

Decentralized Voting System using Blockchain Technology

Harshit Kumar¹, Shubham Rana², Saurabh Yadav³, Jyoti Yadav⁴

¹DPG Institute of Technology and Management (DPGITM), Gurugram, Haryana, India

⁴Assistant Professor DPG Institute of Technology and Management (DPGITM), Gurugram, Haryana, India

Abstract- Over the past ten years, electronic voting systems have developed dramatically; however, there are still issues with regard to security, transparency, and trust. Current electronic voting systems use a centralized database and are therefore vulnerable to such problems as points of failure, data manipulation, and tampering with votes. A blockchain-based decentralised voting system has been developed using SQLite, Flask (Python), and a novel proof-of-work blockchain. This solution provides the ability to store election votes transparently, immutably, and securely. Another critical component of this application is that it creates a publicly auditable blockchain for the entire election process, as well as the tools required for administrative oversight, secure voter authentication, and the ability to tally votes in real time. A demonstration of how blockchain technology can provide superior election systems that increase voter confidence and the integrity of elections has been provided.

Keywords: Electronic voting; Blockchain technology; Decentralized voting system; Election security; Transparency; Immutability; Proof-of-work blockchain; Voter authentication; Real-time vote tallying; Trust in elections.

I. INTRODUCTION

Elections are crucial. They help keep things fair. Elections make sure everyone has a say in what happens. Elections are a part of keeping things fair. Voting systems have a lot of problems. These problems are really big. The issues with voting systems are very serious. Voting systems have issues that need to be fixed. The people in charge keep all the votes in one place, which makes the votes easy to hack and cheat with. They do not do a good job of keeping the votes safe, so it is easy for someone to hack into the votes and cheat with them. This is really bad. Voting on the internet is really easy for people to do.

The internet voting system does not always count the votes correctly. Internet voting also does not always keep the people's votes. Internet voting is a way for people to vote, but it has some problems. The main problems with internet voting are that the votes are not always counted correctly, and the internet voting system does not always keep the people's votes. The Decentralized Voting System is a way to vote on the internet. It uses something called blockchain technology. This is a deal for the Decentralized Voting System because it helps make voting on the internet safe and secure. The Decentralized Voting System is really about using

the internet to vote in a safe way. The Decentralized Voting System is really good because it keeps votes safe. It makes sure votes are fair.

That is what the Decentralized Voting System is about. The Decentralized Voting System is a thing because it helps with a lot of problems. The Decentralized Voting System solves issues. That is why we have the Decentralized Voting System. The Decentralized Voting System is really helpful for people like us. We can use the Decentralized Voting System to make things better. The Decentralized Voting System is a thing because it helps us in many ways. We should look into the Decentralized Voting System. See what it can do for us. This program does things behind the scenes using Flask. It uses Flask to get things done without you noticing.

The program is working with Flask to make things happen. The Decentralized Voting System stores information about the voters and the people who run the Decentralized Voting System using SQLite. This way, the Decentralized Voting System can keep all the details safe. The Decentralized Voting System is a way to keep votes safe. It uses blockchain to do this. So nobody can change the votes of the Decentralized Voting System. This is important for the Decentralized Voting System. The Decentralized Voting System needs to be safe and fair. That is why

the Decentralized Voting System uses blockchain. The system has a way to send emails to users. This is really helpful because it lets people log in safely to the system. The email system is also good because it asks people to confirm they want to register to vote by email.

The system uses emails to help people register to vote. The system sends out alerts about elections, too. It tells people about the elections. The system is good at sending out these alerts about elections. The system is better because of this. People have faith in the system. This is why people trust the system more. The system is more reliable. That is a good thing. People like the system because it is trustworthy. The system is something that people can count on. That is important. The system uses emails to make sure that the emails help everything runs smoothly with the emails. The blockchain and the email system work together. They make sure the votes are safe. The blockchain and the email system also make sure people know what is going on. The blockchain and the email system do this, so everyone is informed about the system and the blockchain and the email system.

