

The Information Technology and Innovation Foundation

Accessible Voting Technology Initiative

Working Paper Series

Working Paper #008

Assessing Usability of the iPad for Ballot Marking with Voters Living in Group Residential Facilities

Greg McGrew, University of Colorado Anschutz Medical Campus

September 29, 2013

The Information Technology and Innovation Foundation
1101 K Street NW, Suite 610
Washington, DC 20005
(202) 449-1351

This research was supported by the U.S. Election Assistance Commission (EAC) under grant number EAC110149B. Any opinions, findings, conclusions or recommendations expressed in this report are those of the authors and do not necessarily represent the views of EAC or ITIF.

Contents

Executive Summary.....	3
Introduction	4
Background	5
Project Initiation	6
Methods.....	7
Usability testing	7
First time use mimics actual use of this product for voting.....	7
The test plan	7
The ballot	8
Target size and stylus use	10
Results.....	11
Pursuing voter privacy and independence in this part of the voting process	11
Other issues	12
Poll worker survey	13
Method	13
Results.....	14
Fundamental messages from this study	14
Secondary usability issues identified	15
Use of stylus	15
Accessing the keyboard’s number keys	15
Mitigation strategies for these access issues.....	15
Future research needs	19
References	20
Appendix A.....	21
Appendix B.....	22

Executive Summary

On August 1, 2012, the Information Technology and Innovation Foundation (ITIF) awarded Assistive Technology Partners (ATP) a small grant to investigate use of digital tablet technology as a tool for enhancing a part of the voting process for people who may not be able to get to a polling place. ATP submitted a proposal to carry out a project focused on assessing the use of Apple's iPad tablet as a tool for people in minimum care residence facilities to mark their voting ballots in an election. The project was designed to identify both strengths and weaknesses of the iPad from a usability standpoint for these types of voters using it at their place of residence for marking their election ballot. The investigation was carried out in two parts, the first involving usability of the iPad during ballot marking by facilities residents at their residence. The second part involved surveying volunteer poll workers in Denver who had been assigned to set up the iPad for ballot marking by residents regarding their experience during the 2012 election.

For investigating resident use, twenty-nine (29) residents from three different residence facilities in the Denver area participated in a usability test of the iPad 3 for marking an online demonstration ballot. Only 4 of these participants had ever used a tablet before. For the test, participants were shown the basic operation and manipulation of the onscreen ballot through tap, swipe, and pinch zoom gestures on the iPad touch screen. They were then asked to fill out the online demonstration ballot by completing the authentication section (putting in a scripted birthdate and social security number) and then selecting from the choices offered for each contest and ballot issue presented on the ballot. The first 17 participants tested used their finger for interacting with the iPad touch screen. The final 12 participants were asked to use a small foam-tipped stylus.

Twenty of twenty-nine (69%) participants completed the 17-step ballot marking process successfully, but all participants encounter varying degrees of difficulty with touch screen response, specifically with the iPad not responding to participants' tap as they intended when touching an onscreen icon or button. It was evident that touch screen response accuracy and effectiveness were enhanced by participant use of a stylus over that of a finger. As defined by the project, 34 percent of participants encountered significant problems in this area. Five causes for the touch screen not responding to tap, or responding in an unintended manner, were identified and described.

Another issue that came forward during testing was some participants' difficulty or inability to determine how to expose the number keys on the onscreen keyboard. This was remedied with assistance from the test monitor, but for over half the participants, this needed to be addressed.

In spite of encountering touch screen response and keyboard issues, most participants liked using the iPad for this purpose. Eighty-three percent (83%) of these participants indicated they liked marking their ballot this way, and seventy five percent (75%) of those said they would prefer it over the way they previously marked their ballot. In addition, the survey of poll workers indicated they and the voters they worked with felt using the iPad for ballot marking was easy to do. And finally, by and large, the usability issues described above can be mitigated with some simple pre-election poll worker training, and the application of some ergonomic accessories.

Introduction

What follows is a final report on a project focused on investigating the use of an iPad 3 tablet as a tool for marking an election ballot by residents of minimum care facilities. As defined by the project, a minimum care facility is a multi-residence facility which would include as residents individuals needing a minimum level of care, and who were not capable of traveling independently away from the facility. The project involved 1) usability testing of the iPad ballot marking process with 29 participants, all residents of minimum care facilities in the Denver metropolitan area, and 2) surveying Denver poll workers who assisted residents in such facilities in voting with the iPad during the 2012 election. The goal of the project was to identify usability and human factors aspects of the iPad used in this way that would enhance or hinder this part of the voting process, and to suggest strategies and methods for mitigating the access and usability barriers identified.

Study findings suggest that while voters may be intrigued with the new technology the iPad represents, and interested in using it in this way, unfamiliarity and lack of touch screen response can impede its independent and effective use. That said, the underlying causes of these impediments can be addressed with relatively simple and inexpensive interventions.

