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AI Enhanced E-Voting System Securing Elections with Face Recognition and OTP Authentication in India

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***Abstract*—** The E-Voting domain seeks to leverage technology to address these issues, enabling citizens to vote securely and conveniently while maintaining the transparency of the electoral process. Machine learning algorithms like Haar cascade and CNN will enhance the system's security, accuracy, and efficiency by leveraging data- driven approaches. Conventional voting techniques frequently encounter obstacles including identity theft, convoluted processes, and hold-ups in the processing of results. This article suggests a complex voting system that combines face recognition with One-Time Password (OTP) authentication to improve efficiency and security to overcome these problems. By utilizing machine learning techniques such as Convolutional Neural Networks (CNN) and Haar cascades, along with Python's robust libraries, the system seeks to enhance the electoral process's dependability and efficiency. By improving the process' accessibility, security, and transparency for all citizens, the solution aims to guarantee voting integrity and operational effectiveness. This sophisticated method presents a possible alternative to standard electronic voting machines, which have shown to be more labor-intensive and unreliable in democracies like India. This approach constitutes a major step in modernizing and enhancing India's political process, given the growing need for secure electronic services and the difficulty of low voter turnout owing to regional mobility.

***Keywords*—** Machine Learning, OTP verification, Haar-cascade Algorithm, CNN, face recognition

I. INTRODUCTION

The Online Voting System Using Face Recognition and OTP is an advanced approach that leverages the latest technology to ensure convenience, security, and precision in electoral processes. Conventional voting techniques frequently encounter problems including identity theft, convoluted processes, and hold-ups in the processing of results. By utilizing face recognition and One-Time Password (OTP) authentication, this system seeks to address these issues and offer a more efficient and safe voting process. The system's dependability and efficiency will be improved using machine learning techniques like CNN and Haar cascade, which are made possible by Python's robust libraries. Using these technologies, this solution seeks to ensure the integrity and efficient operation of the electoral process by improving voting accessibility, security, and transparency for all citizens. Election results are heavily influenced by the voting method in democracies like India. The Indian Election Commission has historically used electronic voting machines, which are less reliable, require more labor, and take longer. Elections, as we all know, are a fundamental democratic procedure that lets voters express their thoughts by choosing a candidate. India is investing enormous sums of money to upgrade the entire voting system to give its citizens better governance [5-9].

For India to have a more robust democracy, the voting process needs to be honest, open, and completely safe. The existing voting procedures are vulnerable to fraud and cheating during the voting process and frequently lack transparency. A more sophisticated voting system is required considering important issues including securing the voting process, protecting voter data, and confirming voter IDs. Demand for safe electronic services, such as electronic voting, is rising as internet and contemporary communication technologies become more widely available. Elections can be made much better by incorporating modern technologies into the voting process, which would increase accessibility and efficiency. For example, many people left their hometowns where they still had active voter IDs after industrialization and relocated to cities in search of employment. These people frequently are unable to return to their hometowns on election day, which lowers voter turnout. The country's declining voting rates are mostly due to this circumstance, for which the administration has been actively looking for the best way to find a solution.

There are significant disadvantages to traditional voting techniques, which rely on tangible components such voting papers, polling places, and administrators. These include voters who live far from their designated polling places and the high cost of setting up voting locations. A more contemporary strategy that uses online and electronic voting could provide a more effective and inclusive voting experience for all citizens.

The e-voting system is a practicable the advantages from cryptographic algorithms. Everyone can add in the election over the globally, and thus increasing the rate of e-voting.

Ensuring the confidentiality of the candidates and the accuracy of the votes is the major objective of a secure electronic voting system. There are two types of electronic voting:

(a) Poll-booth e-voting,

(b) remote internet voting.

Although the cost of erecting ballot booths remains unresolved, the category eliminated the distance problem generated for those who are far from their voter. Our electronic voting method prioritizes the category where the problems of money and distance are resolved. We rely on that as the source for any suggested electronic voting system in our system.

