Auto cue system for the person with Mild Cognitive Impairment

Team SNAIL

Dr. jiro SAGARA : Kobe Design University
Dr. Kiyohiro OMORI : Hyogo Assistive Technology Research Institute
Dr. Rumi TANEMURA, Dr. Toru NAGAO, Dr. Kazue NODA : Kobe University
Situation in Japan

• The Aging Ratio = 28.1% in 2018
• Expected 30%+ in 2025
• Dementia 4.62 million in 2012, expected 7 million in 2025
• Around 20% of elderlies will be dementia in 2025
To be dementia is fear for everyone

Alzheimer disease

Core symptoms
- Memory loss
- Loss of judgement
- Dysfunctional behavior
- Disorientation

BPSD: Behavioral and Psychological Symptoms of Dementia

- Wondering
- Fantasm
- Depression
- Sleep disorder
- Dirty action
- Angor
- Insecure
- Violence
- Anxiety
Countermeasures in Japan

**Pre**
- Prevention
- Cognition + Exercise, Drills for simple task as like as kids

**MCI**
- ???

**Post**
- Care
- Institution or Hospitalization
- Reminiscence therapy
Memory loss causes

• Make some troubles by the memory loss
• Forgot kitchen stove by interruption such as phone call or delivery, then Burn the pot on the stove
• Outing without key, Wallet or mobile phone
• Outing with some aim, however lost it, destination and way to home

Do nothing !!

Disuse syndrome
Hypothesis

• If some advice or cue by someone such as secretary or steward, person with dementia may do a lot of things
• Never order, urge or scold
• Just Tell the situation to ensure making decision
Problems found in interviews

a) Problems which may be covered by auto cue
b) Auto cue may be effective but not so urgent
c) Important problems but not solved by auto cue
d) Unnecessary or unrelated
Modeled auto cue scenarios

1) At the entrance, confirm appropriately dressed in outing
2) At the entrance, tell outdoor climate
3) At the entrance, detain according to time zone
4) In the kitchen, tell which door of fridge was opened, and forgot to close
5) In the kitchen, fire on the stove burning
continue

6) In the living room, tell out of range of temperature and humid to evoke proper control of air-conditioner
7) In the living room, evoke tooth brushing after meals
8) In the toilet, tell forgot flushing.
9) In the bedroom, evoke toileting before sleep
10) In the bed, advice try to be asleep according to time
Additional one

• PWD tend to forgot important items and doubt relatives or care staff may take away it
• Keep important items in the definite place

11) In the living room or in the hall, evoke to put wallet or porch in the definite area for example in the definite basket.
MESH IoT kit by SONY

1: Push button switch
2: LED
3: 3 axis motion sensor
4: IFR human body sensor
5: Light sensor
6: Temperature & Humid
7: GPIO General Purpose Input and Output
We adopt these 5 tags

Light : Human : Motion : Temp & Humid : GPIO
Trial in the model house @ Hyogo Rehab.
Example of auto cue: at the entrance

1) Door of the living room open
2) Human detected at the hall
3) Choose message according to Temp of outdoor, time
Questionnaire to the 53 visitors

Responders feature

<table>
<thead>
<tr>
<th>Ages</th>
<th>25-44</th>
<th>45-64</th>
<th>65-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>20</td>
<td>20</td>
<td>13</td>
</tr>
</tbody>
</table>

Relationship to the dementia

<table>
<thead>
<tr>
<th>Relationship</th>
<th>In the job</th>
<th>As a family</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>42</td>
<td>22</td>
<td>48</td>
</tr>
<tr>
<td>No</td>
<td>10</td>
<td>29</td>
<td>5</td>
</tr>
<tr>
<td>N/A</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Responses for the trial

- **Usefulness**
  - Useful: 36
  - Neither: 13
  - Useless: 2

- **Loudness of the message**
  - Appropriate: 41
  - Small: 6
  - Loud: 3

- **Timing of the message**
  - Appropriate: 38
  - Slow: 6
  - Fast: 4
Useful auto cue scenarios

- Entrance/dresses
- Entrance/outing at...
- Refrigerator door
- Stove
- Temperature
- Tooth blushing
- Toilet flush
- Toilet before asleep
- Bed time to sleep
Long term test in real dwellings

