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EXPERIENCING SMALL-SCALE E-DEMOCRACY IN IRAN

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ABSTRACT
Electronic voting is a relatively new application of information technology. Many governments are investigating how e-voting can be deployed as part of their e-government initiatives. In this article, the requirements of e-voting systems are described and experiences of achieving e-voting on a small scale in Iran are discussed.

Keywords
e-democracy, e-voting, information technology, Iran

1 INTRODUCTION

The emergence of the World Wide Web in the last decade of the previous century has had enormous effects on our lifestyles. Seen as a disruptive technology, the Internet has spread into nearly all parts of the world, and everyday new applications emerge. This trend is transforming societies into e-societies, as applications such as e-business, e-learning, e-healthcare, and e-government, etc have already been substantially deployed in many developed countries.

e-Democracy refers to the use of information technology (IT) for balloting. The gradual decline in the number of voters in elections and the desire of many developed country governments' to use an electronic voting system by 2006 has resulted in many researches being conducted to consider the perceived barriers to the implementation of electronic voting (MORI, 2005).

However, there are many other issues when considering IT applications in developing countries. The lack of proper infrastructure, low information literacy rate, low Internet penetration ratio and lack of skilled persons are among the most important barriers. Therefore, before considering major IT projects, such as e-voting, pilot, small-scale projects should be undertaken to ensure that the e-voting system is feasible.

In this article, the use of electronic voting on a small scale in Iran is investigated. After reviewing the background literature on e-voting systems, two experiences of organizing e-ballots are described. The first experience relates to the use of e-voting to elect the student scientific committees in Ferdowsi University of Mashhad (FUM), Iran. In the second experience, however, the use of e-voting for election of the high council of a prestigious and important non-government organization, the Construction Engineering Disciplinary Organization (CEDO), is described. Finally, the lessons learned from achieving these experiences are discussed and conclusions about the future deployment of e-voting systems in Iran, as well as in developing countries more generally, are drawn.

2 E-VOTING SYSTEMS

Electronic voting refers to the use of computers or computerized voting equipment to cast ballots in an election. This term, sometimes, is used more specifically to refer to voting that takes place over the Internet. Electronic systems can be used to register voters, tally ballots, and record votes.

The first electronic voting system was used for the Chicago and Cook elections in 2000, using punch cards (ERI, http://www.electionline.org). A card is given to every eligible voter. The card is punched by the voter, based on his choices. Then, the card is read by another machine. In case the card has not been punched correctly, another card is given to the voter and the process is repeated.

The ACT e-voting system was used in an election in Australia in October 2001 (ACT, 2001). Voters had the choice of manual or electronic balloting. Those who chose to vote electronically were given unique random barcodes. The barcode did not identify the voter, but his/her electorate and the polling place. It contained a digital signature to prevent forgery. Then, the voter should use a system consisting of a small keypad, a barcode reader and a display to cast the ballot using a computer as shown in Figure 1. The software was open source.

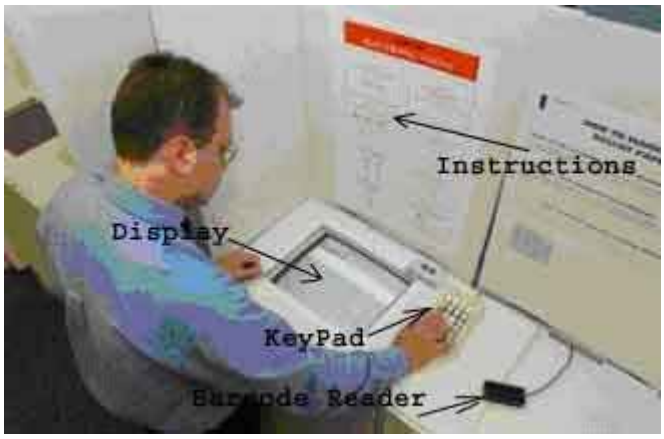

Figure 1- ACT e-voting system.

