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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 ofElectronicVotingMachine(EVM)performanceusingfingerprint 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 overcomethis problem. To conquer the issues existing in the electionprocessfor voter identificationthe biometric fingerprint andweb cameras are introduced in the EVMs. The people at the polling booth need to put the finger in the fingerprint equipment andface 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 officersare havingtheright toenablethepollingdevice 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 thegovernancetomeet equal rights to all peoples. Twenty years back all the countries followedtheballotpaper system for theelection process.Inthisprocess 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 introducedtheEVMforconductingasmoothand fair election.

With lesstimeconsumption and lowcost. 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 gavea lot of explanations still some oftheparties wereunable 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, theEVM 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.

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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 withvarious 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, inthis point of viewing artificial neural network techniques with support vector machineis introduced andtested in theelection 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 withinnovativedetection techniques.In thismanner,[12]-[15] Arduino controller is used for making smart E-Votingmachine 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.

InthisregardthesafetyandsecurityofEVMareveryimportant because peoples 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. Eventhough, this latest technique has some benefits the executing time ismoreandunreliability[21-[22].Manoharan,J.Samuel[23] have discussed layer cloud security model withfingerprint biometric traits. Here the fingerprint biometrictraits are used to make a security system of cloud access by different users. AkeySungheetha and Rajesh Sharma [24] have proposed a machine learning technique for 3D image processing tointeract with man-machine. Sayantan Duttaand 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 varioussectors. Thistechnologyis widelyused for analyzing and measuring the biological data for human body characteristics [26]. However, fingerprintand facerecognition are not implemented in EVM so far in the literature.To overcomethelimitationsintheconventionalEVMlatest smart devices are introduced.

In this paper, fingerprint and face recognition techniques areembedded with EVMtoenhancetheperformanceoftheE- Voting system. The technologyhas brought drastic changesin almost every field; the election process is not an exemption from thistechnology. People areexcepting tomaketheir work easy, fast, and accurate. The conventional paper ballot-based voting system is simple but it isnot 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

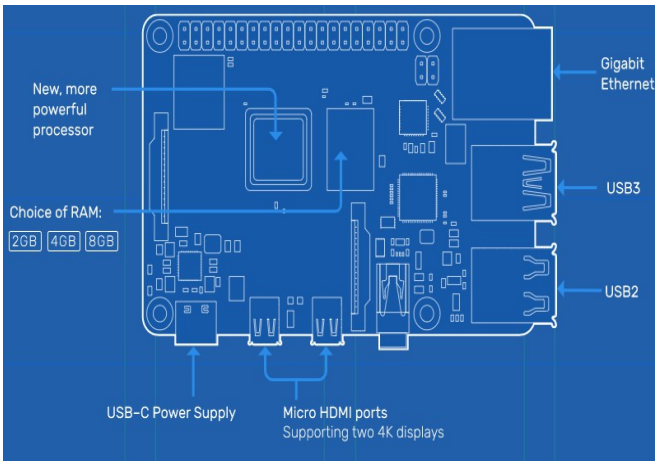


Fig. 1Raspberry Pi 3 Circuit Diagram

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III. PROPOSED SYSTEM DESCRIPTION

Intheproposedsystem, whenever a voter comestocast their vote initiallythe 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 toput their thumbimpression. The given thumb is searched in the database and if it is found and matchedwiththeserver dataafter thatthevoter ispermittedto cast their vote. If the thumb impression in the database failsthe voter has to verify their documents manually. If the documents areverified and ifthevoter 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.

