



# IJRASET

International Journal For Research in  
Applied Science and Engineering Technology



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# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

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**Volume:** 14    **Issue:** III    **Month of publication:** March 2026

**DOI:** <https://doi.org/10.22214/ijraset.2026.78571>

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# AI-Assisted Fingerprint Based Voting: Artificial Intelligence Techniques for Accurate and Reliable Voting

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**Abstract:** In developing countries like "INDIA", the election commission follows manual voting mechanism which is done by the electronic voting machine. But instead of this, The poll rate of India has only increased by 4 percent from 1952 to 2014. So a machine was required to automate the process and can be avail machine is placed in the poll booth center and is monitored by higher officials, due to some illegal activities the polling center are misused and people's right to has been denied. This seldom occurs in rural areas as well as in urban cities because the educated people are not interested in casting their votes to candidates who represent their respective areas. To ensure 100% voting, automation came into play. But this automated system has been approved only on some developed countries since security have not been ensured to a large extent. The poll percentage of India has never exceeded 67% till date.

This paper presents the enhancement of Electronic Voting Machine (EVM) performance using fingerprint and face recognition. In democratic countries, the EVM plays a vital role in the election process. Even though it has more benefits; still the malpractices are continued due to manual verification of electoral documents for all elections in democratic countries. In this proposed method EVM with biometric fingerprint and face recognition devices are used to overcome this problem. To conquer the issues existing in the election process for voter identification the biometric fingerprint and web cameras are introduced in the EVMs. The people at the polling booth need to put the finger in the fingerprint equipment and face to be captured by the web camera provided to recognize them. The controller fetches the data from the input devices and compares it with the database to enable the polling device to cast their votes. In practice, due to some technical issue either in the input devices or from the voter side the election process will be continued by document verification. In the polling booths, the presiding officers are having the right to enable the polling device by pressing the enable button after document verification. The performance of the proposed method was validated with EVM successfully.

**Keywords:** vote, electronic voting machine, aadhar card, finger prints, voter id, Electronic voting, Fingers, Databases, Authentication, Mobile communication

## I. INTRODUCTION

A Fingerprint Voting System is an innovative approach to enhance the voting process by using biometric authentication. This system ensures secure, efficient, and tamper-proof voting by uniquely identifying individuals based on their fingerprints. The main objective is to overcome the drawbacks of traditional voting methods, such as impersonation, invalid votes, and low voter turnout. In this world, most of the countries are under democratic systems for decentralizing the governancetomeet equal rights to all peoples. Twenty years back all the countries followed the ballot paper system for the election process. In this process every country facing various problems like malpractice, more time consumption for voting as well as counting, and more expensive. To overcome these problems especially like India introduced the EVM for conducting a smooth and fair election.

With less time consumption and low cost. Initially, most of the political parties objecting the EVM system. Later the election commission takes necessary action to create awareness about the EVM mechanism. Even though, the election commission gave a lot of explanations still some of the parties were unable to understand or accept the E-Voting systems rather than the ballot paper method. In this regard, the government has to increase the performance of the EVM to prove reliability, security, and safety in the election process. However, the EVM play a vital role in the Election Commission of India to conduct the smooth and fair election for various setups like Parliament election, Assembly election, and Local body's election.

## II. LITERATURE REVIEW

Kumar [1] has described a review of the electronic voting machine process. Bohli et al,[2] have discussed the enhancement of performance of the voting machine with an example of bingo voting. Another one of the researchers tried to reduce the trust in EVM using trusted platforms with various techniques [3]. Antonyan et al,[4] have discussed the optical scanning system for voter's data verification to ensure the reliability of the E-voting system. The same type of research continues to enhance the performance of EVM, in this point of viewing artificial neural network techniques with support vector machine is introduced and tested in the election process [5]. Likewise, [6]-[10] various researcher spending their valuable effort to enhance the efficacy of the EVM by making solar-powered and tensor voting with a closed forum. Randhawa et al, [11] have discussed the majority of voting with innovated detection techniques. In this manner, [12]-[15] Arduino controller is used for making smart E-Voting machine with various features like voters document verification, safety and security, and less cost. Most of the researchers still they are putting in their valuable time and effort to enhance the performance of EVM in various aspects.

