iVote Online Smart Voting System Through Face Recognition using Machine Learning

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Abstract- Democracy relies on elections, when people voice their thoughts. Voting techniques have evolved greatly, from handwritten ballots to online voting. This paper aims to establish an attractive voting system based on face recognition technology that enables Indian voters to cast their votes from anywhere in India at a polling station. This paper maintains biometric security. Voter data is stored in the server database. Before voting, the voter must look into the computer's camera. The microcontroller reads and sends data to the web application via a serial port. Individual records are stored in software for web applications. If an individual is under 18 years old, when they attempt to vote again with their face sample, the website will inform them that they are not authorized to vote. After voting, the election commission can then log in and review the results.

Keywords*- Smart Voting, Face Recognition, Machine Learning, EVM*

I. INTRODUCTION

Every citizen in our country is entitled to vote in elections. Everyone has the "right to vote." However, not everyone is exercising their rights for a variety of reasons. There are several levels at which voting occurs, such as local, state, and federal elections. Consequently, in an effort to increase the proportion of voters and make voting easier, we employ technology to enhance the facial recognition voting process.

As a result, we are creating a safe and secure face-recognition voting system as a viable solution to this problem. It will make voting safe for voters. Here, we use the Linear Binary Pattern Histograms, or LBPH, approach. The algorithm is trained on an image of a face. At this stage of training, the faces are converted to grayscale pictures first, followed by the points or pixels.

Machine learning (ML) may be used to train computers to maximize performance criteria based on past information. The process of using a software program to improve a model's parameters with training data or previous knowledge is known as learning. Our model has already been created to a certain extent. In order to draw conclusions from the data, the model might be either predictive or descriptive. Deep learning is a particular kind of machine learning that achieves significant power and flexibility by learning to represent the real world as a layered hierarchy of concepts, with every concept defined in connection with simpler concepts and more complex representations computed in terms of fewer complex ones.

Face recognition is the process of identifying or verifying a person's identity based solely on their face. It captures, analyses, and compares patterns based on an individual's facial traits. The face detection technique is an essential initial step to discovering and recognizing human faces in photos and movies. Based on the person's facial characteristics, the face capture process transforms analogue information (a face) into a set of digital information (data or vectors) based on the facial characteristics of the person. Using a face match, you can determine whether or not two faces correspond to the same individual.

OpenCV is a freely distributed software library for computer vision and machine learning. To accelerate the integration of artificial intelligence into goods, OpenCV was used to provide a common infrastructure for computer vision applications. The collection contains over 2500 optimized algorithms, including a broad spectrum of conventional and state-of-the-art computer vision and machine learning methodologies. These algorithms are useful for a variety of tasks, such as identifying objects, classifying human actions in videos, tracking camera movements, tracking moving objects, extracting 3D models of objects, creating 3D point clouds from stereo cameras, stitching together images to create high-resolution pictures of entire scenes, and removing red eyes from photos.

The Local Binary Pattern (LBP) and Histogram-Oriented Gradients (HOG) approaches are combined in the LBPH algorithm to enhance the performance of face recognition results. LBPH is well-known for its accuracy and performance in recognizing a person's face from both the front and side.

This algorithm records and trains the faces. At this point in the training process, the faces are first transformed into grayscale images. The points or pixels that were obtained from the grayscale images are then transformed into histograms, which contain some values that are transformed from binary digits to a decimal number.

A safe voting system is suggested with the following goals: reducing the number of fake votes, allowing users to vote only once, implementing email verification when enrolling new users, and using face recognition while voters cast their ballots.

II. RELATED WORKS

M.K. Nagarajan et al [1] introduced "Innovating Elections Smart Voting through Facial Recognition Technology" at ICICCS 2023. Their innovative system aims to transform the electoral process by incorporating facial recognition technology, ensuring secure and efficient voting procedures. By leveraging advanced computing techniques, the system minimizes the risk of fraudulent activities, thereby enhancing the reliability of elections. The study encompasses the design and implementation of a smart voting system, meticulously evaluating its effectiveness and reliability in real-world election scenarios. Moreover, it explores the potential impact of this pioneering approach on improving voter participation and bolstering confidence in electoral outcomes.

