What Can Democracies Gain From E-Voting?

Cost Benefit Analysis, Turnout and Privacy

Huseyin Helvacioglu
Bilkent University

Onur Kocak
Bilkent University

Nurhan Guner
Bilkent University

ABSTRACT

``*...enhancing the applicability of the right to vote…„*

Internet and its capability of enhancing and strengthening democracy has been discussed for a long time. Some researchers are focused on the social aspects of the Internet, as in, it is a hub for discussing ideas, free from temporal and spatial conditions and ideally without any restrictions. Beside from providing the public sphere a chance for a better democracy, Internet based voting systems can directly change the perception of a representative democracy as we understand it. Internet voting introduces better means for democracy, where the applicability of the right to vote has been enhanced with less limitations for voters.

With this project, it been has aimed to prove that e-voting has been successful to increase voter participation, as well as decreasing the costs of running elections. Although privacy is an important concern over e-voting, due to the usage of advanced technologies, such as biometric identification and public key cryptography, privacy of the voters has been improved. These aspects mentioned will be illustrated with relevant data and tables, and examples from different countries.

INTRODUCTION

From pebble stones to cable television systems, voting technology evolved continuously. With the invention of internet and personal computers, e-voting has emerged. Process leading to e-voting is important for understanding what has changed in voting systems. Aiming to explain the process and the motives behind it, this paper will cover the brief history of voting technologies and what can be concluded from the opportunities e-voting could bring.

Cost benefit analysis and turnout section aims to prove that e-voting would increase the turnout by appealing the rational motives of the voters. This will be explained by the voting behaviour models outlined by Harrop and Miller (1993), and mostly focusing on the rational choice model. When voting by rational choice model, voters run cost benefit assessments and cast their votes according to the results. This idea will be supported by economical model of voting behaviour by Downs (1957). Downs suggest that voters cast their votes, only if the expected benefit multiplied with actual benefit they are getting is higher than the cost. These two theories will be applied to the e-voting. The effects of e-voting on electoral cost, electoral choice and electoral decisiveness will be explained, as well. Finally, by following the measurements of democracy that are provided by Dahl (1971), it will be analysed whether e-voting has effects on the levels of democracy in a regime.

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In the third section, the requirements of e-voting protocols and systems will be analyzed. The recent developments in technology and cryptography made e-voting easier and more secure. Gerck's offered an architecture design for robust and secure e-voting. Boyd and Lee's voting protocol eliminates the coercibility issue. Katiyar et. al. have proposed a authentication protocol for e-voting by implementing biometric security and steganography. These solutions will be covered in privacy section in detail.

HISTORY OF E-VOTING

Brief History of Voting Technologies

According to history, Spartans used to gather around for deciding on issues. The side that shouted out louder would win the argument. Although the principle of voting throughout the history was similar, procedures has changed immensely. History section of this paper aims to show that despite the idea of voting stayed the same, technologies used in the process has continuously changed, and have been innovated.

In Ancient Greeks, beside from applying democracy directly by talking to each other, it is known that in some cases, citizens used pebble stones to cast their vote. Every urn was representing a choice and a pebble stone in that urn would define how many people were approving that cause (Stephan, 2016).

Early Systems

After pebble stones and Ancient Greeks, democracy held off for many centuries. When voting has returned for masses, there were no pebble stones. In 19th century in United States, a voter would go to voting ballot, say an oath in front of a judge, stating that he has the right to vote, and did not vote before. Voter would declare his choice vocally to two clerks, who keep two separate pollbooks (Jones, n.d.) This process looks primitive, however, considering it in detail, it is evident that there are precautions developed for a just election. First; voter sweared under the supervision of judge, to make sure that he is religiously, morally and constitutionally under scrutiny to vote properly. Secondly, for preventing mistakes by clerks, two pollbook system was used. Even in one of the earliest forms of voting, there are precautions for providing a secure and just election system.

Paper Ballots

Besides the vocal voting process present in United States in 19th century, paper ballots were also in use. Instead of keeping records of vocally made choices, there were paper trail for votes. With paper ballot system, every voter would bring their choice of candidate on a written paper. This paper could be both prepared by voter himself/herself or the candidate (Jones, n.d.). Paper ballots resolved the mistakes that clerks would make, however, it brought another problem.

