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Gamifying motion control assessments using leap motion controller

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Outline

- Introduction
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- Our solution
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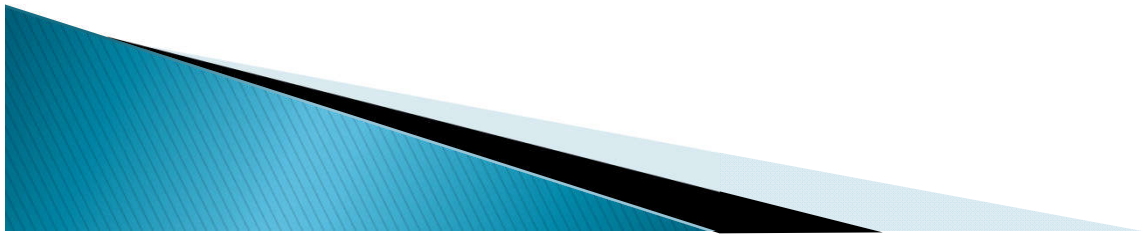


ΠΡΟ.ΜΕ.Σ.Ι.Π.

Introduction

- Focus of this paper
- Serious games/exergames and rehabilitation
  - Situations they are applicable
- Why exergames?

Motivation

- Requirements for a successful therapy:
  - Trained therapists / professionals
  - Necessary equipment
  - Adequate number of therapy sessions
- Lack of motivation
- Need of means for extensive and in-depth analysis

Our solution

- Our implementation is based on these key concepts:
  - Therapeutic exercises in virtual gaming world with
    a. an interactive scenario
    b. a set of goals

- Tele-rehabilitation should be feasible, to remotely monitor:
  - Progress
  - Adherence to the therapy

- Can be used by:
  - Rehabilitation professionals, physiotherapists
  - Rehab labs or institutions
  - Individuals with motion disorders

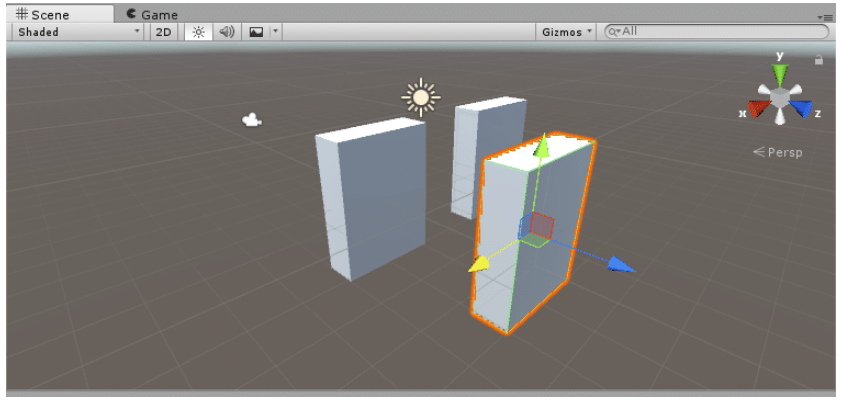
Development requirements

- **Interaction** through physical movement detected with **biosensors.**
- **Movement associated** with therapeutic – **rehabilitation** process and **entertainment.**
- Support of both **supervised** use and **unsupervised** use.
- **Low cost** infrastructure.
- **Monitoring** of response via **stored activity data.**

Leap Motion Controller

- Low cost sensor that can track position of hands, fingers and joints in 3D space.
  - The device's tracking accuracy has been studied and is used widely in virtual rehabilitation projects
    - Uses 2 VGA cameras and 3 infrared LEDs and the field view is a reverse pyramoid shape

