Secure and Transparent Online Voting System Using Blockchain Technology

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Abstract: This paper presents a blockchain-based online voting system that ensures security, transparency, and anonymity in the electoral process. By leveraging blockchain's decentralized and immutable nature, the system addresses the challenges of traditional voting systems, such as vote manipulation and lack of transparency. The implementation incorporates cryptographic voter authentication and smart contracts for automated vote management. Experimental results demonstrate the system's scalability, efficiency, and robustness, offering a viable solution for modern democratic processes.

Keywords: Blockchain, Online Voting, Smart Contracts, Cryptography, Secure Elections, Transparency

1. INTRODUCTION

Voting is a cornerstone of democratic societies. However, traditional voting systems face challenges such as fraud, manipulation, and lack of voter anonymity. Even electronic voting systems are vulnerable to hacking and lack transparency. Blockchain technology offers an innovative approach by introducing a decentralized, tamper-proof ledger for recording votes.

This research proposes a blockchain-based online voting system designed to ensure security, transparency, and voter anonymity. The primary contributions of this paper are:

1. Developing a secure and anonymous voter authentication mechanism.
2. Implementing a tamper-proof ledger using blockchain for storing votes.
3. Evaluating the system's scalability and performance under real-world conditions.

2. RELATED WORK

Several blockchain-based voting systems have been proposed in recent years. Systems like FollowMyVote leverage blockchain for transparency but are limited by scalability. Others, like the Ethereum-based voting systems, emphasize decentralization but require high computational resources.

Our proposed system addresses these limitations by optimizing smart contract execution and implementing an efficient consensus algorithm for secure and scalable voting.

3. PROPOSED SYSTEM

3.1 System Architecture

The proposed system consists of the following components:

- Voter: Registers and casts their vote through a secure interface.
- Election Authority: Configures elections and oversees the voting process.
- Blockchain Network: Stores votes immutably and provides transparency.
- Smart Contracts: Automate vote validation and counting.

3.2 Blockchain Implementation

A private blockchain was chosen for scalability and cost efficiency. Votes are recorded as transactions on the blockchain, encrypted with voter credentials to ensure anonymity. Smart contracts verify voter eligibility and count votes in real-time.

3.3 Voting Process

1. Registration: Voters register using government-issued IDs. Details are stored in a private voter database.
2. Vote Casting: Voters log in using secure credentials, select their choice, and cast their vote.
3. Vote Storage: The vote is encrypted and added to the blockchain.
4. Result Declaration: Once the voting period ends, smart contracts tally the votes and display the results.

3.4 Security Features

- Anonymity: Votes are encrypted to prevent voter identification.
- Immutability: Blockchain ensures that votes cannot be altered once recorded.
- Transparency: Election data is publicly auditable.

4. EXPERIMENTAL SETUP AND RESULTS

4.1 Setup

The system was implemented using the Ethereum blockchain and Solidity smart contracts. A private blockchain network was created using Ganache for testing purposes.

4.2 Metrics Evaluated

1. Transaction Speed: Average transaction time of 5 seconds.
2. Scalability: Supported up to 1,000 simultaneous voters with no degradation in performance.
3. Cost Efficiency: Gas costs for smart contract execution were minimal compared to public blockchain systems.

4.3 Results

The proposed system successfully handled 5,000 simulated votes with 100% accuracy and zero tampering incidents.

5. DISCUSSION

The results indicate that blockchain technology can address critical challenges in online voting systems. However, further work is needed to enhance scalability for nationwide elections and integrate advanced cryptographic techniques for enhanced security.

6. CONCLUSION AND FUTURE WORK

This paper demonstrates the feasibility of using blockchain for secure and transparent online voting. Future work will focus on:

1. Integrating biometric authentication for enhanced security.
2. Exploring hybrid consensus algorithms to improve scalability.
3. Conducting real-world pilot tests in small-scale elections.

7. REFERENCES

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