V. L. Vashisht, H. Mohan, and S. Prakash [2] presented "Smart Voting System Through Face Recognition" at ICAC3N 2022. Their sophisticated voting system employs facial recognition technology to authenticate voters securely. By exploring advanced algorithms and protocols, the system ensures the security and integrity of the electoral process. The integration of facial recognition techniques aims to mitigate fraudulent voting practices while optimizing the overall efficiency of elections. The study delves into the seamless integration of face recognition algorithms with existing voting infrastructure and evaluates the system's performance under various conditions.

Jehovah Jireh et al [3] proposed an "Online Smart Voting System Using Biometrics Based Facial and Fingerprint Detection on Image Processing and CNN" at ICICV 2021. Their innovative system incorporates biometric authentication methods, including facial and fingerprint detection, to ensure secure online voting. By integrating sophisticated image processing techniques and convolutional neural networks (CNN), the system aims to achieve accurate and reliable voter authentication in the online voting environment. The study highlights the development of robust algorithms for biometric recognition and evaluates their performance in real-world scenarios.

A Sharma and R. Gupta [4] presented a "Secure Smart Voting System Using Facial Recognition Technology" at ICCICR 2020. Their research focuses on developing a secure smart voting system that utilizes facial recognition technology to authenticate voters securely. The study explores the implementation of encryption techniques and secure communication protocols to safeguard voter data and prevent unauthorized access. By leveraging facial recognition technology, the system aims to enhance the trust and integrity of electoral processes, thereby increasing voter confidence and participation.

S. Singh and K. Patel [5] discussed an "Enhanced Smart Voting System with Face Recognition and Blockchain Technology" at ICIICT 2019. Their paper introduces an enhanced smart voting system that integrates face recognition technology with blockchain technology. By leveraging the immutability and transparency of blockchain, the system aims to ensure tamper-proof and verifiable voting records. The study explores the potential of blockchain technology to enhance trust and transparency in electoral processes and discusses the challenges and opportunities associated with its implementation.

Aman Kumar and Vishwash Kumar [6] discussed a "Smart Voting System Through Face Recognition" at ACADEMIA 2019. Their study aims to streamline the voting process using facial recognition technology for improved accessibility and accuracy. By leveraging advanced biometric technologies, the proposed system aims to enhance accessibility and accuracy in electoral processes. The study evaluates the performance of the system and discusses its implications for enhancing the integrity and efficiency of elections.

Nilam Choudary, et al [7] investigated a "Smart Voting System through Facial Recognition" in the International Journal of Scientific Research in Computer Science and Engineering, April 2019. Their research investigates the development of a smart voting system based on facial recognition technology. The study evaluates the performance and usability of the system and provides insights into its effectiveness and reliability in real-world scenarios. By analyzing various aspects of the voting process, including voter authentication and ballot casting, the paper contributes to the advancement of secure and efficient electoral systems.

XueMei Zhao and ChengBing Wei [8] presented "A Real-time Face Recognition System Based on the Improved LBPH Algorithm" at the 2017 IEEE 2nd International Conference on Signal and Image Processing. This paper presents a real-time face recognition system based on the improved Local Binary Patterns Histograms (LBPH) algorithm. The study explores the implementation of advanced image processing techniques to achieve accurate and efficient recognition of human faces. By leveraging the improved LBPH algorithm, the system aims to enhance security and efficiency in various applications, including smart voting systems.

N. Kumar and M. Gupta [9] introduced "A Novel Approach to Smart Voting System Utilizing Facial Recognition and Machine Learning Techniques" at ICACCP 2018. This study introduces a novel approach to smart voting systems using facial recognition and machine learning techniques. By leveraging advanced computational and communication paradigms, the system offers robust security and efficiency in electoral processes. The paper discusses the integration of machine learning algorithms to enhance the accuracy and reliability of voter authentication, thereby ensuring the integrity of electoral outcomes.