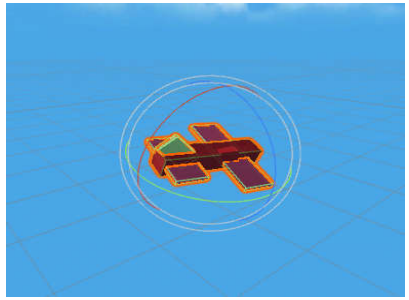
Unity 3D

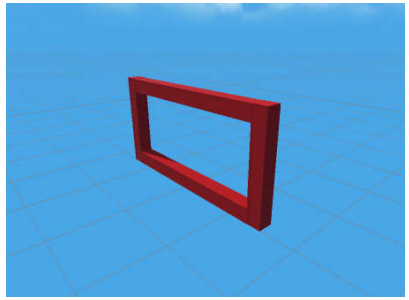


"*Unity3D is a powerful cross-platform 3D engine. Anyone can create 3d games and applications for mobiles, desktop, web and consoles.*"

Implementation

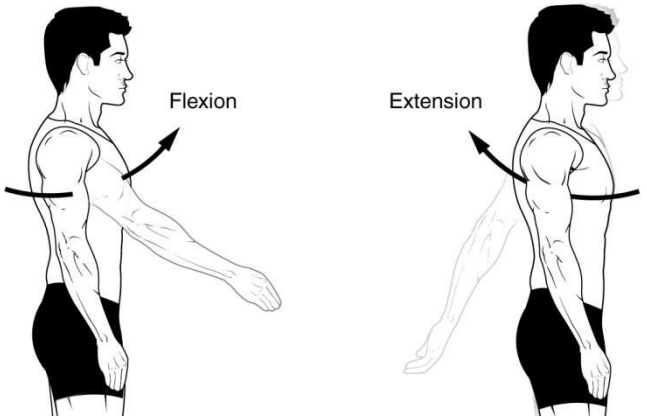
- Game metaphor – physical exercise
- Goal of the game – waypoints
- Customization and experimental parameters



