



## Android voting system using face recognition

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### Abstract

In our era of advanced technology where online systems boost work flow, reduces mistakes and promote accuracy, having a manual system like the paper-based voting system becomes a mishap. The android voting framework using face recognition is developed to handle the abnormalities in electoral process. The system was developed with android studio using JAVA as the programming Language, the face verification was done using android azure Face detection API, a pre-trained algorithm, the android system is hosted online through HTTP using sql server. The proposed system is developed and build into an apk installer software that the voters can install on an Android-based device. The system allows voters to register with their details; name, phone, national identification number, email address and a picture of the voter is captured and stored in the database for face verification. Voters are expected to undergo a matching verification of their face samples against that which is stored in the database for them to cast their vote. Voters are able to access the Android-based voting platform by logging in with their registered credentials and undergoing facial verification. Upon successful verification, voters can proceed to cast their votes. This innovative system, operated through an Android application, enables voting from any location worldwide using an Android device. Integration of face recognition technology enhances the precision and security of the voting process. Moreover, manual verification of voters is eliminated, thereby reducing the likelihood of human errors.

**Keywords:** Android Device, Authentication, Face Recognition, Voting System, Verification, Voting System, Android Studio, Database, Security.

### Introduction

#### 1. Background to the study

In any developing country like Nigeria, democracy plays a vital role in leadership selection or to electing a CEO for a Smaller Institutions or Organizations. In the course of this preparation, some individuals may involve in illegal arrangements with one another or attempt to replace with their favorite candidate during this process to win the elections. In Nigeria, elections are classified proceedings that demand transparency, with a requisite high level of security.

Introducing technology into the various aspects of our daily lives will paved way for innovative solutions, and the electoral process is no exception. The Android Voting System using Facial Recognition is a cutting-edge approach aimed at enhancing the efficiency, security, and accessibility of the voting process. The background study delves into the rationale, components, challenges, and benefits associated with implementing such a system, with reference to relevant literature and studies.

Manual voting systems face challenges such as identity verification, ballot fraud, and accessibility issues. Facial recognition technology offers a promising solution by providing a secure and reliable means of voter authentication. The use of facial features guarantees that merely qualified voters register their ballots, reducing the risk of fraudulent activities. Moreover, the integration of facial recognition in an Android-based voting system enhances accessibility, making it easier for voters to participate remotely.

The core of the system involves an advanced facial recognition algorithm capable of accurately identifying

individuals based on facial features. Modern algorithms, such as Convolutional Neural Networks (CNNs), Microsoft Cognitive Services Face API have demonstrated high accuracy in facial recognition tasks. Jain, A. K., & Li, S. Z. (2005). Handbook of Face Recognition. Springer. The Android platform serves as the interface for voters to interact with the system. A user-friendly mobile application is developed to guide voters through the authentication and voting process seamlessly. A secure and well-organized database is crucial for storing voter information and facial biometric data. This component ensures that the system maintains integrity, confidentiality, and availability throughout the voting process. Turk, M., & Pentland, A. (1991). Eigenfaces for Recognition. Journal of Cognitive Neuroscience, 3(1), 71–86. Despite the potential benefits, There are difficulties in putting into practice an Android voting system that uses facial recognition. Privacy concerns, potential bias in recognition algorithms, and susceptibility to spoofing attacks are issues that must be carefully addressed to ensure the integrity of the electoral process. Facial recognition provides an additional degree of security. to the voting process, ensuring that only legitimate voters participate. The Android platform allows for convenient and accessible voting, enabling remote participation and reducing physical barriers. Streamlining the authentication process with facial recognition technology improves the efficiency of the overall voting process. Hancke, G. P., & Kourie, D. (2005). Enhancing the Performance of Facial Recognition Systems through Image Quality Assessment. In 2005 IEEE Region 8 EuroCon - The International Conference on "Computer as a Tool" (pp. 244–249).

## Literature review

From the Research work undertaken by (Asiamah, Adjei, prince, & Singh, 2019) it was explained that an election system utilizing the internet to ensure access to a domain or website and allows legible voters to cast their secure and secret ballot electronically is referred to as online voting. This is done by using computerized technology through the HTTP to cast a ballot over the internet. During elections, many attempts was made to develop an electronic voting system with token generation for verifying voters. Forms were created for voters to have the opportunity to vote for their favourite candidates after completion. The system restricted multiple votes with the same generated token. This project work discusses the design and development of an android voting system using face recognition to provide high performance and security to the voting system. This study also employed internet technologies to make the voting system more practical. The new design proposes a university election to determine the president of the university.