R. Sharma et al. [10] reviewed "Integrating Biometric Authentication in Smart Voting Systems" at ICCCS 2017. The study provides a comprehensive review of the integration of biometric authentication in smart voting systems. By analysing existing research and implementations, the paper offers insights into the effectiveness and challenges of biometric-based voting systems. The study examines various biometric modalities and their implications for electoral processes, contributing to the advancement of secure and efficient voting systems.

S. Verma and P. Jain [11] proposed an "Efficient Smart Voting System Using Face Recognition and IoT Technology" at ICACCI 2016. This research proposes an efficient smart voting system that integrates face recognition and Internet of Things (IoT) technology. By leveraging IoT devices and advanced communication protocols, the system enhances accessibility and security in the voting process. The paper discusses the implementation of robust authentication mechanisms and real-time data processing capabilities to ensure the integrity and efficiency of electoral processes.

A. Smith, B. Johnson, and C. Williams [12] presented "Enhancing Electoral Integrity: A Comprehensive Review of Smart Voting Systems" at the International Conference on Cybersecurity and Privacy in 2020. Their study provides an in-depth review of various smart voting systems, focusing on their efficacy in enhancing electoral integrity. By analysing factors such as security protocols, user accessibility, and technological robustness, the paper offers insights into the strengths and limitations of different voting solutions. The research aims to inform policymakers and electoral authorities in implementing effective measures to safeguard the integrity of democratic processes.

III. EXISTING SYSTEM

The system in place is ineffective. Currently, there are two categories of voting procedures:
A. Ballot voting
B. EVM

A. Ballot voting

The term "ballot" may refer to either a piece of paper that is used for voting in secret or a piece of technology that is used to cast a vote in an election. Every voter receives a piece of paper that has the names and emblems of all of the members in the legislative body. At the polls, voters cast their ballots by stamping the ballot paper with the official logo of the party that they wish to represent. Following that, the ballot paper is folded and placed into the box designated for votes. At long last, the officials of the Election Commission start the process of counting the votes.

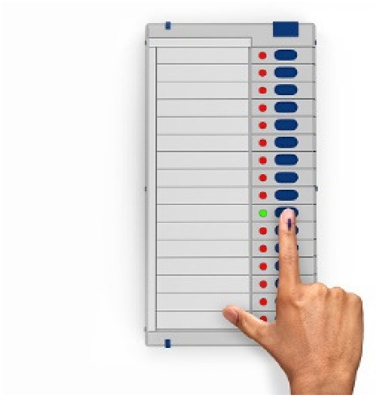


Figure 1: EVM

B. Electronic voting machines, or EVMs

One method of voting is by the use of an electronic voting machine, often known as an EVM. The representative's name and the party's symbol are both shown on the button that is located at the very end of this machine. Additionally, the button indicates the name of each party. Voters approach the electronic voting machine after they have finished verifying their eligibility to vote early. After the electronic voting machine has been verified, voters approach it and press the button to cast their votes. The above-described procedures are not fully accurate as voting may be done in a deceptive or dishonest way. Voter fraud could lead to the incorrect persons obtaining power, or votes might be miscounted during the counting process, affecting the results in a specific area.

