INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION & MANAGEMENT

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A STUDY OF INTERNET VOTING FOR THE ELECTIONS OF UNIVERSITIES IN SRI LANKA

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ABSTRACT

Most institutions of higher learning such as universities and colleges world over provide for an electioneering process where students elect their union leaders in a democratic manner. This is of great importance as it inculcates the principle of democracy into the students who are at the peak of their learning stage and would need these skills for better statesmanship. In the past, people go to polling place and take the blank ballots, then punch a hole or append the seal. If the seal is not clear enough, or the vote is damaged by soiling, it may bring some debate on the result. In order to resolve these situations, the technology of electronic voting (E-voting) comes into existence. Proper management therefore is called for to provide fool proof processes which can be termed as free and fair in the standards of universal democracy and employment of Information Technology (IT) is a sure way to realize this. This research carried out at USJP (University of Sri Jayeward-enepura) and the process undertaken to achieve development and deployment of a web based system to promote free and fair democratic electioneering process: computerizing registration, voting and tallying process involved. The system was developed using the incremental prototyping due to the adaptive nature of web based applications and the system proved that a computerized solution is possible with elimination of human related faults that are a commonplace in employment of human clerks to manage the election process. Integration with short message service (SMS) functionalities helped increase safety and reliability of the system. Application of the online voting has resulted in many advantages in the efficiency of the entire electioneering process and reduced costs the university used to incur using the human clerk.

KEYWORDS

ballot, cast E-voting, vote,

I.   INTRODUCTION

In a true democracy, elections are the basis for the nation functions healthy. Also this is similar to the university council elections. As the elections are hold frequently, the costs of voting are increasing geometrically. In order to save human resource and time, the current trend is using information technology (IT) on elections.

The USJP council members had not used IT for their elections still. But they identify integrated IT to satisfy the characteristic of election such as uniqueness, accuracy, completeness, verifiability and privacy. Not only that with IT, can simplify the traditional electoral procedures and saving the cost of human resource and time. In addition, use the touch screen panel to be the input interface with accessibility, and it can decrease the learning difficulty when the voters are instructed in how to use the new system.

Recent years the issues of combining voting with IT have developed into two directions. The former one is E-voting, which is voting on the particular machine in the fixed position; the latter is internet voting (I-voting), which is voting on the internet without limiting people in the polling station but needs higher level of security. Therefore, identifying deference between these two methods developed this system. Because using this system and can save their valuable time (Time is the very important factor for university students), reduce paper cost, increase accuracy, and improve students' attention and attraction.

II.   LITERATURE REVIEW

David Chaum[7] addressed the concepts of untraceable electronic mail and digital pseudonyms, which can apply for electronic voting for anonymity. In order to reduce the cost of human and material, moreover, to enhance the convenience in the task of polling, E-voting has taken the place of traditional voting in a considerable number of countries over the past few years. In this section, my aim to review literature consider relevant to E-voting.

EVALUATION OF VOTING EQUIPMENT

In the recent years, voting equipments which were widely adopted may be divided into five types[8]:

(1)   Paper-based voting: The voter gets a blank ballot and use a pen or a marker to indicate he want to vote for which candidate. Hand-counted ballots is a time and labor consuming process, but it is easy to manufacture paper ballots and the ballots can be retained for verifying, this type is still the most common way to vote.

(2)   Lever voting machine: Lever machine is peculiar equipment, and each lever is assigned for a corresponding candidate. The voter pulls the lever to poll for his favorite candidate. This kind of voting machine can count up the ballots automatically. Because its interface is not user-friendly enough, giving some training to voters is necessary.

(3)   Direct recording electronic (DRE) voting machine: This type, which is abbreviated to DRE, integrates with keyboard; touch screen, or buttons for the voter press to poll. Some of them lay in voting records and counting the votes is very quickly. But the other DRE without keep voting records are doubted about its accuracy.

(4)   Punch card: The voter uses metallic hole-punch to punch a hole on the blank ballot. It can count votes automatically, but if the voter's perforation is incomplete, the result is probably determined wrongfully.

(5)   Optical voting machine: After each voter fills a circle correspond to their favorite candidate on the blank ballot, this machine selects the darkest mark on each ballot for the vote then computes the total result. This kind of machine counts up ballots rapidly. However, if the voter fills over the circle, it will lead to the error result of optical-scan.

