

The Future of Electronic Voting (Final Report)

Over the years, there have been many issues relating to electronic voting and electronic voting systems. Various companies and software specialist have tried to develop a system that will address electronic voting issues, but all have been unable to develop an optimal system, or even anywhere near optimal. Society has not been able to develop a universal, secure, user-friendly and private electronic voting system.

Many electronic systems have been developed, but all have fallen short one way or another, often with some segment of society being left out. By continuous research, Dr. Gilbert and his (Prime III) team have developed a unique system known nowhere else in the world. They have developed the Prime III electronic voting system which is somewhat of an untouchable system compared to others, and it is the only system that is universal enough to capture votes from all persons in society.

The two main voting procedures that have been used by developers in electronic voting are Mark-Sense ballots where the user shades in their vote and the other is Direct Recording Elections (DRE's) which allows users to vote via touch (Kohn, Stubblefield & Rubin). Both have fallen short in being universal, in a sense that mark-sense ballots can only be used for sighted voters or those with hands, and issues also arise when the scanner is unable to detect the darkest mark (Kohn, Stubblefield & Rubin). In reference to the DRE's, again the issue arises if the user is blind or does not have any hands. There are also many other issues with these systems such as security vulnerabilities. There are other smaller systems, however many have not been developed enough to be used in general elections.

My research at Auburn University for summer 2009, involved the development and enhancement of the Prime III electronic voting system, which is a universal, multimodal and optimal electronic voting system that meets the needs of the public. Prime III is an electronic voting system that can address many of the questions which arises among electronic voting system including security, universality and accessibility (Cross, Rogers, McClendon, Mitchell, Rouse, Gupta, Williams, Mkpong-Ruffin, McMilliam, Neenly, Lane, Blunt & Gilbert). It is universal in a sense that it meets the needs of all regardless of one's abilities including, the blind, deaf or even those without any limbs (Cross, Rogers, McClendon, Mitchell, Rouse, Gupta, Williams, Mkpong-Ruffin, McMilliam, Neenly, Lane, Blunt & Gilbert).

My project included conducting two main usability studies with the Prime III electronic voting system and also many other research tasks in an effort of enhance the system. I made various changes to the Prime III code throughout my research experience. Another major part of my research included Optical Character Recognition, (OCR) which was due to a possible inclusion of OCR into Prime III. However, from my findings thus far, OCR is not accurate enough for Prime III, and when one is on the topic of electronic voting system, there is no room for error, especially when dealing with Prime III (Cross, Rogers, McClendon, Mitchell, Rouse, Gupta, Williams, Mkpong-Ruffin, McMilliam, Neenly, Lane, Blunt & Gilbert).

Studies have shown that Optical Recognition accuracy rate is relatively high, however, it has errors (Rice, Jenkins & Nartker). Enough errors to possibly throw off an election, and we certainly have no room or leniency for errors with our Prime III electronic voting system. Optical Character Recognition is an excellent idea, but Prime III is not ready for OCR as yet due to a possible misinterpretation of characters of letters on a page. As OCR gets developed and enhanced, in a few years, it should eventually be accurate enough for Prime III.

The first usability study that was carried out with Prime III for my research experience was at the Alabama Institute for the Deaf and the Blind (AIDB) in Talladega, AL. This was the largest or in a sense the most demanding part of my experience mainly because I had to carry out a detailed analysis of all the data received from this study. I had just arrived at Auburn University the previous week before we went to AIDB to carry out my research, and at the time I was very unfamiliar with Prime III, however, I would not allow my inexperience to hinder any of my research. I went over detailed description of what Prime III is and has to offer with my mentor, and also separately with four different members of the Prime III group. After these meetings I was very informed about Prime III.

The basic code for Prime III system had already been developed, the working physical prototype of the system is currently being designed, and usability studies such as the one at AIDB are continuously being carried out on the system to attain meaningful data with reference to what needs to be changed. With repeated usability test and revisions of the system, in a very short period of time, the world will have an optimal and universal electronic voting system. This system is not all electronic as some may think, however, it produces a paper ballot which is essential for voting, which then passes through a tally machine.

On Thursday June 4, 2009 a usability study was carried out at the Alabama Institute for the Deaf and the Blind (AIDB) by five of the Prime III team members. The five Prime III members included Ashley Wiggins White-Spunner, Shanee Dawkins, Jerome McClendon, Dwight McCants and Jerone Dunbar. Three Prime III terminals were set up but the team and they were made available for all those who choose to use the system. All participants including blind and visually impaired used the system and their feedback about the system was documented.

Participants first read, or was read a consent form to gain their consent, after which a pre-survey and post-survey was asked to gain additional information. The pre-survey had questions mainly relating to demographic information and also questions regarding how computer literate the users were. The post-survey mainly included questions relating to each specific users experience with the Prime III electronic voting system.

