Smart Voting Joystick for Accessible Voting Machines

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Project Team

- Sarah Swierenga, Director, MSU UARC (PI)
- Graham Pierce, Jennifer Ismirle, James Jackson, and Robert Decloniemaclennan, User Experience Researchers, MSU UARC
- Stephen Blosser and Aditya Mathew, MSU Resource Center for Persons with Disabilities
- Engineering Design Capstone Team:
  - Yangyi Chen, Tyler Dennis, Graham Pence, Behdad Rashidian, Joy Yang
- Introductory engineering student teams

Accessible Voting Systems

- Existing electronic voting systems are **inadequate**
  - Many individuals with disabilities cannot use them at all
  - Take a very long time and are painful to use, even with no major disabilities
- Project funded by ITIF/AVTI to create “Smart Voting Joystick”
- Other MSU Usability/Accessibility Research and Consulting (UARC) voting projects (http://usability.msu.edu/research/projects)
  - Enhancement of Accessible Mobile Voting System Standards
    - Ongoing, funded by NIST
  - Design of Accessible Mobile Voting System Standards
    - Complete, funded by NIST
  - Testing Usability Performance of Accessible Voting Systems
    - Complete, funded by NIST

Standard Electronic Voting System Controls

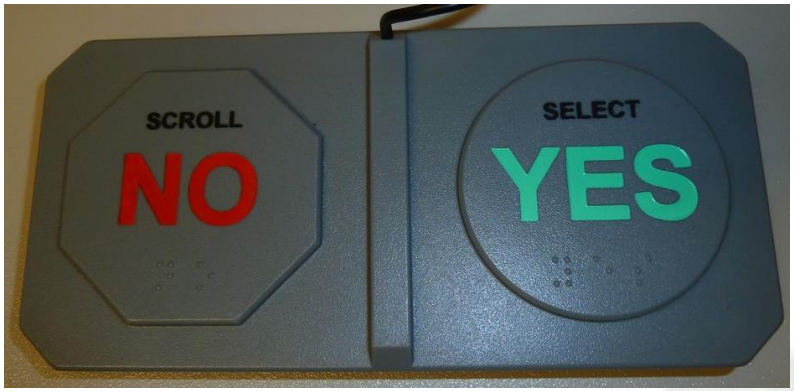
- **Touchscreen** requires hand, arm, and shoulder strength and accuracy.
- **Button panel** requires finger/hand strength and accuracy.

- Neither can be used by individuals with significant hand/arm/shoulder disabilities.

- Most controls cannot be moved.
  - Many individuals (including those in wheelchairs) cannot reach them.

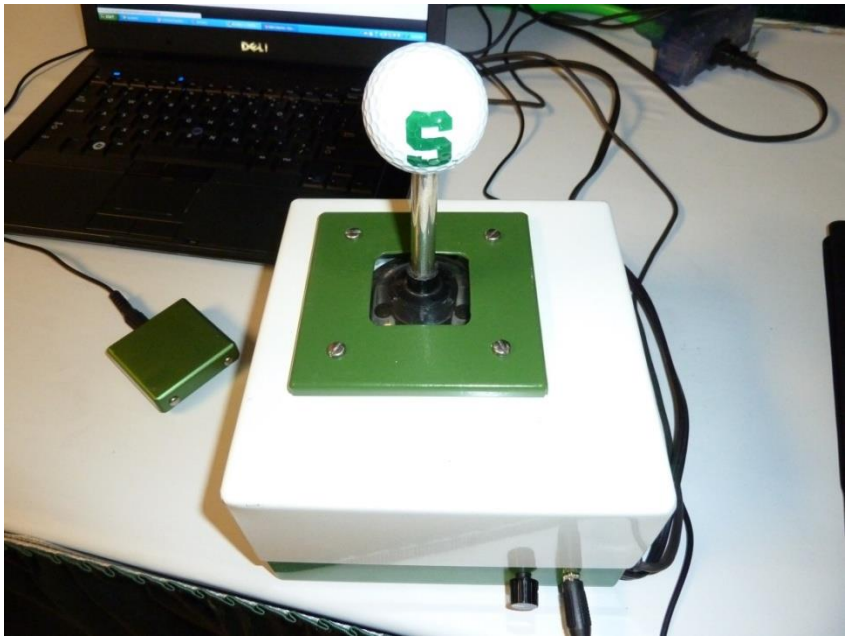
Alternative Electronic Voting System Controls

- **Two-button switch** is painful/impossible with hand/arm problems.
  - Requires up to 1200 button-presses to complete the NIST Standard Test Ballot with no mistakes.
  - Every change or mistake can take 100+ button-presses to modify/fix.
- **Sip/puff** is only used by individuals with no hand/arm control.
  - Same drawbacks.



Smart Voting Joystick – Project Overview

- Goal: Create **smart joystick** to plug into electronic voting systems.
- Obtain feedback from users with dexterity and mobility limitations.
- MSU Electrical and Computer Engineering capstone design team created initial prototype.