EFFECTIVENESS OF E-VOTING AMONG DIFFERENT COUNTRIES

Recent years, a considerable number of countries has adopted E-voting for their official elections. In this section, some empirical examples are enumerated as following.

(1)   America: Government of the United States hold election collaterally in several ways, in other words, each state can choose the suitable way to hold elections independently. Because there are some debates about E-voting, such as some vote casts were not counted, or election system crashed during the Election Day. Secretary of State Kevin Shelley established an "Ad Hoc Touch Screen Task Force" to research the debates on DRE in February 2003[9]. Shelly advanced that DRE should include voter verifiable paper audit trails (VVPAT) to solve electoral debates.

(2)   India: Elections in India are conducted almost exclusively using electronic voting machines developed over the past two decades by a pair of government-owned companies. One is Electronics Corporation of India (ECIL) and other one is Bharat Electronics Limited (BEL). Their Electronic Voting Machines ("EVM") are being used in Indian General and State Elections to implement electronic voting in part from 1999 elections and in total since 2004 elections. The EVMs reduce the time in both casting a vote and declaring the results compared to the old paper ballot system. However, EVMs have been under a cloud of suspicion over their alleged tamping arability and security problems during elections (especially after the 2009 general elections). After rulings of Delhi High Court, Supreme Court and demands from various political parties, Election Commission decided to introduce EVMs with Voter-verified paper audit trail (VVPAT) system.

(3) Japan: Japan adopted E-voting for local election in 2002, such as mayor and councilor election of Niimi city in Okayama prefecture in June 23, 2002; mayor election of Hiroshima city in February 02, 2003; and mayor election of Kyoto city in February 08, 2004. Take mayor and councilor election of Niimi city for example, electoral center surveyed the voters' reliability when the election finished. There are 83% of voters considered that E-voting system is trusted. 56% of them considered that the results of E-voting and paper-based voting are the same therefore E-voting is sufficient for reliable. The reasons why voters can't trust the E-voting system are voters worried about the abuses in E-voting system, and they cannot make sure their ballot are recorded correctly.

(4) Belgium: Election for the Federal Parliament is held in May 18, 2003. In order to assist voters in being familiar with E-voting system, electoral center held short-term training. Counting efficiency in the election with E-voting system was faster than convention. Belgium's compulsory voting system and E-voting complement each other, voters' satisfaction and attending willingness of join voting are improved obviously.

(5) Brazil: Brazil used E-voting in 1998. When the voter reaches the polling place, he shows his identity card for authenticating; if he is an eligible voter, he can get the ballot for E-voting. Brazil's E-voting system transmits votes to electoral center immediately, so that the count of votes can announce rapidly while the voting finished.

COMPARISON OF E-VOTING SYSTEM

Besides many vendors to develop and sell commercial electronic election machines, there are various open source E-voting systems. I cite some examples as following [6, 1]:

(1) AccuVote-TS: AccuVote-TS's vendor is Diebold Election Systems. This system includes touch screen, card reader, keyboard, headphone, and paper tape printer. The voter selects his favorite candidate on touch screen, and the vote will be printed on the paper tape. Its design balances the policy, electoral procedure and technology. But all the electoral information (including identity authentication, audit, or counting of votes) are stored in Microsoft Access database without setting password so there are high risks of attack.

(2) iVotronic: The vendor of iVotronic is Election Systems and Software (ES&S). iVotronic provides multi-language, and uses flash memory to save voting records. Electoral workers use PEB (Personal Electronic Ballot, a device which is similar to disk) to start polling machine up. When the election is finished, the workers use PEB to access voting records in the polling machine, then delivers PEB to electoral center or transmits data from network. Because the PEB's password is only three characters, the risk of password breaking exists. This system has made mistake in the past elections, such as the number of voters is not corresponding between master server and backup server, the candidate selected on the ballot is not the voter's selection, and so forth.

(3) eSlate 3000: Hart InterCivic invented eSlate 3000. The voter gets a personal identity number (PIN) as four digits from electoral workers, then goes to the booth to input the PIN into polling machine to login. He can rotate selector wheel to select the candidate whom he wants to poll for. Each terminal connects to the server which is named JBC (Judges Booth Controller). Counting of votes will send to JBC from every terminal by network, then save it in MBB (Mobile Ballot Box). This system doesn't encrypt voting data, so there are some risks of data security. Furthermore, the electoral functions are not protected with password, anyone, even the voter, can finish the election.

