Virtual Promenade: A New Serious Game for the Rehabilitation of Older Adults with Post-fall Syndrome


4th IEEE International Conference on Serious Games and Applications for Health (SeGAH), Orlando, USA – May 13th 2016
Motivations

• 35% of people in developed countries will be over 60 by 2050
• Falls cause many deaths and disabilities in older adults
• 35 to 40% of older adults over 65 fall at least once a year
• 10% of fallers get seriously injured
• Psychological consequences are often neglected in care practices
Outline

1. Motivations
2. Post-fall syndrome
3. Living lab participatory design
4. System description
5. Preliminary study
6. Designing the VP game
7. Conclusion, latest evolutions and future work
Post-fall Syndrome (PFS)

- Psychological and psychomotor consequences of falls:
  - Fear of falling
  - Psychomotor disadaptation syndrome
- PFS resembles post-traumatic stress disorder (PTSD)
- Virtual reality has proved useful in treating PTSD and phobias

Can virtual reality help treat PFS?
Living-lab participatory design

• Iterative design cycle

• Basic principles:
  o Openness
  o Influence
  o Reality
  o Value creation
  o Sustainability

• Fast prototyping

Figure 1 – Living lab design cycle
System description (1/2)

• System features:
  o Repurposed chair with moving seat by Backwell (Israël)
  o Virtual strolling game

• Game development in Unity using ready-for-use graphical assets for fast iterations

Figure 2 – The Virtual Promenade system
System description (2/2)

Figure 3 – Virtual Promenade system setup

Figure 4 – Screenshot of the game

Figure 5 – Game controllers used in the study

Flight simulator controller
Arcade-like controller
Sony Playstation controller
Nintendo 64 controller
Preliminary study

- **Goal:** Assess feasibility and check for safety and acceptance
- **Participants:**
  - 4 males, 4 females
  - 81 < age < 94 (mean = 87.4)
  - Mean MMSE score = 25.8
  - Moderate or severe gait disorder
  - 5 with fear of falling
- **Tried moving chair and virtual reality separately**
- **Results:** no pain; no nausea; positive feedback; no obstacles to deployment

*Figure 6 – The game used in the preliminary study*
### Serious game participatory design

- Start with one environment, one avatar and one controller
- Participants: 8 women over 80 (1 with PFS)
- Evolutions through testing:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Response</th>
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<tbody>
<tr>
<td>City environment is unwelcoming</td>
<td>Added forest and park environments</td>
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<td>Players did not identify with the avatar</td>
<td>Added 7 extra character models</td>
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<td>Flight simulator joystick is too stiff</td>
<td>Added support for other game controllers</td>
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<td>Older adults need time to familiarize with the controls</td>
<td>Added tutorials explaining how to play and give players time to adapt</td>
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<td>Players keep moving their avatar when they are supposed to read instructions</td>
<td>Freeze the avatar when instruction text is on</td>
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Visuals from the game

Figure 7 – Top left: city; top right: forest; bottom left: tutorial; bottom right: characters’ faces renderings
Game contents after iterations

• Tutorial level explaining how to control the avatar and the game mechanics of path following through cube collection
• Free strolling in the forest environment
• Cube collection task in the park environment
• City level still available with cube collection task
Conclusions

• Novel method to tackle PFS through virtual reality exposure
• Well-tolerated and deployable in hospital environment
• Players enjoyed the experience
• Virtual environments’ aesthetics are important to older adults
• No perfect fit for the game controller
Latest evolutions

• Spotting other design issues:
  o Playtesting session with 9 older adults
  o Focus group with physiotherapists
  o Focus group with psychomotricians
  o Physicians’ requirements
  o Testing with 6 hospitalized older adults with cognitive impairment and PFS

• Changes made:
  o Added a level with single directional axis control
  o Flattened path in forest environment
  o Split tutorial in three parts (one before each level)
  o Added “easy” mode for people with cognitive impairment
Future work

• Prototype validation study (ongoing)
• Randomized controlled study to assess PFS treatment efficacy and long-term benefit
• Explore other interaction modalities
• Enrich game mechanics with other activities, NPCs (pedestrians) and moving objects (cars)
• Include a virtual coach/therapist?
Demo video

Available at https://youtu.be/5kFZ2z3d7rs
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