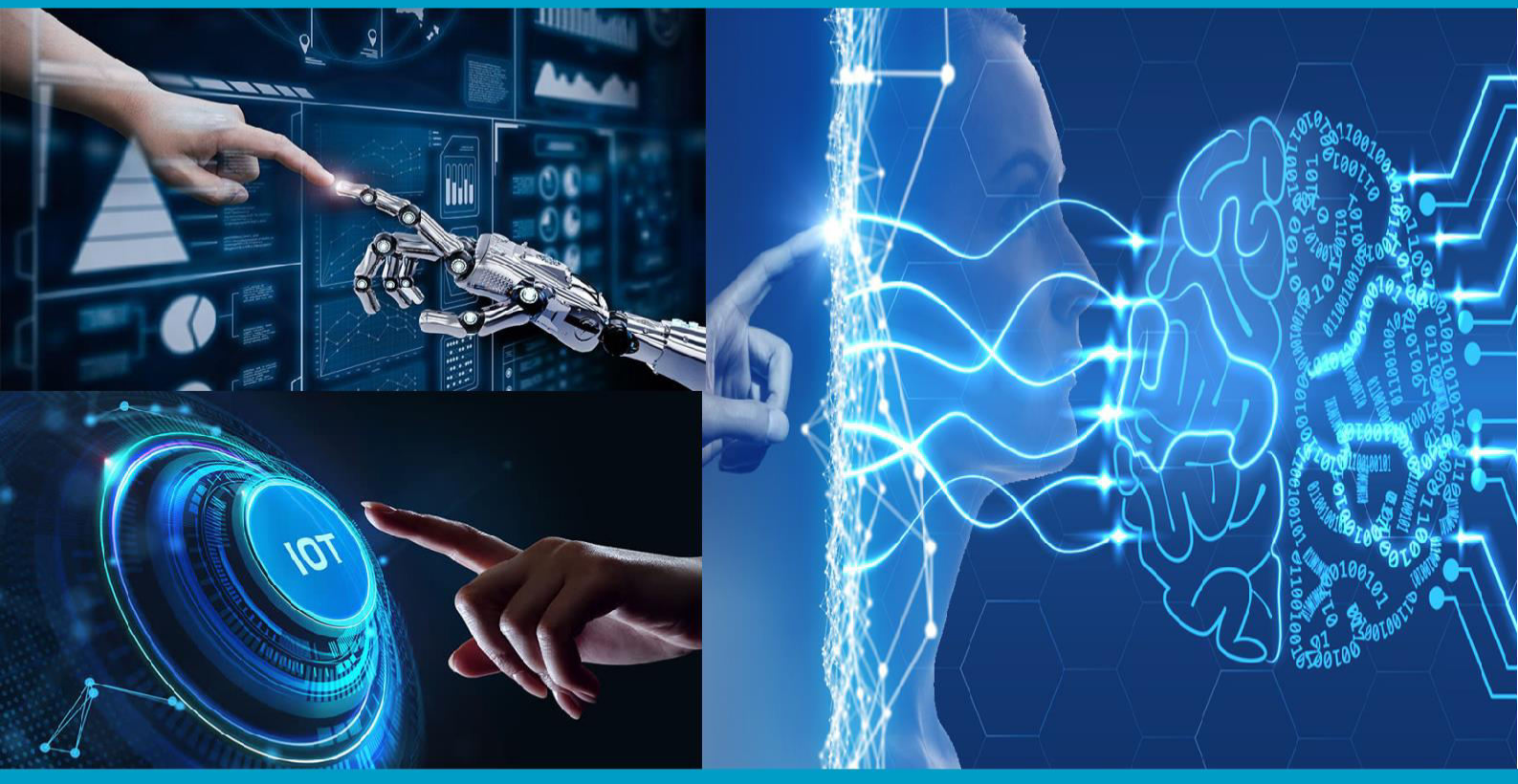
IJMRSETM

e-ISSN: 2395 - 7639



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

Volume 12, Issue 6, June 2025

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.214

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 8.214 | A Monthly Double-Blind Peer Reviewed Journal |

| Volume 12, Issue 6, June 2025 |

Blockchain-Based Voting System for College Elections

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ABSTRACT: In recent years, the integrity and transparency of voting systems have come under increasing scrutiny, even in smaller environments like college elections. Traditional voting methods, whether manual or electronic, often suffer from issues such as vote tampering, lack of transparency, and centralized control. This paper proposes a Blockchain-powered voting system tailored for college elections to ensure secure, transparent, and tamper-proof voting processes. By leveraging the decentralized nature of Blockchain, each vote is recorded as a transaction on a distributed ledger that is immutable and verifiable by all stakeholders. The proposed system uses smart contracts to automate the voting process, enhance trust, and eliminate the need for intermediaries. Additionally, voter anonymity and eligibility are maintained through cryptographic techniques such as zero-knowledge proofs and digital signatures. This system not only increases trust and participation in student governance but also demonstrates the practical applicability of Blockchain technology in real-world democratic processes at an institutional level.

