University of Pittsburgh

Department of Veterans Affairs

# Overview of HERL Assistive Robotics Research

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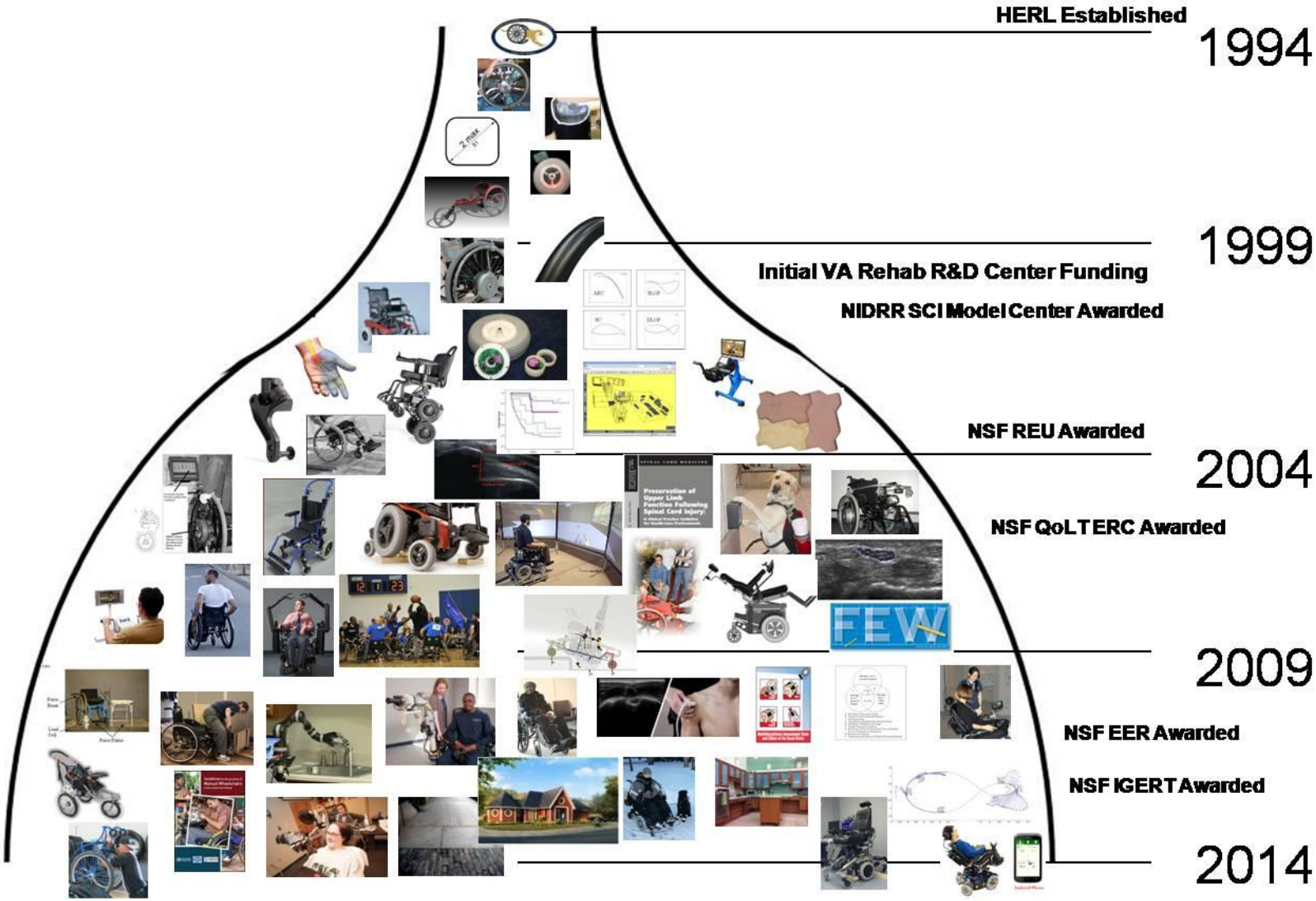
And

Rehabilitation Research and Development Service

Department of Veterans Affairs


HERL Established
1994
1999
Initial VA Rehab R&D Center Funding
NIDRR SCI Model Center Awarded
NSF REU Awarded
2004
NSF QoL T ERC Awarded
2009
NSF EER Awarded
NSF IGERT Awarded
2014

# Participatory Action Design - Paradigm


**Standard of Care**
(if applicable)

**Insurance Coverage**
(if applicable)

**FDA Approval**
(if applicable)

**Community Participation Employment Living Healthy**

**Story Boards**

**Initial User Data**

**Prototype Systems**
(Capabilities)

**Product Available**

**User Need Identification**

**Mock-Up Systems**

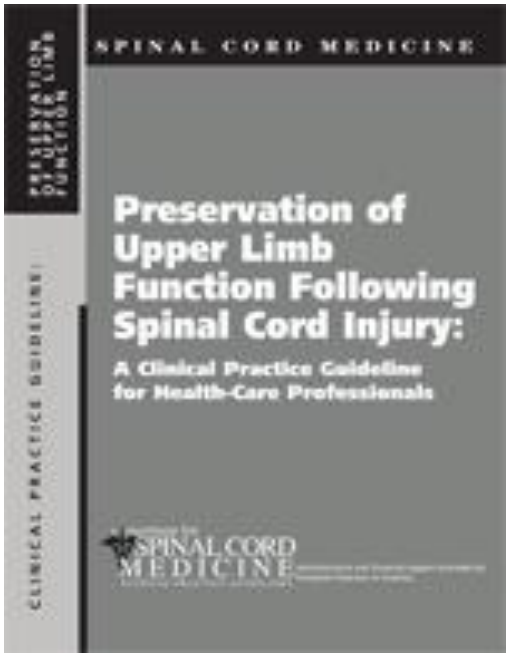
**Technical Data**
(Safety)

