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E-voting: a proposed framework for the Albania scenario

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Abstract

Albania has held elections with a paper-based system for many years now. However, with the innovative technological developments that have taken place in the country, there is the possibility to apply these technologies to better impact the voting process. This study aims to propose an electronic voting architecture, using a hybrid solution that integrates voting kiosks within the country and online voting for Albanian citizens living abroad. The study uses a review of the literature method. This study analyses the voting process in Albania, focusing on two key issues: the accuracy of the process and the impossibility of voting for the citizens living outside the country. The electronic voting process through electronic voting machines and online systems are analyzed as new technological approaches to address and solve the issues mentioned above. From the study, electronic voting process implementation has a higher cost. Moreover, to evaluate the feasibility of the system implementation, a detailed analysis of costs is needed, security requirements specifications, and a legal framework.

Keywords: Devices; DRE; elections; e-voting; E2E.

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1. Introduction

Albania holds elections with a paper-based system since the residents were allowed to vote in 1921. For many years now, this form of voting has been considered the best to express one's right to representation, but nowadays with the innovative technological developments that have taken place in the country, there is the possibility to apply these technologies to better impact the voting process. The Office for Democratic Institutions and Human Rights, part of the Organization for Security and Co-operation in Europe (OSCE/ODIHR) outlined in their final report on parliamentary elections held in Albania on 25 June 2017 that the parliamentary voting process in Albania is currently facing difficulties regarding justice and transparency (Albania, Parliamentary Elections, 2017).

As mentioned in the report, all incident cases are identified through media instead of reporting directly to the Central Elections Commission (CEC). Political parties' representatives prefer to claim their complaints via media because of the low trust in the accuracy and correctness of the voting system. Fictive voters are another issue when it comes to voting in Albania. In many cases, unregistered voters appear on the voting list leading to fictitious votes, which can alter the results. In conclusion, the report states that the administration should be able to guarantee free as well as secret choices for everyone, where any association between a voter and a specific vote should not be possible. Resolving all these issues could provide constitutional elections.

1.1. Purpose of study

This study aims to propose an electronic voting architecture, using a hybrid solution that integrates voting kiosks within the country and online voting for Albanian citizens living abroad.

2. Materials and Methods

This study analyses the voting process in Albania, focusing on two key issues: the accuracy of the process and the impossibility of voting for the citizens living outside the country. The electronic voting process through electronic voting machines and online systems are analyzed as new technological approaches to address and solve the issues mentioned above. Data was sourced from previous literature and election report. Based on the findings, this study proposes a framework for Albania's voting system architecture.

3. Results

Figure 1 shows the data from the final report on local elections (Local Elections 2019 Report, 2019) stating that the list of Albanian citizens at voting age is about 3.5 million. According to a study on international migrants by country over the world, the number of Albanian citizens living abroad is about 1.15 million which is 33% of the total of people with the right to vote (International Migrants by Country, 2019). An interesting fact is that the destination of those emigrants is the two neighboring states: Greece (Population and Housing Census, 2014) and Italy (Resident Foreigners on 1st January - Citizenship, 2021). These two countries have the biggest piece of the cake with about 83% of all Albanian citizens living abroad.

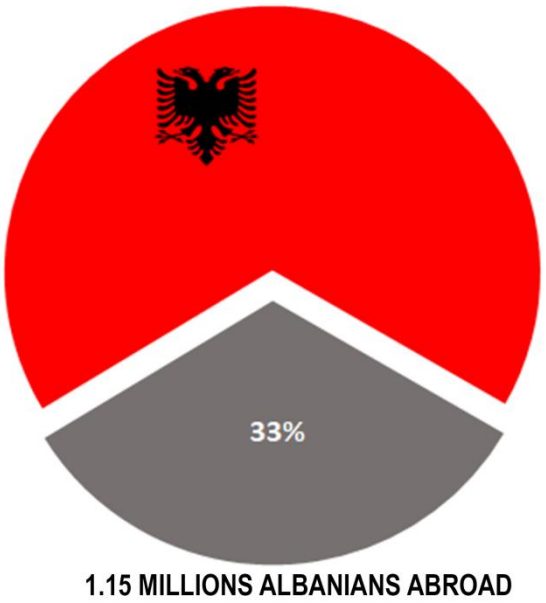

Fig.1. Albanian citizens with the right to vote.