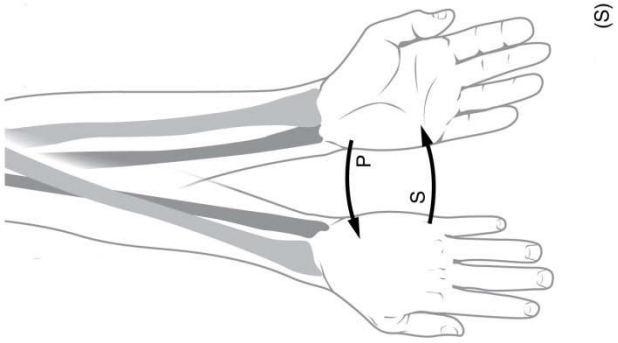


Types of exercises

- 1st type of exercise:
  - Flexion
  - Extension



- 2nd type of exercise:
  - Pronation
  - Supination

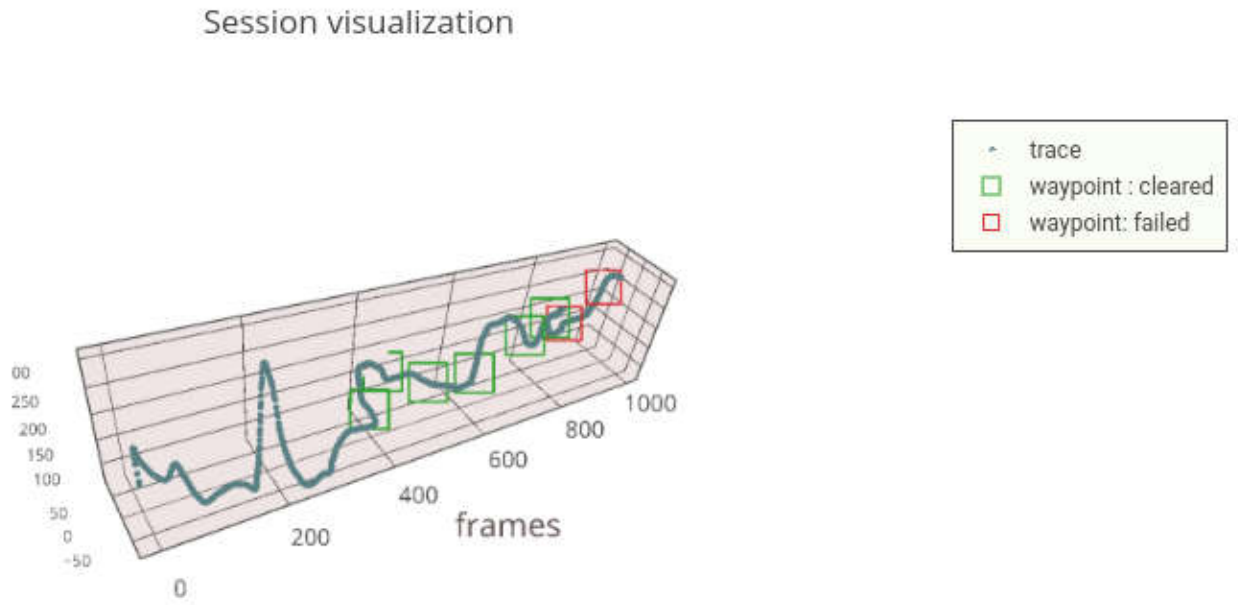


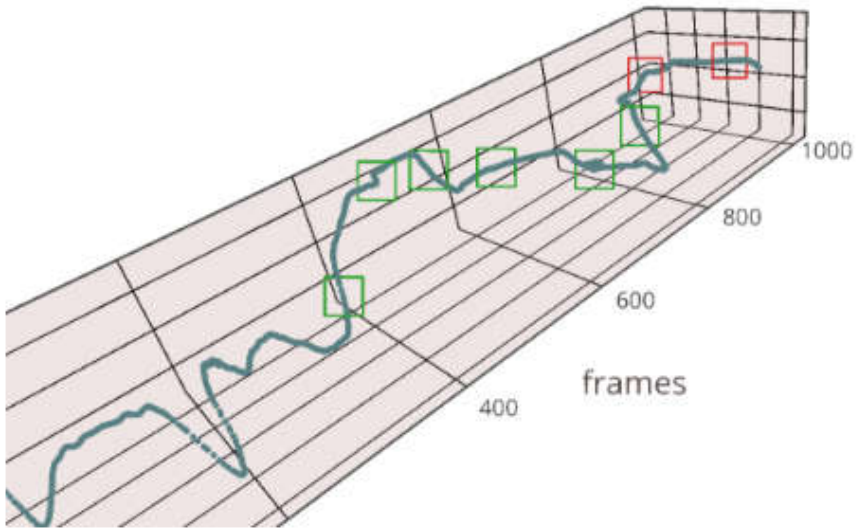
*Images from https://cnx.org/ under the Creative Commons Attribution license.

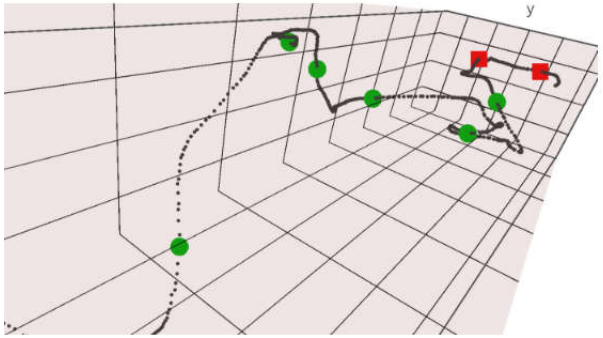
But the data?