**Demonstration Studies**
(Effectiveness)

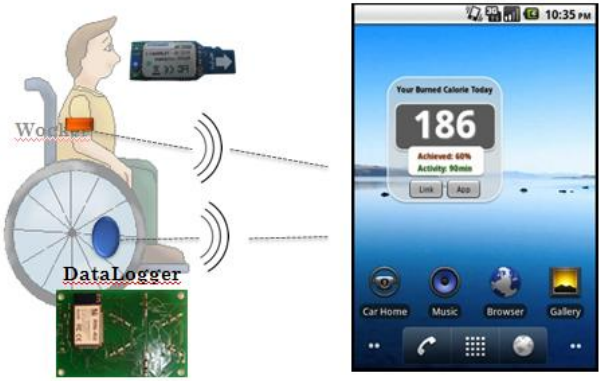
**Consumer Trials**
(Acceptance & Cost)

**Best Practice Evidence**
(Policy)

# Preserving arms…




*Preserving Upper Limb Function in Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals*. 2005, Consortium for Spinal Cord Medicine: Washington DC.

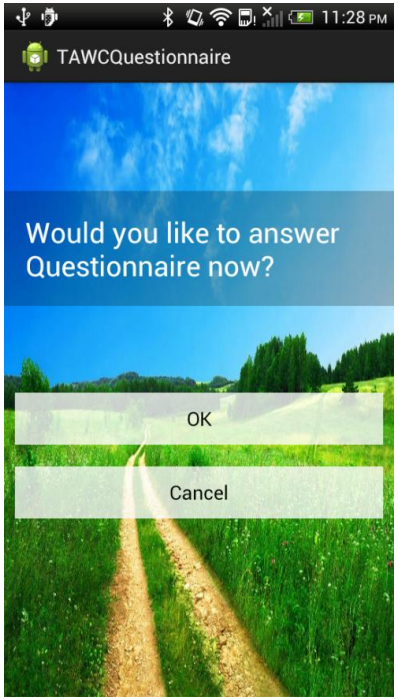


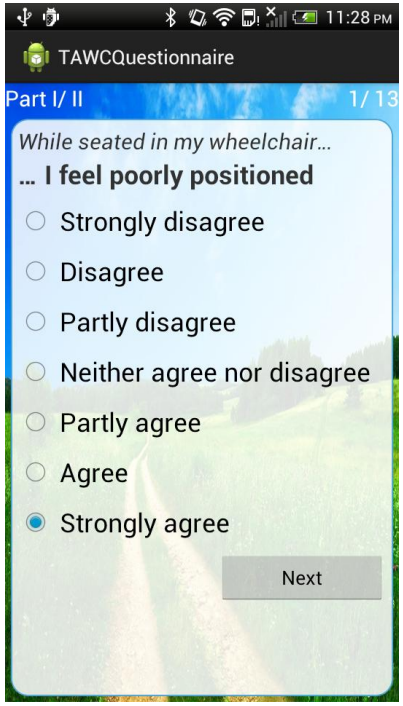

# Coaching Safe Behavior

| (Data from 8 subjects) | Baseline (n=96) | Intervention (n=308) |
|---|---|---|
| PSF Usage Frequency (times/day) | 15 ± 16 | 23 ± 22 |
| Driving Distance (km/day) | 1.8 ± 2.3 | 1.7 ± 2.1 |
| Spearman's rho | .322** | .551** |

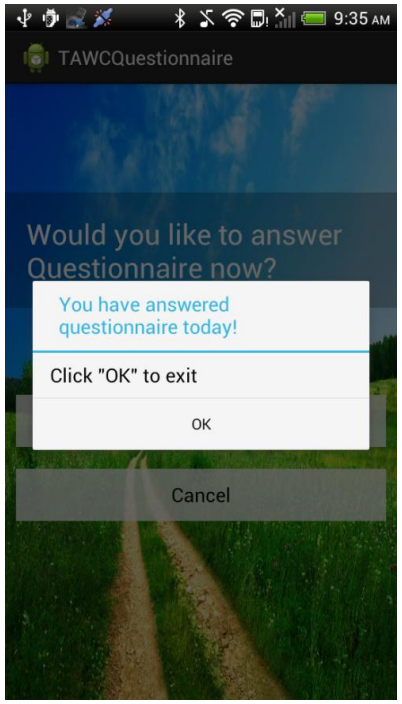
# TAWC Questionnaire

- Automatically appear at 4:00pm every day
- Generate alert on the notification bar
- Answers are stored into database
  - Check whether users have answered the TAWC each day
  - Data will be uploaded with SVSC data as well







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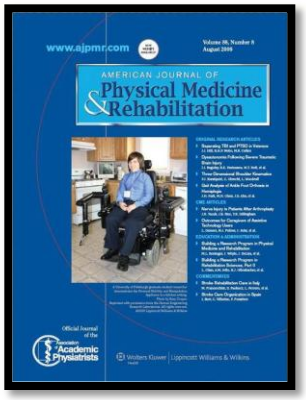
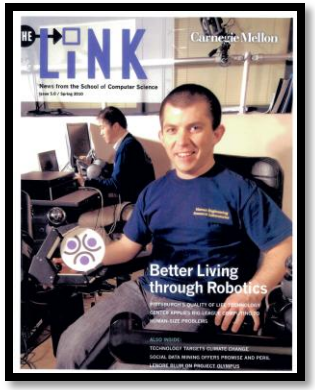
# PerMMA





