Phizi Project Requirements Document

Abstract

This document is the first of three documents describing the final project in the software engineering program. Specifically, this document describes the requirements of the software project from the standpoint of the customer. Phizi company offers motor therapy for children in a virtual environment.

Contents

Chapter 1

Introduction

1.1 The Problem Domain

Our system provides tools that help overcome developmental problems among children in the early stages, and in addition provides enjoyable care from a distance, without difficulty and frustration that supports both the children, the professional therapists, and the parents.

1.2 Context

During the project we will sample images and analyze the user's movements to allow the product to diagnose whether the user is in the correct position.
The program runs in the browser without any installation on the user's computer.
We will conduct several calculations on the user's estimated skeleton to calculate his joints, angles, and body-parts' length and use this data to match against a known pose.
All the calculations will occur on the client side and the derived data will be sent to the server.
The server stores all the relevant data to the users of the system in a remote database.

1.3 Vision

Creating a fun application that will allow children with developmental coordination disorder to improve their daily life and let their physiotherapists supervise and help them in their progress.

- Additional goals of the project from our side:
1. To get exposed to advanced algorithms from the worlds of artificial intelligence and the use of visual signals.

2. Building an end-to-end architecture involving Client/Server and even Serverless functions.

1.4 Stakeholders

The product is mainly intended for children with Developmental Coordination Disorder (DCD) problems, their parents, and their professional caregivers. Our game will allow them to improve without interfering with their daily lives. Most of the requirements will come from the therapists' side.

1.5 Software Context

Our system creates a three-dimensional estimation of the patient's skeleton and performs accurate analysis of his movements. The entire interface is based on computer vision from a standard RGB camera.

Project progress:
- Frame sample from an RGB camera on the end device (lean frontend UI/Client).
- Implementation of neural networks (familiar pre-trained architectures) that were pre-trained on the client-side with the aim of identifying the skeleton, tracking the points of the skeleton, and performing depth reconstruction. When the product will be an identification skeleton in three axes.
- Transferring the sample to the server (backend/cloud)
- 2D drawing of the skeleton on the video.
- Calculation of relationships between points, constraints, angles, and their derivatives.
- Add functionalities – add pose, add session, handle users etc.
- Implement pose matching mechanism.
- Add animation and keep scores of the user's progress.

Chapter 2

User Scenarios

1.6   User Profiles – The actors

- Children - 17% Of children worldwide are diagnosed with a development disability. A significant percentage of them are still diagnosed late after suffering a lot of frustration and almost in sporadic manner. The majority of them suffer from musculoskeletal disorder and could benefit from continuous occupational therapy (OT) and physical therapy (PT).
- Therapists – professionally trained therapist registered by us and Phizi who aim to provide the most accurate and personal treatment to their patients.

1.7   Use-cases

Use-case name		**Pose matching**
Actors		Server, Client, User
Preconditions		The customer has a camera installed on his device
Normal flow	Description	The user takes a video of himself. The video is passed through the pose-estimating model and pose-matching algorithm. The data is sent to the server.
	Post conditions	Feedback about the movement is sent to the client.
Alternative flows		• An error occurs when the client tries to detect the skeleton. • Communication error with the server. • Cannot provide feedback about the pose.

Use-case name		**User management**
Actors		Server, Client, User
Preconditions		The user has access to Phizi's website
Normal flow	Description	The user registers/logs-in/ logs-out from the system.
	Post conditions	The action was completed successfully.
Alternative flows		• Communication error with the client.

Use-case name		**Start Session**
Actors		Server, Client, User
Preconditions		The user is logged in and has a camera installed on his device
Normal flow	Description	The user selects a session from a list of available sessions based on his goals. The user then clicks on "start session" button and the game starts.
	Post conditions	A series of poses are sequentially presented on the screen for the user to perform.
Alternative flows		• Communication error with the server. • Camera not detected.

Chapter 3

Functional Requirements

	Description	Priority	Risk
1	Sampling the client's webcam	MH	Low
2	Extract skeleton (x, y, z for 33 landmarks) points from the sampled video	MH	High
3	Draw a 2D skeleton on a user's video input in real time	MH	Medium
4	Calculate angles for specific joints in 3D space	MH	Low
5	Calculate angles for specific joints in 3D space	MH	Low
6	Calculate speeds for joints in 3D space	MH	Low
7	Send each frame to the server as a JSON	MH	Medium
8	Display 3D Skeleton in real time and according to the user movements for testing purposes	NTH	Low
9	Store all the user's information (score, login info, treatment progress, etc.)	MH	Low
10	Provide Client with all the exercises needed for a specific user using existing data and data received by the user (start session)	MH	Medium
11	Progress report, provides the client with his progress so far and with various statistics regarding his performance	NTH	Low
12	Collect various statistic information about clients' behavior for internal use and Improvement (success rates, playing time, recurrent users, etc.)	NTH	Low
13	Registration to the system	MH	Low
14	Login into the system as admin\user	MH	Low
15	Calibration of user data in first use	MH	Low

16	Logout from the system	MH	Low
17	Adding poses as therapist	MH	Low
18	Therapist can view details on the clients	MH	Low
19	Therapist can assign a goal to clients	MH	Low
20	Therapist can add a new session	MH	Low

Chapter 4

Non-functional requirements

4.1) Implementation constraints

Performance - Get as close as possible to Real Time at a minimum of 30FPS.

Reliability – Pose-matching should succeed regardless of user's physical attributes.

Usability - The system should be suitable for use by children and therefore be as easy to use and understandable as possible

Format - The points output will be exported as a file in JSON format.

4.2) Platform constraints

The pose-detection has well as the pose-matching algorithm should take place in the client-side to allow better performance for multiple users. The application should be web-based and available for most modern machines.

4.2.1) SE Project constraints

In our system we will not need special hardware components because we want to sample any camera. In addition, we will sample real data from our computer camera or any other camera and not from random data.

4.3) Special restrictions & limitations

Users with less-powerful machines will experience some FPS drops as well as lower pose-matching performance.

Chapter 5

Risk assessment & Plan for the proof of concept

Risk assessment

The purpose of this risk assessment is to identify and evaluate potential risks that could impact the success of our Phizi project.

Risk	Likelihood	Impact	Response
Dependence on third-party software could lead to failures if any issue arises with the software	Low	High	Using multiple third-party dependencies in case one of them fails
Too many calculations on the client side can lead to fps drops and failure	Moderate	Moderate	Testing the client's performance for each calculation that is being added, and if needed move some of the calculation to server side

Therapists may add useless poses to the system and that can lead to too many poses in the database and will cause the process of adding a session to be confusing.	Moderate	Low	Once a month, an admin will go through the added poses and filter out the useless ones.

Proof of concept

1. For the proof of concept we will develop: 1. Client-side app that runs on the browser, sampling the user's webcam running it through 'Media Pipe – Blaze Pose' and extract the 3D skeleton. This is the main part of the project and the most risky one, extracting an accurate 3D skeleton from a user's webcam.

2. Display, on the user's video, a 2D skeleton using the browser. Displaying the 2D skeleton will allow us to estimate the quality of the Blaze Pose output.

3. Analyze the 3D skeleton, calculate the lengths of body parts and the angle of the joints. This is done on the client side and passed to the server, there in the 3D skeleton we will display the information and see if this is accurate. This calculation, if accurate, will allow us to do more complicate calculations in the future.