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With political parties preparing paper ballots, it was more difficult for voters to keep their choices confidential. This problem lead to the invention of another voting system. Practiced first in 1858 in Australia, later known as The Australian Paper Ballot system, was simple, and it revolutionized voting systems. Instead of political candidates or voters themselves preparing paper ballots, the state would prepare a paper ballot with the names of candidates on it, and distribute the paper ballots to each voter. Voter would choose his/her candidate and cast the vote in the ballot. Privacy issues were handled better with the Australian Paper Ballot system.

The Mechanical Era

Apart from the introduction of paper ballot systems, 19th century was also the period of Industrial Revolution. 19th century and the beginning of 20th century was the time that mechanical voting machines were started being developed.

The First Voting Machine: The Chartist Voting Machine

In 1838, the first idea of a voting machine's schemata were published by "The People's Charter" in England. It was a social movement which fighted for worker rights, trying to reform the voting infrastructure, as well. They suggested a voting hall scheme with the voting machine itself. Machine would not work properly, if the voting hall is not prepared accordingly. The system was planned not only based on the voting machine itself, but on the combination of the machine and the hall together. The mechanism was based on brass balls, which a voter would send to the tube of his candidate. To prevent multiple voting, there were judges on the other side of the machine, controlling tubes if anyone sended more than one brass ball. (Haeberlin, 2013; Jones, n.d.). The Chartist Voting Machine is important for the reason that it is first the suggestion for a mechanical voting machine. Believing in reforms, The Chartists saw the importance of election systems and the need for just elections. They believed reforms would not be enough if it is not supported with an election system that strengthens the system. This shows that, people believing in reforms and better democracies, were also interested in improving election systems to make the reforms permanent and provide a just system for everyone.

The Late 19th Century – Early 20th Century Voting Machines

Besides Charting Voting Machine, especially 19th century has witnessed many attempts to develop voting machines. Some of these machines will be described.

In 1848, an Englishman called Mr. Chamberlain introduced his voting machine in World Exhibition in London. According to his claims, this voting machine was solving all the issues that voting process have. With this machine, a voter would be certain of who he or she voted for without anyone learning. Mr. Chamberlain suggested that his machine eliminated the problem of multiple voting (Haeberlin, 2013).

In 1849, Baranowski came up with three different voting machine mechanisms in France. One was working with cranking the preferred candidate box you will vote for, the second was for binary choices and third one designed for elections with multiple choices (Haeberiln, 2013).

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The first pattern for voting machines in United States is acquired by Monaghan. This simple machine was not designed for general elections but to be used in parliament. Every representative with levers in front of them has right to choose "yea" or "nay" to declare their decisions for legislative processes. Two similar inventions have been proposed by two famous scientists, as well. Similarly, In 1856 in Germany, Siemens constructed an electronic voting machine for the legislators in parliament with only yes or no choices. Parliament rejected this invention. In 1869 this time Edison come with a similar idea. The only difference was whoever vote what would be visible for everyone. This invention is rejected in Washington for the concern of ideas and rights of minorities would be in danger with such an open system (Haeberlin, 2013).

On the other hand, Austrian engineer Maryhofer came up with a system based on pneumatics in 1877 called Pneumatischer Abstimmungs-Apparat. In 1902 Odhner in Russia came up with simple only yes or no voting machine which is called Ballotierapparat. In 1905 Boggiano came up with Psephograph at Lombardy Peace Society Exposion in Milan in 1906 (Haeberlin, 2013).

Implemented Voting Machines in Elections

Most of the voting machines mentioned were not implemented into any elections or used in any other ways. The enthusiasm and willingness to build a voting machine resulted in implementation and different usages of voting machines.

Myer's Lever Voting Machine

Myer's lever voting machine was used in elections firstly in New York in 1892. Machine consisted of a voting booth. Voter would cast the vote through turning levers in the machine and finally turning a final button. That way voting was casted and it could be seen as the count of vote was increased by one. These machines were complex, big and heavy and they consisted of many parts. One of the negative outcomes of these machines also, voter could not be notified if his or her vote casted correctly. The only control mechanism was the general vote count. Besides these negative sides, Lever Voting Machines were widely circulated and used in many US elections and their production did not stop until 1892 (Jones, n.d.).