Additionally, for this particular study at AIDB, the number of participants was minimal. The low turnout may have been directly related to the heavy showers that occurred early in the morning on the day of the study. Aside from the five students that went to AIDB to represent Prime III, there were many other companies and organizations, mainly promoting their vision enhancers for visually impaired individuals at AIDB.

In reference to the Pre-Survey there were five responses relating to the answers that could be given, which ranged from Strongly Agree to Strongly Disagree. Below you will be able to see the percentages of the results from all the pre-surveys.

Statement: I am computer literate.

67% of participants believed that they are computer literate.

Statement: I am good with computers

75% of participants believed that they were good with computers.

Statement: I trust computers to do online shopping.

67% of participants trust computers to do online shopping.

Statement: I am comfortable using computers to pay household bills.

59% of participants are comfortable using computers to pay household bills, however, 41% of participants do not trust computers on this matter.

Statement: I trust computers to securely send my personal information over the internet.

50% of participants trust computers to securely send this personal information over the internet, while another 25% do not, and the remainder had a neutral response.

From the data received it is evident that the majority of participants were computer literate (67%). A large amount of participants also believed that they were good with computers (75%). The participants trust in computers to do online shopping was also somewhat high (67%). However, many participants had a flip side in trusting computers to pay household bills, a little more than half of the participants trusted the computer for that, while a little less than half did not. In reference to the final question which asked the participants if they trust the computer to securely send their personal information over the internet, only half trusted the computer to do that while the remaining half did not have that level of trust with computers.

It is important to note that the data received from this year's AIDB study is less than half the amount that was received from last year's study. With less data the result may not be as stable or general, due to the minimal participants, nevertheless data is essential to our research. In addition to the pre-survey, participants were given a post survey to fill out after they interacted with the Prime III electronic voting system. The structure of the questions were very similar to the pre-survey with answers ranging from strongly agree to strongly disagree. A five point Likert scale was also used to capture certain responses from the users, with 5 being the most positive response and one being the least. Below you will find the main questions in the post-survey and a guide to the responses that the users gave.

Statement: Please mark the number that best reflect your reaction to Prime III.

When participants were asked if the reaction was terrible or wonderful, 58% of participants had a rating of 4 or better.

When participants were asked if their reaction to Prime III was Frustrating or Satisfying, 58% selected a rating of 4 or better.

When participants were asked if their reaction to Prime III was Usable or Not Usable, 75% selected a rating of 4 or better.

Statement: To what extent do you trust Prime III to accurately count your vote?

When participants were asked how much they trust Prime III to accurately count their votes, 75% gave a response of 4 or better.

For the remainder of the post-survey all responses to the suggested statements ranged from strongly agree to strongly disagree.

Statement: The feature I used helped me to complete the task.

92% of participants agreed or strongly agreed with the statement.

Statement: I liked the appearance of the Prime III voting system.

75% of participants agreed or strongly agreed with the statement.

Statement: I would use Prime III again.

83% of participants agreed or strongly agreed with the statement.

Statement: Prime III would be easy to use by people who do not know a lot about computers.

81% of participants agreed or strongly agreed with the statement.

Below are questions that directly relate to the touch screen feature, for the participants that used that particular feature.

Statement: The feature was easy for me to use.

100% of participants agreed or strongly agree with the statement.

Statement: It was easy to get started.

88% of participants agreed or strongly agreed with the statement.

Statement: It was easy to cast my vote.

100% of participants agreed or strongly agreed with the statement.

Statement: I knew what to say or do during the task.

88% of participants agreed or strongly agreed with the statement.

Statement: If I made a mistake, it was easy to correct.

88% of participants agreed or strongly agreed with the statement.

Statement: I was able to successfully complete that task.

88% of participants agreed or strongly agreed with the statement.

Below are the statements that related directly to the speech feature, for the participants that used this specific feature.

Statement: I would have preferred a male voice.

33% of participants strongly agreed with the statement, while 67% had a neutral response.

Statement: It was easy to get started

89% of participants agreed or strongly agreed with the statement.

Statement: It was easy to cast my vote.

86% of participants agreed or strongly agreed with the statement.

Statement: I knew what to say or do during the task.

78% of participants agreed or strongly agreed with the statement.

Statement: If I made a mistake, it was easy to correct.

86% of participants agreed or strongly agreed with the statement.

Statement: I was able to successfully complete that task.

78% of participants agreed or strongly agreed with the statement.

Statement: It was easy to understand the system's instructions.

44% of participants agreed or strongly agreed with the statement, while 33% gave a neutral response and the remainder disagreed with the statement.

Statement: It was easy to speak to the system.

75% of participants agreed or strongly agreed with the statement.

The last section of the post-survey asked the users for their comments on how to improve Prime III, if given the option to vote using paper or Prime III. Many of the responses by the participants were to change the voice of the machine speaking in Prime III to a more user friendly voice. The majority also opted to use Prime III instead of using paper, if they were given the preference.

