Experimental Design for Cognitively Impaired Wheelchair Users Evaluating a Visual Control Interface of a Robot Arm

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Collaborators

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- NSF IIS-0534364

IROS'07 October 29, 2007

Research Question

- What is the most effective user interface to manipulate a robot arm?
- Our target audience is power wheelchair users, specifically:
  - Physically disabled, cognitively aware people
  - Cognitively impaired people who may not have fine motor control

V1: Interface Design

- Left:
  - Original image is quartered.
  - Quadrant containing the desired object is selected.
- Middle:
  - Selection is repeated a second time.
- Right:
  - Desired object is in 1/16th close-up view.

V1: Demo

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

V1: User Trials

- Participants
  - 12 able-bodied participants (10 male, 2 female)
  - Age: [18, 52]
- Experiment
  - AB, alternating, within subjects
  - Menu vs. computer

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

Current Work

End-User Trials

- Evaluate current work with target population
- Summer 2007
  - Recreation of the preliminary user trial with the target population

Population

- Crotched Mountain Rehabilitation Center
  - School
  - Brain Injury Center

QuickTime™ and a
decompressor
are needed to see this picture.

Cognitive Impairments

- Abstraction
  - Physical object
  - Visual representation of object
  - Written representation of object
- Multi-stepped processes
  - Prompting

Task

- Matching game
  - Objects
  - Size of object
  - Flash cards
  - Configuration

Object Configuration

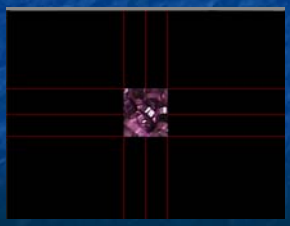
Process

1. Select object from interface
2. ARM opens and moves to *XY* position
3. ARM drops for depth *Z*
4. Take picture of object



Collecting Data

- Quantitative
  - Automated time logging of events
  - Close-up object photos
- Qualitative
  - User exit survey questions
  - Experimenter notes

Collecting Data

- Manual logs
  - Object configuration
  - Interface version
  - User settings
  - Length of reorientation
  - Amount of prompting
  - Attentiveness

Trials

- Conducted by Crotched Mountain Assistive Technologists
- Session
  - Length: ~30 minutes
  - Setup
  - Training
  - 3 objects
- 8 week trial

Lessons Learned: Mounting

- Need to customize for users
  - Joystick placement
  - Touch screen placement

Lessons Learned: Motivation and Interest

- Must have appropriately challenging task
- Task must fulfill user need
  - Education
  - Daily routine
  - Quality time

Lessons Learned: Accessibility

- "The ability of a person to understand and manipulate a device"
- Considerations
  - Physical
  - Cognitive
  - Sensory / visual
  - Behavioral / social

Future Work

- Additional trials to be completed by December 2008 at Crotched Mountain
  - Late Winter/ Early Spring 2008
  - Summer 2008
  - Late Fall 2008

Testing Guidelines

- Multidisciplinary collaboration
  - Design, test, repeat
- Clear definition of user population
  - Accessibility
  - Composition
- Appropriately challenging task
  - Customizable
  - Qualitative and quantitative measures
- Minimal setup time

http://www.cs.uml.edu/robots