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Face Recognition Based Voting System

Bhagyavantha G [(1)], Dr. Kumar Siddamallappa. U [(2)], Shreedevi Prakash Gotur [(3)]

(1) Student, DOS in Computer Applications (MCA), Davangere University, Shivagangothri, Davanagere-577007, Karnataka, India
(2) Assistant Professor, DOS in Computer Applications (MCA), Davangere University, Shivagangothri, Davanagere-577007, Karnataka, India
(3) Research Scholar, DOS in Computer Science, Davangere University, Shivagangothri, Davanagere-577007, Karnataka, India
(1) bhagyavanthag10@gmail.com
(2)kumarkumarsm@gmail.com Orcid-0000000219753868
(3) shreegotur@gmail.com Orcid- 0009000191858998

A B S T R A C T

Biometric security that relies on facial features, commonly known as face recognition, is an advanced method used for reliable voter verification. This project introduces a Face Recognition-Based Voting System that integrates the Haar Cascade algorithm, which detects facial features by tracking Haar-like characteristics. Haar Cascade is a well-known technique for rapid object detection and provides a balance between accuracy and efficiency, making it suitable for election environments where both speed and reliability are critical. The proposed system follows a three-level confirmation process to ensure maximum security. The first level verifies the user ID, followed by the validation of the voter card number. If both steps are successfully completed, the voter moves to the final stage—facial recognition. This step serves as the ultimate security layer to confirm the authenticity of the voter, ensuring that only legitimate individuals are allowed to cast their vote.

By combining biometric authentication with digital verification, the system reduces impersonation, prevents fraudulent activities, and minimizes errors caused by manual intervention. It also enables faster result generation while protecting voter privacy through secure data encryption. Overall, this project aims to deliver a safe, transparent, and efficient voting framework that strengthens trust in the democratic process.

Keywords: **Face Recognition, Electronic Voting, Bio-metric Authentication, Haar Cascade algorithm**

1.Introduction

The foundation of democracy is that the people are entitled to have a free and fair election of their leaders. Voting is also a way of choosing the representatives as well as an opportunity whereby people can give their views and shape up the governance. Paper ballots and electronic voting machine have been popular methods in traditional systems of voting. Although these systems have been effective, they tend to face a number of challenges such as impersonation, multiple voting, tampering of votes, long queues in the polling stations and inefficiencies in logistics. These problems usually lower the confidence of the population in the results of the election and deter turnout.

Technology based solutions are being considered in order to break these constraints. Biometric based voting systems have attracted a lot of attention among them because of their personal identification capabilities. Especially face recognition is a secure and non-invasive biometric method. Facial features can be captured instantly and precisely without necessarily having to touch the person unlike with fingerprints or iris scans, and it is more convenient to the voter.

In this project, a Face Recognition-Based Voting System, which combines sophisticated machine learning algorithms and digital authentication methods, are presented. The system provides voter legitimacy with a three-tier verification of user ID, voter ID and face recognition. The proposed system promotes efficiency and transparency in addition to providing better security since it aut.omates the process of authentication and vote counting.

Finally, the strategy will help ease the voting process, enhance its reliability, and safety, which will empower democracy and build citizen trust in the election process again.

2. Literature Survey

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3. Proposed Method

The Face Recognition-Based Voting System is aimed to eliminate the shortcomings of the current way of voting and increase the degree of security, efficiency and transparency of the voting process. The main principle is to employ facial biometrics as the main method of voter identification, whereby all citizens are able to vote only once, safely and with ease.

3.1 Problem Statement

Even though the current voting systems have undergone tremendous technological improvements, there are various challenges that remain in the systems, which undermine its reliability, security, and accessibility. Paper-based ballot systems are sluggish, costly, and can be easily manipulated, and electronic voting machines (EVMs) do not usually have a strong biometric authentication system and may be compromised. Such constraints lead to various problems including:

- Impersonation and Multiple Voting: People can seek to impersonate others and vote on behalf of victims or vote twice.
- Vote Tampering: Manual handling and electronic systems are weak thus making it a risk of tampering or failing to count the votes.
- Manual Identity Verification: Voter Identity checks conducted by humans are subject to errors, delays and contention.