Background

Americans with disabilities face many obstacles to voting including physical, cultural, economic, educational and political barriers (1). Although much has been done to increase voting accessibility, more progress is needed (2). Assistive Technology Partners (ATP), University of Colorado, Anschutz Medical Campus, supports this effort through our work addressing the technology needs of people with disabilities. With the 2012 elections, ATP had the opportunity to research issues related to voting accessibility through the application of innovative technology for people with disabilities and seniors. The project reported on here addressed a critical need to acquire evidence-based data and information on the experiences of people with disabilities, particularly those with cognitive disabilities, when they participate in the voting process (3).

The City and County of Denver received a small grant through the Help America Vote Act (HAVA) to carry out a project during the November 2012 election. It involved residents using iPads as a tool to mark their ballots without having to travel to their voting precinct. This pilot project was designed to modernize an existing legal requirement that county election administrators send bipartisan teams of election judges into group residential facilities to assist elderly and voters with disabilities to cast their ballots in an independent manner. Unfortunately, funding was not included in the project to investigate the usability and accessibility of the tablet system.

Seizing an opportunity to look at the usability of applying this technology in this way, ATP proposed to evaluate the usability of tablet technology used in an innovative manner to facilitate voting for 30 adults with cognitive disabilities and seniors with disabilities living in group residential facilities in the City and County of Denver. ATP was interested in investigating issues surrounding not only the end user (voters), but also those who directly facilitated their use of the iPad for ballot marking – poll workers who set up and provided the iPad ballot to voters, and assisted them when they needed it.

This is a report of that work, how it evolved, what results it produced, and what insights those results have provided regarding this population's use of the iPad as an in-residence tool for marking their election ballot. The author believes use of the iPad in this way offers benefits for both election administrators and for these voters living in residence facilities over the options offered this population in the past. It is hoped that these insights, and the suggested methods and strategies for enhancing the usability and accessibility of this new ballot marking process will increase its adoption around the country, and in so doing, expand the number of individuals participating in future local, state, and federal elections.

Greg McGrew
Coordinator, Product Test Lab
Assistive Technology Partners

Project Initiation

The Denver Elections Division (DED) of the Office of Clerk and Recorder for the city and county of Denver is responsible for administering elections and voter registration in Denver. In late 2011, the office received a small grant to pilot a program of taking specially equipped iPads to local residence facilities for residents to use to mark their ballots during elections. These iPads were to be equipped with software that would display and accept the marking of a ballot for the 2012 national election. Assistive Technology Partners (ATP) contacted DED prior to the election in an effort to seize this opportunity to assess the usability of the iPad being used in this way. ATP developed a study proposal to investigate two aspects of the application of this technology in the arena of election voting. Part one would involve running formal usability testing of the iPad being used for marking a voting ballot by people living in residence facilities, and part two would involve surveying DED poll workers post-election to gather their perceptions about their experience in setting up the iPad for ballot marking by voters in residence facilities.

DED administrators and staff expressed interest in working with ATP on this project. Timing was such that ATP decided to submit a proposal for funding the project to the Information Technology and Innovation Foundation (ITIF) in response to their request for proposal for projects related to technology and accessible voting. A small grant was awarded, starting August 1, 2012, to ATP to develop and carry out this project.

Prior to the award, ATP had discussed their interest in this work with DED who agreed to collaborate on the project. After the award, ATP negotiated with DED regarding what level of access they might have to the Denver iPad voting process. It was decided that it would be better to carry out this project after the election so as to avoid disrupting the actual voting process as it was taking place. After the election, ATP contacted some of the local residence facilities where the DED pilot project had been implemented to recruit test participants. At the same time, a memorandum of understanding was signed with the organization Everyone Counts for ATP to use one of their existing online demo ballots for testing the iPad with participants in this study.

Residence facilities administrators were briefed on the proposed ATP project and ATP's interest in carrying out usability testing with interested residents at their facility. Several facilities indicated they felt their residents would want to participate in testing the iPad for use in voting. Over the course of the next several months, testing would take place at three different minimum care residence facilities in Denver. A total of 30 participants were tested, providing usable data from 29 of them. One set of data was eliminated from the study due to an incomplete consent form from a participant.

The survey for part two of the project was designed to capture poll worker perceptions about their experience setting up and assisting voters living in residence facilities with the use of the iPad for ballot marking in the actual 2012 election.

Methods

As discussed previously, this project had two parts, 1) usability testing of 30 minimum care facility residents who were eligible to vote, and 2) the surveying of poll workers who had assisted residence voters using the iPad to mark their ballots.