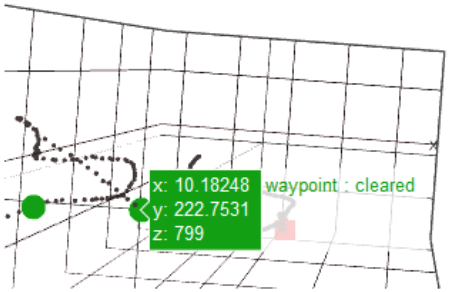
- Core benefit of this type of rehabilitation is the collection of data that can found use in:
  - Clarification of patient's status
  - Tailoring of the therapy
- Further advantage is that we can produce visualizations for the various therapeutic sessions

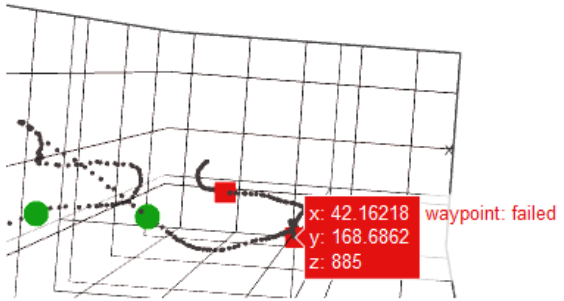
Visualization



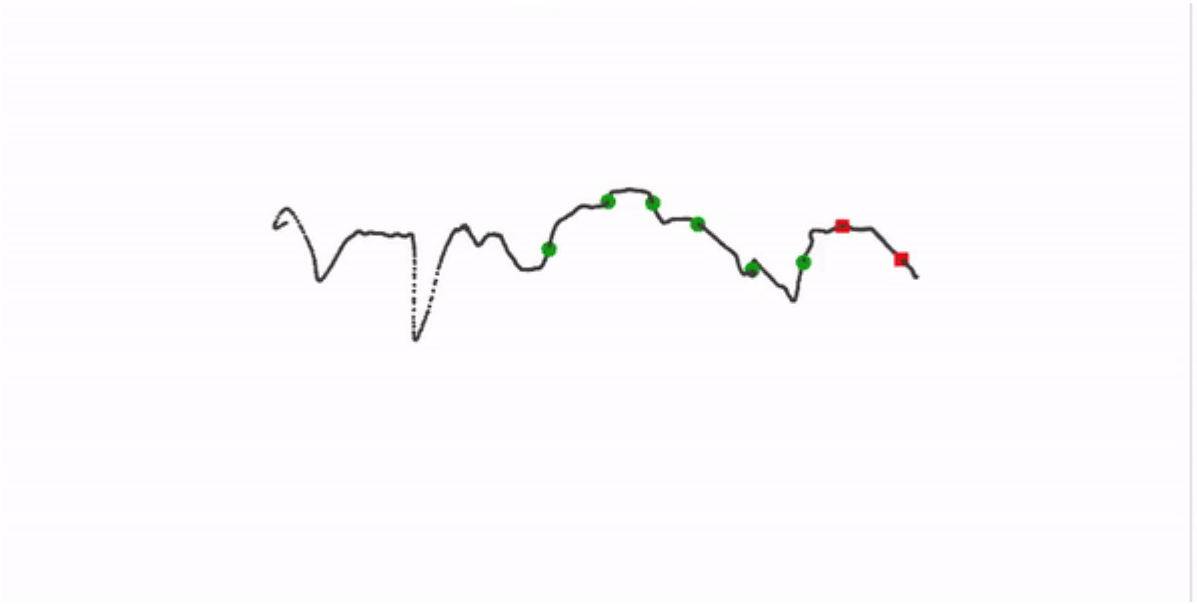

1000
800
600
frames
400


y

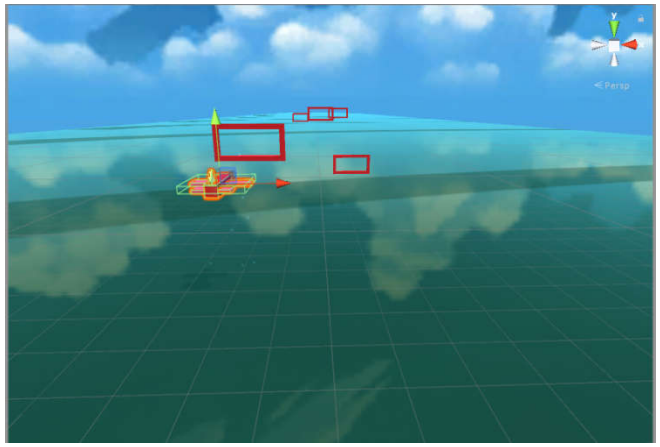

x: 10.18248
y: 222.7531
z: 799
waypoint : cleared

