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Implementation of an Electronic Voting System with Contactless IC Cards for Small-Scale Voting

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***Abstract*—There have been several studies on using computer technologies to improve elections and these studies lead to widespread adoption of "direct recording electronic" (DRE) voting systems in recent years. In an electronic-voting system, voters go to their voting places and prove that they are allowed to vote there by presenting an ID card with signet. After this, the voter is given a token that allows them to vote for their candidates of choice at a voting machine. When the voter's selection is complete, DRE systems with typically present a summary of the voter's selections, giving them a final chance to make changes. Subsequent to this, the ballot is cast and voter shall return the given token to ballot box and leave voting place.**

In this research, we design and implement an e-voting system that provides DRE capability. Our e-voting system is equipped with an IC card reader and a touch-panel LCD. Cost and security are the two most important facts to the success of our e-voting system. Low cost on the token is obtained by selecting re-usable contactless IC card as voting token. Security of our e-voting machine is obtained not by secrecy, but by openness and secure coding of software.

Keywords-e-voting; contactless card; information security

I. INTRODUCTION

Traditional voting which has several problems in the real life. First, the voting was held which cost a large numbers of resources and money. Secondly, the tally clerk might make erroneous judgment which will lead to the injustice and incorrect election result. Many studies were conducted on how to integrate the information technology into the voting in recently years. E-voting, I-voting, cell phone E-voting, and Post-voting were proposed in USA, UK, and several European countries [5].

In this research, we developed an E-voting system which uses contactless IC cards as reusable ballot, without storing any private information on the IC cards.. Such system could reduce the voting, cost, simplify the procedure, decrease the erroneously judged votes. In addition, this study enhances the ballots being verified, prevents someone who attempts to malicious attack, and avoid the administrator who makes the counterfeit votes. Finally, we used the touch screen as input interface then improved security of E-voting and raised approval rating of voters. The small-scale means about 50 to 100 people to vote at the same time.

II. RELATED WORKS

An integration E-voting system not only could simplify the procedure, reduce the election cost but also ensure the ballot produce that is secret. In 1992, Fujioka et al applied the secret channel to the E-voting [3]. Because of the election be held that took a lot of cost and wasted the human-recourses in recently years. However, many countries adopted to implement several ways of E-voting.

There are many advantages of E-voting, including fast finished the procedure of counting votes and reduced the social costs. Already several countries had held E-voting in their official election [4-6].

In E-voting systems, we have to setup the election information before the polling and install to each polling station. Then, we have to setup the system with initial data before the polling day. The voter has an identifier authentication card that might be memory card or smart card. Size of the card is like a credit card and can be saved data.

When the voter put the card onto the reader of voting machine, then the card will be verified by the machine. If the card is valid then voter would cast a ballot, then the voting result will be shown on the screen. If voter were to exit the voting place, then the card would not be cast again. This function would prevent the voter for repetition polling.

After voting completion, the tally clerk inserted a security IC card into the voting machine for counting votes. This card should be checked by PIN number then entered the system for saving the election result. The voting result would be written into a portable storage and be sent or read to back-end server [4].

E-voting systems overcame many traditional voting obstacles such as improving the speed of counting votes and reducing the costs. However, it also brings up with many security issues [1, 2, 6]. There are some e-voting problems as usual, including: hacker invasion, limited by software manufacture, vote rigging by using computer, incorrect program, vote fraud, and computer is crashed, etc.

III. THE PROPOSED E-VOTINGSYSTEM

We designed and implemented an E-voting with software created under Borland C++ 6 tool. To reduce software vulnerability [8], our source codes have been checked with open source scanning tool.

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Te proposed E-voting system is illustrated in Fig. 1. Each voting machine is equipped with a contactless IC card reader and each legal votes will be issues with a contactless IC card at polling place. Some public data will be written on IC cards, such as the election name, the candidates, and the electoral district before polling that could help reducing inputting the duplicate information. These data have to be read before voter cast a ballot. In addition, the system would produce a random number automatically on the ballot card that is not only used to avoid faking cards, but also used as a verifying code at the voting center and counting center.