There are other e-voting methods that use a touch screen, light pen, or optical mark reader (OMR). Modern systems have utilized smart cards, as well (Daly, 2004). Direct-recording electronic (DRE) machines require voters to use a keyboard, touch screen, or pointer to mark their ballot on a computer terminal. The votes are immediately added to a running tally. The original DRE machines were simply electronic implementations of the traditional mechanical lever machines. Newer DRE models look more like ATMs or PCs and can display images as well as text (Cranor, 2001). DRE machines often use closed source proprietary software, and although used for some elections, many people question their credibility and accuracy.

Internet voting has gained some attraction too in recent years (Coleman, 2003). It has two types. One takes place at traditional polling site, and the other method is to cast ballots over the Internet from remote locations using electronic authentication and computer security technologies. For the Arizona Democratic Party election both methods were used. However, there are security concerns when Internet voting used for public sector large scale elections (Jefferson et al., 2004).

2.1 E-Voting System Requirements

Regardless of the technology, a voting system must have a set of characteristics, so that the results can be trusted (e-VOTE, 2001). These features are briefly discussed here, and the differences between manual and electronic systems are highlighted.

1. *Accuracy*: The system should ensure that no one can falsify or modify the result of the voting by eliminating a valid vote or counting an invalid vote in the final tally. As it is very difficult to systematically eliminate this risk, the elections should be handled by trustworthy organizations. Although intentional or unintentional errors of manual systems

can be avoided in an e-voting system, the hardware and software should be checked vigorously by experts to ensure they work flawlessly.

2. *Democracy*: The system should ensure that each voter is eligible to vote and can vote only once. In traditional voting systems, ID cards are checked. Usual computer authentication schemes (password, biometrics, …) are used for e-voting (Internet based or otherwise). However, it is more difficult to use somebody else's ID card and vote in traditional systems, compared to using another person's password and voting electronically.
3. *Privacy*: The voting system should ensure that nobody (organizers, administrators, voters etc) can link any ballot (contextually) to the voter, and none of the voters can prove that they voted in a particular way. Although it not difficult to design a system that ensures privacy, it is difficult to assure voters that really nobody can trace a vote to the voter.
4. *Verifiability*: The system should allow everybody to independently verify that all votes have been counted correctly, and everybody's vote has been tallied in the final count. In case of objections to the final result, a recount can easily be done in a manual system, while in electronic voting recount can employ the VVAT (Voter Verified Audit Trail) technique (Mercuri, 2002), or similar techniques, if the voting is done only in specific locations.

   VVAT is a piece of paper which contains the vote and should be verified by the voter. For instance, the voting machine can be connected to a printer. After voting, the ballot is printed and verified by the voter and is placed in a box. In case of recount, the papers can be tallied. However, the printing process increases the voting time.
5. *Convenience*: The voting system should allow and assist voters to cast their votes quickly, in one session, and with minimal equipment or special skills. Proper Graphical User Interface (GUI) and touch screen can increase voting speed and minimize errors.
6. *Flexibility*: The system should allow a variety of ballot formats and it should be customized to the specific characteristics of the voting process. This feature is a limiting factor, as many e-voting systems only support limited types of election formats.
7. *Mobility*: The system should not pose any restrictions on the location from which a voter can cast a vote. Internet voting has more advantages in this regard, as voters can cast their votes from virtually any place.
8. *Efficiency*: The election should complete its task in a reasonable amount of time and voters should not wait too long until the system completes the process.
9. *Scalability*: Size of election should not drastically affect efficiency.

It should be noted that some of the features contradict each other. To satisfy one requirement other features would be affected. For example, the *privacy* requires storage of little information, while *verifiability* would require more information. Also, satisfying these requirements (using some techniques) would affect other features such as flexibility, convenience and mobility.

2.2 E-voting System Categories

There are 4 categories for Internet voting, depending on the level of security, privacy and trust that they maintain (Adler).

- **E-commerce**: These systems provide no security except possibly on the communication channels, as is used in e-commerce system. Ballot box stuffing is tolerated, the voter's privacy is not maintained, and vote tampering is not prevented. It is suitable for an Internet polling site.
- **Trusted Authority:** Voter privacy is somehow maintained and vote tampering is prevented in these systems. However, the election officials are trusted to maintain the

integrity of the election. This type of voting system is suitable for small scale voting, for which the election officials can be trusted.