Punchcard Systems: Votomatic Machines

In 1960s, based on an earlier patent, punching card based Votomatic Machines was developed. Unlike the Lever Voting Machines, they were lightweight, simpler and easy to carry anywhere. Even though many positive attributes was related to Lever Voting Machines, Votomatic Machines had its own problems. Punched cards were not always clear in showing voters choice. This was criticized in many cases but still Votomatic Machines are widely used in US elections (Jones, n.d.) In 1996 presidential elections of United States, %37.3 of voters voted using punch card systems (Punchcards, n.d.).

Digital Era

After mechanical voting machines, digital voting machines had started to appear. One of the early examples was the Optical Scan Voting System. It was first used in 1962 in United States

and many companies developed different optical scanning voting systems throughout the time. The advantage of these systems was, when the vote was casted on an optical form and put on the machine, if any mistake is made such as multiple voting or filling the boxes wrongly, the system was giving a warning. This was, an officer could come and help to fix the error. Again, in this system voters choice was protected (Jones, n.d.).

After optical machines, 'direct recording electronic voting systems' has appeared. This systems with an interface similar to a computers was specialized for elections Throughout the history complex machines and different usages have been invented for voting. However, with direct electronic systems, everything was put into a box and the voter only had to choose his or her candidate through buttons. Of course, there are security problems with these machines which has closed box understanding. These issues will be mentioned and explained throughout the paper

Early Voting From Distance Systems: Qube Experiment

After a wide adaptation of cable television in North America, in Columbus Ohio, Qube experiment was conducted. Technology and democracy enthusiasts' demand for teledemocracy ended up with a commercial, interactive cable system. People who had these systems, were able to cast votes for on supported television programs for any purpose, if it was demanded by the TV producers. Same system was used for broadcasting of town meetings on television, before the widespread distribution of internet and personal computers (Dahlberg, 2001).

Lessons from History

19th century inventions proves the interest of democratic countries to develop better voting systems. The history of voting machines shows that, every invention focused towards solving a problem regarding election system and security. It is witnessed that the machines used in United States did not disappear when a newer machine came up. Not every machine could respond to the every need, nor all of them were complete without any weaknesses. This reminds us that voting technology is not progressing linearly. Since elections are the most crucial part of democracy, every invention would be tried out many times and every new invention would be taken cautiously.

COST BENEFIT ANALYSIS AND TURNOUT

Modern democracies require elections for functioning as a cohesive system. Due to the fact that it contains a transfer of power, choosing representatives by elections is the most important step of democracy. In this section, the factors that are leading the citizens to vote will be outlined. These factors are going to be linked with the related aspects of e-voting. In other words, it will be argued whether a cost benefit analysis conducted by a voter on e-voting is affecting the turnout. Finally, the possible effects of e-voting on democracy will be covered through the means of the inclusiveness that this voting type brings.

Role of Elections in Democracy

Elections are the primary element of a fully functioning democracy. They enable the system to run on three main elements of democratic values: provision of citizen opinions, support of the citizens and serving towards the citizens' benefit (Lubis, Kartiwi & Zulhuda, 2017). The step that follows an election is representation. The representative process requires elections and voters. Through the political principle of representation, elected individuals or groups stand for, or act on behalf of the voters and the geographically prominent group of people they are included in (Heywood, 2013). Although, elections are not sufficient enough to legitimise the representatives, it cannot be denied that the electoral process is obligatory in a democratic system.

Incentive to Vote

Despite the fact that elections are providing citizens the right to choose their representatives, hence the indirect right to rule, there are many examples of democracies in which the turnout is low. As Harrop and Miller (1993) suggests, there are different motivations that lead citizens to vote. They outline three models of voting, sociological theory, psychological theory (party identification) and rational choice (pragmatist voting). The sociological model focuses on electoral behaviour that can be explained by social properties including social background, education, age, gender. Psychological model or party identification is a concept which refers to an individual's sense of self, identification with another group without any questioning of the choice during the process. Finally, Rational Choice is based on assumption that citizens act rationally and aim to maximise utilities by conducting cost-benefit assessments. Furthermore, while creating an economical model of voting, Downs (1957) based this model on the idea that voters are very rational, and they need to maximize the utility of the act of voting. He formulized this idea as following:

*People vote if: **(P*B) – C > 0***

P: Probability of getting benefit

B: Benefit

C: Cost

This means that citizens would only choose to vote if the probability of getting benefit multiplied with the benefit they are getting is bigger than the cost of voting for them.