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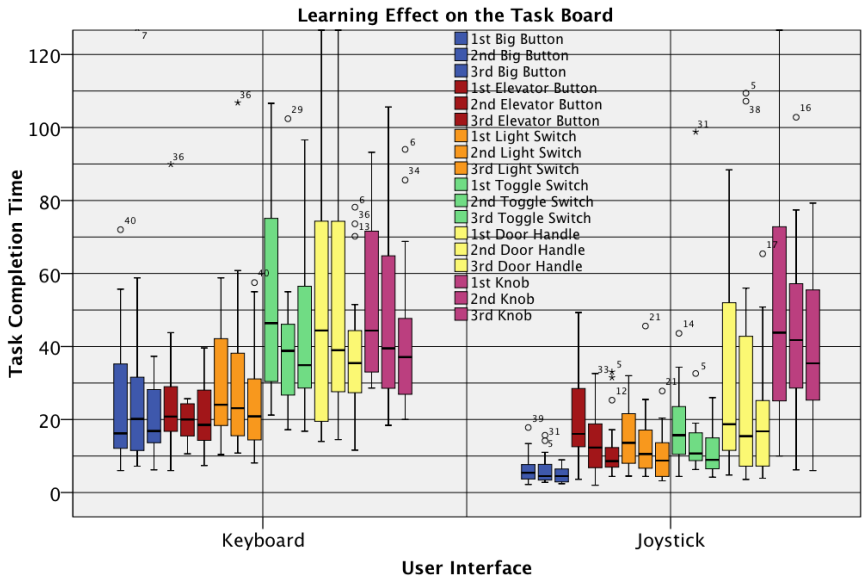
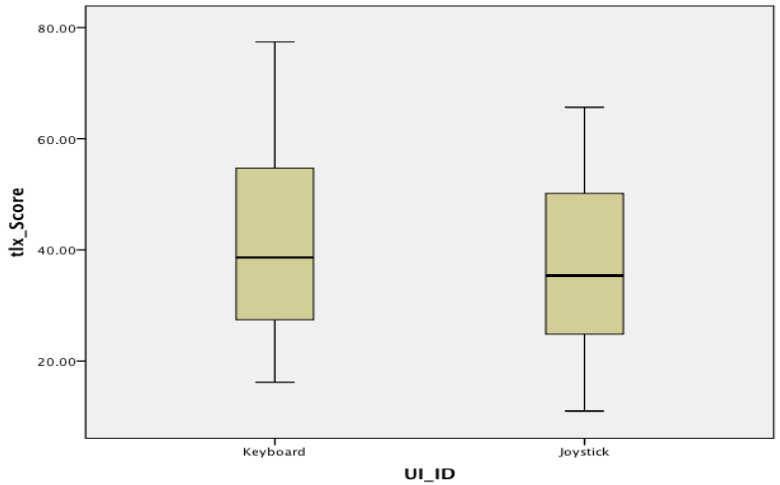
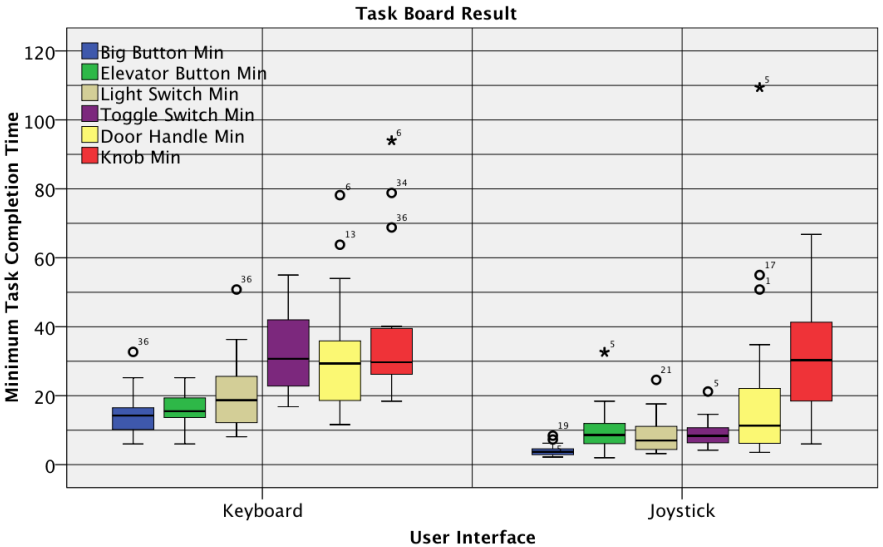
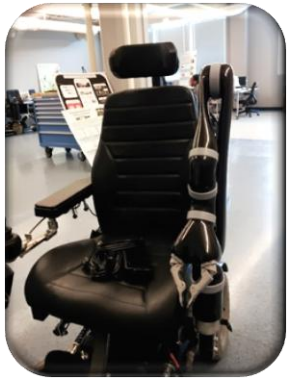
# Wheelchair Mounted Robotic Manipulator

