

# FINGERPRINT BASED ELECTRONIC VOTING MACHINE: A REVIEW

Debojyoti Ghosh<sup>1</sup>, Anushka Banerjee<sup>2</sup>, Pratik Ranjan Roy Chowdhuri<sup>3</sup>, Ankur Sen Gupta<sup>4</sup>, Barnasha Pal<sup>5</sup>,  
Sahana Khatun<sup>6</sup>

(1-6) Future Institute of Engineering and Management, Kolkata, India

**Abstract:** *Through this review, we intend to present a review on previous works involving Electronic Voting Machines where biometrics, particularly fingerprint have been used for authentication purpose. Several proposals of Online e-voting have also been studied. Upgrading the polling process to Android OS platforms have also been discussed. Proposals of additional authentication measures like alcohol sensors have also been taken in consideration*

**Keywords:** *EVM, Biometric, Aadhar, GSM module, Online e-voting*

## Introduction

Every nation around the world with democratic legislative elects its rulers using their respective voting systems. Different types of mechanisms are employed for voting ranging from ballots to electronic voting machines. With ever increasing corruption all around us, specifically in the third world countries there is an urgent need to employ secure strategies to make the procedure of voting during elections free from any sort of rigging or other illegal interventions.

Many attempts have been made by several people in the academic field to develop systems which promote secure means of voting. Using fingerprint for authenticated entry to enter the voting procedure has been proposed in several articles. Ideas of web-based voting where the voters are allowed to cast their votes using the voting website or e-voting with physical entities (fingerprint, voice recognition) through computer network have been put forward [1, 9]. Several models with GSM alert and updating along with implementing iris recognition and finger vein sensing apart from fingerprint verification for authentication purpose have also been discussed [2, 7, 16, 19]. In some of them, proposals of enrolling the fingerprint to create a database following which during the elections

the test fingerprints are matched against the available ones in the pre-created database, which on successful matching allows the voter to continue with voting have been presented [3, 8]. RFID tags have also been used as a valid id to conduct secure voting through the electric voting machines or implemented as a prototype of Aadhar id along with other security measures like finger vein sensing and using alcohol sensors to provide peaceful environment in polling booths [4, 24, 18, 10]. Android mobile OS has also been used to develop an application and fingerprint supported biometric control information to make voting process more secure. Using android smart mobile device makes the system more robust [5]. Using of Aadhar QR code and UID numbers have the ability to provide added security measures to the voting system [6, 11, 23]. The concept of online e-voting for casting vote online without going to any polling booth has also been proposed. This system claims to be helpful for voters staying away from their home cities but wish to exercise their right to vote [12]. Along with these, proposals for online updating of votes using Zigbee or using the distributed server approach to add for added accuracy and reduced travelling distance have also been doing rounds in the academic circle concerned with developing a secure system of voting for conducting rigging-free elections [15, 17]. Many proposals involve using the Aadhar number for entry to the voting procedure or using the available Aadhar database instead of enrolling the fingerprints separately along with providing the feature of sending confirmation message to voters' mobile number [20, 13, 14]. Another paper incorporates the display of Aadhar card details along with the fingerprint authentication [21]. In order to make the system more secure, the voter is required to fill a registration form through user id and password which gets checked by the database server. If any of the previously stored information is wrong, the voter will not be allowed to participate in polling [22].

The above paragraph presents a brief introduction to the EVM systems proposed by several literary journals along with the technologies implemented in them for the betterment of the existent system.

