

BLOCKCHAIN-BASED BIOMETRIC VOTING SYSTEM USING FACE AND FINGERPRINT AUTHENTICATION FOR SECURE AND TRANSPARENT ELECTIONS

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Keywords:

Blockchain, Electronic Voting, Multimodal Biometrics, Face Recognition, Fingerprint Verification, CNN, Smart Contracts, Ethereum, Privacy, Attestation

Introduction:

1. Free and fair elections are fundamental to democracy, but traditional voting systems suffer from issues such as inefficiency, lack of transparency, and vulnerability to fraud. Existing electronic voting systems also face challenges including security threats, lack of trust, and weak authentication mechanisms.
2. To address these problems, this project proposes **BlockVote**, a blockchain-based electronic voting system integrated with multimodal biometric authentication using face and fingerprint recognition. The system enhances voter verification, ensures transparency, and provides tamper-proof vote recording.
3. By combining blockchain technology with biometric authentication and liveness detection, the system ensures secure, reliable, and privacy-preserving digital elections suitable for institutional and governmental use.

Objectives:

1. To design a secure electronic voting system using blockchain technology.
2. To implement multimodal biometric authentication using face and fingerprint recognition.
3. To ensure privacy by storing sensitive biometric data off-chain.
4. To provide transparency and tamper-proof voting using Ethereum smart contracts.

Methodology:

The project follows a hybrid architecture combining off-chain biometric verification with on-chain blockchain recording.

- **Enrollment Phase:** Voter's register using a unique ID (Aadhaar or institutional ID) along with face and fingerprint samples.

- **Biometric Processing:** CNN models such as MobileFaceNet/ResNet are used for face recognition, and fingerprint features are extracted using minutiae-based techniques.
- **Authentication:** During voting, multimodal biometric verification with liveness detection ensures genuine user presence.
- **Attestation:** Upon successful verification, a short-lived attestation is generated linking user identity with a blockchain wallet.
- **Blockchain Integration:** Votes are cast via MetaMask and recorded using Solidity smart contracts on Ethereum (tested using Ganache).
- **Security:** The system prevents duplicate voting, replay attacks, and unauthorized access while ensuring data privacy.

Result and Conclusion:

The proposed system demonstrates improved accuracy and security using multimodal biometric authentication compared to single-modality systems. Liveness detection effectively prevents spoofing attacks, and blockchain ensures immutable and transparent vote recording.

The system achieves low latency, reliable performance, and secure voting with privacy preservation. Overall, BlockVote provides a practical and scalable solution for secure digital elections.

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Future Scope:

The future scope of this project includes:

1. Integration of zero-knowledge proofs for enhanced privacy.
2. Deployment on Layer-2 blockchain solutions to reduce cost and latency.
3. Improvement in biometric fairness and accessibility for diverse users.