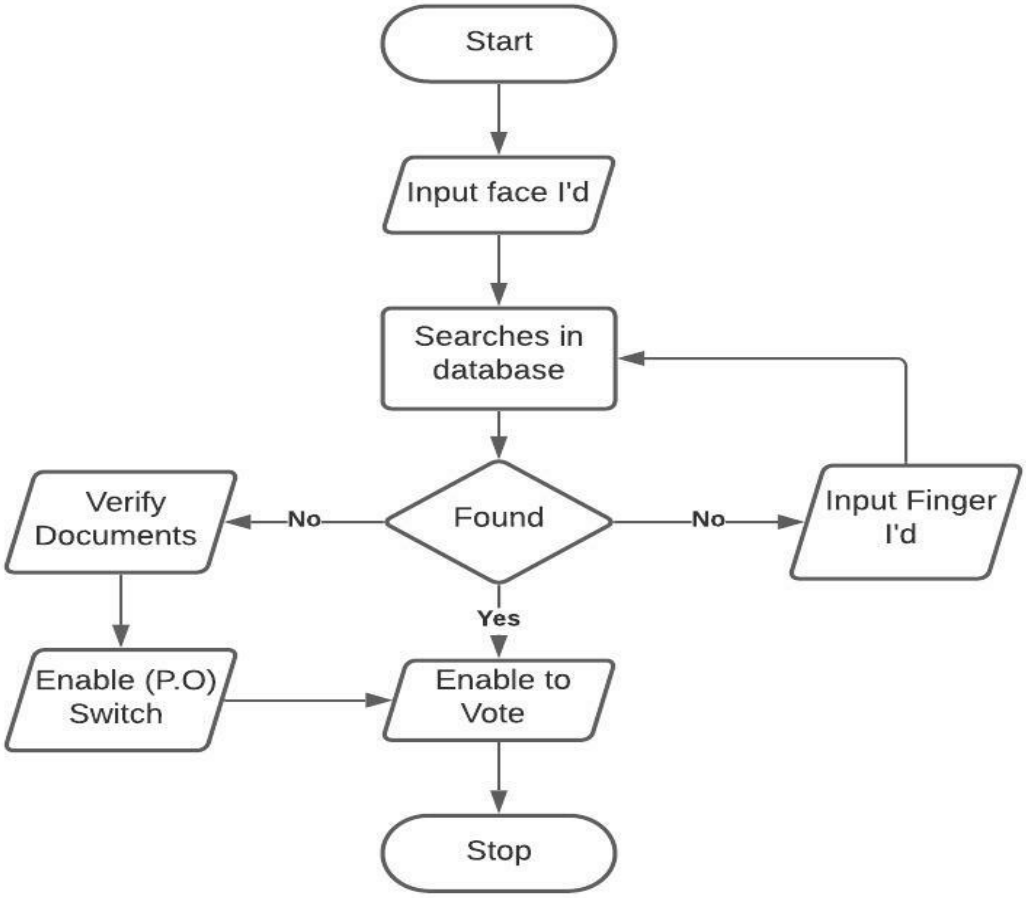


Fig. 2 Flow Chart for EVM

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 inthe file, while in 1: Nsearching and matching, themodule can consider a full image library for matching fingers. Thisprocess will ultimately end in failure or success.

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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 isarranged to manage the adjustment of face recognition. Thepin 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 programsareimplementedusingopen CVlibraries.Herethree stages of operation are carried out for face recognition as mentioned below.

- VotersimagesIDscollection.
- Unique feature extraction, classification, and storedin 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 thefaceis detected, theposition of theeyes 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 imageis 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.