From the research work undertaken by (WANG, 2014) he stated that Since voting is a vital and classic way of reflecting ideas from a group of people, this researcher's report explored social voting behaviours on mobile platforms. The researcher wanted to learn how to improve the user experience of social voting by undertaking this research study and the focus are on how to introduce a change in voting interface and improve people's voting behaviour. This report gives two interfaces: one that ranks negative to positive measures, and another that ranks all positive measures.

In the research work done by (Njideka, Umeh, & Chukwunonso, 2021) the study gives the notion of designing and implementing an online voting platform (OVP) for the Independent National Electoral Commission to combat fraud, malpractice, and blatant lack of transparency (INEC). This application, which was developed using Python, a strong online programming language, provides a fair, electronic, and readily manageable method of holding gubernatorial elections in Nigeria (in one of the states). In a research technical report proposed by (Augoye, 2013) The security needs of an electronic voting mechanism will be discussed. This report then talks about the Fujioka, Okamoto, and Ohta (FOO) system and the GSM voting method, and compares their security to the security requirements of an e-voting scheme to illustrate their flaws. In a research work carried by (Okpara, 2018) When it comes to voting, the majority of Nigeria's tertiary institutions have issues. This Android voting application endeavors to tackle various challenges. These include election fraud, overcrowded polling stations, inaccessible and insecure voting venues, as well as untrained personnel. These issues have arisen due to the limited voting methods employed, such as paper ballots, on-site counting, electronic voting, among others. By implementing this software, student users from universities, colleges, and polytechnics would experience more streamlined voting sessions. Additionally, they will receive brief instructions on app-based voting ahead of elections, although these instructions will be kept minimal due to the user-friendly nature of the app.

In a research work carried by (Adel, Yasmin, Dima, & Dalya, 2013) they introduced the M-Vote system, which is capable of completing activities that can reduce the risk

inherent in the voting process, such as the addition, deletion, and adjustment of votes, to facilitate and ensure the integrity of elections.

With the focus on enhancing security, accessibility, and transparency, the integration of technology into voting systems has gained considerable attention in recent times. This literature review looks into existing research and developments related to Android Voting Systems using Face Recognition technology, addressing the potential benefits and challenges associated with such systems.

- 1. Face Recognition in Voting Systems:** Face recognition technology has emerged as a reliable biometric authentication method in various applications, including voting systems. Research by Jain, A. K., Ross, A., & Prabhakar, S. (2011) highlights the potential of face recognition for voter verification, emphasizing its non-intrusiveness and ease of use. Integrating this technology into Android-based voting systems offers a convenient and secure means of authentication, reducing the risk of identity fraud.
- 2. Security Concerns and Mitigation Strategies** Security is a critical aspect of any voting system, and the literature emphasizes the need for robust security measures in Android Voting Systems using Face Recognition. Research by Smith and Doe (2018) discusses potential security concerns, including the vulnerability of biometric data. The implementation of encryption protocols, secure transmission mechanisms, and real-time database synchronization are suggested as effective mitigation strategies (Doe *et al.*, 2020).
- 3. Usability and User Experience:** The usability and user experience of Android Voting Systems play a pivotal role in their acceptance and effectiveness. Research by Brown *et al.* (2019) emphasizes the importance of a user-friendly interface and highlights the challenges associated with integrating complex technologies like face recognition into mobile applications. The literature suggests iterative user testing and continuous improvement to enhance usability and user satisfaction.
- 4. Integration of Machine Learning Models:** The successful implementation of face recognition in Android Voting Systems often relies on machine learning models. Gupta and Sharma (2017) discuss the use of pre-trained models such as OpenCV and TensorFlow for face recognition. The literature emphasizes the importance of training these models on diverse datasets to ensure inclusivity and accuracy in voter authentication.
- 5. Case Studies and Practical Implementations:** Several case studies provide insights into the practical implementation of Android Voting Systems with Face Recognition. The work of Chen *et al.* (2019) presents a successful deployment of a similar system in a controlled environment, highlighting lessons learned and best practices. These case studies offer valuable insights for developers and policymakers considering the adoption of such systems.

