# Immutable and Transparent Electronic Voting Platform leveraging Blockchain Technology

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**Abstract**
The project aims to develop an electronic voting platform utilizing blockchain technology for immutability and transparency. Through decentralization and cryptographic techniques, platform ensures the integrity and security of votes while preserving anonymity. Smart contracts automate processes, eliminating intermediaries and reducing manipulation risks. Real-time verification enhances trust in the electoral process. User-friendly interfaces promote inclusivity and participation. Rigorous testing and collaboration with regulatory authorities ensure compliance and reliability. Robust encryption safeguards against cyber threats. Continuous innovation enhances the platform’s effectiveness. Overall, our project seeks to strengthen democratic process by providing a trustworthy electronic voting solution. Furthermore, our platform will be designed to be scalable, capable of handling large-scale elections with ease. By leveraging blockchain technology, our platform will offer a level of transparency and security which has never been there in traditional electronic voting systems. The goal of our research and development initiative is to completely transform the electoral process by making it more transparent, safe, and open to all.

**Keywords** Immutable, Transparent, Electronic Voting, Blockchain Technology, Voting system.

## 1. Introduction

In an era marked by technological advancement and the quest for democratic integrity, the development of an electronic voting platform leveraging blockchain technology emerges as a paramount endeavor. With the escalating demand for secure, transparent, and accessible electoral systems, our project aims to address these critical needs. By harnessing the decentralized nature of blockchain, our platform endeavor to revolutionize the voting process, ensuring the immutability and transparency of each ballot cast. Through the implementation of cryptographic techniques, voter anonymity will be preserved without compromising on the robustness of security measures. Smart contracts will automate voting procedures, mitigating the risks associated with human intervention and manipulation. Real-time verification mechanisms will instill confidence in the electoral process, fostering trust among stakeholders. Furthermore, user-friendly interfaces will promote inclusivity, enabling seamless participation from all eligible voters. Collaborative efforts with regulatory authorities will ensure compliance with legal standards, while continuous innovation will drive the evolution of our electronic voting solution, bolstering democratic processes worldwide. To achieve these ambitious goals, our platform will employ a multi-faceted approach that integrates cutting-edge technologies with a user-centric design philosophy. One of the key features of our platform is its utilization of blockchain technology, which will serve as the backbone of our system. Blockchain's decentralized nature ensures that no single entity has control over the network, making it inherently resistant to tampering and fraud. Each vote cast will be recorded as a transaction on the blockchain, ensuring its immutability and transparency. To further enhance the security and integrity of our platform, we will implement a range of cryptographic techniques. These techniques will be used to encrypt votes, ensuring that they remain confidential and secure. Additionally, cryptographic algorithms will be used to verify the authenticity of each vote, mitigating the risk of fraudulent activities. Smart contracts will play a crucial role in automating the voting process. These self-executing contracts will be used to define the rules and conditions of the election, ensuring that the voting process is fair and transparent. By removing the need for human intervention, smart contracts reduce the risk of errors and manipulation, further enhancing the integrity of the electoral process.

## 2. Literature Survey

Mahender Kumar et al. [1] proposes internet-voting system leveraging identity-based blind signatures for security. The authors aim to enhance the system's accuracy by evaluating additional test cases. Key features include batch verifiability, early voting support, and the use of elliptic curve cryptography for security. Because of the system's end-to-end verifiability, the voting process's integrity is guaranteed. It also utilizes functional digital signatures for authenticity. The system addresses the need for secure internet-based voting solutions.

Hanlin Zhang et al. [2] proposes work which focuses on designing an efficient and provably secure Attribute-Based Signature with Collaborative Key Generation (ABSC) scheme, ensuring CCA2 security. The scheme excludes the distribution phase from user concerns, simplifying the user experience. However, it does not address outsourcing for distribution. The paper emphasizes the use of cloud computing, secret sharing, and secure outsourcing for enhanced security in cloud environments.

Wenyi Xue et al. [3] presents ACB-Vote, a system for blockchain-based score voting with anonymously convertible ballots. The system aims to achieve efficiency, flexibility, and privacy while ensuring security through a provably secure ABSC scheme achieving CCA2 security. It introduces convertibly linkable signatures (CLS) to maintain anonymity. The paper contributes to enhancing the security and privacy of voting systems leveraging blockchain technology.

