Prime III Voting System Aids Voters in Ballot Verification

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ABSTRACT
Prime III is a unique electronic voting system that allows everyone, regardless of inabilities to independently and securely cast their votes. Developed by Dr. Juan E Gilbert and this team, Prime III is the first of its kind and promises to revolutionize voting as we know it. In addition to its accessibility, Prime III also aids voters in the detection of anomalies on the review screen. Previous research by Everett (2007) and also Campbell (2009) has shown that only 50% of voters noticed anomalies on the review screen. Our research is a replication of these works and found that over 93% of voters noticed anomalies when voting with Prime III.

Keywords
Prime III, DRE

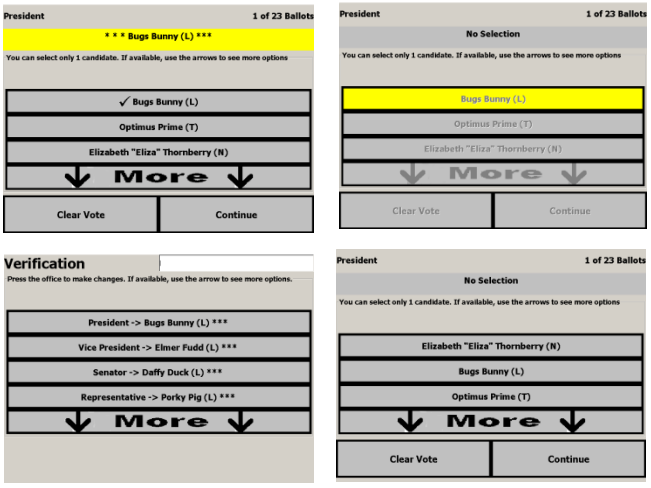
1. INTRODUCTION

The integrity of America's voting system has been an ongoing issue for many years. Traditional voting equipment such as punch cards and ballot has done little for the affirmation of the integrity. This was made clear by the infamous "Hang Chad" in the highly contentious 2000 United States presidential election. [1] Electronic voting machines, also commonly known as DREs (Direct Recording Electronics), are increasingly being used in many states today. However this is not without significant controversy. These systems pose a number of risks and issues including being prone to hacking and the inaccessibility to individuals with disabilities.

Prime III was developed using the Human-Centered Computing approached and was aimed at solving all these problems. [2] It features a multimodal user interface design that allows users to interact with system in a variety of ways. This makes it the first electronic voting system that allows individuals to cast their votes independently regardless of inabilities and disabilities. Not only is Prime III accessible to virtually everyone, but it is more secure than other DREs as it aids users in the verification of their ballots.

The verification of the review screen is extremely important when considering voting security. It safeguards against software and hardware malfunctioning such as the miscalibration of touch interface, accidental candidate selection as well as malicious attempts to alter votes. Despite this well known risk, Campbell (2009) showed that 50% of do not verify votes on the review screen.

Prime III allows the voter to selects their desired candidate by either touching the screen, speaking, writing in the candidate or even blowing into a microphone. After a selection has been made, the inputs are temporarily deactivated to prevent against accidental selection by smears on the screen or any accidental utterance. The selection is recorded and showed on the screen and progression is only possible by the voter's prompt. Prime III also allows the user to scroll through or listen to all the candidates selected before finally prompting to cast the votes. The printed ballot allows the voter to perform additional verification of the ballot. Figure 1 is a depiction of Prime III's interface.



2. BACKGROUND AND RELATED WORK

Campbell (2009) spoke of the shortcomings of the Everett (2007) study. He claimed that the previous study did not emphasize to the participants the importance of verifying the review screen. In addition to this, the review screen did little to aid with the verification process. Accordingly, Campbell (2009) conducted his study with enhanced instructions to participants and a remodel of the review screen.

These changes did result in an increase of the detection rate from approximately one-third to exactly 50%. During Campbell's study, participants were asked to vote twice, once using a DRE and then using another voting technology (either using a paper ballot, punch card or a lever machine). Half the number of participants were given a list of candidates and told exactly for whom they should vote and the other half was just informed of the voting instructions and voted as they desired.