The new system uses blockchain technology and Ethereum smart contracts to make the voting process fair. The new system is like a book that keeps track of all the votes that people make for the election. This book is very important because it helps make sure the election is fair. The new system is a way to keep track of votes for the election. When someone goes to vote, their vote is actually written down in this book. The vote is recorded in this book so that it can be remembered. This book is used to keep track of all the votes that someone makes when they vote. When you write a vote, in this book, it is final. The results are honest because nobody can alter them. This voting system is fair. Nobody can cheat with it. The voting system is a way to make sure everything is fair. The voting system is also very affordable.

A lot of people are able to use the voting system. The voting system is a thing because the voting system is easy to use. The blockchain technology voting system is really good for places, like colleges and

companies, to use when they have elections. The blockchain technology voting system makes the voting process safe. The blockchain technology voting system is also very transparent. People can see what is going on with the blockchain technology voting system. Ethereum smart contracts are used with the blockchain technology voting system to keep the votes honest and make sure the blockchain technology voting system is fair. The blockchain technology voting system is a way for NGOs and community organizations to have elections, too.

Blockchain technology is very important. It keeps the votes safe. Blockchain technology makes sure the results are fair. We use blockchain technology to keep everything safe. Its scope includes secure voter registration with SMTP-based email verification, user-friendly web interfaces for voters and administrators, smart contracts for vote recording and validation, and an administrative panel for election management and result viewing—collectively establishing a secure, decentralized, and trustworthy electoral framework [1] [2].

Blockchain technology is a system that keeps track of things in a kind of book. This book is not kept in one place; it is kept in places at the same time. The blockchain technology makes sure that all the information in this book is safe and cannot be changed. When the blockchain technology was first introduced in 2008 it was used for Bitcoin. The blockchain technology was really good for Bitcoin because it helped people trust each other when they were buying and selling Bitcoin. The blockchain technology did this by being very open and honest and by making sure that nobody could cheat. Now, the blockchain technology is used for more than Bitcoin.

It is used for things like keeping track of products as they move from one place to another and for helping doctors keep track of people's information. The blockchain technology is also used for things like helping people prove who they are, for making sure that votes are counted correctly when people vote. The blockchain technology is a useful tool, and it is being used in many different ways. In the present era, blockchain enables secure data sharing, smart

contracts, and tamper-resistant record-keeping, significantly reducing fraud and increasing system reliability. Looking toward the future, blockchain technology is expected to play a vital role in building decentralized applications, enhancing cybersecurity, enabling trustworthy digital governance, and supporting emerging technologies like the Internet of Things (IoT) and artificial intelligence, making systems more transparent, secure, and efficient.

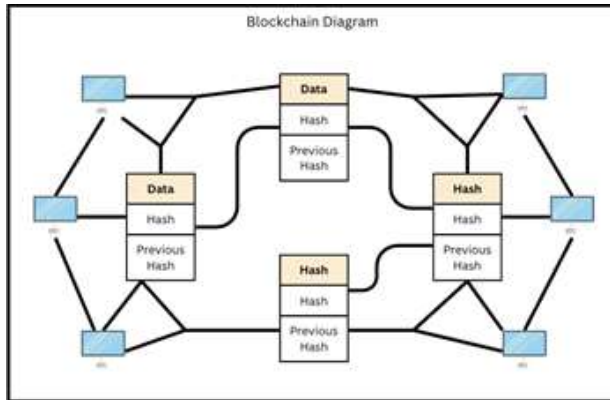


Fig 1: Blockchain Diagram

II. LITERATURE SURVEY AND REVIEW

Comparission of Studies

When you look at the types of voting systems that are out there you can see some big differences. Traditional voting systems are pretty simple and easy to set up. They have some major problems. They are not very secure. It is hard to see what is going on. People can also make mistakes. Cheat when they use these systems. centralized online voting systems make it easier for people to vote because they can do it from anywhere.