Xuechao Yang et al. [4] introduces a secure online voting system based on homomorphic encryption, providing security against existential forgery attacks under chosen message and ID. The paper demonstrates that the CMV approach has less delay overhead in simulated mesh sizes when compared to the PMV approach. This work contributes to the advancement of secure online voting systems, particularly in the context of ranked choice voting.

Alireza Namazi et al. [5] address the design targets of real-time performance and reliability in digital systems. It introduces CMV, a clustered majority voting reliability-aware task scheduling approach for multicore real-time systems. The paper emphasizes the use of network-on-chip (NoC), replication, and efficient task scheduling to improve reliability and real-time performance.

S. S. Hossain et al. [6] proposes a system to counter issues like low turnout, tampering, and security concerns. Blockchain technology offers a solution, providing transparency, security, and decentralization. Blockchain's key features include immutability, security, and anonymity, making it suitable for e-voting systems. A sample e-voting application was implemented and tested on the Ethereum network using smart contracts and the Solidity language. This approach ensures the integrity of the voting process by preventing duplication of votes.

B. Shahzad and J. Crowcroft [7] proposes a framework using effective hashing techniques to secure data. It introduces concepts like block creation and sealing, making the blockchain adaptable for polling needs. The use of a consortium blockchain, owned by a governing body like the election commission, is suggested to prevent unauthorized access. The framework claims to handle security and data management difficulties in blockchain for better electronic voting. It covers topics such as polling process effectiveness, hashing methods, block creation/sealing, data accumulation, and result declaration.

M. S. Farooq et al. [8] plan to introduce a blockchain-based platform aiming to address these challenges by providing a transparent, secure, auditable, and efficient system for charity management. The platform includes features such as crypto wallets, ICO, and a digital currency called CharityCoin (CC). Smart contracts are used for a number of use cases, such as converting fiat money into cryptocurrency, purchasing and selling cryptocurrency, transferring cryptocurrency, and soliciting donations. The suggested design is scalable for big data sizes, according to the performance evaluation.

## 3. Proposed System

The proposed system leverages Ganache, a personal blockchain for Ethereum development, to enhance the security and reliability of electronic voting. By utilizing Ganache's local blockchain environment, our platform ensures a controlled and secure testing environment for smart contracts and voting mechanisms. Through Ganache's features such as instant mining and customizable settings, our system can simulate various voting scenarios and validate the integrity of the system. This allows for thorough testing of the electronic voting platform, identifying and addressing potential vulnerabilities before deployment. Additionally, Ganache's integration with popular development tools like solidity streamlines the development process, enabling efficient deployment and management of smart contracts. By harnessing Ganache's capabilities, our proposed system aims to provide a robust and trustworthy electronic voting solution that fosters transparency and trust in democratic process.

**Methodology:**

This project involves several key steps. First, we will conduct thorough research to understand the current state of electronic voting systems and identify key challenges and opportunities. Next, we will design the architecture of our electronic voting platform, focusing on decentralization, cryptographic techniques, and smart contracts to ensure security, integrity, and anonymity. We will then develop the platform, implementing user-friendly interfaces, real-time verification, and encryption to enhance usability and security. Throughout the development process, we will conduct rigorous testing to ensure compliance, reliability, and effectiveness. Finally, we will collaborate with regulatory authorities to ensure that our platform meets legal standards and drive continuous innovation to improve its functionality and security.

**Advantages: -**

- Utilizes blockchain's decentralized ledger to store votes in a tamper-resistant and transparent manner, ensuring the immutability and integrity of the electoral data.
- Provides a transparent and auditable voting process. Each transaction (vote) is recorded on the blockchain, accessible to all participants, enhancing trust and accountability.
- Implements smart contracts to automate aspects of the voting process, ensuring predefined rules are executed transparently and reducing the potential for errors or manipulation.

- Utilizes cryptographic techniques to enhance the security of the voting process, protecting against unauthorized access, tampering, or hacking attempts.

