Triple Authentication mechanism for a reliable Voting Set

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Abstract

The voting process decides a person or team/party to rule an organization, division, state, country, or such others. In democratic countries like India, voting plays a vital role. Voting generally uses manual/semi-automated/automated election mechanisms. As the manual voting process has many drawbacks, most of the countries are transitioning from manual to e-voting.

Although technology has been improved a lot from the ancient world, to till date a lot of demerits existed in e-voting using EVM also such as rigging, deleting votes that are even eligible. In addition to the above drawbacks, improper authentication, storage mechanisms, and security are some of the challenges still facing e-voting.

A lot of research is conducted to attack the challenges and design a fully automated e-voting system. Many researchers are doing hard work regarding this. Some issues identified with the already existing proposals; hence this paper is trying to provide a way to design an automatic e-voting system using an Automatic Decision System [3]. The current study's main objective is to increase the utilization of vote right through remote voting in which the literacy rate is less.

Keywords: *Voting, Elections, Automated Decision System, Democratic, Authentication*.

Related Work

Technology is playing a crucial role in our daily life. Even though technology spreads throughout the world, awareness is not in this proportion about voting/election procedures. A lot of underdeveloped and developing countries are still using manual/semi-automated voting. Some developed countries are gradually implementing automated/remote/e-voting by facing little efficiency due to security, rigging, and other problems. The organizations/countries that are using remote voting are also facing vulnerabilities like malicious software, coercion, vote-selling, and others [1]. In spite of the voting method, various issues and challenges are arising especially in India like large democratic countries [14]. These issues and challenges are definitely changing the

results in elections. The verifiability aspect is one of the parameters in e-voting [15]. The verifiability metrics include an identity card, QR code, amount of ballots data, and others.

The traditional voting system suffers from a variety of drawbacks starting from information collection of voters to result from processing [2]. Technology improvement also influenced the old election system and led to the introduction of the E-voting process. Proper implementation of E-elections offers features like reaching of information to voters, avail his/her vote from any constituency and others [3]. Recent research on automation of voting addressed the evaluation of methods like Business Processes of an Election System [2], E-Voting using blockchain [4], E-Voting using Biometrics [5], using ring signature [7], Watermarking in e-voting [6]. These methods are definitely reaching towards efficient electronic voting. Prior predictions on voting results might also change the mindset of people and so clear result prediction is required by using emerging techniques such as machine learning-based strategy [8] for accurate predictions.

One of the emerging needs to be addressed is to implement e-voting that avoids the drawbacks of traditional voting and identifies fraud voters. Blockchain provides cryptographically secured records and giving voter access by eliminating voter fraud [4]. The overall count of votes in form of number and percentage can be specified in a short span if an automatic/electronic voting system [3] is used. After availing the vote right, securing the data confidentially on servers is a challenging activity in E-voting [9]. The sociotechnical and environmental issues need to be considered [12], during the designing phase of E-voting systems. Securing of the ballot (either manual or automated) is also required to prevent from interrupting it from an insider or outsider [10]. The automation voting system must consist of various considerations such as anonymity and verifiability [11]. During the E-voting process, in addition to security, anonymity is also required that removes the voter identity to safeguard the privacy of voter details [11]. Anonymity ensures the counting without infringement and eligible voters count.

One of the major identifications with the voting system is, to improve voting percentage. For this purpose, the usage of the digital division of voters might be conducted based on age, income, locality, education, internet use and others [13] and so the impact on E-voting can be increased. In addition to that, the mindset of voters needs to be static, as voting will be changed in seconds due to money, caste, communalism, lack of moral values in politics, and others [14]. Advanced algorithms/methods required to address the E-voting system with a huge number of voters [10]. To reduce the complexity in large-scale e-voting systems are adding Watermarks to ballots so that the fake ballots will be identified and removed easily [6]. Another interesting thing in recent times is many machine learning algorithms are working on the election process, especially in predicting the percentage of voting as well as results before starting the election process. Normally the voter opinions are identified casually and used as a training set for predictions. The accuracy rate is also verified with the model [8].