These systems have a big weakness. They rely on one server, which means that if someone gets into that server they can do a lot of damage. They can mess with the data. Even bring down the whole system. Blockchain-based voting systems are different because they are more secure and they are more transparent and they are not rely on one server. Voting are a part of our society and we need to make sure they are working well. Traditional voting methods and centralized voting systems have

their own set of problems. Blockchain-based voting systems can help solve some of these problems.

Motivation for the project:

The reason we are doing this work is because of the problems I found in the voting systems we have now. These systems do not tell us what is going on they are not safe and they are hard to use when organizations and colleges are voting. The old way of voting relies too much on people we are supposed to trust, which makes voters worried and can lead to cheating. Even though using blockchain can make voting safer and keep everything many of the blockchain voting systems we have now are too complicated, too expensive or hard for people to use who do not know a lot, about technology like the voting systems that use blockchain.

Therefore, there is a strong need for a voting system that combines the security and transparency of blockchain technology with a simple, user-friendly interface and reliable authentication mechanisms. The proposed decentralized voting system is motivated by the goal of providing a practical, cost-effective, and trustworthy solution that can be easily adopted by educational institutions, corporate organizations, and NGOs, while ensuring voter anonymity, real-time result monitoring, and election integrity.

Limitations of Existing Systems:

The literature survey identified weaknesses across current voting methods:

1. **Traditional Methods:** Whether using paper ballots or basic Electronic Voting Machines (EVMs) in colleges and corporate settings, these methods are susceptible to manipulation, favoritism, errors, and long manual counting times, leading to disputes and mistrust [3].
2. **Online/Web-Based Systems:** Although these systems enhance accessibility and convenience, they are centralized. This centralization means votes are vulnerable to tampering at the database or server level, and security issues like unauthorized access or fake logins limit their trustworthiness [4].

Existing Blockchain Research and Identified Gap:

Recent studies have recognized blockchain as a promising technology for delivering fair elections across various institutions. Blockchain provides key benefits such as immutability (tamper-proof storage), transparency, and decentralization in vote recording [5].

Table 1: A review of decentralized voting research in India highlights ongoing efforts:

Year	Institution	Methodology	Advantages	Drawbacks
2022	ISb&M College, Pune [6]	Blockchain-based DApp for an E-voting system,	High security, transparency, tamper-proof ledger	Complex for small institutes, requires technical awareness
2022	Dr. Babasaheb Ambedkar Technological University [7]	Smart contracts for automated result handling	Removes manual intervention, trustless system	High execution cost of contracts
2024	IIT Madras (Healthcare) [8]	Blockchain-based Healthcare information system	First practical test, reduced malpractices	Limited scale, fewer participants

Despite all those studies, there are still some challenges, like scalability, ensuring ease of use for the non-technical voters, and strong authentication. The primary research gap is that current solutions either compromise security (traditional methods) or suffer from the risk of centralization (web apps). Many blockchain proposals are currently theoretical or tested only on a single platform with a small population. There is a need to focus on practical, scalable, and secure blockchain-based platforms specifically designed for organizations and academic institutions.

Contribution of the Proposed System

The DVS proposal addresses those gaps by integrating secure login mechanisms, smart contracts, and blockchain technology to prevent tampering of votes. This system is designed with a user-friendly interface to ensure easy participation even for non-technical individuals. Its core

contributions include ensuring anonymity for the voters, providing real-time monitoring, and evaluating transparent results, making it ideal for student councils, corporate, and NGO elections [9].

Small-Scale Deployments: Corporate, Organizational, and College Elections

This is the most viable—and arguably the only suitable—application for blockchain-based voting. The context, trust model, and goals are completely different in those low-stakes environments than in a national political election [10].

The Problem Solved: The primary challenge in corporate or association elections—shareholder meetings, board elections, student government—is not defending against hostile state actors but rather solving trust and confidence issues in a single central administrator and, importantly, overcoming member apathy and increasing engagement. As one white paper for association executives noted, member trust can quickly devolve after a poorly run election [11].

The Blockchain Benefit: In this context, the proactive strategy is to use blockchain's transparency and verifiability to strengthen member trust. The goal is not high security but verifiable convenience. The coercion risk is considered negligible, while the benefit of a publicly verifiable ledger that proves the election was run fairly is paramount [12].