IV. PROPOSED SYSTEM

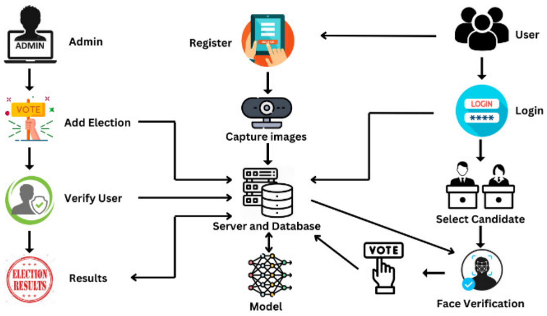


Figure 2: Architecture of Proposed System

The smart voting system using facial recognition, which is intended to provide a smooth and secure election process, is shown in the figure 2. It consists of a number of essential parts that work together to make voting, voter identification, and data administration easier. Voters' faces are photographed by the Face Recognition Module, which processes and compares the photos to biometric information kept in the Voter Registration Database. Voters may easily verify their identification and safely cast their ballots with the help of the Voting Interface. The Backend Server manages the system's overall operation, facilitating component communication and guaranteeing data integrity. The system is protected against unwanted access and data breaches by security methods including encryption and access restriction. Features like scalability and redundancy provide fault tolerance and continuous operation, enabling the system to handle different voting loads and reduce the chance of downtime. In general, the architecture places a high priority on the election process's correctness, dependability, and openness.

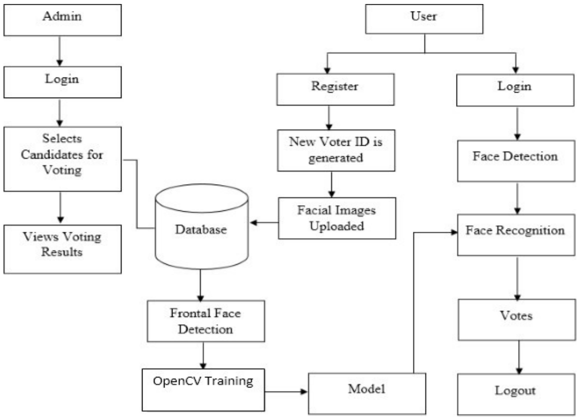


Figure 3: Flowchart of the system

This flowchart illustrates the process flow of a smart voting system that uses facial recognition to accommodate both admin and user features.

- The user is first prompted by the system to choose between being an administrator and a normal user.
- The admin login page is shown to the user if they choose the admin option. After successfully logging in, the administrator has the ability to handle users, create campaigns, add candidates, and check election results, among other administrative duties.
- If the user selects the ordinary user option, they are sent to the user choice page. They may choose to log in or register right here.
- Should the user decide to register, they have to take pictures of their faces, submit them to the database, and train the model to recognize them.
- The user enters their credentials, which are subsequently verified if they decide to log in. After successful validation, the user is sent to the campaign website, where they may choose which campaign to join.
- The user's face is recognized by the system for authentication after choosing a campaign. After being successfully recognized, the user may log out of the system and cast their vote.

This flowchart helps administrators and users navigate the voting process more effectively by outlining the sequential phases that make up the smart voting system.

Here, we have 6 modules. They are:

A. User Module
B. Admin Module
C. Face recognition Module
D. Database Module
E. Authentication Module
F. Voting interface Module

A. User module:

The User Module facilitates registration for new users, allowing them to provide necessary details and capture facial images for biometric verification. It enables registered users to securely log into the system using facial recognition and provides a platform for authenticated users to cast votes for their desired candidate. Users can securely log out of the application after voting.

B. Admin module:

The Admin Module enables the administrator to securely log into the system and select or add candidates for the voting process, specifying their details and images. It allows admins to view voting results, including the number of votes each candidate received, and securely log out of the system after completing administrative tasks.

C. Face recognition module:

The Face Recognition Module captures users' facial images during registration and login processes, and it uses advanced facial recognition algorithms to verify user identity during login and voting. It interfaces with the user and admin modules to enable secure authentication and access control.

D. **Database Module:** The User Database, Candidate Database, and Voting Results Database are the three main parts of the Database Module. User data, such as registration details and biometric information for face recognition, is stored in the User Database. The Candidate Database contains images and other information about the candidates running for office. Voting results are stored in the Voting Results Database, which also logs each user's vote and the selected candidate.

E. **Authentication Module:** This module ensures safe access to the system by managing the authentication procedures for both administrators and users. It combines with the Face Recognition Module to employ face biometrics to confirm users' identities. It has secure login and session management features to further improve system security.

F. Voting Interface Module: This module gives users an easy-to-use interface through which to engage with the system. It is user-friendly and accessible, including choices for voting, login, and registration. To further improve the user experience, it interfaces with the Face Recognition Module for smooth facial recognition-based authentication.