In this regard, the safety and security of EVM are very important because people still doubt the EVM process. Scientists and young engineers are involved more to design powerful voting machines by reducing all types of drawbacks [16]-[20]. Blockchain technology was also introduced in the development of high secured E-Voting machines. Even though, this latest technique has some benefits the executing time is more and unreliability [21]-[22]. Manoharan, J. Samuel [23] have discussed layer cloud security model with fingerprint biometric traits. Here the fingerprint biometric traits are used to make a security system of cloud access by different users. Akey Sungheetha and Rajesh Sharma [24] have proposed a machine learning technique for 3D image processing to interact with man-machine. Sayantan Dutta and Ayan Banerjee [25] have described the latest optimization technique for image fusion. Recently, the biometrics access controls play a vital role in the view of the authentication process for various sectors. This technology is widely used for analyzing and measuring the biological data for human body characteristics [26]. However, fingerprint and face recognition are not implemented in EVM so far in the literature. To overcome the limitations in the conventional EVM latest smart devices are introduced.

In this paper, fingerprint and face recognition techniques are embedded with EVM to enhance the performance of the E-Voting system. The technology has brought drastic changes in almost every field; the election process is not an exemption from this technology. People are expecting to make their work easy, fast, and accurate. The conventional paper ballot-based voting system is simple but it is not transparent and error-free.

### A. System Configuration of EVM

The EVM consists of components such as a Raspberry Pi Board, Fingerprint Scanner, Web camera, LCD Monitor, and momentary push buttons integrated using breadboard and programming using Python programming language. The UI component is used for the configuration of the EVM device, by providing the initial values and commands needed. The designed EVM units are kept under the supervision of booth-level officers in election counters throughout the election process. The device must operate independently and interact via the wireless network with the central database to authenticate voters. Citizens can visit one of the counters and exercise their voting rights. The Raspberry Pi microcontroller is the brain of the EVM. All other integrated devices are controlled by this controller. The Raspberry pi 3 microcontrollers as shown in Fig.1

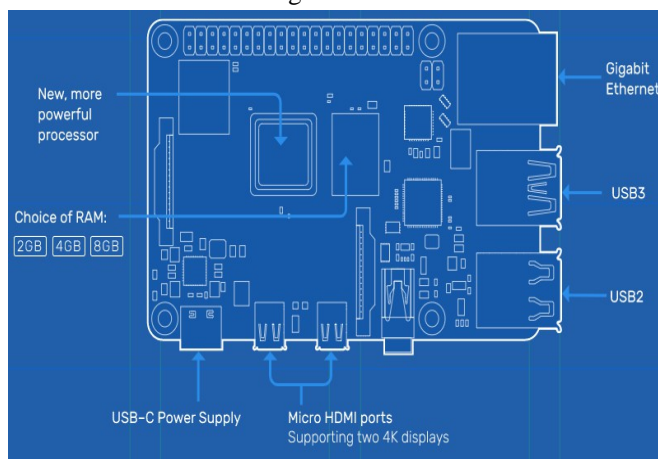


Fig. 1 Raspberry Pi 3 Circuit Diagram

### III. PROPOSED SYSTEM DESCRIPTION

In the proposed system, whenever a voter comes to cast their vote initially the name of the voter will be entered. Then the web camera will take the picture of the voter. It runs the face recognition of the voter in the database. If it is found and matched with the existing data in the server then the voter is permitted to cast their vote. If the face recognition in the database fails the voter has to put their thumb impression. The given thumb is searched in the database and if it is found and matched with the server data after that the voter is permitted to cast their vote. If the thumb impression in the database fails the voter has to verify their documents manually. If the documents are verified and if the voter is an authorized person then the voter is permitted to cast their vote. Fig.2 represents the function of EVM in the form of a flow chart.

