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Usability Study of Dominion Voting Systems ImageCast and ImageCast with Ballot Marking Device, version 1.30/4.0

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Notice of Confidentiality and Nondisclosure

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Allowed Authors

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Firstname LASTNAME	subversionID	TitlePosition

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Chapter 1

Executive Summary

During the usability test, [XX] voters from the general population used the ImageCast in a simulated election. The election consisted of a test ballot with [xx] contests, including:

- Federal, state and local contests
- Partisan and nonpartisan contests
- Partisan and nonpartisan contests
- Single member and multimember contests
- Retention races
- Constitutional amendments
- Referenda and ballot initiatives

The test ballot developed in conjunction with the State of New York Board of Elections was used to simulate the tasks that users will be asked to perform during an election.

This ballot includes a number of tasks that model typical ballots from around the country, including:

- Voting for names at various locations within a list of names
- Voting a partial slate in a multimember contest
- Skipping elements of a ballot
- Write-in votes

During the usability test, participants worked alone and were provided limited assistance or help by the test administrators. Following the conclusion of the testing, the results were analyzed to determine participants effectiveness, efficiency and satisfaction using the ImageCast with and without Ballot Marking Device (BMD). During the usability test, the testing team collected and analyzed the following types of data:

- Number of ballots successfully submitted
- Percent of tasks completed without error
- Time to complete the voting session
- Voters confidence that they had used the system correctly
- Lastly, voters' overall satisfaction with the ImageCast System

1.1 Target Population - Context of Use

The combination ImageCast Ballot Counter and Ballot Marker Device is designed to enable people with disabilities to effectively produce a permanent paper ballot without the use of a pen. Some examples of electors include:

- people with some form of visual impairment

- people who benefit from simultaneous audio and visual communications

- illiterate voters

- voters that are unable to hold a pen

- persons who are quadriplegic or paraplegic

Figure 1.1 depicts a quadriplegic voter voting on the Ballot Marker using a sip & puff device connected to the Audio Tactile Interface. The sip & puff allows the voter to navigate the candidate names and contests without the help of a third party assistant.

Figure 1.1: A quadriplegic voter using the Ballot Marker

1.2 Full Product Description

This document addresses usability issues for a portable ballot marking system called the ImageCast Ballot Counter and Ballot Marker Device (or BMD). When used for voting, the unit is part of a specially designed ballot box with the following components:

- an ADA[1] voting terminal consisting of an Audio Tactile Interface (ATI) and display screen,

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[1]American Disabilities Act

Figure 1.2: ImageCast Precinct Ballot tabulator

Figure 1.3: Audio Tactile Interface (ATI)

- an electronic ballot printer that prints a ballot for the ADA voter,

- a ballot scanning station for review and accounting of marked ballots,

- a main compartment for storing ballots that have been reviewed and accepted by the voter.

The system uses a composite ballot that has all offices and questions printed on it. The voters may mark their ballots by using either a special marking pen to mark the box(es) corresponding to the candidate(s) of their choice, or by using the ADA interface that prints a paper copy of their marked ballot. The paper ballot is then inserted into the ImageCast Ballot Counter which reads the ballot, reviews ballot selections for the voter, and deposits the ballot into an internal compartment of the ballot box. After the close of voting, the ImageCast prints a results tape that shows the number of votes cast, but does not show any tabulated results. The components which make up the ImageCast Ballot Counter system are depicted in Figures 1.2 through 1.5.

The BMD features interfaces that allow persons with many different types of disabilities to effectively vote independently. These features include a spoken version of the ballot, contrast and zoom controls for the display, and both paddle button and sip & puff access through the ATI. Regardless of the presence or absence of the BMD, audio ballot session presentation and input go through the ATI box to the ImageCast scanner. If the BMD is absent, the voters choices are stored electronically in the ImageCast scanner rather than being turned into a ballot as part of the voters audio voting session.

Figure 1.4: The adjustable arm-mounted LCD is shielded with a privacy cowl
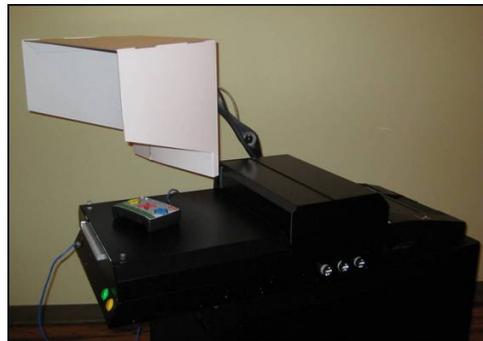
Figure 1.5: Ballot Marking Table and LCD Display with adjustable arm on Ballot Box

1.3   Operational Environment

The election environment for the Ballot Marker is a conventional polling location. In the situation where a BMD is used exclusively for disabled voters, the unit is placed into any available voting booth/station and plugged into a standard AC outlet. The unit needs to be positioned such that the display can be seen by the voter, but at the same time cannot be viewed by other persons walking past the voting station if used in a general polling location.

1.4   Test Objectives - the purpose of the test

The primary objective is to provide people with disabilities the opportunity to test and help improve the usability of the device. The study is designed to collect and capture areas for improvement and to identify to what level the Ballot Marker Device suited the needs of each person. An important object is also to provide feedback to the design team to facilitate final improvements to the Ballot Marker Device. Changes may be performed on existing units, or may be the subject of future enhancements. A further objective is to improve voter and poll worker education efforts. Voter interaction problems may be addressed through improved training and documentation, allowing modifications to operator documentation rather than to the device.

All participants in the test interacted directly with the four major components which make up the Ballot Marker. These included the ATI, the display, the ImageCast Ballot Marker Device and the ImageCast scanner. The collected material will also be contributed to interested parties (independent living centers) as well as regulatory agencies (such as NIST) for consideration in future voting systems standards (such as Election Assistance Commission next generation standards).

Chapter 2

Methods

The summative usability test described here is based on the reports from the Usability Professional's Association 2004 Workshop on Voting and Usability and Common Industry Format [1].

2.1 Participants

The recruiting profile for usability test participants is always a critical factor in conducting a usability test. Participants must be selected carefully.

Younger and older voters are more likely to have usability problems, so they should comprise a large portion of the selected participants (middle aged voters have more voting experience than younger people, and fewer disabilities than older voters (ref Summative Us)). Prior voting experience is an important consideration. This includes the number of years the participant has voted, as well as the type or variety of voting systems the participant has used. In addition, their voter type, or their social relationship to elections, must be considered.

Please see Table 2.1 for a full list of voter types that should be considered in ensuring the full spectrum of election experiences are covered:

Voter Type
Avid
Civic
Issue
Excluded
Apathetic

Table 2.1: Attributes of test participants

Demographic characteristics to be considered in creating the participant profile are listed in Table 2.2.

The participant profile must include a range of disabilities which can be seen in Table 2.3.