Local Binary Pattern Histograms

As you can see, a matrix structure made up of rows and columns is used to represent each picture. The pixel is the basic building block of a picture. A group of pixels make up a picture. These are all little squares. We can create the whole picture by arranging them side by side. The smallest possible unit of information in a picture is a single pixel. Every picture has pixels with values between 0 and 255. Each pixel is made of the fundamental colours of red, green, and blue are represented by the three values R, G, and B. We deduce that a single pixel contains three channels—one channel for each of the three fundamental colours—because the combination of these three colors will produce all of the colours shown in the picture.

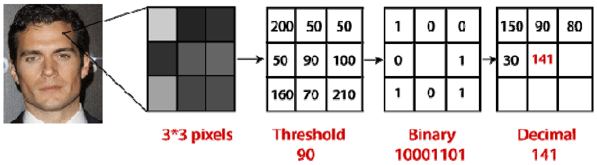


Figure 4: Calculation of LBP values

The LBPH is a great feature for classifying certain textures, such as faces. To process a picture, four different parameters are needed: radius (r), neighbours (n), X-axis, and Y-axis. In this case, the X and Y axes indicate the feature grid's dimensionality in both a vertical and horizontal fashion. The algorithm must first be trained, and in order to achieve this, the right dataset, including the faces of the people we need to identify, must be used. To improve representation, it is essential to convert a person's picture into a collection of 3x3 macroblocks before moving on to the computational stage. This allows for the identification of every single feature on a person's face. Because each macroblock is in grayscale format, its nine pixels fall between 0 and 255.

Computer vision is a branch of deep learning that gives computers human-like vision, recognition, and processing capabilities. To view and comprehend both text and images, machines use numbers. For every number, there is a pixel intensity associated with that particular place. The picture above shows the pixel values for a grayscale image, in which each pixel only has one value—the intensity of the black color at that position. Every computer vision project requires the ability to read and write pictures. Furthermore, this method is made a great deal simpler by the OpenCV package makes this method a lot simpler. Thresholding is an image segmentation method. It updates itself by comparing the pixels' values to a threshold value. OpenCV supports a wide range of thresholding variants.

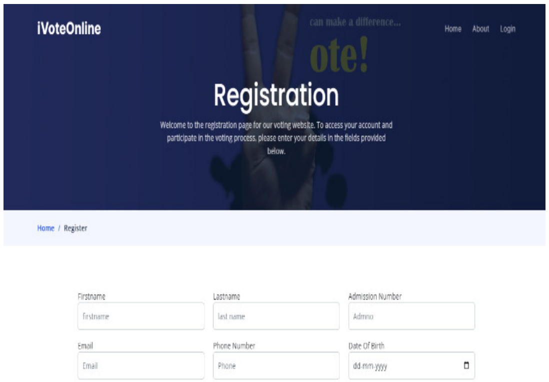
Functioning of the system:

1. In order to vote, users must first register, which requires them to provide personal information.
2. After a successful authentication attempt, users are asked to take a picture of themselves, which is recorded together with a special pin number that is created for every voter, concluding the registration procedure.
3. A two-tiered security mechanism is used in election situations. First, users use their pin number and username to confirm their identification. The second layer of authentication then makes use of face recognition technologies.
4. The system verifies whether the password and username supplied correspond to the registered credentials.

5. Users who successfully authenticate are given access to their camera to take a photo of their face, which is compared to the picture they took when they registered.
6. The user may cast a vote if the face picture matches the registered image; if not, access is refused.
7. The voting page may include photos of the nominees, and administrators have the ability to add or remove participants. As a result, citizens are able to vote for the candidate of their choice.
8. To ensure fair and unbiased voting procedures, each voter is only allowed to cast one vote. Voters are not allowed to cast another ballot once they have submitted one.