- **Individually Verifiable:** The election system supports secure, efficient, and private elections. Blind signatures (Chaum, 1981), a class of digital signatures that allow a document to be signed without revealing its contents, are used in these systems. The most significant disadvantage is that the voter is responsible for ensuring that his vote has been accounted for in the final election tally. These systems are impractical for civic elections as no independent observer can verify the election.
- **Universally Verifiable**: Anybody can verify the election without compromising voter privacy in this system. Provision of this level of protection is difficult. Currently, these systems can only be used for *yes/no* elections due to contradictions among requirements.

3 FIRST EXPERIENCE

Ferdowsi University of Mashhad (FUM) is one of biggest universities in Iran. It has four campuses and 12 faculties. Nine of them are located in the main campus along with veterinary faculty inside the city, while the remaining two faculties are in nearby cities, which are at distances of 100 and 200 kilometers away. There are over 15000 students studying in 150 courses within 52 departments.

FUM has an advanced IT deployment. The fiber optic network backbone within the main campus connects faculties, laboratories and rooms. The current speed of the network is 100 Mbps, and is planned to be upgraded to 1 Gbps. There is a general web-based application framework. A vast range of application programs are deployed in FUM, including financial, educational, human resource management, student facilities, operating within this framework. Access to the systems is through a single sign-on screen, with different levels of authorization. Many security protocols have been deployed at network, system, application and database levels, and no major security outbreak has been reported since its deployment more than three years ago. Software applications are developed and maintained by the university Information Technology Services (ITS) centre. The framework and systems are based on LAMP (Linux, Apache, MySQL and PHP) and are open source. Some of them have been installed in other universities country-wide, as well.

Three portals, one for academics, a second for staff, and a third for students, are defined for the system. The students' portal provides access to whatever information a student needs. After logging on to the system, a user can fill in detailed information at admission time, enroll for subjects, add and drop subjects within the specified periods, view marks, use the e-learning system, register for dormitory residence or vote for candidates in the elections. In this paper, only the voting system is explained. Figure 2 shows a screenshot of the student portal that contains one page of the e-voting system. The portal language is Persian (Farsi).

Annually many elections at different levels (department, faculty, …) are held within FUM. Students elect their representatives in scientific committee, union, sport, cultural activities and many political associations. The e-voting system was designed so that it can cover the election at all levels plus a free-form election with predefined voters. The open source program '*devote'* (DEVote) was used and modified to fit within the framework. This system falls into the second category of Internet voting systems.

This system was used for scientific committee board elections for the first time. For each department, a few students were candidates and everybody could vote for 5 persons within his department. On average, the number of candidates was twice the number of final winners. There was a one-week campaign period. Although the system supported online campaigning, it was decided by the authorities to use a conventional campaign. A brief

tutorial about the e-voting system was prepared, placed on the university homepage and distributed to the students. The voting system is shown in Figure 2.

Figure 2 E-voting system within student portal

The election was held successfully and representatives were elected. About 20 percent of students participated in the voting, which was about 20 percent more than the previous year's election.

4 SECOND EXPERIENCE

The Construction Engineering Disciplinary Organization (CEDO) is an NGO which oversees all activities related to building and urban design. The steering boards in the provinces are elected directly by engineers. The board members (about 300 persons) then annually attend a meeting and elect 64 persons among themselves and submit the list to the Ministry of Housing and Urban Development. The minister, according to specified rules, chooses 32 of them as the members of the high council of CEDO.

CEDO consists of 3 main sections: civil; equipment; and architecture and urban design, having 3, 2 and 2 subgroups, respectively. In the election, members elect the candidates from the list. They can vote for 30 persons from the civil section, 18 persons from the equipment section, and 16 persons from the architecture and urban design section. In the high council there should be at least one member from each subgroup.

Because of an unsuccessful electronic election that had been conducted in the previous year, it was decided to relinquish the design, implementation and execution of the electronic election to the FUM ITS center.

