



AN E-VOTING SYSTEM FOR LEBANESE ELECTIONS

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ABSTRACT

This paper aims to present an electronic voting system (E-Voting), hopefully, to be applied to the Lebanese electoral system. This E-Voting system (E-VS) was designed for electorates through computers programmed with convivial Graphical User Interfaces. The complex treatments and features are achieved at the levels of applicative layer and database. Several security measures were integrated into the E-VS in order to achieve an enhanced, speedy and accurate performance. It is about time that conventional voting in Lebanon gives way to E-Voting and hence simplifies the task for Electorates, Deputy Returning Officer and Returning Officer.

Keywords: e-Government, elections, e-voting, Lebanon, Security

1. INTRODUCTION

E-Voting is a type of voting that includes the use of a computer rather than the traditional use of ballot at polling centers or by postal mail. It encompasses various types of voting: kiosks, the Internet, telephones, punch cards, and marksense or optical scan ballots. All these types of E-Voting have shown an accurate and speedy performance.

Despite the advantages of E-voting, the range of its use worldwide is still, however, limited as it has a downside on many levels such as: legislative, social, political and technological levels (Watt, 2002), (Mitrou et al., 2003), (Riera and Brown, 2003). The paper underlines the political and cultural aspects of Lebanon's case for they are the main factors to influence the government's decision concerning the use of the E-Voting system in Lebanon. Legitimacy: it concerns citizens' approval of a voting without material trace, but it doesn't concern monitoring of voting. Management of risks: confirms the fact that the system is being tampered with.

The implementation of the E-voting system raises several issues related directly to elections such as legal, social, technical, political, administrative and financial issues. However, Benefiting from the positive aspects of E-Voting requests the implementation of security measures in order to repair the lack of transparency and to regain the trust of electorates and liable Authorities (Watt, 2002), (Riera et al., 2003), (Xenakis and Macintosh, 2004). Due to the special case of Lebanon several elements should be held

into account during the processing of the E-voting system:

- A. Functionality: the voting process should be functional and simple since voters have little knowledge of the E-voting process (Rubin, 2001). The E-voting system provides a unique interface that prohibits any attempt to tamper with the system itself (Alexander, 2001).
- B. Confidentiality: the voter's ballot should be accurately and confidentially registered (Bederson et al., 2003), (Burmester and Magkos, 2003). The confidentiality feature protects voters' choices in a way that it will be impossible to join a voting and a voter well to prove the voter's ballot.
- C. Security: ballots should not be intercepted nor tempered with. The results should not be known until the official opening of the electronic urn. Only eligible voters whose names appear on the Voters List are entitled to vote and according to the law the voter has the right to vote one time. The system would consider invalid any ballot cast before the opening or after the closing of poll. In the past few years, especially after the year 2000, the advantages and the security risk of E-Voting have been at the core of several debates (Riera and Brown, 2003). A large number of publications detailed security risks and integrity related to E-Voting (Neumann, 1993), (Philips and Jefferson, 2000), (Rubin, 2001), (Mercuri 2000)



D. , 2003), (Burmester and Magkos, 2003), (Boutin, 2004), (Schruen, 2004).

Meanwhile, E-Voting remains unpopular and limited to few countries. The United States of America is considered the leading country in implementing E-Voting system (Paielli and Ossipoff, 1988). However, some E-Voting systems are complex leading to a lengthy voting process (Buck, 2004). In Europe, E-Voting was introduced to Belgium's elections November 24th 1991. Amongst provinces in Belgium, two were chosen to try the E-voting system. In 1999, the system was extended to 44% of the population. However, authorities still aim to achieve 100% coverage by 2006 elections (De Vuyst and Fairchild, 2005). Geneva had been using E-Voting ever since 2000 through the internet. However, E-Voting did not replace two other types of voting already in use there: postal and conventional voting (Chevalier, 2004). As for UK's case, several pilot projects have been conducted in order to modernize the voting process. On May 2nd 2000, 16 UK Local Authorities carried out E-Voting and counting pilot schemes. 76 resorted to conventional paper ballots, 6 resorted to touch-screen voting kiosks, 5 resorted to internet, 3 resorted to the phone (touch tone) and 2 resorted to SMS text message (Pratchett, 2002). It has to be said that during UK Local elections on May 1st 2003, 20 E-Voting pilot projects got the approval. 8 Local Councils piloted E-counting of paper ballots while other Councils gave voters the chance to vote electronically through various channels: 8 offered Kiosk voting at polling centers or in public spaces, 14 offered Internet voting, 12 offered phone voting, 4 offered SMS voting, while 3 offered interactive digital television voting (Xenakis and Macintosh, 2005).

