An Immersive Virtual Reality Exergame for People with Parkinson's Disease

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Background

- Neurodegenerative disease

- Affects 7-10 million people worldwide

- Affects primarily motor system, but also memory and executive functions

- The disease progresses as the patient ages

- Currently no cure

- Physical exercise can be beneficial

However, exercise adherence is challenging

Benefits of Virtual Reality exergames

- Provide a motivating and engaging interactive environment

- Allow for individualized skill practice

- Improve motor functioning, balance and coordination, cognitive function and quality of life (Triegaardt, et al. 2019)

However, current VR exergames for people with PD have limitations

Limitations of current VR exergames

- Off-the-shelf VR games focusing on gait and balance training

- Lack of custom-made VR exergames specifically addressing PD patients' needs
  - Skill specific exercises
  - Stage of the disease

- Lack of immersive experiences

An immersive VR exergame

- Fine motor training on fingers and hand-and-eye coordination

- Early-stage Parkinson's disease

- HTC vive
 - Head-Mounted Display (HMD)
 - Two wireless handheld controllers

Design and development

- Focus group interview
  - 20 people with PD and 7 healthcare workers

- Design considerations from literature
  - *Meaningful play* and *challenges* for engagement (Burke, et al. 2009)
  - Five challenges in virtual reality exergame design (Shaw, et al. 2015)

- Iterative process

Shoot the balloons

- Sitting down position

- Game showing balloons in different colours

- Player moving the controllers to target the laser on the balloons

- Player using finger to press the trigger and shoot

- Visual and haptic feedback without noticeable delay
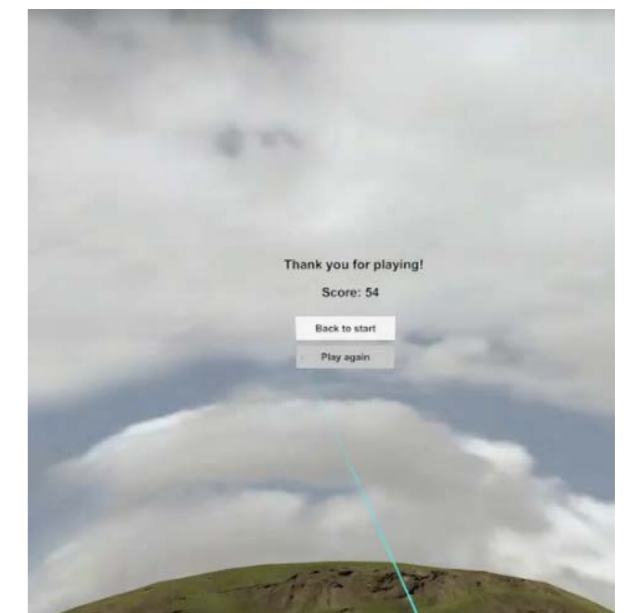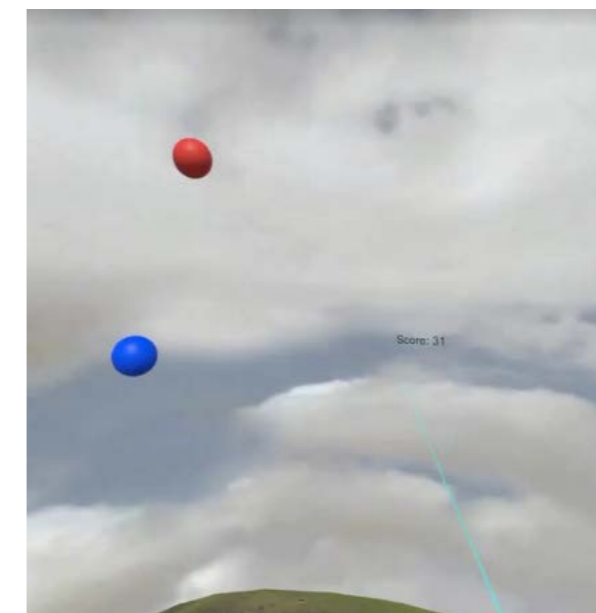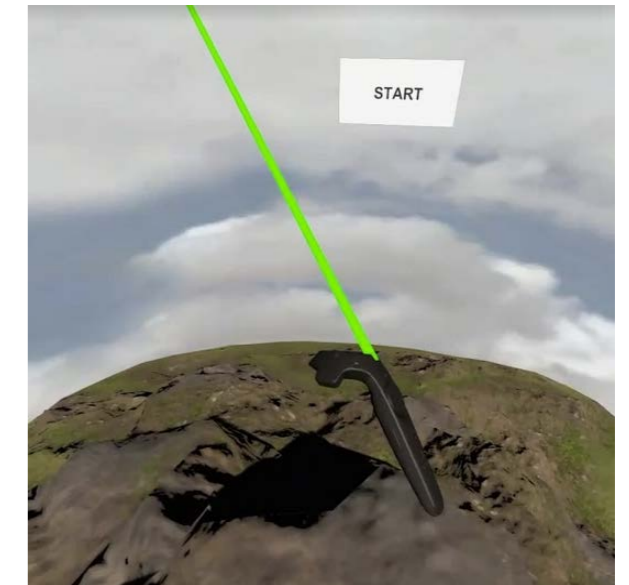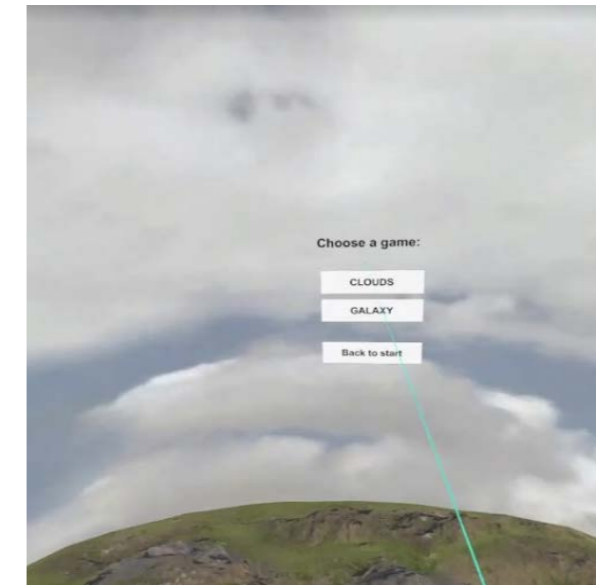
Evaluation