Following these theories, it could be said that e-voting is a systems that would appeal to voters by the means of rational choice, as it saves the voters from the costs that traditional voting brings. To exemplify such a cost, it could be pointed out that in order to make sure that all the citizens are able vote by only being faced with minimal challenges, voting dates are carefully picked during traditional voting process.

Norris (2004) use her own theory that explains the three elements determining the incentive to vote by a citizen (Norris, 2002). By this, she outlines how e-voting can appeal to voters.

Electoral participation theory of Norris (2002) suggests that citizens are affected by three factors when casting their vote. First, electoral costs, for the reason that registering a vote involves expenses; second, electoral choices, as a citizen has to decide how to vote by evaluating the information relevant to the process; finally, the effect of electoral decisiveness.

Electoral Costs

In addition to the idea that voters would only be willing to vote if the benefit they are getting is bigger than the cost (Downs, 1957), it could be said that electoral cost has an important effect on the turnout. Costs could be listed as registering to vote, having access the relevant information about the parties and candidates as well as the whole electoral process, and casting the vote at the end. As mentioned before, date of the election plays an important role, as a day in the spring or fall period is less costly than a day in summer or winter. Furthermore, it is much harder for a disabled or an old person to cast a vote. Considering such facts, e-voting brings significant advantages towards eliminating the electoral costs (Norris, 2004). Usage of electronic devices increases the benefit of voting for the voter, therefore this will have a positive effect on the voting turnout.

Electoral Choices

Electoral choice is dependant on the number of choices that is provided to the citizens. According to the rational model, voting preferences are volatile (Harrop & Miller, 1993). Therefore, more variety of choices the electoral system has, voting choice shift more easily. Although that decreased costs in e-voting makes it easier for the electoral system to provide more options, Norris (2004) suggests that this type of voting has no effect on electoral choices.

Electoral Decisiveness

Similarly, it is suggested that e-voting has no effect on the perception of the voter by the means of electoral decisiveness (Norris, 2004). No difference can be observed in the chances of changing the result of the election by the voters.

This analysis shows that the most important aspect of e-voting on behalf of the voters is the electoral costs. Reduction on the costs are not only effective on the general voting behaviour of the citizens, but also a determinant of the choice between traditional voting and e-voting.

Moreover, e-voting's cost efficiency has affected the turnout in the elections in which it have been used. In Estonia, the data shows that people with more frequent and more advanced usage of Internet, prefer to cast their votes online (Mellon, Peixoto & Sjoberg, 2017). Figure 1 shows that younger voters' preference of e-voting is significantly high. The age gap between the digitally immigrated older people, and the digitally native younger people show in their preferences. This could be further explained with the graph of internet usage. More frequent users of Internet, have casted online votes almost as twice as the number of offline votes. It should be noted that the daily users group casted the biggest number of votes when offline and online votes are combined, hence providing the biggest effect on the turnout. Combined with the education graph, it could be said that higher the education people have, they choose to cast their votes online. This could be developed by saying that e-voting users are more informed