LITERATURE SURVEY

Online voting systems offer increased accessibility and convenience, potentially leading to higher voter turnout and cost savings through streamlined processes.

Y. Vijaya Lakshmi1, V. Amrutha [1] The primary objective of this study is in terms of security, the voting problem has not been resolved. The main component of this system is a web-based voting decision tool that utilizes Gmail verification and facial recognition software. Fundamentally, online voting systems limit the number of times a person can vote, ensuring that their vote counts. They also discuss the possibility of including other aspects, such details about the policies put in place by political parties, so that voters can base their decisions more intelligently. This strategy highlights how crucial voting knowledge and transparency are in the internet era.

The authors Nidhi Nagoju and Eaga Bhargava Chakravarthi [2] suggest that an E-Voting website be integrated with the conventional electronic voting machine (EVM) to boost both security and performance. Using a secure interlocking mechanism, their system maintains votes on both a server and the EVM, guaranteeing a trustworthy and impenetrable voting process. To confirm voters' identities against recorded data, the EVM's hardware configuration includes extra security elements including a fingerprint sensor and a web camera. The upgraded EVM setup's efficacy when combined with the E-Voting website is demonstrated by the test results the authors present, verifying the setup's ability to offer a more effective

and safe electronic voting solution.

In their analysis of the Republic of Iraq's present voting system, Wasan Salman and Viktor Yakovlev [3] find several crucial problems with both its overall efficiency and security. According to their study, there are serious flaws in the current system that jeopardize the fairness of the voting process. They recommend implementing information and communication technologies (ICT) that comply with international standards to upgrade the voting system to address these issues. The authors contend that the implementation of an online voting system would provide a new degree of security and trust between Iraqi citizens and the administration. This shift is thought to be crucial for resolving the current problems and improving the nation's voting process's general dependability and transparency.

Using the Selene protocol, Muntadher Sallal and Steve Schneider [4] suggest a method for progressively moving to an online voting system that includes a verifiability layer. To create an entirely transparent and verifiable electronic voting system, their strategy focuses on improving an already-existing system that depends on a reliable third party. Because distributed ledger technology (DLT) enables the decentralized management of verifiability data, the authors stress the significance of DLT in their implementation. Using DLT, the voting process is kept safe and transparent for all participants, enhancing the system's resilience and reliability. Their research demonstrates how the integrity and openness of online voting systems may be greatly enhanced by making little adjustments and utilizing cutting-edge cryptographic techniques.

Ramya Govindarajan Kumaresan P and K. Sree Harshith [5] draw attention to the drawbacks and difficulties of conventional manual voting systems, which frequently require voters to appear in person at polling places to cast their ballots. They draw attention to the fact that manual voting procedures are not only laborious but also vulnerable to fraud and manipulation, which could jeopardize the accuracy of the election results. The authors suggest an online voting system that uses digital technology to improve election security and efficiency as a solution to these problems. According to their analysis, switching from a manual to a digital voting method may considerably lower the risk of fraud while also increasing voter convenience.

Siripurapu Lakshmi Rikwith et al. [6] investigate how incorporating AI-powered biometric technologies, such as facial and fingerprint recognition, can improve Electronic Voting Machine (EVM) performance. This strategy aims to strengthen voter authentication and lower fraud in democracies where electronic voting machines are essential to elections. The system seeks to improve the security and dependability of elections by employing AI to confirm voter identity, demonstrating the technology's promise in vital public functions like voting.

By enabling voters to cast their ballots remotely from any location with internet access, online voting methods improve accessibility and eliminate obstacles like mobility and distance. They offer convenience, enabling voters to participate at their convenience and potentially increasing voter turnout. Additionally, online voting can streamline election processes, reducing administrative costs and expediting result tabulation. By leveraging technology, online voting systems promote efficiency, adaptability to evolving technological advancements, and environmental sustainability by reducing paper usage and waste.