Albania has no legal framework that establishes a way to vote from abroad, which means that key points such as the model of political representation for out-of-country voting; the voting procedures; the out-of-country voters' lists; the creation of structures to administrate the process; and the budget to cover costs are not yet analyzed, designed or implemented. Moreover, there is a limitation as stated in the Ministry of Diaspora's report (Out-of-Country Voting for Citizens of the Republic of Albania, 2018), where the Electoral Code sets the domicile as an additional criterion, besides the age and citizenship of the voter. The inclusion of the domicile criteria excludes citizens who are abroad on the election day and constitutes a limitation of the constitutional right to vote.

However, related to the electronic voting approach, the first pilot project was implemented only in one voting center zone (zone no. 40, in Tirana), during the elections held in Albania on April 25, 2021. There were 12096 voters there, and the results were announced ten minutes after the end of voting time.

3.1. Electronic voting systems

Both systems, electronic voting through kiosks and online voting, have been used for years around the world, especially polling kiosks, which were implemented in the USA in the 1970s, and were first used in real elections in 1975, in Streamwood and Woodstock Illinois (Jones, 2005). One of the best-known technologies is known as Direct Recording Electronic (DRE) technology. The operation of the DRE system is directly linked to the use of smart cards or PIN-encoded cards, given to voters. By obtaining these types of cards, everyone is registered as a unique voter, but as concluded in Laurer's study (2004), the most important issue addressed through this system is the elimination of the chances of recounting one vote. As a result, the turnouts obtained are calculated to achieve almost 100% accuracy. The enhanced versions found in the literature are DRE-i, an End-to-End (E2E) verifiable

electronic voting system, first designed by Hao et al. (2014), and DRE-ip including privacy features (Shahandashti & Hao, 2016).

The concept of E2E verifiability introduced in literature is defined as "a collection of techniques for replicating, and in some ways exceeding, the standards of evidence provided by an ideal, observed polling place. This includes two principal components, which are: voters can verify that their selections are correctly recorded, and any member of the public can verify that every recorded vote is correctly included in the tally" (Benaloh et al., 2015).

The concept of online voting, otherwise known as electronic voting, essentially does not differ from the onsite voting used nowadays in Albania. The management of the voting process is the same from the voter identification and the voting center identification to the candidate selection. In technology terms, the scheme of the voting process defines the elements that make the process fully valid from the identification of the voter through a password account, fulfillment of the relevant data, the verification to determine if this individual is eligible and has the right to vote, the opening of the voting site, and finally the real-time counting of votes for each registered candidate. Remote voting through electronic systems has been considered the promising future in partisan democratic affairs (Smith, 2002).

3.2. Electronic voting System Requirements

There are several protocols defining the properties that an electronic voting system should have (Cetinkaya & Doganaksoy, 2007; Delaune et al., 2006). We will list the major characteristics and requirements that a system should satisfy to be an eligible one:

3.2.1. Privacy

The complex privacy procedure is based on the inverse links that must not exist between the voter and his vote. The system should prevent the identification of the vote of an individual. A vector attack using the Internet that can occur when implementing such property is explained by (Lauer, 2004), who concludes that by using a "Trojan Horse" the attacker can monitor the vote of each voter. The concept of privacy assumes that the system shouldn't be able to know how the voter voted. This property requires the identity of the voter to remain anonymous during the vote and even after the conclusion of the elections (Jefferson, 2004). Receipt-freeness is another concept related to privacy, which ensures the voter must keep his vote private (Jonker & de Vink, 2006).