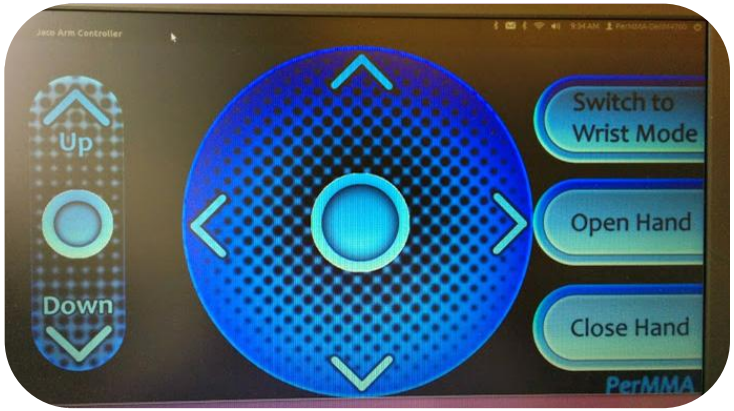


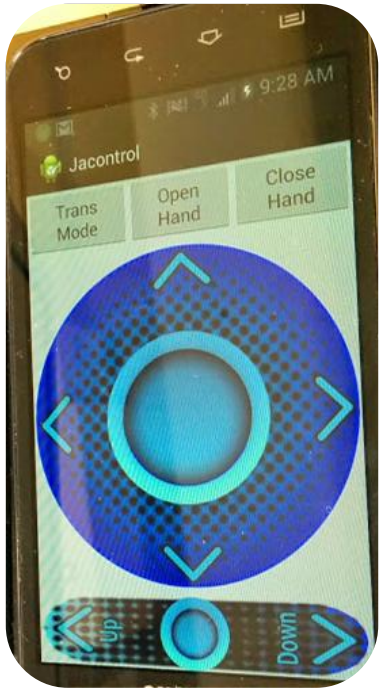



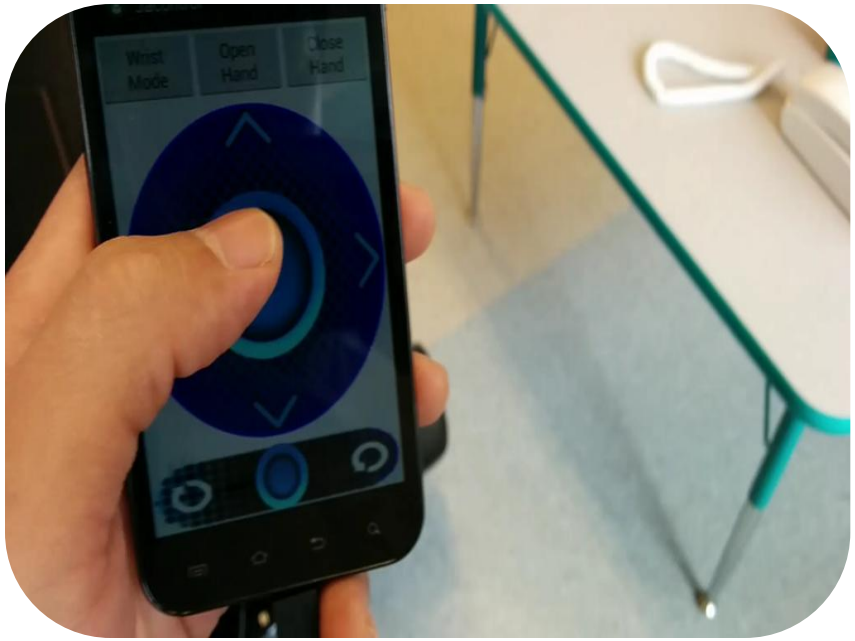



# Smart Phone Robotic Arm Interface



# MEBot - Problem Statement

2003, 100,000 wheelchair related injuries were treated in an emergency room (Xiang, 2006)


2010, 3.6 million people 15+ years old used a wheelchair (Brault, 2012)

Estimation of 330,000 use an EPW (Kaye, 2000)

Tips and falls account for 65-80% of the injuries (Xiang, 2006)

Causes include loss of traction, being immobilized, or the loss of stability (Salatin, 2011)

# Previous Design – Personal Mobility and Manipulation Appliance II (PerMMA II)

- Six wheeled EPW
  - Front and rear wheels move up and down via pneumatic actuators
  - Drive wheels mounted to a carriage system
    - Move up and down with pneumatic sleeve spring
    - Move forward and backward with electric linear actuator