II. PRESENT METHODOLOGY

Before using the system, the user needs to register by providing details such their age, city, mobile number, Aadhar number, and password. This data is included in the voter dataset. A camera is used by the system to take an input picture of a person when they register. This picture is retained in the face dataset to comply with templates. They can then cast a ballot after entering their Aadhar number and password to log into the system. Next, a security question needs to be answered by the user. The user proceeds to the next page, where they can select which candidate to vote for, assuming the verification process is successful. The camera activates and compares the user's face to the dataset after the vote button is pressed. An OTP will be delivered to the registered mobile phone number of the user upon successful confirmation of the face verification. If the OTP is confirmed, then the vote is successful.

A. MODULES:

1. Voter (User): Voters are crucial in this case because they choose which candidate to support. The voter is a confirmed user who has been given admin permission to vote.

2. ML Process: The purpose of machine learning is to teach voter faces to recognize voting times for candidates.

3. Face and OTP Verification: The suggested architecture states that there are two methods of voting-time authentication: facial recognition and OTP verification.

B. SOFTWARE INFORMATION:

1. **PYTHON:** Python is a programming language known for its emphasis on readability, using indentation and whitespace to clearly define code structure. It's simple and intuitive syntax, along with its object-oriented principles, makes it easier for developers to write clean and understandable code for both small and large projects. Python is dynamically typed, meaning variables do not need explicit declarations, and it includes automatic memory management through garbage collection. It supports various programming styles, such as procedural, object-oriented, and functional programming. Python is often referred to as a "batteries-included" language because it comes with a rich standard library that provides tools and modules for many common tasks right out of the box.

2. **ANACONDA:** Python and R programming are computer languages that are specifically designed for scientific computing tasks including data science, machine learning, large-scale data processing, and predictive analytics. Anaconda is a free, open-source distribution company that offers these languages. Its goal is to make managing and deploying environments and packages easier. Numerous data science packages that work with Windows, Linux, and macOS are included with Anaconda. Conda, the package manager included with Anaconda, proved to be so beneficial that it was separated into its own open-source project, enabling it to be utilized for a variety of purposes and without Python. Additionally, there is a simple alternative to Anaconda called Miniconda, which is a lightweight version of Anaconda that just requires the installation of a few necessary programs, conda, Python, and their dependencies. The block diagram of online voting system is shown in figure 1.