Usability testing

First time use mimics actual use of this product for voting

This was the first time the majority of these participants (25/29) had seen or used an iPad or iPad-like product. As such, the test experience was similar to that encountered in an 'open box' usability test, where the participant experiences using the product for the first time "right out of the box". For this test population (residents of minimum care facilities), voting could well be the first and only time they would use the product, and they may not encounter it again until the next election. This is important to note because this time frame would likely be too long to allow these voters to become familiar with the product and enhance their performance beyond that of a first-time user. Using the iPad during an election will, for many in this population, be new to them each and every election.

The test plan

This project was specifically about use of the iPad as a tool for ballot marking for voters who lived in minimum care residence facilities. It was this population that the DED targeted with their pilot project during the 2012 election. ATP was interested in testing with voters in this type of living arrangement not only to test with a group that mimicked the population served by DED, but because many of these voters had age-related disabilities which could impact their ability to use the iPad effectively. ATP, as an organization focused on technology for people with disabilities, was interested in what role age-related disabilities might play in how effectively iPads could be used in this application. It was in this context that the project test plan was developed.

The objective of the test was to identify any significant usability issues posed by the iPad during ballot marking among voters living in residence facilities. Test scenario development, pre and post test questions, and test results analysis focused on functions and features of the iPad employed during ballot marking and how effectively participants used the iPad to mark their ballot. The project did not investigate or address ballot design issues, but only those issues associated with participant use of the iPad itself.

Prior to testing, each participant was asked questions to determine their level of experience with the iPad and with touch screens in general (Appendix A). They were also asked about the last voting experience and what method or device they used to mark their ballot.

Once each participant completed the pre-test questionnaire he/she was given a short demonstration of how to interact with the iPad through its touch screen. The test monitor demonstrated the gestures 'tap', 'swipe', and 'pinch zoom', and asked the participant to perform each. Once each participant did so, the monitor brought up the online demo ballot, explained again the purpose of the study and the participant's role, and asked them to complete the ballot as they would if they were actually voting.

Assistance was provided to participants only when they requested it. When that occurred, requests were mostly about wanting to increase the print size or whether they should tap an onscreen button to advance to the next page.

Testing at each of the three residence facilities was carried out in a conference room or community room at a small table. The iPad was positioned lying flat on the table in portrait orientation in front of the participant. This orientation was consistent with the design of the demo ballot used for testing.

The ballot

A memorandum of understanding was signed with the organization, Everyone Counts, for ATP to use one of their existing online demo ballots for testing ballot marking with the iPad. The online ballot started with a home page introducing the ballot to the voter with a touch screen button labeled “Vote Now” (Image 1).



Image 1 Ballot intro page

Once this button was pressed, the participant was presented with a log in form (Image 2). Proper input for this form involved correcting the birthdate listed by changing ‘1’ to ‘15’ for the day of the month. This required the participant to tap on the drop down icon (▼) next to the day. This opened a scrollable list of numbers from 1 to 31 from which the Participant could select ‘15’. This was followed by an entry box requiring the participant to enter the “last four digits of your SS number”. For the demo ballot, this number was 1234. This in turn required the participant to toggle the iPad’s onscreen keyboard from qwerty letters to one with numbers. Once this was completed and the number was entered, the participant was directed to scroll to the bottom of the screen and select the “Log In” button.