Introduction

In Democratic countries, elections are very important as the voters are the overall population of the country. The voting process is crucial to elect officials who are sworn in to rule. The study of the voting/election specifies that the voting process takes three variations - traditional (manual ballot voting), semi-automated (Electronic Voting Machines), and automated (remote voting). In all these three categories, the overall conduction process is the same, but the difference is, the activities that are conducted either manually or automatically. The traditional voting system is a pure manual-based election process shown in figure-1, in which data collection of voters to results processing is conducted manually. In traditional voting, a lot of demerits existed such as:

- Inaccurate / inconsistency in data collection
- Voting may not be possible due to the pandemic situations like Swine flu, COVID-19.
- Cross voting
- Delay in voting
- Storage of physical ballot boxes in a secured manner
- Duplication of voter names
- Mistakes in the counting of votes
- Votes that are invalidated due to ambiguous selection of contestant
- Rigging and so on

Figure 1. Manual Voting

Electronic Voting Machines (EVM) introduced in semi-automatic voting and some activities are automatic and the remaining is manual. Hence some time will be saved while giving persons' vote as it is less time-consuming than traditional voting as per the figure-2. The current process is also having almost similar drawbacks to that of traditional except delay in voting. Different research institutes like IITs, NITs are utilizing their experience to evaluate a voting process that is fully automatic with as possible effectiveness and accuracy. With the advent

of improvements in technology and different available research studies, remote voting-like approaches enlightening gradually. Though remote voting requires more team effort and network possibilities, the accuracy of voting and effectiveness in result processing might be high. A fully automatic or full E-election system provides benefits such as fearless voting, guarantee not to leak votes in front of anybody [3].

Figure 2. Electronic Voting Machine

The basic idea behind remote voting is to eliminate the drawbacks of traditional / semi-automated voting as possible. The main concern in this approach is to utilize the vote right from anywhere so that percentage of voting must be improved. A method like UVote can work as a front-end for traditional voting [1]. Another general requirement with a remote voting system should be designed in a way, such that the voter can change the vote before pre-set deadline time [4], but it is not always a preferable idea for effective voting especially in India-like countries. The objectives of remote voting are:

- Availability of complete and accurate information of voters
- Ease-of-use availing vote right
- Reachability about elections information in a fast and highly updated manner
- Elimination of cross-voting and rigging
- Improvement in voting percentage
- Lot of manpower and security issues for the election commission can be reduced [5].

The conduction of remote voting is a complex thing and not easily solvable as converting the voters' data from manual to automatic is not a single-day process. The countries with less literacy face problems in this situation, as the automatic registration of voter information, should require knowledge on the usage of computer systems and their applications. Remote voting is possible in countries with high literacy. A solution for this is automation centers like e-Seva / Mee Seva services will be utilized for voter registration as nearby future linked with technology usage only.

Methodology

Proper work out on the electronic election system excludes inaccuracies and misunderstandings of traditional or old election systems [2]. In India-like countries, the voting aggregate percentage throughout India is about 75% only in general like elections, whereas in some areas it is even less than 45% also. The primary reasons behind less percentage of voting are lack of awareness in electing a representative or contestant to rule, long waiting time in queues; traditional methods of voting are not possible in pandemic situations such as COVID-19, Swine flu; lack of security for voters in areas; unclear information regarding polling booths; away from constituency; less awareness on the election process and so on. Making the voting process online is the better solution to resolve the problems in traditional voting and the online/E-voting has an advantage of digital divide impact [13]. The main advantage of E-voting is that voters will confirm his/her details and also be able to avail themselves the vote from the current location [3].

Hence remote voting is a solution to improve the voting percentage and awareness. But in this type of moderate voting system also some vulnerabilities should exist that are to be eliminated in nearby future. To face the vulnerabilities of the remote voting approach, encryption algorithm-like techniques will be used [10]. UVote is an alternative for remote voting, which provides a convenient voting solution along with a guarantee of security [1]. Another promising digital technique is ring signature, as it has the benefit of the inability to conduct double waste attacks [7].

Triple Authentication:

The current study proposes a triple Authentication approach for automation of the voting system under remote voting. The word triple authentication specifies that registering the voter details securely using unique identifiers such as aadhar is the first authentication. In this process, the manual entry of voter details was eliminated. The consequence to this is identifying a voter using finger biometric using biometric sensors is the second authentication. Finally, the third authentication is, a voter will be identified clearly by displaying the details automatically after capturing his/her face using a face recognition sensor.

Authentication-1 (Voter Registration):

In this system, the voter details are captured into a database server by transferring the details of aadhar-like a face recognition system. Figure-3 shows how the capturing of face recognition happened. The face recognition using the eye retina gives a unique identification of each individual person and is dissimilar to any other second person. Hence Aadhar card type of data can be considered for voter registrations. A lot of manual effort will be saved from this type of registration. This type of recognition is more powerful and secured than only using finger biometric, as an aadhar card-like system captures fingerprints, eye retina rays and also allocates

unique numbers to individual persons throughout the country. Hence much time will be saved in data collection and revising. A voter can be given the facility of updating / deleting his/her own details using OTP like mechanism through the web or by using online centers.

