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Online Voting System using Face Recognitions

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Abstract: *To counter the growing threat of data tampering in the digital age, especially in critical processes like voting, we propose a decentralized national e-voting system utilizing secure Face Recognition technology. This system minimizes the risk of fraudulent votes and ensures accurate results. It features an admin panel for comprehensive election management, including scheduling, candidate oversight, and result declaration. Voters authenticate using their Aadhar ID and a live photo, with further verification via OTP. During the voting process, camera monitoring adds an additional layer of security. This platform promotes remote voting, improving accessibility for citizens in all areas, and its user-friendly interface maintains rigorous security. Detailed analytics, including demographic data, will enhance transparency and public confidence in the electoral process*

Keywords: Face Authetication, Security

I. INTRODUCTION

In reality, we are encircled by people who can take in everything from their encounters with their learning ability, and we have PCs or machines which work on our directions. In any case, can a machine likewise gain from encounters or past information like a human does? So here comes the job of Machine Learning. Machine Learning is said as a subset of man-made reasoning that is essentially worried about the advancement of calculations which permit a PC to gain from the information and past encounters all alone. With the assistance of test authentic information, which is known as preparing information, AI calculations construct a numerical model that helps in settling on forecasts or choices without being expressly customized. AI brings software engineering and measurements together for making prescient models. AI builds or uses the calculations that gain from recorded information. The more we will give the data, the higher will be the exhibition. "A machine can learn in the event that it can improve its exhibition by acquiring information.

II. RELATED WORK

A Machine Learning framework gains from verifiable information, assembles the expectation models, and at whatever point it gets new information, predicts the yield for it. The precision of anticipated yield relies on the measure of information, as the colossal measure of information assists with building a superior model which predicts the yield all the more precisely.

Assume we have an intricate issue, where we need to play out certain forecasts, so as opposed to composing a code for it, we simply need to take care of the information to nonexclusive calculations, and with the assistance of these calculations, machine assembles the rationale according to the information and foresee the yield. AI has changed our perspective about the issue. The beneath block outline clarifies the working of Machine Learning calculation:

Features of Machine Learning,Machine learning uses data to detect various patterns in a given dataset. It can learn from past data and improve automatically. It is a data-driven technology. Machine learning is much similar to data mining as it also deals with the huge amount of the data.

Need for Machine Learning: The need for machine learning is increasing day by day. The reason behind the need for machine learning is that it is capable of doing tasks that are too complex for a person to implement directly. We can train machine learning algorithms by providing them the huge amount of data and let them explore the data, construct the models, and predict the required output automatically. The performance of the machine learning algorithm depends on the amount of data, and it can be determined by the cost function. With the help of machine learning, we can save

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both time and money. The importance of machine learning can be easily understood by its uses cases, Currently, machine learning is used in self- driving cars, cyber fraud detection, face recognition, and friend suggestion by Facebook,

III. LITERATURE SURVEY

A worldwide centralized database is maintained on the server side, storing essential data for all registered candidates and voters. This database acts as the digital backbone of the entire e-voting system, ensuring seamless access and management of electoral information across multiple regions. The server also supports backend operations such as vote counting, authentication tracking, and constituency mapping. Operating in real time, the system ensures updates and verifications are processed instantly, thereby improving efficiency, responsiveness, and accuracy during the voting process [1].

[2] The use of mobile device cameras has been leveraged to implement facial recognition technology for user identification. With nearly every citizen owning a smartphone equipped with a camera, this approach promotes accessibility and scalability. This face recognition system captures a live image of the user during login or voting and matches it with stored data to ensure only the registered voter is allowed to proceed. This mobile-based feature makes the voting process more convenient while still maintaining a high level of security [2].

[3] Two-factor authentication (2FA) is integrated into the voting system to strengthen security and reduce the chances of vote tampering or impersonation. In addition to facial recognition, an OTP (One-Time Password) is sent to the registered mobile number of the voter. Only upon successful verification of both factors is the user allowed to cast their vote. This dual-layer verification adds a robust layer of protection, making it extremely difficult for unauthorized individuals to manipulate or gain access to the system [3].