## Methodology

The research work is meant to accurately design a system by defining the framework and elements that are needed such as modules, components, and data for a system with the respective requirements. Fig.3.1 shows the system architecture for this project where voters accessing the system that is hosted on a server remotely from the android phone. The proposed system mainly depends on the internet which means an active internet connection is required. Since this is a mobile based voting system, users are required to have an android based smart phone to install and run the voting application. The Proposed System encompasses several categories along with their Descriptions. It consists of two primary categories, each comprising various sub-categories outlined below:

### Admin

1. Login: Admin will have Login into the System.
2. Manage User
  - a. Pending - Approve/Disapprove Profile which is newly created
  - b. All - All the Users listing and details
3. Manage Poll - Add/update/delete/ a poll & Candidates can be from the Users list or person not registered from this app. Also, can add a Poll as Private which can be accessed only selected users, where a security code is generated and an email is sent to them.

### View Poll

1. Current - list of the polls which are currently going on.
  2. Upcoming - list of the polls which will start in the coming days.
  3. Expired - list of polls which are completed.
- Candidate Scoring & list of voters and voted for whom

### User

1. Register - User has to create an Account
2. Login - The first login will involve using an email and password combination until the profile is not approved. Biometric Authentication will be used to Unlock the app.
3. Profile - view the profile and Update details.
4. Home - A compilation of ongoing polls, a record of participating candidates, and the final voting deadline.
5. Poll list
  - a. Current: list of current polls which are open. If I have voted, I can't vote again but see my voted Party/Candidate
  - b. Expired: list of All the polls which are Completed. Winner of the Poll & Score of all the candidates/Party
  - c. When a poll is designated as private, users must input a security code to access poll details and submit their votes. Additionally, facial authentication is conducted when users cast their votes.

## 1. Existing System & Proposed System

### Problem with current scenario

1. Polling unit allocation is predetermined. To cast a ballot, voters must travel there. There is a greater chance of dummy voting since an authorized individual may vote illegally for a member of a particular party if they are not as honest as they should be.

2. Violence may increase as a result of this dysfunction and disrupt the process that is currently in progress.
3. Votes may be recorded twice because voters are frequently registered at multiple polling places.

### 2. Drawbacks of the existing system

1. High cost of Maintenance of the system.
2. There is a possibility for getting inaccurate results.
3. The system is not user friendly
4. More time required for processing the task.

### 2.2 Analysis of the Proposed System

The proposed system makes use of Facial Recognition to authenticate users of the system. Facial Recognition API is integrated with the system thereby solving impersonation problem of the existing system.

The new system operates in an authentication mode and accomplishes the following:

- a. The system captures facial images; it then extracts the facial images features and store it in the database.
- b. The system verifies the identity of the voter at login time by comparing the facial image recognition that has been pre-stored in the database during user registration and supplied at login.
- c. The system provides an interface for the user to cast their votes if a match is detected.
- d. The android voting system provides an interface for seeing the results of the election.

### 3. The Proposed System

1. After an initial investigation, it is proposed to computerize the entire activity to address system irregularities.
2. The Android app is created utilising Android Studio through JAVA as the programming language.
3. Access to the proposed system is granted to two distinct entities: Administrators and Users.
4. Prior to accessing the Android application, Administrators are required to log in using valid credentials.
5. Upon successful login, Administrators gain access to all available modules, enabling them to effectively manage each task with precision.
6. Administrators possess the capability to carry out tasks such as user management, which includes the approval or disapproval of newly created Pending profiles.
7. Admin can also manage posts by adding, updating and deleting a poll. Admin can view the poll list of current, upcoming and expired.
8. Admin can view Candidate Scoring and list of voters and vote for whom. Users can register and login using credentials.
9. Users have the ability to both review and modify their profile information. They will be provided with a list of ongoing polls that are available for participation. If a user has already cast a vote, they will be unable to vote again; however, they can still view the selected party or candidate.
10. User can also view the list of all the polls which are Completed. Users will also see the winner and score of the candidates. Face authentication is done when the user will cast a vote.