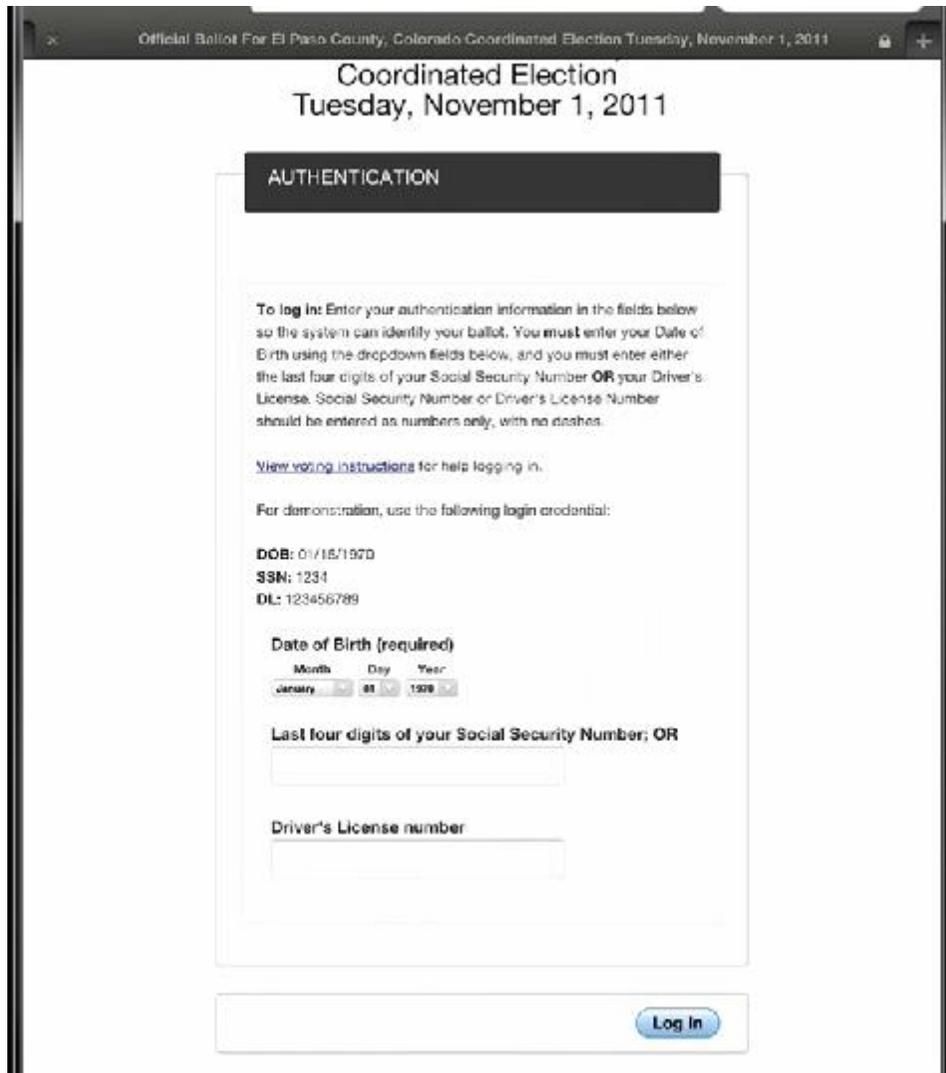


Image 2

With a successful tap of the Log In button, the participant was presented with the actual ballot (Image 3). It consisted of two election contests – the first requesting the voter choose two of the five candidates displayed. The second contest had two candidates and the voter was to choose one. The last question was a ballot issue for which the participant was to select yes or no. The ballot was all on one online page, and required the voter to scroll down the page to access all the items. At the end of the ballot was a button labeled 'Submit', which the participant pushed to move to the next screen.

