A Consideration of Voting Accessibility for Injured OIF/OEF Service Members: Needs Assessment

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PREPARED FOR:
Election Assistance Commission
1201 New York Avenue, N.W.
Suite 300
Washington, D.C. 20005

PREPARED BY:
Human Systems Integration Division
Electronic Systems Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology
Atlanta, Georgia 30332

Annotated Literature Review Results

Usability of Voting Systems

Arzt-Mergemeier, J., Beiss, W., & Steffens, T. (2007). *The digital voting pen at the Hamburg Elections 2008: Electronic voting closest to conventional voting.* Paper presented at The International Conference on E-voting and Identity, Bochum, Germany.

> The city of Hamburg revised its election laws so that each voter has more than one vote making the voting process more complicated. Tallying all of the votes would be complicated and time consuming using traditional ballots, so an electronic voting system called the Digital Voting Pen System ("Digitales Wahlstift-System", or DWS) is proposed. The DWS was selected due to its security, verifiability, and closeness to the conventional voting procedure and therefore its acceptance among voters. The digital pen is used like an ordinary pen but contains a microprocessor that scans the marks the user places on a special piece of paper with a specific dot pattern printed in the background. The paper booklet is collected along with the electronic vote for spot tests or, as needed, in depth verification of polling results.

Bederson, B. B., Lee, B., Sherman, R. M., Herrnson, P. S., & Niemi, R. G. (2003). *Electronic voting system usability issues.* Paper presented at the SIGCHI conference on Human Factors in Computing Systems, Ft. Lauderdale, FL.

> Usability problems associated with paper and mechanical voting devices were brought to the public eye after the elections of 2000. In response, many precincts nationwide have begun to use electronic voting machines. However, electronic voting machines have usability problems as well. This paper discusses benefits and drawbacks of both kinds of voting machines, as well as the issue of technology acceptance by different demographic groups. Some groups, such as older adults and those of lower socioeconomic status, are less familiar with electronic devices, and may therefore less readily accept the new technology. They also may experience significantly more difficulty when using the new technology.

Bederson, B. B. & Sherman, R. M. (2002). Usability review of the Diebold DRE system for four counties in the state of Maryland. Retrieved from www.capc.umd.edu/rpts/MD_EVoteMach.pdf.

> The results of a usability evaluation of the Diebold AccuVote-TS voting system are reported. The system, a direct reported electronic voting system, was evaluated using three methods: expert review, close-up observation, and field testing. The system exhibited both strength and weaknesses. Some of the weaknesses included the absence of a dedicated help button, unclear and long help instructions, and inconsistent terminology. Although most of the users responded favorably to the system, some users did report a need for improvements.

Byrne, M. D., Greene, K. K., & Everett, S. P. (2007). *Usability of voting systems: Baselines data for paper punch cards, and lever machines.* Paper presented at CHI 2007, San Jose, CA.

> Computer-based direct recording electronic (DRE) voting systems are being adopted by jurisdictions in the United States to replace older technologies such as paper ballots, punch cards, and lever machines. The computer-based DRE systems could potentially improve the usability and accessibility of the voting process, but the only way to know if these systems do improve usability is to have baseline data on the usability of the older technologies. The authors performed an experiment to assess the usability of punch cards, lever machines, and two forms of paper ballots (a bubble ballot and an arrow ballot). They found that while there was no significant difference in the amount of time required to complete the ballots, the four methods did vary in error rates with users making the fewest errors when using paper ballots. Additionally, the bubble ballot was seen as the most usable by individuals who participated in the study.

Campbell, B. A. & Byrne, M. D. (2009). *Now do voters notice review screen anomalies? A look at voting system usability.* Paper presented at the 2009 Electronic Voting Technology Workshop / Workshop on Trustworthy Elections, Montreal, Canada.

> The research summarized in this article builds on previous research indicating that approximately two thirds of voters do not notice discrepancies between the review screen on an electronic voting machine and the selections they intended. In the previous study, the instructions did not emphasize to voters the need for verification. The current study improved the instructions by explicitly instructing voters to review their choices before casting their ballot. Additionally, the review screen was redesigned so that it included party information and made undervotes more visually salient. The changes made to the instructions and interface did increase the detection rate but only moderately to 50%.

Conrad, F. G. (n.d.). Usability and voting technology. White paper for Voting Technology Workshop.

> Usability testing assesses speed, accuracy, and user satisfaction. It has a long history of use and domains other than voting technology. Lessons learned from these other domains should be applied to the assessment of emerging voting technologies. Practical issues such as the participant recruitment and development of metrics are discussed. The paper concludes with a critical evaluation of several usability claims made by voting machine manufacturers.

Everett, S. P., Greene, K. K., Byrne, M. D., Wallach, D. S., Derr, K., Sandler, D., & Torous, T. (2008). *Electronic voting machines versus traditional methods: Improved preference, similar performance.* Paper presented at CHI 2008, Florence, Italy.

> The usability of a computer-based direct recording electronic (DRE) voting system was compared to more traditional voting techniques including paper ballots, punch cards, and lever machines. The usability of each method was determined using efficiency, effectiveness, and user satisfaction metrics. The results indicate that there is little difference between the DRE and the traditional methods in efficiency (time to completion of ballot) and efficacy (error rate).

However, the DRE was reliably superior to the traditional methods in terms of user satisfaction. These results indicate a disconnect between the subjective and objective usability of DREs.

Greene, K. K., Byrne, M. D., & Everett, S. P. (2006). *A comparison of usability between voting methods.* Paper presented at the 2006 USENIX/ACCURATE Electronic Voting Technology Workshop, Vancouver, Canada.