# Robots for Wheeled Mobility: MeBot (GEN-1)

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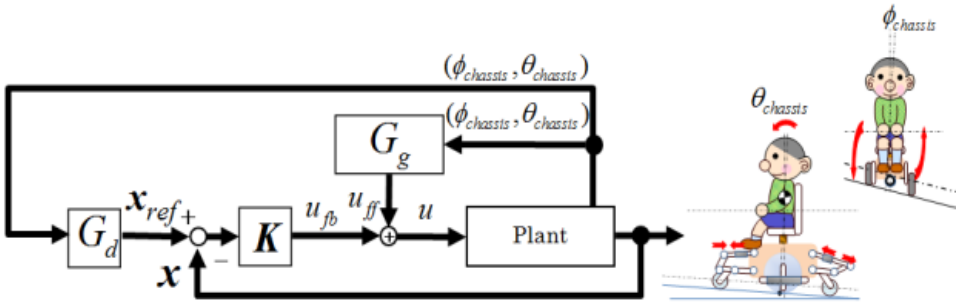
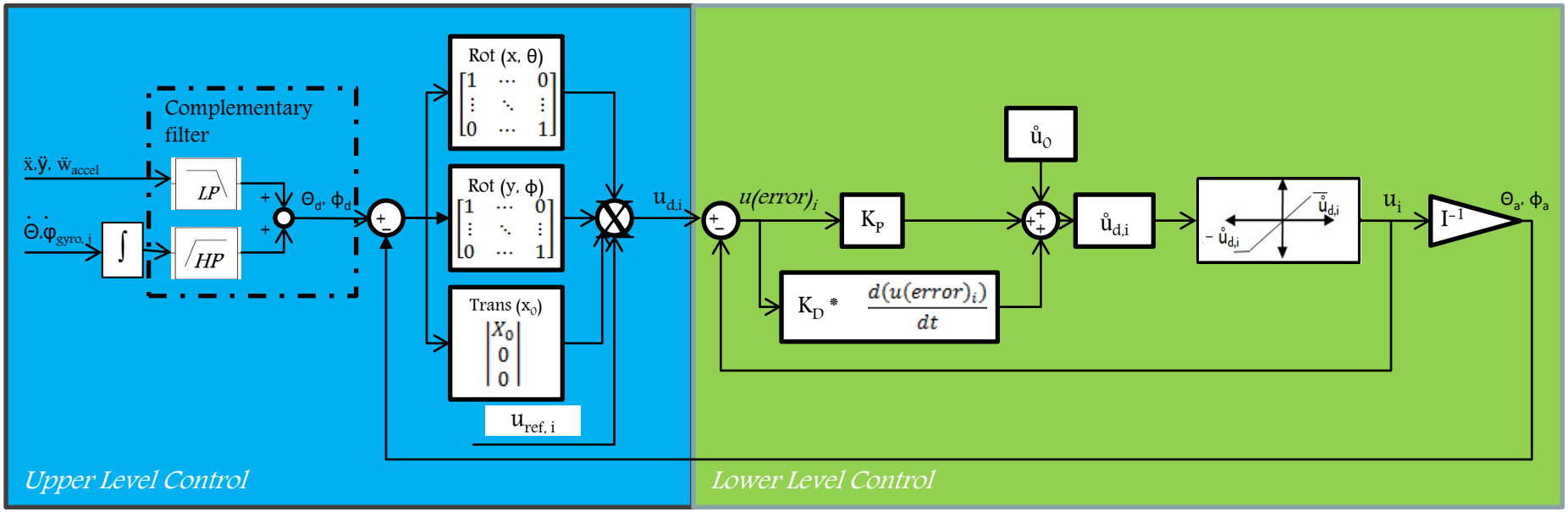
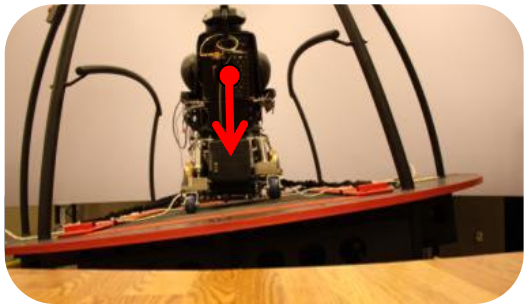
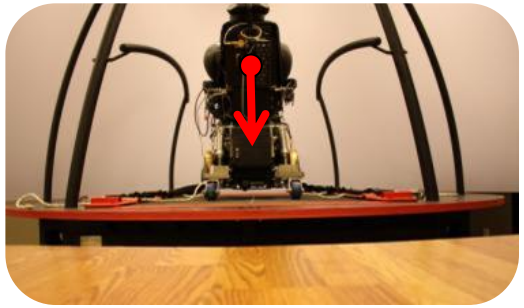
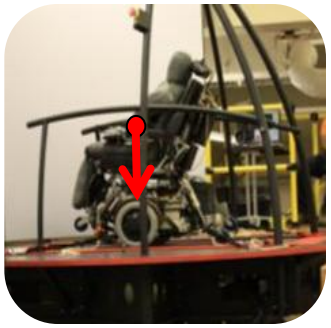