(4) AVC Edge: AVC Edge is a multi-language polling machine which is manufactured from Sequoia Voting Systems. This machine includes touch screen and flash memory for saving voting recorded, and its electoral procedure is similar to a foregoing E-voting machine, Accu Vote-TS. There were some stumbles when this machine operated in the elections. For example, the E-voting system crashes when the user chose language; the counting of votes is not correct; and the ballot became blank because of the system breakdown.

(5) SAVIOC: SAVIOC is an open source E-voting system and all the source code and software can download from its official website [4, 5]. This system is written in C language, and it can be saved in disk with voting system and all the source code and software can download from its official website [8, 9]. This system is written in C language, and it can be saved in disk with Free DOS. This system operates from disk, so hard disk is not necessary and the discarded computer is enough. This system is not connected to any networks and most of keys on the keyboard are disabled, attackers can't find the way to invade. SAVIOC's advantages are its simple disposition and low cost, but on the other hand, there are short of GUI and ease of use on SAVIOC.

III.   NEED/IMPORTANCE OF THE STUDY

Proposed system is supposed to provide convenient and easily manageable system for the election process of student's council in Sri Jayewardenepura University. This is providing convenience to the voter and possible to reduce waiting time in queues at election centers. Also result can provide instantly at the end of the election.

IV.   STATEMENT OF THE PROBLEM

Manual voting system has been deployed for many years in our university. In Traditional elections process, voter goes to the voting station and casting vote. After completing verification of particular voter, he/she is allowed to vote. The voter is then given a ballot which allows a single vote. Once the ballot is used, it cannot be used again. However, this ballot must also be anonymous. The ballot must identify the voter as being permitted to vote, but not reveal their actual identity, and the voter must also be given assurances of this. In the university has 10000 students enrolled in the diverse fields in various faculties and departments of study. Student Union elections within the university had been faced with many challenges given variations in reporting time and academic year cycles as leading the list of challenges. This made fixing a specific date for elections a challenge as no single semester would suit all the students. Moreover, the all students cannot attend the voting because of several reasons and students are faced with problems during voting. So there is a need of a contemporary online election voting system that contributes to the development of the university's democracy in addition to classical voting system.

V.   OBJECTIVES

The objectives of the study are:

- Investigate the user preference for a web based voting portal
- Provide comfortable and easy way to manage and monitor the entire election process from a computer based interface
- Provide online voting facility, automatically process the result at the end of election, summarized and detailed reports and votes distribution Report among candidates
- Reduce/Avoid number of Invalid cast, election corruption at the vote casting stage and vote counting stage and counting effort and associated cost

VI.   RESEARCH METHODOLOGY

Throughout this research, it is desired to provide high secure, easily accessible and highly accurate online voting system to the student council of the university. This is a web based system. The administrator adds students, remove students, and disqualify students due to election rules violation. In the voter registration process, the system administrator fed student's details in to system including name, registration number, academic year and NIC. Then system will issue a password for log in to system for the casting and voter will receive an email or SMS confirmation. There is another login page and the system generated user name and pass code for that. This is the process for validate the voter and ensure the vote is done by the desired voter. This second username and pass code is generated by the system and email/SMS to each and every voter after the first login. Successfully cast the vote, automatically logging out process required to avoid corruption. If someone try to log using already casted logging details, system should provide warning and should not be able to log for the system. At the end of the casting period, each and every candidate's vote count, vote distribution among candidates, total number of voters, each and every voter's preference should be provide as a report and distribution should be graphically visualized. The result should be sent to the each and every voter and to candidate through an e mail/SMS.

VII.   RESULTS & DISCUSSION

When a ballot is added to an election, the format of the vote for that ballot is derived from the key size chosen for the election and the number of "candidate" choices on the ballot. These two values determine the maximum number of voters allowed. The total size of the vote is limited to the key size k (in bits). The vote is split into c bit fields where c is the number of candidates. The size of the bit fields $v_c=k/c$. However, v_c is limited to 32 bits so that each candidate's field will fit into a 32-bit integer (for ease of extraction only). Therefore, if $k/c > 32$, $v_c=32$ and only the first $32*c$ bits of the vote will be used. To cast a vote, a voter votes the value $2^{\wedge}(i_c*v_c)$ where i_c is the desired candidates ballot index (0, c-1). By using votes of this format, the tally can be computed by multiplying all of the votes together and decrypting the product.

