A Seminar Report
on

Integrated Election Voting System: A Model for Leveraging ICT in the Indian Election Scenario

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In partial fulfillment of the requirements for the award of the degree of

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under the guidance of

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DECLARATION

I, Gurpreet Singh Matharu, student of M.Tech (IT) hereby declare that the seminar titled **"Integrated Election Voting System: A Model for Leveraging ICT in the Indian Election Scenario"** which is submitted by me to Department of Information Technology, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida, in partial fulfillment of requirement for the award of the degree of Master of Technology in Information Technology, has not been previously formed the basis for the award of any degree, diploma or other similar title or recognition.

Noida

Date Gurpreet Singh Matharu

CERTIFICATE

On the basis of declaration submitted by Gurpreet Singh Matharu, student of M. Tech (IT), I hereby certify that the seminar titled **"Integrated Election Voting System: A Model for Leveraging ICT in the Indian Election Scenario"** which is submitted to Department of INFORMATION TECHNOLOGY, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida, in partial fulfillment of the requirement for the award of the degree of Master of Technology in Information Technology, is an original contribution with existing knowledge and faithful record of work carried out by him under my guidance and supervision.

To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

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FEEDBACK BY EXAMINERS

A. Comments From Seminar Guide

B. Comments From External Examiner

ABSTRACT

In India, Information and Communication technologies (ICT) are being implemented in almost all sectors like health, education, transportation, media, etc. But when we look towards the domain of Indian Election Voting, it is felt that the ICT is still to be exploited to accrue its benefits. Several initiatives are being rolled out by the Election Commission of India to promote the application of ICT in the Indian Elections. After studying the way in which Indian Election Voting is held and the low voting percentages being reported year after year, we are of the opinion that India still needs to have a much more participative model of election voting system in place to ensure much higher voting percentages. In the existing election polling system, the electorate has to visit the designated polling booth and have to be identified before being able to cast their votes. This procedure consumes a lot of time in casting votes by the electorate. This report proposes an E-Voting System to provide a solution to the problem of low voting percentages among the Indian electorate in the democratic elections, especially among the affluent classes of the society. The deployment model "Integrated Election Voting System" leverages existing ICT technologies and existing ECI databases to integrate the existing EVM Voting System with the proposed E-Voting System.

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1. INTRODUCTION

India being the world's largest democracy, holding free and fair elections here has always been a herculean task. The Election Commission of India has been discharging its constitutional duties very well. Also, a well-known fact is that elections in India are accorded a very significant status and are a part and parcel of everyone's life in the Indian society.

In India, the Information and Communication technologies (ICT) are being leveraged in all the sectors be it health or education or transportation. But when we turn around and see towards the current scenario of Indian Election Voting, we discover that a slew of e-initiatives have been rolled out by the Election Commission of India to improve the way in which polling is conducted during the Indian Elections. But the maximum potential of ICT is yet to be exploited to accrue its benefits.

After studying the statistics related to electorate turnout percentages in the Indian Elections being held since Independence, it has been found out that the voting percentages has fluctuated just between 55% and 65% for the combined total of male and female voters. For male voters, it has remained between 60% and 70% whereas for female voters, it has remained between 50% and 60%. No rocket science required to understand that these voter turnout percentages are exceptionally low and are not signs of a healthy and vibrant democracy.