Figure 3. Voters registration using Unique Identification and Eye retina image

Authentication-2 (Fingerprint Biometry):

On the day of voting, the web page/application that consists of contestant details along with the party symbols will be displayed as a list. This page will be enabled only at the specified time on that day. At the time of voting the voter places his/her finger on the sensor that detects a person. A finger biometric sensor is used to identify a voter immediately after opening the web page/application. It identifies a voter by comparing the details from the database [5] like the below figure-4. If this fold is successful then only the system enables the voter to proceed. But there is a chance of rigging, as nowadays some distractions are going with fingerprint biometry also.
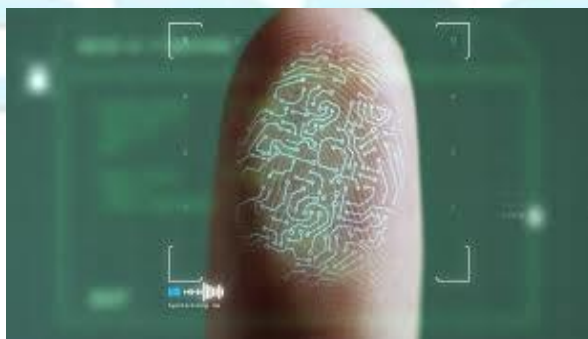

Figure 4. Fingerprint Sensor

Authentication-3 (Face Recognition):

So after successful completion of fingerprint authentication, a face recognition sensor is used by voters to capture the details. If all matched then only the page with ballot details will be

displayed, otherwise the web page/application redirects to the home page. After choosing the desired contestant, a confirmation will be asked before submit. In this process definitely, some urban and remote village people will face problems and so proper training must be required. The future is all interlinked with technology and so learning this process is important for each and every citizen. It is not so easy to maintain sensors in each and every individual house to detect fingerprints, as well as the voter's face and so some pooling centers, are definitely required to cope up with this criterion. Strong rooms like patterns can be used for this type of voting process so that only one person can enter into the room to avail his/her vote confidentially. Below figures 5 and 6 are representing the samples about the current step.
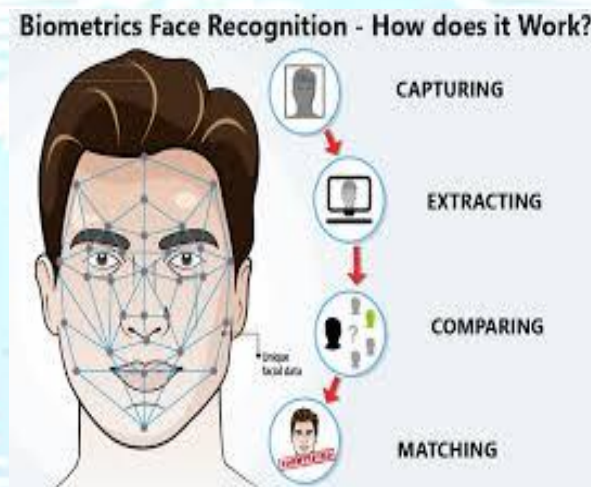

Figure 5. Process of detecting a voter

*Step-by-step approach in remote/e-voting:*

The following is the step-by-step approach for the process of remote/e-voting system.

Figure 6. Face recognition before attempting to avail vote right

1. Initially take assistance from UID (Unique IDentifier) database/data warehouse that also consists of biometric and eye retina ray information.
2. Now apply pre-processing technique(s) on the collected UID database such that information is consistent, complete, and accurate. Only consider the details of voters greater than or equal to a limited threshold age value (for example 18 in India).
3. Now classify the post-processed database into disjoint clusters so that each cluster represents an individual unit/constituency of voter information.
4. As the first step in the Triple authentication method was completed in step (1), conduct second and third steps of the method are going to be applied to every eligible voter.
5. If both the steps are successful then, he/she is able to vote and proceed for the voting.
6. The procedure is applicable for each and every voter until the voting time is closed.
7. If the time is over for the voting, then no voter will be allowed for voting.