Finally, the voter experience should be noted as specified in Table 2.4.

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[1] Defining a Summative Usability Test for Voting Systems - A report from the UPA 2004 Workshop on Voting and Usability, September 2004, W. Quesenbery *et al.*

Demographic
Age
Gender
Race/ethnicity
Access of experience with computers and technology
Socio-economic stats
Level of education
Rural/urban
Region of country
Primary language
Low literacy / English proficiency

Table 2.2: Voter demographics

Disability Type	Number of Persons
Physical	
Blind	
Low Vision	
Cognitive	
Mental Health	
Multiple	
Sensory	
None	

Table 2.3: Focus group disability types

2.1.1 Number of Participants

Standard research guidelines suggest 50-100 participants be used per voter segment.

2.2 Context of Product Usage in the Test

2.2.1 Test Facility

Most usability tests are conducted in an artificial environment, though it may simulate aspects of the normal context of use. A polling place is typically set up for an election in a space normally used for other purposes, such as a school gymnasium, a firehouse, a room in a community center, a church or a civic center. The usability test should be conducted in a similar environment, following the best polling place arrangement practices to ensure privacy and accessibility.

Creating a realistic test environment is an important consideration in designing the test.

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	(%)	(%)	(%)
No	(%)	(%)	(%)
Unsure	(%)	(%)	(%)

Table 2.4: Focus group participant experience levels

Standard usability testing procedures for obtaining consent forms and informing participants that their actions will be recorded must be incorporated into the test plan, but this housekeeping can be done outside of the mock polling place.

The physical environment should be similar for all tests. This includes general environmental factors such as:

- Lighting

- Temperature

- Noise level

As well as considerations such as:

- General room layout

- Proximity of individual voting systems

- Traffic corridors around the voting systems

- Number of people in the simulated polling place

2.3 Experimental Design

2.3.1 Procedure

Testing is performed using a range of voters with different abilities.

Time slots of up to 45-minutes are allocated for each participant to cast a ballot. This period provides ample time to interview the participants after voting in order to receive feedback about the use of the machine, as well as any time that was necessary to properly cast a ballot. All comments from participants are gathered and at the end, a group discussion is held. During this time, the collective results of all feedback received from the testers is shared.

The usability goals for a voting system are ones that allow voters to:

- Correctly use the voting system to register their intended selections with minimal errors and easily detect and correct errors when they occur.

- Efficiently complete the voting process in a timely manner and without unproductive, unwanted, incomprehensible, or frustrating interactions with the system.

- Feel confident (1) in the actions they had to perform in order to vote, (2) that their votes were correctly recorded by the system and will be correctly counted, and (3) that their privacy is assured.

2.3.2 Tasks and Activities for Test Participants

The basic task of a usability test of a voting system is to cast a vote. The test activities are very simple and simulate a typical voting process as closely as possible. In a mock polling place, each participant in the test goes through a complete voting process, including:

- identifying themselves and signing the elections register

- receiving their ballot paper or any other materials required to vote

- receiving any instructions that are part of the normal voting process

- voting as instructed

To ensure that the full functionality of the machine is exercised during the test and to control for the expected results, the participants should be given specific instructions about how to vote, including the candidates or answers to ballot questions. (This is similar to a logic and accuracy test sample set). However, whether the choice of how to vote is left to the participant or dictated to them, the selection must be done in a format that does not directly copy the ballot layout format, for example, use a voter information brochure or other material.

During the test, no attempt is made to interview participants to understand their cognitive or emotional interaction with the voting system. While the voters are in the mock polling place, especially the voting booth, they are not interviewed, given test instructions, or prompted to talk aloud. This is especially important with regards to measuring efficiency, especially as the actual task of voting is relatively short. Any observation should be done remotely (for example, through a discrete camera), rather than with a second person in the voting booth with the participant. Any test instructions, questionnaires or debriefing interviews take place outside of the mock polling place (much as news reporters, campaigners, and others are kept outside of a 50 foot radius from most polls). In order for the usability test to be repeatable, the activities and scripts must be detailed and precise. Although it might seem artificial to read from a script, it is important that every participant receive exactly the same instructions (outside of any differences in the details of their task assignments). This includes:

- any pre-test information or general instructions,

- the format, delivery methods and wording of task assignments,

- any instructions given for how to complete the usability test,

- any instructions, training, or practice on how to vote that are given to all participants,

- availability of sample ballots,

- any additional instruction, training, or practice offered on the voting system before the participant begins to use the system to vote, and

- any assistance or additional instructions available during the test, with the same answers, instruction or help given for each question that the test participants may ask.

This test uses a single voting device, but might include a range of ballots, ranging from a very simple (few races, with a single selection in each race, first-past-the-post rules) to more complex ballots (including straight party voting, multiple selections in a race, a mix of partisan and non-partisan races, ballot issues, and schemes such as preferential voting).

2.4 Data Collected or Measured During the Test - Usability Metrics

There are three main categories of data collected during the test, corresponding to the three broad usability requirements: Interfaces Used, Overall Performance and Time Studies.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle
Frequency						

Table 2.5: Frequency of use of voting interfaces. Total participants = x

2.4.1 Interfaces Used

Each participant is asked to cast one complete ballot using the Ballot Marker Device. Depending on the type of disability or level of assistance required by each voter, a different set of interfaces are employed. The breakdown of how each interface was employed is detailed in Table 2.5.

2.4.2 Correctness

Unlike a real election (where the vote is secret), the test is set up so that the voter can be discretely observed, and their actions inside the voting booth recorded. This allows the test observers to collect information about the voters actions and to compare the vote as cast to the intended vote. This ability to observe is relevant to assessing whether voter confidence in the system is warranted.

There are several different outcomes of the voting activity for each participant.

- The participant voted as intended.

- A vote was cast, but there was an error of some kind:
  - The participant did not vote as intended.
  - The ballot was invalid in some way: unintentionally undervoted, overvoted, a spoiled write-in, or some other voter error

- The participant did not succeed in casting a vote. The usability test report should include an enumeration of each outcome, as well as the specific types of failures when a vote is cast.

2.4.3 Overall Performance

Each participant is asked to rate the overall effectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are collected and seen in Table2.6:

	Score
Spread	to
Average	

Table 2.6: Likert Scale Performance Data

2.4.4 Time Study

Actual ballots are used for the purposes of this study, and all participants may not use the same ballot with the same candidate names and contests.

The size of the ballot may influence the ratings, so details on the ballots are collected in Table 2.7 below.

The effectiveness of the unit can be determined by several other factors, which are seen in Table 2.8 below.

