

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

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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:
 - Openness
 - Influence
 - Reality
 - Value creation
 - Sustainability
- Fast prototyping

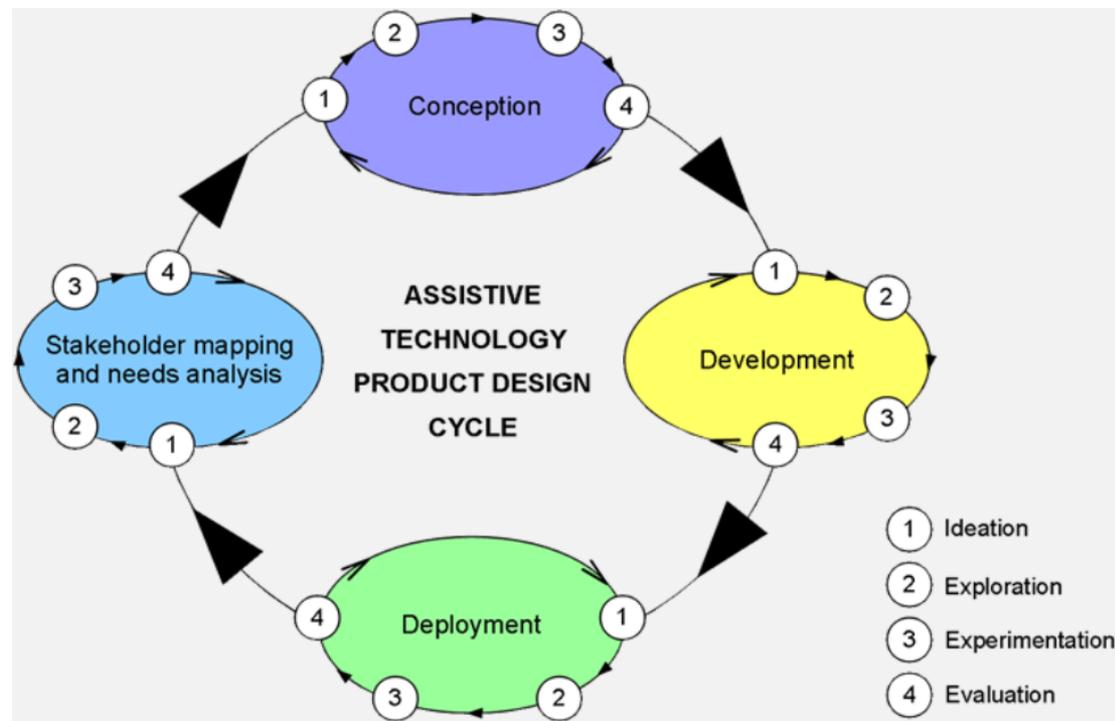


Figure 1 – Living lab design cycle

System description (1/2)

- System features:
 - Repurposed chair with moving seat by Backwell (Israël)
 - Virtual strolling game
- Game development in Unity using ready-for-use graphical assets for fast iterations

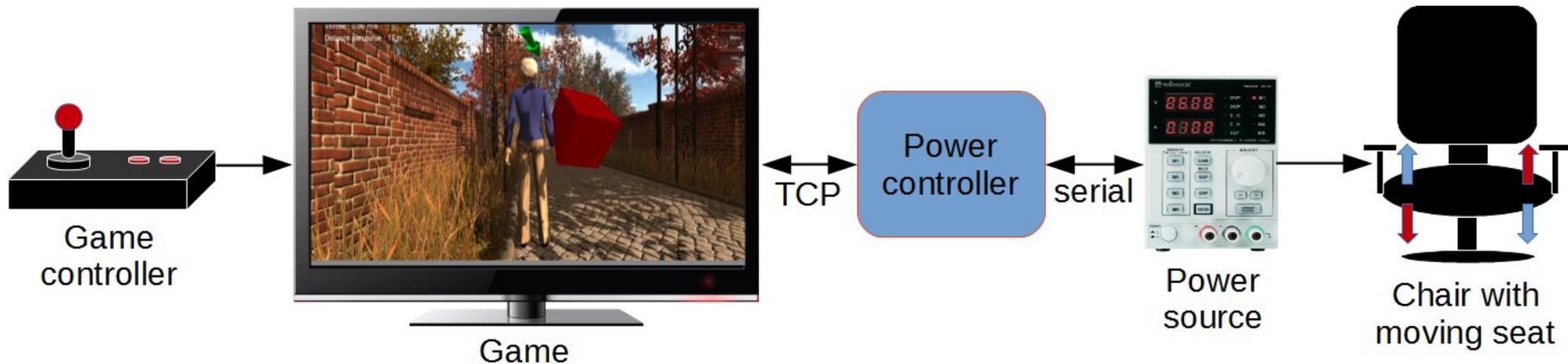


Figure 2 – The Virtual Promenade system

System description (2/2)



Figure 3 – Virtual Promenade system setup



Figure 4 – Screenshot of the game



Flight simulator controller



Arcade-like controller



Sony Playstation controller



Nintendo 64 controller

Figure 5 – Game controllers used in the study

Preliminary study

- Goal: Assess feasibility and check for safety and acceptance
- Participants:
 - 4 males, 4 females
 - $81 < \text{age} < 94$ (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:

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

Visuals from the game

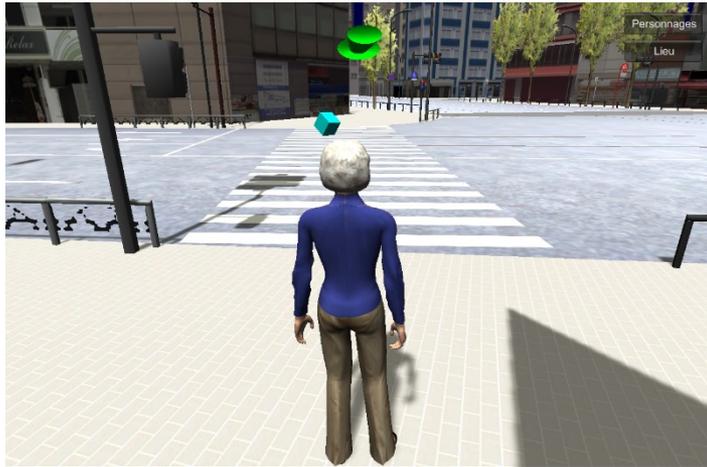


Figure 7 – Top left: city; top right: forest; bottom left: tutorial; bottom right: characters' faces renderings

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:
 - Playtesting session with 9 older adults
 - Focus group with physiotherapists
 - Focus group with psychomotricians
 - Physicians' requirements
 - Testing with 6 hospitalized older adults with cognitive impairment and PFS
- Changes made:
 - Added a level with single directional axis control
 - Flattened path in forest environment
 - Split tutorial in three parts (one before each level)
 - 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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