Blockchain Based Secure Voting System with Multi- Factor Authentication

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Abstract: *This project presents a Blockchain-Based Secure Voting System with MultiFactor Authentication, designed to ensure transparency, integrity, and accessibility in digital elections. The system integrates blockchain technology to guarantee tamper-proof and immutable vote records, while a four-step multi-factor authentication process ensures that only authorized voters can participate. The authentication flow includes Face Recognition, Fingerprint Verification, OTP Validation, and Dummy Aadhar Authentication, thereby minimizing risks of impersonation, fraud, or unauthorized access. .An Admin Panel is developed to manage voters registration, candidate and election setup, and result monitoring.*

Keywords*: Blockchain, Secure Voting System, Multi-Factor Authentication, Biometric Verification, ace Recognition, Fingerprint Authentication, OTP Verification, Dummy Aadhar Validation*

I. INTRODUCTION

Electoral systems worldwide continue to grapple with fundamental challenges that undermine public trust and democratic participation. Paper-based voting systems, while traditional, suffer from logistical complexities, susceptibility to physical tampering, lengthy counting processes, and difficulties in maintaining chain of custody. . Blockchain, initially developed for cryptocurrency transactions, offers inherent properties ideal for electoral systems: immutability ensures votes cannot be altered post-submission, decentralization eliminates single points of control, transparency allows public verification without compromising voter privacy, and cryptographic security protects against unauthorized access.

II. SYSTEM DESIGN

The system employs a three-tier architecture comprising the presentation layer (web/mobile interfaces for voters and administrators), application layer (authentication services, Firebase integration, blockchain interface), and data layer (Firebase Realtime Database for biometric templates and user data, Ethereum blockchain for immutable vote records). The system is managed through an Admin Panel, where the admin registers voters and sets up elections. Voters must pass four levels of authenticationface recognition, fingerprint scanning, OTP verification, and dummy Aadhar number validationbefore being allowed to vote. All votes are immutably stored on the blockchain, and final results are viewable in the admin dashboard.

III. RESULTS AND DISCUSSION

This project involves the development of a **highly secure, blockchain-integrated online voting system** with robust software-based multi-factor authentication mechanisms. The system aims to eliminate voter fraud, ensure only authorized users can vote, and maintain tamper-proof, transparent election records using blockchain. The system is managed through an **Admin Panel**, where the admin registers voters and sets up elections. Voters must pass **four levels of authentication**face recognition, fingerprint scanning, OTP verification, and dummy Aadhar number validationbefore being allowed to vote. All votes are immutably stored on the blockchain, and final results are viewable in the admin dashboard.

Admin Dashboard

Logout

Voting Statistics	Manage Candidates	Manage Voters

Candidate Management

+ Add Candidate | Export CSV | Export JSON

ID	Name	Aadhaar	Phone	DOB	Education	Votes	Actions
1	Sam	123456789101	1234567899	5/4/1999	BA	3	
2	Ram	123456789102	1234432112	6/5/2000	MA	1	

Admin Dashboard

Logout

Voting Statistics	Manage Candidates	Manage Voters

Voter Management

Register Voter | Export CSV | Export JSON

ID	Name	Aadhaar	Vote Status	Registered	Actions
1	Lakshmi	123456789101	Voted	11/6/2025	Reset Delete
2	Thasleem	987654321234	Voted	11/6/2025	Reset Delete
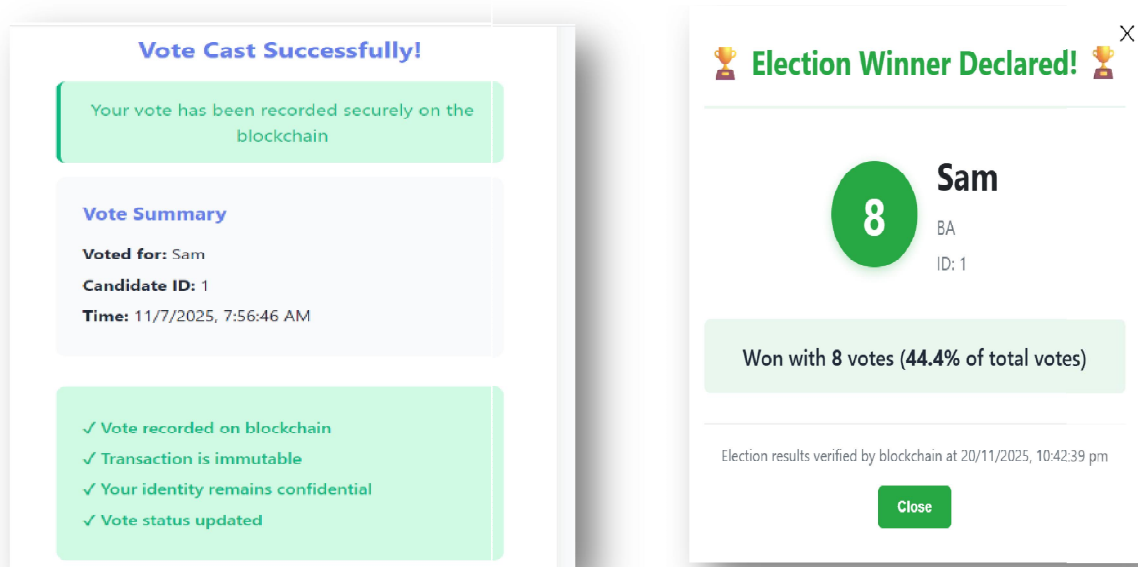
IV. CONCLUSION

This project presents a comprehensive, production-ready solution to fundamental challenges plaguing electoral systems worldwide. By integrating blockchain's immutability and transparency with multi-factor biometric authentication, the system addresses security, trust, and accessibility concerns that have limited adoption of electronic voting. The four-level authentication pipelinecombining facial recognition, fingerprint verification, OTP validation, and identity confirmationcreates formidable barriers against impersonation and fraud while maintaining user experience feasibility. The ESP8266-based fingerprint module with Firebase integration demonstrates practical IoT implementation for biometric authentication in cloud-connected systems. Smart contract-based vote storage on Ethereum blockchain ensures tamper-proof records with public verifiability.

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