AI Physical Rehabilitation

Product Requirements

AI Physical Rehabilitation

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**Document History**

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| **Rev Number** | **Date** | **Modified By** | **Reason** |
| 0 | 9/19/23 | Noah Rieth | Initial Release |
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# Objective

The objective of this document is to document the requirements and functionality for the AI Physical Rehabilitation system that have been indicated by the client.

# Scope

The scope of this document is to define the requirements of the sponsored AI enhanced smart physical rehabilitation project. We will outline the input requirements and output requirements of the model we will develop/enhance.

# References

## Documents provided by our clients

Jiang, Chen, Liu, Yu, Yu, Chen. *MotionGPT: Human Motion as a Foreign Language.* <https://github.com/OpenMotionLab/MotionGPT>.

Wang (2023) UbiPhysio: Support Daily Functioning, Fitness, and Rehabilitation with Action Understanding and Feedback in Natural Language:  [arXiv:2308.10526](https://arxiv.org/abs/2308.10526)

Zhang (2023) - MotionGPT Finetuned LLMs are General-Purpose Motion Generators:  [arXiv:2306.10900](https://arxiv.org/abs/2306.10900)

## Acronyms

LLM Large Language Model

NLP Natural Language Processing

# Functional Requirements

## What it should do

The completed system must be able to extract skeletal information from a video, taken by a smartphone, of a patient performing one of several exercises (see section 7.1), compare the video in a deep learning model we will create or innovate against a database of similar data, and provide meaningful feedback to the patient about the quality of the exercise they performed.

The feedback must include a quality score (integer value in the range 1-10) where a higher score will be assigned if the exercise was performed better, and it must include text output that explains what the patient is doing incorrectly in the exercise and how the patient could improve the exercise.

# Mechanical Requirements

N/A

# Electrical Requirements

N/A

# Software Requirements

## Functionality

The final product must employ a single model that can analyze a video and provide tailored feedback for any of the rehabilitation exercises in the following section.

The project should analyze at least 100 human skeletal movements of a supported exercise (7.2) and give a numerical accuracy rating (1-10).

## Supported Exercises

- Jumping Jack (We will focus on analyzing video and completing feedback for one exercise first. Then if our model is successful and we have more time for additional analysis we may add more supported exercises)

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(Additional specific exercises will be added to this list with the guidance of the client as the product is developed. The client would like there to be about 5 supported exercises with a requirement of 1 deliverable exercise.)

## User Interface

The user interface must be able to support a video (recorded on a smartphone) being submitted as input. The user interface must also be able to display text as an output that the user can read.

The client would like (NOT required) this user interface to be implemented as a single smartphone application.

# Environmental Requirements

The deep learning model must complete its analysis of video in a reasonable amount of time. The goal of this project is to create a way for clients to get real time feedback of their exercise. This may be measured by timing the response time of the model.

# Regulatory Requirements

The project may utilize pre-existing LLMs that are open source and can be tuned, e.g. those listed in section 3.1.

# Cost Requirements

This project should not have any expenses as it will use open-source software. If any expenses occur, a discussion with the client should be held.

# Schedule Requirements

Project Schedule:

* Project Definition Sept. 21, 2023
* Project Plan Oct. 3, 2023
* Snapshot Day #1 Oct. 10, 2023
* Concept Design Review Nov. 10, 2023
* Snapshot Day #2 Dec. 5, 2023
* Project Portfolio Dec. 8, 2023
* Engineering Release Review Feb. 16, 2023
* Snapshot Day #3 March 27, 2023
* UI Design EXPO April 26, 2023
* Design Report May 4, 2023

Project Milestones:

* Collected a database of 100 videos
* Extract skeletal data from smartphone video
* Use skeletal data in a model for comparison of accuracy
* Provide an accuracy rating (1-10)
* Ensure that the accuracy rating measures correctly against actual precision of exercise.
* Analyze video for incorrect movements
* Provide written feedback for improvement of incorrect movements
* SLACK TIME GOALS:
  + User interface
  + Additional exercises