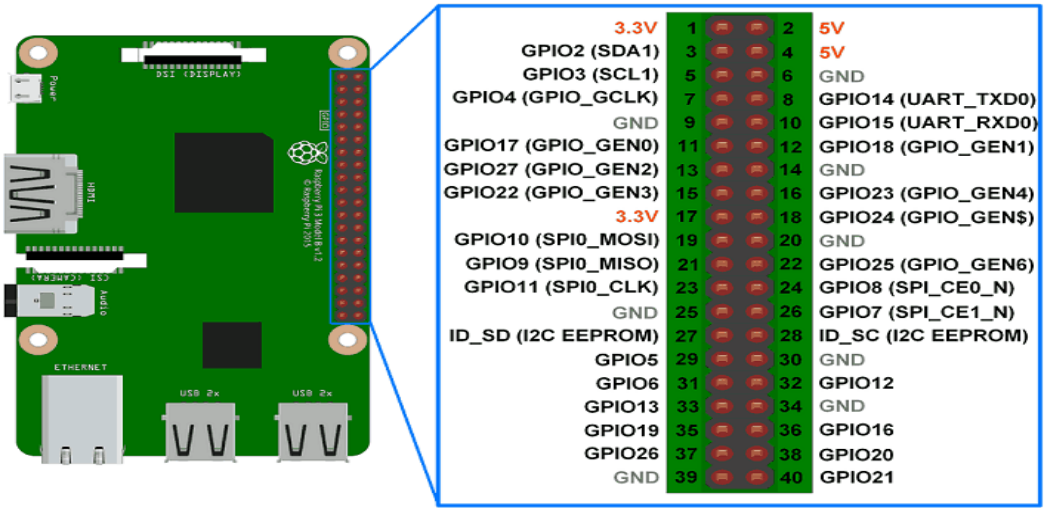


Fig. 4RaspberryPiPinDiagram

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D. Programs

E. Facetaker:

```
importnumpyasnp import cv2
importos
SOFTWARE CODE
#Checkiffolderexists
 ifnotos.path.exists('images'): os.makedirs('images')

print("\n[INFO]ExitingProgram.")
cam.release() cv2.destroyAllWindows() Face trainer:
importcv2
import numpy as np fromPILimportImage import os
#Directorypathnamewherethefaceimagesarestored. recognizer.write('trainer.yml')
.print("\n[INFO]{0}facestrained.
```

F. FaceRecognizer:

```
importcv2
importRPi.GPIOasGPIO import numpy as np import os
importpandasaspd import time
importdatetime
fromdatetimeimportdatetime import csv GPIO.setmode(GPIO.BCM)
.
print("\n[INFO]ExitingProgram.")
```

G. Fingerprintaccess:

```
#SPDX-FileCopyrightText:2021ladyadaforAdafruit Industries
#SPDX-License-Identifier:MIT import time
importboard importbusio importserial
fromdigitalioimportDigitalInOut,Direction importadafruit_fingerprint
:
adafruit_fingerprint.OK:
        print("Deleted!") print("Failedtodelete")
```

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 axiswhich is stored in the database and that data is used to match theface oftheperson whois going tocast their vote. Theface is stored using the Haar cascades of the person's face axisand that is used to detect the face.

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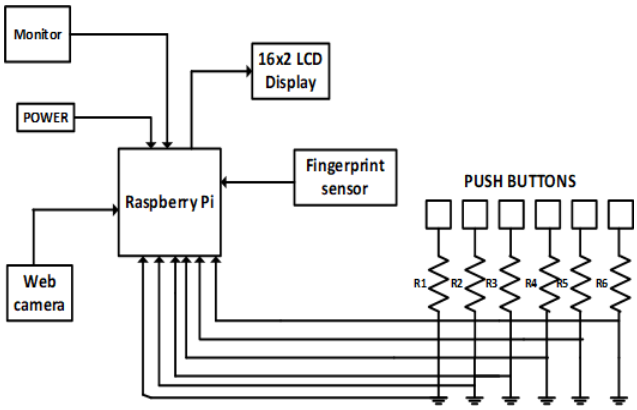


Fig. 5Block Diagram of Control Circuit

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 likeone 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 faceandbiometricdataaresearchedinthedatabaseandallows the person to cast their vote. The third button is usedfor closing the election process. The LCD is used to displaythe voting count and result. The complete election data issaved in an excel sheet and cannot be rewritten because thefile is a READ ONLY file. The malpractices are not possiblein the process.

VI. HARDWARE

Fig.6. depicts the overall hardware details. The programis 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 itselflike 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.