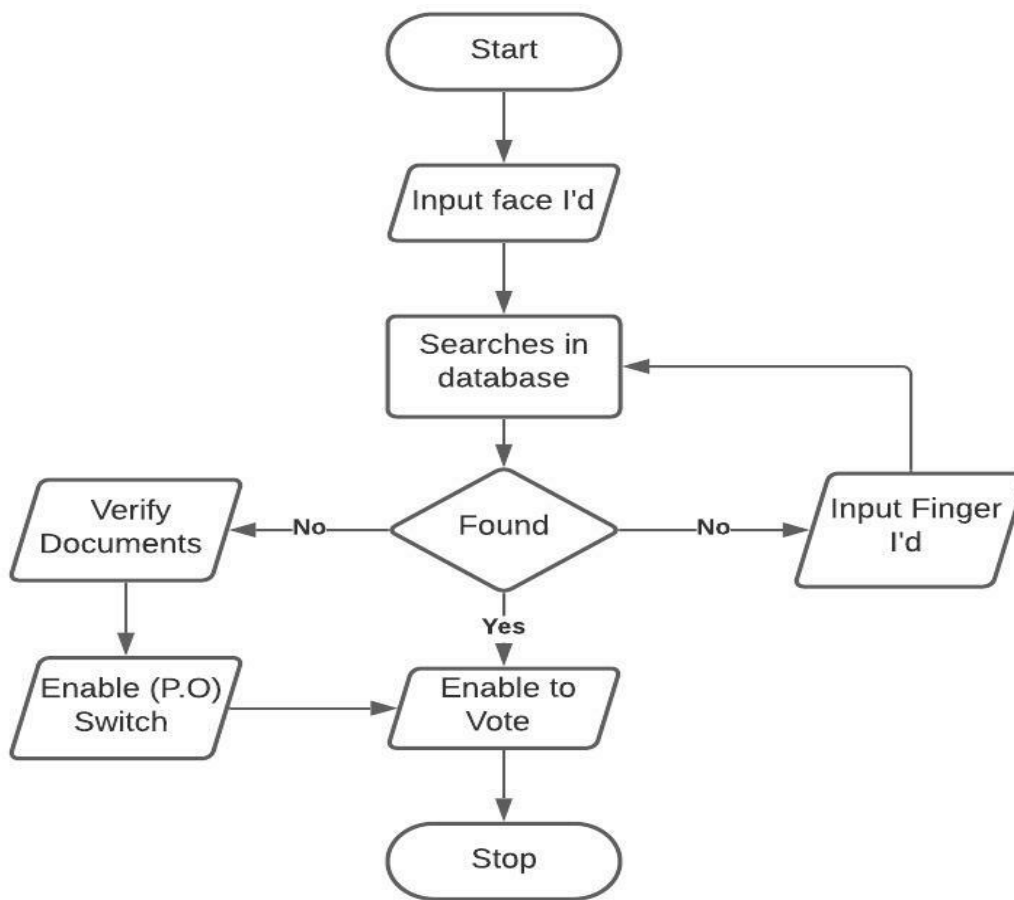


Fig. 2 Flow Chart for EVM

### IV. LIST OF COMPONENTS AND THEIR SPECIFICATION

#### A. Fingerprint Module

Fig.3 depicts the R307 sensor which is used to recognize the fingerprint. This fingerprint module is used to verify voter's thumb impression which is already available in the database [27],[28]. Here, a DSP chip is used for detection, verification, and it is connected to the microcontroller with TTL serial. It sends data packets of fingerprints for detection. As every person has a unique finger image, a secured method is used for authentication of the voter at a low cost. The fingerprint processing unit has two functions: fingerprint enrolment and matching. The user can configure and store fingerprints in 1:1 or 1:N mode for the person and which is used at the voting period for identification of a person with multiple fingerprints also. In 1:1 comparison, this module compares the thumb impression with existing data stored in the file, while in 1:N searching and matching, the module can consider a full image library for matching fingers. This process will ultimately end in failure or success.



Fig. 3R307 Sensor

### B. RaspberryPiPinConfiguration

In this pin configuration total of 40 pins are available out of which the top 26 pins are used for input supply, GPIO, UARTs, and GPIOs connections. In such a manner, the RaspberryPi pins are connected to the Model B as well as the B+ terminal. If the voters may sit in the correct position in front of the cameras or not but technically the setup is arranged to manage the adjustment of face recognition. The pin configuration of the controller is shown in Fig.4. Raspberry Pi is connected in a secured manner to the product from rough handling by public people [29],[30]. In this setup plastic clips are used to hold the Raspberry Pi in a particular place. Once the installation is overall the peripherals were connected to it and protected with tight an enclosure.

### C. FaceRecognitionProcess

In this EVM operation, three algorithms are used separately for different actions. Like, Face recognition, fingerprint recognition, and pushbutton identifications. These programs are implemented using open CV libraries. Here three stages of operation are carried out for face recognition as mentioned below.