	Score
Number of Contests	
Number of Faces (1=single sided, 2= double sided)	
Number of Parties	
Number of Voting Candidates	
Number of Propositions	
Number of Voting Options (total number of voting choices)	

Table 2.7: Collecting the ballot parameters

	Score
Time required to for instructions	
Time required to for first contest	
Time required to for final contest	
Total time required	
Number of requests for assistance	
Number of times the voter requests a new ballot or requires an official restart a ballot	
Number of accidental selection mistakes	
Number of intentional changes	
Number of write-ins (if applicable)	
Number of ballot reviews	
Number of ballot edits	

Table 2.8: Collecting the voting parameters

The results of the time study are collected using Table 2.9 below.

	Range		
	Min	Max	Average
Voting			
Ballot Print/Mark			
Verification			
Total			

Table 2.9: Time study values for various voting functions (measured in minutes)

2.4.5   Independent and Private Use Survey

Participants are asked whether or not they felt that their voting session was independent and private.

A copy of the survey used to gauge the performance of the Ballot Marker is provided on page 12. The survey is generic in nature and thus intended to be all-encompassing.

Voting Machine Survey

tester:		location:		time/date:	

Voter information

Voter type (circle)		Demographic			
Avid		Age			under 30/ 30 to 60 / over 60
Civic		Gender			M / F
Issue		Race/ethnicity			White / Black-Afr. A. / Hispanic / A. Indian / Alaska Nat.
Excluded		Experience with computers			H / M / L
Apathetic		Socio-economic status			H / M / L
		Level of education			less than high school / high school / college or univeristy
		Locale			Rural/urban
Disability Type		Region of country			NW / NE / Central / SE / SW
Physical		Primary language			ENG / SPA / Mandarin / Cantonese / other
Blind		English proficiency			H / M / L
Low Vision					
Cognitive		Voter experience			
Mental Health		Registered Voter?			Y / N / Unsure
Multiple		Frequent Voter?			Y / N / Unsure
None		Familiar with Accessible Technology?			Y / N / Unsure

Data collection

Ballot information			
Number of Contests			
Number of Faces (1=single sided, 2= double sided)			
Number of Parties			
Number of Voting Candidates			
Number of Propositions			
Number of Voting Options (total number of voting choices)			

Activities			
Time required to for instructions			
Time required to for first contest			
Time required to for final contest			
Total time			
Number of requests for assistance			
Number of times new ballot or official restart is requested			
Number of accidental selection mistakes			
Number of intentional changes			
Number of writeins (if applicable)			
Number of ballot reviews			
Number of ballot edits			

System Interfaces Used	
Visual screen	
Zoom button	
Contrast button	
Audio	
ATI	
Sip & Puff	
Paddle Buttons	

Voting Experience			
Was the ballot cast correctly?		Y / N / Unsure	
Was the expereince private?		Y / N / Unsure	
Was the process efficient		Y / N / Unsure	
On a scale from 1 to 10 (0= worst, 10 = best) how would you rate the overall performance of this voting machine?			

Figure 2.1: VotingMachineSurvey

Chapter 3

Results

Usability metrics are the key indicators of a successful voting system. The information collected in each focus group is analyzed using a set of measurements and data mining operations.

3.1 Data Analysis

Data analysis is performed by compiling a set of scores, reducing data into subcategories for comparison, and performing statistical analysis on the scores and data reductions.

3.1.1 Data Scoring

Data scoring is the overall observations and calculations form the scoring set. The scoring set consists of measurements of overall satisfaction, efficiency and ease of use factors, usability, and voter experience.

The most important metric is the overall satisfaction (high low average) as measured on the Likert Scale. This value covers the entire voting system for all users.

Considerations for efficiency are important to voters and election providers. Time factor measurements are:

- Time per selection (seconds)

- Average time spent on instructions (minutes)

There are also scores for overall usability:

- Requests for assistance (average number per session)

- Accidental selections (average number per person)

- Average time for first contest (minutes) *this identifies how quickly the voter can get started*

- Average time for last contest (minutes) *this reveals how quickly the voters learns during the first ballot*

- Mistaken selections (average number per person) *does the voting interface have anything which may lead to accidental selections?*

Finally, the voting experience scores are critical in understanding the confidence levels of voters using the system:

- Percentage agreeing system is private

- Percentage agreeing system is correct

- Percentage agreeing system is efficient

3.1.2 Data Reduction

While overall scores are important, they do not provide the specific information required to improve the voting experience. For instance, a process might be acceptable for some but not all voters. Without breaking the data into small groups, this information cannot be determined.

Data is reduced and produced for:

- Satisfaction rate based on each user type (Blind, Cognitive, Low Vision, Mental Health, None, Physical, Sensory, Multiple, Unsure)

- Satisfaction rate based on age groups (under 30, 30 to 60, above 60)

- Satisfaction rate based on registered voter status (yes, no, unsure)

- Satisfaction rate based on voter frequency status (Avid, Civic, Issue, Excluded, Apathetic)

- Satisfaction rate based on accessibility skills (yes, no, unsure)

- Satisfaction rate for each voting interface (Visual Screen, Zoom, Contrast, Audio, ATI, Sip & Puff, Paddle Buttons, Pen, Other)

3.1.3 Statistical Analysis

Statistical analysis will consist of comparative analysis between user groups of the metrics listed above. Each focus group will form on set of data which will be compared within a tabular format. The results are presented below.

3.2 Presentation of Results

3.2.1 Performance Results

Performance results are reported for all events. The chart is presented on the following page.

Performance results are reported for all events. The chart is presented on the following page. Initial measurements indicate that while most users (more than 94%) consider the system private and correct, not all users found the system efficient. This is partially a result of all voters types participating in the study, including those that would normally mark a paper ballot with a pen (denoted as disability=none).

Also presented in the chart is the average time with instructions, the average number of requests for assistance, and the average time per selection. These data can be used to predict Election Day usage. Of note is a measurement of the ratio of time required to complete the first contest, to the time required to complete the final contest.

If the voters become more comfortable with the device during the completion of the ballot, the voters will complete the last contest faster than the first. The higher the number, the faster the voter appears to be learning. The first measurement of the value was 1.8, meaning that voters are nearly twice as fast at the end of the ballot as at the beginning. This indicates fast learning on the device.

3.2.2 Satisfaction Results

Satisfaction results are reported for all events. The chart is presented on the following page.

Preliminary results indicate that user satisfaction is highest for voters who report blindness, physical, and multiple disabilities, but lower for those with partial vision or no disability. This is to be expected, as the interface is not designed for those who can complete a ballot using a pen and paper. For voters with low vision, alternatives using optical magnifiers will be introduced in the next rounds of focus groups. The other user group which could be improved is the cognitive group. Improved voter orientation instructions were successful to better explain the process to these voters. A complete introductory script will be added to all user manuals.

Early testing was very experimental, often asking people to try new interfaces in order to test the limits of the device. While this provides good suggestions for future developments, it alters the accuracy and repeatability of the data. The processes was changed for the Westchester/Newburgh study, and encouraging people to utilize their preferred assistive device, not ones that are new to them, was a definite factor in improving the Likert Rating.

Figure 3.1: Table of satisfaction measurements.