When participants voted using the DRE, their votes were either switched to an opposing candidate or the vote was dropped and the selection changed to "none". Either 1, 2 or 8 alterations were made to the votes and this was either done in the first half of the races on the 27-race ballot or the second half.

After voting, the participants were directly asked if the noticed changes on the review screen. Although this method is flawed because it is prone to deception, half of the participants still report that they did not notice any change to their votes.

3. RESEARCH AND IMPLEMENTATION

3.1 Participants

The solicitation of participants was done via a mass e-mail to students, faculty and associates of Clemson University. The only prerequisites were English speaking and age must exceed 18 (participant must be of voting age). There were 60 participants including 25 males and 35 females. Their ages ranged from 18 to 65 with an average age of 29.

3.2 Design

Although, this research replicated the works of Everett (2007) and Campbell (2009), the designed used for our study was not as complex. The participants only voted once using Prime III, and were all asked to vote for all members of a specific party. Prime III was modified to always change the votes casted by the participants of the study, however there were two variables manipulated.

Anomaly Type (2 levels, between subjects)
Participants' votes were either switched to a rivaling opponent for that race or the vote was dropped. In the case of the latter, the selection was changed to "No Candidate". The probability of either one of these choices where made was equal.

Number of Anomalies (3 levels, between subjects)
The number of anomalies on the review screen varied between 1, 2 and 8.

Anomaly Location
The locations of changes were randomly chosen for all participants.

Detection of anomalies was determined by participants attempting to make changes to their votes once they realize discrepancies. If the participants failed to realize the anomaly, he/she was allowed to proceed to cast their vote and obtain the printed ballot. The participants were then given a second opportunity by reviewing the printed ballot, and told to notify the conductor when he/she is satisfied with the ballot.

3.3 Procedure

On arrival, the participants were given the experiment instructions and informed consent. After given time to read both documents, they were also verbally informed of study procedures. Once the instructions were fully understood, participants were instructed to use Prime III and vote for all members of a specific party. This made it easy to remember for whom they voted when verifying the review screen.

All candidates and parties of the elections were fictitious. There were three parties, namely Transformers, Looney Tunes and Nickelodeons, and candidates were characters of the respective well known cartoons and movie. Participants were observed as they navigated through the interface and the review screen. Once the participants revert from the review screen to make changes to their vote, the study was immediately ended. When the participants failed to realize the change on the review screen, they were allowed to go on to cast their votes and printed their ballot. After printing, the participants were allowed time to review the printed ballot and were

asked to inform the administrator when they are satisfied with their vote. The post experiment survey was administered after completion of the voting process and participants were debriefed and thanked for their contribution.

4. RESULTS AND CONTRIBUTIONS

Recall that Campbell (2009) showed that approximately 50% of voters do not notice anomalies on the review screen. We hypothesized that Prime III aids voters in the detections of anomalies. There were 59 usable participants and our studies showed that over 93%, i.e. 56 out of 59 participants did notice the changes made to their votes. Table 1 below shows the detection of changes by the number of anomalies. As seen in the table, there is no significant difference between the detection rates for the number of anomalies. However, the rate at which participants noticed anomalies when there was just one changed was slightly less than 2 and 8 anomalies.

Table 1: Detection by number of anomalies

Number of Anomalies				
	1	**2**	**8**	**Total**
Noticed	17	18	20	**55**
Did not	3	1	0	**4**
Total	**20**	**19**	**20**	**59**

Table 2 shows the number of participants who notice the change on screen as well as on the printed ballot. Again, there is no significant difference between the numbers of anomalies. It is also important to note that majority of the participants those who realized the change, i.e. 83% noticed it on screen.

Table 2: Detection whether on screen or on paper

Number of Anomalies				
Noticed	**1**	**2**	**8**	**Total**
On Screen	15	14	17	**46**
On Paper	2	4	3	**9**

5. CONCLUSION

The Prime III voting system has not only proved to be more accessible that other DREs but has also proved to be more secure by aiding voters in the verification of their ballots. Its interface design helps voters to cast their votes securely and confidently, from the selection of a candidate to the verification screen, and the printed ballot gives the voters additional assurance. The use of Prime III will indeed revolutionize a voting system that is truly in need of an overhaul.

6. ACKNOWLEDGMENTS

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7. REFERENCES

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