## Literature Survey

The paper deals with the design and development of a web-based voting system using fingerprint authentication. The proposed EVS compels the voters to scan their fingerprint, which in turn is matched with preloaded image within the database. Being nationally connected, an user can cast votes from anywhere in the country through the web only after successful progress through the validation procedures. Casted vote will be updated immediately [1]. It is basically an extension of the previous where aspects like authenticated voters and polling data security for e-voting systems are discussed. The voter authentication in online e-voting process can be done by formal registration through administrators and by entering one time password. In Offline e-voting process authentication can be done using Iris reorganization, finger vein sensing which enables the electronic ballot reset for allowing voters to cast their votes. Also the voted data details with voter details could be sent to the nearby Database Administration unit in a timely manner using GSM System with cryptography technique [2]. The implementation of Biometric Electronic Voting System Software (BEVSS) integrated with a biometric fingerprint machine that allows eligible voters during the registration process with subsequent verification on Election Day has been projected. The BEVSS would be implemented on personal computers over a Local Area Network at each polling station [3]. This paper focuses on sophisticated voting system using RFID and Finger print technologies to ensure unique casting. RFID acts as a substitute for voter ID and the Fingerprint sensor data generates an alert depicting mismatches. Keypad is used for selecting the voting preferences. LCD is used to display the corresponding data for each key to the user [4]. The proposed work uses

android mobile OS to develop an application and fingerprint supported biometric control information to make voting process more secure. Using android smart mobile device makes the system more robust [5]. This project proposes a secure online e-voting system that uses UIDAI or Aadhar database as its backend. The system ensures authentication of an individual by matching fingerprints and eligibility is checked by calculating the age of the voter thus making the existing voting cards redundant [6]. A simple and secured method of polling vote by using biometrics – the proposal avoids false voting relying on fingerprint verification. The algorithm uses a cancelling approach, where each authorized person in the Government’s database is struck off in a polling area on successful polling – an attempt towards irradiating multicasting [7]. The paper deals with the accessibility of biometrics in a practical application like polling of votes – e-voting using a physical entity (fingerprint, Voice Recognition) through computer network [8]. In this version of EVM, user at the polling booth needs to place his finger on the device allowing the acquisition of an on-spot fingerprint from the voter which serves as an identification. This Fingerprint reader reads the details from the tag which is then passed onto the controlling unit for the verification. The controller compares this data with the already existing data stored during the registration of the voters. If the data matches with the prestored information of the registered fingerprint, the person is allowed to cast his vote. If not, a warning message is displayed on LCD and the person is barred from polling his vote. The vote casting mechanism is carried out manually using the push buttons. LCD is used to display the related messages, warnings and ensuing results[9]. Another form of biometric EVM where the Gov. database has retrieved biometric data of fingerprint and IRIS. One more advantage of this project is, if an alcoholic person enters into polling booth, buzzer will alert authorized persons or constables who are on election duty. Because of Alcoholic sensor, we can provide peaceful environment at polling booth. If an unauthorized person or anyone who has already casted his vote enters into the polling booth with his RFID tag, buzzer will alert booth level officer [10]. In this proposal all the users should login by Aadhar card number and password and click on his/her favorable candidates to cast the vote. The extra feature of the model is that the voter will ensure if his/her vote has gone to correct candidate/party [11]. In this paper, the EVM is based on the online services where a voter can use his/her voting right online without any difficulty. In this system people can cast her vote online without going to any polling booth. The election commission of India has maintained a database server in which all the names of the voter with complete information is stored. The voter has to fill a registration form to register himself with the help of a USER ID and PASSWORD. This information is checked by the database server which has already all the information about the voter. If conditions are wrong then that entry will be discarded and he would not be able to vote. This system will be helpful for voters who live far away from their home city and want to cast their vote from anywhere in India [12]. In Aadhar based electronic voting machine voters have to register their fingerprint, based on which the features of fingerprint it gets matched with the person who will cast the