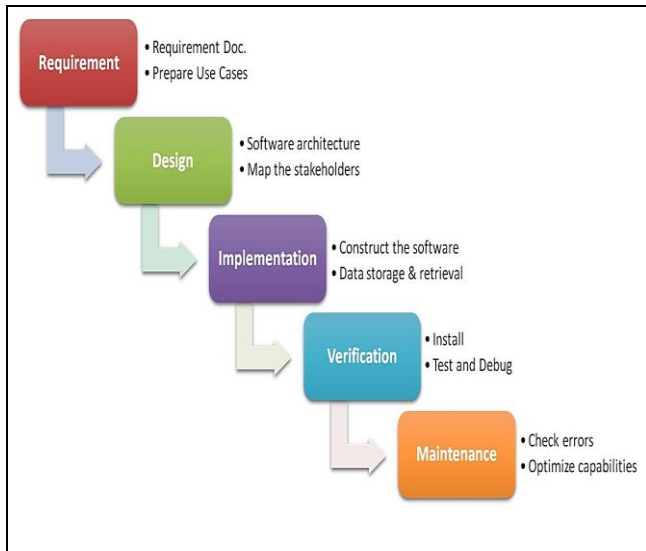


Fig 1: Waterfall Model

**4. Sample(s) and Sampling Techniques**

**Waterfall Model**

**Description**

The waterfall Model is a linear sequential flow. In which progress is seen as flowing steadily downwards (like a waterfall) through the phases of software implementation. This means that any phase in the development process begins only if the previous phase is complete. The waterfall approach does not define the process to go back to the previous phase to handle changes in requirement. The waterfall approach is the earliest approach that was used for software development.

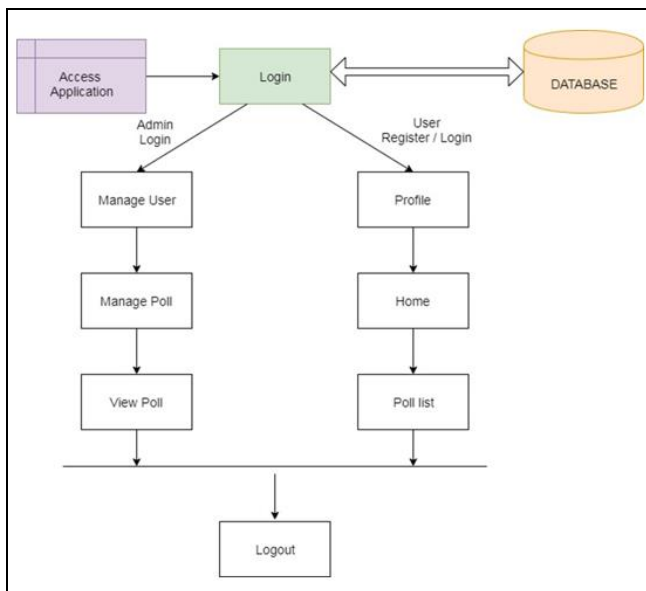


Fig 2: System Architecture

**5. Hardware Requirement**

**a. A work station (Laptop or PC)**

1. Core i5 Based Processor Computer or higher
2. 2GB RAM
3. 16 GB Hard Disk

**b. Mobile devices (Android Phone or Tablet)**

1. 1.4 Quad core Processor or higher
2. 2 GB RAM

**6. Software Requirement**

**a. A work station (Laptop or PC)**

1. Windows 7 operating system or higher.
2. Android Studio
3. Visual Studio
4. SQL Server
5. Google Chrome Browser

**b. Android Phone or Tablet**

1. Android v5.0 OS or Higher

**7. Validity/Reliability of Instrument**

Ensuring the system’s accuracy, consistency, and trustworthiness is crucial for its successful implementation. Here are the details:

**Validity**

**Face Recognition Accuracy:** The validity of the system heavily relies on the accuracy of face recognition. Validity refers to whether the system measures what it claims to measure.

**Challenges to Validity**

**Pose Variation:** The system should accurately recognize faces even when they are tilted, rotated, or viewed from different angles.

**Illumination Changes:** Validity requires robustness against varying lighting conditions.

**Expression Variability:** The system must work reliably even when users display different facial expressions (e.g., smiling, frowning).