- Problems in Accessibility: Voters with physical challenges, aged and geographically isolated voters may find it hard to access polling places and hence they are disenfranchised.
- Absence of Transparency and Trust: Delays in tallying and verifiable audit trails lower the confidence of the populace in the results of the election.

Election should embrace digital transformation in an age where the digital revolution is radically transforming essential services so as to be fair, inclusive and safe. It is urgent that a modernized voting system is developed that incorporates biometric authentication to ensure that there is compliance with one person, one vote, curb impersonation, enhance ease of access and provide real time accurate results.

Face Recognition-Based Voting System will directly solve these issues by using a three-tier authentication system, which is the user ID, voter ID, and facial recognition, thereby preventing unauthorized voters, as well as, allowing only legit voters to vote. The approach promotes the transparency, efficiency, and security of elections and the rebuilding of trust in the electoral process among the people.

3.2 Objectives

The main aim of the planned Face Recognition-Based Voting System is to come up with a secure, reliable, and efficient voting system that improves the credibility of the elections besides making the voting experience of voters very simple. The specific objectives are:

Enhance Security in Voting:

- Eradicate impersonation, multiple voting, fraudulent issues by use of biometric based authentication.
- Launch a three-step authentication procedure with user ID, voter ID and face recognition.

Enhance Productivity and precision:

- Automatize voter credentials checks and vote counting to reduce the number of people involved.
- Guarantee rapid, instantaneous result production with a smaller number of errors and conflicts.

Secure Transparency and Trust:

- Keep good audit trails and ensure secure logs as a way of enhancing accountability.
- Facilitate access and management of votes in a non-tampered fashion.

Increase Accessibility:

- Give a system which may be employed by the voters in distant areas, the elderly and physically challenged.
- Give flexibility in voting without necessarily being tied to the polling station locations.

Safeguard Data Privacy:

- Encoding biometric data is necessary to ensure that the privacy standards are met with the assistance of storing biometric data in encrypted formats.
- Secure voter data against unauthorized access or abuse.

Support Scalability:

- Design a system that is deployable to small scale institutional elections as well as national elections at large scale.
- Make sure that it is robust on a high volume of voters at a time.

Promote Cost-Effectiveness:

- Less reliance on paper ballots, manual work and use of resources that are resource intensive.
- Offer a long term solution on recurrent elections.

3.3 Existing Method

Current voting practices, which include paper ballot system and electronic voting machine (EVM) have been the mainstay of elections over the decades but still they have had a number of challenges. The paper ballots are very rudimentary but they are time consuming, labour intensive and can be manipulated through ballot stuffing, ballots loss and also when counted. To counter these problem, electronic voting machines were incorporated, which are faster in casting and counting votes. Nonetheless, EVMs do not have good biometric authentication, and they are likely to suffer impersonation, multiple-voting, tampering, and technical malfunctions. In the recent years, pilot systems have tried a few biometric authentication systems such as fingerprint and iris recognition. Although such methods introduce an additional layer of security, they also have their drawbacks the fingerprints can be

obscured by age or by human hands and the iris scan can only be obtained by very costly equipment and cannot be user-friendly. More so, these systems too tend to rely on manual checks at some point that add errors and delays. In general, the current mechanisms do not offer the level of security, efficiency, and accessibility that is required in the current digital age, which is why there is a need to have a more sophisticated and trusted system that guarantees one person one vote and prevents fraud and enhances inclusivity.

3.4 Implementation

Face Recognition-Based Voting System is conducted in an ordered way starting with voter registration but ending with safe voting of the votes cast. To achieve accuracy, efficiency, and security, a machine learning technology, image processing technology, and database management technology are used in developing the system.

Voter Registration

- Registries, demographic information and a photo of the face are supplied by citizens.
- The data obtained is encrypted in a centralized database which is secure.
- Every registered user receives a user ID and a login.

Authentication Process

Step 1: Checking of User ID and Password- Voters use their credentials to log in. When they are correct, then they move to the next step.

