



Applying Human Factors Psychology Principles to Design Graphical User Interface of an Assistive Robot

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Research Objective

• Human factors psychology principles were applied to the graphical user interface of the system in attempts to find the ideal graphical user interface layout for the MANUS assistive robotics system.

Hypothesis

• By creating a component-based ranking system, various ranking graphical user interfaces can be created and analyzed, revealing the most ideal interface.

MANUS Assistant Robot System



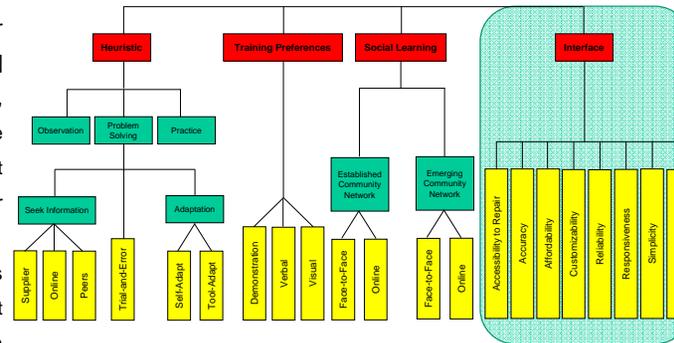
Background

• The MANUS robotics system is an assistive robotics system designed to be attached to a wheelchair and used by patients with limited mobility or minimized upper-body movement.

• The researchers designed a computer-based graphical user interface for the MANUS. This project focused on the process of creating the ideal graphical user interface, since the MANUS robotics system is specifically designed to assist patients with limited upper-body movement.

Methods & Results

Focus Group Results: Ideal Robot Features

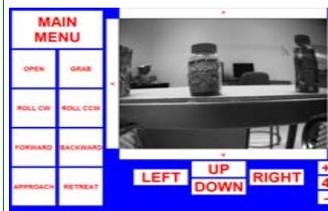
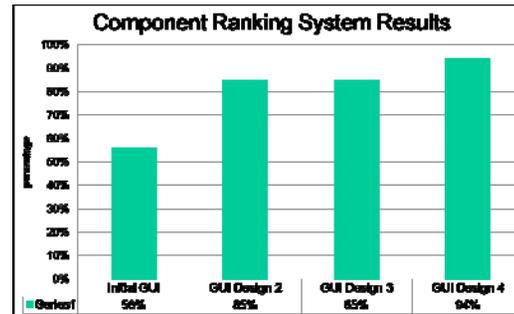


• The researchers conducted a focus-group in April 2009 comprised of four traumatic spinal cord injury [TSCI] patients with various levels of ages, ethnicity, and injury levels, the purpose of the focus group being to find out what the users would find necessary in their ideal assistive robotics system.

• 10 general website heuristics developed by Jakob Nielsen and patient comments made during test trials with the MANUS robot were also considered.

$$SCORE = \sum (Importance of Factor i * Efficacy of Factor i in Design)$$

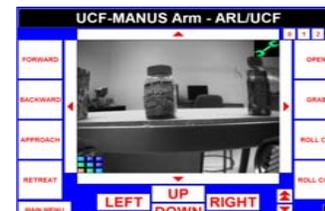
• The initial GUI was then evaluated according to the component ranking system and 3 subsequent GUI designs were created in an effort to find the GUI with the highest component ranking – which would theoretically be the ideal MANUS GUI. The original GUI, which had already been tested with users, was considered the control. Components of the ranking system were given a percentage rating based on their overall relative importance to the system.



Initial MANUS GUI:
 Component score of 56%



GUI Design #2
 Component score of 85%



GUI Design #3
 Component score of 85%



GUI Design #4
 Component score of 94%

Component Based Ranking System

Safety – 30%

- user activated stop function
- prevents user from impossible actions

Simplicity – 25%

- minimum number of buttons/screens necessary for functional use of system
- function of buttons clear to user
- dialogues contain relevant information
- interface layout optimum for functional usage
- interface accessible to both healthy and disabled users

Responsiveness – 20%

- interface acknowledges user entries immediately
- interface keeps users informed of system status

Accuracy – 10%

- interface offers feedback/suggestions when expected (user-created) errors occur
- interface responds the same way every time user does the same actions

Reliability – 10%

- design has minimal system resets and unexpected errors
- interface behaves in expected manner – minimal errors, unfamiliar functions/messages

Customizability – 5%

- design has relevant customizable features

Conclusions & Future Work

• GUI Design #4 had the highest score due to

- an easily visible dialog box in the bottom right corner
- most oft-used buttons larger in size
- an undo button that allowed users to correct error-causing actions

• Research will be further conducted with each of the new GUIs tested and ranked by potential users.