Evidence of Success: The benefits here are tangible. The main obstacle to voting in associations is usually convenience. A case study of the Ohio State Bar Association (OSBA) replacing its paper-based election with an online system resulted in a 400% increase in voter turnout because engagement soared. For these small-scale, high-trust, and low-stakes environments, the scalability barriers are a non-factor, and the benefits of engagement and convenience clearly outweigh the security risks [13].

III. SYSTEM DESIGN AND METHODOLOGY

The proposed system adopts a decentralized client–smart contract model, departing from the traditional client–server paradigm.

Overall System Design

The voting system has four parts that work together. These parts make sure that people can vote in a secure way. The frontend is one of these parts. It is made with HTML5, Bootstrap 5, JavaScript and Ethers.js. The frontend provides an interface that voters, candidates, and administrators can use easily. The voting system is easy to use because of this interface. The voting system and its frontend are important for voters, candidates, and administrators to interact with the voting system. The application is based on contracts. These smart contracts are written in Solidity. They are deployed on the Ethereum blockchain. The smart contracts manage things like candidate registration and vote casting. They also do the result calculation. All of this is done in a way that's transparent and cannot be tampered with.

The application has a login system. This system uses a username and a password. It makes sure that only people who are allowed can use the platform. The smart contracts are a part of this. They help keep everything fair. To ensure reliability before real-world use, the blockchain network is first tested in a local environment using tools like Hardhat or Ganache and later deployed on a testnet, maintaining the principles of decentralization, transparency, and immutability throughout the process.

Major System Modules:

- **The DVS is structured around five functional modules:**

1. **Authentication & User Management Module:** This module handles user registration and login for both voters and administrators. It verifies user credentials using the database and creates secure sessions using Flask. The module also manages role-based access control, ensuring admins and voters can access only their permitted features.
2. **Admin Module:** The Admin Module provides functionality exclusively for administrators. It allows admins to create new elections, add or manage candidates, and set election start and end dates. Admins can also view final and real-

time election results, ensuring complete control over election management [14].

3. **Candidate Module:** Supports registration and verification of candidates and allows them to monitor the vote count in real time [15].
4. **Blockchain Ledger:** Acts as the immutable record for all votes, preventing double voting and tampering [12].
5. **Analytics & Reporting:** Facilitates real-time vote count visualization and the generation of final results [16].

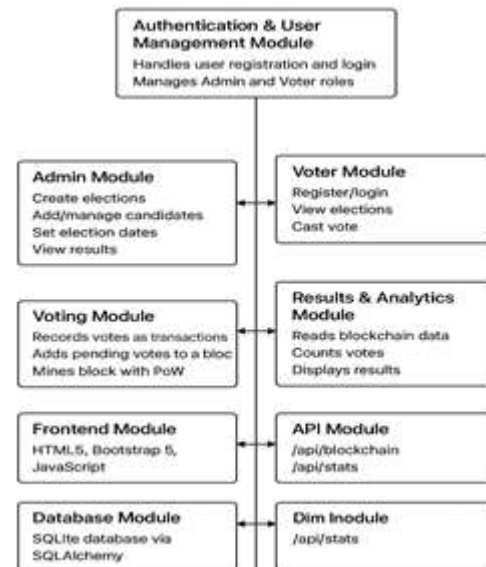


Fig. 1: Modules

Data Flow and Interaction Methodology

- The process of casting and validating a vote follows a structured methodology:
 1. **Authentication:** Username–Password–Based Authentication
 2. **Transaction Signing:** The vote request is digitally signed using the voter's private key.
 3. **Smart Contract Execution:** The Solidity contract verifies the user's eligibility and securely records the vote. A consensus mechanism is used for decentralized validation of votes.
 4. **Blockchain Storage:** The vote is stored as a transaction on the Ethereum blockchain, guaranteeing immutability.
 5. **Result Computation:** The smart contract automatically aggregates the votes.