There is no baseline usability data for traditional voting methods, such as lever machines and paper ballots, to compare the new direct recording electronic (DRE) voting system to. In this study, the usability of three traditional voting methods was compared. The efficiency, effectiveness, and user satisfaction of two paper-based ballots (one open-response and one bubble ballot) and one mechanical lever machine were measured. The efficiency (time to completion of ballot) and efficacy (error rate) of the three methods did not significantly differ. However, there were significant differences in user satisfaction for the three methods. Participants reported that they were most satisfied with the bubble ballot and least satisfied with the lever machine.

Herrnson, P. S., Niemi, R. G., Hanmer, M. J., Bederson, B. B., Conrad, F. C., & Traugott, M. W. (2006). *The importance of usability testing of voting systems.* Paper presented at the 2006 USENIX/ACCURATE Electronic Voting Technology Workshop, Vancouver, Canada.

The usability of six voting systems was assessed by expert reviews, a laboratory test, and a field study. Across the six systems, usability problems were identified in signing-on to the machines, navigating the ballot, reviewing and changing votes, marking write-in candidates, and casting the ballot. In the field study, most voters ignored the paper trails provided by the machines. Although most voters were generally able to vote as intended both inside and outside the laboratory, certain activities proved to be problematic; these included changing votes, detecting errors, and making a straight-party vote. The types of errors that occurred most frequently differed across the voting machines, suggesting that each machine had unique deficiencies.

Herrnson, P. S., Niemi, R. G., Hanmer, M. J., Bederson, B. B., Conrad, F. C., & Traugott, M. W. (2008). *Voting technology: The not-so-simple act of casting a ballot.* Washington, DC: Brookings Institution Press.

The authors evaluated five commercially available voting systems and one prototype system. Evaluation metrics included ease of use, speed, and accuracy. Expert reviews and observations of users indicated that mechanical interfaces, such as scroll wheels and buttons, and interfaces that present the entire ballot at once pose greater physical and mental challenges.

The authors recommend that usability testing include poll worker operations, including voting machine setup, maintenance, and shut down. These tasks can be unclear and difficult, and recovery from mistakes is often complicated.

Herrnson, P. S., Bederson, B. B., Lee, B., Francia, P. L., Sherman, R. M., Conrad, F. C., . . . Niemi, R. G. (2005). Early appraisals of electronic voting. *Social Science Computer Review, 23*(3), 274-292.

> In response to the problems in the 2000 U.S. elections, new electronic voting machines have become more popular because of the speed and accuracy with which they are able to record and tabulate votes. However, there is little evidence about the interface between the voter and the voting system to support this transition. Some of the concerns include: the accessibility of the system; the effects of age and technical experience on usability; the potential for bias; the costs associated with purchasing, evaluating, and maintaining new systems as well as training election workers on the new technology; and the security of electronic voting machines. The authors evaluated the Diebold AccuVote-TS machine in a series of studies involving expert review, close observation, a field test, and an exit poll. The results of the study indicated that, while the systems worked well, there were several issues related to usability and user-acceptance that need to be addressed.

Norden, L., Kimball, D., Quesenbery, W., & Chen, M. (2008). *Better ballots*. New York: New York University School of Law, The Brennan Center for Justice.

> The authors provide substantial evidence that a large number of voters have been disenfranchised by poor ballot design. They document empirical evidence from past elections to support their case. The solution, of course, is to produce ballots that are more simple and easy to use. The report outlines ballot design problems, laws that interfere with good design and usability, and policy recommendations and directions for the future. A checklist for evaluating ballot usability is also provided.

Sherman, A. T., Gangopadhya, A., Holden, S. H., Karabatis, G., Koru, A. G., Law, C. M., . . . Zhang, D. (2006). *An examination of vote verification technologies: Findings and experiences from the Maryland study.* Paper presented at the 2006 USENIX/ACCURATE Electronic Voting Technology Workshop, Vancouver, Canada.

> A technical review of vote verification systems was conducted for the Maryland State Board of Elections. The vote verification and post-election auditing capabilities of five touchscreen vote verification machines, to be used in conjunction with a ballot machine, were evaluated. Other secondary considerations of the evaluation included general functionality, security, reliability, accessibility, and privacy. The evaluation results concluded that the currently used Diebold voting system (ballot) could provide better vote verification by being integrated with any of the four vote verification systems. Only small modifications would be needed for integration of the voting machine with the vote verification machine.

Yee, K. P. (2007). *Extending prerendered-interface voting software to support accessibility and other ballot features.* Paper presented at the 2007 USENIX/ACCURATE Electronic Voting Technology Workshop, Boston, MA.

> A pre-rendered user interface (PRUI) can be designed and audited independently of the voting machine manufacturers. This paper describes software to be used on a PRUI system in conjunction with accessible technologies, including touchscreen interfaces, alternate input

devices, and concurrent speech output (i.e., synchronized audio and visual displays). A prototype was developed in Python.

Yee, K. P., Wagner, D., Hearst, M., & Bellovin, S. M. (2006). *Prerendered user interfaces for higher-assurance electronic voting.* Paper presented at the 2006 USENIX/ACCURATE Electronic Voting Technology Workshop, Vancouver, Canada.

The authors developed a software program, which they call a pre-rendered user interface (PRUI), but can be published before election day. The PRUI is an electronic sample ballot that could enable the general public to participate in the verification, usability testing, and accessibility testing of the ballot to be used on election day. Problems that are identified by the public could be remedied before the election. By preparing the user interface apart from the voting machine, the difficulty of software verification is greatly reduced. The prototype developed by the authors supports a variety of user interface styles.