**System Architecture:**

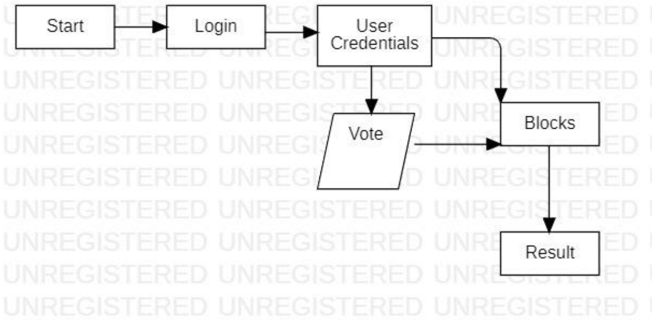


**Figure 1: system architecture of electronic voting platform.**

The following elements of the model's basic work flow are explained in Figure l:

**1. Start:**
It is the initial step for the system to enter the condition by starting up of the connection by usage of the software's to value in it.

**2. Login:**
It is the next step to move in it the software with a user authentication to start up the new function between the admin and the user.

**3. User Credentials:**
It is the process where the user can register the page and create an account to the next step of the process to provide the necessary details and for the next module to process in it.

**4. Vote:**
It is the process which after the modules the user can login in the data and provide the function of the user to give the voting for the necessary persons and to show out the output in it.

**5. Blocks:**
It is done after the functions of the users and its voting section it will comes or stores into the blocks as in the form of the database into it after to provide the data and to create the security and privacy details.

**6. Result:**
The final step of the voting system to provide the details and check the final output by analyzing all over the details and to logout the page and final output will be stored in the form of blocks or in the dashboard.

**Working:**

**Ganache**: It provides a local blockchain environment that developers can use for testing and development purposes. Ganache allows developers to simulate various blockchain scenarios, including deploying smart contracts, running transactions, and testing interactions with decentralized applications (DApps), all within a controlled and secure environment.

**Node.JS**: With the open-source, server-side JavaScript runtime environment Node.js, programmers can create web apps that are fast and scalable. It is effective at managing concurrent processes because it makes use of an event-driven, non-blocking I/O paradigm. JavaScript can now operate on the server thanks to Node.js, allowing for full-stack development using just one programming language. Its extensive ecosystem of frameworks and libraries makes it easier to quickly construct web servers, APIs, and real-time applications. Because of its well-known efficiency and lightweight design, Node.js is a great choice for developing contemporary, data-intensive applications.

**React.JS**: An open-source JavaScript package called React.js is used to create user interfaces, mostly for single-page apps. It enables programmers to efficiently manage the state of their applications and generate reusable user interface components. React.js updates only the essential portions of the interface as data changes, using a virtual DOM for best efficiency. Its component-based architecture encourages the reuse and maintainability of code. React.js is a well-liked option for front-end development because of its declarative and effective method of creating user interfaces.

Data Flow Diagram:

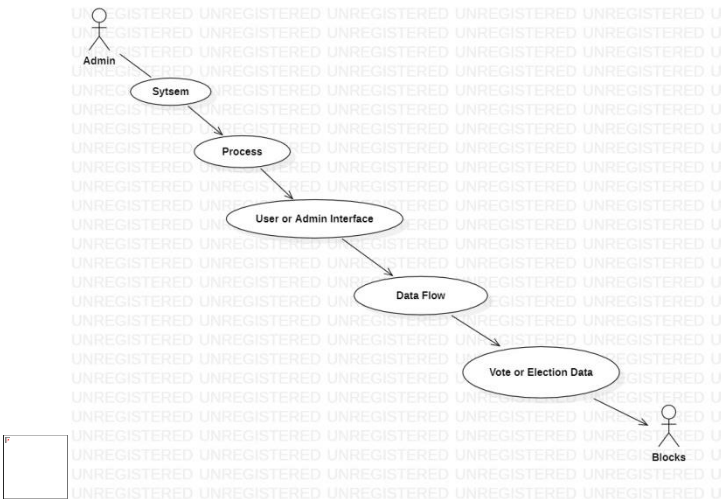


**Figure 2: Level 0 Data Flow Diagram**

The Figure 2 resembles the Data Flow Diagram for Level 0 which consists of user who uses the website to cast their vote.