The following figure-7 shows an overview on remote / e-voting in form of a flow chart.
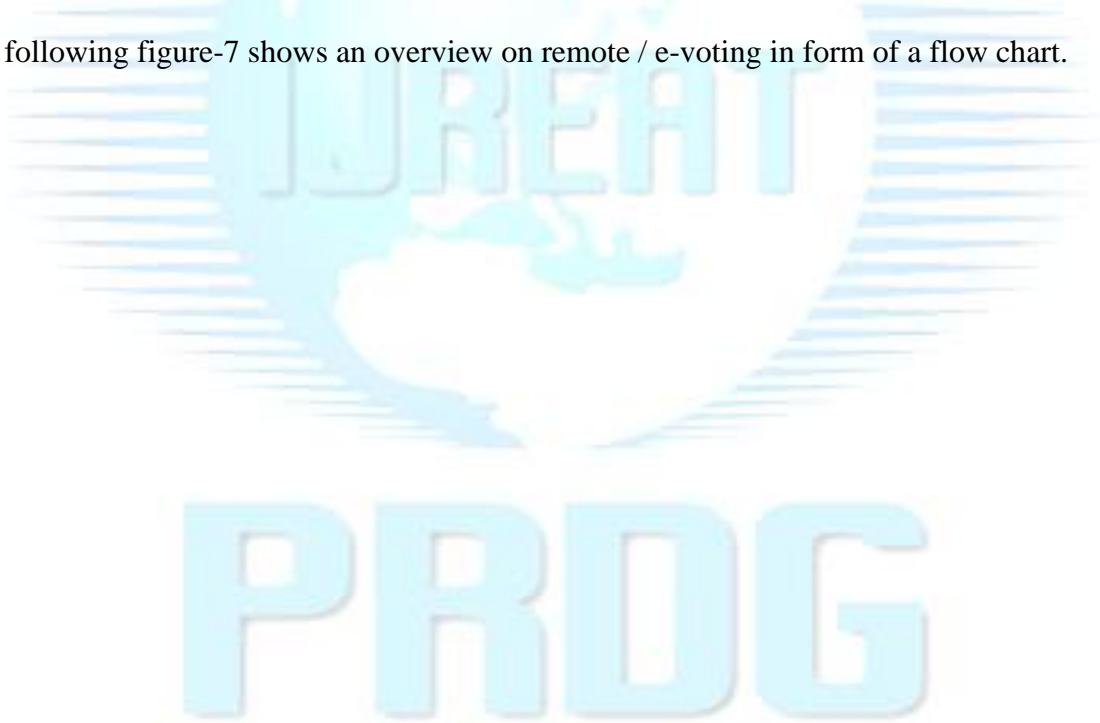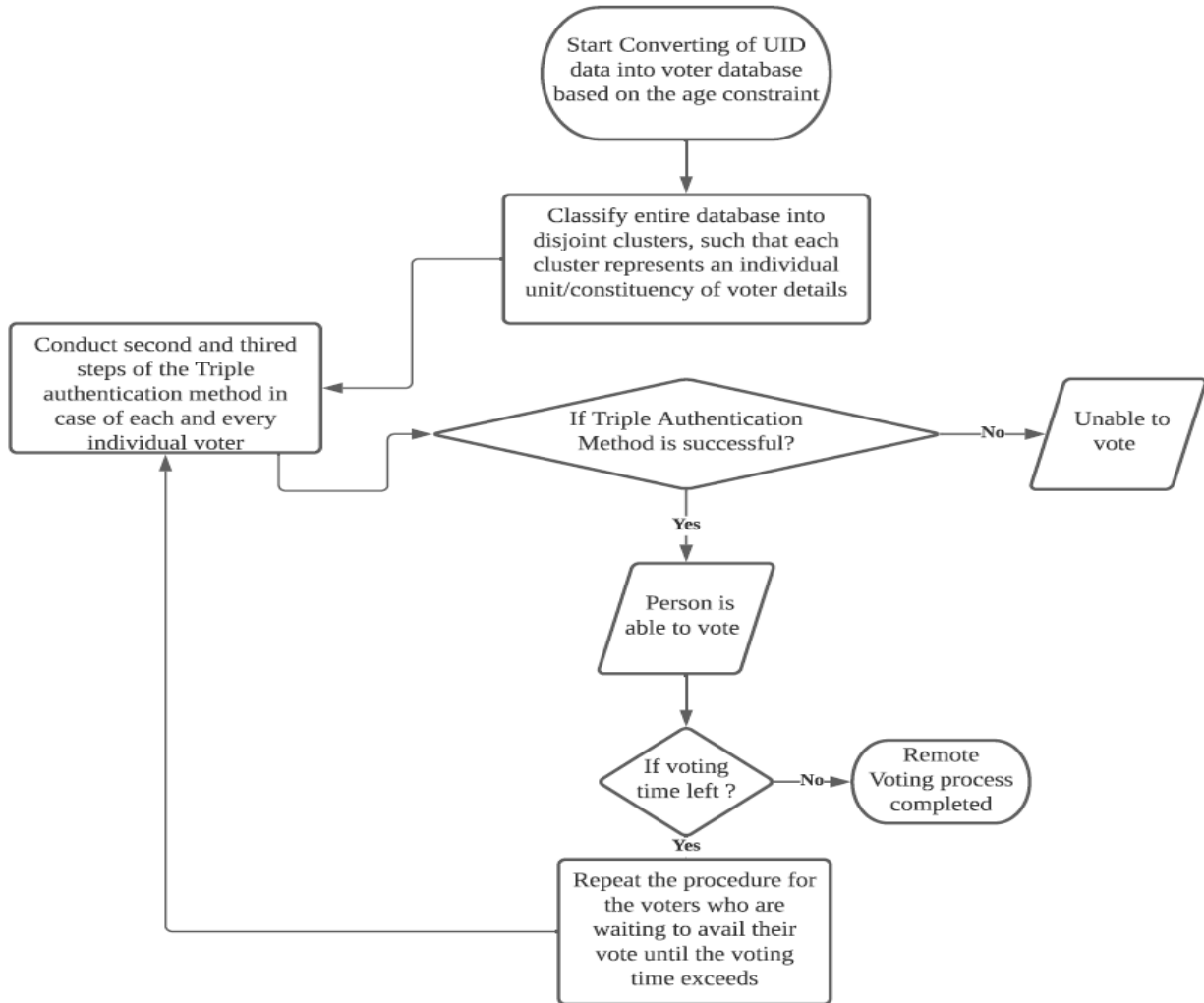
Figure 7. Flow chart for E-Voting system