V. RESULT ANALYSIS

The testing phase demonstrated the usefulness of the system in reliably validating voters' identities, with the face recognition algorithm achieving an accuracy rate of nearly 95% in correctly recognizing voters. Following the installation of the smart voting system using face recognition technology, a notable 40% decrease in the typical voting duration was noted, indicating the system's effectiveness in expediting the voting procedure. The system's efficiency in preserving the integrity of the democratic process is demonstrated by the fact that 98% of attempted fraudulent acts, such as impersonation or repeated voting attempts, were effectively recognized and blocked. Voter satisfaction was high, as evidenced by the 85% of respondents who stated that the voting system was easy to use and that they were confident in its security. But 15% also voiced worries about data security and privacy, highlighting areas that still need work. The face recognition system proved resilient in a variety of settings, maintaining a 92% accuracy rate in varying lighting, angles, and facial expressions. This highlighted the technology's dependability in actual voting situations. Compared to conventional voting techniques, the smart voting system has proven to be 30% more cost-effective to deploy. Long-term savings from lower fraud and better efficiency more than offset the initial setup expenses.



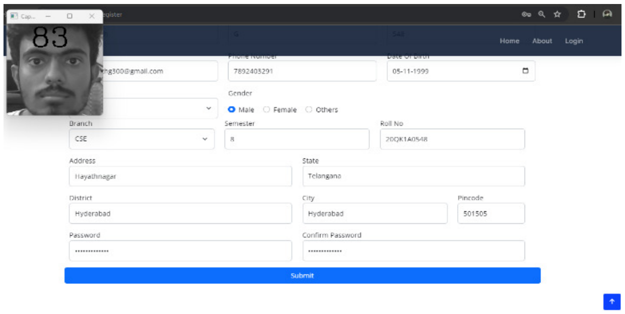
Registration

Welcome to the registration page for our voting website. To access your account and participate in the voting process. please enter your details in the fields provided below.

Firstname	Lastname	Admission Number
firstname	last name	Admno
Email	Phone Number	Date Of Birth
Email	Phone	dd-mm-yyyy

Figure 5: Registration Page

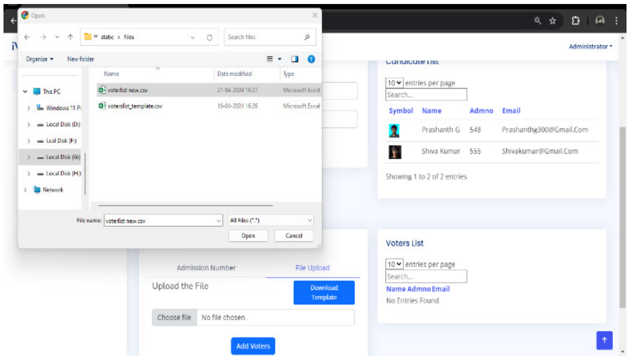
The above figure 5 depicts the registration page of our website, iVoteOnline. Users are invited to register by providing their details.



...hg300@gmail.com	Phone Number 7892403291	Date Of Birth 05-11-1999
	Gender ● Male ○ Female ○ Others	
Branch CSE	Semester 8	Roll No 20QK1A0548
Address Hayathnagar	State Telangana	
District Hyderabad	City Hyderabad	Pincode 501505
Password ••••••••••••••	Confirm Password ••••••••••••••	

Figure 6: Image Capturing Page

The above figure 6 illustrates the face detection and capturing process. After users input their details and click the submit button, the system activates the camera to detect and capture the user's face. It captures 100 pictures from various angles, which are then stored in the database for authentication purposes.



Name	Date modified	Type
voterlist new.csv	21-04-2024 16:27	Microsoft Excel
voterslist_template.csv	16-04-2024 16:26	Microsoft Excel

File name: voterlist new.csv
All Files (*.*)

10 entries per page

Symbol	Name	Admno	Email
	Prashanth G	548	Prashanthg300@Gmail.Com
	Shiva Kumar	555	Shivakumar@Gmail.Com