[4] The system employs two levels of authentication to significantly enhance security. The first level involves Face Detection and Recognition, ensuring the voter is physically present and their face matches the stored biometric data. This method has demonstrated effectiveness, achieving over a 66% detection rate and identifying more than 94% of suspicious or fraudulent activities with a false positive rate of less than 0.3%. Such high accuracy helps eliminate misuse and fraudulent attempts during voting .

[5] The need for transformational digitalization in election systems is evident as it provides advanced means of verifying actions, voter identities, and participation integrity. While many countries have moved towards digital voting systems, some, like Iraq, still rely heavily on conventional paper-based voting methods, which are prone to manipulation, logistical challenges, and inefficiencies. Adopting digital authentication tools like face recognition and OTPs can modernize and secure electoral processes [5].

[6] On election day, photographs captured during the voting process are stored securely on a central database or cloud server. These images are then verified against pre-existing data to ensure voter identity. This real-time comparison guarantees that only legitimate voters cast their ballots and that no duplication or impersonation occurs. This step is vital in building trust and transparency in the overall voting system [6].

[7] The research includes a comparative analysis of various facial recognition algorithms, evaluating their performance across accuracy, speed, and scalability. Such a comparison allows system developers to select the most suitable algorithm that balances precision with resource efficiency. The outcomes of this in-depth study guide the development of a reliable and robust face recognition module within the voting application [7].

[8] The new digital voting system simplifies the entire process by removing the dependency on traditional physical voter identification methods. Instead of requiring voters to physically present identification cards or appear at designated polling stations, the system identifies users based on facial features. This shift not only enhances user experience but also encourages higher voter turnout, especially among those unable to travel to polling locations [8].

[9] To prevent fraudulent voting, the system is further enhanced with biometric and OTP-based verification options. Voters can authenticate themselves using fingerprints, iris scans, or mobile-based OTPs. These additional verification methods serve as alternatives or complements to face recognition, providing flexibility while ensuring the highest level of security. Together, they create a fail-safe environment that discourages and detects any attempt to falsify votes [9].

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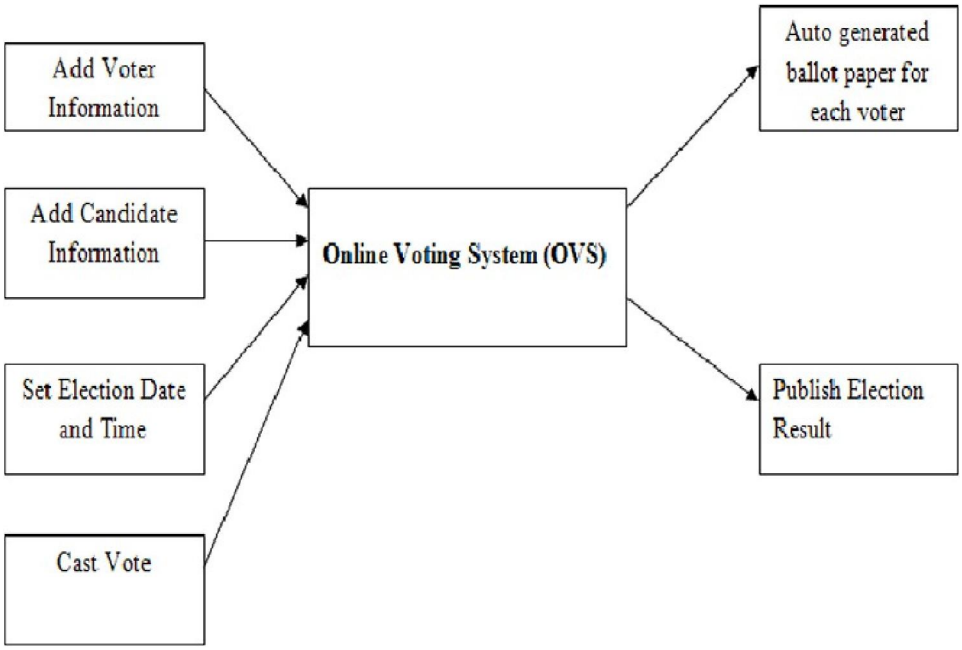
IV. METHODOLOGY

