COGNITIVE ASSESSMENT IN VIRTUAL ENVIRONMENTS
HOW TO CHOOSE THE NATURAL USER INTERFACES?

Dr Florian MARONNAT (M.D, PhD student)
Frédéric DAVESNE
Pr Samir OTMANE
Conflicts of interests

None
Alzheimer’s disease

- 1907: first description by Aloïs Alzheimer
- 2015
  - 47 million of patients
  - 723 billion €
  - Gross domestic product n°18
  - No treatment
- 2050
  - 132 million of patients
  - 1 767 billion €
  - GDP n°9

Scheltens and al, 2002
Cognitive assessment

- Numerous paper tests
  - Mini Mental Status Examination (MMSE)
    - Folstein and al, J Psychiatr Res (1975)
  - Montréal Cognitive Assessment (MoCA)
  - Five words of Dubois (F5D)
    - Dubois B and al, Presse Med (2002)
New evaluation tool


⟨hal-03404812⟩
New evaluation tool

- New immersive virtual tool
- Cognitive assessment based on MMSE, MoCA, and F5D
- Find the most adapted Natural User Interactions for older adults with cognitive impairment

Navigation  Manipulation  Selection  Application control
Choice of material

## Choice of material

<table>
<thead>
<tr>
<th>Desired characteristics</th>
<th>Characteristics of OQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full immersion</td>
<td>Six degrees of freedom</td>
</tr>
<tr>
<td>Possibility of <strong>appearance of hands</strong></td>
<td>Two touch controllers with four integrated cameras</td>
</tr>
<tr>
<td>Sounds compatible with hearing impairment or <strong>hearing aids</strong></td>
<td>3D positional audio directly broadcasted from the headset</td>
</tr>
<tr>
<td><strong>Compatible with glasses</strong> (vision impairment)</td>
<td>OLED screen</td>
</tr>
<tr>
<td>Own storage</td>
<td>1440 x 1600 Resolution Per Eye</td>
</tr>
<tr>
<td>Free movements (<strong>no cables</strong>)</td>
<td>72 Hz Refresh Rate Supported</td>
</tr>
<tr>
<td>Could be proceeded while sitting</td>
<td><strong>Glasses Compatible</strong></td>
</tr>
<tr>
<td><strong>Low weight</strong></td>
<td>128 GB</td>
</tr>
<tr>
<td></td>
<td>Battery included</td>
</tr>
<tr>
<td></td>
<td>Possible</td>
</tr>
<tr>
<td></td>
<td>Less than 600 grams</td>
</tr>
</tbody>
</table>
Welcome and training task

- Discover the environment
- Discover the material
- Test the interactions
- Oral instructions
Welcome and training task

**Navigation**

**Body's movements and gaze directed**

**Virtual hand**

**Selection**

**Manipulation**

**Virtual hand**

**None**

**Application control**
Orientation task

- **Original task:** Spatio-temporal orientation
- **Natural action:** Oral answers
- **Virtual action:** Selection of items
Orientation task

- Navigation
- Body's movements and gaze directed
- Virtual hand
- Selection
- None
- Manipulation
- None
- Application control
Attention tasks

- **Original task:** Calculation
  - **Natural action:** Oral answers
  - **Virtual action:** Selection of items

- **Original task:** List of letters
  - **Natural action:** Movements
  - **Virtual action:** Push on a button

- **Original task:** Number series
  - **Natural action:** Oral answers
  - **Virtual action:** Selection of items
Attention tasks

- Navigation
- Selection
- Manipulation
- Application control

Body's movements and gaze directed

Virtual hand

None

Virtual hand
Language tasks

- Original task: Name objects
- Natural action: Oral answers
- Virtual action: Selection of items

- Original task: Written order and lecture
- Natural action: Movements and writing
- Virtual action: Selection and movements of items
Language tasks

- **Navigation**
- **Selection**
- **Manipulation**
- **Application control**

**Body's movements and gaze directed**

**Virtual hand**

**None**

**Virtual hand**
Praxis task

- **Original task:** Drawing
- **Natural action:** Draw a figure
- **Virtual action:** Selection and movements of items
Praxis task

Navigation

Body's movements and gaze directed

Virtual hand

Selection

None

Manipulation

Virtual hand

Application control
Abstraction task

- **Original task:** Find the similarity between items
- **Natural action:** Oral answers
- **Virtual action:** Selection and movements of items
Abstraction task

Navigation

Body’s movements and gaze directed

Virtual hand

Selection

None

Virtual hand

Manipulation

Application control
Memory task

- Original task: Remembering five words
- Natural action: Oral answers
- Virtual action: Selection of items
Memory task

Navigation

Body's movements and gaze directed

Virtual hand

Selection

None

Manipulation

Virtual hand

Application control
Executive functions tasks

- **Original task:** Logical sequence
- **Natural action:** Draw lines
- **Virtual action:** Selection of items

- **Original task:** Clock test
- **Natural action:** Draw a clock (figures and arrows)
- **Virtual action:** Selection of items
Executive functions tasks

- **Navigation**
- **Selection**
- **Manipulation**
- **Application control**

- **Body's movements and gaze directed**
- **Virtual hand**
- **None**
Discussion and conclusion

- OQ already used in cognitive assessment
- Autonomous system
- Based on classical tests
- Several cognitive functions

- Use of hand controllers
- Limits in speech recognition
- No writing function
- Reading tasks
- Untested among an elderly population