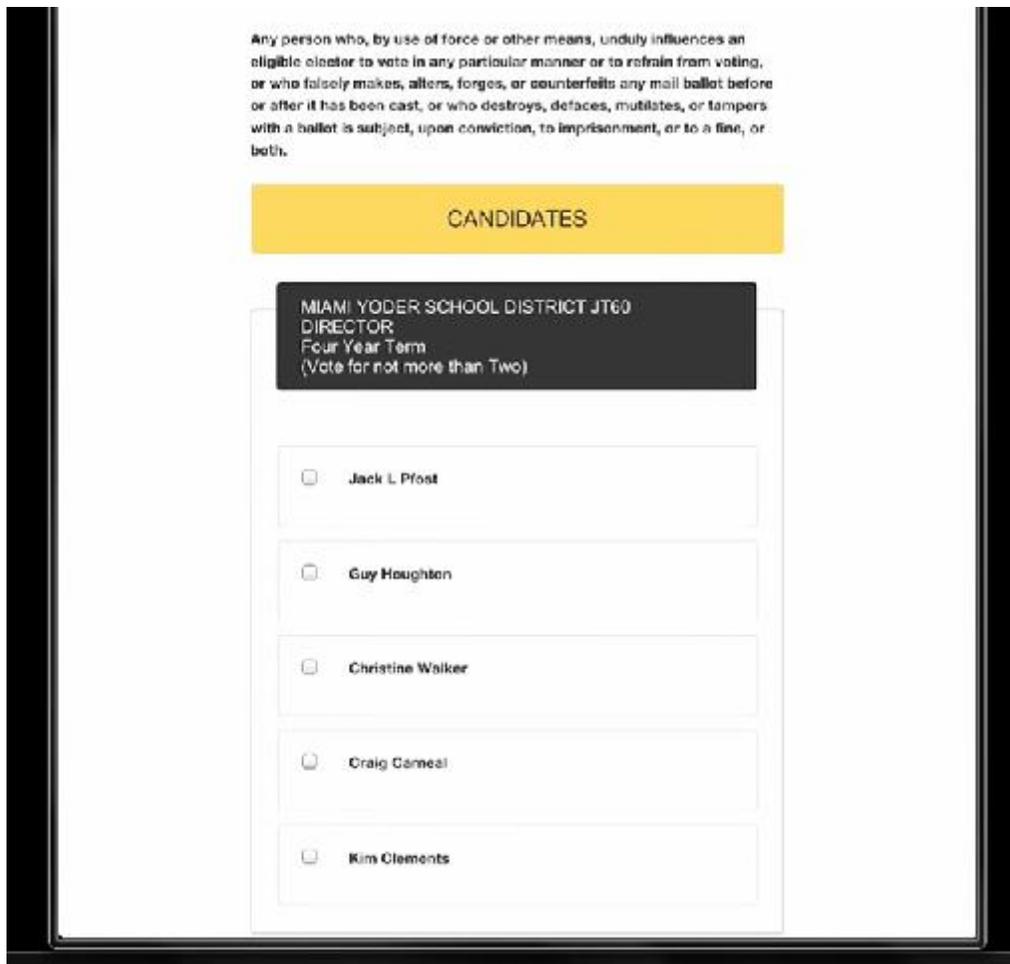


Image 3

Target size and stylus use

Tap target sizes for the ballot as initially presented on the web page were 3/32 inches high but varied in width based on the length of candidate's name, which was included as part of the touch response field. That said, tap target size encountered by participants varied depending on whether they chose to enlarge images and text through the zoom pinch gesture when going through the ballot. During testing, fifteen (15) of the twenty nine (29) participants chose to increase image and text sizes. All did it through the pinch zoom gesture.

The first 17 participants in the test used one of their fingers to interact with the iPad touch screen. Based on the apparent difficulties many of these participants had in getting the touch screen to consistently respond to their touch, it was decided to ask the remaining participants (12) to each use a foam tipped stylus when using the iPad during the test.

Results

Pursuing voter privacy and independence in this part of the voting process

While most participants had seen an iPad either personally or on TV, only six (6) had ever used a touch screen device (smart phone or tablet) before. Generally, participants were curious about the iPad and interested in trying it out.

One of the stated goals of each election program employing the iPad for stay-at-home ballot marking is enhancing voter privacy. The iPad is often viewed as simple and intuitive, and marking one's ballot in this way is deemed less complicated than using a voting machine or marking a paper ballot. This view suggests that in using an iPad to mark his/her ballot the voter will require less assistance from someone else to successfully complete the process, thereby making the process more private. This study suggests that is not necessarily the case for many voters living in minimum care residence facilities, as many residents may need assistance when using the iPad to carry out this part of the voting process. As shown by this assessment, reasons for this include

- Residents having little or no previous exposure to touch screen devices like the iPad , or to similar user interfaces
- Difficulty in getting iPad touch screen to respond to input attempts

Twenty (20) of the twenty (29) participants completed the 17-step ballot marking process successfully, not requiring assistance. The remaining third of participants asked for assistance to continue marking the ballot after being encouraged to try to complete it on their own. Of those, five expressed frustration with what they perceived as their inability to use the iPad effectively based on the inconsistency of touch screen response to their taps.

Problems in using the iPad arising from the touch screen's lack of response to user input were categorized for purposes of this study into four levels of severity.

Category	Criteria
No problem	3 or fewer errors when tapping
Some problem	4 to 8 errors when tapping
Problem	9 to 16 errors when tapping
Significant problem	16 or more errors when tapping

Table 1 Categories of severity levels of touch screen tapping errors

The distribution of severity levels experienced across participants is shown in Chart 1 below.

Distribution of level of input problems experienced by participants

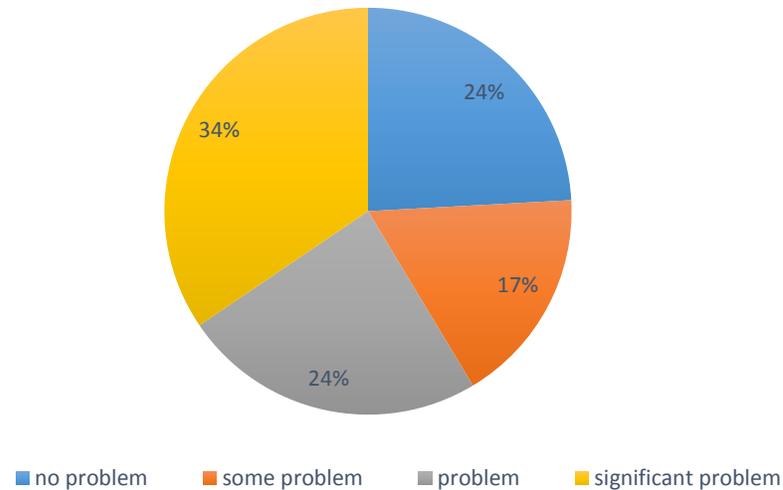


Chart 1

When participants attempted to tap (select) an intended target such as an icon, onscreen button, or form field, the iPad would often not initiate any action, would slide the screen image slightly, or would open a copy window for the space around the item. Over three-quarters of participants experienced at least some problem with touch screen response during testing. There were several possible reasons for participants having trouble getting the iPad to respond correctly.

- Dry skin (insulates finger from touch screen capacitance) (4, 5)
- Even mild fine motor control impairment (causes finger to slide along touch screen surface during touch initiation, and/or increases finger dwell time on the screen) (6)
- Participants' finger nails (insulating) would hit the touch screen rather than the skin on their finger (conductive)
- Participants would touch the screen with other parts of their hand (or their other hand) in the process of trying to use a finger to engage something on the screen
- Participants would miss the touch screen target (icon, button, box, they intended to touch)

Other issues

This study also indicates that some facility residents may prefer absentee voting with a paper ballot for other reasons.

