. However, this is extremely difficult where it cannot be independently audited and has been noted in most cases of vote fraud.
- **Slow results:** This can take a lot of time and energy in counting of paper ballots this slowing down the official announcements of the election results.
- **Cost:** Traditional voting systems are usually expensive; there should be an employment of poll workers, procurement of voting machines or paper ballots, and rentals of the polling place.
- **Centralization:** Often, traditional voting system tends to have a centralized control, which is exercised at few points of power. It gives a leeway to misuse authority and corruption in voting process by individuals with influence.
- **Limited Accessibility:** There are some types of voting systems that necessitate voters to travel to select polling centers, and if one is disabled, has restricted mobility, or similar circumstances it might turn out hard or even impossible to come into those facilities. However, this may lead to voter disenfranchisement.

4. PROPOSED SYSTEM

4.1 BRIEF EXPLANATION OF PROPOSED SYSTEM

The proposed voting system is the one that uses the Ethereum blockchain technology which aims at bringing transparency during elections. It works through smart

contracts on Ethereum platform which makes it possible for people to vote without revealing their identities though it keeps the data integrity intact hence nobody can ever change vote once it has been saved. As a result, this will lead to assurance from electorates about how voting processes happen while at the same time minimizing chances of acts like impersonation leading to confidence among various stakeholders in election process including voters.

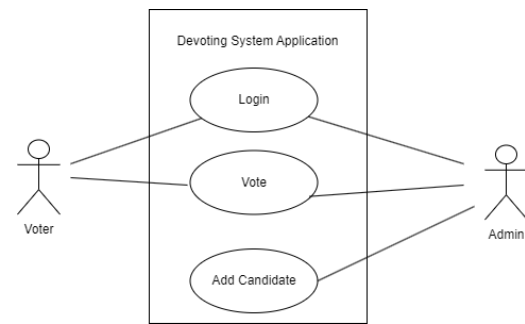
4.2 ADVANTAGES OF PROPOSED SYSTEM

- With decentralization it is ensured that no entity or party controls the whole voting process.
- There is transparency throughout the voting process.
- Voters have the liberty to vote from any part of the world.
- On a large scale this method is very cost effective.
- The whole process is tamper proof.
- The results are provided accurate in real time.

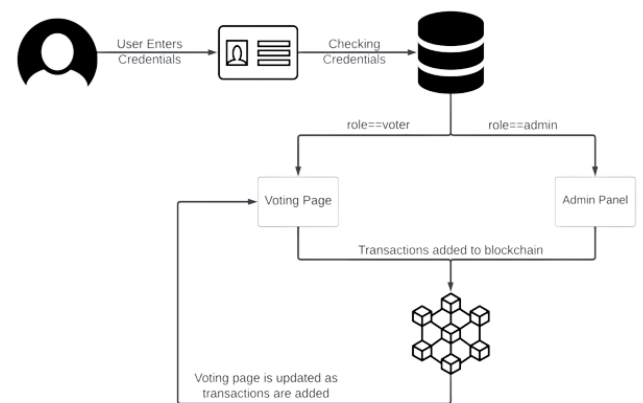
4.3 OBJECTIVE OF PROPOSED RESEARCH

- **Transparency:** This system seeks to offer voters full visibility into the entire voting process, allowing them to see everything from vote counting to final results.
- **Security:** This system is designed to offer a safe platform for elections, removing any chance of vote tampering and ensuring that the election results are both transparent and verifiable.
- **Efficiency:** This system seeks to streamline the voting process by minimizing the time and resources needed to conduct elections. Because it's automated and doesn't rely on intermediaries, it can greatly cut down on the cost and time typically involved in traditional voting systems.
- **Accessibility:** This system is designed to make voting more accessible for all eligible voters by removing the requirement to physically visit a polling station, which can help boost voter turnout.
- **Trust:** This system aims to build greater confidence in the voting process by offering a transparent and tamper-proof method for recording and counting votes.

4.3 USE CASE DIAGRAM



4.4 SYSTEM ARCHITECTURE



- **User Authentication:**

- Users gain entry to the system by inputting their Voter ID and password.
- The system authenticates provided credentials against a centralized database.

- **Role-Based Access:**

- After a successful login, the system assesses the user's role (admin or voter) to determine the appropriate redirection.
- Admins are guided to the admin page, while voters are directed to their respective voting interface.

- **Admin Functionality:**

- Admins hold the authority to start the voting process and can also select election details such as voting dates.
- They can introduce candidates into the system, entering information like names, photos, and party name.
- Admins are equipped to manage and update candidate information as required.