Step 2: Voter Id Verification- The entered voter id is verified by cross checking with the Election Commission records to ascertain genuineness.

Step 3: Face Recognition- A live picture is taken with a webcam and its facial image is matched to the stored facial template with the Haar Cascade algorithm. The voter can go on only when the face matches

Voting Stage

- After the verification, the voter will be sent to the digital ballot interface.
- The voter then casts his/her vote using an electronic system which ensures the vote is registered.
- The database updates automatically the status of the voter as voted to avoid duplication of voting.

Result Compilation

- Votes are coded and are saved in a safe server.
- The tallies are automatically counted in real time, minimising time wastage and human interference.
- The system produces audit logs that are tamper free.

3.4.1 System Architecture

- Face Recognition Algorithm: Haar Cascade is applied initially to detect face and after that, features are extracted and classified to make sure that the face is recognized rightly.
- Database Management: Voter details, facial templates are stored in centralized and encrypted databases.
- Compliment of Results: Voting will be done electronically in real-time, eliminating delays and time consuming manual work.

3.4.2 Security Measures

- Voting data and biometric data are encrypted.
- Check of impersonation and multi-voting by multi-factor authentication.
- Periodical system audits and logs to make sure it is transparent and verifiable.

Such a stratified system guarantees that only qualified voters have the opportunity to vote, and fraud is eradicated, and it offers a solution to effective elections on large scale. Combining biometric authentication with the digital platform does not only make elections safer, but it also enhances voter accessibility because it enables voting even in remote geographic areas or at places with physical limitations.

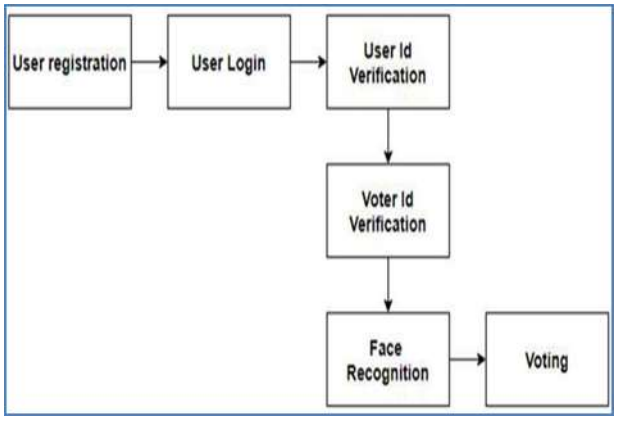

Figure 1: Block diagram for a face-recognition voting system

Figure 1 depicts the entire workflow of the suggested system, from gathering data from various platforms to storing it in a database to finally using it for verification.

Three degrees of confirmation are included in the suggested framework, and this is a practical way to cut down on instances of erroneous voting.