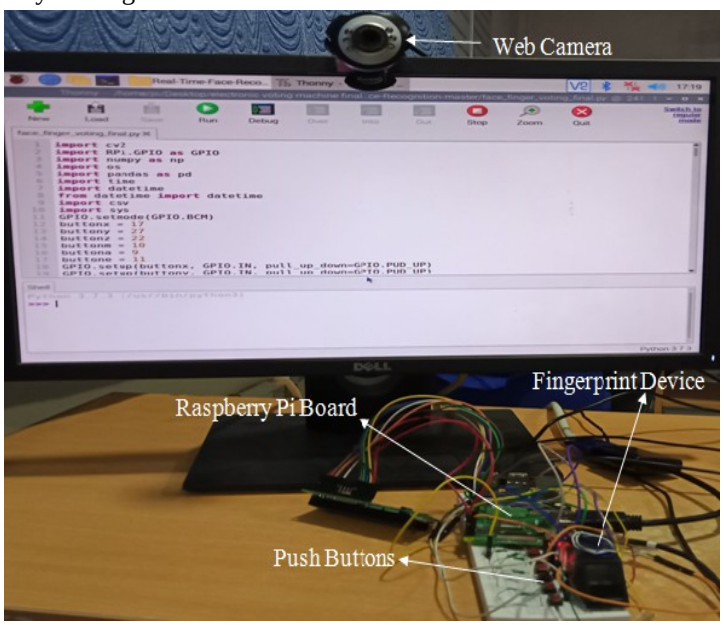


Fig. 6 Hardware Model.

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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 thenthepersoniseligibletovote. Now, ifthe person who is previously cast their vote cannot be eligible to vote again it shows as an alert message as FRAUD and they areunableto cast their vote onceagain. In such a manner fake voting and malpractices are reduced. The election result is shown in Fig.7. Thename of the voter and at which time they have cast their vote and to which partytheyhave voted is also saved confidentially. And if the voter previously cast theirvote and again attempted to cast their vote illegally. Then the controllersends asignalas ALERTFRAUDwhichmeansthevoter has already cast their vote and is not eligible for casting their vote.

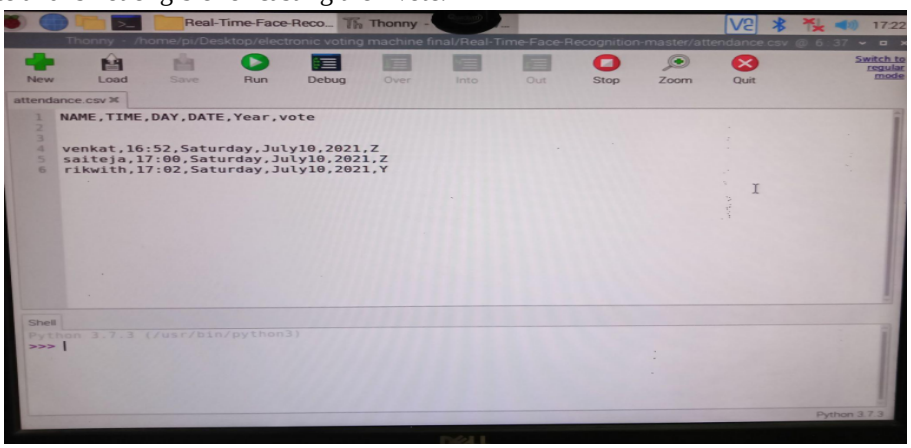


Fig. 7Election Result

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 suchas 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 optionsarenot satisfied bythevoter the presiding officer hastoverifytheir detailswith documentation and permission will be given by pressing the manual switch. Once a voter completed their role once again it is not possible tocast multiplevotes. Because ofheremanual verification isa third option only. At present these types ofsafetyand security system is not available in the existing EVMs.

B. Advantagesanddisadvantages

Advantages:

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

Disadvantages:

- Beforevotingtheuserhastoenrollfirst.
- The sensitivity of the fingerprintmodule 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 thisproblem 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 votingsystem is not entrenched in the EVM. Right now, the government of India taking a lot of effects to make 100% polling.

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Duetoa lack of facilityin theEVM, it isnot possible. In the future, this EVMperformance tobe enhanced with help ofIoT andcloudcomputingtoensurean onlinevotingsystem. Once this project is completed voters can able to vote from their workplace place itself as well as 100% polling will be possible.

