EZ Ballot with Multimodal Inputs and Outputs

Seunghyun “Tina” Lee¹, Xiao Xiong ², Liu Elaine Yilin ¹,³, Jon Sanford¹,³

¹Center for Assistive Technology and Environmental Access, Georgia Institute of Technology, Atlanta, GA, USA
²School of Literature, Media, and Communication, Georgia Institute of Technology, Atlanta, GA, USA
³School of Industrial Design, Georgia Institute of Technology, Atlanta, GA, USA

{tinline, xxiong6, yliu451}@gatech.edu, jon.sanford@coa.gatech.edu

ABSTRACT

Current accessible voting machines require many voters with visual, cognitive and dexterity limitations to vote with assistance, if they can vote at all. To address accessibility problems, we developed the EZ Ballot. The linear layout of the EZ ballot structure fundamentally re-conceptualizes ballot design to provide the same simple and intuitive voting experience for all voters, regardless of ability or input/output (I/O) device used. Further, multimodal I/O interfaces were seamlessly integrated with the ballot structure to provide flexibility in accommodating voters with different abilities.

Categories and Subject Descriptors

H.5.2. Information interfaces and presentation: User Interfaces—input devices and strategies.

General Terms
Design, Human Factors.

Keywords
Accessible voting, multimodal input, multimodal output, gestural input

1. INTRODUCTION

Compared to older technological voting systems such as paper ballots, levers, or punch cards, electronic voting machines are capable of being adapted to provide access to voters with a broad range of disabilities through a variety of alternative inputs and outputs [1,7]. These features, which are typically added to existing hardware and/or software architecture, have primarily focused on accommodating voters with the types of impairments (i.e., vision and dexterity) that are most likely to limit access to voting machines. However, despite providing technical accessibility, the accessible input and output features that are added to a conventional ballot not only make the voting experience more complex and difficult for voters with vision and dexterity limitations compared to voters without disabilities, they generally ignore and can exacerbate problems experienced by voters with cognitive limitations.

To address these problems, we developed a prototype of an EZ ballot that integrates a simplified ballot design with a range of I/O interfaces. The linear layout of the ballot structure fundamentally re-conceptualizes ballot design to provide the same simple and intuitive voting experience, regardless of ability or I/O interface used. Further, multimodal input and output interfaces are seamlessly integrated with the ballot structure to provide the flexibility to accommodate voters who are most likely to have problems with voting machines, including people with cognitive, visual and dexterity limitations. Ultimately, this prototype could be generalized to other applications such as electronic kiosks.

2. RELATED WORK

Voters with vision, cognition and dexterity limitations experience different types of problems using accessible voting machines. For blind and visually-impaired voters, voting takes significantly longer (31 vs. 5 minutes) compared to sighted voters [7] and navigating a ballot often leads to confusion [3, 5, 8]. These difficulties can often be attributed to the accessible features that are added to standard ballots, which are designed to be used visually. For voters with cognitive limitations who can be confused and overwhelmed by the amount of information and visual complexity of a full-face or the lack of overall orientation in page-by-page ballots, there is a need to incorporate more cognitive supports [6]. To provide access to voters with dexterity limitations, a variety of assistive technology inputs (e.g., sip-and-puff, jelly switch devices) have been added to voting machines. In addition to creating set up problems for poll workers who are unfamiliar with these input devices [8], they can negatively affect the voting experience.

A number of efforts have been undertaken to develop alternative ballots, such as the zoomable voting interface which provides an overview of the entire ballot as well as a detailed zoomed view of each race [1], and Prime III, which offers multimodal touch and/or voice and/or A/B switch inputs [4]. However, each of these systems only accommodates voters with specific limitations. To date, there are no voting systems that accommodate all voters across the range of ability.

3. DESIGN OF EZ BALLOT

3.1. EZ Ballot Structure

To provide equal access for voters with cognitive, visual and dexterity limitations, the EZ Ballot was designed with a simple, consistent linear structure. To reduce cognitive demand, EZ Ballot breaks down the voting process (e.g., contests, candidates, review of the ballot and casting the ballot) into simple questions that are easy to understand and answer using either a “yes” or “no” response, which provides consistency and simplicity. Each screen contains only one question that is presented both visually and through audio (see Figures 1). For example, “Do you want to vote for democratic Barack Obama & Joe Biden for president and vice president?” will be displayed visually and through audio (see Figure 1). The question itself serves as a prompt that can remind and orient voters. Responses on the existing prototype are limited to pressing a physical buttons on the left and right sides of the device or by using touch buttons on the iPad touch screen.
3.2. Multimodal Inputs of EZ Ballot

EZ ballot is designed with integrated multimodal inputs to provide flexibility for users with different levels of vision and dexterity. Multimodal inputs include physical tactile input, touch screen input, and gestural inputs. The physical tactile input is designed with two conductive buttons on each side of the screen where the iPad is typically grasped (see Figure 2). Though not following the principle of proximity between physical buttons and onscreen ones, button placement will be varied and tested as part of the next phase of the project. The buttons also have embossed letters of “Y” and “N” for the voters with visually impaired. Although red and green are indistinguishable to individuals who are color blind, the colors were chosen as they are internationally recognizable for yes and no buttons. For individuals who are color blind, buttons can be differentiated by contrast, text, and icons.

Gestural interfaces can be 2D touch gestures that use of fingers on touchscreens or 3D air gestures that involve free movement in space [9]. In this project, we will embed 2D multi-finger gestures (e.g., pinching and scrolling) for magnification and navigation that recognizes defined gestures, such as swipe, circle, zoom, or a gestural development kit, which permits user-defined gestures such as a check. For 3D gestures Kinect technology or Apple iSight, which recognizes air gestures using the iPad camera, will be used to record head gestures (e.g., shaking up and down), or hand gestures (e.g., thumbs up and down).

![Figure 1. EZ Ballot interface](image1)

3.3. Multimodal Outputs of EZ Ballot

EZ ballot was also designed with integrated multimodal outputs to provide flexibility for users with different cognitive and visual abilities. Multimodal outputs include visual, speech, and tactile feedback. To provide multi-modal outputs orientation and feedback cues, a progress bar and non-speech sounds will be incorporated in the EZ Ballot. To compensate for the linear structure of the EZ Ballot, which currently provides no cues about the nature of the overall ballot, an overview of the ballot and progress bar will be added in the next phase to orient the voters to the overall voting process. In addition, based on feedback from visually-impaired users in the pilot testing, non-speech sound will be added to indicate that an action has occurred.

4. INITIAL USER STUDIES

In a pilot study, users reported that the prototype was easy to use and understand. A blind user particularly liked the simplicity of the “yes” and “no” tactile buttons and the ability to use both hands compared to a typical one-handed keypad. A dexterity-impaired user responded that the touch screen buttons were easy to use. Similarly, an English-as-second-language speaker preferred the simple “yes” and “no” questions which make the process easy to understand.

5. ONGOING WORK

Usability studies are currently being conducted to identify and refine issues with the EZ ballot structure and the I/O interfaces. A total of 40 participants, including 10 participants with visual, dexterity, and cognitive impairments and ten without disabilities, will be recruited. Four sample ballots covering a range of contest types (e.g., choose one, choose three, write-in, referendum) will be designed that require no more than 10 minutes each to complete. Quantitative measures of task performance will include task completion, task success (accuracy of voting), number of assists required (asking for help), and the number of errors made (incorrect inputs). Following each trial, participants will be asked to complete a post-trial interview to elicit in-depth, qualitative feedback about the usability of each of feature and their satisfaction with the EZ Ballot.

6. REFERENCES


