3D serious games for Parkinson's disease management

Bojan Blažica, Franc Novak, Anton Biasizzo
(Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana)

Ciril Bohak
(Faculty of Computer and Information Science, Večna pot 113, 1000 Ljubljana)

Parkinson's Disease (PD)

- A long-term disorder of the central nervous system that mainly affects the motor system.
- Symptoms:
  - tremor (hands, arms, legs, jaw, and face),
  - rigidity, or stiffness of the limbs and trunk,
  - bradykinesia, or slowness of movement,
  - postural instability, or impaired balance and coordination.

- => IMPACT ON INDEPENDENCE AND QUALITY OF LIFE

Parkinson's Disease (PD)

- 10 million patients worldwide
- 1.2 million patients in the EU
- Costs:
  - Combined direct and indirect (treatment, social security payments and lost income from inability to work) cost of PD estimated to be nearly **$25 billion/year** in the US alone,
  - Medication costs for an individual person with PD average **$2,500/year**, therapeutic surgery can cost up to **$100,000/patient**.
- PD-related EU projects:
  - Rempark,
  - Sense-Park,
  - Cupid,
  - Neurotremor,
  - **PD_manager project.**

Serious games requirements

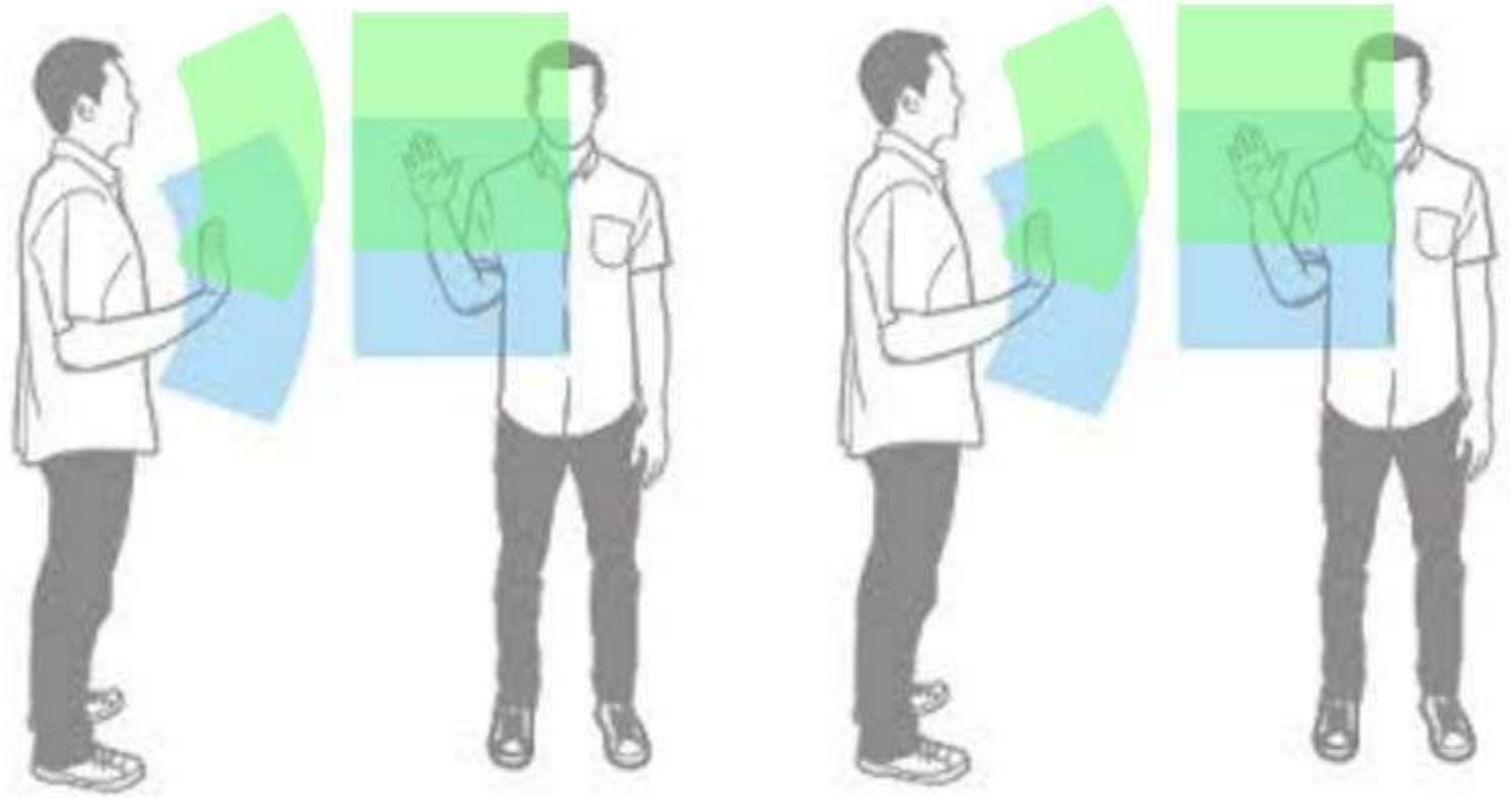
- General:
  - Encourage rehabilitation using gamification concepts.
  - Performance tracking of individual patients.
  - Use in hospitals and at home.
- Specific:
  - Preserving the range of movement of the patient's arms.
  - Preserving the patient's fine motoric skills.