IX. CONCLUSION

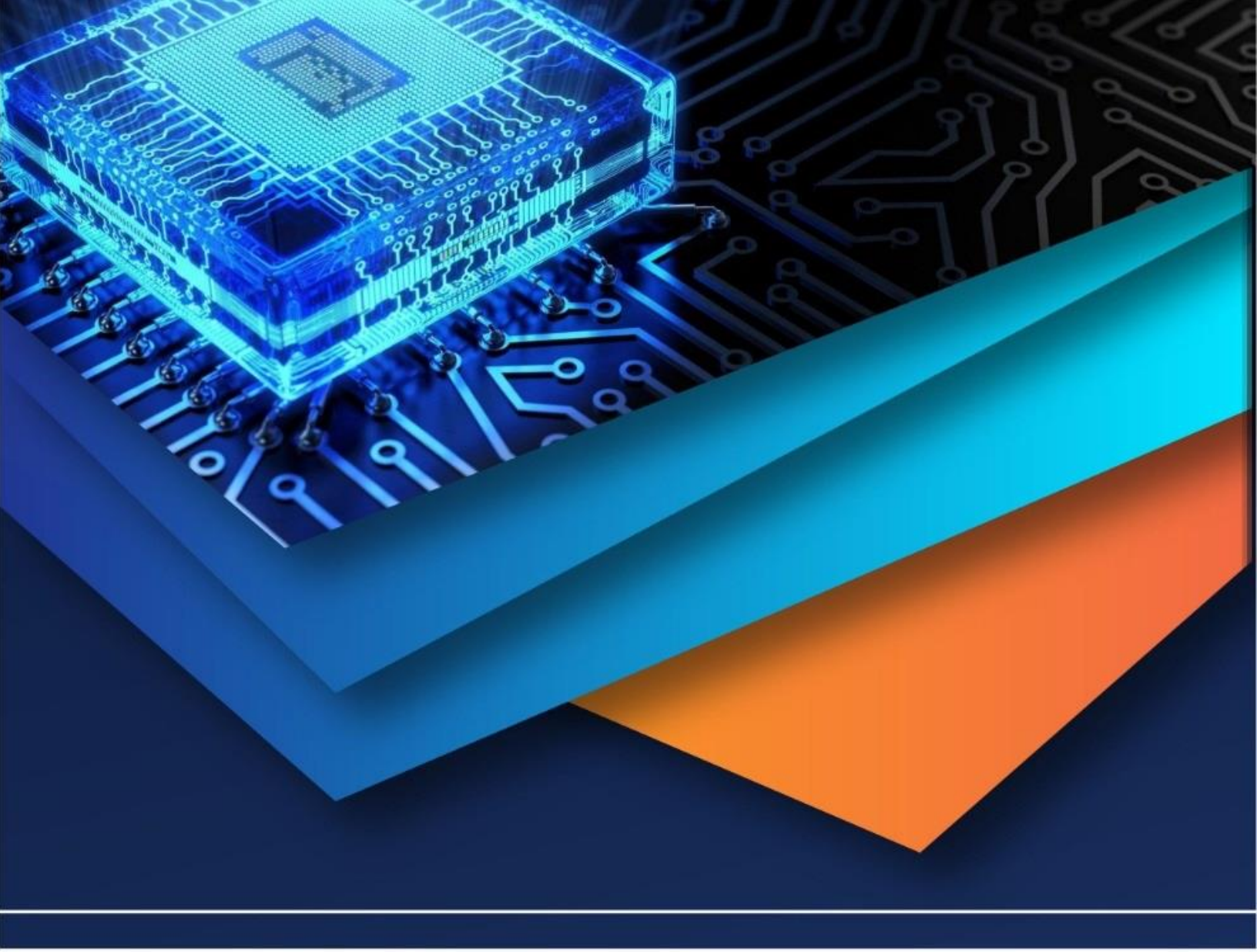
The work is mainlyintended to develop a fingerprint and face-recognition-based advanced EVM. This helps to conduct free and fair elections in democratic countries like India. To ensure the security of the voter and preserve the sanctity of the method, a two-layer security scheme has been introduced. The pushbuttons 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 pushbuttons given separately. Finally, all data is stored in an excel sheet and the results are announced for the particular election.

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