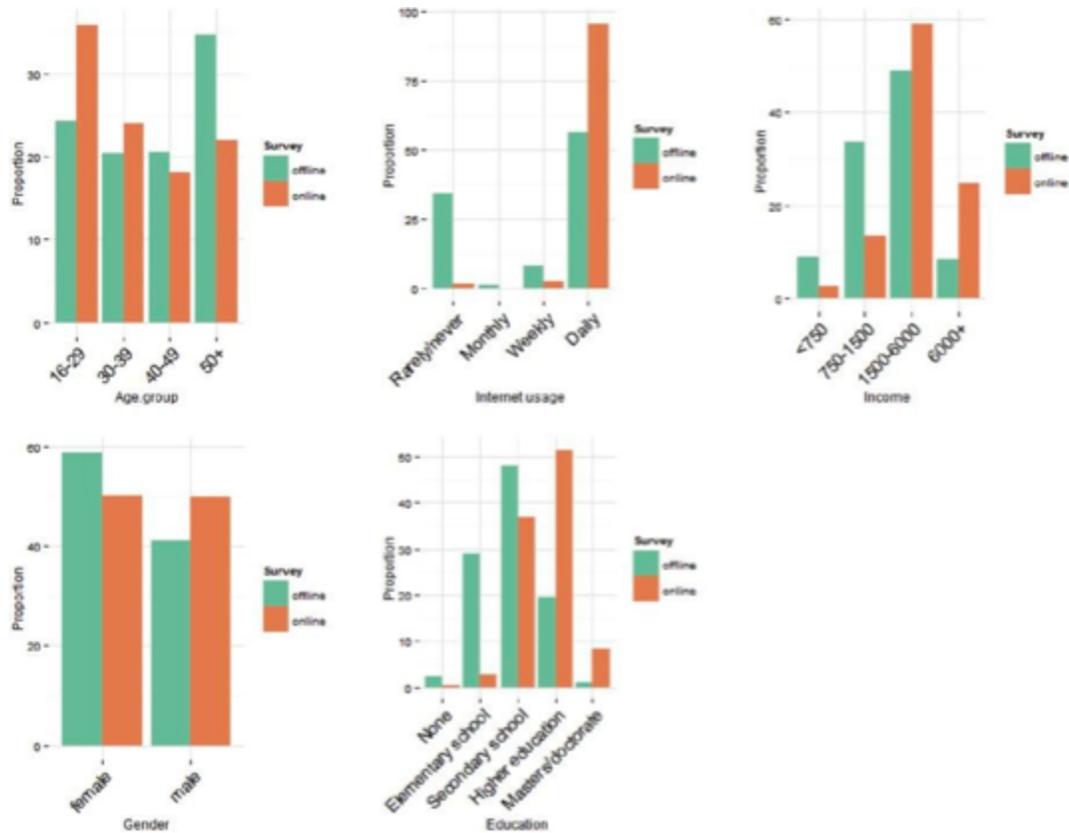about the elections. Income and gender graphs will be not analysed.

Figure 1: Differences between social aspects of voters and their effect on the type of the voting technique used

Outcomes of this analysis shows that online voters are not only voting by rational choice model by conducting cost benefit assessments, but also following the sociological model. This is for the reason that their electoral behaviour can be explained by their social properties such as age, education and Internet usage.

Enhancement of Democracy

Final point that will be covered on the political aspects of e-voting, will be its effects on the levels of democracy in a political regime. According to Dahl's study at 1971, there are two dimensions for classifying political regimes: contestation and inclusiveness. This substantive view of democracy classifies the regimes by the means of the outcomes that they produces and not just the institutions they contain. Higher the contestation and inclusiveness scores are, more democratic the regime is.

In this conceptualisation, contestation is the extent to which citizens are free to compete for pressing desired policies and outcomes by organising themselves into blocs. On the other hand,

inclusion is determined by the diversity of the people participating in the political processes. Inclusiveness include regulations that are defining the qualifications for the right to vote, requirements in respect to property ownage, education, gender, ethnicity, language or geographical location.

E-voting increases the inclusiveness of the political system, by eliminating the limitations that are present for the voters that existed in the traditional voting. It will be focused on the effect on the inclusiveness levels for this analysis, because unlike contestation that affects the periods before and after the election, inclusiveness is directly related to the elections.

This type of voting brings convenience for the citizens, as they can cast their vote independent from their geographical location. Only thing that is necessary is Internet connection and a device that would connect Internet. In addition, this means that people with limited mobility such as older people, caregivers that are obliged to stay at home for taking care of a dependant person, or workers that have little flexibility to their shifts and working hours (Norris, 2004). Unlike traditional voting systems, e-voting enables these people with limitations to cast their votes much more easily. They would be integrated into the electoral process, instead of being excluded by it.

PRIVACY

As elections and polls are critical events for the proper operation of a modern democracy, a secure and privacy concerning e-voting system is required. In this section, privacy and security requirements in e-voting will be discussed and illustrated with various approaches to meet these requirements. Although privacy is an important concern over e-voting, due to the usage of advanced technologies, such as biometric identification and public key cryptography, privacy of the voters has been improved. On the other hand, although the voting process must meet high standards of security, the implemented security standards also needs to be simply understandable by average citizens to satisfy the trust and encouragement of citizens.

Privacy in e-voting systems have been discussed by many authorities and organizations such as California Internet Voting Task Force, IPI National Workshop on Internet Voting and European Union IST (Information Society Projects) to identify the requirements, risks and how to overcome this issues. One of the most important concerns is that all kinds of e-voting systems are susceptible to a certain extent to insider attacks and Denial of Service (DOS) attacks(Gritzalis, 2003). Another concern is that e-voting systems should be accessible and easy to use by every citizen. Therefore, when designing e-voting systems, the balance between security, ease-to-use, and accessibility must be assured (Gritzalis, 2003). In the following section the basic requirements of a perfect e-voting system are described and recent technologies and academic papers to meet these requirements are provided.