- Time pressure and comparative lack of privacy inherent in this process, versus being provided an absentee ballot for marking and mailing one's ballot - and an extended time frame for doing so
- Inability or difficulty in applying familiar assistive tools (e.g., small magnifying glass) in using the iPad versus a paper ballot

In addition to employing usability measures of successful task completion and number of errors, pretest and posttest surveys were administered to each participant (Appendix A). Responses to the pretest questions showed that 21% of participants had some experience using an iPad or other tablet, while 69% had used a computer. All but 3 of the 29 participants had voted in the past (90%), and 88% of those last voted using a paper absentee ballot.

- Even after experiencing some difficulty with touch screen response, most participants like using the iPad, or liked the idea of using it to mark a voting ballot.
- Almost all participants (27/29) had voted previously using a paper absentee ballot. Most of those that preferred that method to one using the iPad indicated they did so because they felt more in control of the process (more time to read ballot and choose, more comfortable and confident with that process).
- When asked if they would choose to mark their ballot using the iPad next time if offered, eleven (11) out of the twenty-nine (29) participants, or 38 percent, said they would not.
- As has been shown in other studies (8), user performance with the touch screen improved with use of a stylus. Fifty-three percent (53%) of participants using their finger experienced a significant number of tap errors (16 or more), versus eight percent (8%) of those using the stylus. Conversely, only 17% of participants that used their finger experienced no appreciable number of tap errors (3 or fewer), while 33% using the stylus did.

Poll worker survey

Part of this study was designed to assess the ease or difficulty poll workers had in setting up the iPad for facility residents to use, as well as their perceptions regarding the voters' experience marking their ballots in this way.

Method

The Denver Elections Division of the Office of Clerk and Recorder for the city and county of Denver is responsible for administering elections and voter registration in Denver. In late 2011, they received a small grant to pilot a program of taking specially equipped iPads to local residence facilities for residents to use to mark their ballots during elections. These iPads were to be equipped with software that would display and accept the marking of a ballot for the 2012 national election. Assistive Technology Partners contacted Denver Elections prior to this election in an effort to seize this opportunity to assess the usability of the iPad being used in this way. After discussing their interest with Denver Elections and negotiating what level of access they might have to this voting process, it was determined that Denver Elections would send out an ATP-designed survey to their participating poll workers once the election was over. The survey would be designed to capture poll worker perceptions about their experience setting up and assisting voters living in residence facilities with the use of the iPad for ballot marking.

To that end, a survey was designed and administered to poll workers from Denver Elections who assisted residents with using the iPad to mark their ballots (Appendix B). These workers set up the iPad with the appropriate ballot, explained to voters how they would mark their ballot, and assist them in using the iPad if they needed it. The survey was sent to the nine poll workers who assisted voters in

marking their ballots at their residence facilities using the iPad (Appendix A). It consisted of 13 questions, the first three inquiring about their previous experience and training with the iPad, and the remainder dealing with their experience working with residents in using it to mark their ballots.

Results

ATP received five responses from the group of nine poll workers. All but one had used an iPad before being asked to work on the Denver Elections project. Each worker received training by Denver Elections on how to set the iPad up for voters in this program.

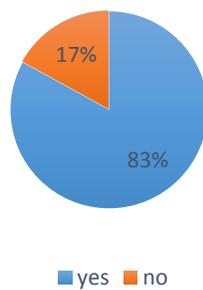
When asked to choose which best described how the iPad was to set up for voter use – easy, hard, or neither easy nor hard – this worker indicated ‘neither easy nor hard’. The other four respondents indicated ‘easy’. The number of voters each worker assisted was low for four of the workers (4, 2, 2, and 1), but one worked with 20 different voters. All thought use of the iPad for ballot marking was easy for their voters.

The only accessibility feature used by voters was pinch & zoom, used by the majority of the 29 voters assisted by these poll workers. It was not determined what percentage of voters who did this performed the gesture themselves or were assisted by their poll worker in making it so.

Fundamental messages from this study

What is the take away from this study regarding the appropriateness of using the iPad in this way – for marking a voting ballot? This study clearly shows that under these test conditions (arid, low humidity environment) this population can experience difficulties marking a ballot in this way, most likely related to the inconsistency with which the iPad responds to user touch as the user intends. That said, the study also shows that this does not necessarily translate into voters not wanting to use the iPad to vote. Eighty-three percent (83%) of these participants indicated they liked marking their ballot this way, and seventy five percent (75%) of those said they would prefer it over the way they previously marked their ballot.

Did you like using the iPad to mark your ballot?



Would you prefer to mark your ballot using the iPad the next time you vote?