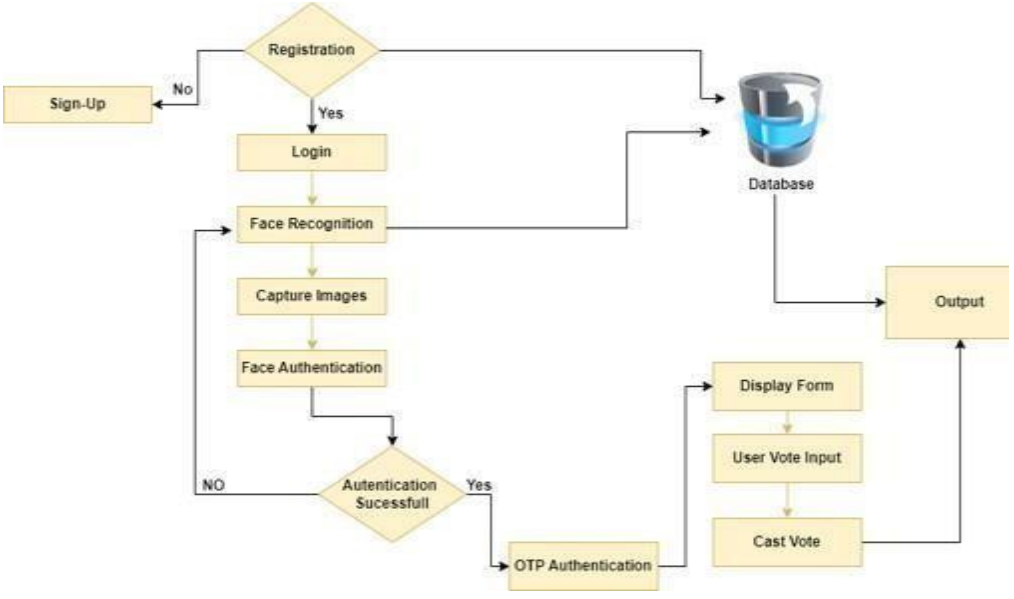

Fig. 1: Block Diagram of Voting System

III. IMPLEMENTATION AND RESULT

1. Testing and Deployment: Conduct comprehensive testing to confirm the accuracy, security, and functionality of the system. Test the system's scalability and speed to make sure it can handle a lot of users at once. Install the system on a robust and secure infrastructure, considering things like disaster recovery plans, server capacity, and data backup options.

2. Face Recognition: For tasks like face identification, feature extraction, and matching, choose a suitable face recognition algorithm or library, such OpenCV or dlib. Create the facial recognition module so that voters' identities

can be confirmed using the biometric information they registered. To make sure the face recognition system produces accurate and consistent results, test and refine it.

3. OTP Authentication: Provide a mechanism that allows each voter to receive a unique One-Time Password (OTP). Provide a safe way for voters to receive these OTPs via email addresses or registered cell phones. Create an authentication module to confirm the OTPs voters provide when logging in.

4. Login Page

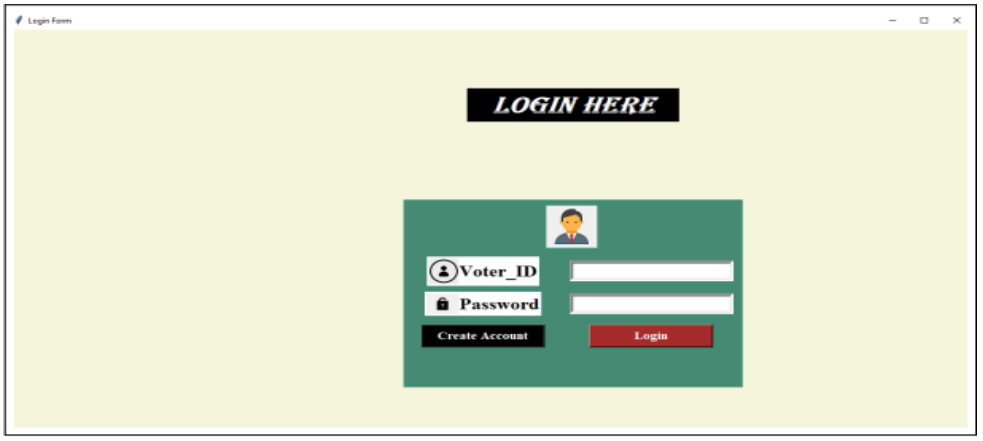

Fig.2: Login Page

The platform's login page (Figure 2) serves as the point of entry for authorized users. Typically, it has places where users can enter credentials like their email address or login and password. The page was created with security in mind, and encryption is used to protect user data while it is being transmitted. To assist users who experience login difficulties, it frequently offers choices for password resets and account recovery. The page may additionally include multi-factor authentication and CAPTCHA verification to improve security and user experience. In conclusion, the login page plays a crucial role in guaranteeing user privacy and data integrity protection while offering safe access to the online voting system.

Registration Page

Fig.3: Registration Page

The registration page (Figure 3) of a remote voting system is where eligible users sign up to participate in the voting process. The registration page collects personal details like name, address, date of birth, and sometimes identification documents to confirm eligibility. It usually involves setting up a unique username and password for future access. To prevent fraudulent registrations, security features such as CAPTCHA and email verification may be used. The page must also adhere to data protection regulations to safeguard users' privacy and confidentiality.