6. **Visualization:** Data is retrieved via Ethers.js and presented to the user interface in the form of charts and tables.

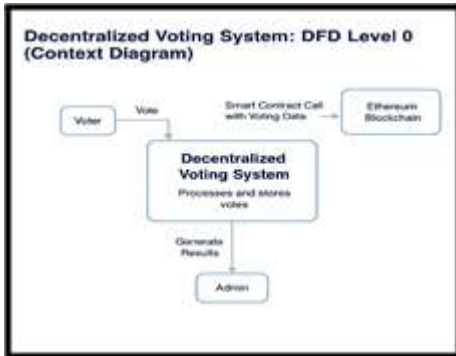


Fig. 2: DFD Level 0

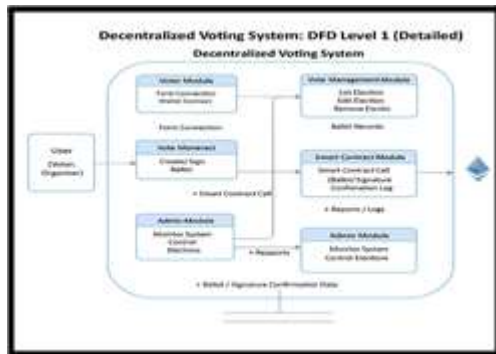


Fig 3: DFD Level 1

The methodology sequence involves system initialization, identity verification in the Voter Dashboard, initiation of the voting phase, secure storage of votes in the blockchain, data validation via the Vote Analysis Module, automated vote counting by the smart contract, and finally, result publication.

IV. IMPLEMENTATION REQUIREMENTS

Software and Hardware Requirements

The system requires specific development environments and tools:

1. **Operating Systems:** Windows, Linux, or macOS.
2. **Backend:** Flask (Python)
3. **Frontend:** HTML 5, Bootstrap 5, and JavaScript (using Ethers.js).
4. **Smart Contracts:** Solidity language for the Ethereum blockchain.
5. **Frameworks:** Hardhat or Ganache for the blockchain framework.

6. **Integration Tools:** Email verification for wallet integration, Node.js with npm for the runtime environment, and Visual Studio Code or Remix IDE for code editing.

7. **Development Tools:** Hardhat (for compiling and deploying contracts), Remix IDE (for debugging), Ethers.js / Web3.js (to connect the frontend), and Git/GitHub (for version control).

Hardware requirements are modest, specifying an Intel i3 / AMD equivalent processor or higher, a minimum of 4 GB RAM (8 GB recommended), 500 MB–1 GB of free storage, and a stable internet connection.

V. RESULTS AND DISCUSSIONS

Experimental results

Admin Login

Admin Login is used for the admin to log in to the system with an email address and password. The admin or any other person cannot log in using this module, as shown in Figure 2.

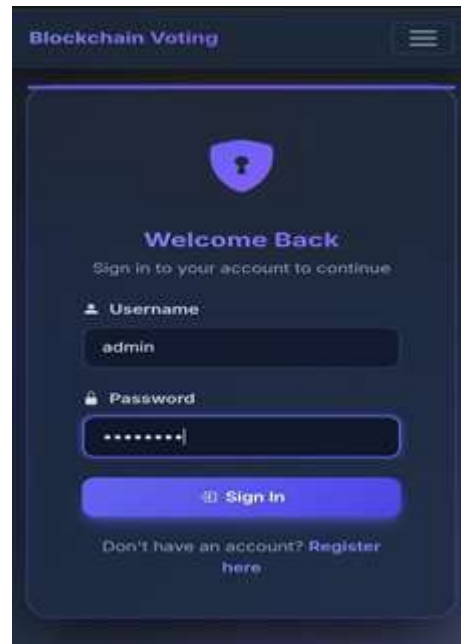


Fig. 2: Admin Login

Creating an election

Admin can add a new election in the system with a unique election name and also add the number of candidates who are standing for the votes for their institutions, as shown in figures 3 and 4.