Once an election has been created, saved, and posted to the election web service, voters can create and cast votes. After the user login page user logs in either as an Administrator or a voter. If the user logs in as an Administrator, he will have a link from the menu for the voting page. If the user has logged in with voter credentials, then he will be connected to the voting page automatically. When connected to the voting page, a list box will have all the elections available for the voters. This list is the list of the elections in the elections folder. After highlighting the election and clicking to the button to load the election, election details will be loaded for voters to vote. The ballots from the election will be loaded, with each issue being loaded into the issue text box, and its corresponding choices loaded into the textbox to the right (the choices textbox). The voter can make his/her choice simply by clicking on the desired choice. That issue's choices will then be displayed in the choices textbox. Again, select the desired choice by clicking on it in the choices textbox. Once a choice has been selected, the ballot issue and the selected choice will appear in the "Current Votes" textbox. To the right of the issue question and the selected choice is the hex value of the vote to be cast. Once all choices have been made, the voter can submit his/her vote by selecting "Submit Vote" button at the bottom of the page. This button will call the web services and save the vote into the database. Once the vote is submitted, no changes can be made.

VIII.   FINDINGS

In the past, student council use paper based voting method for their election. In 2012 they had conducted an election to select the president for their council. At that time 7200 students were there as the voters and 6 students were registered as the candidates. Those students came from 30 departments of 4 faculties. But all students didn't use their votes.

TABLE 1

Year	All voters	Casted Votes	Not Casted	Rejected
2012	7200	4400	2800	120
2009	6400	5180	2020	241
2006	5000	3910	1090	310

STRENGTHS AND WEAKNESSES OF THE SYSTEM

Strengths

* Faster vote count and tabulation
* More accurate results as human error is excluded
* Efficient handling of complicated electoral systems formulae that require laborious counting procedures.
* Potentially increased participation and turnout, particularly with the use of Internet voting.
* More attuned to the needs of an increasingly mobile society.
* Increased accessibility, for example by audio ballot papers for blind voters, with Internet voting as well for housebound voters and voters from abroad.

Weaknesses

* Limited openness and understanding of the system for non-experts.
* Lack of agreed standards for e-voting systems.
* System certification required, but no widely agreed standards for certification.
* Potential violation of the secrecy of the vote, especially in systems that perform both

IX.   RECOMMENDATIONS/SUGGESTIONS

According to that data Internet voting is useful than the paper based voting. Because of at the internet voting, we can store every data. Not only that, paper based election takes very huge cost for everything of the elections. With wasting time and want to huge space for the paper based election. But internet voting is very easily used and manages

X.   CONCLUSIONS

In the past, people go to polling place and take the blank ballots, then punch a hole or append the seal. If the seal is not clear enough, or the vote is damaged by soiling, it may bring some debate on the result. In order to resolve these situations, the technology of electronic voting (e-voting) comes into existence. 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. Due to construct an E-voting system with practical utility, at first, I compared many E-voting systems clarify the existing problem.

Over the years, the scholars are addressed their concept of e-voting, they integrated information technology to satisfy the characteristic of election such as uniqueness, accuracy, completeness, verifiability, privacy, and enforceability. But most of these researches focused on designing encryption algorithm, a usable and applicable implementation is rarely.

In this project, I have described the specification and architecture of an Internet Voting System with Identifying some benefits and faults. In the election period as a voter or as candidate, students have very workload. So they have not enough time to their studies. Another one is their cost is increasing. I think Internet voting system is a very best answer for that. But there are many problems. Because all student has not enough knowledge about develop the voting system and how we use it. In addition, various fault-tolerance and security issues are delegated to the platform itself, therefore relieving the application designer from accommodating these features in the application design itself. This approach allows for the easy development and deployment of applications.

The most pressing question facing the authors is the extent to which electronic elections will face legal scrutiny in the future. We have evaluated the concept of an electronic election to be both constitutional and compatible with federal laws. Therefore, we find that a constitutionality claim is unlikely if the election is properly implemented. I feel that such authentication is inherently flawed, at least for the purpose of ensuring anonymity, and that it is unlikely at the current time to create any authentication system that does not provide a cause of action if such a system depends solely on Internet-based methods.