Serious games requirements

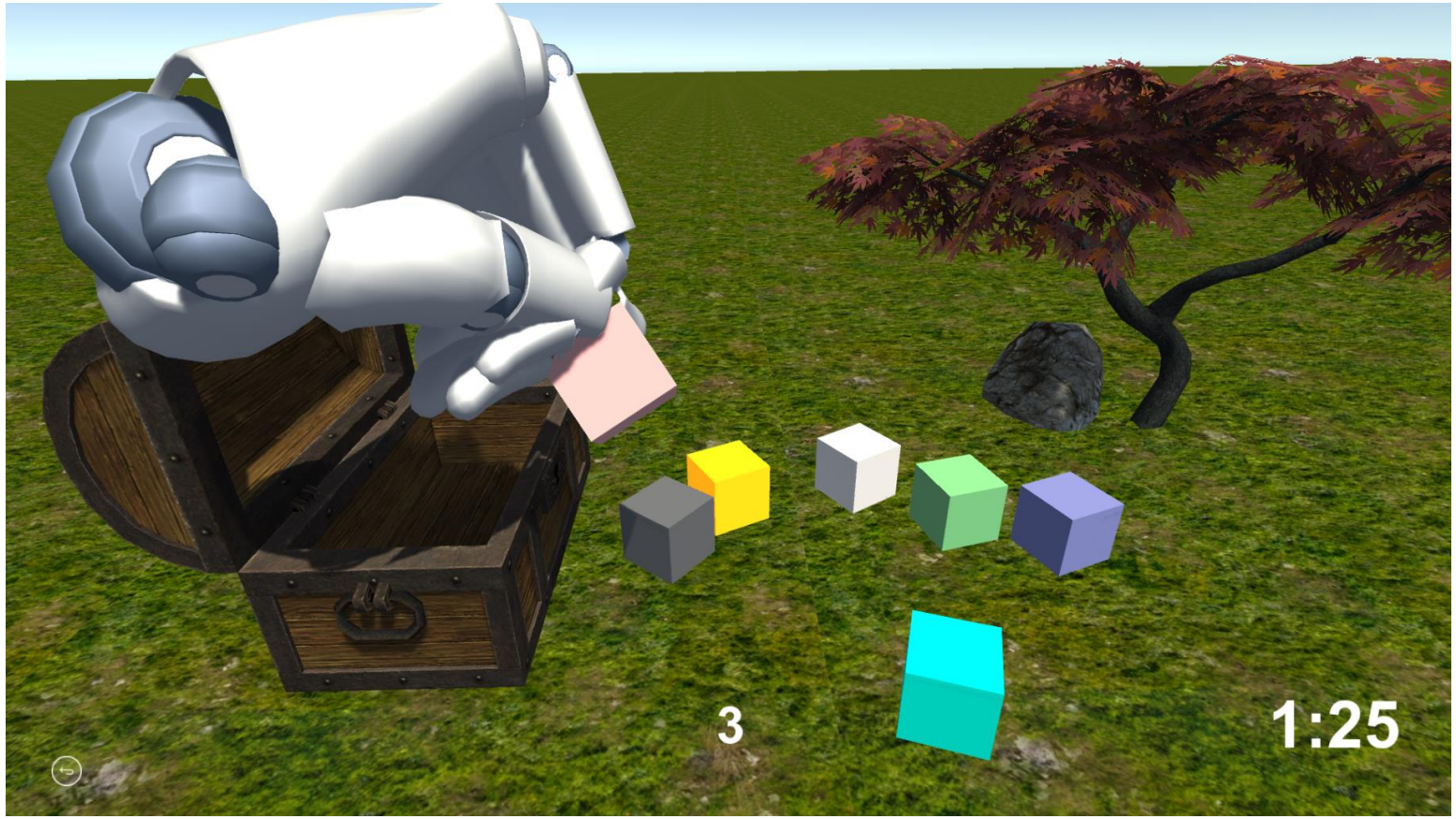
Task	Reach	Fine motor skills
Requirements	Stimulate user to move hands above shoulder blades up and outwards	Stimulate user to use fine motoric skills of fingers
Sensor selected	Kinect v2	Leap motion
Relevant sensor specifications	3D tracking of 26 skeletal joints @30 Hz, seated mode, hand pose tracking (open, closed palm)	detailed 3D tracking of fingers@115 Hz