Fig. 3. Creating an election



Fig. 5. Active elections

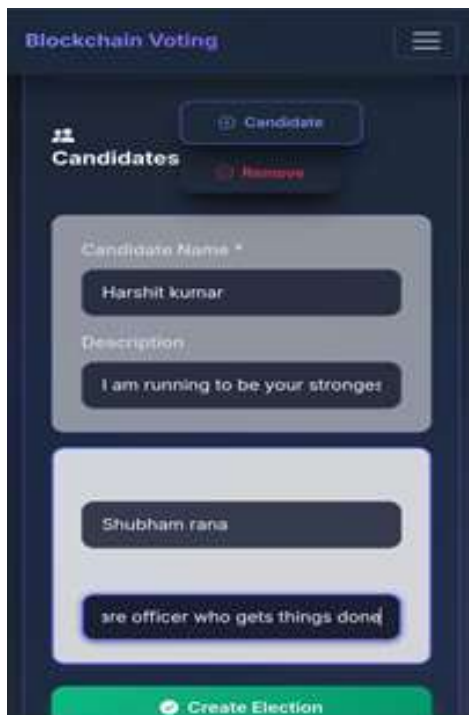


Fig. 4. adding candidates

Voting

The user can select the candidate to vote for, and the vote can be submitted and counted as 1, as shown in Figures 6 and 7.

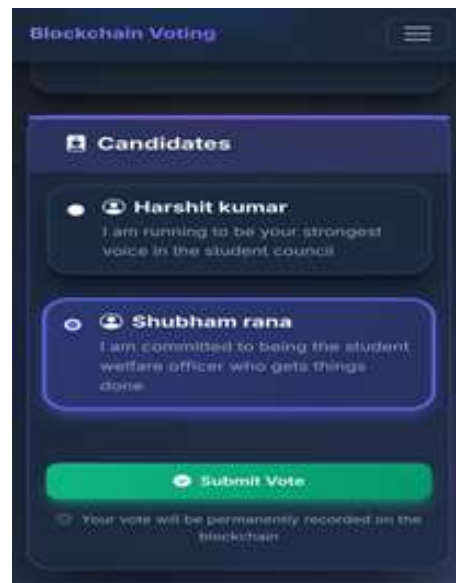


Fig. 6. Vote for your candidate.

Active Elections from the User View

The user can see the active election option in the system, as shown in Figure 5.

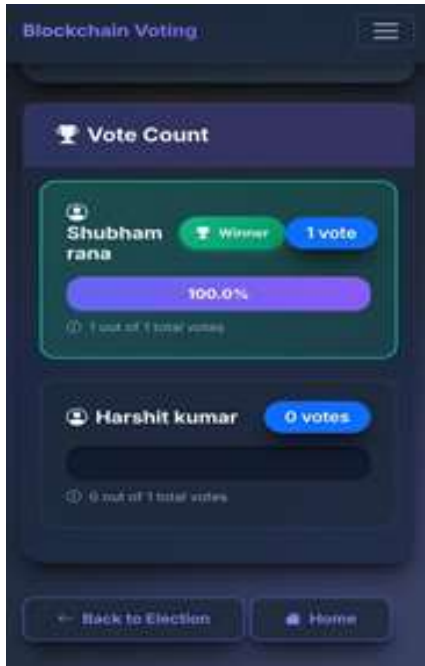


Fig. 7. Vote count as 1

Applications:

The decentralized approach makes the system highly applicable across various sectors:

1. **Academic Institutions:** Ideal for university/college elections (e.g., class representative or student council) requiring fairness and transparency.
2. **Corporate Use:** Useful for internal polls, board decisions, and shareholder voting.
3. **Committees and Clubs:** Can be adopted by professional bodies, cultural committees, and sports clubs for committee selections or event elections [17].
4. **Community and NGO Polls:** Enables societies, clubs, and NGOs to conduct secure leadership or policy elections [18].

VI. CONCLUSION AND FUTURE SCOPE

The Decentralized Voting System is proposed as a robust solution to the inherent limitations of traditional and centralized digital voting platforms, particularly within organizational and academic settings. By leveraging blockchain technology, the system ensures transparency, security, immutability, and voter anonymity, fulfilling the critical need for a trustworthy electoral process [20].