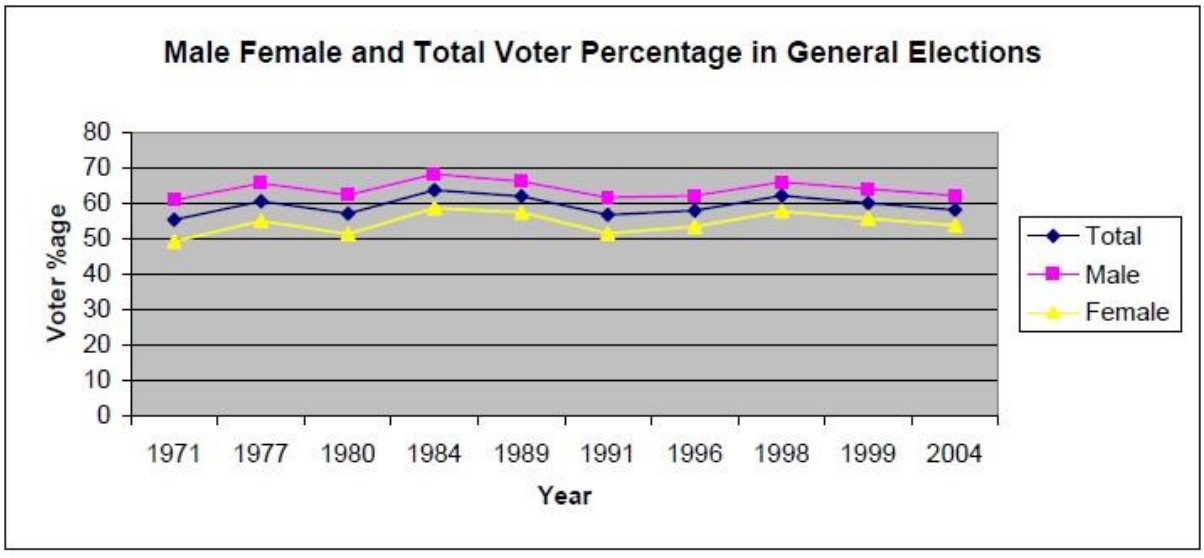

Figure 1: Male Female and Total Voter Percentage in General Elections

Another well-established fact is that the people belonging to influential classes and much percentage of the upper middle class are those who are behind in the race when it comes to casting their valuable ballot in the elections whereas a very high percentage among the rural people cast their vote in the elections. Hence, we need to focus on how to increase voting percentages among the people from influential and upper middle classes.

As a very high percentage of people from upper middle class and influential class have access to the Internet and many are equipping themselves with latest smart phones out in the market, we can leverage the ICT technologies to boost the voting percentages among them.

In this report, an E-Voting System has been proposed to provide a way to the people who have got internet access to be able to cast their votes at the ease of their homes or while on-the-go. Also, an "Integrated Election Voting System" has been proposed which integrates the already existing EVM Voting System with the proposed E-Voting System. This would ensure that all the sections of the society can cast their votes wherein the people with internet access can opt to vote online and the people not having access to the internet services can continue casting their votes through the present EVM Voting System.

2. LITERATURE REVIEW

In his work, Hari K. Prasad highlights the fact that although the Electronic Voting Machines have been admired for their simple design, ease of use, and moreover for reliability and precision, but in recent times they have been criticized following widespread reports of election irregularities. Despite the criticism for EVM, the details related to the machines' hardware design have never been publicly disclosed by the Election Commission, and also they have not been subjected to a rigorous security evaluation by an independent agency. The author concludes that although the Electronic Voting Machines have simplicity in design, they are vulnerable to security attacks that can alter election results and infringe on the secrecy of the ballot results.

In his work, Mayur Patil has conducted a survey of all available voting system techniques including Paper Ballot System, Electronic Voting System, Online Voting System, SMS Voting through mobile phones. The author after a comparative study of all the voting systems concludes that there is a need for developing a new voting system that combines the advantages of all the existing voting systems and overcomes the drawbacks of all those voting systems.

2.1 INITIATIVES BY ELECTION COMMISSION OF INDIA

The Election Commission of India has come up with several new ICT initiatives in the recent past. One of them that require special mention is computerization of electoral rolls. This has resulted in large databases being created at the disposal of the Commission. Our proposed model leverages these existing databases along with a number of ICT technologies and security mechanisms to allow for the integration of existing Electronic Voting Systems with the E-Voting Systems being proposed.

Also, the Commission has introduced Online Voter Enrolment wherein anyone who is eligible to vote and does not possess a voter card can opt to apply for the same through the web portal of the Commission. This has provided for an easy and simplified method for the citizens to enroll as a voter at the comfort of their homes.

Another e-initiative introduced by the Commission is a scheme which enables the political parties out in the fray to use the State owned Electronic Media for broadcasting their content. This scheme provides for a level playing field for all the political parties contesting in the elections. Also, the Commission has introduced e-filing of poll affidavits by candidates for the first time in the history of Indian Elections.