Satisfaction Measurements

Group	Date	Participants	overall	user group									age			registered?			frequency					experience with accessible devices?			per interface								
				blind	cognitive	low vision	mental health	none	physical	sensory	multiple	unsure	under 30	30 to 60	60 plus	yes	no	unsure	avid	ad-hoc	issue	excluded	apathetic	yes	no	unsure	Visual Screen	Zoom Button	Contrast Button	Audio	ATI	Sip & Puff	Paddle buttons	pen	other
NFBC	March, 2008	11	6.06	10	7.25	5.6	5	6.2	7.5	7	8.6	8	8.1	7.5	NA	7.2	10	NA	NA	NA	NA	NA	NA	7.2	7.4	8.5	7.4	6.9	6.8	7.3	7.3	9	7.25	NA	7.3
Watertown/Syracuse/Utica, NY	June 23–26, 2008	33	7.31																																
Westchester/Newburgh	July 7–8, 2008	19	8.34	7.3	10	9.25	NA	4	9.75	NA	8.5	NA	9	8.5	10	8.7	9	NA	8.5	NA	10	10	8	8.6	8.9	NA	8.9	8.7	9.7	9.1	8.8	8	7	NA	NA

Figure 3.2: Table of performance measurements.

Performance Measurements

Focus Group	Date	Participants	Time per selection (seconds)	Average time spent on instructions (minutes)	Requests for assistance (average number per session)	Accidental selections (average number per person)	Ratio - average time for first contest to last contest	Percentage agreeing system is private	Percentage agreeing systems is correct	Percentage agreeing system is efficient
Watertown/Syracuse/Utica, NY	June 23–26, 2008	33	12.2	2.5	1.72	1.04	NA	94%	97%	82%
Westchester/Newburgh	July 7–8, 2008	19	17.9	2.2	0.95	0.26	1.8	79% yes, 21% unsure	95% yes, 5% unsure	95% yes, 5% unsure

Chapter 4

Individual Study Results

4.1 Westchester, Newburgh Focus Groups - July 7-8, 2008

4.1.1 Overview

The testing took place over a two day period. Participants cast ballots on a first come first served basis, which permitted ample time to interview the participants after voting. All data and comments from participants were entered directly into a laptop computer by an observer who would not be present in an actual election.

Usability results were analyzed to determine gaps in the system or poll worker instructions by comparing this focus group with previous ones. No changes were made to the system, but a better voter orientation session was used to introduce the election process to the voter. The script of this orientation will be added to the user manual.

A new ballot was used for the study. Previous ballots began with a vote for 6 contest, and not only was this quite confusing to voters, but also is not a typical ballot used during any election.

4.1.2 Participants

A total of 19 individuals were involved in the focus group used to test the Dominion Voting Ballot Marker. Details about these participants are outlined in Tables 4.1 and 4.2.

Disability Type	Number of Persons
Physical	4
Blind	3
Low Vision	4
Cognitive	3
Mental Health	0
Multiple	4
Sensory	0
None	1

Table 4.1: Focus group disability types - Westchester and Newburgh

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	15 (79%)	13 (68%)	10 (53%)
No	4 (21%)	6 (32%)	9 (47%)
Unsure	0 (0%)	0 (0%)	0 (0%)

Table 4.2: Focus group participant experience levels - Westchester and Newburgh

4.1.3   Ballot Details

The ballot was a general ballot. The ballot details are shown in Table **??**.

	Score
Number of Contests	8
Number of Faces (1=single sided, 2= double sided)	2
Number of Parties	4
Number of Voting Candidates	23
Number of Propositions	1
Number of Voting Options (total number of voting choices)	25

Table 4.3: Collecting the ballot parameters - Westchester and Newburgh

4.1.4   Interfaces Used

Each participant was asked to cast one complete ballot using the Ballot Marker. Depending on the type of disability or level of assistance required by each voter, a dierent set of interfaces were employed to cast each ballot. The breakdown of how each interface was employed is detailed in Table 4.4.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	7	3	17	17	2	1

Table 4.4: Frequency of use of voting interfaces - Westchester and Newburgh - Total participants = 19

4.1.5   Overall Performance

Each participant was asked to rate the overall eectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are shown in Table 4.5.

All ratings were between 7 and 10 except for one person who was deaf. This voter's rating was 4. Deafness is not included as a VVSG disability type, and this voter could have voted using a pen and paper. However, it was pointed out that deafness could be combined with another disability type and should be considered.

4.1.6   Time Study

An actual ballot was used for the purposes of this study. All participants used the same ballot with the same candidate names and contests. The ballot consisted of eight contests. The results of the time study are shown in Table 4.6.

	Score
Spread	4 to 10
Average	8.74

Table 4.5: Likert Scale Performance Data - Westchester and Newburgh

	Range		
	Min	Max	Average
Total	6	17	9.68

Table 4.6: Time study values for various voting functions (measured in minutes)- Westchester and Newburgh

4.1.7 Independent and Private Use

Participants were asked whether or not they felt that their voting session was independent and private. A total of 79% of the participants believed that their voting session provided both independence and privacy for the voter using the assisting technology. The other 4 voters replied to this question with "unsure". No voter responded that their voting session compromised the privacy, condentiality, or secrecy of their selections.

Voter choices, errors, and adjusted choices are shown below in Table 4.7. The results show both higher involvement in the ballot process and a lower rate of changes than previous focus groups, largely due to better verbal instructions.

Adjustment	Count
Number of requests for assistance	18
Number of times new ballot or official restart is requested	0
Number of accidental selection mistakes	5
Number of intentional changes	1
Number of write-ins (if applicable)	1
Number of ballot reviews	12
Number of ballot edits	6

Table 4.7: Number of voter choices and adjustments - Westchester and Newburgh

4.1.8 User Comments

General comments about using the Dominion Voting Ballot Marker Device

- No recommendations (for future changes). [The test unit] would be the right machine.

- Educational process needs to be reiterated beforehand. Take a test run beforehand instead of just listening to instructions. For example, give people 1-2 days before election to test out machine and become familiar. Simplify language instructions for audio because not everyone will understand. Instructions should be balanced depending on demographic background and area you are coming from (e.g.: rural versus urban).

- Voter was able to cast ballot independently.

- Voter was given and taught the ATI before beginning his voting session. Yet, once his voting session began he scrolled through the entire ballot without making any selections. Poll worker decided to give him the paddle buttons instead, which he used during ballot edit mode. He found the paddle buttons much easier to use and marked the entire ballot in ballot edit mode. His time greatly increased when using the paddle buttons again. Although his entire voting session lasted 18 minutes, it only took him 6 minutes to complete the ballot when using the paddle buttons. It only took him 30 seconds to vote in the rst contest, whereas it took him 45 seconds when using the ATI even though he did not make any selections. It is also important to note that this blind voter cannot read Braille so was solely relying on the shape of the buttons on the ATI to orient himself.

