Blockchain Powered Voting system for college elections

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Abstract
Efficient voting systems are critical for democratic processes, but traditional methods often encounter challenges related to security, transparency, and accessibility. This project presents a college-level voting system designed to address these issues using the MERN stack (MongoDB, Express.js, React, Node.js), providing a secure, scalable, and user-friendly platform for voting. The system integrates React for an interactive user interface, Node.js with Express.js for a robust backend, and MongoDB to securely store user data and voting records. Key security measures, such as user authentication, data encryption, and secure data storage, are incorporated to prevent tampering and ensure the integrity of voting records.
The system's backend is structured to handle high traffic and prevent data breaches, leveraging MongoDB's flexible schema and Node.js's asynchronous architecture. Voters can cast their votes, verify their submissions, and receive real time feedback. The system is accessible from any device, providing students with flexibility in voting while reducing the dependency on traditional, labor-intensive voting methods. With a focus on accessibility, transparency, and security, this MERN-based voting system offers a modern solution to college-level voting, potentially paving the way for more reliable and effective digital voting solutions
 Keywords: Voting System, MERN Stack, Web Security, User Authentication, Digital Voting

1. INTRODUCTION
Voting is a cornerstone of democratic systems, enabling individuals to participate in decision-making processes. In educational institutions, voting is essential for events such as student council elections, club leadership, and various other decision-making processes that impact the student body. Traditional voting methods, however, face challenges such as logistical complexity, time consumption, and risks related to tampering and fraud. These issues highlight the need for a secure, efficient, and transparent digital voting solution that can meet the unique demands of a college environment.
This project introduces a digital voting system designed specifically for college-level use, leveraging the MERN stack (Mo MERN stack not only enables a responsive user Interface but also offers a secure and organized backend system. Key features of the system include   robust   user authentication to ensure voter legitimacy, data encryption for security, and real-time vote tracking to enhance transparency. These features aim to mitigate the common   challenges   associated with traditional voting, making the voting process more accessible and   trustworthy   for   all participants.

1.1. Motivation
The integrity and transparency of electoral processes are fundamental pillars of a functioning democracy. However, traditional voting systems, whether paper-based or electronic, are often susceptible to various challenges such as fraud, tampering, voter coercion, miscounting, lack of transparency, and limited accessibility for remote or disabled voters.

1.2. Problem Statement
Elections are a critical component of democratic governance, yet traditional voting systems face numerous challenges that threaten their reliability, transparency, and public trust. Paper-based

voting methods are prone to human error, ballot tampering, loss or damage, and slow result tabulation. While electronic voting (e-voting) systems were introduced to address some of these issues, they have introduced new concerns, including security vulnerabilities, lack of transparency, susceptibility to hacking, and central points of failure.

Table 1. Tools and Technology

Component	Technology / Tool Used
Frontend	React.js
Backend	Node.js
Blockchain Platform	Hyperledger Fabric
Smart Contracts	Chaincode (Hyperledger)
Database	MongoDB
Authentication	OAuth 2.0
Encryption	AES
Consensus Mechanism	Proof of Authority (PoA)
Cloud / Servers	AWS
Notification	Firebase Cloud Messaging
Analytics Dashboard	Power BI