- Voters images ID collection.
- Unique feature extraction, classification, and stored in XML files.
- Voter's prediction by matching input image features with the saved XML files.

Here, the process starts with a request for the name to be entered to be stored with the ID in a text file. The face detection system starts in the first half. However, before capturing begins, the application checks for the brightness levels and will capture only if the face is well illuminated. Furthermore, after the face is detected, the position of the eyes is analyzed. If the head is tilted, the application automatically corrects the orientation. These two additions were made considering the requirements for the Eigen's face. The image is then cropped and saved using the ID as a filename to be identified later. A loop runs this program until 50 viable images are collected from the person. This application made data collection efficient.

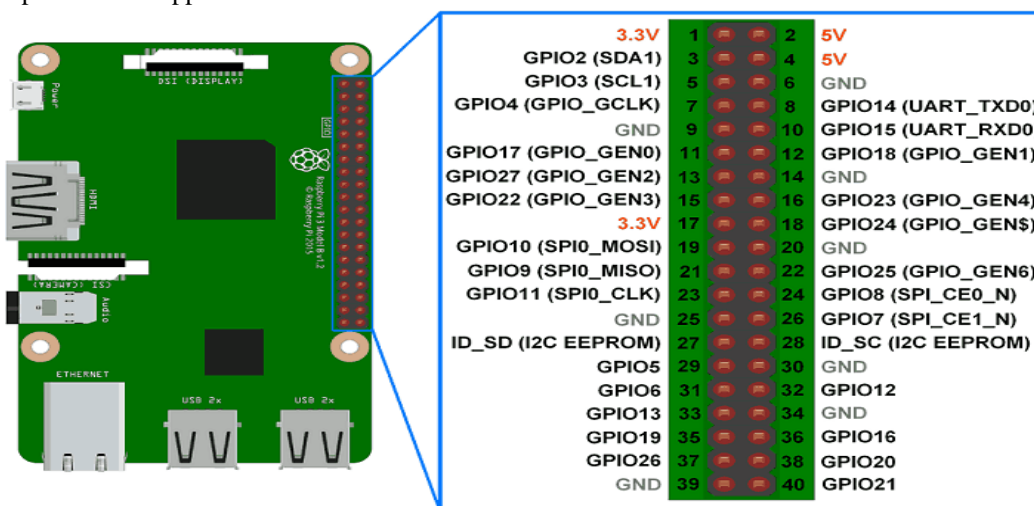


Fig. 4RaspberryPiPinDiagram

*D. Programs*

*E. Facetaker:*

```
import numpy as np
import cv2
import os
```

SOFTWARE CODE

```
#Check if folder exists
if not os.path.exists('images'): os.makedirs('images')

print("\n[INFO]ExitingProgram.")
cam.release() cv2.destroyAllWindows() Face trainer:
import cv2
import numpy as np
from PIL import Image
import os
#Directory path name where the face images are stored.
recognizer.write('trainer.yml')
print("\n[INFO]{} face trained.
```

*F. Face Recognizer:*

```
import cv2
import RPi.GPIO as GPIO
import numpy as np
import os
import pandas as pd
import time
import datetime
from datetime import datetime
import csv
GPIO.setmode(GPIO.BCM)

print("\n[INFO]ExitingProgram.")
```

*G. Fingerprint access:*

```
#SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
#SPDX-License-Identifier: MIT
import time
import board
import busio
import serial
from digitalio import DigitalInOut, Direction
import adafruit_fingerprint
:
adafruit_fingerprint.OK:
print("Deleted!")
print("Failed to delete")
```

*H. PushButtons:*

```
import RPi.GPIO as GPIO
GPIO.setmode(GPIO.BCM)
import time
buttonx = 17
buttony = 27
GPIO.setup(buttonx, GPIO.IN, pull_up_down=GPIO.PUD_UP)

print(faceDis)
if match[matchIndex]:
name = classNames[matchIndex].upper()
print(name)
```

**V. BLOCK DIAGRAM OF CONTROL CIRCUIT**

Fig.5 depicts the block diagram of a control circuit of the EVM which has a Raspberry pi controller, fingerprint sensor, web camera, and pushbuttons. The controller plays a vital role in this proposed system. The EVM process program is dumped in the controller and the fingerprint scanner is used to scan the biometrics of the person that is connected to the controller. A web camera is used to detect the facial axis which is stored in the database and that data is used to match the face of the person who is going to cast their vote. The face is stored using the Haar cascades of the person's face axis and that is used to detect the face.