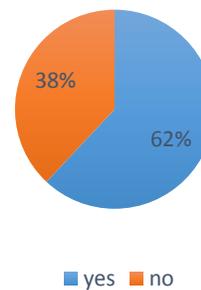


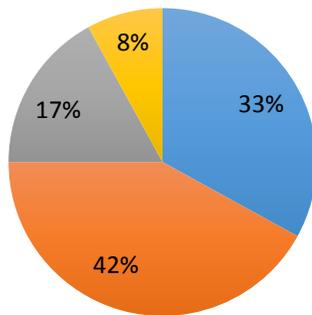
Chart 2

Secondary usability issues identified

Use of stylus

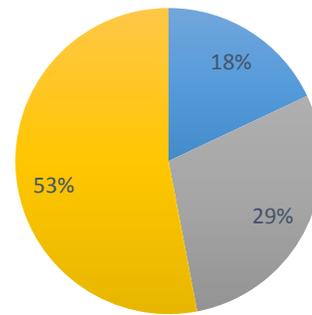
Confirming results from other studies (5), user performance among our test cohort improved with use of a stylus with the iPad's touch screen. Seventeen participants used their finger to interact with the touch screen. The remaining twelve used a foam tipped stylus. Fifty-three percent (53%) of participants using their finger experienced a significant number of tap errors (16 or more), versus eight percent (8%) of those using the stylus. Conversely, only 17% of participants that used their finger experienced no appreciable number of tap errors (3 or fewer), while 33% using the stylus did.

Percent of participants using **stylus** who had touch screen response problems with iPad



■ no problem ■ some problem
■ problem ■ significant problem

Percent of participants using **finger** who had touch screen response problems with iPad



■ no problem ■ some problem
■ problem ■ significant problem

Chart 3

Accessing the keyboard's number keys

iPad onscreen keyboard use – as with other interactions through the touch screen – was difficult at times for some participants because of tap inaccuracy or non-response by the iPad. That said, an additional issue for over half the participants was their inability to recognize how to input numbers from the keyboard. The onscreen keyboard key for toggling the keyboard to one that contained numbers was not an intuitive control for most participants.

Mitigation strategies for these access issues

Given the apparent advantages for election organizations and poll workers in providing the iPad as a tool for voters to mark their ballots, it should be determined if there may be strategies and techniques that might help voters overcome the problems encountered during the study and documented in this report. The author offers five mitigation strategies that could help, including examples of suggested accessories.

1. Offer voters a high quality, easy to hold stylus to use to interact with the iPad. An example of one is shown below.



Image 4 Touchscreen stylus (<http://www.wacom.com/us/en/everyday/bamboo-stylus-solo>)

2. For iPad use by the voter, position it ergonomically so that screen glare is reduced, and accurate, touch screen interaction is facilitated which minimizes user muscle stress. This will likely involve the purchase of an aftermarket iPad

holder or stand of some type. Two examples of such devices are shown below.



Image 5 <http://www.thoughtout.biz/products/Stabile-PRO.html>



Image 6

Portable iPad stand

<http://www.amazon.com/AmazonBasics-Portable-Fold-Up-Travel-Samsung/dp/B006ZT4VA0>

3. Ensure users are informed on the simplest ways to increase the print and image size of the onscreen ballot. Over half of test participants needed to have the screen magnified (all via pinch zoom)
4. Ensure users are aware of how to access numbers on the onscreen keyboard
5. Ensure users are instructed on the nuances of touch screen interaction
 - a. Tapping – simple touch and lift off in one location, without sliding (swiping)
 - b. Swiping – with one finger or stylus point
 - c. Effects of touching the screen at more than one location at the same time (like resting part of your hand on the screen while using it)
 - d. Effects of leaving your finger on the touch screen button longer (dwell) than what the iPad recognizes as ‘tap’ (versus ‘select’)

Future research needs

The results and analysis provided here can be used to inform future work regarding the application of this and similar technologies to the voting process. This study did not attempt to address the impact of online ballot design on ballot-marking usability, which could, obviously, be significant. Nor did the study assess the efficacy of using other tablet platforms, such as Android and Windows 8 for ballot marking. While similar, there are differences in each platform's user interface that might render one more effective than another at facilitating accurate and independent voting.

Future research could also test the effectiveness of the supplemental tools listed here, and how they are employed in enhancing voters' ability to complete the ballot marking process more accurately, efficiently, and independently.

The application of this technology to improve the quality of the voting process for poll workers, and for voters, shows great promise. It is the hope of the author that the information provided here will support that effort, and provide useful information and strategies for those administering elections, and in so doing, help to increase participation in future elections.

