SWARM VISIONS
SWARM AND MEDICAL APPLICATIONS:
TECHNOLOGY TO ASSIST INDIVIDUALS WITH DISABILITIES

Swarm Visions Symposium
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“It was much nicer before people started storing all their personal information in the cloud.”

and medical
OTHER DOCS ASKED: NOW...WHAT'S A SWARM???

- Much innovation and opportunities
  - Clinical care
  - Medical and translational research
  - Important and useful products
  - Innovative and creative solutions

- Importance of communication and collaboration
  - across different domains of science and medicine
**DISABILITY IN THE U.S.**

- **54 million** Americans with at least one disability (2005)
- **35 million** with “severe” disabilities
- **11 million** requiring assistance with basic ADLs
- **5.5 million** children with disabilities

<table>
<thead>
<tr>
<th>Impairment Classification/Domains</th>
<th>U.S. prevalence in 2005, in millions</th>
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</thead>
<tbody>
<tr>
<td>Hearing Impairment</td>
<td>7.8 (1.0 million with severe hearing loss)</td>
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<tr>
<td>Vision Impairment</td>
<td>7.8 (1.8 million with complete vision loss)</td>
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<tr>
<td>Speech Impairment</td>
<td>2.5 difficulty with speech being understood</td>
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<tr>
<td>Cognitive, Mental, Emotional Impairment</td>
<td>16.1 (9.6 million with cognitive impairment)</td>
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<tr>
<td>Lower body impairment</td>
<td>27.4 (10.2 significant mobility difficulty)</td>
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<tr>
<td>Upper body impairment</td>
<td>19.0 (12 difficulty reaching overhead)</td>
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COMPLEXITY AND DIVERSITY OF DISABILITIES ACROSS LIFESPAN AND ENVIRONMENTS

- Individuals often with multiple disabilities
- Disabilities change across lifespan
- Impacted by environment (home, school, work, leisure)

- Additional challenges for the future:
  - Aging population (+48 million >65 from 2010 to 2050)
  - Increasing chronic illness and disabilities with aging
  - Increasing cost of care (> 3-5x for those over 65)
  - Estimated direct health care cost increase 25% by 2030
  - Indirect cost >$3.4 Trillion by 2023 (lost productivity, work time)
  - Shortage of caregivers, medical professionals, and therapists
    - Physician: 125,000 by 2025
    - Nursing: 500,000 by 2025
    - PT, OT, and speech therapy jobs demand + 105,000 by 2018
NEEDS → OPPORTUNITIES

- Population Aging
- Chronic Disease Incidence
- Economic Constraints
- Caregiver Shortages

Growing number of persons with disabilities

Fewer resources to support persons with disabilities

Need new ways for patients, families, and caregivers to help themselves in community settings
SO... HOW CAN TECHNOLOGY ASSIST INDIVIDUALS WITH DISABILITIES?

WHO ICF

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH)
**SWARM VISION:**

PROPOSED EVOLUTION OF TECHNOLOGY
TO ASSIST INDIVIDUALS WITH DISABILITIES

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
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<tbody>
<tr>
<td>Individual Devices</td>
<td>Integrated Environments</td>
</tr>
<tr>
<td>One Person, One Need</td>
<td>Many People, Many Needs</td>
</tr>
<tr>
<td>Fixed Functions and Configuration</td>
<td>Flexible and Adaptive Tools</td>
</tr>
</tbody>
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Swarm and Disability

Goals:
- Harness the power of inter-connected devices and sensors
- Adapt input-output modalities to the capabilities (or lack thereof) of the user
- Improve function and independence

Projection: 1000 radios per person on Earth by 2025
TRILLIONS OF CONNECTED DEVICES

[J. Rabaey, ASPDAC’08]
THE ROLE OF THE ‘SWARM’ IN THE INTERACTION WITH INDIVIDUALS WITH DISABILITIES

1. Assessment of Capabilities and State
2. Adaptation of I/O modalities to support desired interaction
SWARM VISION:

POTENTIAL OF THE **SWARM and UNPAD CONCEPTS** TO BENEFIT INDIVIDUALS WITH DISABILITIES

- **personalizable** — responds to and matches to the needs and capabilities of a given individual;

- **adaptive** — adjusts based on the evolving capabilities of the individual and environment over time and space;

- **scalable** — serves a broad population of disabilities, and is open to the inclusion of new capabilities and technologies when they become available.