KEYWORDS: Voting System, MERN Stack, Web Security, User Authentication, Digital Voting

I. INTRODUCTION

The integrity and transparency of electoral processes are vital to any democratic setup, including student governance within academic institutions. Traditional voting systems in college elections often face challenges such as vote tampering, lack of verifiability, and inefficient counting processes. To address these issues, a **Blockchain-powered voting system** offers a modern, secure, and transparent alternative. Blockchain technology ensures that each vote is recorded immutably and can be independently verified without compromising voter anonymity. By leveraging the decentralized and tamper-proof nature of blockchain, this system can enhance trust, reduce administrative overhead, and provide real-time results in college elections. This paper explores the design, implementation, and benefits of integrating blockchain technology into student voting systems, aiming to revolutionize how elections are conducted in academic environments.

II. METHODOLOGY

The methodology of a blockchain-powered voting system for college elections involves the integration of decentralized ledger technology to ensure transparency, security, and integrity throughout the voting process. Initially, eligible voters such as students and faculty are registered and authenticated using unique identifiers, such as student IDs or biometric verification. Once authenticated, voters receive access to a secure digital ballot through a web or mobile interface. Each vote cast is encrypted and recorded as a transaction on a blockchain network, where it is permanently stored and time-stamped. The use of smart contracts automates vote validation, prevents double voting, and ensures real-time tallying without human interference. The immutability of blockchain guarantees that once a vote is recorded, it cannot be altered or deleted, thus eliminating risks of tampering or fraud. The final results can be publicly audited without compromising voter anonymity, ensuring a transparent and trustworthy electoral process tailored to the needs of academic institutions.

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III. MODELING AND ANALYSIS/ARCHITECTURE

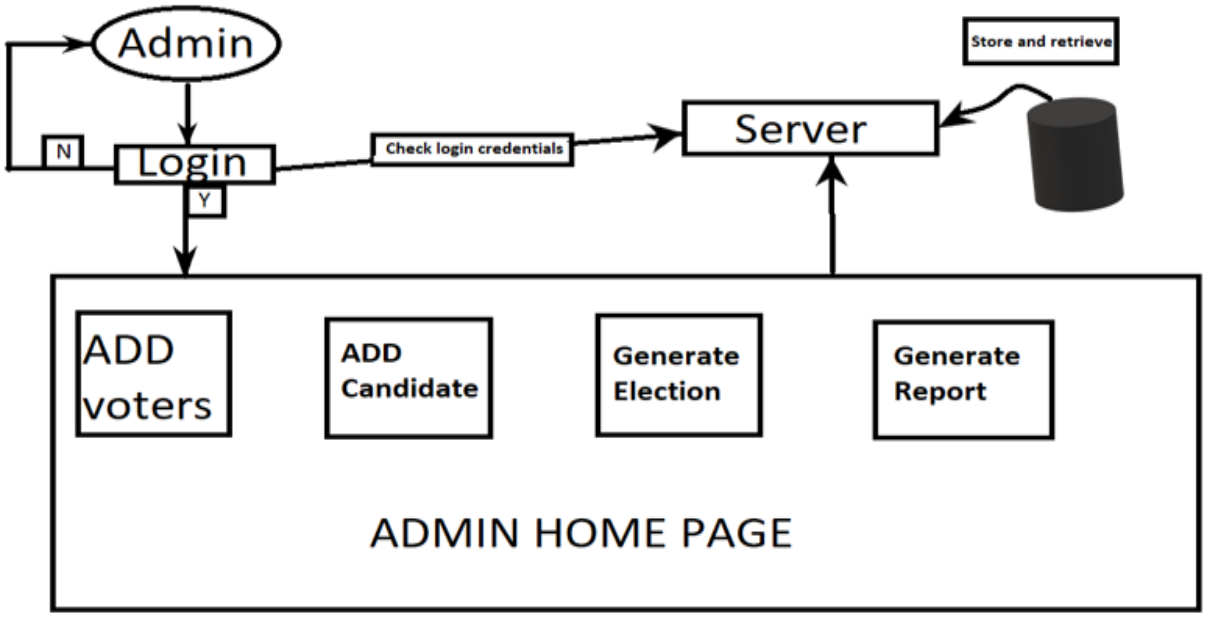

Fig. System Architecture

The proposed system architecture is centered around the **admin interface**, which acts as the control point for managing the entire election process. The process begins with the admin attempting to access the system via a secure **login module**. This module checks the login credentials by communicating with the **server**, which then verifies the admin's identity against stored data in a **centralized or blockchain-backed database**. If the credentials are valid, the admin is granted access to the main dashboard or **Admin Home Page**. If the credentials are invalid, access is denied, ensuring only authorized personnel can manage election data.