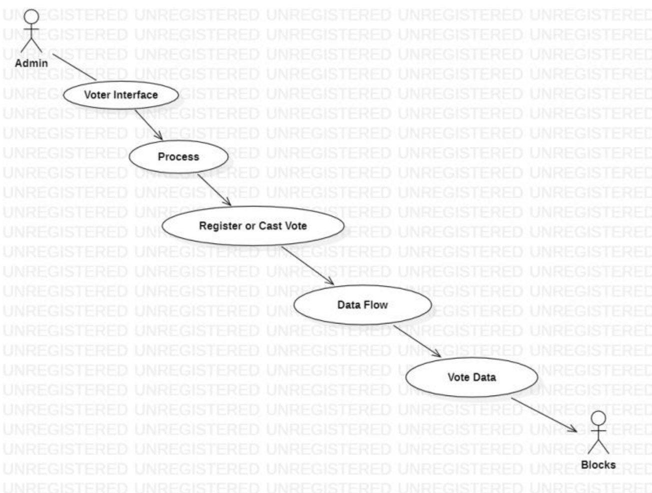


**Figure 3: Level 1 Data Flow Diagram**

The Figure 3 presents the Data Flow Diagram for Level 1 that includes how the voting process takes place from user interface to the blockchain.

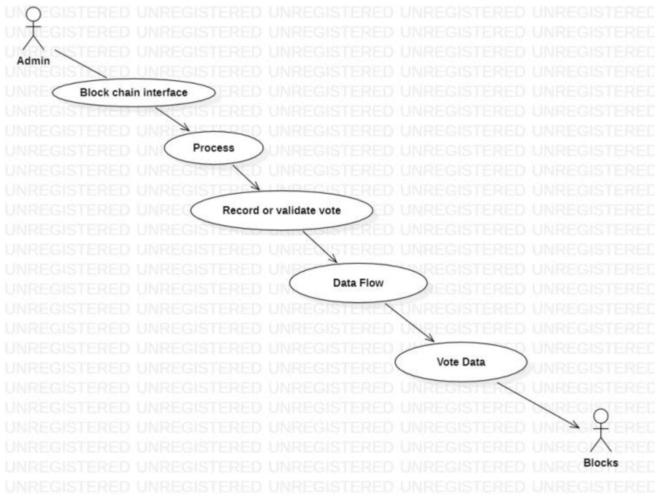


**Figure 4: Level 2 Data Flow Diagram Level**

The Data Flow Diagram for Level 2 is displayed in Figure 4, which streamlines the system's overall operation.

## 4. Results

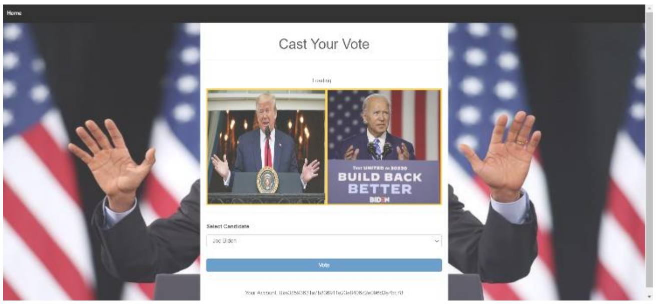


**Fig 5: Result**

The Figure 5 displays the result which shows the cast your vote page There are options to choose your candidate using dropdown menu. Further, vote button is there clicking upon which results to casting vote to chosen candidate.

## 5. Conclusion

An immutable and transparent electronic voting platform powered by blockchain technology offers unprecedented levels of security and trust in electoral processes. By leveraging blockchain's decentralized ledger, it ensures tamper-proof record-keeping, thereby safeguarding the integrity of votes cast. The transparency inherent in blockchain architecture fosters accountability and eliminates doubts surrounding electoral outcomes. Furthermore, this innovation enhances accessibility, enabling citizens to participate in the democratic process securely from anywhere in the world. Voter intent is protected by the immutability of blockchain, which ensures that once a vote is cast, it cannot be changed or removed.. Such a platform not only modernizes electoral systems but also strengthens democratic principles by promoting inclusivity and fairness. As we continue to evolve technologically, embracing innovations like blockchain-based voting platforms becomes imperative for upholding the democratic values upon which societies are built.