vote in the database. With the help of keypad matrix voter can select the candidate to whom they wish to cast their vote and a message is displayed in LCD confirming the vote casted [13]. The main purpose of this project is to develop a secure Electronic voting machine using Fingerprint identification method and AADHAR card database model. In this system, a confirmation message is sent to the voter’s registered mobile number regarding the casted vote and also the voted data and voters details can be sent to the nearby Database Administration unit using IOT. If an unauthorized person or anyone who has already casted his vote enters into the polling booth with his RFID tag, buzzer will alert booth level officer [14]. The project is mainly divided into two sections - voter registration and the actual voting action through voting console. In voter registration phase, the database will get upgraded corresponding to the unique biometrics of each user. The biometric device will retrieve an identity from the database records saved in repository by the communication of Wi-Fi module and if respective voter is identified then authorization will approve to that respective voter at the same time in other section of repository. Legal amendments allow any user to cast once on authorization successful and correspondingly the database gets upgraded; also it will prevent the duplication and falsification of voter; after getting authority from the repository voting enabling signal will be sent using ZigBee to voting console for enabling voting for that particular voter [15]. This paper will attempt to solve the problem of bogus voting with the help of fingerprint scanner and Microcontroller which will be convenient for every citizen at the polling booth. Citizens have to place their finger in fingerprint sensor. When it is matched with the stored fingerprints, then we can go to the voting process. Supervisor can know the details of voting and a GSM modem is interfaced to send SMS to the corresponding authority [16]. In this paper, we present a Novel Electronic Voting System which is based on biometric authentication and distributed servers approach which provide high security for voting process. Whole voting system is divided into two parts one is a voting machine and another is server system. Raspberry pi 3 model B is a heart of the voting machine. This host minicomputer has the ability to control complete activity of voting process. Voting machine is developed based on biometric authentication and distributed server system. So for authentication purpose we use a biometric database of Aadhar card which is already given from all Indian citizens by the Unique Identification Authority of India (UIDAI). So the voter authentication can be done by using biometric information (Thumb impression) which is pre-stored at the government database. The significance of adding thumb impression results in exact authentication of voter before casting of vote. The main advantage of this system is, it is based on a distributed server approach, which will ultimately add the accuracy of casting of votes and reduce long distance travelling to cast a vote. Therefore a reliable, flexible system will be established which will be easy to handle by all populations considering their literacy and age factor, also to control fake voting which ultimately adds transparency in voting system [17]. Fingerprint is one of the unique identities of a human being which is being used in the aadhar system. By using arduino software we capture the finger print of every individual. At the time of voting in the elections, the authentication can be done using Aadhar Card Id and Finger Vein Sensing, which enables the electronic ballot reset for allowing voters to cast their votes [18]. Persisting with the prevalent trends, the paper deals with AADHAR CARD based voting system. Aadhar records being a valid ID proof is expected to be updated in the national database together with the corresponding finger scratches. At the time of voting, data is received from fingerprint scanner and compared with AADHAR CARD database fingerprint. After casting vote or completion of vote GSM send a conformation message on voter’s mobile [19]. This paper proposes policy regarding the electronic approaches and developments towards electronic data storage and transmission. The finger print devices for voting machine and different existing identity documents are mentioned and enforced. The voting system is managed in an easier manner since all the users should login by Aadhar card number and password and click on his/her interested candidates to cast the vote [20]. The key functions of this paper are enrolment and matching. Initially, the voters’ fingerprints are enrolled and stored. Once the fingerprints are stored it can be retrieved at any time for authentication. The voter’s fingerprint when stored, the already stored Aadhar card details will be displayed from the database [21]. Here arduino technology has been used where a voter can poll his vote easily. In this database server all voters’ information was stored to register in this system, the voter should fill a registration form with the help of a user id and password. This information will be checked by the database server. Because all the information about the voter would be already there is anything wrong, the system will not allow the voter to poll his or her