Once logged in, the admin is provided with four core functional modules: **Add Voters**, **Add Candidate**, **Generate Election**, and **Generate Report**. Through the "Add Voters" module, the admin inputs and registers all eligible students or staff as voters. The "Add Candidate" feature allows for registering contesting candidates along with their details. With these inputs completed, the "Generate Election" module enables the admin to schedule and configure election parameters such as date, time, and position titles. After the election concludes, the "Generate Report" module retrieves voting results from the database and presents them in a secure and tamper-proof manner. These modules interact with the server, which acts as a middleware, executing logic, managing transactions, and handling all data operations securely.

The **server and database** form the backend of the system and are responsible for storing, retrieving, and validating all information related to voters, candidates, elections, and results. In the context of a blockchain-powered voting system, this database can be replaced or enhanced with a **blockchain ledger**, where each transaction (i.e., vote) is encrypted, timestamped, and stored immutably. This ensures transparency, prevents tampering, and allows for easy auditing of election results without compromising voter anonymity. The system architecture thus ensures a secure, transparent, and efficient election process, making it well-suited for digital governance in academic institutions

IV. SYSTEM OVERVIEW

A Blockchain-Powered Voting System for college elections introduces a secure, transparent, and tamper-resistant approach to student voting. By leveraging the decentralized nature of blockchain technology, each vote is recorded as an immutable transaction on a distributed ledger, ensuring that it cannot be altered or deleted once cast. This system significantly reduces the chances of electoral fraud, vote tampering, and unauthorized access, while also increasing trust among participants. Voter identities can be securely authenticated using cryptographic methods, and the results can be made verifiable by all stakeholders in real-time. Additionally, the system offers accessibility through digital devices, enabling students to cast their votes from remote locations, thereby improving participation. Overall, this approach modernizes traditional election processes with enhanced security, transparency, and efficiency tailored to the needs of academic institutions.

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V. ALGORITHM

1.Voter Registration & Verification
Students register through a secure portal using their college credentials (e.g., roll number, email, or Aadhaar if integrated). The system verifies eligibility from the college database.

2.Digital Identity Creation
A unique digital ID or cryptographic key pair is generated for each verified voter. This ensures anonymity and security during the election process.

3.Ballot Generation
An electronic ballot containing the list of candidates is generated and linked to the voter's ID (not personally identifiable, to maintain privacy).

4.Vote Casting
The voter selects their candidate choice via a secure web or mobile interface and submits the vote using their digital ID.

5.Vote Encryption
The vote is encrypted using cryptographic algorithms (e.g., AES or RSA) before being transmitted, ensuring confidentiality during transmission.

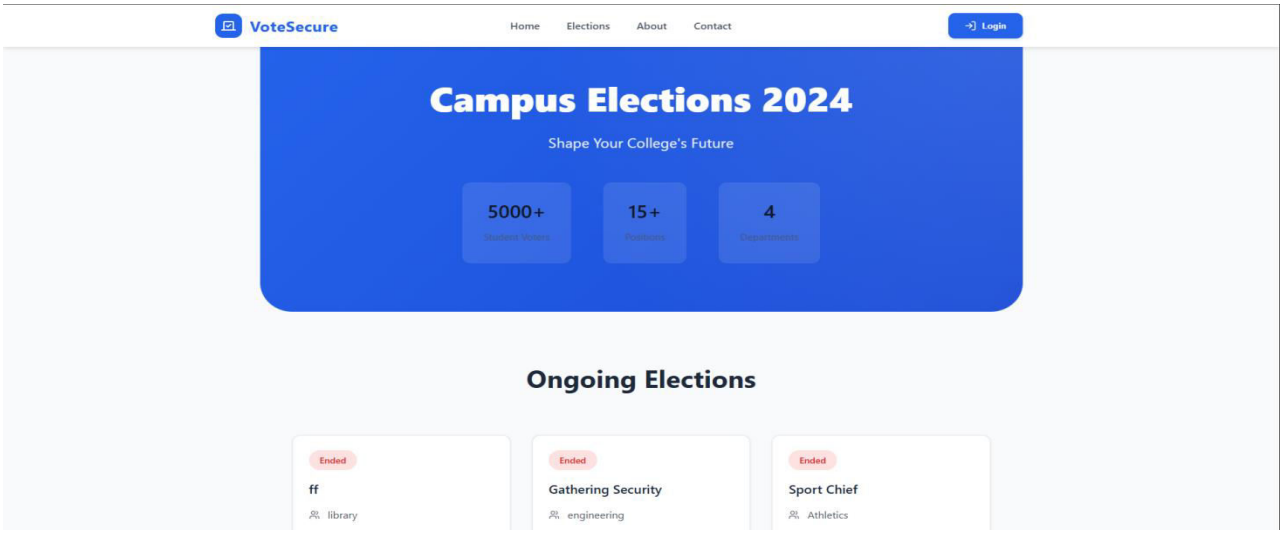
6.Blockchain Submission
The encrypted vote is recorded as a transaction on the blockchain. Each vote becomes part of a block containing multiple votes.