Smart Voting Joystick – Final Prototype

- Final prototype includes Smart Joystick and three buttons
- Provides haptic feedback to users
- Can be customized via software

- MSU Press Release with video available at:

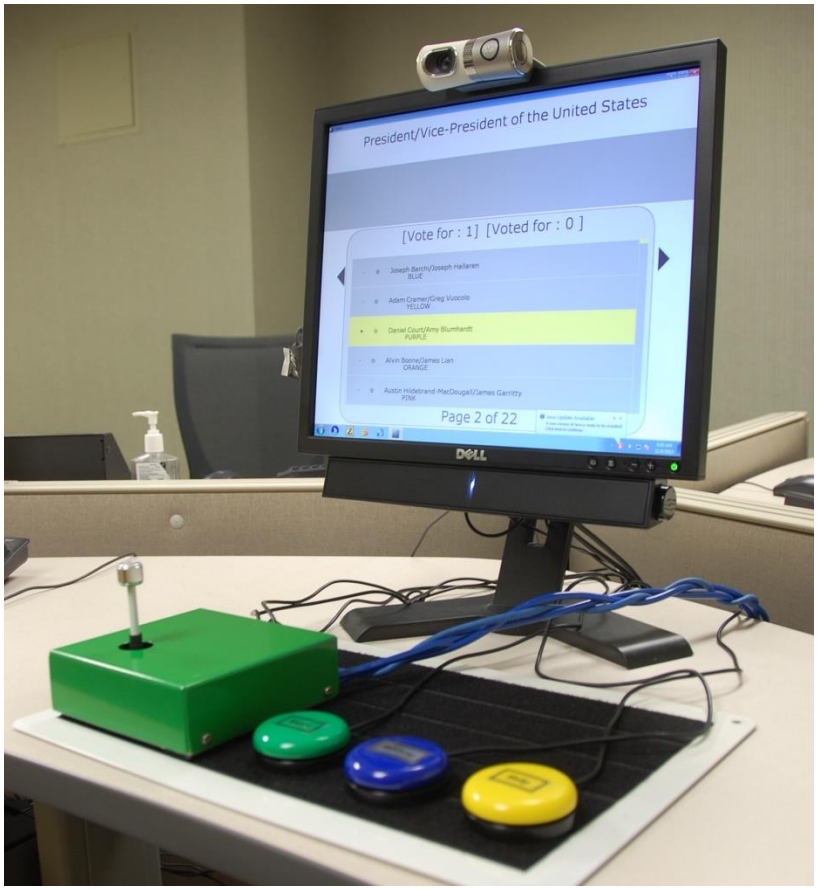
http://msutoday.msu.edu/news/2013/msu-created-joystick-advances-independent-voting/

Mounting Options Design Challenge

- MSU Engineering student teams asked to design universal mounting devices for alternative inputs.
- Goals:
  - Easy to set up
  - Quick mounting
- Several designs:
  - Table mount
  - Chair mount (with/without armrests)
  - Wheelchair mount
  - Free-standing mount

Usability Evaluation Setup

- Joystick attached to PC and interactive sample ballot.
- Participants recruited from MSU and mid-Michigan (sample of convenience).
- Conducted in UARC lab.



Usability Participants and Protocol

- Six participants with mobility/dexterity disabilities with voting experience.

- Protocol
  - Task instructions, voting task, post-study questionnaire

- Usability metrics:
  - Effectiveness: Percentage of votes completed accurately.
  - Efficiency: Average time to complete voting.
  - Satisfaction: Post-study questionnaire, written feedback, and comments made during the session.

Usability Results

- Moderate Disability Group:
  - 4 of 4 users completed the voting task.
  - 3 of 4 users voted the ballot exactly as instructed.
  - Average time to complete the ballot: ~ 9 ½ minutes.
    - Average time to change a vote was 30 seconds.
- Severe Disability Group:
  - 1 of 2 users completed the voting task.
  - Neither user voted the ballot exactly as instructed.
  - Time to complete the ballot: ~ 29 ½ minutes.
    - Average time to change a vote was 5 ½ minutes.
- Post-study Questionnaire:
  - Most gave positive ratings and comments about the Smart Joystick

Design Recommendations

- Ability to adjust amount of feedback and return-to-center force for the joystick is essential.
- Provide single- vs. dual-axis choice up front.
- Joystick should be shorter and thicker, and potentially more spherical, to allow for easier usage when grasping or pulling it.
- Sufficient arm support needs to be provided.

Future Research Directions

- Joystick characteristics, e.g., adjustable feedback and return-to-center force settings, optimal debounce time, and stem/knob dimensions
- Implementation and testing of universal mounting systems
- Real-world testing of joystick (in an election)
- Explore ballot user interface components, such as requiring users to choose to advance to the next contest

Implications for Real-world Voting Systems

- The Smart Voting Joystick has demonstrated tremendous potential to enable voters with physical impairments to vote privately and independently—without significant discomfort and within a reasonable amount of time.
- Initial reactions from the public have also been positive, with interest from election officials and media.
- The Smart Voting Joystick has strong potential for commercial development after further refinement .

Contact Information

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