Authentication and Correctness

Correctness is crucial requirement is e-voting. It can be achieved by authenticating the voters such that only eligible voters can vote and they can vote only once. The integrity of the results

must be guaranteed, and all valid votes must be counted. To assure correctness, authentication of citizens should properly done. In Estonia's case,shown in Figure 2 , citizens use their National ID smart cards to authenticate on e-voting software (Springall et al. ,2014). The voting system verifies a citizens to vote and displays a QR code. The QR code is then used for verification after the elections completed.
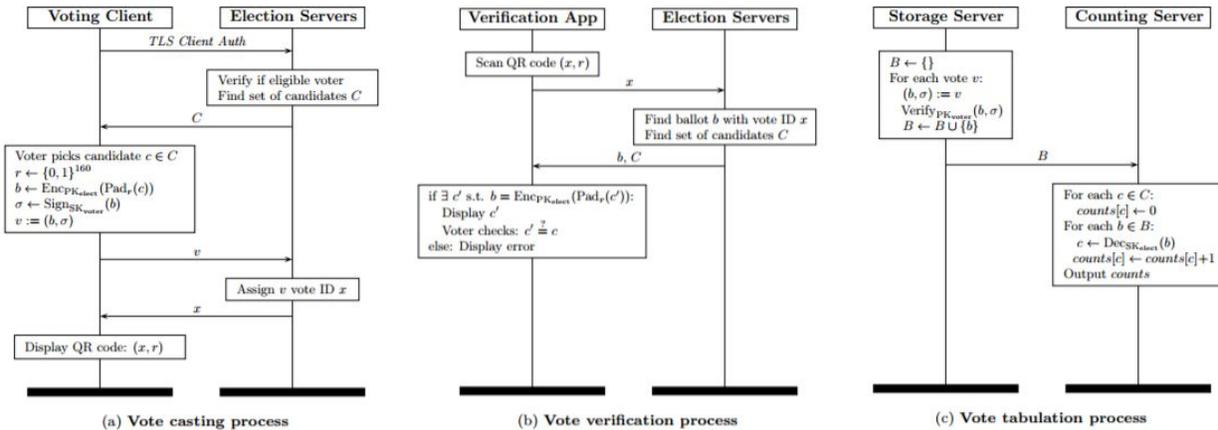
Figure 2: Voting protocol used in Estonia

A better alternative to Smart Card authentication is biometric identification. Thanks to the advancements in technology, recent mobile phones and notebook computers have fingerprint scanners. Since governments already have fingerprint data in national security databases, authentication using fingerprints and eye retina might be a better authentication solution compared to Estonia's smart cards. In 2011, Katiyar et al. have proposed a new authentication scheme for e-voting powered by biometric security using steganography.

Vote Privacy

In e-voting, privacy can be defined as the anonymity of the voters and votes. During the protocol, no one should be able to see the vote. Vote privacy is achieved by the help of public-key cryptography. In 1992, Fujioka et al. have proposed a voting protocol that meets the privacy requirement in large scale elections. The proposed protocol uses public key cryptography and blind signature schemes. Figure 3 illustrates how the protocol carried.
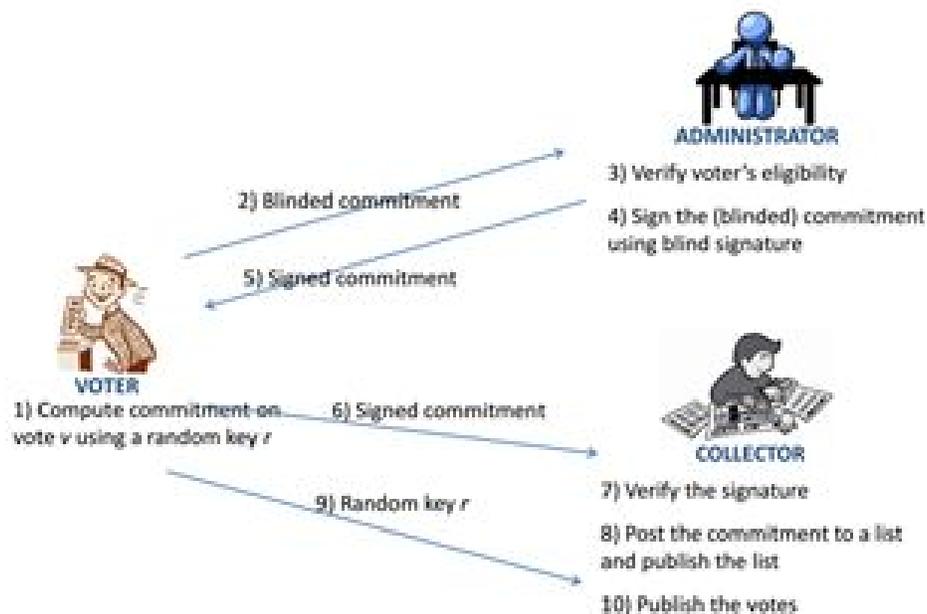
ADMINISTRATOR