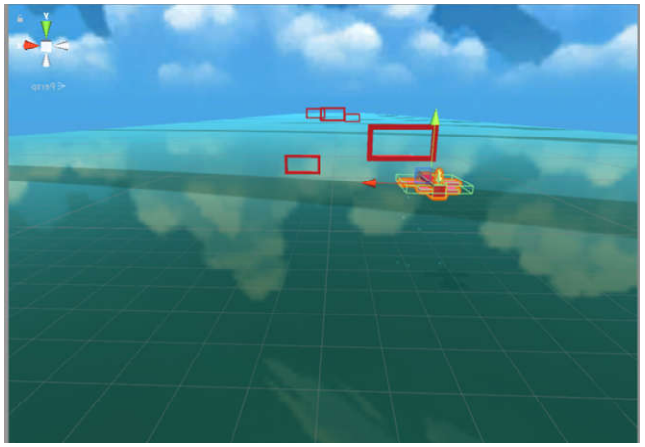

x: 42.16218
y: 168.6862
z: 885
waypoint: failed

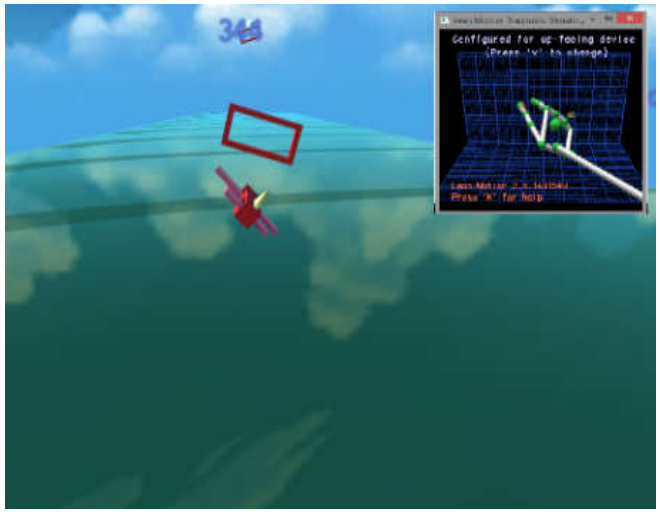
Signal .gif

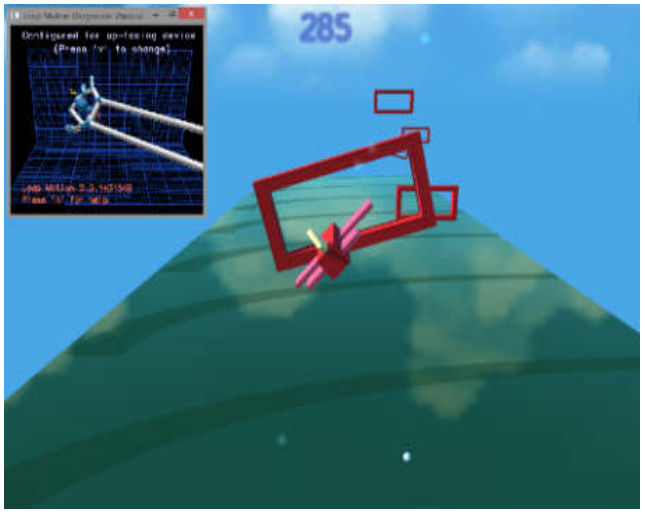


Game screenshots









Example video

Future steps

- More extensive analysis and evaluation of the process
- Test the use of other sensors and compare them or even try a combination of them
- Bring rehabilitation in the patient's house after appropriate training (un-supervised rehab)

Questions

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