- Successfully cast ballot.

"Things I liked"

- Very easy. Directions easy to understand.

- It's better than the touch screen.

- I have spastic movement and sometimes I touch a candidate I do not want. I have more control with the ATI because I have to touch it. And then the review is helpful. I always needed an aid before. I refused to have an absentee ballot, which made them upset. There was no privacy. This time I was able to do the whole thing myself. The audio was good and allowed you to follow along, and told you when you made a mistake and allowed you to correct it.

- Poll worker instructing voter beforehand would be necessary because audio instructions alone would be confusing.

- Good tone, liked human voice. It was cool. Female voice better than male's voice but I can deal with either.

- The verbal instructions are necessary because I have a hard time ltering things out, so the audio and visual helps me focus. Efficient, gave you a little more time. Other voting processes don't allow you to change your vote, you're just done. I liked the ballot review option. The zoom option made the font large enough to read.

- Used to audio and found it easy to follow along. Voter most used to audio and would probably still use audio even if greater magnication available.

- Found it very easy and simplistic. Audio easy to follow along with.

- Very clear. Audio was easy to follow along with. Audio was good. Speed increase good because allowed me to navigate quickly. Once you get used to everything, you want to speed it up.

- Machine is totally awesome. Audio and text good. Voice was kind of cute.

- Buttons. Audio. Best thing they could have done for the handicapped.

- Zoom and contrast buttons made it easier to read. Machine reading to you made me more sure of names and instructions. Instructions from poll workers at beginning made it easier as well.

- Audio. Buttons. Gives me the ability to vote independently. It's long overdue.

- Being able to vote independently.

- Black background with white lettering instructions were very cool. Easy to read. Just used audio to vote for candidates because couldn't read the names. Liked the combination of audio and visual. Audio conrms what voter thought they saw. Liked removing privacy screen so could get closer. Felt claustrophobic otherwise. Now blind/low vision people can vote on their own.

- Audio and visual complimented each other well. ATI very easy to use, very helpful.

"I want poll workers to know the following when working with someone with my disability"

- Poll workers should be educated on how to use body language. For example, a quadriplegic could use their eyes to signal answers to questions. Also, before people begin to vote, poll worker should ask them what he/she should look for if they need help, e.g.: a certain body movement. All eectiveness of the machine depends on poll workers - their training and willingness.

- Make person feel comfortable from the beginning, adjust the machine to their abilities and preferences. Both the poll worker and voter should have the freedom to adjust the machine before beginning.

- Assistance - explain machine at beginning of use with more information than is included on audio instructions.

- Ability of ease would vary depending on mental capability of voter.

- Just be patient. If we're asking questions it's not because we're trying to give a hard time.

- Speak directly to the person. We deserve the same rights and respects as an able-bodied person gets.

- To be patient. It's good for voters to know they should feel free to remove the privacy screen so they don't feel claustrophobic.

- Patience. Realize you're talking to a human being. Instructions explained in person made it easier to understand so able to skip audio instructions.

Items for future enhancement

- I'd like more zoom settings. Multiple zoom levels would be useful instead of just two because there is a vast dierence between the two zoom levels.

- Allow for a larger magnication.

- Some large words in sentences on machine. Some voters may have diculty understanding. A lower register word might be better instead of owery language, e.g.: "choose" instead of "select."

- Perhaps a close button would be better instead of having to go through each remaining contest, ballot edit and ballot review.

- How it automatically goes into the contests in ballot edit mode caused concern.

- Voter wasn't using audio, so pressed buttons during audio, causing selection to go unrecognized and vote(s) cleared.

- Proposition button direction is confusing. It looks like you use yellow arrows to navigate "yes" and "no", but that causes you to skip the proposition. The "yes" and "no" should be above and below each other.

- A common suggestion was that dierent users get dierent interactions. This will be considered for future systems.

  - Both audio and video instructions made it confusing to follow. Wasn't sure what to do when skipping an office. Confused with write-in because there were a lot of instructions at once. A sip and pu user would need help.

- Instructions for dierent interfaces should be broken up, it is confusing otherwise.

- A "No Audio" button so deaf people don't have to wait for audio and can go more quickly through the ballot. Change help button to red, it will be more clear that way. Perhaps add ASL instructions at beginning on top of the English ones because some deaf people have problems with English. (note: this is a reference to a voter who would use sign language in addition to audio)

- There were also continued comments about the rate of button selecting - the function of the unit is directly related to two requirements of the federal voting standard 1) no button is to have any repetitive eect (not common practice for electronic interfaces), and 2) audio and video must be simultaneous (creating a lag between instantaneous visual information and slower audio communications). These two requirements lead to reduced usability which is reected in the comments below which conict with the interpretation of regulations.

  - Tedious if you don't want to continue through ballot.

  - Used to using a computer where everything is much quicker. Rating would have been a 10 if there wasn't such a lag time. Sometimes button didn't respond when pushed. Too much delay between button response time. Had to increase rate because growing impatient. Once you know the candidates you are going to vote for, it would be easy to be able to press button x number of times and land on what you want.

  - A bit slow when it moves across the ballot. Confusing when you reach the last contest and it just sits there. I didn't know if I did something wrong or if I was supposed to sit there. Better if it said "one moment please."

  - A little slow. The ballot review moved slowly. If you were more familiar with it beforehand it may make it easier. Perhaps put machine in a community center for people to try out before election.

  - Better response time. If I knew what it was going to say I'd press the button ahead of time, but it would wait.

  - Slow response time between pressing the button and response.

  - Continuously tried to press button before audio was nished, which caused voter to sometimes have to wait because machine hadn't registered her selection even though she thought it had.

The system can be adapted to eliminate the issues listed above. Continued examination of these requirements will be performed in order to determine if voters prefer the system as described/required by standards, or would prefer a system with better usability.

Items that are operational or impossible to address due to regulations

- Voter expressed concerns about privacy regarding the physical set up of the machine on election day.

- Once voter was able to get very close to the monitor, she was able to see much better.

- Proper training of the poll workers required to ensure BMD set up correctly to ensure privacy is maintained.

- May make people using it feel self-conscious. Maybe better to put it in its own room because may bother people to have to be so visibly dierent.

4.2 Syracuse, Watertown and Utica Focus Groups - June 23-25, 2008

4.2.1 Overview

The testing took place over a three day period. Participants cast ballots on a rst come rst served basis which permitted ample time to interview the participants after voting. All data and comments from participants were entered directly into a laptop computer by an observer who would not be present in an actual election (some voters commented that the test voting did not seem private due to this obvious intrusion).

4.2.2 Participants

A total of 33 individuals were involved in the focus group used to test the Dominion Voting Ballot Marker. Details about these participants are outlined in Tables ?? and 4.9.