- Five early-stage PD patients
  - 2 females and 3 males
  - 65–74 years old
  - an average of 5 years with PD
  - Intermediate level in computer knowledge and skills

- Procedure
  - Introduction and consent
  - Pre-interview
  - 2 rounds of play with think-aloud
  - Post-interview and System Usability Questionnaire (SUS)

Findings

- Game and controls easy to understand

- Simple, fun, immersive and competitive

- SUS score 90 (average for SUS: 68)

- Improvement suggestions:
  - Buttons should have a larger distance from each other
  - More game play options such as size, moving speed, location, and type of the objects to hit, different scores for different types of objects, and their distances to the player
  - Different backgrounds, settings, music and colours

Further development

- Level of difficulties

- Leader board for high scores

- Size, moving speed, location of balloons and their distances to the player

- Progress bar and number of streaks

- Sound and animation

- Addressed usability issue
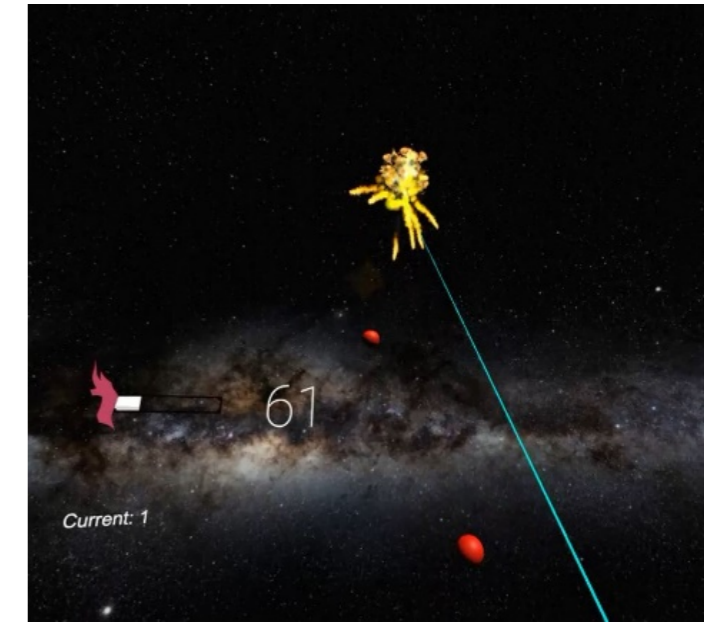
Conclusion and future work

- Engaging experience

- High level of acceptability, ease of use, learnability and confidence

- More user testing with larger number of participants and longitudinal study

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THANK YOU!