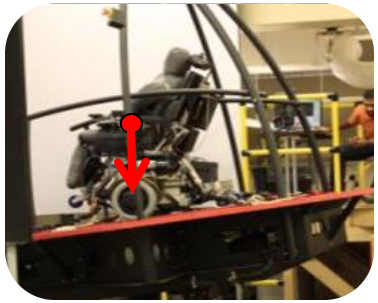

# CAREN System to Assess Mobility



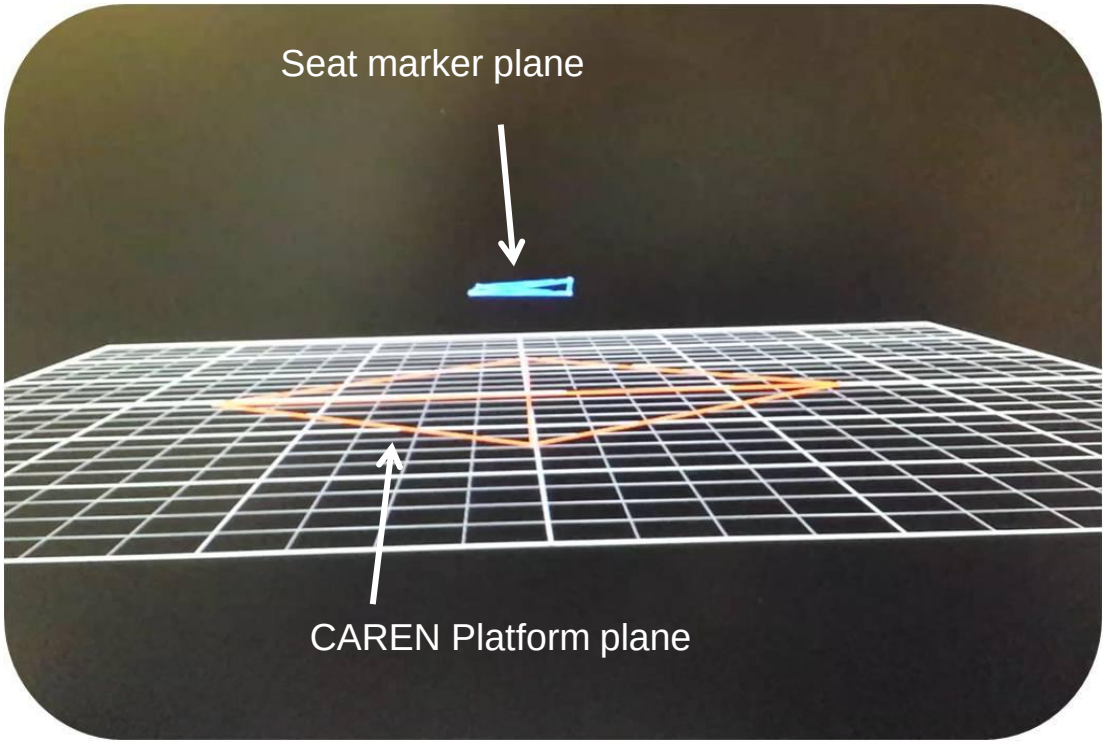









# MEbot Self-Leveling Video

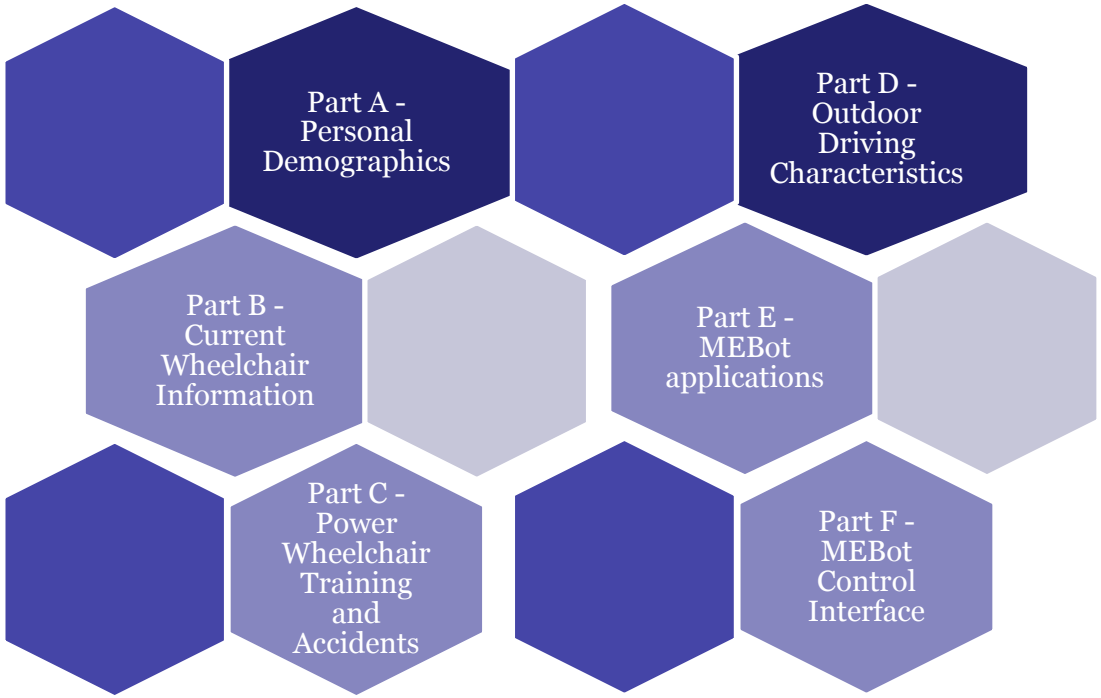


# MEBot and PerMMA II design comparison

| Comparison Item | MEBot | PerMMA II |
|---|---|---|
| **Time to perform curb climbing** | 30 seconds | 2 minutes and 30 seconds |
| **Maximum curb height** | 8 inches | 6 inches |
| **Horizontal drive wheel movement** | 14 inches | 7 inches |
| **Vertical drive wheel movement** | 8 inches | 3.3 inches |
| **Number of actuators** | 4 pneumatic actuators, 2 electronic actuators | 4 pneumatic actuators, 2 pneumatic sleeve springs |
| **Air supply** | High Pressure Air | Compressed CO2 |
| **Ground clearance** | 1-9 inches | 0.5-3.8 inches |
| **Driving wheel camber** | Steel mounted, tight fit axle housing | Aluminum mounted, loose fit axle housing |

# Focus Group Prototype Evaluation

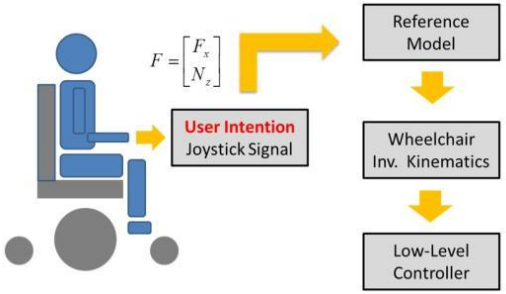
- Methodology – Data Collection
  - Questionnaire broken into parts

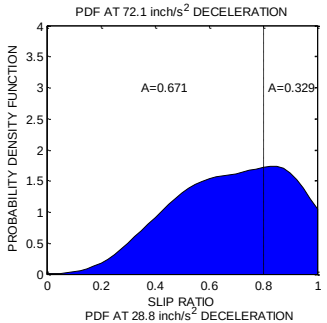


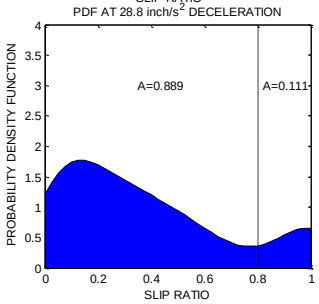
# Focus Group Results

- Overall dimensions similar to Group 4 EPW
- Advanced features
  - Curb climbing
  - Self-leveling
  - Traction control
  - Selectable drive wheel positioning