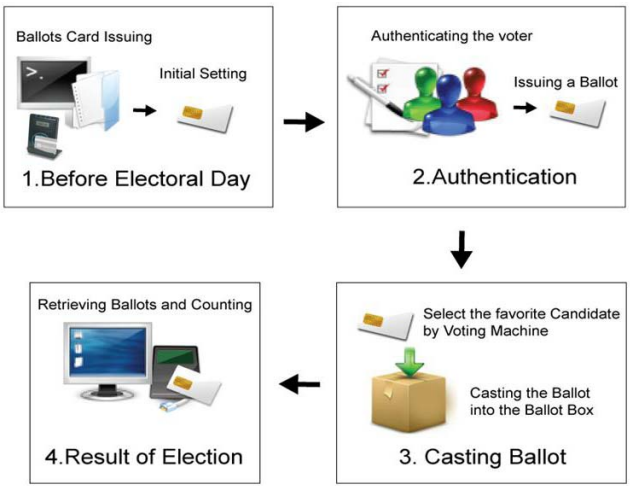

Figure 1. Illustration of the proposed E-Voting System

The real voting procedures are simulated on the proposed system and our system is composed of three parts, issuer center, voting center, and counting center. Fig. 2 is the system architecture. Before the issuer center issuing IC cards, each card will store a private number to be used as the verifying code. Voting center adopted many machines and each machine would save its voting result to a counting IC card. Finally, counting center will sum up data from voting machines and show the election results.

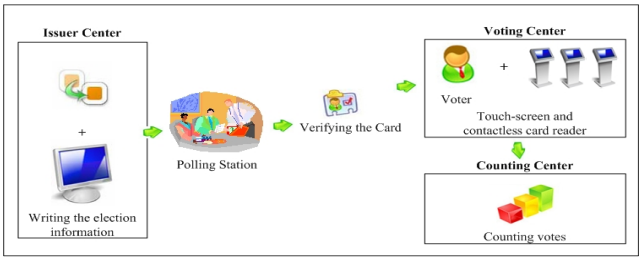

Figure 2. System architecture

Flowchart of the proposed system is shown on Fig. 3. We will explain in more details.

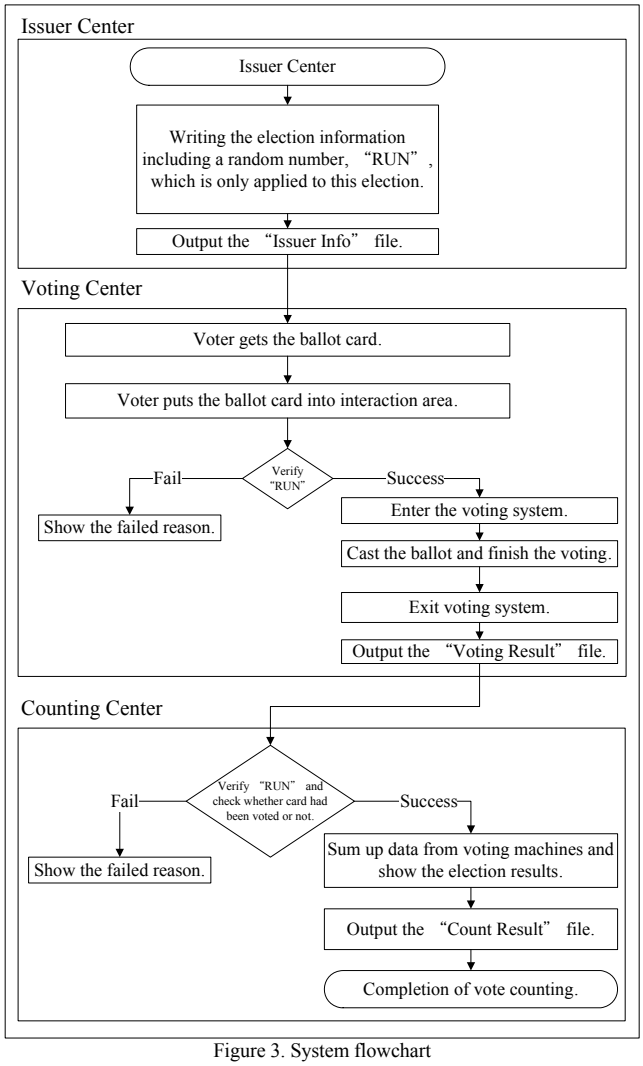

Figure 3. System flowchart

A. *Issuer Center*

Every center has dual operating languages, either in English or in Chinese. Administrator can choose the suitable language. Administrator has to set two different types data. First, administrator input the election information, including what is the number of "District", how many "Candidates", the name of this election such as "First district", and the names of each "Candidate". This process is shown in Fig. 4.