1.1. Figures
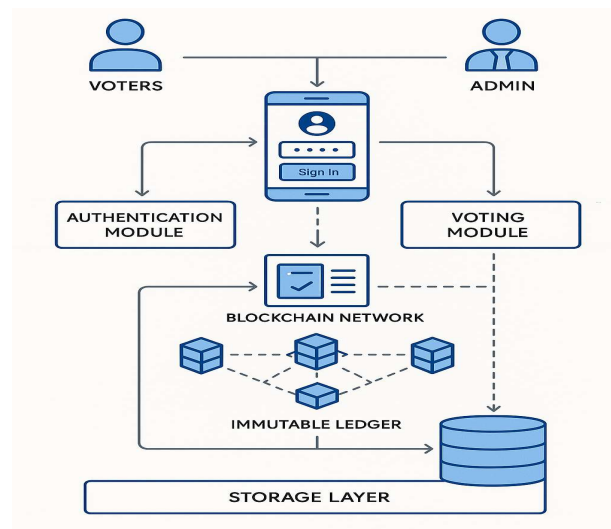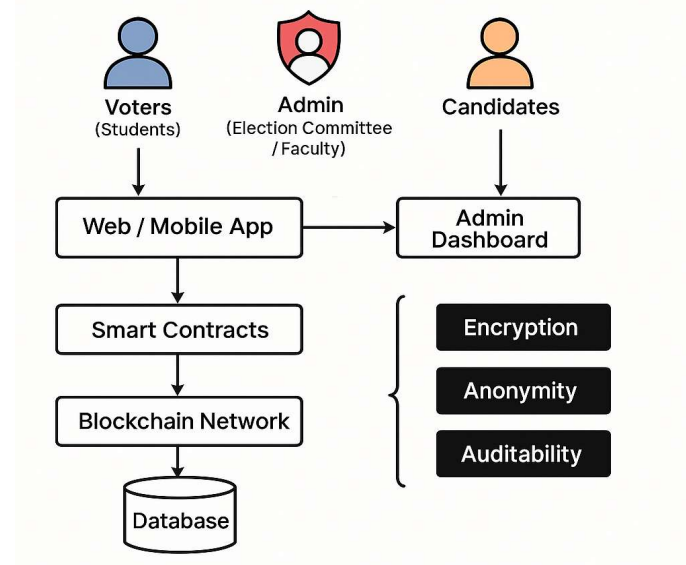
FIGURE 1. Proposed System Architecture

2. RESULTS AND DISCUSSION

2.1. Results

The **Blockchain-Based Secure Voting System for college elections** ensures a transparent, tamper-proof, and efficient electoral process within educational institutions. By leveraging blockchain technology, the system guarantees that every vote cast is securely recorded on a decentralized ledger, making it immutable and verifiable. Students can easily log in through a secure web or mobile interface using their student ID, email, or biometric authentication, ensuring only eligible voters participate. Once a vote is cast, it is encrypted and submitted to the blockchain network where smart contracts automatically validate and record the transaction without revealing the voter's identity, thus preserving anonymity.

The system enables real-time vote tallying, and results are instantly available on a public or admin dashboard, eliminating the delays and manual errors associated with traditional counting methods. Additionally, the use of blockchain provides a transparent audit trail, allowing election authorities, students, and external observers to independently verify the results. Overall, this system enhances trust, reduces the risk of fraud, improves voter turnout through ease of access, and ensures a fair and credible election process for college communities.

2.2. Discussion

A Blockchain-Based Secure Voting System for college elections offers a robust solution to address common issues such as fraud, tampering, and lack of transparency in traditional voting systems. By utilizing blockchain technology, the system ensures that each vote is securely recorded, traceable, and immutable. This eliminates the risk of vote manipulation, as all transactions (votes) are logged in a decentralized ledger that is tamper-proof once confirmed.

Limitations and Improvements

• Blockchain systems can be difficult for non-tech-savvy users to understand, leading to confusion about how to vote securely.System scalability may require more robust computing

• As the number of voters increases, the blockchain network may face delays or inefficiencies in processing votes in a timely manner.

• Future enhancements could include:

1)Mobile and Offline Voting Solution

      2)Integrity with identity manegement systems

CONCLUSION

The proposed MERN stack-based voting system offers an innovative, secure, and efficient solution tailored to collegelevel voting needs. By leveraging modern web technologies and implementing robust security protocols, the system

addresses critical issues inherent in traditional voting methods, such as time consumption, potential for fraud, and lack of accessibility. This platform enhances voting integrity through secure user authentication, real-time vote tracking, and reliable data protection, ensuring that each vote is counted accurately and securely

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