3) Verify voter's eligibility

4) Sign the (blinded) commitment using blind signature

2) Blinded commitment

5) Signed commitment

VOTER

1) Compute commitment on vote v using a random key r

6) Signed commitment

9) Random key r

COLLECTOR

7) Verify the signature

8) Post the commitment to a list and publish the list

10) Publish the votes

Figure 3: Fujioka's protocol for privacy concerning e-voting

Briefly, there are 2 authorized parties that manages the protocol. First party is a registration agency which is responsible for authentication of citizens if they are eligible to vote, and second party is the election commission, which is responsible for counting the votes. Votes are encrypted with public keys of these parties. Since registration agency has only its private key, it can decrypt the first encryption, and validate the voters' identity. Then vote is redirected to election commission which has its own private key to decrypt the vote itself. At this time, vote does not include any information regarding to the voter. The election commission is responsible for counting the votes and publishing the results.

Receipt-Freeness

Receipt-freeness eliminates vote buying which is an ultimate problem in e-voting. With the assumption that vote-buyer is not next to the voter during the e-voting process, Voter cannot gain any information (a receipt) which can be used to prove to a coercer that he voted in a certain way (Fujioka, Okamoto, & Ohta, 1993). If a voting protocol is receipt-free then it also respects privacy. In 1992, Okamoto firstly proposed a new protocol with trap-door bit commitment scheme to have receipt-freeness (Okamoto, 1996).

Coercion Resistance

In coercion-resistant e-voting, a voter cannot cooperate with a coercer to prove to him that she voted in a certain way (Delaune, Kremer & Ryan, n.d.). Coercion resistance guarantees receipt-freeness and vote privacy at the same time. First coercion-resistant voting protocol have proposed by Boy et al. (2004)

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Note that in literature the distinction between receipt-freeness and coercion-resistance is not very clear. The difference is considered such that it lies in the powers of the coercer to interact with the voter during the voting stage. In receipt-freeness, it is assumed that a coercer who simply examines evidence gained from observing the election process. Such evidence includes information provided by the cooperating voter, e.g., the voter's private key and random coins used for probabilistic encryption. In coercion-resistance, the coercer has additional capabilities. He can interact with the cooperating voter, for example by (adaptively) preparing messages which the voter will send during the process (Delaune, Kremer & Ryan, n.d.).

Verifiability

The results in elections should be publicly verifiable and the logic behind the privacy implementations should be understandable and acceptable by everybody. Most e-voting systems have a publicly accessible bulletin system that allows citizens to follow election results. In Estonia, after voting online, citizens are provided with a QR code that could be used to verify that they voted properly and their vote had been counted (Springall et al.). Verifiability can be assured in different forms. Public verifiability implies that any parties in elections (citizens, authorities, auditors) can follow the announcement of tally. Individual verifiability is a weaker requirement that needs every vote to be verified in the open objection to the tally. [04]