7.Consensus & Block Validation
Blockchain nodes (or authorized validators, like college servers) validate each vote/block using consensus mechanisms (like Proof of Authority or Practical Byzantine Fault Tolerance for private blockchains).

8.Result Tallying & Display
Once voting ends, the blockchain is scanned for all valid votes. Since all data is immutable and traceable, the final results are tallied automatically and displayed transparently.

VI. RESULTS

In a blockchain-based secure voting system for college elections, the result declaration process begins once the voting period concludes. All votes, which were previously encrypted to maintain voter privacy, are decrypted using secure cryptographic techniques such as threshold decryption or multi-party computation. This ensures that no single entity can decrypt the votes prematurely or manipulate the data.



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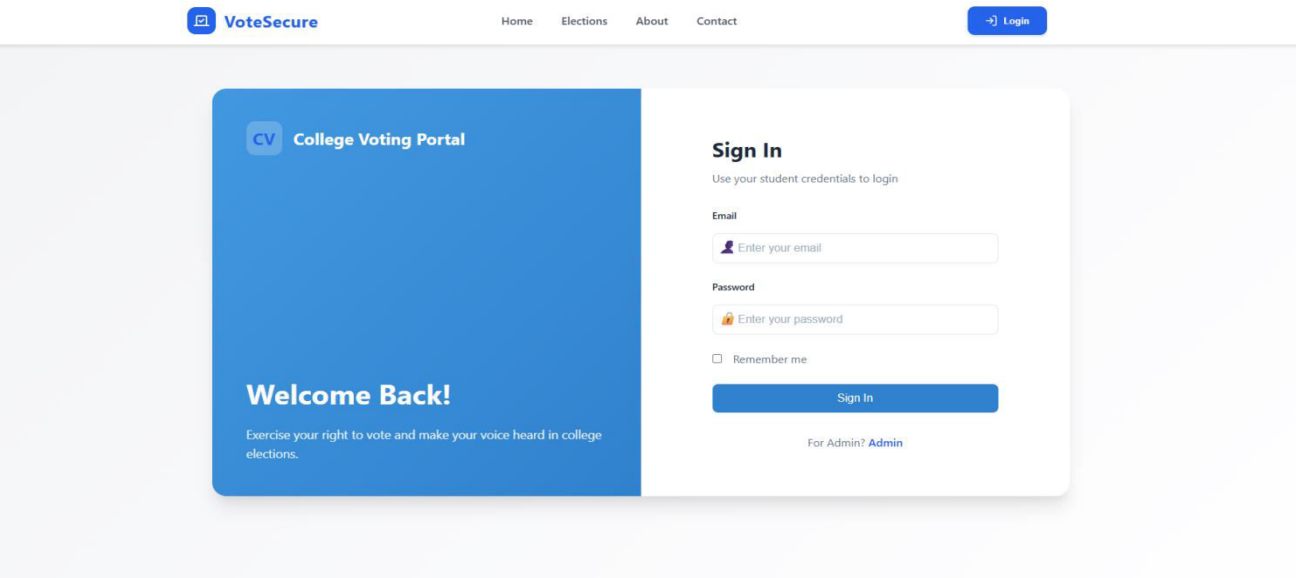

VII. CONCLUSION

In conclusion, a Blockchain-Powered Voting System for college elections offers a transformative approach to ensure transparency, security, and trust in the voting process. By leveraging the decentralized nature of blockchain, this system minimizes the risks of vote tampering, unauthorized access, and data manipulation. It ensures that every vote is encrypted, time-stamped, and stored in an immutable ledger, which can be audited at any time. This significantly enhances voter confidence and makes the election process more accountable and reliable for all stakeholders involved.

