A Design approach to gerontechnology --
Bring research to daily living

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3G’s for the aged society: Gerontology, Geriatrics, Gerontotechnology

• It is only natural to consider applying technologies for the care of older adults…

• First International Congress on Gerontotechnology, 1991
• International Society for Gerontotechnology, 1997

“Design technology and environment for independent living and social participation of older persons in good health, comfort and safety”

• Scope of Gerontotechnology: Health, Housing, Mobility, Communication, Leisure, Work
Gerontechnology is only valuable if we can bring research to daily applications.

A design approach to gerontechnology:
Creativity ➔ Prototype ➔ Products ➔ Sales

Mission: To carry out a successful industrial and educational experiment
One day when Zeng was out cutting wood among the mountains, there came a visitor to his house. After awaiting her son’s return in vein, his mother bit her finger.

Zeng felt heartache all of a sudden and knew there was an emergency. He rushed back home with a burden of wood, and on arrival, knelt down to asked his mother what happened. His mother replied, “Here is a visitor who needs you urgently. So I bit my finger to awake you to come back…”

From the “24 stories of filial piety”
Zeng was a disciple of Confucius 2,500 years ago…

THE BEGINNING OF TELEHEALTH…
Why are technological products not used for caring the older adults?
Persuasive technology: How technology is designed to change behaviors of the users

- A new behavior was created in 2007
- User Centered Design: Need ≠ Motivation

More fun than functions…

Fogg Behavior Model

\[ B = \text{mat} \]

at same moment

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If telehealth systems connect older adults with family members

The son is the trigger… Care, interaction, connection, in addition to health monitoring
Bringing research to daily applications: More DESIGN THINKING!

- Empathy: User centered, persona…
- Define the right problem: What, how, why
- Think like a boss… (not like a professor…)

Proud to be a designer!

IDEO (http://www.ideo.com) CEO Tim Brown
Supporting the caregivers --

Use smart technologies to provide real-time status and long-term patterns of the older adults

According to the “Basic Survey on Employment Structure,” by Ministry of Internal Affairs Japan, the number of employees who left work because of caring or nursing was 99,100 during the year from October 2016 to September 2017.
Transfer familiar artifacts in the homes into IoT devices

- **WhizPad** is an extremely comfortable mattress capable of motion sensing
- Pressure-relieve material for prevention of pressure ulcer

- In Taiwan 2017, 22.5% hospital falls occurred when patients leave the beds
- Three-stage leave bed alert (sit-up, sitting at the side, leave bed) for fall prevention.
- Four sensing areas / rule based
- Private cloud IoT
2nd generation: Machine Learning to capture the intention of leaving bed

- 1000+ learning samples from 31 testers in 7 weight groups
- 30 sensing areas, classification of Lying/sitting/left edge/right edge

**Edge AI:** NeuralNet model deployed on chip
  - Testing accuracy: 96.0% (360 test examples)

- Individual patient management
  - 3-stage leave bed alert
  - Long pressure area alert

- Using 2 AAA batteries

- Amazon Web Service (AWS) for data storage and **Cloud AI:** Daily living pattern, sleep quality…
Motion sensing WhizCarpet: Fall detection and mobility monitoring

- Easy and flexible set up; soft surface reduces risk of fracture when falling
- Real time position display, fall detection and alert
- Mobility and pattern analysis, abnormal pattern alert
- Wandering behavior, path, hot spot analysis of demented patients
Bluetooth IoT gateway WhizConnect: AIoT bedroom integrating Bluetooth products

- Environmental data
- Vital signs
- Long term health and living pattern
- Real time status and event alerts

WhizConnect

WhizSeries
**WhizTouch: IoT call button for bedridden older adults**

- Big button; mobile phone as receiver; green light to confirm the call
- But…

**IoT care products at home?**

- Internet usage is low for older adults (31.1% /8.6%@2018). **High monthly fee for Internet service is not acceptable.**
- Connecting the IoT product to home Wi-Fi AP has been a major **usability issue**; **Wi-Fi coverage** is often poor in bedroom
- **LPWAN:** Sigfox, LoRa?

**Narrow Band IoT: the last mile**

- Sim card connects directly to NB-IoT base station; used anywhere without setup
- NB-IoT based *WhizConnect* to bring smart homecare products to the homes…
Serious games for non-pharmacological intervention for preventing cognitive decline in older adults
Non-pharmacological intervention appears to be effective…

• … in reducing behavioral and psychological symptoms of dementia (BPSD).

• Physical activity (PA) programs for older adults could integrate challenging cognitive exercises to improve cognitive health.

• In an meta analysis of 41 studies, combined PA + CA (cognitive activity) intervention showed significantly larger gains in cognition relative to the control group. (Gheysen et. al, 2018)

<table>
<thead>
<tr>
<th></th>
<th>Cognitive</th>
<th>ADL</th>
<th>BPSD</th>
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<tbody>
<tr>
<td>Cognitive training</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Cognitive rehabilitation</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Cognitive stimulation therapy</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Snoezelen/multisensory</td>
<td>+</td>
<td>+</td>
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<tr>
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<td>+</td>
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<tr>
<td>Reminiscence therapy</td>
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<tr>
<td>Physical activity</td>
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<tr>
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<td>+</td>
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<tr>
<td>Music therapy</td>
<td>+</td>
<td>−</td>
<td>+</td>
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<tr>
<td>Animal-assisted therapy</td>
<td>−</td>
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Takeda et al. (2012)
What are the values brought by technologies?

(1) Combining physical exercise, cognitive training, and multi-sensory stimulation.
(2) Caregivers can choose and design games suitable for older adults

- Chasing game
- Mahjong matching
(3) Generate and record data that could be helpful to elderly care

- **Timed up and go (TUG)**
  - 3 meters

- **Time (sec), step length (cm), cadence (steps /min), difference in left and right steps (%)**

- **Error within 5%**

<table>
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<th>Age</th>
<th>Seconds</th>
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<tr>
<td>60-69</td>
<td>7.9 +/- 0.9</td>
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</tr>
<tr>
<td>70-79</td>
<td>7.7 +/- 2.3</td>
<td></td>
</tr>
<tr>
<td>80-89</td>
<td></td>
<td>11.0 +/- 2.2</td>
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<tr>
<td></td>
<td></td>
<td>With accessories: 19.9 +/- 6.4</td>
</tr>
<tr>
<td>90-101</td>
<td></td>
<td>14.7 +/- 7.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With accessories: 19.9 +/- 2.5</td>
</tr>
</tbody>
</table>

(Lusardi et. al, 2003)
To make some sense out of the performance in, Whack-a-Roach

• 30-second chasing game (Whack-a-Roach)
• Collect scores from 73 participants
  ♦ 54-69 years old : N=39
  ♦ 70~92 years old: N=34
• Normal distribution for 70-92 years old
• For whacking 11 roaches: 65%
What is the trigger for older adults?
“Pillow Fight”, 3rd Place in Stanford Center on Longevity Design Challenge

- Intergeneration game: Changed video game controllers to familiar household items - pillows, enabling older adults and children to play together by punching the pillow.

GRC Deputy Director Prof. CK Lim and students presenting “Pillow Fight” at Stanford, April 2019
We are designers!
UX: User Experience Design

Find that Trigger — Caregivers are the best designers!

The future world needs transdisciplinary talent

Transdisciplinary learning
Real world problem and experience

Thank you
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Call for abstracts, due Friday, November 15, 2019