Haar Cascade Algorithm: Haar Cascade Algorithm is a machine learning based algorithm proposed by Paul Viola and Michael Jones in which the cascade image is trained by providing a lot of positive and negative images, that is used to detect the object in images. This algorithm needs a lot of positive images (images of faces) and negative images i.e. images without faces to train the classifier. The Haar Cascade algorithm is a machine learning-based object detection method used to identify faces (and other objects) in images or video. It is especially known for being lightweight, fast, and effective for real-time face detection. It is based on the concept of Haar features—patterns of black and white rectangles that resemble edge detection filters. The algorithm relies on Haar-like features, which are simple rectangular shapes (lines and rectangles) with varying pixel intensities. These features are designed to detect edges and textures, which are common characteristics of objects. Each feature is essentially a single value calculated by subtracting the sum of pixels in a white rectangle from the sum of pixels in a black rectangle. These features are:

Simple differences in pixel intensities

Captured over rectangular regions

Similar to filters used in convolutional neural networks



1. Presentation Layer (User Interface)

This layer interacts directly with users—voters, administrators, and candidates. It presents input forms and displays output.

Components:

• Voter registration form (Add Voter Information)

• Candidate registration form (Add Candidate Information)

• Election setup UI (Set Election Date and Time)

• Voting screen (Cast Vote)

• Election result dashboard (Publish Election Result) Technologies:

• HTML/CSS, JavaScript (frontend)

• Django templates or React/Angular (if using frontend frameworks)

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2. Business Logic Layer (Application Logic)

This is the core of the application that enforces business rules and processes data. Functions:

• Validate voter and candidate information
• Schedule and manage election timings
• Control voting process (allow only once, during valid period)
• Tally votes and generate results
• Generate ballot papers dynamically per voter Technologies:
• Django views and models
• Python classes and functions
• Face recognition & OTP logic (via OpenCV, face recognition libraries, Twilio/email OTP)

3. Data Layer (Database)

Handles data storage and retrieval. Database Tables:

• Voters: voter ID, face image, OTP info, etc.
• Candidates: name, party, photo
• Votes: voter ID, candidate ID, timestamp
• Elections: date, time, status
• Results: aggregated vote counts Technologies:
• PostgreSQL / MySQL / SQLite
• Django ORM for database access

4. External Services

Used for functionalities beyond the system's internal logic.

Examples:

• OTP Service: Twilio, SendGrid, or email/SMS API to send OTP for voter verification
• Face Recognition: OpenCV + face recognition Python library (or cloud-based APIs like AWS Rekognition)
• Hosting/Deployment: AWS, Heroku, or DigitalOcean
• Security APIs: reCAPTCHA, email verification, or blockchain (if used for vote integrity)

V. CONCLUSION

The proposed method is to develop a secure internet voting system based on face recognition which tried to overcome all the drawback occurs in traditional or current voting system. The proposed system has many strong features like correctness, verifiability, convenience etc. For this system no requirement of an election officer, paper ballot or any electronic voting machine only the internet connection and Face scanners are required one can vote from anywhere secure..

VI. FUTURE WORK

The future scope of the "Online Voting Using Face Recognition and OTP Verification" system is highly promising, with potential advancements in biometric accuracy through deep learning-based face recognition and liveness detection to prevent spoofing. Integration with mobile applications and multi factor authentication methods like fingerprints or iris scans can enhance user accessibility and security. Incorporating blockchain technology can ensure transparency and tamper-proof voting records, while AI-powered analytics can offer real-time insights for election authorities. Additionally, expanding the system for national elections, enabling remote voting for NRIs and defense personnel, and ensuring accessibility for differently-abled users can make the voting process more inclusive, secure, and efficient.

Unit Testing: Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests

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perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Integration testing : Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

Functional test : Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals. Functional testing is centered on the following items:

• Valid Input : identified classes of valid input must be accepted.
• Invalid Input : identified classes of invalid input must be rejected.
• Functions : identified functions must be exercised.
• Output : identified classes of application outputs must be exercised.
• Systems/Procedures: interfacing systems or procedures must be invoked.

System Test : System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

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