GUI Main

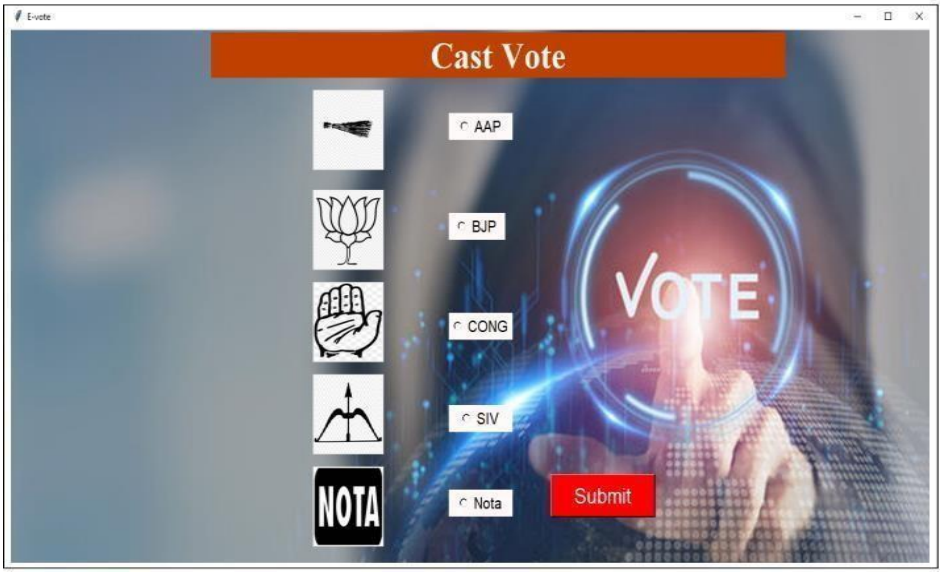

Fig.4: GUI Main

The GUI main screen (Figure 4) ensures user-friendliness and accessibility, providing clear navigation and instructions for various voting- related actions. Essential security features like face recognition and OTP verification are integrated seamlessly within the GUI to maintain the integrity and security of the voting process. Once logged in, users are presented with a dashboard that displays essential election information, their voting status, and details about upcoming elections. The voting interface itself is straightforward, guiding voters through the process of selecting candidates, reviewing choices, and casting votes. To accommodate users with various needs, the GUI also includes accessibility capabilities including font size adjustments, screen readers, and high contrast settings. Real-time feedback is provided to confirm successful logins, completed registrations, and submitted votes, enhancing user confidence and overall experience.

Haar Cascade Algorithm

Haar cascade classifiers are used in face detection, a crucial step in face recognition systems. In an online voting system, this technology could be employed to verify the identity of voters by capturing their facial features through webcams or uploaded images is shown in figure 5. Haar cascades work by identifying features like edges, lines, and rectangles in images, making them suitable for detecting faces amidst varying backgrounds and lighting conditions This might be included into an online voting system to improve security and stop fraud. For face detection, the classifier is trained on images containing faces (positive examples) and images without faces (negative examples). The algorithm extracts feature from these images using Haar-like features, which are essentially small rectangular regions with intensity differences.

Fig.5: Face detection using Haar Cascade Classifier

CONCLUSION

The implementation of an online voting system presents a promising avenue for enhancing democratic participation and efficiency in electoral processes. By leveraging digital technologies, such a system offers increased accessibility, convenience, and flexibility for voters, potentially leading to higher turnout rates. Additionally, it can expedite the voting process, saving money and lowering administrative demands related to conventional procedures.

However, ensuring the security, integrity, and privacy of online voting remains paramount, necessitating robust authentication measures and encryption protocols. Additionally, comprehensive testing, auditing, and ongoing monitoring are essential to mitigate risks of cyber threats and tampering. While challenges persist, the potential benefits of an online voting system are considerable, promising a more inclusive and resilient democratic framework for the future.

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