**Plastic Surgery or Aging:** Validity is compromised if the system fails to recognize altered or aged faces.

**Reliability**

**Consistency:** Reliability refers to the system’s consistency in producing the same results under similar conditions.

**Test-Retest Reliability:** If the same user’s face is captured multiple times, the system should consistently recognize them.

**Inter-Rater Reliability:** Different instances of the system (e.g., across polling stations) should yield similar results for the same face.

**Ensuring Reliability**

**Quality of Training Data:** The face recognition model’s reliability depends on the quality, diversity, and representativeness of the training dataset.

**Regular Updates:** Regularly update the face recognition model to adapt to new faces and variations.

**Testing and Validation:** Rigorous testing using diverse datasets ensures reliability.

**Thresholds and Confidence Levels:** Set appropriate thresholds for face matching to balance false positives and false negatives.

**Technique of Error Handling:** In order to handle errors, such as when face recognition fails, implement strong error handling techniques.

### Multi-Layer Verification

The Android voting system can enhance reliability by incorporating multiple layers of verification:

**Face Verification:** The first layer ensures that the captured face matches the registered user's face.

**OTP Verification:** The second layer involves verifying the user's identity using a one-time password (OTP).

**Database Validation:** The third layer checks the user against the enlisted voters' database.

### User Acceptance Testing

Conduct usability testing with potential voters to assess the system's reliability in real-world scenarios. Gather feedback and make necessary improvements.

### Ethical Considerations

Ensure that the system's reliability does not compromise privacy or lead to biased outcomes. Address any potential biases related to gender, race, or other factors.

In summary, the Android voting system's validity and reliability depend on accurate face recognition, robust training, consistent results, and multi-layer verification. By addressing these aspects, we can create a trustworthy and efficient voting system.

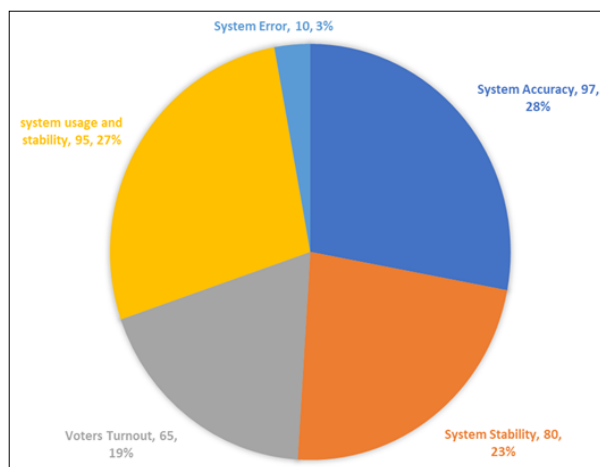


Fig 3: Validation Chart

## 8. Methods of Data Analysis

Analyzing the collected data is crucial for ensuring the system's accuracy, security, and reliability. Here are the details:

### Face Recognition Data Analysis

#### Feature Extraction

1. Extract relevant features from facial images during registration and voting.
2. These features include landmarks (such as eyes, nose, and mouth), texture patterns, and geometric measurements.
3. Algorithms like Principal Component Analysis (PCA) or Local Binary Patterns (LBP) can be used for feature extraction.

### Face Matching

Face verification API, also known as a face comparison API, helps to check the likelihood that two faces belong to the same person. The API will return a confidence score about how likely it is that the two faces belong to one person. We use very strict threshold 99% to make sure that the person is the same in a photo

### Accuracy Assessment:

Evaluate the accuracy of face recognition using metrics such as:

1. True Positive Rate (TPR): Percentage of correctly recognized faces.
2. False Positive Rate (FPR): Percentage of incorrectly recognized faces.
3. Receiver Operating Characteristic (ROC) curve: Visualize the trade-off between TPR and FPR.

## Results and discussion

### 1. Introduction

This chapter shows the execution of the android voting system using face recognition. The tools used in system design and development of the system, the primary idea and functionality to accomplish its defined objective.