References

1. Ward, A., Baker, P. M. A., Moon, N. W., Ensuring the Enfranchisement of People With Disabilities
Journal of Disability Policy Studies September 2009 vol. 20 no. 2 79-92
2. Cross, E.V., Dawkins, S., McClendon, J., Sullivan, T., Rogers, G., Erete, A., and Giblert, J.E. (2009).
Everyone Counts: Voting Accessibility. In C. Stephanidis (Ed.), Universal Access in Human-
Computer Interaction. Applications and Services (pp. 324-332). Berlin/Heidelberg: Springer
3. Hall, T., Alvarez, R. M., Defining the Barriers to Political Participation for Individuals with
Disabilities, 2012, Washington, DC: ITIF
4. E. Foy White-Chu, Madhuri Reddy, Dry skin in the elderly: Complexities of a common problem,
Clinics in Dermatology, Volume 29, Issue 1, January–February 2011, Pages 37-42, ISSN 0738-
081X, <http://dx.doi.org/10.1016/j.clindermatol.2010.07.005>.
(<http://www.sciencedirect.com/science/article/pii/S0738081X10001203>)
5. Jeffrey S. King ; Dragan Pikula ; Zachi Baharav; Touch sensing analysis using multi-modal
acquisition system Proc. SPIE 8661, Image Processing: Machine Vision Applications VI, 86610D
(March 6, 2013); doi:10.1117/12.2006294.
6. Curt B. Irwin, Mary E. Sesto, Performance and touch characteristics of disabled and non-disabled
participants during a reciprocal tapping task using touch screen technology, Applied Ergonomics,
Volume 43, Issue 6, November 2012, Pages 1038-1043, ISSN 0003-6870,
<http://dx.doi.org/10.1016/j.apergo.2012.03.003>.
(<http://www.sciencedirect.com/science/article/pii/S0003687012000312>)
7. Hugo Nicolau, Joaquim Jorge, Elderly text-entry performance on touchscreens, Proceedings of
the 14th international ACM SIGACCESS conference on Computer and Accessibility, October 22 –
24, 2012, Boulder, Colorado, USA, doi> [10.1145/2384916.2384939](https://doi.org/10.1145/2384916.2384939)
8. Arif, A. S., & Sylla, C. (2013). A Comparative Evaluation of Touch and Pen Gestures for Adult and
Child Users. Short papers from Interaction Design and Children 2013, June 24 – 27, New York
City

Appendix A

Pre and post surveys for iPad Voting

Screening/background questionnaire

1. Have you ever used a tablet or e-reader?
 - a. If so, what did you use it for?
 - b. Do you like using it?
2. Have you used a computer before? If so, do you own one? What do you use it for?
3. Do you have or use a cell phone with a touch screen?
4. Did you vote in this last election? How?
5. Do you remember it as a good experience?

Post-test questions

1. Did you like voting this way, or the way you voted in the recent election, better?
2. Do you think you would like to vote this way the next time you vote?
3. What did you like most about using the iPad to mark your ballot?
4. What didn't you like about using the iPad to mark your ballot?
5. Was there anything you would have liked it to be able to do that it didn't do?

Appendix B

Thank you for helping us evaluate the user-friendliness of the iPad as used with people casting their ballots.

Experience

1. Had you used an iPad before you volunteered to help Denver Elections?

Yes

No

2. If yes, do you or anyone you live with own an iPad?

Yes

No

3. What training did you receive in helping others use the iPad for marking their ballot?

Using the iPad with voters

4. How many voters did you work with using the iPad? _____

When using the iPad to mark their ballot, the iPad may have been held by the voters themselves, it may have been laid on a counter or table, or someone else may have held it for them.

5. Of the voters you worked with, please estimate how many held the iPad themselves when they marked their ballot (could be in their hands, on their lap, etc.) _____

6. Initially, did you present the voter with the iPad with the home voting page (might be referred to as the Voter Introduction Page) showing?

Yes

No

7. When the voter got to the home voting page, did you tell the voter to hit the "Vote Now" button?

Yes

No

8. In terms of setting the iPad up for voters to use, would you say it was

___ easy to set up ___ hard to set up ___ neither easy or hard

9. Would you say most voters you worked with found it

___ easy to use ___ hard to use ___ neither easy or hard

10. Roughly, how many of the voters you worked with needed to use one of the iPad's Accessibility features?

___ fewer than 1/3 ___ around half ___ more than 2/3

11. Of the Accessibility features used, among all the voters you worked with which was used most often?

___ Pinch-to-zoom

___ VoiceOver (speaks items on the screen)

___ Zoom (magnifies the entire screen)

___ Large Text (just enlarges text)

___ Invert colors

12. Did you work with any voters using the iPad that had difficulty completing the ballot marking process?

Yes

No

If so, they may have had difficulty related to the iPad itself, or related to how the ballot was laid out on the screen, or because of some unrelated issue (maybe they were not feeling well).

13. Please estimate as best you can how many people you worked with had difficulty completing the ballot marking process in part because of a problem using the iPad itself.