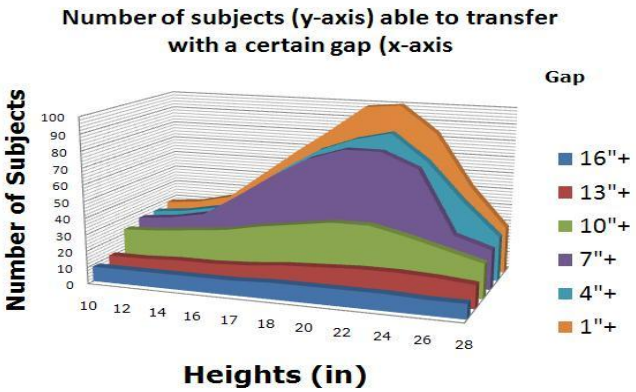
# Traction Control and Surface Compensation




# Robotic Assisted Transfers

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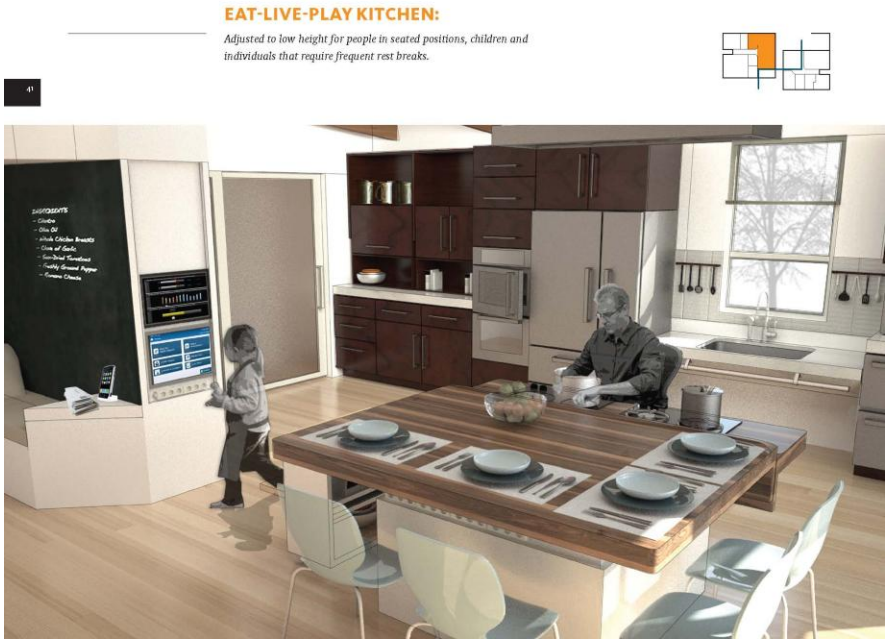
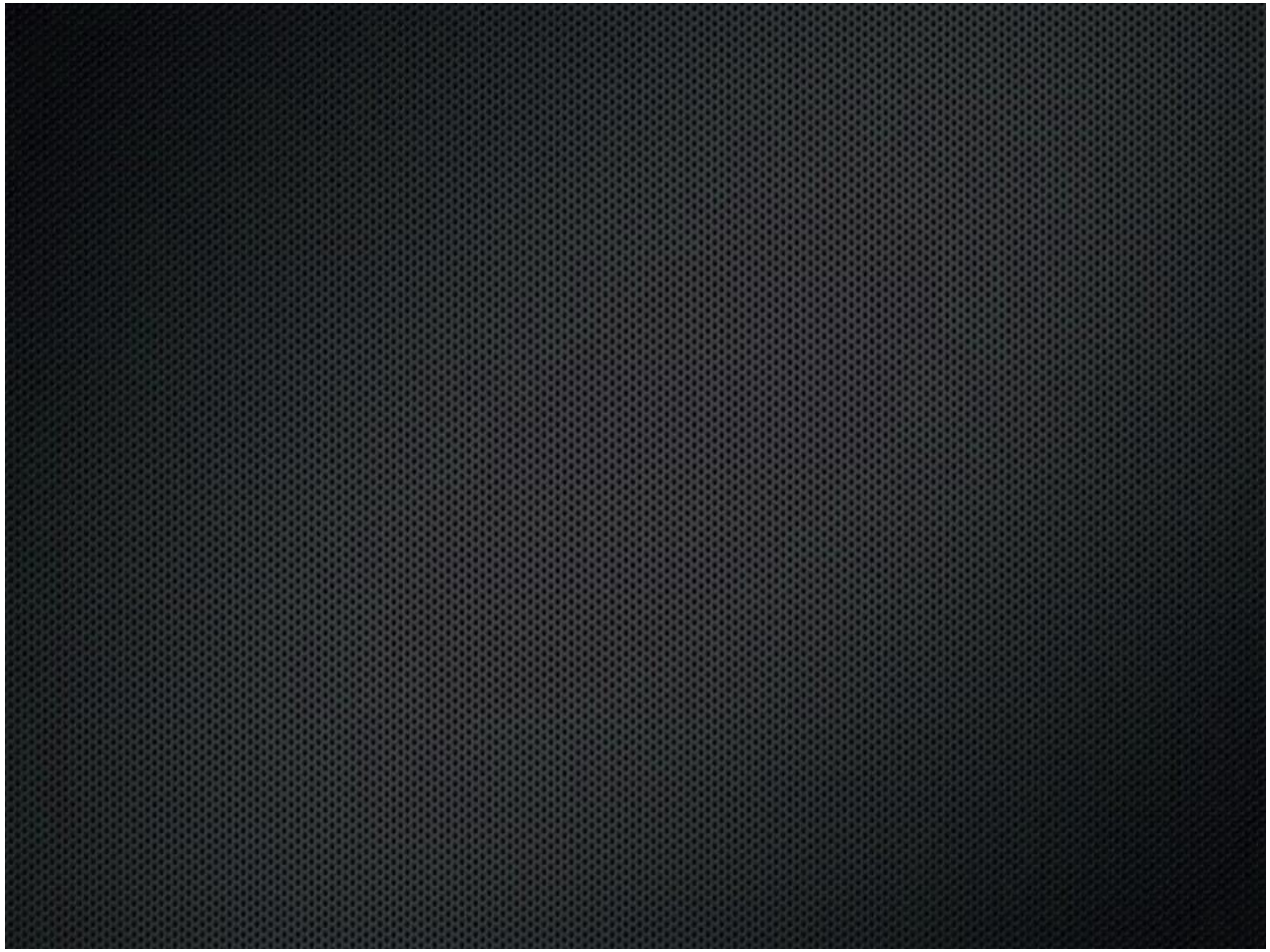
# Wounded Warrior Home