• The three volunteers test the Mesh Auto cue system three months each
  • Subject A: 82 yo Male with MCI
  • Subject B: 87 yo Female with Dementia
  • Subject C: 76 yo Male with Higher Brain Dysfunction
Types of dwellings

• Subject A: Live with spouse in detached house in sub-urban area

• Subject B: Live with sun’s family detached house in rural area

• Subject C: Live alone in urban apartment house
Auto cue in subject A

- Ensure locking the front door when outing
- Flush at toilette
- Doors of fridge are left open
- Ensure locking the front door when go to bed
Algorithm at front door

• Step 1: IFR sensor detect the person come out
• Step 2: Light sensor detect the room light off
• Step 3: Say “Good night, ensure locking the front door please”
• Step 4: Sleep 10 minutes to inhibit repeatable message >>> added in the trial
Demonstration by Dr. Kiyohiro Omori

Good night, please ensure locking the front door
Auto cue in subject B

• Confirm the Day Service in the Breakfast
• Confirm took medicine before the lunch
• Tell the power of the KOTATSU (heating device) when go to bed

>>> Abundant with MESH Tag

• She has hearing loss, so we adopt lighting speaker to catch her attention
Demonstration with daughter in law

Granma, Today is the day for day service, please go there
Auto cue in subject C

- Confirm the lock of front door
- Flush at toilette
- Door of refrigerator
Welcome back, ensure locking the door, please
Results in install

• Subject A:
  • The toilet door left open or not flushed sometime intendedly
  • Adjustment of timing or volume of cue message
  • Some Tags dropped after house keeping (Tags are settled by adhesive tape)

• Subject B:
  • Answer ‘Yes’ for the cue, consequently lost the continuing message
  • Added the jingle, and renewed the message

• Subject C:
  • Do not close the toilet door to hear the phone call or door bell
  • Incorrect action, sometimes stay sit on the toilet after flush it
  • Nervous in making sound worry about neighbors

• Adjustment required according to not only the layout but also the life style
Result: Is it useful?

1: Useless  2: Slightly Useless  3: Not Sure  4: Slightly Useful  5: Useful

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Install</th>
<th>A month</th>
<th>2 month</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front door</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Toilet Flush</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Fridge Doors</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Go to bed</td>
<td>3</td>
<td>1</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>Subject B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Lunch</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Subject C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front door</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Toilet Flush</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Fridge Door</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Result: Other

- It is pleasure to hear the voice of sun or grandchild
- Feel sense of security for the housemate
- Subject C (HBD): It is meaningful for the person with short term memory disorder, that confirm the lock at the front door, as forgot thing when some interrupt occurred

- Definite useful example: Stay opened fridge door in Subject B
Limitation of the MESH Tags

- The MESH tags are designed for experiment or educational trial
- The buttery drops rapidly
- No sensor for the fire on the stove
- The tablet such as iPAD is not suit for this purpose
- Bluetooth connection dropped in long term use between MESH tags and iPAD, it need continuous communication.
- The screen of the tablet may get PWD’s hooks into
IoT device for the system

- Door sensor with magnet switches and ESP8266
IoT device for the system

- Outdoor climate sensor
- ESP8266 by Espressife with BME280
- Jacked into Solar Lantern
The Basket and the Porch

- **Basket**
  - Pressure Sensor or IFR distance sensor
  - ESP-8266

- **Time&In/Out**

- **Porch**
  - TWE-Lite2525A

- **IEEE802.15.4**

- **LQI [0-255]**
  \[ \frac{1}{\text{Distance}} \]

- **LQI**
  - \( LQI < n1 \): far away
  - \( LQI > n1 \): approaching
  - \( LQI > n2 \): near
  - \( LQI > n2 \) and Sensor on -> In
Prototype

ATP2012 voice synthesizer
TWE-Lite

Digital Amp
ESP8266

TWE-Lite 2525A
Thank you for your patience

Acknowledgement

• This research is supported by grants-in-aid scientific research by Ministry of Education, Culture, Sports, Science and Technology, Japan as 25282008, 22615047 and 16H03024.

• Professor Louise Nygård in Karolinska Institute, and their post-Doctoral students exchange useful information in discussing cross-cultural survey.

• Kobe Design University, Kobe University and the Hyogo Institute of Assistive Technology Research Institute gave us research resources and time for execution of this research.

• All subjects of our interview and long term test gave us a lot of valuable information or suggestions.

• The authors would also express gratitude to all of them.