But, in India, several ICT and allied technologies need to be leveraged to improve and upgrade the mechanisms being employed for holding free and fair elections. The success of elections not lies as much as who is the winner and by what margin as is the percentage of registered voters who casted their ballot. Hence, ICT must be leveraged to its fullest potential in the domain of Indian Election Voting to boost the voting percentages and thus, ensure the success of the elections being held to elect the representatives of the people.

2.2 EXISTING E-VOTING SYSTEM

Tata Consultancy Services has developed an Online Voting System to be implemented in the Indian State of Gujarat. It was deployed on behalf of State Election Commission Gujarat in the elections to the local civic bodies of Surat, Vadodara, Bhavnagar, Jamnagar, Rajkot and Ahmedabad held on October 10, 2010.

It was first of its kind project in India where online voting was also made an option for casting the ballot in the elections. It was very innovative in the sense that the people got a chance to vote from the very comfort of their home. It gave way to a new voting channel in Indian elections which was not implemented till recent times.

The post-election results show that much higher voter percentages were recorded through online voting channels as compared to EVM and ballot voting systems. Also, the project results show that the voters and all other stakeholders involved were satisfied by the online voting channel.

But the overall findings suggest an altogether different story. The results were disappointing as out of a total of 8.61 million registered voters, just 183 had actually e-voted on the voting day. This may be due to some shortcomings that exist in the model implemented by Tata Consultancy Services.

In this report, the proposed model ensures a much better implementation of E-Voting System in terms of authentication, validation, security issues and database handling. Also, the proposed model makes more sense to the current Indian Election Scenario as it provides for integration of the existing Electronic Voting Machines with the proposed E-Voting System.

2.3 CHALLENGES IN E-VOTING SYSTEMS

1) *Compliance to Laws & Regulations*

The inclusion of E-Voting in the Indian Elections would require some changes in the law to include it as another means of casting the vote by the citizens of the country. Also, it needs to be in accordance with the guidelines and legal requirements issued by the Election Commission of India.

2) *Security Issues*

The entire E-Voting system and the E-Voter database would be operating using the Internet services which makes them more susceptible to online threats. Therefore, multiple layers of security are being implemented through use of firewall, anti-virus, SSL to ensure highest levels of security for the web portal and mobile applications. Also, various encryption mechanisms would be employed to ensure that the login id and password of all the E-Voters are stored in an encrypted format in the databases.

3) *Authentication*

The model incorporates various authentication mechanisms to authenticate the identity of users during the registration phase. It includes a two-step authentication process. First being

authentication through online means. This would be followed by physical verification by an Election Commission official at the applicant's residence.

The online authentication module is implemented by asking the users to submit a prescribed set of documents through the web portal or mobile applications which would be further processed for verification. Another level of authentication is provided for by asking the user to register an email address and mobile number in addition to other necessary details and documents. The web portal is integrated with the SMS gateway to send One-Time Password (OTP) code on the user's registered mobile phone and then that code is compared with the code the user fills in the verification module.

4) *Issues during E-Voting*

With a very low probability, some issues may arise while a user is in the process of casting the vote through online means. It may happen that the server on which the web portal meant for e-voting has been hosted goes down due to excess traffic load. In this case, the user would have to visit the polling booth and get a referral token generated using the services of the vote mapping module and cast the vote through the Electronic Voting Machines.
Also, the user may lose access to the registered phone number or email address required for authentication purposes. In such cases also, the user would have to visit the polling booth to cast the ballot.

Another issue can be that the user is having access to poor quality Internet services or has completely lost access to the Internet. Then, the user has the option to visit the polling booth and use the E-Voting nodes over there to cast the ballot online.

3. PROPOSED MODEL (IEVS)

This report proposes theoretical deployment model “Integrated Election Voting System” through the use of various ICT technologies including the use of Private Cloud for storing the E-Voter Database and also leveraging the existing electoral databases being maintained and managed by Election Commission of India.

Integrated Election Voting System: As the name suggests, this model provides for integration of existing Electronic Voting Systems and the newly introduced E-Voting System using the technological advancement in ICT domain.

The model being proposed not only leverages the ICT technologies but also ensures that it does not compromise on the secrecy of the ballot required for a free and fair election. Also, the model attempts to cover all the existing loopholes in the electoral systems that would otherwise allow manipulation in the election voting process.