Game 1:
Fruit Picking

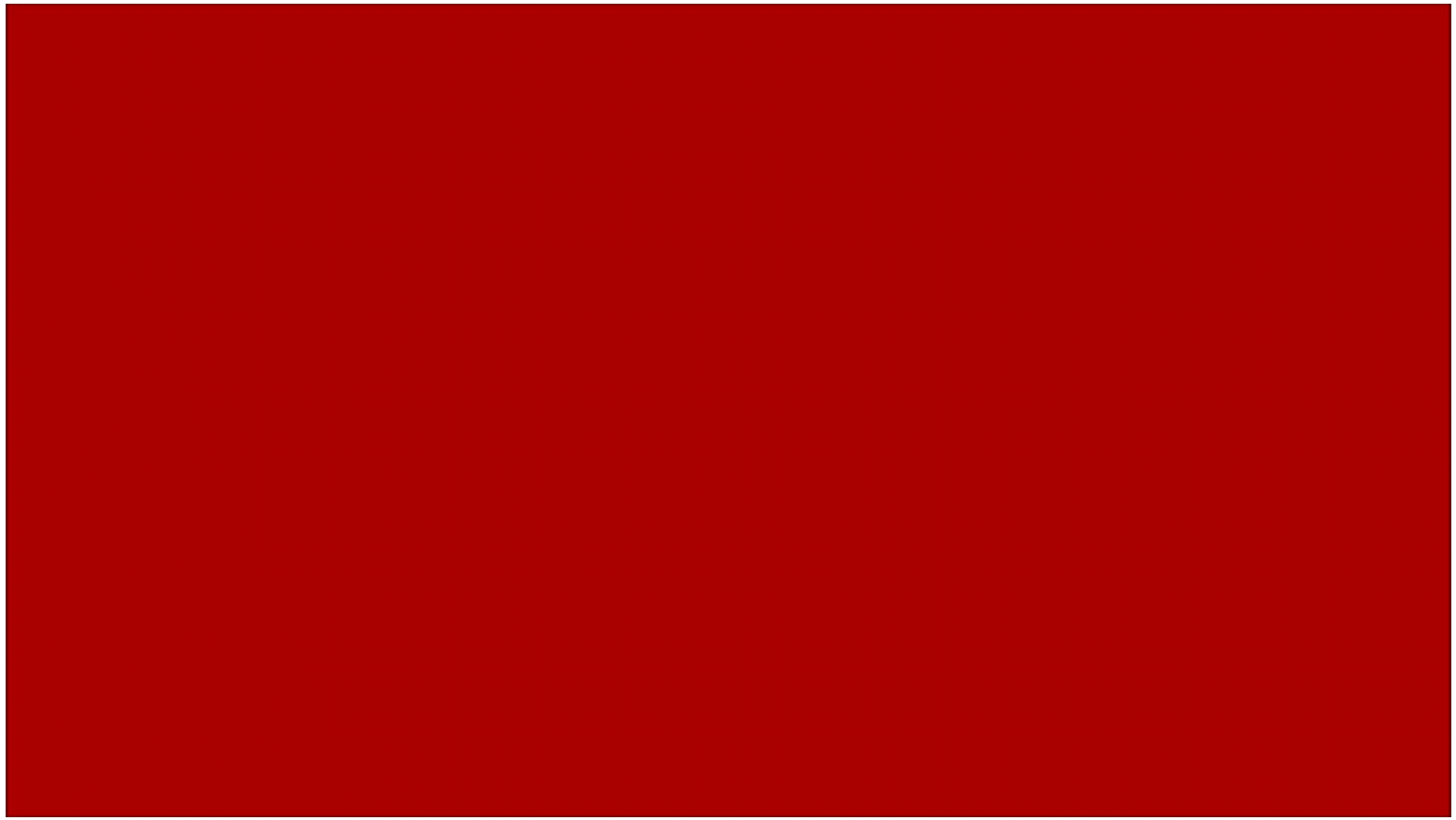
Physical interaction zone - PHIZ



Game 2:
10 cubes



Video



Collected data

- Game scores
- Kinematic data:
  - Position vector (x,y,z) and quaternion orientation (w,x,y,z) of all joints.
    @ 30 FPS (5MB per session)
  - Palm position, velocity, vectors for the palm normal and direction to the fingers, list up to five fingers, the anatomy of each finger described with four bones, each bone described with length, width, center position, orientation, next and previous joint.
    @ 115 FPS (100MB per session)

Lessons learned and future work

- *Lessons learned:*
  - *Connectivity*
  - *Other players*
  - *Ease of use for both patients and therapists*
  - *Giving feedback is not always positive*
- *Future work:*
  - *Trials with more patients*
  - *Analysis of kinematic data collected*
  - *Large scale evaluations*
  - *Make software freely available*
  - *Development of new games*

Questions?

3D serious games for Parkinson's disease management

www.parkinson-manager.eu

Bojan Blažica, Franc Novak, Anton Biasizzo
(Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana)

Ciril Bohak
(Faculty of Computer and Information Science, Večna pot 113, 1000 Ljubljana)

PD_Manager project

www.parkinson-manager.eu

- **mHealth, patient-centric ecosystem for Parkinson's disease management.**

- PD_manager goals:
- model the behaviors of intended users of PD_manager (patients, caregivers, neurologists and other health-care providers),
- educate patients, caregivers and healthcare providers with the focus on occupational and speech therapies and
- propose a **set of unobtrusive**, **simple-in-use**, co-operative, mobile devices that will be used for **symptoms monitoring** and **collection of adherence data**.