CS Capstone Problem Statement

Fall Term

October 10, 2017

Kinect Based Virtual Therapy Solution

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Abstract

The purpose of this document is to define and describe a possible solution for physical therapists to utilize when monitoring a patients prescribed therapeutic movement set. The solution involves the use of a Kinect sensor to track a patients movements when performing exercises. The data that the sensor records will be stored and sent to their physical therapist to allow them to monitor their patients progress. The task is to develop software that includes an interface for patients and physical therapists to interact with. Pre-defined exercises will be implemented in the software and compared against a patients movements to determine the accuracy of the therapy. The project will be completed once a working prototype is prepared and the clients requirements are satisfied. The document is structured into three sections which provide a high-level description of the problem, solution, and performance metrics.

CONTENTS

1 PROBLEM DEFINITION AND DESCRIPTION

The main point of this project is to provide a solution for physical therapy patients which will allow them receive aid from their physical therapist remotely. This project is aiding the research of Oregon States Healthcare System Engineering Lab on sensor-based healthcare solutions. Through the use of a Kinect sensor which tracks the human body movement, we hope to develop some software that stores and tracks the movements of the patient. That information can then be sent to their physical therapist who can analyze and further prescribe any exercises they deem necessary for their patient.

This form of technology benefits both patient and physical therapist because it reduces the number of times the patient must travel to a clinic and enables frequent symptom monitoring. Thus, the physical therapist can verify if their patients have been performing their prescribed exercises correctly given the sensor data and generated reports. The sensor will be more accurate than a physical therapists eyes making it more likely to detect early stages of Parkinsons disease.

When working with patients with a disability such as Parkinsons disease, the software we develop may be used to track their symptoms over time by measuring common symptoms and movements of their body. A physical therapist can then analyze the data over time to see if their condition has worsened. A tool such as this may also be very useful when detecting early signs of developing Parkinsons disease. The physical therapist should be able to generate reports and customize exercises for each individual patient using this tool. An interface needs to be implemented which allows patients to interact with the software and receive instructions as well as feedback about their assigned movement sets. The software must be accurate and simply interactive in order for the patient to receive proper treatment.

2 PROPOSED SOLUTION

The first step in our proposed solution towards this project will be to become familiar with the Kinect sensor and its various capabilities. This knowledge will be essential for programming the back end of the software. The proper configuration of the hardware will be the next step. As developers, we have the option of specifying the manner in which the sensor can track a human body. This includes tracking human skeleton and joint movements and collecting data from the accelerometer. Using these capabilities, we will program pre-defined exercises such as repeated arm movements that a patient might have to perform. The program will instruct the patient to raise their arm in a specific way and then measure their range of motion and speed.

The Kinect sensor also has built in audio processing that may prove extremely helpful with patients who have limited range of motion or difficulty standing. Microsoft has provided an SDK or software development kit that will be essential towards developing pre-defined movements sets and report generation. As the sensor collects data, we will process that data and store it in a file where it can be sent to a physical therapist. This will allow the physical therapist to look at the data and prescribe or modify exercises, as well as diagnose early signs of any potential disability.

Our solution also has the potential to let the user know whether or not they are correctly completing the exercises through an on-screen interface. This can be done by comparing the sensor data with a correct version of the pre-determined exercise code. The patient may be asked to try again for a certain amount of times before we can come to the conclusion that the patients range of motion has been limited.

3 PERFORMANCE METRICS

After communicating with the client, we have established that the project is completed when we have a working prototype that fulfills the base requirements. Those requirements of the software our team will be developing include: tracking and storing human body movements using the Kinect sensor, the ability to define and customize physical therapy exercises for each patient, and report generation of the physical therapy exercises and patient progress.

The requirements also include a working interface for patients to interact with the program. A patient should to be able to receive and read on-screen instructions for physical therapy exercises. The program will be able to recognize users and accurately track their body movements as well as provide spoken instructions to patients if needed. The solution should be fairly robust and easy to use. In order to ensure that, we will be working with the Samaritan Physical Rehabilitation clinic to test the interactivity of the interface.

Our solution should be tested to the extent that the program works and provides a solution to our clients needs. We will be coding in pre-determined physical movements that a physical therapist provides and testing to see if our program recognizes that we did that exercise correctly and incorrectly.