Components of Integrated Election Voting System:

3.1 USERS

The model being proposed has been designed keeping in mind all categories of users. The voters may cast their ballot either through the Electronic Voting Machines or through the E-Voting Systems. The method chosen by them for casting their ballot depends upon how suitable it is for them and also upon what is feasible for them.

As a large number of voters may not have access to the Internet, therefore they would have to cast their vote as is being done currently, i.e. through the Electronic Voting Machines. The model aims to boost the voting percentages among the people belonging to affluent and upper middle classes. Most of them have internet connectivity at their disposal which they can leverage to cast their votes through the e-voting channel being offered by the proposed model.

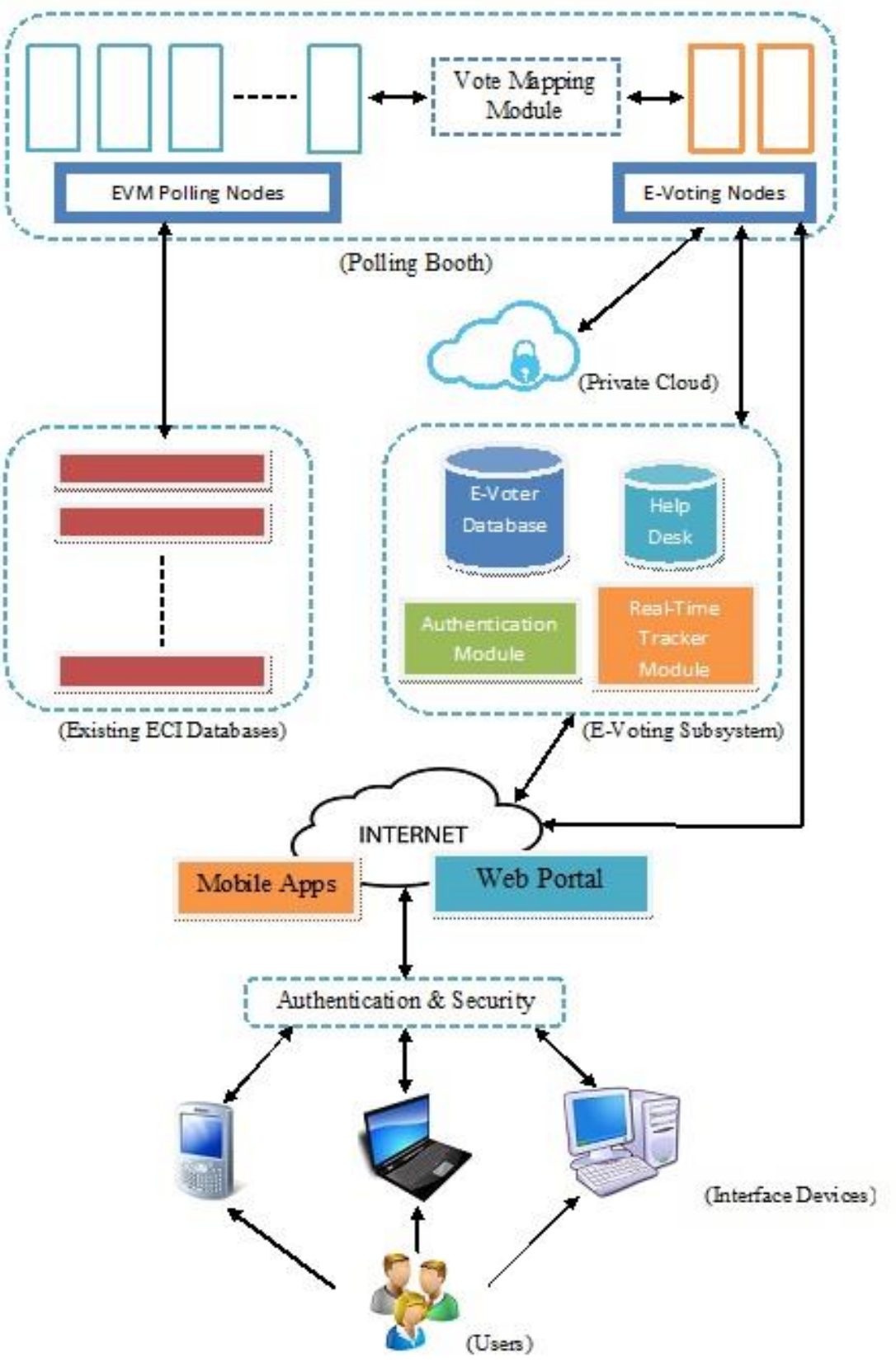

Figure 2: Model Architecture for Integrated Election Voting System

3.2 INTERFACE DEVICES

The proposed model includes the following interfaces devices to allow the voters to cast their votes through online applications:

1) *Desktop Computer:* The proposed model makes possible both, registration for e-voting and casting of vote through a desktop computer with required Internet Connectivity. The users may cast their vote through a personal computer either from their place or from any other personal computer node. The tasks of registration for e-voting and casting of online ballot requires for the user to access the Web Portal designed and developed for E-Voting by the Election Commission India.

2) *Laptop*: The user may also choose to cast his or her online ballot using a laptop with Internet connectivity. This allows for leveraging the mobility benefits of the mobile devices such as laptop and the existing wireless Internet services. The model allows for casting of vote by the user while on-the-go using a laptop and wireless internet service. Both, registration for e-voting and casting of online ballot are possible through a Web Portal designed and managed by the Election Commission of India.

3) *Smartphone*: The proposed model is also leveraging the ever-expanding smart phone segment of mobile users. The users may choose to register themselves as E-Voters and cast their online ballots through the smart phones having popular operating system such as Google Android, Apple iOS, Windows Phone OS, Blackberry OS. The model proposes that mobile applications for all the popular mobile operating systems be developed so that the users are able to leverage their smart phones to cast their vote online.

3.3 AUTHENTICATION & SECURITY MODULE

The model incorporates various authentication mechanisms to authenticate the identity of users during the registration phase. It includes a two-step authentication process. First being authentication through online means. This would be followed by physical verification by an Election Commission official at the applicant's residence.

The online authentication module is implemented by asking the users to submit a prescribed set of documents through the web portal or mobile applications which would be further processed for verification. Another level of authentication is provided for by asking the user to register an email address and mobile number in addition to other necessary details and documents. The web portal is integrated with the SMS gateway to send One-Time Password (OTP) code on the user's registered mobile phone and then that code is compared with the code the user fills in the verification module.

Also, multiple layers of security are being implemented through use of firewall, anti-virus, SSL to ensure highest levels of security for the web portal and mobile applications.

3.4 USER APPLICATIONS

The model allows the user to register for E-Voter and cast their vote either through a web portal or through mobile applications. The user may access the web portal through a desktop computer or through a laptop or tablet. Also, if the user wishes to register for e-voting and casting his or her vote through the use of smart phones, he or she can do that through the use of mobile applications developed based on popular mobile operating systems such as Google Android, Apple iOS, Windows Phone OS and others.

3.5 EXISTING ECI DATABASES

It is known that the Election Commission of India has recently implemented computerisation of electoral rolls. This has resulted in huge databases at their disposal. Our proposed model leverages these existing databases along with a number of ICT technologies, authentication and security mechanisms to allow for the integration of existing Electronic Voting Systems with the E-Voting Systems being proposed. Also, the EVM polling nodes leverage the existing electoral rolls stored in huge databases being managed and maintained by the Election Commission of India.

3.6 E-VOTING SUBSYSTEM

1) *E-Voter Database*

To achieve the objectives of proposed election voting model, a centralized and efficient database is required to store and manage the data of millions of E-Voters. The online registration for E-Voting collects necessary details and prescribed set of documents from the applicants and stores them into a centralized database at the back-end. These databases are to be managed and maintained by the Election Commission of India for ensuring its secrecy and protection against unauthorized entities.

The E-Voter central database is basically a private cloud owned by the Election Commission of India which will provide Platform as a Service (PaaS) to store all the E-Voter related data, which would be accessible only to the authorized users. The access level of database for the registered E-Voters would be limited to registration, verification and authentication purposes.

Cloud Service Models

The cloud offers Information Technology as a service to the users, thus making it feasible for them to make use of Xaas i.e. X as a service, where X can be software, platform, infrastructure or anything without knowing the physical location or configuration of the system that is delivering these services. These are termed as Cloud Service models.

Cloud Deployment models

Public cloud: The cloud infrastructure is owned by an organization selling the cloud services and these services are made available to the general public or a large business or industrial group.