3.2.2. Eligibility

This is related to the right of voting once and only once during an election session. The system should ensure that re-entering or re-voting is not allowed. We find this concept in literature also, as democracy (Augoye, 2013) or un-reusability (Fujioka et al., 1993).

3.2.3. Verifiability

This is the ability to verify or audit an election to ensure votes have been counted correctly (Anane et al., 2007). The procedure should be public and allow not only the voter to check it, but also the external auditors should be able to verify that the voting process is fair. It is generally required as a substitute for accuracy since it essentially performs the same function. Verifiability also includes

individual accuracy, which is the possibility to allow the voters to control whether their vote is counted or not.

3.2.4. Robustness

The system is designed in a way that still maintains the stability and performance of its core functions. Translated into electronic voting, the votes cannot be included by fraudulent attackers, and the systems should recover from any external attack such as a denial of service (Lambrinoudakis et al., 2003).

4. Discussion

4.1. The Proposed voting system architecture for Albania

The examination of the requirements mentioned in the previous section leads to some criteria to be considered when assessing an electronic voting system and its "goodness". For this type of system to be considered "good", it implies the following functions and processes to be implemented:

- Voter authorization: the operation of permitting access only to eligible voters.
- Recording of the votes: the process of recording the casting vote.
- Voting: the process of marking and casting a ballot following the voters' preferences.
- Storing votes for tally: the process of storing the cast votes after casting and before tallying.
- Tabulation of the voting result: the process of producing the correct result by tabulating valid, cast ballots, following the election rules.

Due to the characteristics of the election day organization in Albania and the typology of Albanian voters, we propose an architecture that combines both DRE systems and online voting, to offer the best experience to all the voters in and out of the country (Figure 2).

The proposed electronic voting system architecture and the process of voting in this environment are explained as follows: in every ballot zone, several booths are installed and each of them has a DRE and fingerprint authentication device. Once the voter is identified through an electronic voter identification system, he is enabled by the commissioner to vote through the DRE device. A receipt is printed and for some seconds only the voter can see his choice before it falls in the ballot box. The DRE device logs the phases of the voting process encrypts the vote and sends it through a LAN on the ballots' zone datacenter. It should be noted that the network is not connected to the Internet. There is a Virtual Private Network (VPN) connection at the end of the process, where every local data center integrates its counting votes with the central counting data center.

When it comes to online voting the problem becomes more complex, because we have to deal with data integrity, privacy, transparency, eligibility, and verifiability in the internet environment. Estonian Internet Voting System is a good, consolidated example to follow (Springall et al., 2014). A VPN connection and the possibility to encrypt through a digital signature are techniques that help ensure the properties of privacy and integrity. Implementing the voting procedure through blockchain technologies implies transparency and digital verification from the point of casting to counting. Jafar et al. (2021) have treated an extended review and open challenges related to blockchain used for

electronic voting systems. Blockchain technologies can also help with the concept of E2E verifiability. Regarding the property of eligibility, we propose a two-factor authentication, but the best solution should be authenticating through fingerprints that are implemented as a technology for identity cards. In online voting, we propose to use the same server for authentication and counting, located at Central Election Commission (CEC) headquarters.