Robustness and Security

There are several other requirements of e-voting systems and protocols such as accessibility, ease-to-use availability and reliability. E-voting systems should work robustly, even in the face of numerous failures(Internet Policy Institute, n.d.). Gerck (2002) has suggested a robust and redundant architecture design named DVS for private, secure, and auditable e-voting. Figure 4 illustrates Gerck's design which consists of multiple security layers protected by 4 firewalls.
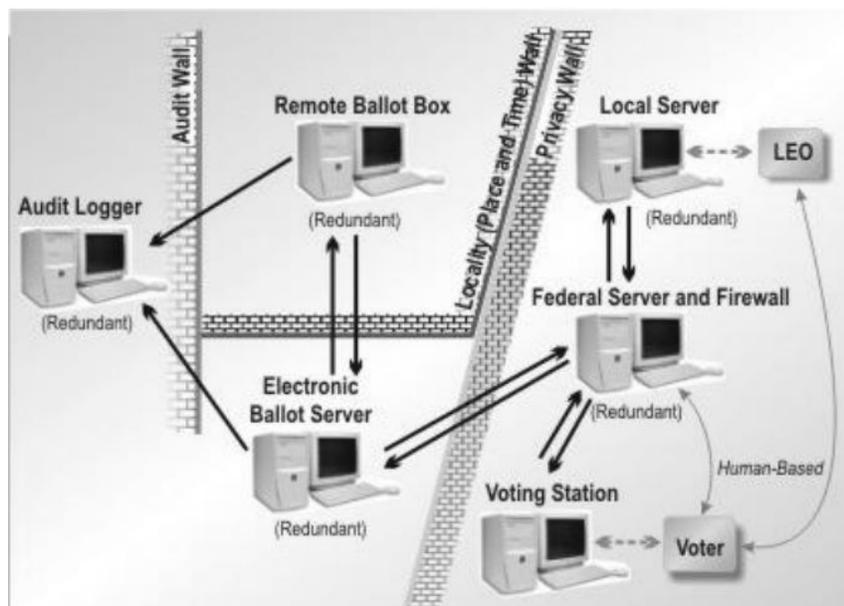

Figure 4: The DVS Process with an example of hosting and sub-system layers building "walls" for five servers.

Voter Confidence

Voter confidence is the level of certainty in a particular voter's mind that his/her desired election choices were actually transcribed as intended into the equivalent computer-readable indicators(Gritzalis, 2003). Voter confidence is essential in a democratic notion. On top of all the technical requirements described previously, an e-voting system should provide same level of trust to the voters as if they voted in the traditional way. Therefore, all systematic and cryptographic design of system must be easily understandable and adopted by the citizens.

Government Responsibilities

Before practicing e-voting in country-wise, authorities must discuss the most recent technologies and protocols on e-voting and criticize its aspects deeply. Investments in the development of ICT technologies and their usage in e-government systems and democracy must be made. The Institute of Electronics and Electronic Engineers (IEEE) is currently developing a standard numbered (P1583). The aim of the standard is "to provide technical specifications for electronic, mechanical, and human factors that can be used by manufacturers of voting machines or by those purchasing such machines. The tests and criteria developed will assure equipment: accessibility, accuracy, confidentiality, reliability, security, and usability" (IEEE, 2002). Such standards should be supported and funded for the further improvements.

CONCLUSION

Historically, voting technologies followed the advancements in democracy. Providing more secure elections have been one of the main concerns of democracies. Innovations started to develop more rapidly since the 19th century. With the emergence of Internet and personal computers, a different era with digitalized voting mechanism has started. Similar to other voting systems, e-voting would also be under investigation for many to make sure that it provides what it promises. We tried to show in this article that it has many advantages than the previous voting systems. Time will also show that if our claims will hold to be true.

With the cost benefit analysis and turnout section, it has been proved that e-voting would appeal to voters and increase the turnout. Voting behaviour theory of Harrop and Miller (1993) and economical voting model of Downs (1957) has been used to explain that rational choice has the biggest impact on voters when using e-voting. Voters that vote by rational choice, run cost benefit analysis. e-voting's biggest earning for the voters is its cost efficiency. Analysing the concerns of voters as electoral cost, electoral choices and electoral decisiveness, it has been concluded that e-voting is most impactful in appealing the voters eliminating some of the costs for the voters. Furthermore, it has been seen in the demographical statistics of the Estonian voters, frequent Internet users, more educated people, and younger voters are more likely to cast their votes online. By this, it has been concluded that not only rational choice is effective in e-voting behaviour, but also sociological theory is observable in online voters. Lastly, it has been explained that the e-voting has positive effects on the levels of democracy, by influencing the inclusiveness.

In the privacy section, the privacy requirements of e-voting systems and proposed solutions for a perfect e-voting system have been covered. New encryption and communication protocols and recent developments in technology such as biometric identification have made e-voting more secure, cheaper and preferable solution to traditional voting.

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