4. Architecture

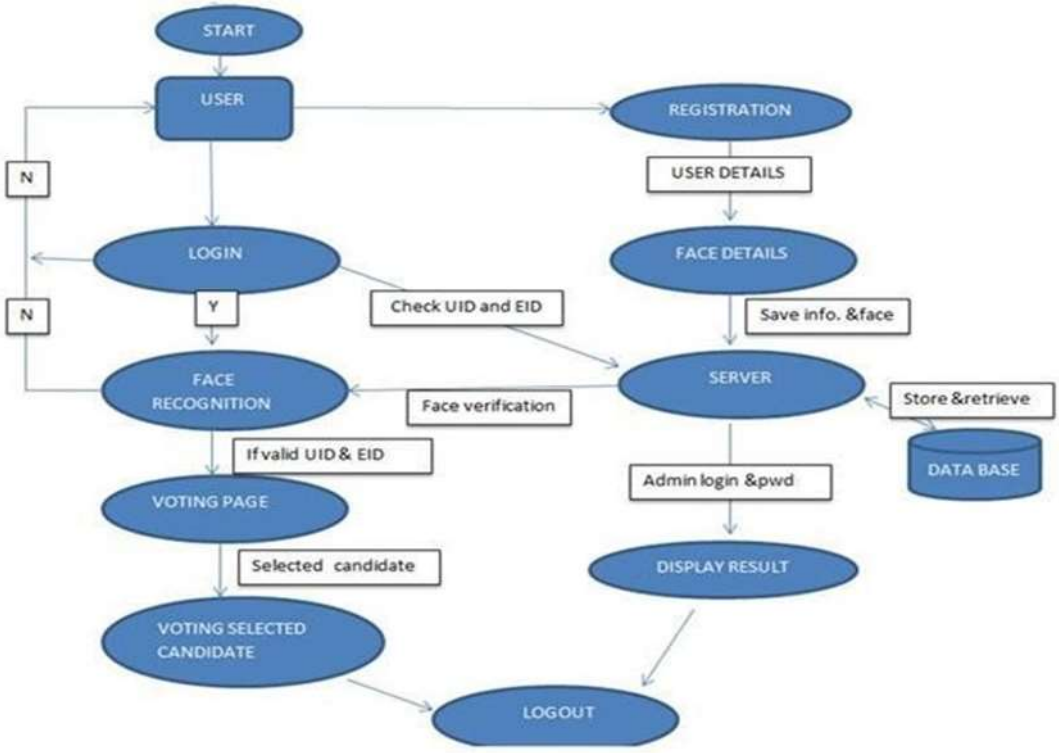

Figure 2: Voting system Architecture

The system begins with user registration, where voter details and facial images are collected and stored securely in the database. During login, the user enters their unique ID (UID) and election ID (EID), which are verified by the server. If valid, the system performs face recognition to confirm voter identity. Upon successful authentication, the voter is directed to the voting page, where they can select their preferred candidate. The vote is securely stored in the database, and results are compiled and displayed by the server. Finally, the process ends with logout, ensuring security and transparency throughout.

5. Conclusion

The proposed Face Recognition-Based Voting System offers a modern and secure alternative to traditional voting methods, addressing the shortcomings of paper ballots and electronic voting machines. By integrating a three-level verification process—user ID authentication, voter ID validation, and

biometric face recognition—the system ensures that only legitimate voters can cast their votes, thereby eliminating impersonation, multiple voting, and other fraudulent practices. The use of the Haar Cascade algorithm for face detection, coupled with centralized and encrypted data storage, significantly enhances both accuracy and security.

Beyond security, the system improves efficiency by automating authentication and vote counting, reducing the need for manpower and minimizing human errors. Real-time result generation and digital audit trails further promote transparency and strengthen public trust in the electoral process. Moreover, the system provides greater accessibility by enabling remote participation, which benefits elderly, physically challenged, and geographically distant voters.

In conclusion, the proposed system demonstrates that integrating biometric authentication with digital voting platforms can create a secure, efficient, transparent, and inclusive election framework. By reducing costs, enhancing voter convenience, and ensuring fair results, this solution has the potential to revolutionize the voting process and reinforce the core values of democracy.

6. Future Work

While the proposed Face Recognition-Based Voting System strengthens the security and efficiency of elections, there are still areas that can be further improved and extended in future research and development. One important direction is the integration of liveness detection techniques such as eye-blink detection, depth sensing, or infrared imaging to prevent spoofing attacks using photos or videos. Another improvement could be the adoption of deep learning-based face recognition models (e.g., CNNs, ResNet, or FaceNet) to enhance accuracy under varying lighting conditions, facial poses, or partial occlusions, which are limitations of Haar Cascade methods.

Scalability is another key aspect for future work. The system should be tested and optimized to handle large-scale national elections with millions of voters accessing the platform simultaneously, requiring robust cloud-based infrastructure and distributed databases. To further strengthen transparency, the integration of block chain technology could be explored, ensuring end-to-end verifiability of votes while maintaining voter anonymity.

Additionally, provisions can be made to extend voting to mobile and edge devices, enabling voters in remote areas or with limited internet connectivity to participate securely. Enhanced data privacy mechanisms such as homomorphic encryption or cancellable biometrics can be included to meet global privacy standards. Finally, pilot studies and real-world testing can provide valuable insights into user experience, accessibility for differently-abled individuals, and legal or ethical considerations.

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