Disability Type	Number of Persons
Physical	9
Blind	2
Low Vision	5
Cognitive	6
Mental Health	1
Multiple	4
Sensory	2
None	4

Table 4.8: Focus group disability types - Syracuse, Watertown and Utica

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	39 (97%)	28 (85%)	20 (61%)
No	1 (3%)	3 (9%)	11 (33%)
Unsure	0 (0%)	2 (6%)	2 (6%)

Table 4.9: Focus group participant experience levels - Syracuse, Watertown and Utica

4.2.3 Ballot Details

The ballot was a general ballot and is known as the Cicero ballot because it is an actual ballot used in 2004. Unusually, it begins with a 'vote for 6' contest which is very atypical. The ballot details are shown in Table 4.10.

4.2.4 Interfaces Used

Each participant was asked to cast one complete ballot using the Ballot Marker. Depending on the type of disability or level of assistance required by each voter, a dierent set of interfaces were employed to cast each ballot. The breakdown of how each interface was employed is detailed in Table 4.11.

	Score
Number of Contests	7
Number of Faces (1=single sided, 2= double sided)	2
Number of Parties	6
Number of Voting Candidates	49
Number of Propositions	2
Number of Voting Options (total number of voting choices)	66

Table 4.10: Collecting the ballot parameters - Syracuse, Watertown and Utica

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	13	3	31	22	2	5

Table 4.11: Frequency of use of voting interfaces - Syracuse, Watertown and Utica - Total participants = 33

4.2.5 Overall Performance

Each participant was asked to rate the overall eectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are shown in Table 4.12.

	Score
Spread	1 to 10
Average	7.31

Table 4.12: Likert Scale Performance Data - Syracuse, Watertown and Utica

4.2.6 Time Study

An actual ballot was used for the purposes of this study. All participants used the same ballot with the same candidate names and contests. The ballot consisted of seven contests. For one contest with many candidate names, each voter was asked to vote for a total of six (6) candidates out of a possible twenty-four (24). For a second contest, the voters were asked to vote for a total of two (2) out of a possible seven (7). The results of the time study are shown in Table 4.19.

4.2.7 Independent and Private Use

Participants were asked whether or not they felt that their voting session was independent and private. A total of 94% of the participants believed that their voting session provided both independence and privacy for the voter using the assisting technology. Three participants answered that they were not sure. One voter responded that the test observer compromised privacy. Another user who did not feel the vote was private was listed as being a voter with 'no disability'. This person also stated their overall satisfaction was low (Likert $\bar{3}$) and questioned why the device was needed. This person may not have understood the purpose of the device, legal requirements, or the purpose of the test.

Voter choices, errors, and adjusted choices are shown in Table 4.14.

*NOTE: The three ballot restarts seen in Table **??** resulted from an accidental selection of Spanish as the audio language - these counties do not support Spanish on the ballot so the voters would not have been aware that a ballot may have more than one language.*

	Range		
	Min	Max	Average
Voting	NA	NA	NA
Ballot Print/Mark	NA	NA	NA
Verification	NA	NA	NA
Total	6	33	13.46

Table 4.13: Time study values for various voting functions (measured in minutes)- Syracuse, Watertown and Utica

Adjustment	Count
Number of requests for assistance	38
Number of times new ballot or official restart is requested	3
Number of accidental selection mistakes	24
Number of intentional changes	2
Number of write-ins (if applicable)	6
Number of ballot reviews	15
Number of ballot edits	3

Table 4.14: Number of voter choices and adjustments - Syracuse, Watertown and Utica

4.2.8 User Comments

General comments about using the Dominion Voting Ballot Marking Device

- Able to vote.

- Somewhat confusing for user, but generally okay.

- Large print font is good, but zoom confusing (re: entire ballot).

- Lot of good attention from poll worker. Hopes county election aides will be the same.

- Other than no privacy sleeve, fairly simple to use.

- Easier to use than Auto Mark.

- Better than the old-fashioned current ones, which are useless.

- Positive.

"Things I liked"

- Found it easier to use than other accessible machines used

- Push buttons

- Easy, audio, buttons

- Reviewing the ballot for any race you didn't vote for allowed me to vote in the race I intentionally left blank.

- I liked the clear voice, and how I was able to turn volume up and down and change the rate of speech. I liked the practice in the instructions.

- Eort being made to make voting process accessible.

- Paddle buttons

- Loved the audio, easiest to follow along with.

- Sip and pu easy to use even though it was my rst time using a sip and pu.

- Ability to change font sizes.

- I really appreciate the improvements done to the machine. Audio voice is easy to understand and friendly, especially for people with sensory issues (react to voices, etc). Screen and audio were helpful.

- Clear speech.

- Privacy screen useful to read monitor because it blocks the glare of light. Magnifying text and changing the contrast makes it easier to read text, especially when a candidate or contest is highlighted green. The voice combined with large print is helpful.

- Clear audio. Good instructions. Good Braille. Straightforward. Ability to review your ballot. Used the rate button and liked that.

- Buttons better than straw. Audio.

- Audio was useful.

- Audio was useful to follow along with. Likes the ATI because plays a lot of video games. Liked the screen. Very innovative, I liked it.

- Enjoyed the ballot review.

- Reviews. Privacy, giving disabled people the ability to vote alone.

- Sitting is good.

"I want poll workers to know the following when working with someone with my disability"

- Be direct, use simple language, repeat instructions.

- Poll workers should explain where the ballot will come out, that the ballot will have a privacy sleeve over it, and what the voter should do when the ballot comes out because there are no audio instructions for these steps.

- Legally blind people tend to be over 65 and experience a loss of vision due to aging. These people are not used to using technology, and thus must use magniers.

- Just to be patient

- This machine will help out a lot of people with disabilities.

- Learn to work together, be patient with each other. Poll workers can ask questions of the disabled. It is a learning curve for everyone.

- Be patient.

- Poll workers will need to be very well trained.

- Voter used Braille on ATI to orient herself. Had to ask poll worker how to select candidates and move through ballot after listening to the audio instructions.

Items that have subsequently been corrected Procedural changes (instructions or addition of peripheral devices) have been made addressing these items.

- Mount box somewhere for people to rest the ATI.

- Confusing at rst because didn't realize all the candidates were part of the rst contest.

- Instructions for each device would be helpful. Instructions tell you to select one of the paddle buttons, but doesn't specify if button should be red or green. For example, "red button on the left" would be more helpful for people who need sensory clues.

- Magnication is not large enough. Low vision voter can't get close enough to the screen to see so instead remove privacy screen, turn and lean in as close as possible to read the monitor.

Items that are actionable

- Volume [of human voice recording in a studio] could be more consistent

- Continuous training needed for voter to become accustomed with the machine. Perhaps put it in a disability center and allow voters to practice on it every day for six months so they will be familiar with it by election day.

- Suggested voters with low vision bring their own magniers to the polling places, which she could advertise in her newsletter. Oer training sessions for people with low vision and hearing prior to voting day to make process easier and more familiar.