Key considerations in the Triple Authentication method:

Requirements:

- Encouraging of voters strongly towards remote/e-voting.
- Highly configured and large capacity Servers to store and retrieve voter details automatically
- Portable and ubiquitous application that runs anywhere to vote
- Effective sensors to capture fingerprint and retina rays
- Laptop / PC that runs the above-specified app
- Other supporting equipment

Advantages:

- Availing the vote right from any location
- Long waiting in queues eliminated
- Security is more
- Awareness to voters
- Reducing accidents while taking travel for a vote
- Chance of announcing results in less time
- Some relaxation would be faced by Election commission / policemen

Drawbacks:

- It is expensive to maintain the required infrastructure.
- Some voters will face problems during online voting for the first time
- Without proper awareness on implementation, the system will fail.
- Server availability and/or reliability is the major threat in the current method.

Results and Predictions

Irrespective of the election mechanism such as traditional or semi or automatic voting, the percentage of votes polled plays a vital role in the election process.

State	2018/19	2013/14	2008/09
Andhra Pradesh	79.74 (2019)	74.20 (2014)	72.37 (2009)
Telangana	73.74 (2018)	76.80 (2014)	
Karnataka	72.57 (2018)	71.45 (2013)	64.68 (2008)
Tamilnadu	74.81 (2016)	78.01 (2011)	70.82 (2006)
Kerala	77.53 (2016)	74.92 (2011)	72.38 (2006)

Table 1. Recently polled votes percentage in Southern states of India

The countries like India are highly influenced by religion, locality, caste, community, and others [14] and the results also drastically change in the election process. The above table-1 shows the statistics on the percentage of votes polled in the last three general elections in southern Indian

states [16]. If we move on to automated voting using remote voting or any other approach, the polling percentage of votes will be increased and expected to be more than 90%.

Conclusion and Future Enhancements

Recent GHMC elections in Hyderabad had shown the impact of manual voting. The percentage of voting was decreased drastically due to the pandemic COVID-19 situation. The hurdles we faced with traditional voting [5] partially avoided with the introduction of EVMs. But still, EVMs are also insecure and hence research is fast on remote voting. The current proposal implementation is not so easy to implement as the system was complex. Another issue is that the understanding of the mechanism by voters is also very important for success.

Hence it is better to implement the approach to small organizations / local elections. If accuracy is achieved, then promote it to small area-wide elections. Proper accuracy is not reached, make adjustments for improvement. The authentication and security methods like Digital Watermarks [6] used to validate the procedure of e-voting. If accuracy is satisfactory, then extend the method to various large organizations / voluminous population countries also.

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