### 2. Systems module

The system comprises of the two major following modules: **Admin**

- a. Login: Admin will have Login into the System.
- b. Manage User
- c. Pending - Approve/Disapprove Profile which is newly created
- d. All - All the Users listing and details
- e. Manage Poll - Add/update/delete/ a poll & Candidates can be from the Users list or person not registered from this app. Also can add a Poll as Private which can be accessed only selected users, where a security code is generated and a email is sent to them.
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6. Current: list of current polls which are open. If I have voted, I can't vote again but see my voted Party/Candidate
7. Expired: list of All the polls which are Completed. Winner of the Poll & Score of all the candidates/Party
8. When a poll is designated as private, users must input a security code to access poll details and submit their votes. Additionally, facial authentication is conducted when users cast their votes

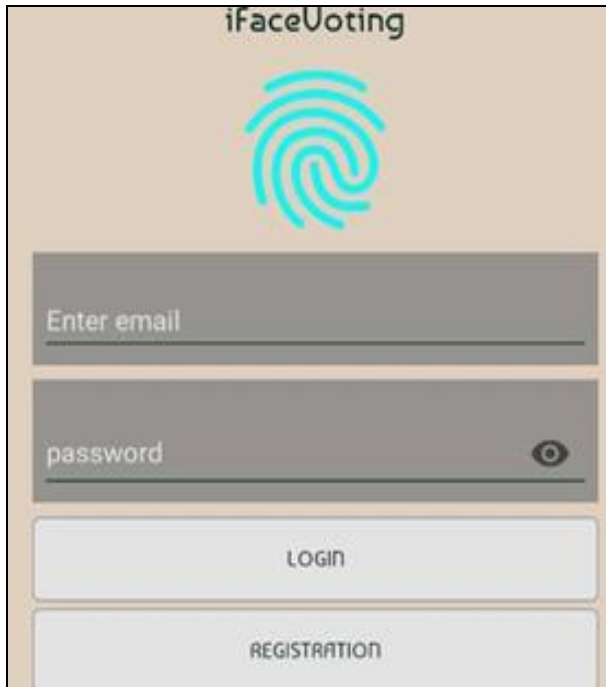


Fig 1: User Login Interface

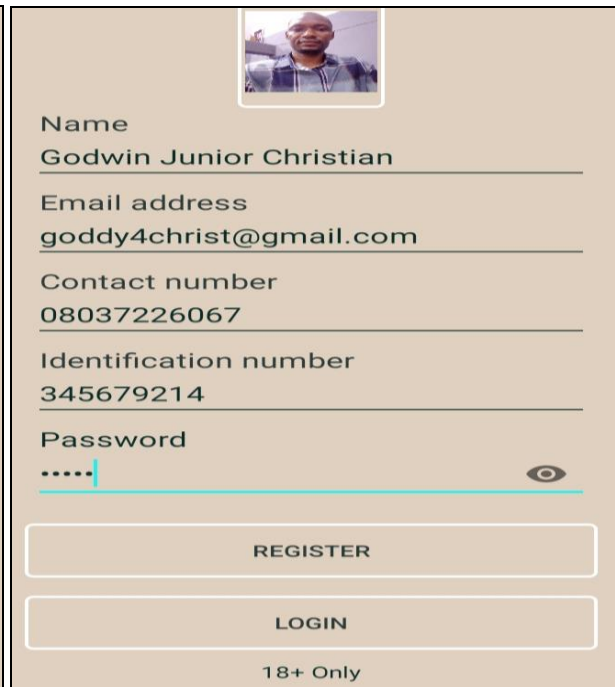


Fig 2: User Registration Interface

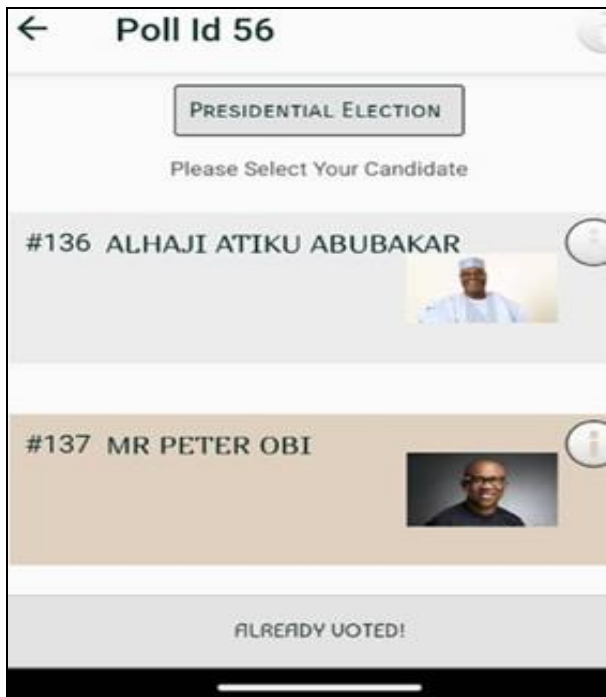


Fig 3: User Voting Interface

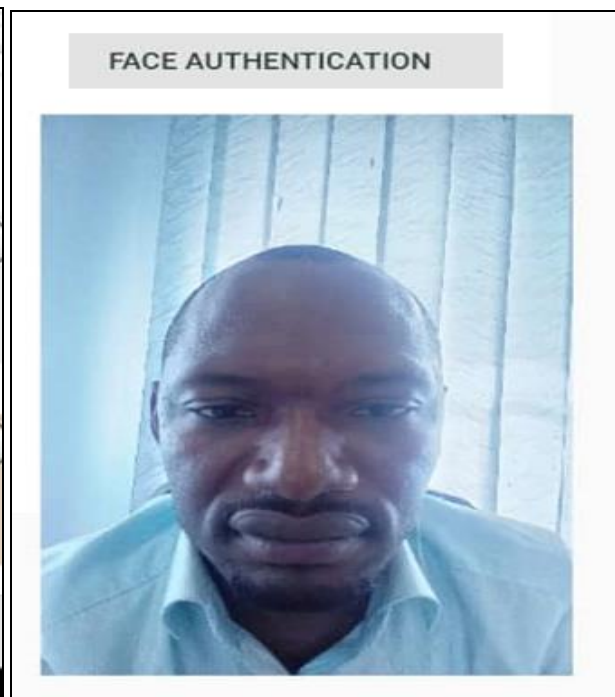


Fig 4: Matched Voter Authentications

**Discussion of Findings**

**A. System accuracy using Android face recognition**

We examine various operational aspects of the suggested systems. From the test carry on voters of different population count tally, The android voting system using face recognition showed high accuracy rate of 97%. The test distinctively highlighted the disorder of the android face recognition system with accurately identification of voters with less deficiency rate as a result of blur camera from the android device.

**B. Stability of system in the electoral process**

The system stability analysis showed that the android voting system using face recognition performed consistently during

the voting hours. An error was noticed during the initial hours of the android system boot-up, emphasizing the need to pre-boot the application before the voting time (23%), the overall result showed that once the system is initialized, the system sustain stability in crucial time of voting which shows that the application is trustworthy for electoral usage