- Privacy issues a slight concern. Voter was told how BMD would be set up in a normal polling place, but she still expressed concerns about privacy.

Items that are future enhancements

- A scanning option [understood to be a continuous run mode] may be better as opposed to using the next and previous buttons to navigate ballot, where the voter will hit a switch [i.e. conrm using a pu] to mark selection when scanner lands on the candidate they want to vote for.

- Use an on-screen keyboard for write-in selection.

- Increased ballot magnication needed.

- Proposition questions not left on screen long enough to read when text is magnied. Doesn't tell you party affiliations on the audio review.

- Adjustable keyboard or controller mount, including zoom and contrast buttons. Make buttons better so people can hit them.

- Sip and pu mounted on a board to place in lap.

- Make the control box (ATI) bigger.

- Up and down arrows for volume and rate buttons on ATI were slightly confusing. Perhaps make the buttons in the shape of up and down arrows.

- Touch screen would make process quicker, would avoid listening for prompts. ATI could become a bit confusing for certain voters, a prompt throughout ballot would help, e.g.: a blue arrow beside the contest to vote for.

- For contests where you can vote for more than one candidate, audio tells you how many you can vote for, but doesn't tell you how many choices there are to choose from.

- Braille for the candidate buttons is very close to the top of the triangle button, making it hard to read.

- There should be instructions at the beginning about where the space selection comes in the alphabet.

- There were also many comments about the rate of button selecting - the function of the unit is directly related to two requirements of the federal voting standard 1) no button is to have any repetitive eect (not common practice for electronic interfaces), and 2) audio and video must be simultaneous (creating a lag between instantaneous visual information and slower audio communications). These two requirements lead to reduced usability which is reected in the comments below which conict with the interpretation of regulations.

  - Tedious write-in. I tried to speed it up but the voice rate was only aected. Perhaps use a count for the write-in, so if the voter hits the button ve times, the count will advance ve letters.
  - Lag time between audio and response of the buttons. If voter goes too fast for write in, system lags, which is very frustrating.
  - The lag time (button response time) is very slow, screen moves around the ballot very slowly.
  - A little slow, lag time in between button response.
  - Lag time between buttons made it a bit frustrating, wanted to zoom through it once familiar with the ATI.
  - Sluggish key pad and slow response time.

The system can be adapted to eliminate the issues listed above. Continued examination of these requirements will be performed in order to determine if voters prefer the system as described/required by standards, or would prefer as system with better usability.

Items that are operational or impossible to address due to regulations

- Size of the squares too small. Instructions are a little complicated.

- Tiny type on actual ballot.

- You will need someone manning the BMD to show people how to use it at rst. Voter usually reviews ballot at library the day before election, so right now machine is not familiar to use so voter doesn't like it. Have BMD available in a public place like a library so people can become familiar with voting.

- Size of font not large enough, magnify so one candidate ts on screen at a time.

4.3 NYSILC Testing - March 2008

4.3.1 Overview

The testing took place over a two day period. Time slots of up to 45-minutes were allocated for each participant to cast a ballot. This period permitted both ample time to interview the participants after voting in order to receive feedback about the use of the machine in addition to any time that was necessary to properly cast a ballot. All comments from participants were entered directly into a laptop computer. At the end of the second day, a group discussion was held where the collective results of all feedback received from the testers was shared with attendees.

4.3.2   Participants

A total of eleven individuals were involved in the focus group used to test the Dominion Voting Ballot Marker. Details about these participants are outlined in Tables 4.15 and 4.16.

Disability Type	Number of Persons
Physical	3
Blind	1
Low Vision	3
Cognitive	1
Mental Health	0
Multiple	3
None	1

Table 4.15: Focus group disability types - NYSILC

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	11 (100%)	9 (82%)	7 (64%)
No	0 (0%)	1 (9%)	2 (18%)
Unsure	0 (0%)	1 (9%)	2 (18%)

Table 4.16: Focus group participant experience levels - NYSILC

4.3.3   Interfaces Used

Each participant was asked to cast one complete ballot using the Ballot Marker. Depending on the type of disability or level of assistance required by each voter, a dierent set of interfaces were employed to cast each ballot. The breakdown of how each interface was employed is detailed in Table 4.22.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	7	3	9	9	2	0

Table 4.17: Frequency of use of voting interfaces - NYSILC - Total participants = 11

4.3.4   Overall Performance

Each participant was asked to rate the overall eectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are shown in Table 4.18.

4.3.5   Time Study

An actual ballot was used for the purposes of this study. All participants used the same ballot with the same candidate names and contests. The ballot consisted of seven contests. For one contest with many candidate names, each voter was asked to vote for a total of ten (10) candidates out of a possible twenty-four (24). For a second contest, the voters were asked to vote for a total of three (3) out of a possible seven (7). The results of the time study are shown in Table **??**.

	Score
Spread	2.5 to 8
Average	6.36

Table 4.18: Likert Scale Performance Data - NYSILC

	Range		
	Min	Max	Average
Voting	8	25	18
Ballot Print/Mark	2	3	2
Verification	2	4	3
Total	11	33	23

Table 4.19: Time study values for various voting functions (measured in minutes)- NYSILC

4.3.6 Independent and Private Use

Participants were asked whether or not they felt that their voting session was independent and private. A total of 73% (8 out of 11) of the participants believed that their voting session provided both independence and privacy for the voter using the assisting technology. Two voters felt that the system required more privacy because of the fact that the ImageCast Ballot Tabulator could be used while a ballot was being cast using the Ballot Marker on the other end of the unit. One participant answered that they were 'not sure' because a hardware failure was experienced while their ballot was being printed.

4.3.7 User Comments

Items that have subsequently been corrected

- The handheld tactile device worked well, but there were places where the prompts could be better or places where there were no prompts at all (i.e., like for write in candidates).

- Eliminate reference to 'chevron' which is confusing and stick with more familiar reference to 'arrows' (up, down, left, and right).

- A write in candidate vote was registered as an undervote during the verication process. It needs to be adjusted to record it as a vote.

- Audio/headset with sip and pu device was okay but not needed. Sip and pu device was utilized with sight of choices on monitor. While the sip and pu device worked, the tube would come out of the testers mouth on occasion and have to be reinserted. At the start of the session, it also increased the build up of saliva which blocked the tube.

- Second sip and pu user found the tethered line with a headset to be too intrusive and the control of the device unstable. Tester recommends they scrap the present device and replace it with a sip and pu device that is a stationary tube, attached to a exible and adjustable arm, so a voter can position themselves under it and have more control.

- The screen contrast, audio feedback and headset and handheld tactile device features were functional. The text magnication worked, but would have been better if it was somewhat larger in size. Also, the magnication and contrast buttons were unmarked and on the cart. They should at least be marked in bold print for the voter on the card. Some might argue that they should be buttons under the control of the voter on the handheld tactile device.