This electronic election experience was quite different from the first one (scientific committee election). Because of the high degree of sensitivity of the matter, the election had to be done within a specific place (rather than from the Internet) and within a limited time (2 hours). The number of election choices was high, which could increase the time that a person needed to cast his vote. Many of voters were not familiar with computers and they did not have a previously issued user ID and password.

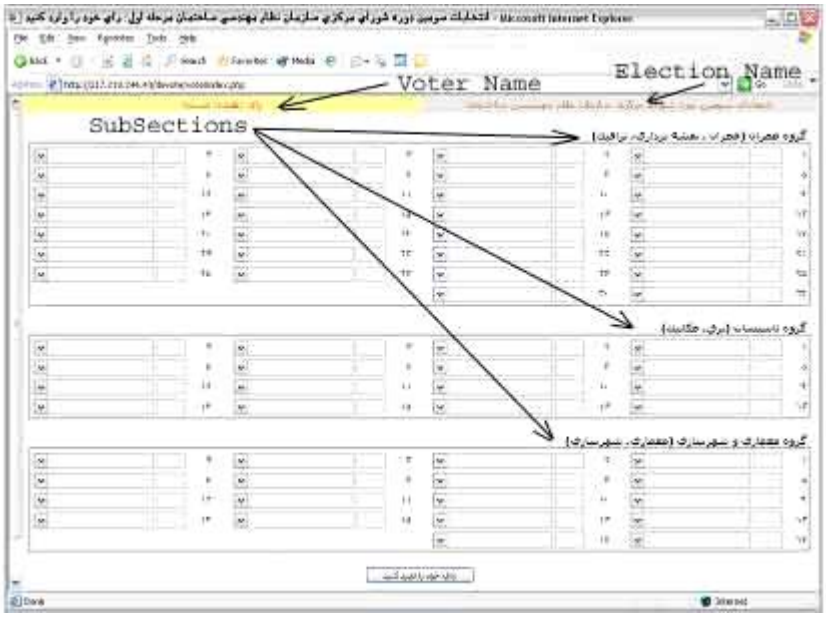

Figure 3- evoting system for CEDO election

The prepared system was having the previous core with a new GUI to avoid user mistakes (repeated vote or vote for more than the permitted number of candidates), and decrease the voting time (Figure 3). It was possible (and recommended) to vote without using a mouse (as some of the users were not familiar with computers and using a mouse could complicate the matter even more). To satisfy these usage requirements, many GUIs were designed and evaluated.

Before the election, lists of the candidates and eligible voters were added to the system. Then, randomly, a user ID and password were assigned to each voter. The name and other attributes of the voters were printed on special cards. After opening the card (by tearing one side of the card), each member could see his user ID and password. The cards were distributed at the entrance to the voting hall. A sample card (opened) is shown in Figure 4.

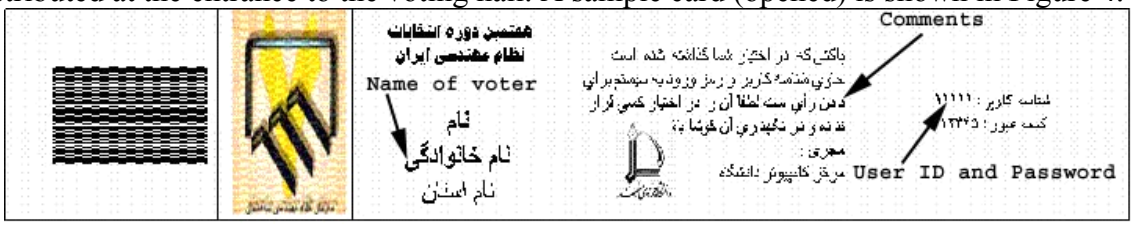

Figure 4- Sample of cards used in CEDO election

In the morning before the election, candidates introduced themselves, and the procedure for casting ballots was demonstrated. A paper similar to what they see on the system was distributed to the voters to draft their vote (including name and code of each candidate). This could speed up the election time, as they only need to type the number from the paper into the system.