What, then, is the future of electronic voting? Despite claims of discrimination and security hazards, the future is bright. Clearly, initial attempts at electronic voting will need to be paralleled with traditional methods, both for the sake of allowing voters maximum access, and for providing a backup in case of technical error. However, it is likely that ultimately advances in technology and legal precedent gained over the course of a "trial period" will pave a more explicit legal path for electronic elections to follow.

XI.   LIMITATIONS

1.   This study pertains to one University. (University of Sri Jayewadenepura)
2.   Tested sample was and small and random

XII.   SCOPE FOR FURTHER RESEARCH

Also there will be an associated android application for the cast votes.

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APPENDIX/ANNEXURE

TESTED SAMPLE

TABLE 2

1	54946	05/4254	Ms. W.M.U. KUMARIHAMI
2	55094	05/4394	Ms. P.M.A. ROHINI
3	56781	06/4836	Mr. G.P.C.S PATHIRANA
4	56999	06/5047	Ms. D.M.S.M KULASINGHE
5	58598	07/5056	Rev. P. AMARAWANSA
6	58600	07/5058	Mr. K.G. SIRIRUWAN
7	58601	07/5059	Rev. A. GNANARATHANA
8	58602	07/5060	Mr. M.A.N. PRIYADARSHANA
10	58604	07/5062	Rev. A. PAGNGNARAMA
11	58606	07/5064	Ms. V.A.M.R.K. ABESINGHA
12	58608	07/5066	Ms. K.G.N.M. ABEYKOON
13	58609	07/5067	Ms. L.L. ABEYSEKARA
14	58610	07/5068	Mr. A.M.P.P.K. ABEYSUNDARA
15	58611	07/5069	Ms. I.G.N. ABEYWICKRAMA
16	58612	07/5070	Ms. K.V.A.A. ABEYWICKRAMA
17	58613	07/5071	Mr. A.D. ADIHETTY
18	58614	07/5072	Ms. A.M.I. ADHIKARI
19	58615	07/5073	Ms. K.M.N.S. ALAS
20	58616	07/5074	Ms. K.M.V.S. ALAS
21	58618	07/5076	Mr. A.R.M.I. AMARASINGHE
22	58619	07/5077	Ms. A.W.N.E. AMBEPITIYA
23	58620	07/5078	Ms. J.S.N. ANURADHA
24	58621	07/5079	Mr. W.T. ANURANGA
25	58622	07/5080	Ms. S.J.M.S. ANURUDDHIKA
26	58623	07/5081	Ms. U.G.N. ANURUDDHIKA
27	58624	07/5082	Mr. G.M.P.L. APONSU
28	58625	07/5083	Ms. P.A.C.P.P. ARACHCHI
29	58626	07/5084	Ms. K.S. ARIYADASA
30	58627	07/5085	Mr. K.G.I.V. ASANKA
31	58628	07/5086	Mr. T.H.A. ASIRI
32	58629	07/5087	Ms. A.A.N.S. ASURUMUNI
33	58630	07/5088	Mr. A.M.S.K. ATHAPATHTHU
34	58631	07/5089	Mr. B.M.N.J.K. BALASOORIYA
35	58632	07/5090	Ms. B.M.S.I. BALASOORIYA
36	58670	07/5128	Ms. K.W.A.D. DASANAYAKA
37	58671	07/5129	Ms. M.J.A.U. DASAWARDHANA
38	58672	07/5130	Ms. R.P.K.M. DAYARATHNA
39	58673	07/5131	Ms. N.D. DE SERAM
40	58674	07/5132	Ms. A.D.B.G. DE SILVA
41	58702	07/5160	Ms. D.A.C. DILHARI
42	58703	07/5161	Ms. B.G.M. DILRUKSHI
43	58708	07/5166	Ms. K.A. DILSI
44	58712	07/5170	Ms. D.M.G.P. DISSANAYAKA
45	58723	07/5181	Ms. N. EDIRISINGHA
46	58725	07/5183	Ms. E.M.C.K. EKANAYAKE
47	58726	07/5184	Ms. J.M.A. ERANDATHI
48	58727	07/5185	Ms. M.A.I.E. ANURA
49	58729	07/5187	Ms. P.P.S. FERNANDO
50	58731	07/5189	Mr. K.I.U.K. FONSEKA

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