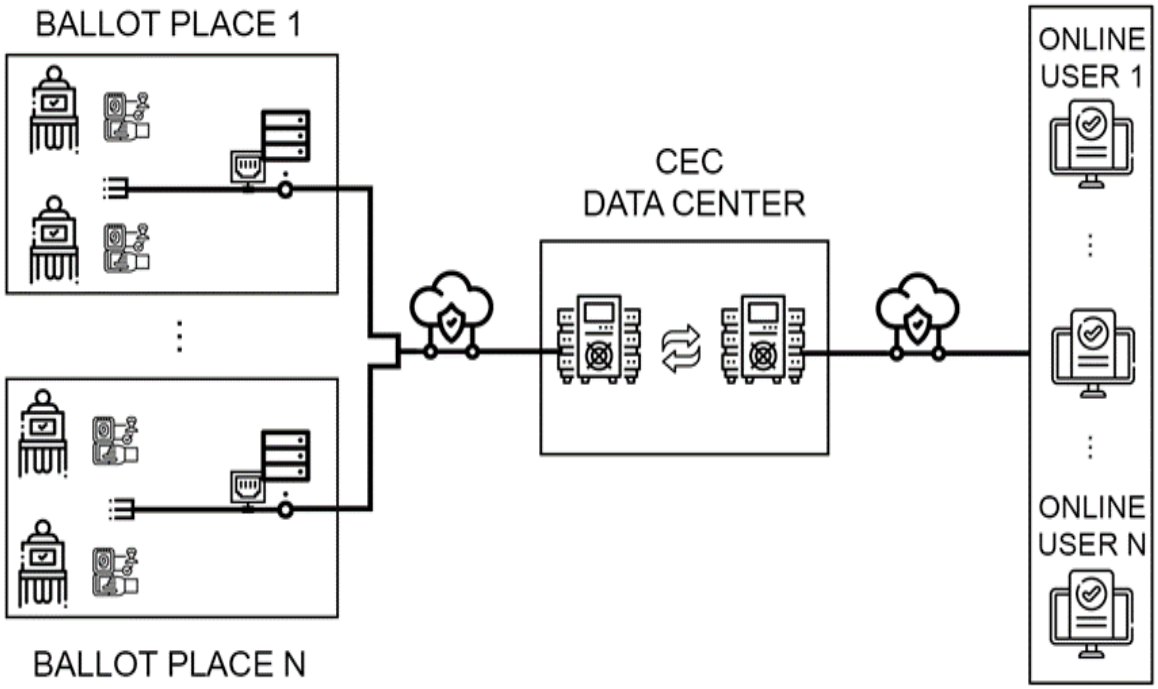

Fig. 2. The proposed electronic voting system architecture

Several countries over the world have implemented electronic voting. However, there have been issues spotted over the years that have led to many states refusing to believe their individual choices of electronic machines or online voting. For example, the Netherlands experimented with online voting in the early 2000s, but in 2007 due to denial-of-service frequent attacks and endless hacking tryouts, the government reverted to paper ballots as a more secure means for voting. Another example is Ireland, which experimented with DRE voting machines until 2006 when it finally refused to move further because of security issues related to backdoors trapped in the machines. There are several deprecated examples from Germany, Austria, and France related to not appropriate legal framework (Driza Maurer, 2016).

5. Conclusion

From the study, electronic voting process implementation has a higher cost. These costs include maintenance, licensing of the software, IT infrastructure, external security tests for auditing, etc. In terms of security, there is no realistic mechanism to fully secure vote casting and tabulation computer systems from cyber threats. Appropriate audits can be used to enable trust in the accuracy of election

outcomes, even if the integrity of software, hardware, personnel, or other aspects of the system on which an election is run were to be questioned.

Despite these issues, the electronic voting system also has benefits. For example, online voting enables citizens of a state, who live outside its borders, to become part of the decision-making process, exercising their legitimate rights. Due to distance removal and time barrier elimination, eligible residents are encouraged to exercise their will. Also, people with special abilities are incentivized because they can vote in autonomy. Other benefits to mention are the accuracy and short time for casting the votes.

After analyzing the typology of Albanian voters, which results in 1.15 million living abroad (33% of the total of eligible voters), and issues related to the voting process, such as accuracy and transparency, we propose a hybrid electronic voting architecture. It is a combination of a system that uses DRE devices for onsite voting, and an online voting approach for remote voting. Considering the trade-off of drawbacks related to benefits, we can say that it would be challenging for Albania to apply a system such as the one proposed in this study. Moreover, to evaluate the feasibility of the system implementation, a detailed analysis of costs is needed, security requirements specifications, and a legal framework.

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