Before the election, the inspection committee attended the voting hall and checked that the database (voting box) was empty. Then the election was started. The eligible voters received their cards at the entrance, sat behind a computer, opened the card, logged on to the system using the user ID and password on the card, and cast their votes. After pushing the 'vote' key, another screen appeared which showed the vote clearly and asked the voter to verify it to prevent unintentional errors. After verification, the vote was recorded and the user was logged off automatically.

There were many technical persons in the hall to help voters. The election took two hours to complete and the result was announced and put on the home page immediately. The

code and the data of this successfully held election was written on a CD and given to the authorities for future reference.

5 LESSONS LEARNED

The above experiences show that most of the issues discussed in section 2 were very important for the users and managers of the elections. The accuracy of the system was a major concern, and only after vigorous testing and accessing was the source code verified.
Democracy issue was easily achieved in CEDO election, as the election was held in a specific hall and entrance to the hall was only possible after checking a person's name name on the list and giving the user/password card to the voter. On the other hand, many problem arose in the case of scientific committee election. One problem was that anybody could vote for another student by knowing the user ID and password of that student. In some faculties where the result was more sensitive, the voting was only permitted from a specific place. Concerns regarding the possibility of multiple voting by one person were addressed by allowing student representatives to test the system repeatedly.

Privacy and verifiability are somehow reciprocal. That is, increasing one would decrease the other. This mismatch makes e-voting on a large scale nearly impossible unless a universally verifiable system is available. In the system, each vote individually was stored in the database along with the time and the IP address of the voting station, but the relation between voters and the votes was not stored.

Before CEDO election, few people discussed the verifiability of the system and the possibility of recounts, and suggested a system similar to VVAT. However, because most people believed in the reliability of the university system and staff, as well as the shortage of time, the matter was not accepted by election authorities. Although the difference between the last elected person and the next one was only one vote, nobody challenged the accuracy of the system.

The user interface was also very important. In the scientific committee election, as the number of eligible voters was high (about 15,000 students), it was not possible to train them individually. Therefore, the user guide was prepared and was placed in many locations and on the site. Simplicity of the GUI and familiarity of students with it solved many problems.

In the second election, the ease of use of the GUI and the time were major concerns. Putting a lot of efforts for GUI design, considering many options and preventing user mistakes solved the problem. Moreover, to help computer-illiterate persons, a few trained persons were present at the election hall.

6 CONCLUSION

In this article, after the discussion of the characteristics of an e-voting system, successful experiences of holding two electronic elections were described. The experiences, in general, showed that using information technology for different applications can result in convenience, accuracy, time and expenses saving. However, advance planning and proper infrastructure are major contributors to the success.

The first issue in the widespread use of e-voting is the cultural issue. That is, the lack of public trust on the accuracy and correctness of software. It needs training and education, and many successful small electronic balloting pilot studies should take place, so as to assure the public that this is a viable and less expensive alternative to the traditional ones.

For instance, computers were extensively used for tallying votes in the *city council election* in 2003 in Iran, and no problem was reported (at least publicly). However, the authorities did not allow it for parliament and presidential elections in the following years. The main reason relates to the lack of trust on the accuracy and correctness of software. The

situation was different at FUM, as the second scientific committee election was held without any problem.

The second issue is the technical issue. Security and authenticity of e-voting software and systems are still being questioned by many IT experts. These objections caused the cancellation of e-voting in the 2004 US presidential election. Unless proper algorithms and software are designed, a full scale Internet voting for an important and sensitive election would not take place.

In developing countries, the lack of infrastructure is another important issue. Specialized e-voting hardware are expensive, Internet penetration rate is low, telecommunication infrastructure is not yet completely established, and more importantly public IT literacy is not high enough. So, it is expected that developing countries will lag behind the developed countries in this regard. In these countries, using pilot projects, similar to what was explained in this paper is recommended.

Based on our experience, starting with an insensitive small scale election, using Internet voting from specified location (not from remote places), with advance planning and preparation, using an open (source) and comprehensively tested software, and adequate training of voters are key elements of successful e-voting experiments.

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BIOGRAPHY

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