Lastly, some of the additional comments mainly included working on the background noise and addressing the feedback issue. Participants mentioned that when the environment is noisy the system accepts interference as an answer in some cases, when the participant did not

mean to select that particular option. However, they said that it was easy to go back to make the correction.

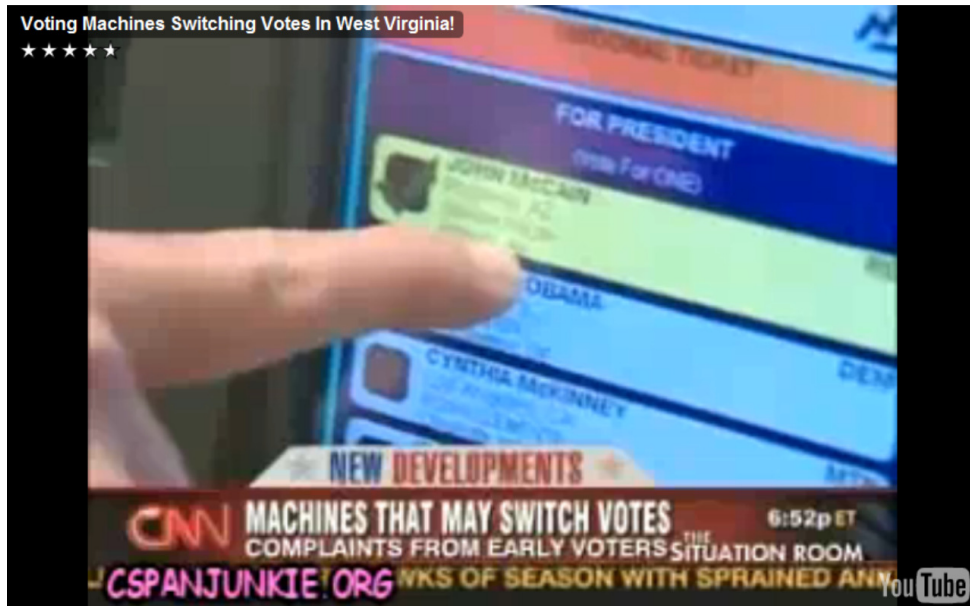
Many participants mentioned that they did not like the voice of the machine in the Prime III electronic voting system and would have preferred a more friendly voice. As my mentor Dr. Gilbert mentioned to me, some may not like the voice, however, all will be able to understand what is being said which is what is essential. The issue is that, as developers, we would not want at anytime for the users to think that the system is being hacked in a sense that the user will have to question if they are being spoken to by a human or a machine. To address the background noise issue, better technologically advanced microphones will be used for enhanced clarity and reduce the effect of any background noise.

The second usability study that I was a part of this summer took place at the Osher Life Long Learning Institute (OLLI) in Opelika, AL on June 29, 2009. The focus of this study was in essence the continuous test of Prime and the study also was a continuation of a previous graduate student (Rogers) research on where people touch touch-screens. This particular research arose from the vote switching issue which occurred in the 2008 elections. Vote switching occurs when selection is given to another candidate instead of the candidate intended (Rogers). This is a problem that should not be taken lightly, it is a problem which can throw off an election, and consequently, the research was carried out.

Vote switching had occurred in the 2008 elections in West Virginia (Rogers). Many had thought that the vote switching occurred because of some technical issue, however, another major possibility was that the user interface was flawed. Mr. Roger's research focused on where persons touch touch-screens, whether it is names or buttons. To view a brief synopsis of this

issue, kindly look at this YouTube video “Voting Machines Switching Votes In West Virginia.”

The picture below shows a snapshot of the issue.



Essentially, the voting machines have poor design. When a voter attempts to select a candidate by clicking on the name, the machine often actually reads the touch as an incorrect selection due to the fact that each candidate name is very close to the button above. The results from the research at the Osher Life Long Learning Institute revealed that 86% of participants in the mock election touched names while the remaining 14% touch the buttons. This shows that if persons are intending to click names and not buttons, then it is very likely that the system will misread the intent. The results clearly support the idea that these particular voting machines were poorly designed.

Within the next few years, with continuous development and enhancement of the Prime III electronic voting system, the world will have a universal, safe and optimal voting system for all. Future work with Prime III involves a Dynamic Brail Keyboard integrated with a single

button control which can aid both blind and deaf, and a write in candidate option which also allows those who are blind to write in a candidate.

Conclusion

Research into an electronic voting system captured the researcher's interest more than I actually thought. A universal, multimodal, and optimal electronic voting system is what the world needs, and Prime III provides that. It is an electronic voting system meeting the needs of all, regardless of being blind, deaf or having no hands. At the time of graduate school I hope to continue research within this field if Prime III is not already fully developed.

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