- **Voter Functionality:**

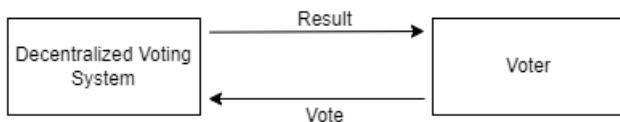
- i. Voters, after the authentication can access the platform and choose the person whom they want to cast their vote.
- ii. Voters will have the option to review candidate information, including profiles education, and many more.
- iii. During the voting process, voters can proceed to cast their votes.

- **Blockchain Integration:**

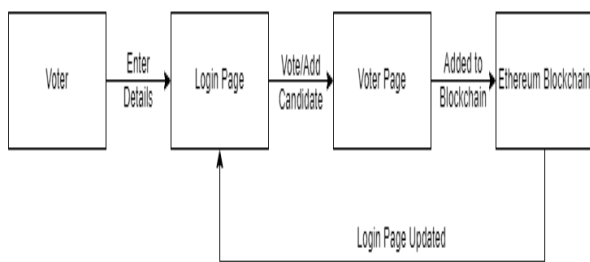
- i. Seamless integration with a blockchain improves the overall voting system's security and transparency.
- ii. Every input or vote casted is immediately recorded as transaction on the blockchain, ensuring an immutable and verifiable election record in the system.

4.4 DATA FLOW DIAGRAM (DFD)

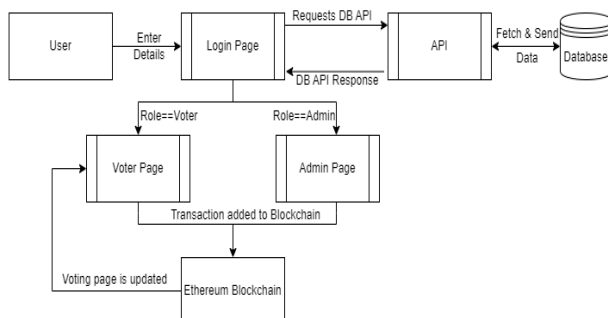
- Level 0 data flow diagram



- Level 1 data flow diagram



- Level 2 data flow diagram



4.5 TECHNOLOGY USED FOR E-VOTING

- **MetaMask:** It is a digital wallet and browser add-on that lets you manage and use decentralized apps (dApps) on blockchain networks, especially Ethereum and similar networks like Binance Smart Chain, Polygon, Avalanche, and others.
- **Ganache:** It is a software tool that lets you create a small blockchain on your computer. Developers use it to build, test, and deploy Ethereum smart contracts without having to connect to a real blockchain like Ethereum's mainnet. It allows them to experiment and see how their smart contracts work in a risk-free, controlled environment.

5. RESULTS

In this system, only the admin has the right to add candidates contesting for the election along with necessary details like name, party name, qualifications and many more. Along with admin also specify the dates for contesting the election in the admin panel itself. Admin also have the exclusive right to view the result.

When the administrator logs in with respective credentials, all candidates who are contesting for election gets displayed on the screen along with party names.

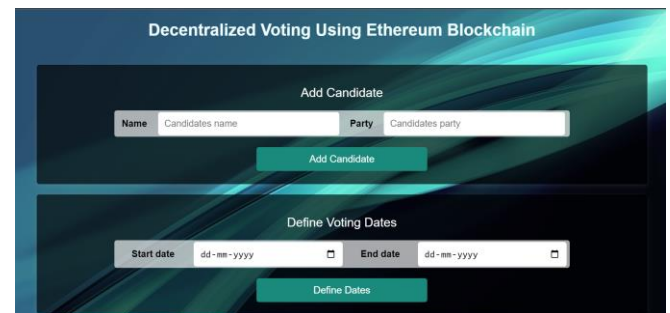


Fig. Admin Panel

When the administrator clicks on the names of the candidates all the votes of that party is displayed. By this means, result is published accurately in real time.

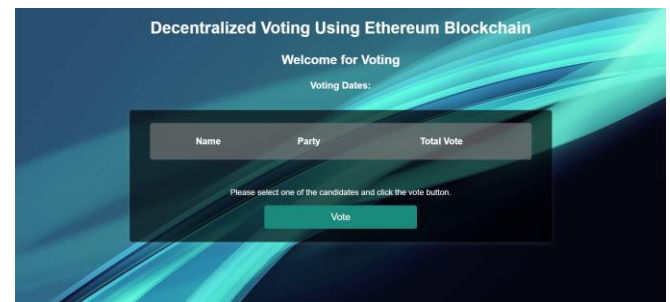


Fig. Voting Panel

Name of Test	Checking JWT Authorization
Test Case Description	The objective of this test case is to check <u>jwt</u> authorization
Input	Login and Password
Expected Output	User should not be able to login without proper authorization
Actual Output	User cannot access voting or admin page without authorization
Result	Pass
Comments	Working Properly