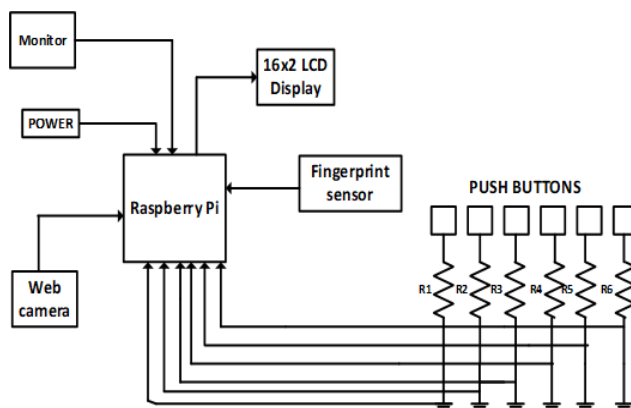


Fig. 5 Block Diagram of Control Circuit

Those who are going to participate in the election are represented using pushbuttons. There are six pushbuttons are used in this EVM in which three buttons are given to the respective party e.g. X party, Y party, and Z party. The remaining three buttons are used for different purposes like one button is used to conduct the election by manual verification of the documents. If the web camera and fingerprint scanner are not working the second button is used for the automatic operation in which the controller takes the face and biometric data are researched in the database and allows the person to cast their vote. The third button is used for closing the election process. The LCD is used to display the voting count and result. The complete election data is saved in an excel sheet and cannot be rewritten because the file is a READ ONLY file. The malpractices are not possible in the process.

## VI. HARDWARE

Fig.6. depicts the overall hardware details. The program is developed in the python language and dumped in the Raspberry pi is connected to the monitor using the VGA to HDMI cable. The program is compiled and run the program through this connection. Once the program is executed and output is shown in the monitor itself like enter your name, the name of the candidate who is going to vote. The operation of the program has to select by a switch for manual operation or automatic operation. Then the automatic operation is selected and the controller sends the signal to the web camera to take the facial axis of the candidate and once the candidate is authorized then they are eligible to vote. If the face of the candidate is not recognized the biometrics of the person are matched, with the database then they are eligible to vote.

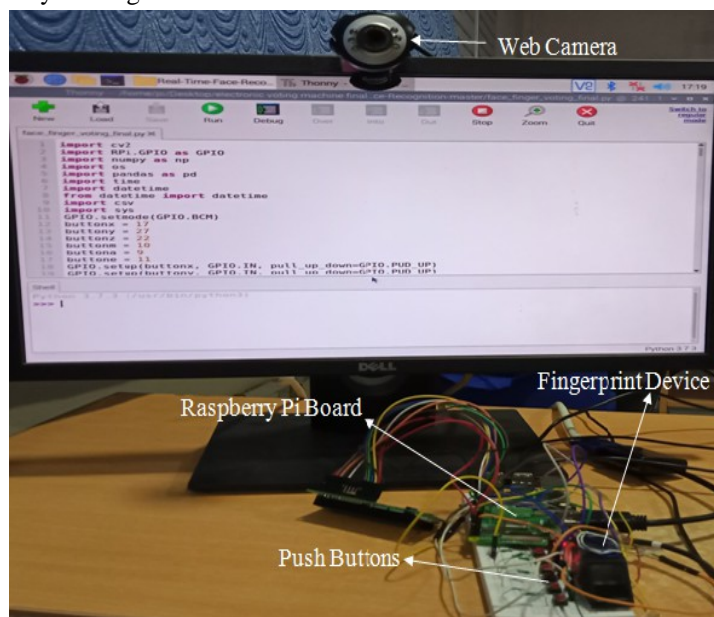


Fig. 6 Hardware Model.