This paper presents E-Voting system that may be used by the electoral system in Lebanon. The E-VS satisfies the above listed conditions: functionality, confidentiality and security. The E-VS was designed for electorates through computers programmed with convivial Graphical User Interfaces. The complex treatments and features are achieved at the levels of applicative layer and database. Several security measures were integrated into the E-VS in order to achieve an enhanced, speedy and accurate performance. The E-VS should replace the conventional voting in Lebanon and hence simplifies the task for Electorates, Deputy Returning Officer and Returning Officer

2. VOTING PROSPECTS IN LEBANON

Lebanon is a republic in which the highest offices are reserved for specific ethnic groups: the President must be a Maronite Catholic Christian, the Prime Minister must be Sunni Muslim and the Speaker of the Parliament must be a Shi'a Muslim. The Parliament elects the President of the Republic to a six-year term. It has to be said that E-VS presented hereby does not cover this type of elections.

2.1 Parliamentary Electoral System:

The Parliament is elected for a four-year term by universal adult suffrage. It provides equal representation of Christians and Muslims through 128 deputies (Table 1). Deputies are distributed confessionally over constituencies according to table 1. Unlike the candidate's case, the voter's religion is not taken into consideration (Lebanese Official Journal, 2000). For instance, *CHOUF* district is represented by 8 deputies: 1 Greek Catholic, 2 Druzes, 2 Sunnis and 3 Maronites. Since the Lebanese electoral system is governed by a confessional distribution, each candidate should specify the confession he is representing. Let's take for instance the following case of candidates in *CHOUF* district: 1 Greek Catholic, 2 Druzes, 7 Sunnis and 5 Maronites. According to facts in this case and the principle of confessional distribution, Druze and Greek Catholic candidates are automatically elected. However, voters should choose 2 between 7 Sunnis candidates and 3 between 5 Maronites candidates.

2.2 Municipal Electoral System:

This type of elections is held in cities within districts. During municipal elections voters in each city elect members of municipal councils regardless of their confessions as confessional distribution is not applied in municipal elections' case (Lebanese Official Journal, 1997). For instance, if 45 candidates were running for municipal council membership in *CHEHIM* city, then, voters should choose 18 out the 45 candidates.

2.3 Administrative preparations

Administrative measures are the same for these two types of elections. Prior to Election Day, authorities provide polling centers with Register of Electors, monitors, cameras and microphones (Lebanese Official Journal, 2000). E-Voting system, in this case, represents a break through



toward a modernized voting process, reduced logistics' use.
 complications, limited time consumption and

Table 1: Seats Allocation in the Lebanese Parliament according to districts and confessions

Confession	Muslim				Christian							Total
	Alawite	Druze	Shi'a	Sunni	Armenian Catholic	Armenian Orthodox	Evangelist	Greek Catholic	Greek Orthodox	Maronite	Minorities	
Aley		2							1	2		5
Baabda		1	2							3		6
Chouf		2		2				1		3		8
Jbeil			1							2		3
Kesrwan										5		5
North Metn						1		1	2	4		8
Akkar	1			3					2	1		7
Batroun										2		2
Bsharreh										2		2
Dennieh				2								2
Koura									3			3
Minieh				1								1
Tripoli	1			5					1	1		8
Zghorta										3		3
Beirut		1	2	6	1	3	1	1	2	1	1	19
Baalbeck-Hermel			6	2				1		1		10
West Bekaa-Rashaya		1	1	2					1	1		6
Zahleh			1	1		1		2	1	1		7
Bint Jbeil			3									3
Jezzine								1		2		3



Marjeyoun-Hasbaya		1	2	1					1			5
Nabatieh			3									3
Saida				2								2
Tyre			4									4
Zahrani			2					1				3
Total	2	8	27	27	1	5	1	8	14	34	1	128
	64				64							

