# Motion capture game-based therapy for physical rehabilitation

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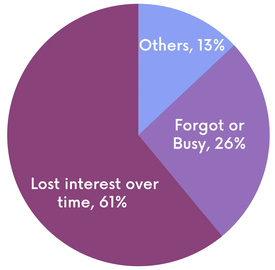
## Introduction

**OUR AIM**
We are designing a video game with a continuous and fun storyline to increase patient engagement for at-home physiotherapy. The game records patient movement information during sessions, allowing physiotherapists to track patients' progress over time.

**MOTIVATION**
For people with disabilities requiring consistent out-of-session exercise, sustained engagement and adherence to a long-term schedule remains tenuous. We therefore want to design a product that bolsters the motivation of these patients, particularly of the younger demographic.

**Survey we conducted on why home exercises are not completed**




## Requirements & Features

**Data protection:** Respect users' privacy

**Motion Capture Data Collection:** Data from the movements has to be collected

**Increase user engagement:** Continued use of our product

**Interface for physiotherapists:** Physiotherapist should be able to access the recorded data easily

**User-friendly interface:** Aiming for an age range of 6 to 25 so it has to be clear and simple to understand and set up

**Affordable & Accessible:** Can be used easily by anyone

→ **Firebase:** Securely stores user data on cloud services

→ **Persee Camera:** 3D capture
**Blazepose detection model:** Captures 33 key joints (1)

→ **RPG (Role Playing) Style**
**Reward system**
**Famous landmarks:** Hyde Park

→ **Website created on Wix:** User-friendly website with data imported from Firebase

→ **Child-friendly mini-games**
**Easy set-up:** Monitor + Persee only
**Clean visuals & Simple language**
**Clear game instructions**

→ **Simple hardware requirement:** Only requires one Persee camera and any TV or monitor

## Development tools

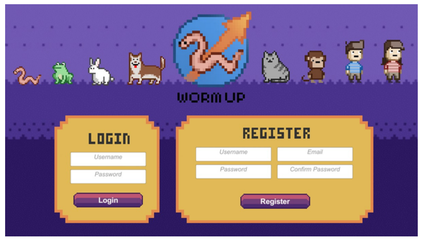
**Unity Engine**
- ✓ Good for beginners
- ✓ Lots of tutorials
- ✓ Free student plan

**Astra Camera**
- ✓ Affordable
- ✓ Works with Unity
- ✓ Minimal set-up

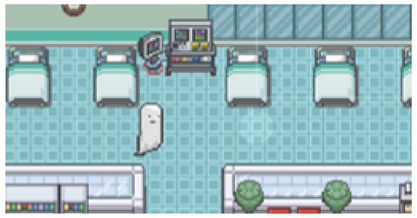
**Firebase Storage**
- ✓ Ready-made Interface
- ✓ Loading and scaling options
- ✓ Cloud service

**Wix.com**
- ✓ Easy to use
- ✓ Compatible with Firebase

## Final Design

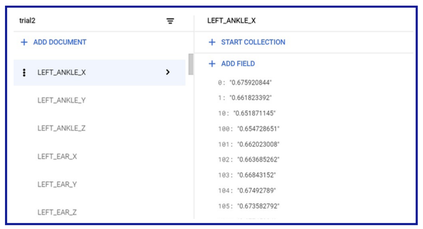



**Login/Register, user data uploaded to Firebase**

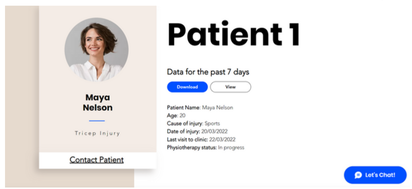


**RPG world, mini-games triggered with storyline (2)**


**Mini-game for actual exercises (4), (5), (6)**




**Data uploaded & stored on Firebase**




**Uploaded to Physiotherapist interface website (Wix)**

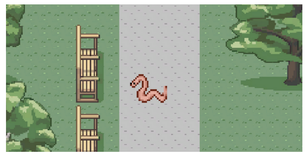
## Game Concept

The player is separated from their physical body, and the game follows their journey as a ghost to regain possession of it. In order to regain enough strength to take their body back, the player must take possession of lesser bodies first, and so progresses through the animals they find throughout the game.

To progress through the hierarchy of bodies the player must complete mini games (exercises) to collect experiences, hence leveling up to the next animal in the hierachy until they regain their body.

**Start** **Finish**


**Player can pick their preferred skin**



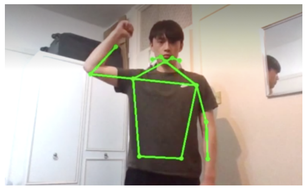
**Landmark: Hyde Park**

## Mini-game: Absurd Fishing

This minigame incorporates the exercise tricep extension, which is ideal for building upper body strength and mobility (3).

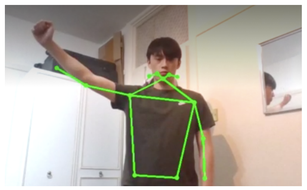
The aim of the mini game is to catch as many fish as possible in a certain amount of time. It is fun and simple to understand regardless of age, with added entertainment from avatar movements being coordinated to that of the user.

This data from Blazepose is then processed using MATLAB and uploaded to Firebase for the physiotherapist to review.



**Elbow Bend**

**Catch Fish**



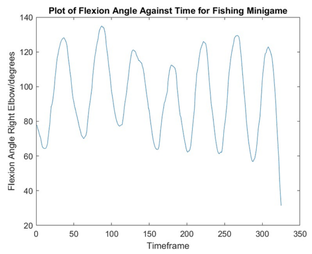
**Stretch And Extend Arm As Far As Possible**

**Cast Out Fishing Rod**

**User Movement Tracked by Blazepose vs. In-Game Avatar Display**

## Results & Evaluation

User-testing was limited to the RPG scenes and single mini-game, receiving feedback from two handicapped children aged 8 and 11:
- Emphasis on endearing character design and whimsical storyline.
- The limited progression at this stage was highlighted.




The plot allows the physiotherapist to easily visualize the range of movement and potential improvement between sessions, with information on maximum and minimum angles, as well as frequency of repetitions.

## Future steps

- More minigames to cater to more exercises for various disabilities
- More difficulty levels and more animals to play with
- More backgrounds and graphics to keep it visually entertaining
- Better interface for physiotherapists using a more professional engine
- Feedback system for Functionality evaluation

**References**

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