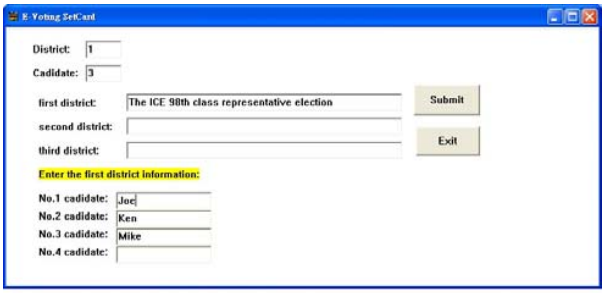

Figure 4. Setting the election information

Then, administrator gives a "RUN" that is randomly generated and used to verify whether the election is available or not (shown in Fig. 5).

Figure 5. Setting authentication code

B. *Voting Center*

When the legitimate voter receives the contactless IC card and prepares to cast a ballot, he/she approaches the voting machine. Fig. 6 shows the reader with card place on the slot and voter could operate on the first touch panel screen, Fig. 7, for polling.

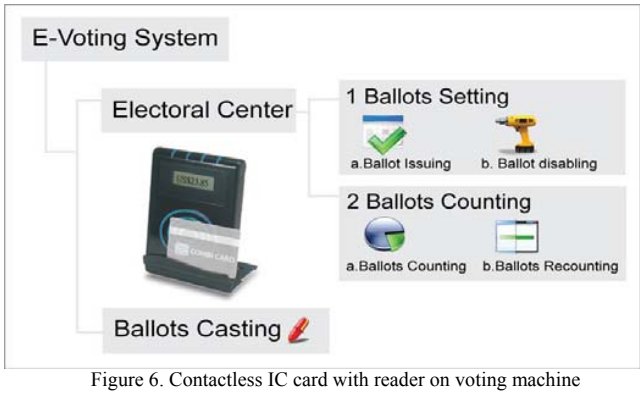

Figure 6. Contactless IC card with reader on voting machine

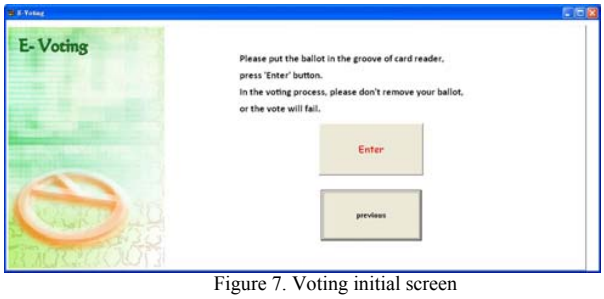

Figure 7. Voting initial screen

The touch panel screen will show the candidate menu to voter, an example is shown in Fig. 8. If voter casts a wrong ballot to the candidate, then voter still have the chance to make correction. This step will double check your selection and double confirm your decision, shown in Fig. 9.

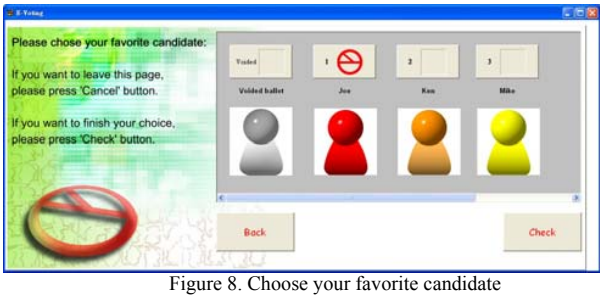

Figure 8. Choose your favorite candidate

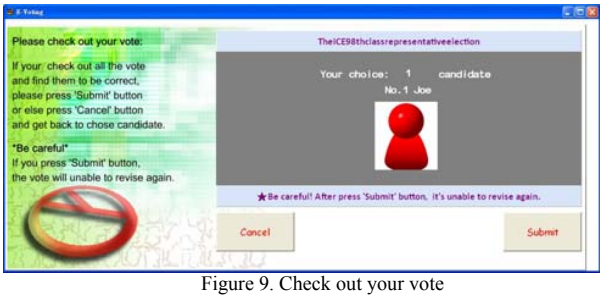

Figure 9. Check out your vote

C. *Counting Center*

After voting, the counting center will collect voting data from all voting machines and sum up for the final voting results. If needed, all votes could be recounted at the counting center.

IV. CONCLUSION

By using information technology, E-voting system can cast and count votes with higher convenience and efficiency, even make the electoral procedures simple and reduce the mistake rate of ballot examination.

In this research, we designed and implemented an E-voting prototype system with contactless IC cards. Our system can not only make sure voter's identity but also ensure the validity of voting IC cards. The developed E-voting system has many features, including user-friendly interface, dual operating languages, enhanced security of the ballot, ballot validation, and elimination of counterfeited card. The small-scale means about 50 people to vote at the same time. On real-time experiment, it takes about 10 minutes for 50 people to vote with one voting machine.

ACKNOWLEDGEMENT

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