3. SYSTEM DATABASE

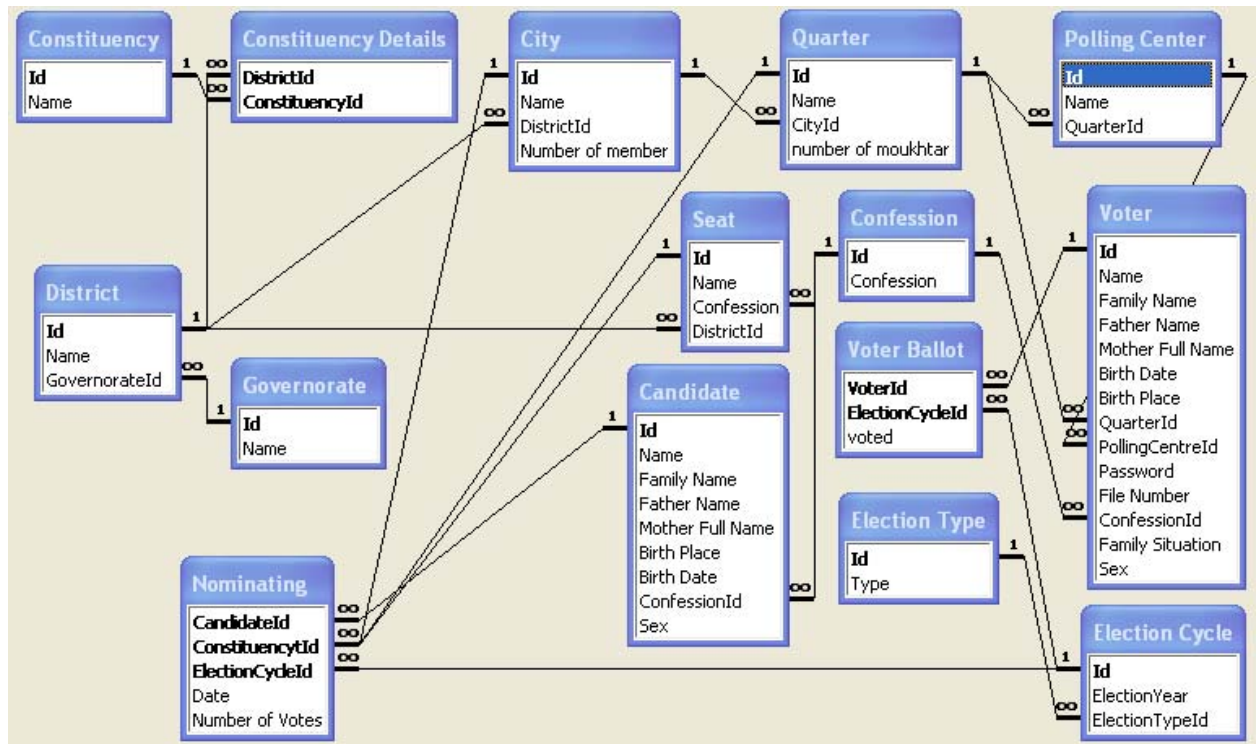


Figure 1: Database Model

Figure 1 shows the Relational Model of the system database. The Relational Model satisfies all the needed features mentioned previously. The function of each section within the Database is described below.

Candidates: includes all candidates.

City: includes all cities/villages in Lebanon and binds every city/village to its district.

Confession: includes all confessions in Lebanon.

Constituency: includes all constituencies in Lebanon. This table is attached to the district table to specify the districts included in any given constituency.

District: includes all districts in Lebanon and binds every district to its governorate.

Election Cycle: includes the election cycles.

Election Type: includes the type of elections: Legislative or Municipal

Governorate: includes all governorates in Lebanon.

Nominating: includes all candidates for a given election cycle. The number of ballot cast for each candidate is incremented according to voters' ballot. The *ConstituencyId* Field designates the *Seat Id* or the *Quarter Id* for the legislative or municipal elections respectively.

Polling center: includes all polling centers in Lebanon and binds every polling center to its quarter.

Quarter: includes all quarters in Lebanon and binds every quarter to its city.

Seat: includes all Parliament seats distribution and binds every seat to its district and its confession.

Voter: includes data for any given voter such as ID, password...

Voters Ballot: includes all voters who participated to a given election cycle. The voters' ballot is not saved in order to maintain confidentiality. Then, it is impossible to join a voting and a voter.