Name of Test	Verify candidate registration
Test Case Description	The objective of this test case is to verify that the candidate can be registered by the admin
Input	Candidate name and party
Expected Output	Registration transaction should be successful
Actual Output	Registration transaction is successful
Result	Pass
Comments	Working Properly

Name of Test	Verify date registration
Test Case Description	The objective of this test case is to verify that date of voting can be specified by admin.
Input	Starting and ending date
Expected Output	Date transaction should be successful
Actual Output	Date transaction is successful
Result	Pass
Comments	Working properly

Name of Test	Verify Voting
Test Case Description	The objective of this test case is to verify that voter <u>is able to</u> cast their vote
Input	Select the candidate and click the "Vote" button
Expected Output	Vote transaction should be successful
Actual Output	Vote transaction is successful
Result	Pass
Comments	Working properly

Vote	
Status	Confirmed
From	0xDB7E5...F...
To	0x7d39b.....
Transaction	
Nonce	21
Amount	-0 ETH
Gas Limit (Units)	6654755
Gas Used (Units)	72567
Base fee (GWEI)	0.06480238
Priority fee (GWEI)	2.5
Total gas fee	0.000186 ETH
Max fee per gas	0.000000003 ETH
Total	0.00018612 ETH

Set Dates	
Status	Confirmed
From	0xDB7E5...F...
To	0x7d39b.....
Transaction	
Nonce	20
Amount	-0 ETH
Gas Limit (Units)	6654755
Gas Used (Units)	6620
Base fee (GWEI)	0.073852308
Priority fee (GWEI)	2.5
Total gas fee	0.00017 ETH
Max fee per gas	0.000000003 ETH
Total	0.00017018 ETH

6. CONCLUSION

Decentralized voting system voting on the Ethereum blockchain ensures flawless voting that is secure. Votes' integrity and a platform that is not prone to manipulation are guaranteed through this method's involvement of blockchain technology. This approach could change democracy by making citizens part of a democratic decision-making process that is much better than the one

we have today due to its increased user friendliness, scalability features for broad use across different contexts including government operations amongst other things.

Decentralized voting system in future can allow for many advantages through inclusion of numerous other features in it. These are real-time vote counting to show instant outcome, secure voter identification process, advanced data analytics to understand voter behaviours, and support for state-of-the-art technologies such as AI and biometrics. These improvements will enable an increase in confidence towards conducting elections through the system due to its efficiency, safety features among other things, hence encouraging greater numbers to partake in voting processes.

REFERENCES

- [1] Blockchain for Electronic Voting System—Review and Open Research Challenges-Uzma Jafar , Mohd Juzaidin Ab Aziz and Zarina Shukur-2021
- [2] Bellini, Emanuele, Paolo Ceravolo, and Ernesto Damiani. "Blockchainbased e-vote-as-a-service." 2019 IEEE 12th International Conference on Cloud Computing (CLOUD). IEEE, 2019.
- [3] Hamidey, Mohammad Hadiff bin, and Swee-Huay Heng. "A BlockchainBased E-Voting System." In International Conference on Computational Science and Technology, pp. 553-567. Singapore: Springer Nature Singapore, 2022.
- [4] Alvi, Syada Tasmia, Mohammed Nasir Uddin, Linta Islam, and Sajib Ahamed. "DVTChain: A blockchain-based decentralized mechanism to ensure the security of digital voting system voting system." Journal of King Saud University-Computer and Information Sciences 34, no. 9 (2022):855-6871.
- [5] Agarwal, Himanshu, and G. N. Pandey. "Online voting system for India based on AADHAAR ID." In 2013 Eleventh International Conference on ICT and Knowledge Engineering, pp. 1-4. IEEE, 2013.
- [6] McCorry, P.; Shahandashti, S.F.; Hao, F. A smart contract for boardroom voting with maximum voter privacy. In Proceedings of the International Conference on Financial Cryptography and Data Security, Sliema, Malta, 3–7 April 2017. [Google Scholar]
- [7] Jafar, Uzma, Mohd Juzaidin Ab Aziz, and Zarina Shukur. "Blockchain for electronic voting system—review and open research challenges." Sensors 21.17 (2021): 5874.
- [8] Prof. Mrunal Pathak, Amol Suradkar, Ajinkya Kadam, Akansha Ghodeswar, Prashant Parde, "Blockchain Based E-Voting System", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395- 6011, Volume 8 Issue 4, pp. 246-251, July-August 2021. Journal URL : <https://ijsrst.com/IJSRST2183200>