vote [22]. To avoid all kinds of problems related to ballot and electronic voting systems a method has been developed, which is based on the authentication of fingerprint and UID number from AADHAR database. The method of electronic voting mechanism helps to simplify the election process, constricts voting fuss; short - term result announcement with enhanced reliability and security of the votes [23]. This project is designed for integrating Electronic Voting Machine with the data of the voter as in the Aadhar. Using the Aadhar Number and its unique biometric identification system to prevent and alert the authorities against fake voting protecting the voting rights of the citizen using fingerprint to ensure the identity of the person who is voting and also to ensure that no single person can vote more than once and aborting and alerting the authorities if otherwise. An RFID is used to represent the Aadhar card of each citizen and can be used only by the respective citizen as the data stored in the Aadhar are exclusive to each citizen [24].

### Working Principle and Relevant Explanation

The basic objective which has unified all the journals considered for review here is enhancing the security of Electronic Voting Machines. Biometrics, particularly fingerprint sensing has been used as the authenticating feature in all the mentioned references here. The basic block diagram as comprehended from the reviewed papers is presented below in figure [1]:

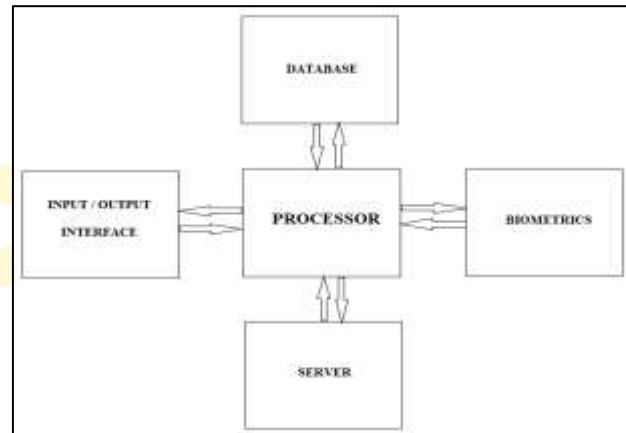


Figure 1: Basic block diagram of biometric-based EVM with server approach

The generalized block diagram has been presented above. There have been several modifications on this where the different blocks are interconnected or cases of several additional equipments are introduced to provide better security and ease the process for the voters. The main phases involved in the voting process which the different reviewed journals have focused on are as follows:

**Registration:** The primary stage before any polling is registration. Since electoral systems exist all over the world, assuming that registration as national citizens have already been done, this section deals with the registration of the authentication features i.e. the biometrics. Initially, database for storing fingerprint patterns have been created as a prior stage to the actual elections where the voters had to register or enroll their fingerprints [1, 3, 4, 8]. Few others have involved the usage of the database provided by government, particularly the one used for Aadhar card [13, 14, 20, 23]. Implementing other biometrics like voice recognition, iris scan, finger vein authentication for security purpose has also been employed by a few journals [2, 9, 10, 18].

**Identity:** The next crucial step during the elections is the selection of a valid identity. Few of the earlier journals have developed there models surrounding the existing national identity proofs [1, 2, 3]. Some of the journals (in India) have proposed using Aadhar number as valid id for voters [21, 24]. Few have substituted this with RFID prototypes [10, 14, 18]. Implementation of scanning the QR code has also been documented [11].

**Processor:** In order to make the systems technologically advanced as well as increasing the horizons for further up gradations, different processors have been used. Implementations have taken place using Arduino [11, 14, 18, 19, 21, 22, 24]. Other microcontrollers like ARM processors with varied versions have also been used to a great extent [2, 4, 8, 9, 13, 15]. Exploiting the android platform has also been attempted [5].

**Voting scheme:** The main and final step of voting is the polling day itself when the hypothesized designs are actually tested. Conventional mechanism follows that the voters need to be present in the polling booth, validation of identity follows and finally voting takes place. Implementing the fingerprint authentication with this method and programming different modes modifies the present approach with added security [23]. Although a majority of the journals have maintained on-site voting, few have proposed the idea of voting online i.e. physical presence in any poll booth is not mandatory [5, 12]. The concept of voting online from the polling booth has also been approached in few of the journals [1, 6, 9, 12]. Apart from this, distributed server technique using Raspberry pi has also been adopted [17, 20, 24]. Apart from this, implementation of GSM alerting has been presented in quite a few journals as well [2, 7, 16, 19].

### Advantages

- Improved accuracy in evaluation of results
- Faster tabulation of results is possible using the user-friendly interfaces.