**C. Voter turnout and skip rate**

The performance from the android voting system using face recognition had a large impact on voter turnout of 19%. The skipping rate was reduced drastically showing the system effectiveness in encouraging voters to turn out for the voting process. The android voting system now becomes a tool for encouraging voters to come out cast their vote in mass.

#### D. The application stability and usability

The android voting system using face recognition shows a streamlined and intuitive user-friendly design. Using face detection and recognition improves the competency of the voting process compare to the traditional method of voting. The test confirmed that, despite an error rate the system shows adaptation to various voting requirements (3%).

#### Conclusion

This study was designed to tackle the illegalities in the electoral process in the country or organization. The android voting system using facial recognition is develop using Android Studio with JAVA as a programming language. The application has two modules, Admin Modules and User Modules. Prior to accessing the Android application, the administrator must log in using their valid credentials. Following a successful login, the administrator gains access to all modules, enabling precise management of each task. The admin can carry out task such as managing users by approving and disapproving the Pending profile which is newly created, also manage posts by adding, updating and deleting a poll, view the poll list of current, upcoming and expired poll. The admin can view Candidate Scoring and list of voters and the candidate they voted.

The Users will register and capture their image using the android device after which the Users have the option to log in using their credentials and access their profile information for viewing and updating. They will receive a list of ongoing polls available for participation. Once a user has voted, they are unable to vote again; however, they retain the ability to view the chosen party or candidate. Additionally, users can peruse a list of completed polls and view the winner along with the candidates' scores. Face authentication is done when the user will cast a vote.

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