## VII. RESULTS AND DISCUSSION

In the worst situation if both the parameters are not recognized the candidate information is verified using the documents then the preceding officer should press the manual operation button then the person is eligible to vote. Now, if the person who is previously cast their vote cannot be eligible to vote again it shows as an alert message as FRAUD and they are unable to cast their vote once again. In such a manner fake voting and malpractices are reduced. The election result is shown in Fig.7. The name of the voter and at which time they have cast their vote and to which party they have voted is also saved confidentially. And if the voter previously cast their vote and again attempted to cast their vote illegally. Then the controller sends a signal as ALERT FRAUD which means the voter has already cast their vote and is not eligible for casting their vote.

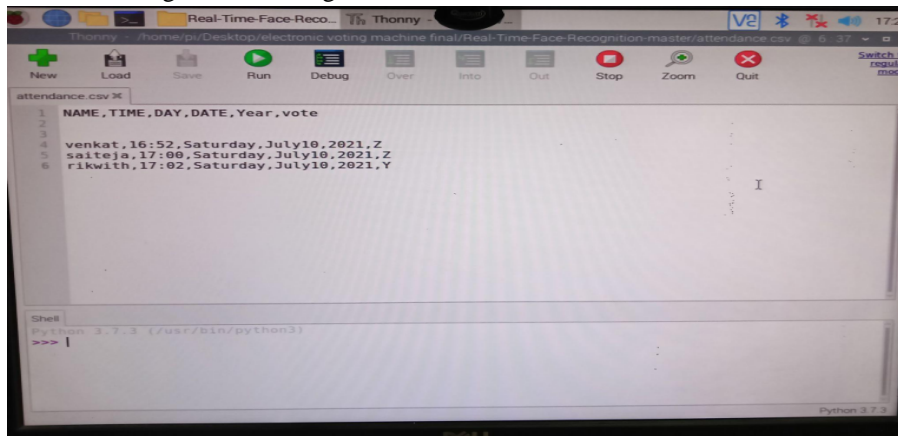


Fig. 7 Election Result

### A. Experimental Analysis

In this experimental setup of the EVM of three candidates will be allowed to participate in the election. Here three switches are provided like X, Y, and Z for these candidates. Four voter's details are stored in the system such as name, spouse name age, date of birth, face image, and fingerprint. Firstly, a voter has to put their face in front of the camera if it is recognized immediately he or she has to cast their vote. If the face is not properly recognized they are advised to put their fingerprint in the biometric device if it is recognized they have a chance to cast their vote. Unfortunately, if both options are not satisfied by the voter the presiding officer has to verify their details with documentation and permission will be given by pressing the manual switch. Once a voter completed their role once again it is not possible to cast multiple votes. Because of the manual verification is a third option only. At present these types of safety and security system is not available in the existing EVMs.

### B. Advantages and disadvantages

Advantages:

- Cost-effective.
- This system allows only authenticated voting than the existing equipment as the person is identified based on his Fingerprint and Face Recognition which is unique to each individual.
- Less manpower required
- Time conscious, less time required for voting & counting
- Avoids invalid voting as it prevents unregistered voters from voting.

Disadvantages:

- Before voting the user has to enroll first.
- The sensitivity of the fingerprint module sometimes causes combine character errors.

## VIII. LIMITATION AND FUTURE SCOPE

In the existing EVM machine voter identification and verification, facility is not available. To overcome this problem in this project EVM is designed with fingerprint and face recognition to ensure a transparent and error-free polling process.

The performance of the proposed method was validated with EVM successfully. But the online voting system is not entrenched in the EVM. Right now, the government of India taking a lot of effects to make 100% polling.

Due to a lack of facilities in the EVM, it is not possible. In the future, this EVM performance can be enhanced with the help of IoT and cloud computing to ensure an online voting system. Once this project is completed, voters can be able to vote from their workplace as well as 100% polling will be possible.

## IX. CONCLUSION

The work is mainly intended to develop a fingerprint and face-recognition-based advanced EVM. This helps to conduct free and fair elections in democratic countries like India. To ensure the security of the voter and preserve the sanctity of the method, a two-layer security scheme has been introduced. The push buttons are used to select the person to whom the candidates are going to vote. Initially, the finger of the voter is placed on the fingerprint sensor and if the voter is authorized then the signals are sent to the controller and then the second step is facial detection in this the web camera is used to detect facial details like iris or the retina scanning and once the voter is authorized then the voter is eligible to mark his vote using the push buttons given separately. Finally, all data is stored in an excel sheet and the results are announced for the particular election.

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