- Using biometrics for authentication provides improved security to the existing EVMs
- Improved accessibility for users
- Improved transparency
- Voting by illegal voters can be prevented
- Prevention of multiple votes
- Cost effective implementation
- Reduction in polling time

### Disadvantages

- Continuous power supply required
- Requirement of high speed internet
- Online voting requires a good share of bandwidth
- A certain level of literacy as well as acquaintance with technology is required
- Online voting increases chance of hacking

### Conclusion:

Through this paper, it has been intended to review the previous works in the field of promoting security of Electronic Voting Machines through biometrics. The referred journals have been thoroughly studied and it has been attempted to understand the development and research works in the field of EVMs over the past years. This paper aims to present a complete review on all such works in this field particularly those involving fingerprint matching as an authentication criteria to secure the significant process of polling and thereby prevent corruption during the elections.

### References

- [1] Firas Hazzaal, Seifedine Kadry, "New System of E-Voting Using Fingerprint (2012)", International Journal of Emerging Technology and Advanced Engineering (IJETA) Volume 2, Issue 10, pg. 355-363, Available: [www.ijetae.com](http://www.ijetae.com)
- [2] Alaguvel.R, Gnanavel, G,Jagadhambal.K, "Biometrics using Electronic Voting System with Embedded Security (2013)", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET),Volume 2, Issue 3,pg.1065-1072.
- [3] M.O Yinyeh , K.A. Gbolagade, "Overview of Biometric Electronic Voting System in Ghana (2013)", International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE), Volume 3, Issue 7, pg. 624-627, Available: [www.ijarcsse.com](http://www.ijarcsse.com)
- [4] Ashok Nalluri, B. BhanuTeja, A.Balakrishna, "RFID and Fingerprint Recognition based Electronic Voting System for Real Time Application (2014)",International Journal of Engineering Development and Research (IJEDR), Volume 2, Issue 4,pg. 3850-3854, IJEDR1404074
- [5] Prajakta S. Ghatol, Neelam Mahale, "Biometrics Technology based Mobile Voting Machine (2014)",International Journal of Computer Sciences and Engineering ICSE,Volume 2,Issue-8, 31,pg. 45-49, Available: [www.ijcaonline.org](http://www.ijcaonline.org)
- [6] Rohan Patel, Vaibhav Ghorpade, Vinay Jain and MansiKambli, "Fingerprint Based e-Voting System using Aadhar Database (2015)", International Journal for Research in Emerging Science and Technology, (IJREST) VOLUME-2, ISSUE-3,pg. 87-90.
- [7] Anandaraj S, "Secured Electronic Voting Machine using Biometric (2015)", International Conference on Innovations in Information, Embedded and Communication systems (ICIIECS)
- [8] Rudrappa B. Gujanatti, Shivaram N. Tolanur, Murughendra S. Nemaoud, Shanta S. Reddy, Sangameshwar Neelagund, "A Finger Print based Voting System (2015)", International Journal of Engineering Research & Technology (IJERT), Vol. 4, Issue 05, pg. 887-892.
- [9] Trupti Umakant Pavshere, S.V.More, "A Survey on Secured E-Voting System Using Biometric (2016)",International Journal of Advanced Research in Science, Engineering and Technology (IJERT), Vol. 3, Issue 3, pg. 1700-1704, Available: [www.ijarset.com](http://www.ijarset.com)
- [10] B.Mary, Havilah Haque, G.M.Owais Ahmed, D.Sukruthi, K.Venu Gopal Achary, C.Mahendran Naidu, "Fingerprint and RFID Based Electronic Voting System Linked With AADHAAR for Rigging Free Elections (2016)", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE),Vol. 5, Issue 3,pg. 1686-1693, DOI:10.15662/IJAREEIE.2015.0503111
- [11] R. Murali Prasad, Polaiah Bojja, Madhu Nakirekanti, "AADHAR based Electronic Voting Machine using Arduino (2016)",International Journal of Computer Applications(IJCA), Volume 145-No.12,pg. 39-42, Available: [www.ijcaonline.org](http://www.ijcaonline.org)
- [12] Sumit Hirve, Bilquees Bhagat, Manali Deshpande, Puja Bhagia, Nikita Zavar, "A Survey on Electronic Voting System Based on Fingerprint Authentication(2016)",International Journal of Computer Applications, Volume 145 – No.12, DOI: 10.15680/IJIRCCE.2016. 0409094
- [13] T.Thamaraimanalan, D.Jayaprada, S.Dhavasree, K.Kasthuri and M.Deenathayalini, "Aadhar Based Electronic Voting Machine (2017)",Asian Journal of Applied Science and Technology (AJAST) ,Volume 1, Issue 2, pg. 145-147, Available: <https://ssrn.com/abstract=2941147>
- [14] Sarankumar.V, Sasikumar.M, Ramprabu.K, Sathishkumar.A,Mr. S. Gladwin Moses Stephen, "Aadhar Based Electronic Voting System using Biometric Authentication and IOT (2017)", Asian Journal of Applied Science and Technology (AJAST), Volume 1, Issue 2, Pages 145-147, DOI:10.23883/IJRTER.CONF.20170331.040.ARATB
- [15] Prof. M.N. Annadate, Shreyans Sunil Gandhi, Nivita Ravi Kaniampal, PushkarSatishNaral, "Online Voting System Using Biometric Verification (2017)",International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE) Vol. 6, Issue 4, pg. 276-281, DOI10.17148/IJARCCE.2017.6452
- [16] V SyamBabu, A L Siridhara, R Karthik, Koppula Srinivasa Rao, G Bhavana, K H Murali, "User Friendly Aadhar based Electronic Voting Machine using ARM7 (2017)", International Journal of Civil Engineering and Technology(IJCIET), Volume 8,Issue 7,pg.214-218,