- The pale color used to highlight the candidate choice being considered is not obvious enough. It should be brighter. Note: A national expert identied during the group discussion that, to better address color blindness concerns, the frame of the cell should be highlighted in bold black.

Items that are actionable

- Audio was rudimentary and slow.

- Left arrow should say 'contest' and right arrow should say 'candidate' using Grade 2 Braille, which is standard for adults. Note: A national expert identied during the group discussion that Grade 1 Braille is more appropriate for all users.

- No instructions were provided in how to verify a ballot. The process would be more private if the voter received instructions from the system. Also, due to the separation of the scanner unit from the ballot marker device, there is a need for a curtain to increase privacy.

- For audio instructions, it should tell the voter how many candidates are in the list they are about to select from. Difficulty skipping to the next contest from manual write-in mode.

- Instructions for the use of all interfaces need to be standardized. Right now, the vendor only provides the user with instructions for the use of the handheld tactile device. They need to provide instructions for how to use magnication and contrast, the audio and headset, sip and pu device, and rocker panels.

Items that are future enhancements

- There are too many symbols on the machine. The symbols on the handheld tactile device need to be more direct. What are the orange buttons at the top for? Tester was not aware of the contrast feature. It needs to be identied at the beginning of the session. Perhaps it was missed due to the lack of labeling and/or instructions.

- Audio instructions were too long and distracting. For handheld tactile device distinguish buttons by shape AND color in a consistent manner through out instructions.

- Would be a lot easier if the monitor had touch screen capability. Need more basic instructions for how to use the handheld tactile device. Found the red/green two button panels easier to use than the handheld tactile device. Need instructions for how to use the red/green two button panels.

Items that are operational or impossible to address

- The doubled-sided ballot printing tray broke during use and had to be dismantled. Fortunately, the ballot being used was only one-sided and printed for the remaining testers.

- The scanning device had some diculty with the rst ballot, but eventually worked successfully.

- More time could be saved during the ballot printing function if it could mark a pre-printed ballot.

- Was able to read from screen with magnication and able to vote using audio feedback/headset and handheld tactile device. Could not read the actual printed ballot. Font too small.

4.4 Oshawa Testing - June 2007

4.4.1 Overview

The testing took place over a two day period. Time slots of up to 45-minutes were allocated for each participant to cast a ballot. This period permitted both ample time to interview the participants after voting in order to receive feedback about the use of the machine in addition to any time that was necessary to properly cast a ballot. All comments from participants were enterred directly into a laptop computer. At the end of the second day, a group discussion was held where the collective results of all feedback received from the testers was shared with attendees.

4.4.2 Participants

A total of eleven individuals were involved in the focus group. The voters used a NY style ballot, which was not familiar to any of them. Details about these participants are outlined in Tables 4.20 and 4.21.

Disability Type	Number of Persons
Physical	2
Blind	5
Low Vision	0
Cognitive	0
Mental Health	0
Multiple	0
None	0

Table 4.20: Focus group disability types - Oshawa

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	0 (0%)	0 (0%)	7 (100%)
No	7 (100%)	0 (0%)	0 (0%)
Unsure	0 (0%)	7 (100%)	0 (0%)

Table 4.21: Focus group participant experience levels - Oshawa

4.4.3 Interfaces Used

Each participant was asked to cast one complete ballot using the ATI units only (there was no screen display). The breakdown of how each interface was employed is detailed in Table 4.22.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	NA	NA	7	7	0	0

Table 4.22: Frequency of use of voting interfaces - Oshawa - Total participants = 7

4.4.4 Overall Performance

Measurements of the overall eectiveness rate of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best) were not collected.

4.4.5 Time Study

Time measurements were not collected.

4.4.6 User Comments

Items that have subsequently been corrected

- Introduction - After explanation of each button give the user the chance to press it.

- Introduction - Instructions should be uniform (always referring to the name as well as description of physical characteristics of the button in question. Example "Please, press Next button Right pointing chevron on the right side of the ATI device".

- Introduction - The Help button color is wrong.

- Introduction - Use shape of the button in the next step descriptions instead of the currently used names ("press Next button" and "press previous button" - Which one is which?)

- Introduction - The user was not clear how to end ATI device introduction and start an election process. [Instructions have been improved]

- Voting - A user perceived a sequence of the contests as "a loop" he did not know how to break. For him, announcements like "Now you have nished making your choices, please, proceed to review" would improve the situation considerably. [Instructions have been improved]

- Voting - The user was not clear about beginning and the end of the individual contests. [Instructions have been improved]

- Voting - No explanations how to make a choice follow a candidate name in individual contests. Just a pause. The user did not know what to do next when he wanted to accept the candidate. [Instructions have been improved]

- Voting - Conrmation of the selection made while doing it. You have selected "Name Name."

- Voting - Ability to change the choices per office individually. At the moment, a user has to go through the entire election, essentially rejecting all previous choices.

- Voting - The user was not clear about the beginning and end of the voting process. [Instructions have been improved]

- Review - Not clear from instructions which button to press during choices review. [Instructions have been improved]

- Review - More clear instructions on how to navigate to review section after voting. [Instructions have been improved]

- Controls use - X button was hard to press on its sides. [xed]

- Controls use - Buttons were clickable only in the center. It would be easier if a user could click anywhere on the buttons. [xed]

- Controls use - ATI unit should have an option to be attached to the table or something like it. Sliding of the unit is distracting. [xed]

- Controls use - It is unclear how to deselect choices.

- Controls use - For the better navigation locations of the buttons should be clearly identied with right/left, top/bottom of the ATI device in all recorded instructions. Overall good. No diculties. [Instructions have been improved]

Items that are actionable

- Introduction - Deeper voices are better perceived by blind people.

- Introduction - Blind people need to know the location so description of positions of the ballots scanner and ATI should be part of explanations before voting.

- Introduction - "... right chevron on the left.." makes the user's hand automatically move to the right side of ATI device.

- Controls use - Hard to read Braille for volume and help buttons

- Review -The choices review was confusing creating an impression that another round of election is started.

Items that are future enhancements

- Voting - Up/Down buttons appear more logical for yes/no type of choices.

- Controls use - Y/N buttons would make referendum questions easier to answer.

- Voting - Enumerate candidates before announcement of their names. Example "3 candidates are competing for Senator office. 1st candidate from Republican party name name. 2nd.from..".

- Controls use - The word "Race" in Brail should be replaced with something closer in meaning to "Contest".

- Controls use - Buttons do not response distinctly enough.

- Voting - Functions of ATI device buttons should be clearly explained while a user makes his choices as well.

- Controls use - Buttons use was acceptable but larger size of the ATI unit and the buttons on it would be a plus. Volume control was especially difficult.

Items that are operational or impossible to address

- Controls use - Too many buttons (some of the functions could be combined. -/+ buttons are too small. [The ATI has the minimum number of buttons required by VVSG]