Private cloud: The cloud infrastructure is operated solely for an organization. It may be managed by the same organization or by a third party. Also, the infrastructure may exist on premise or off premise.

Community cloud: The community cloud infrastructure is shared by several organizations and supports a specific community group having shared concerns related to mission, or security requirements or compliance considerations. It may be managed by the organizations or by a third party. Also, the infrastructure may be located on premise or off premise.

NIST defines Cloud computing as having the main aim to provide convenient, on-demand, network-enabled access to a shared pool of configurable computing resources such as networks, servers, storage, applications, and services, which can be rapidly allocated and released with minimal management effort or service provider interactions. Cloud can be deployed as public, private or hybrid models which may provide services through various service models like Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) at relatively cheaper costs. Hence, Cloud computing is a very powerful tool, which if leveraged efficiently can provide a successful Integrated Election Voting System (IEVS) for the Indian Elections.

2) Real-time Tracker Module

This is another important component of the proposed system. This module would be interfacing with the E-Voter database to maintain the list of registered E-Voters. Also, it would be interfacing with the E-Voting nodes at all the polling booths to provide real-time tracking of the vote status of all the registered E-Voters. It would be tracking the vote status as VOTE CASTED or VOTE NOT CASTED for all the registered E-Voters. Also, this would allow the Election Commission staff on duty present at all the E-Voting nodes available at the polling booths to track the E-Voters who have successfully casted their votes and those who have not done so and this tracking would be provided by the tracker module in real-time.

3) Authentication Module

This module embodies all the authentication mechanisms required to authenticate the E-Voters before allowing them to cast their vote. The web portal or mobile applications for E-Voting would require the E-Voters to login into their accounts through a set of username and password generated at the time of registration as E-Voter. The authentication module would

see if the login details entered by the user actually match with any of the existing accounts. If it matches, the user gets access to his or her account.
Also, the user is authenticated through the registered email address by sending a verification web link to it and asking the user to access that web link to proceed for the online voting. Further, the user is required to authenticate using the registered mobile number before submitting the online vote. The user would receive One-Time Processing (OTP) code onto the registered mobile number which would need to be submitted for casting the online vote.

4) Help Desk

The model also provides a Help Desk, which would be maintaining a database for all the E-Voting related issues along with their appropriate solutions. This would resolve all the problems encountered by E-Voters during registration process and during online election voting, hence providing a common platform for solving the E-Voting related problems.

3.7 POLLING BOOTH

1) *EVM Polling Nodes*

These are the existing systems by which votes are being casted in present times through the use of Electronic Voting Machines (EVM). The beauty of our model lies in the fact the existing Electronic Voting Systems have been made a part of the proposed Integrated Election Voting System. The EVM polling nodes leverage the existing electoral rolls stored in huge databases being managed and maintained by the Election Commission of India.

2) *E-Voting Nodes*

The E-Voters are free to cast their votes at the comfort of their homes or while on-the-go. But, it may happen that a person may experience poor quality of Internet service or face complete loss of Internet access at his or her place or may face issues while validating his or her identity before actual online voting. Therefore, to tackle such unexpected situations, the model has proposed for E-Voting nodes at the very same polling booth having EVM polling nodes so that those registered E-Voters who may not be able to cast their vote due to any

reason get the option to go to their designated polling booth and cast their vote through the E-Voting node available over there.

3) *Vote Mapping Module*

The USP of our model lies in the integration of already existing Electronic Voting Systems and the proposed E-Voting Systems. One of the most important components of the model being proposed is the vote mapping module which provides for interfacing of the electronic voting and e-voting systems.

It may happen that the E-Voters are not able to authenticate themselves due to loss of mobile number SIM registered with the Election Commission or loss of access to the registered email address. Such issues would act as barriers for the user to successfully cast his or her vote online. Therefore, a mapping module is required which provides for a referral system through which the user who was otherwise registered as an E-Voter is able to cast his or her ballot at the EVM polling node. The referral system would generate a referral token for the E-Voters which would make it possible for them to be able to vote through the EVM.

Several of the integration functions required in integrating the existing Electronic Voting Systems and the proposed E-Voting Systems have been included in the Vote Mapping Module. This module would also provide for mechanisms to ensure that no voter casts his or her vote both through the EVM and the online means.