4. USERS' INTERACTION WITH THE SYSTEM

The E-Voting system seeks to computerize the voting process through a convivial, efficient and easy-to-use graphical interface. The E-voting system is managed by three main parties: Election Authority, Deputy Returning officer and voters.

4.1 Election Authority

Election Authority is held by Ministry of Interior. The Ministry is responsible for establishing the sub-systems and declaring the final results. Every polling center is equipped with a plug-and-play system especially custom-designed for the case of this center and it works separately from the main system.



Election Settings	
Governorate	Mount Lebanon
District	Chouf
City	Chehim
Quarter	Sahleh
Polling Center	Sahleh 1
Election Type	Legislative
Deputy Officer	Anis Ismail

Figure 2: Creation of a sub-system

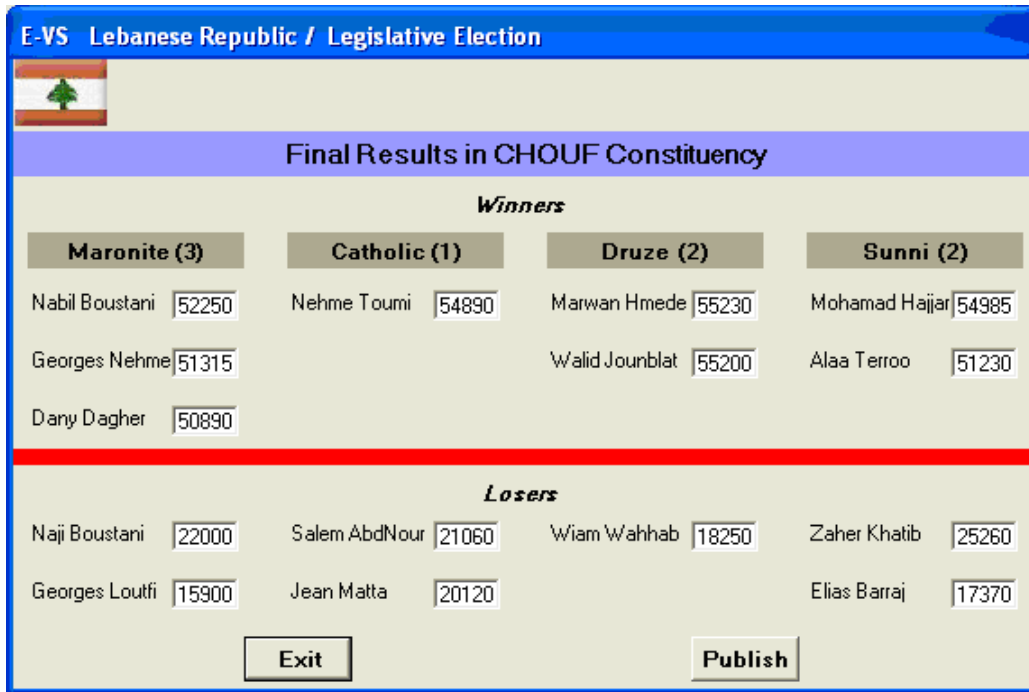


Figure 3: Final results of elections

In order for the Election Authority to create a sub-system, it should select the Governorate and the District within, the city within the District, the quarter within the city and finally the polling center within the quarter (Figure 2). This sub-system is created to gather needed user interfaces as well as data related to each polling center.

Election Authority is responsible as well for gathering and officially tabulating results from sub-systems in every polling center (Figure 3). Only Election Authority has the right to declare officially the results after checking them with memory cards held by the Deputy Returning Officer of every polling center.

4.2 The Deputy Returning Officer

He is appointed by the Ministry of Interior at each polling center to supervise the voting process. He is responsible for the

opening and closing of poll as well as for reporting the center’s results to the main system. He opens and closes the voting process using the interface of Figure 4. As for local results, the Deputy Officer sends them to the main system through the interface of Figure 5.



Figure 4: Election Settings.