Available: <http://www.iaeme.com/ijciat/issues.asp?JType=IJCIET&VType=8&IType=7>

[17] Shendage, PC Bhaskar, “Novel E-Voting System with Biometric Authentication and Distributed Server System (2017)”, International Journal of Innovative Research in Computer and Communication Engineering (IJRSET), Volume 6, Special Issue 14.

[18] Geethamani R, Nithya V, Nivetha B, Pratheebamary R, Rajakumari Agnes A, “Biometric Based Electronic Voting System Using Aadhar (2017)”, International Journal of Innovative Research in Science, Engineering and Technology (IJRSET), Volume 6, Special Issue 14, pg. 75-80, Available: [www.ijrset.com](http://www.ijrset.com)

[19] Jitendra Waghmare, Dhananjay Manusmare, Bhagyashri Dongre, Manisha Bannagare, Shreya Chahande, Kunal Sontakke, “Implementation of Aadhar Card Based EVM Machine with GSM Module, (2017)”, International Journal of Engineering Science and Computing (IJESC), Vol. 7, Issue No.3, pg. 5452-5455, Available: <http://ijesc.org/>

[20] N.N.Nagamma1, Dr. M.V. Lakshmaiah and T. Narmada, “Aadhar based Finger print EVM System (2017)”, International Journal of Electronics Engineering Research (ISSN), Volume 9, Number 6, pg. 923-930.

[21] Sathya.G, Jeevanantham.C, Sangeetha.K, Venmathi.V, Ramya.P, “Bio Metric Authentication System Based On Aadhar Card (2017)”, International Journal of Pure and Applied Mathematics (IJPAM), Volume 117, No. 9, pg. 7-11, DOI: 10.12732/ijpam.v117i9.2

[22] A. Pirathepan, S. Sasikaran, P.Thanushkanth, 1S. Tharsika, M. Nathiya,C. Sivakaran, N. Thiruchchelvanand K. Thiruthanigesan, “Fingerprint Voting System Using Arduino (2017)”, Middle East Journal of Scientific Research, DOI: 10.5829/idosi.mejsr.2017.1793.1802

[23] CH.S.Vineetha Devi, P.Bhavani Sankar, “Finger Print Based Electronic Voting Machine (2018)”, International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 02, pg. 1040-1042,

Available: [www.irjet.net](http://www.irjet.net)

[24] P.Tamilarasu, S.Aadhithyan, K.Gowthaman, V.Hariprakash, “Fingerprint based Electronic Voting Machine (2018)”, International Journal of Current Engineering and Scientific Research (IJCESR), Volume-5, Issue-2, pg. 67-70.