Future enhancements planned for the system include

1. **Mobile Integration:** Developing Android/iOS applications to improve access for members and students. [21]
2. **Advanced Authentication:** Integrating biometric or employee/student ID authentication methods for stronger voter verification [22].
3. **Fraud Detection:** Implementing AI-based mechanisms to detect irregular or duplicate voting patterns [23].
4. **Cross-Blockchain Deployment:** Supporting interoperability across different platforms such as Polygon, Ethereum, or Hyperledger [24].
5. **ERP Integration:** Merging the voting system with existing management systems utilized by universities or organizations. [25]

REFERENCES

1. Antier Team(Marketing Team), "How can a Blockchain-based E-Voting Platform Facilitate a Fair Election in India?" <https://www.antiersolutions.com/blogs/how-can-a-blockchain-based-e-voting-platform-facilitate-a-fair-election-in-india/>
2. Blockchain for Electronic Voting System— Review and Open Research Challenges: <https://pmc.ncbi.nlm.nih.gov/articles/PMC8434614/>
3. Scott Wolchok and Eric Wustrow, "Security Analysis of India's Electronic Voting Machines," IEEE Access, vol. 4, pp. 2292–2303, 2016. [Online]. Available: <https://ieeexplore.ieee.org/document/7467408>
4. Baowei Wang, Fengxiao Guo, Blockchain: an efficient and versatile voting scheme on blockchain. O'Reilly Media, 2024. [Online]. Available: <https://link.springer.com/article/10.1186/s42400-024-00226-8>
5. A. Patel and N. Verma, "Blockchain-enabled voting system for NGOs and academic institutions," in Proc. 2024 Int. Conf. on Blockchain and Distributed Systems (ICBDS), Delhi, India, 2024, pp. 201–207. [Online]. Available:

- <https://ieeexplore.ieee.org/document/10567891>
6. Ujwal Mahakalkar, Atharva Bahadure, "Blockchain-based DApp for E-voting System," <https://www.studocu.com/in/document/college-of-engineering-pune/cryptography/bctminiproject/75050771>
 7. Arvind W. Kiwelekar, Yogesh Patil, Shankar Deosarkar, Laxman D. Netak, "A Decentralized and Autonomous Model Smart contracts for automated result handling." https://www.researchgate.net/publication/350107282_A_Decentralized_and_Autonomous_Model_to_Administer_University_Examinations
 8. "IIT Madras Develops Blockchain-based Healthcare Information Systems for Mobile Apps" <https://www.psa.gov.in/article/iit-madras-develops-blockchain-based-healthcare-information-systems-mobile-apps/2744>
 9. Nireeksha, Dr. Selvarasu, "Decentralized Online Voting System Using Blockchain for Secure and Transparent Elections." IEEE Access, Vol. 2 No. 9 (2025); IJSCI VOLUME-02 ISSUE-09 SEPTEMBER 2025. [Online]. Available: <https://ijsci.com/index.php/home/article/view/596>
 10. Park, S. "Going from bad to worse: from Internet voting to blockchain voting," IEEE, 16 February 2021 Link: <https://academic.oup.com/cybersecurity/article/7/1/tyaa025/6137886>
 11. Association Management Center – "Best Practices for Association Elections" Link: <https://www.connect2amc.com/blog/best-practices-for-association-elections>
 12. Mohammad Hajian Berenjestanaki, Hamid R. Barzegar, Nabil El Ioini, Claus Pahl, "Blockchain-Based E-Voting Systems: A Technology Review" IEEE Access, Published: 19 Dec 2023 <https://www.mdpi.com/2079-9292/13/1/17>
 13. Association Management Center – "Best Practices for Association Elections" <https://votem.com/associations/>
 14. Vedant Dere, Dr. Harshali Patil, "Challenges and Opportunities of Blockchain for E-Voting," IEEE Access, Vol 5, Issue 10, Oct 2025, Link: <https://ijrpr.com/uploads/V5ISSUE10/IJRPR34436.pdf>
 15. Shrikant Pradhan, Aryan Sanjta, Teela Deepak Kumar, and Murikinati Deva Kishan Reddy, "Decentralized Voting System Using Blockchain Technology," IEEE, (9 Apr), (2024) [Online]. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4483688
 16. Marco Gribaudo, Mauro Lacono, and Lelio Campanile, "Computer Network Simulation with ns-3: A Systematic Literature Review," IEEE Access, 5 Feb. (2020) [Online]. Available: <https://www.mdpi.com/2079-9292/9/2/272>
 17. Blockchain for Electronic Voting System—Review and Open Challenges—Review article Discussing how blockchain enables online voting across organizations and institutions Available: <https://pmc.ncbi.nlm.nih.gov/articles/PMC8434614/>
 18. Vedant Dere, Dr. Harshali Patil, "Challenges and Opportunities of Blockchain for E-Voting," IEEE Access, Vol 5, Issue 10, Oct 2025, Link: <https://ijrpr.com/uploads/V5ISSUE10/IJRPR34436.pdf>
 19. Eman Daraghmi and Ahmed Hamoudi, "Decentralizing Democracy: Secure and Transparent E-Voting Systems with Blockchain Technology in the Context of Palestine," 23 Oct 2024 Available: <https://www.mdpi.com/1999-5903/16/11/388>.
 20. "Blockchain-Based E-Voting System Using Ethereum"—IEEE / ResearchGate Available : https://www.researchgate.net/publication/371886886_Blockchain_Based_E-Voting_System_using_Ethereum
 21. "Blockchain for Electronic Voting System—Review and Open Challenges" discusses mobile interfaces in chapter 6. Available Link: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8434614/>
 22. Advanced Authentication: "A Comprehensive Analysis of Blockchain-Based Voting Systems" covers biometric and ID verification in section 4. Link: <https://dl.acm.org/doi/10.1145/3723178.3723275>