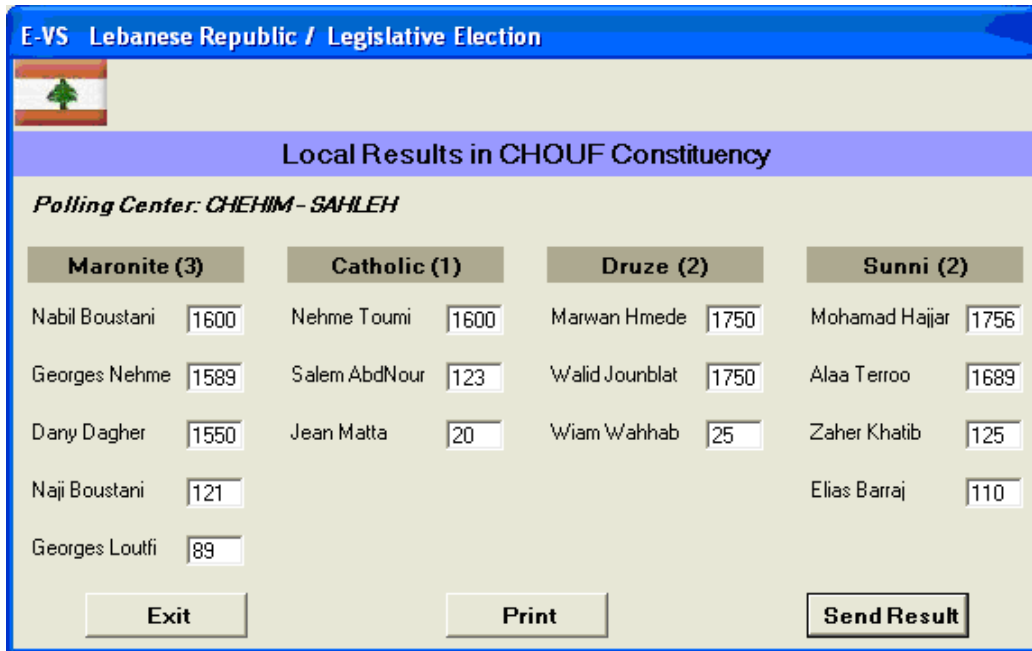


Figure 5: Local Results.

4.3 Voters

A voter is a person who is eligible to vote. In order to vote he/she should go through two steps: authentication and selection of candidates. Authentication prohibits voters from voting more than once. As for the selection of candidates, voters can cast their vote by choosing from confessionally sorted lists (Figure 6). These lists are created automatically by the sub-system of each constituency. For instance, CHOUF district gathers various ethnic groups and seats are confessionally allocated: 3 Maronites, 1 Catholic, 2 Druzes, and 2 Sunnis. The numbers mentioned here represent the

number of candidates voter can select from each list. When the selection is completed the list shows a green background. In case the voter decides to change his choice he could uncheck and select again. After selection is done, the voter should press on “Accept” button. A confirmation window appears presenting all candidates chosen by the voter. The choice of the voter would, then, be accepted. In order to finish, the voter should press on “yes” button or he/she can go back to choose again. Furthermore, in order to maintain confidentiality the ballot cast by the voter is not saved. However, the votes' numbers of chosen candidates are incremented.



Figure 6: The Selection Process.



5. SECURITY

Security is a key factor in any election process. Every voter expects the vote he casts to be confidentially and correctly saved and counted. In order to maintain security, the main interface in the E-Voting system is designed in a full-screen view and cannot be closed or minimized. Voters are given a touch-screen with no keyboard.

Each voting machine in every polling center operates separately during the voting process. As for ballots, they are saved in a local database. As soon as poll closes, the Deputy Returning Officer in every polling center counts ballots and report results to the main server using a special interface and expect confirmation. Encrypted data is transmitted through a secure 128 bits modem-to-modem connection using the Communication Security Protocol (SSL 128). This Protocol allows a safe communication (modem-to-modem) between the authenticated client and the server.

A hard copy of results from the polling center is later delivered to Election Authority that gathers them through the main system in order to quickly deliver final results.

6. CONCLUSION

The E-VS system described in this paper might be proposed as a E-Voting system to be applied during Lebanese elections. The system works visually through interactive, efficient and easy-to-use graphical interface. The complex treatments and features are achieved at the levels of applicative layer and database. Processed data are saved in a relational database and several security measures we integrated as well. The E-VS should replace the conventional voting in Lebanon and hence simplifies the task for Electorates, Deputy Returning Officer and Returning Officer. Implementing the E-Voting system is a step taken towards modernization.

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