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"Blockchain based Electronic Voting System"

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Abstract - *This project presents a secure and user-friendly e-voting system that uses blockchain technology and fingerprint authentication to ensure safe and reliable voting. Built with the Python Flask framework, it focuses on transparency and protecting votes from tampering. The system includes modules for election authorities, voters, and candidates. Authorities manage registrations, approve candidates, and track results. Voters register using Aadhaar, Voter ID, and OTP, along with fingerprint verification. During voting, multiple checks ensure security. Each voter can vote only once, and every vote is stored on the blockchain, ensuring a fair, accurate, and trustworthy election process.*

Key Words: **Blockchain, E-Voting System, Biometric Authentication, Cryptographic Hashing, Transparency**

1. INTRODUCTION

This project introduces a secure blockchain-based voting system that uses multi-factor authentication to improve transparency and trust in elections. Built with Python Flask, it overcomes the limitations of traditional voting by integrating fingerprint-based biometric verification along with OTP and captcha validation. The system supports Election Authorities, Candidates, and Voters, enabling tasks like candidate management, constituency control, and real-time monitoring. Voters are verified through Aadhaar ID, Voter ID, OTP, and fingerprint scanning before voting. Each vote is encrypted and stored on a blockchain, ensuring tamper-proof, transparent results and offering a reliable, fraud-resistant alternative to conventional voting systems.

2. RELATED WORK

Traditional voting methods, such as paper ballots, electronic voting machines (EVMs), and basic online platforms, have long been used to conduct elections, but each comes with its own set of challenges. Paper-based voting, while simple, is often slow and requires extensive manual effort for counting. This process increases the chances of human error and makes the system vulnerable to tampering or manipulation. EVMs were introduced to improve efficiency and speed, but they still raise concerns because their internal processes are not always transparent or easily verifiable by independent parties.

Online voting systems offer convenience, allowing people to vote from anywhere, but they typically rely on centralized databases. This makes them attractive targets for hackers and increases the risk of data breaches, identity theft, and unauthorized access. Another major issue across these systems is the lack of strong authentication methods, which can lead to problems like voter impersonation, duplicate voting, and even automated bot attacks.

Additionally, many of these systems do not provide real-time transparency, which can result in delays, confusion, and disputes over election results. As a result, existing voting methods often struggle to ensure complete security, reliability, and trust throughout the entire election process.

3. PROPOSED WORK

The proposed system presents a secure and transparent digital voting platform that combines multi-factor authentication, fingerprint-based biometric verification, and blockchain technology. Instead of relying on a single method, it uses multiple layers of verification to ensure that only genuine and registered voters can participate.

Voters are authenticated through Aadhaar ID, Voter ID, OTP verification, captcha validation, and fingerprint scanning. This layered approach makes the system highly secure and helps prevent issues like impersonation and duplicate voting. By using fingerprint recognition instead of facial recognition, the system offers a reliable and user-friendly way to confirm voter identity.

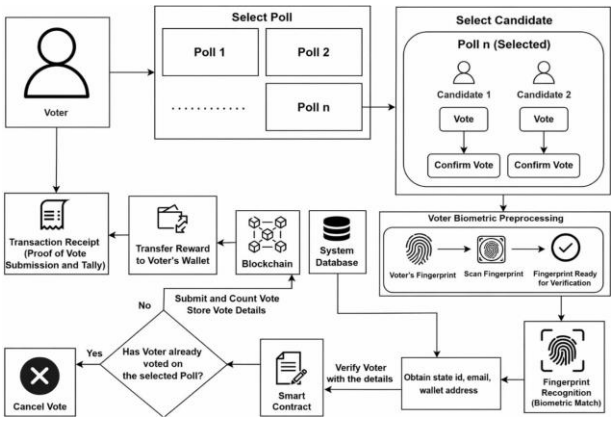

Fig 1: Block diagram of Blockchain Based Electronic Voting System

Once a vote is cast, it is encrypted and stored as a block in a custom blockchain ledger. This ensures that every vote is tamper-proof, cannot be altered or deleted, and remains transparent. Election authorities have full control over the process—they can activate voting sessions, manage

constituencies, approve candidates, and monitor results in real time.

3.1 User Interface Layer (Frontend)

- Voter Interface: A simple and user-friendly web interface built using HTML, CSS, JavaScript, and Flask templates allows voters to log in using their Voter ID and Aadhaar ID. After logging in, they complete OTP verification, solve a captcha, and authenticate using fingerprint scanning before casting their vote.
- Election Authority Interface: A separate interface is provided for election authorities to log in securely and manage constituencies, candidates, and voters. They can also monitor voting progress and view results in real time.
- Fingerprint Interface: The system connects with a fingerprint scanner or compatible input method to capture and verify the voter's fingerprint during login, ensuring accurate and secure identity verification.

3.2 Application Layer (Backend)

- Flask Web Application: The core system is developed using Python Flask, which manages all backend operations and user requests.
- Voter Registration and Fingerprint Authentication: During registration, voters provide details such as Aadhaar ID, Voter ID, and constituency. Their fingerprint data is captured and stored securely for future verification.
- Login and Authentication: The system verifies voters using login credentials, OTP validation, and fingerprint matching, ensuring that only authorized users can access the system.
- Voting Process: After successful authentication, the system checks whether voting is active in the voter's constituency. If active, it displays the list of approved candidates. Once the voter casts their vote, it is recorded in the blockchain, and the system prevents multiple voting.
- Blockchain Voting Ledger: Each vote is stored as a transaction in a custom blockchain. The vote data is encrypted and hashed before being added to a block, making it secure, transparent, and tamper-proof. Authorities can view real-time results from this ledger.
- Constituency and Voting Management: Election authorities can manage constituencies, approve candidates, and control voting sessions through the system.