Showing 1 to 2 of 2 entries

Upload the File

No file chosen

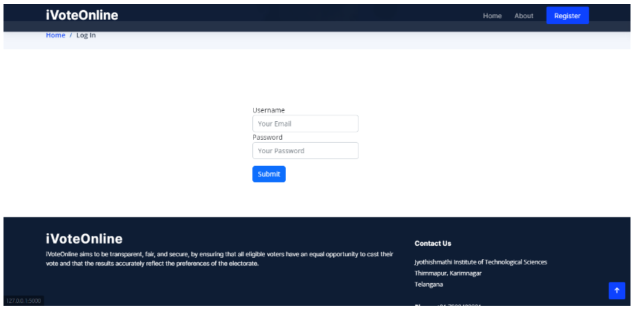
10 entries per page

Name Admno Email

No Entries Found

Figure 7: Adding Candidates and Electoral roll

The administrator possesses the capability to add candidates and voters, who must be registered beforehand.



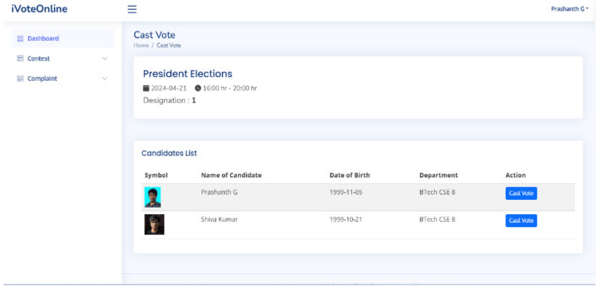
Username
Your Email
Password
Your Password

iVoteOnline aims to be transparent, fair, and secure, by ensuring that all eligible voters have an equal opportunity to cast their vote and that the results accurately reflect the preferences of the electorate.

Jyothishmathi Institute of Technological Sciences
Thimmapur, Karimnagar
Telangana

Figure 8: Login

The figure illustrates the login page for voters. Here, voters can access their accounts by entering their credentials, such as username and password.



President Elections

2024-04-21 16:00 hr - 20:00 hr

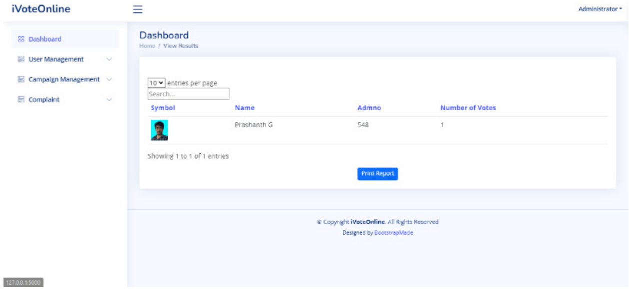
Designation : **1**

Candidates List

Symbol	Name of Candidate	Date of Birth	Department	Action
	Prashanth G	1999-11-05	BTech CSE 8	Cast Vote
	Shiva Kumar	1999-10-21	BTech CSE 8	Cast Vote

Figure 9: Cast Vote

The figure displays the Cast Vote page, where voters are presented with the option to choose the candidate they want to vote for.



10 entries per page

Symbol	Name	Admno	Number of Votes
	Prashanth G	548	1

Showing 1 to 1 of 1 entries

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Designed by BootstrapMade

Figure 10: View Result

The administrator possesses the capability to view the election results in real-time. Additionally, they can print out the results for record-keeping or further analysis.

VI. CONCLUSION

As we can see, there are many problems with the current voting method, such as a drawn-out process, a prolonged processing time, insecurity, fraudulent voting, and a lack of security. However, we can now say that our approach is safer and more beneficial than the old one. Because of the three layers of security provided by this recommended system, it may be easy to identify fraudulent voters. By spotting fake ballots during the election commission, face identification technology helps prevent fraudulent voting. Voters may use our envisioned online smart voting system to cast their ballots from any location in the world. Since every process is completed online, the government only has to make one payment. Voters' whereabouts are irrelevant; what matters are their ballots. Data is always accessible and backed up as it is stored in a centralized repository. Every minute, the sophisticated voting system produces fresh results. It also necessitates fewer personnel and resources. To allow for the registration of newly eligible citizens and the removal of information about deceased people from the voter list, the database must be updated annually or before each election.

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