# Promote Reintegration


[redacted]

# KitchenBot – Increasing independence for cooking and cleaning - video



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# We must work together

"... a life with a disability is still a life after all, to be enjoyed and lived to the fullest."

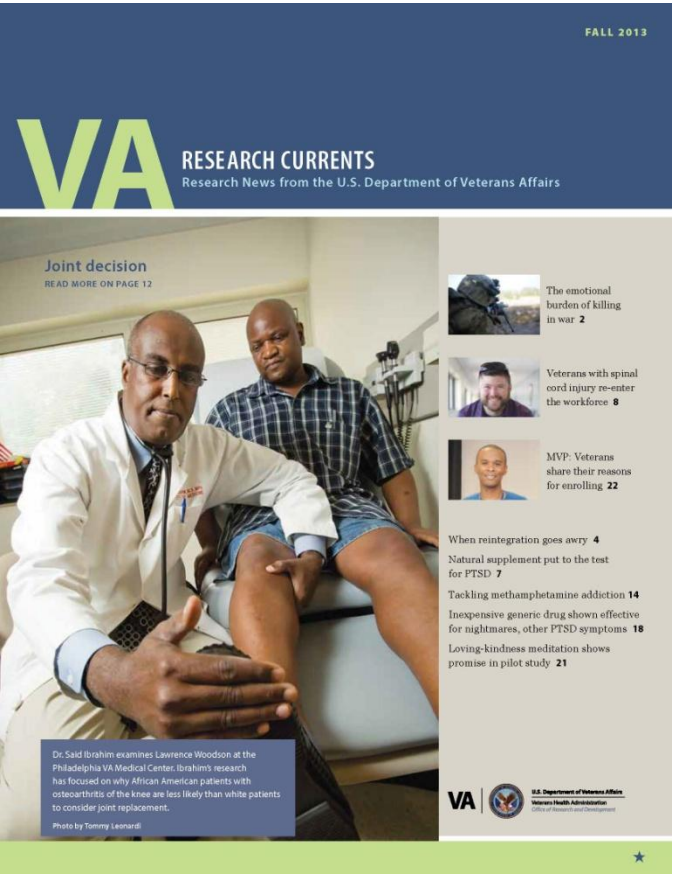
— HolLynn D'Lil
Mainstream, *magazine of the able-disabled, November 1997*

putting lives in motion

At the Center for Assistive Technology (CAT), we know that living with a disability brings changes. Disability need not prevent you from enjoying the life you want to live. The team of professionals at CAT provides innovative solutions for individuals with disabilities who need assistive technology for mobility, hearing, speech, and other everyday needs.

A joint program of UPMC and the University of Pittsburgh, CAT has emerged as a leader and innovator in the assistive technology industry. CAT is located on UPMC's Oakland campus in Pittsburgh and offers services at sites throughout the region. Whatever your assistive technology needs, CAT can provide you with a bridge to independence and an opportunity to live life to the fullest.

UPMC Center for Assistive Technology page 2




# Research lab **offers job training** for wounded warriors

A joint research program between VA and the University of Pittsburgh that studies wheelchairs and related technology is now helping to train disabled Veterans for careers in machining.

The program is called Fabrication of Assistive Technology Program for Wounded Warriors. It's run by the Human Engineering Research Laboratories, a collaboration between the VA Pittsburgh Healthcare System and the University of Pittsburgh School of Health and Rehabilitation Sciences.

The program is being launched this fall with the help of a $100,000 donation from Highmark Blue Cross Blue Shield.

Created by director Rory Cooper , PhD, and education and outreach project director Mary Goldberg at HERL, the program will prepare participants to pass a basic machining exam. The participants will also get on-the-job training at local companies, which could lead to permanent, full-time jobs.

To learn more about HERL, visit www.herl.pitt.edu. ★




**1. Shop supervisor Garret Grindle** shows Veteran Keniel Martinez how to smooth the burrs on a stainless steel plate.

**2. Veterans** (from left) Keniel Martinez, Shawn O'Donnell, Artem Lazeckin, Gary Rethage, and Adam Benjamin Campbell listen to Garrett Grindle explain how to operate a drill press.

**3. Veterans Michael Malloy and Keniel Martinez** watch as Grindle demonstrates a task on the drill press.

Photos by Bill George

# Contact information

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**Adversity → Advantage**

**$A^4$**

**Action → Accomplishment**