REFERENCES

1. Mahender Kumar, Satish Chand, and C. P. Kat ‘‘A secure End-to-End verifiable Internet-Voting System using Identity-Based Blind Signature’’, IEEE Systems Journal PP(99): 1-10, DOI:10.1109/JSYST.2019.2940474.
2. Hanlin Zhangi, Jia Yu, Chengliang tian, Puzhaoi G, ‘‘Cloud Storage for Electronic Health Records based on secret sharing with verifiable reconstruction outsourcing’’, IEEE Access PP(99):1-1 , DOI:10.1109/ACCESS.2018.2857205.
3. Wenyi Xue, Yang Yang, Yungjiu Li, Hwee Hwa Pang, “ACB-Vote: Efficient, Flexible, and Privacy-Preserving Blockchain-Based Score Voting with Anonymously Convertible Ballots.”, IEEE Transactions on Information Forensics and Security PP(99): 1-1, DOI:10.1109/TIFS.2023.3287394.
4. Xuechao Yang, Xun Yi, Surya Nepal, Andrei Kelarev, Fengling Han, ‘‘A Secure Verifiable Ranked Choice Online Voting System Based On Homomorphic Encrytion”, IEEE Access PP(99): 1-1, DOI:10.1109/ACCESS.2018.2817518.
5. Alireza Namazi, Saeed Safari, Siamak Mohammadi, “CMV: Clustered Majority Voting Reliability – Aware Task Scheduling for Multicore Real-Time Systems”, IEEE Transactions on Reliability PP(99): 1-14, DOI:10.1109/TR.2018.2869786.
6. S. S. Hossain, S. A. Arani, M. T. Rahman, T. Bhuiyan, D. Alam, and M. Zaman, ‘‘E-voting system using blockchain technology,’’ in Proc. 2nd Int. Conf. Blockchain Technol. Appl., Dec. 2019, pp. 113–117, doi: 10.1145/3376044.3376062.
7. B. Shahzad and J. Crowcroft, ‘‘Trustworthy electronic voting using adjusted blockchain technology,’’ IEEE Access, vol. 7, pp. 24477–24488, 2019, doi: 10.1109/ACCESS.2019.2895670.
8. M. S. Farooq, M. Khan, and A. Abid, ‘‘A framework to make charity collection transparent and auditable using blockchain technology,’’ Comput. Electr. Eng., vol. 83, May 2020, Art. no. 106588, doi: 10.1016/j.compeleceng.2020.106588.
9. F. P. Hjálmarsson, G. K. Hreiòarsson, M. Hamdaqa, and G. Hjálmtýsson, ‘‘Blockchain-based E-Voting system,’’ in Proc. IEEE 11th Int. Conf. Cloud Comput. (CLOUD), Jul. 2018, pp. 983–986.
10. N. M. Crosby, P. Pattanayak, S. Verma, and V. Kalyanaraman, ‘‘Blockchain technology—Beyond bitcoin,’’ Sutardja Center Entrepreneurship Technol., Univ. California, Berkeley, CA, USA, Tech. Rep., Oct. 2015. Accessed: Jan. 24, 2018. [Online].
11. Mohammad Hajian Berenjestanaki, Hamid R. Barzegar, Nabil El Ioini and Claus Pahl, "Blockchain-Based E-Voting Systems: A Technology Review", School of Computer Science, University of Nottingham Malaysia, Semenyih 43500, Selangor, Malaysia, https://doi.org/10.3390/electronics13010017
12. Anitha, Orlando Juan Marquez Caro, R. Sudharsan, S. Yoganandan and M. Vimal, "Transparent voting system using blockchain", Department of CSE, Panimalar Engineering College, Chennai, TamilNadu, India, https://doi.org/10.1016/j.measen.2022.100620.
13. Tarik Chafiq, Rida Azmi, and Ouadoud Mohammed, "Blockchain-based electronic voting systems: A case study in Morocco", LGAGE, Faculty of Sciences Ben M'Sik, Hassan II University of Casablanca, Morocco, https://doi.org/10.1016/j.ijin.2024.01.004.
14. Basit Shahza AND Jon Crowcroft, "Trustworthy Electronic Voting Using Adjusted Blockchain Technology", Computer Laboratory, University of Cambridge, Cambridge CB3 0FD, U.K., DOI:10.1109/ACCESS.2019.2895670.

15. Said El Kafhal, Faculty of Sciences and Techniques, Computer, Networks, Mobility and Modeling Laboratory x(IR2M), Hassan First University of Settat, Settat, Morocco, "Blockchain-Based Electronic Voting System: Significance and Requirements", https://doi.org/10.1155/2024/5591147.