Moreover, such a system promotes increased voter participation by enabling secure remote voting through smartphones or computers, making the process more accessible and convenient. It also reduces the administrative burden and cost associated with traditional paper-based voting methods. As colleges continue to embrace digital innovation, blockchain-based voting systems serve as a stepping stone toward smarter governance models, not just within academic institutions but potentially at broader organizational and governmental levels in the future.

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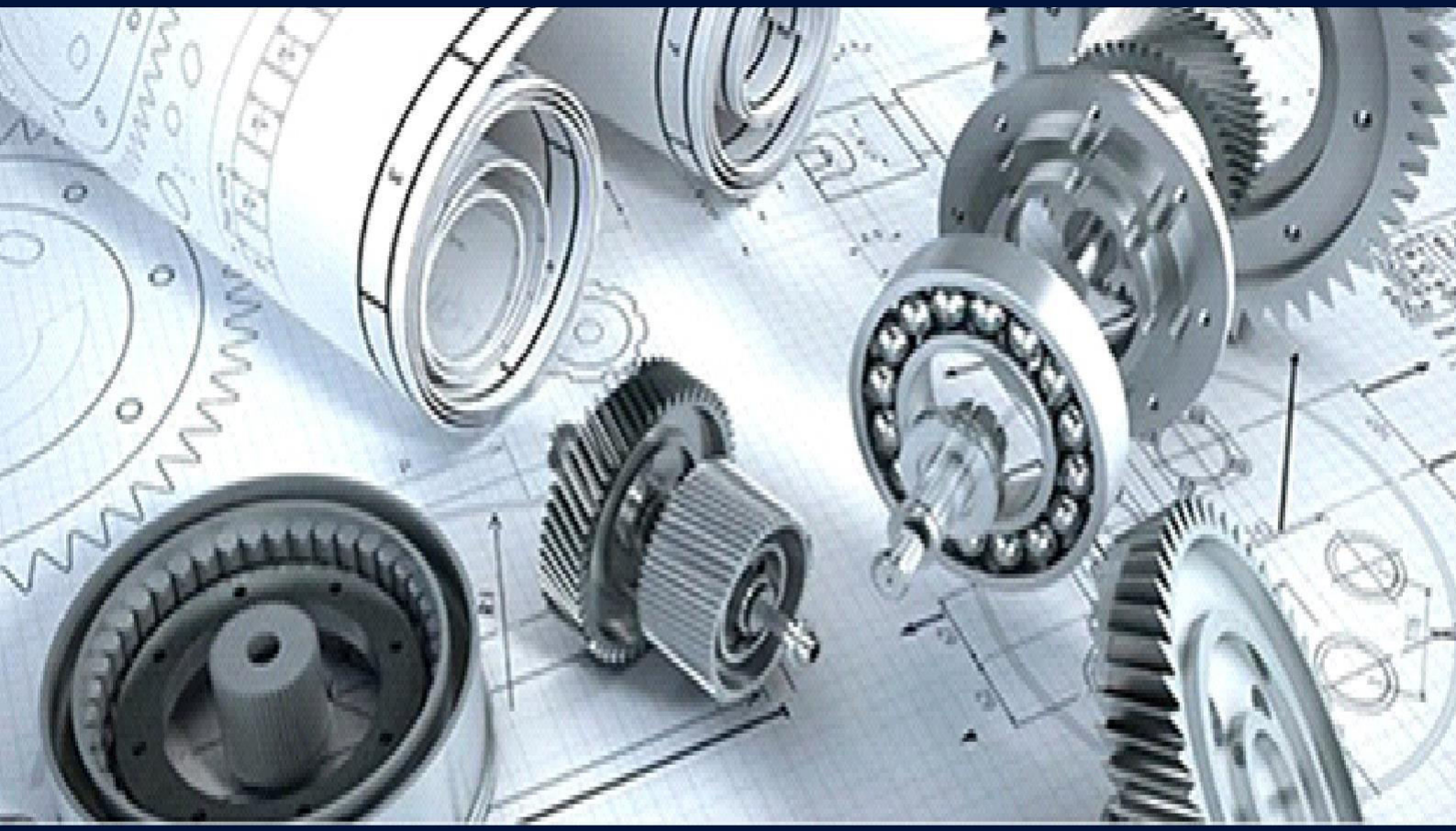

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