3.3 Data Layer

- MySQL Database: This stores all important data such as voter details (Aadhaar ID, Voter ID), constituency information, and candidate records. Fingerprint data is also securely stored for authentication purposes.
- Blockchain: The blockchain acts as a secure ledger for storing votes. Each vote is encrypted and added as a block using cryptographic hashing, ensuring that the data cannot be modified. This provides transparency, security, and real-time tracking of votes.

Overall, the system reduces manual effort, minimizes errors, and improves transparency through easy-to-use dashboards, making the entire voting process more efficient, secure, and trustworthy.

4. OBJECTIVES

- To design and develop a simple and user-friendly login page that acts as the first step for user authentication in the blockchain-based voting system.
- To create a secure and transparent electronic voting platform using blockchain technology, ensuring that all votes are tamper-proof and trustworthy.
- To implement smart contracts along with cryptographic techniques that automatically record votes, prevent duplicate voting, and protect voter identity and privacy.
- To test and validate the system on a blockchain test network in order to evaluate its performance, efficiency, and security, and compare it with existing traditional voting methods.

5. FUNTIONAL REQUIREMENT

5.1. Election Authority Functions

- Election authorities should be able to log in securely using their registered credentials.
- They can create and manage constituencies as needed.
- The system allows them to review candidate applications and either approve or reject nominations.
- Authorities can start or stop voting sessions for specific constituencies.
- They should also be able to monitor real-time vote counts directly from the blockchain.

5.2. Candidate Functions

- Candidates can register by providing necessary details such as name, party, symbol, address, and password.
- They can log in using their credentials to access the system.
- Candidates are able to check whether their nomination has been accepted or rejected.

5.3. Voter Functions

- Voters must register using Aadhaar ID, Voter ID, constituency, and email ID.
- Identity verification is done through an OTP sent to their registered email.
- Voters must also provide fingerprint data for biometric authentication.

Voting Process:

1. Login using Voter ID and Aadhaar ID
2. Verify OTP and complete captcha verification
3. Authenticate using fingerprint scanning
4. Once verified, view approved candidates and cast the vote

- The system ensures that each voter can vote only once.

5.4. Blockchain Functions

- Each vote is recorded as a unique transaction on the blockchain.
- The system ensures that all votes are secure, immutable, and tamper-proof.
- Votes can be retrieved for counting in a transparent way without revealing voter identity.

6. NON-FUNTIONAL REQUIREMENT

6.1. Security

- Sensitive data is protected using end-to-end encryption.
- Blockchain technology ensures votes cannot be altered.
- OTP and captcha help prevent unauthorized access and bot attacks.
- Fingerprint authentication ensures genuine voter identity and prevents impersonation.

6.2. Reliability

- The system guarantees one vote per voter with no duplication.
- Vote counts are accurate and updated in real time from the blockchain.

6.3. Performance

- Voter verification using OTP and fingerprint should be fast and efficient.
- Blockchain transactions should be processed with minimal delay.

6.4. Scalability

- The system is designed to handle multiple constituencies, voters, and candidates.
- It can be expanded to support large-scale elections at state or national levels.

6.5. Usability

- Provides a simple and user-friendly interface for all users.
- Clear guidance is given for OTP, captcha, and fingerprint verification steps.

6.6. Maintainability

- The system follows a modular design using Flask, making it easy to update and maintain.
- Both database and blockchain records are organized for easy management.

6.7. Transparency & Integrity

- Once recorded, votes cannot be changed or deleted.
- Users can only access information relevant to their role, ensuring data privacy and integrity

7. FUTURE SCOPE

The future scope of this blockchain-based voting system includes enhancing scalability to support large-scale national and international elections. Advanced biometric methods like multi-modal authentication (fingerprint, iris) can further improve security. Integration with mobile applications can make voting more accessible and convenient. The system can also incorporate AI-based fraud detection to identify suspicious activities in real time. Using more efficient blockchain frameworks can reduce transaction time and cost. Additionally, linking with government databases can streamline voter verification. Overall, the system can evolve into a fully digital, secure, and widely adopted voting solution for modern democratic processes.

8. CONCLUSION

In conclusion, this project demonstrates how combining blockchain technology with fingerprint-based authentication can create a secure, transparent, and reliable e-voting system. By integrating multiple layers of verification, it minimizes the risks of fraud, duplicate voting, and unauthorized access. The use of blockchain ensures that every vote is permanently recorded and cannot be altered, maintaining the integrity of the election process. Additionally, the system simplifies election management for authorities while providing voters with a safe and user-friendly experience. Overall, this approach offers a modern and efficient solution for conducting fair and trustworthy digital elections.

9. REFERENCES

[1] Swan, M. (2015). Blockchain: Blueprint for a New Economy. O'Reilly Media. This book provides foundational knowledge about blockchain technology and its potential applications in secure systems, including voting.

[2] Zhang, L., White, J., Schmidt, D. C., & Lenz, G. (2018). Applying Blockchain Technology for Secure Voting Systems.

[3] Sharma, T. K., & Bhushan, B. (2020). Blockchain for Voter Identity Verification and Secure Election Process

[4] Nguyen, Q. K. (2016). Blockchain - A Financial Technology for Future Sustainable Development.