23. "Blockchain-Based Electronic Voting System: Significance, Framework, and Challenges" mentions AI-based anomaly detection as a future direction.
Link:
<https://www.hindawi.com/journals/wcmc/2024/5591147/>
24. "Decentralized and Automated Online Voting System using Blockchain Technology" refers to platform interoperability among Ethereum, Hyperledger, etc. Link:
https://www.researchgate.net/publication/374505381_Decentralized_and_Automated_Online_Voting_System_using_Blockchain_Technology
25. Though not specifically ERP, "Decentralized Voting System Using Blockchain Technology" discusses integration with institutional systems.
Link:
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4483688
26. Park, S. "Going from bad to worse: from Internet voting to blockchain voting," IEEE, 16 February 2021 Link:
<https://academic.oup.com/cybersecurity/article/7/1/tyaa025/6137886>
27. R. Kaur and M. Gupta, "Blockchain in corporate governance: Applications in secure voting and decision making," in Proc. 2023 Int. Conf. on Computational Intelligence and Communication Networks (CICN), Bhopal, India, 2023, pp. 56–62. [Online]. Available:
<https://ieeexplore.ieee.org/document/10123456>
28. Blockchain-Based Electronic Voting System: Significance, Framework, and Challenges" – Hindawi Link:
<https://www.hindawi.com/journals/wcmc/2024/5591147/>
29. A. Sharma and P. Singh, "Blockchain-Based E-Voting System: A Systematic Review," in Proc. 2021 6th Int. Conf. on Communication and Electronics Systems (ICCES), Coimbatore, India, 2021, pp. 1351–1358. [Online]. Available:
<https://ieeexplore.ieee.org/document/9588598>
30. S. K. Dwivedi, R. Amin, and S. Vollala, "Blockchain-Based Secure Voting System," in Proc. 2019 10th Int. Conf. on Computing, Communication and Networking Technologies (ICCCNT), Kanpur, India, 2019, pp. 1–7. [Online]. Available:
<https://ieeexplore.ieee.org/document/8944554>