3.8 ADVANTAGES OF PROPOSED MODEL

The model being proposed offers several advantages, some of which are as follows:

1) *Increase in Voting Percentages*

The model integrates the existing EVM System with the proposed E-Voting System. The people having Internet connectivity at their disposal, especially those belonging form affluent and upper middle classes can leverage the E-Voting channel and cast their ballot online. This would certainly boost the voting percentages from the currently prevailing low levels.

2) *E-ballot paper*

The online ballot has many advantages such as the user can change the font attributes like colour and size as per his or her suitability.

3) *Portability*

The model adds portability to the system in the sense that it works on Internet and therefore, the user can cast the ballot while on-the-go using an internet supporting device and wireless Internet connectivity.

4) *Faster systems*

The E-Voting method is very fast as compared to the traditional EVM Voting method. The voter would not have to wait in long queue for voting.

5) *Mobility*

The E-Voting system gives the freedom of casting the vote from anywhere in the country. This is beneficial for the voters who are regularly out of their constituency.

6) *Saves time*

The E-Voting method of casting the ballot would save a lot of time for a large number of people. The time required for travelling to and from the polling station would be saved. Also, the time otherwise required for standing in long queues to cast the ballot also would be saved.

7) *Lesser queue lengths at polling stations*

The availability of E-Voting system would mean that a number of people would like to cast their vote through online channel and this would reduce the queue lengths at the polling booths.

8) *Lesser traffic on roads*

As many people would choose to cast their ballot online, there would be no need for them to travel to the polling booth. This would ensure lesser traffic on roads on the election voting day.

9) *Local languages*

The model provides E-Voting through web portal and mobile applications which would be available in various regional languages of the country.

10) *Help for Handicapped people*

Also, the E-Voting System can prove to be a boon for handicapped people who otherwise find it impossible to reach the polling booth to cast their vote. They can opt to cast their ballot through the online means and this would ensure that our Election Voting System is truly participative and inclusive.

11) *Help for Ill and Injured people*

Similarly, the ill and/or injured ones can leverage the E-Voting system to cast their ballot through online means, who otherwise find it very inconvenient to visit the polling booth for casting their vote.

12) *Help for those who are out of their Constituency*

In some cases, a voter may be out of his or her constituency for a few months and may not be able to travel back to his or her constituency just for casting the ballot. Our model offers them with an option to register for e-voting and cast their ballot online. This would further increase the voting percentages.

Also, the proposed model incorporates benefits of Cloud computing as the E-Voter database is stored on a private cloud.

1) *Data Management:* The E-Voter data will be stored centrally and managed by a team of trained personnel of Election Commission of India, thus ensuring efficient data management.

2) *Security*: Since a private cloud is being implemented for E-Voter database storage, a very high level of database security is maintained due to the security mechanisms the cloud offers.

3) *Common Platform for Resolving Problems:* The model provides a Help Desk, which would maintain a database for all e-voting related problems along with their appropriate solutions. This will resolve all the issues encountered by E-Voters before elections and during online election voting, hence providing a common platform for election voting related problem solving.

4. CONCLUSION

The Election Commission of India has recently rolled out a number of Information and Communication technologies (ICT) based initiatives. But the ICT remains to be exploited to its fullest potential with the aim of streamlining the Indian Election System. India still requires a much more participative model of Election Voting System in place to ensure much higher voter participation. The existing Election Voting System requires the voters to visit the designated polling booth and cast their votes through Electronic Voting Machines. This consumes a lot of time in casting votes and also does not achieve high voter turnout levels.

This report proposes an E-Voting System to overcome the problem of low voting percentages among the Indian electorate, especially among the affluent and upper middle classes of the society by providing them with an online voting channel. Also, this report further proposes the deployment model “Integrated Election Voting System” that integrates the existing Electronic Voting Systems (EVMs) and the proposed E-Voting System. Also, the proposed model leverages the existing ICT technologies and the existing ECI databases.

The proposed model in addition to various ICT technologies, leverages the Cloud computing as the E-Voter central database would be maintained through a private cloud owned by the Election commission of India. The model performs well on all the service parameters including portability, reliability, security and authentication. Also the model promises to achieve its design objective by boosting the voter participation levels in the Indian Elections, thus offering a truly participative election voting model.

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