

2024-25 HIVE Summer Internship Project

Adaptive Virtual Reality Systems for Balance Rehabilitation

41SAE_EECMS_VRBalanceRehab

Primary Academic Supervisor

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Project Background

The population aged over 65 is increasing and with this increase healthcare expenditure is also increasing. (DataBank,2022) With the increasing aging population, enhancing the country's healthcare system is imperative. The aged population tends to be hospitalized more often due to injuries. Therefore, it is essential to have a high-quality homecare systems to enhance the quality of life of these patients. Many studies were conducted on falls and associated risk factors in the aged population. This is mainly because falls in elderly persons are a major problem for the healthcare system and can lead to institutionalized care, reduced mobility, loss of confidence, and psychological effects. Some patients may fully recover back to their original status while others may need help from a nurse for their daily activities. The risk of falls will also reduce their mobility and may lead to less physical activity. In this study, the feasibility of a balance rehabilitation program for the elderly population will be assessed. The initial study for this project was done with the help of academics from Brunel University London.

Project Description, Expected Outputs, Possible Stretch Goals

A telerehabilitation platform to simulate and help people overcome balance problems will be developed using VR technology. VR will be used to guide the patient with the exercises. The exercises will include different tasks and games to achieve physiotherapy exercises. The output of this project is to develop a VR application with an avatar and add gamification aspects. The student should be able to develop and demonstrate that the application works on a VR headset. This project is offered in partnership with Brunel University London. The student has the opportunity to work with researchers from Brunel University.

Links to background reading and any relevant recent work in the field

1. Virtual Reality in the Rehabilitation of Patients with Injuries and Diseases of Upper Extremities-

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9222955/>

2. Games for Stroke Patients - Role of VR Stroke Rehabilitation Exercises-

<https://www.cognihab.com/blog/virtual-reality-for-stroke-rehabilitation/>

3. A task-specific interactive game-based virtual reality rehabilitation system for patients with stroke-

<https://jneuroengrehab.biomedcentral.com/articles/10.1186/1743-0003-11-32>

What type of visualisation will the student develop or produce?

VR application using Unity that can work on VR headsets like Meta Quest 3 and pro.

How will the visualisation contribute to your research outcomes?

The next step in this project is to use Inertial Measurement Units to get feedback and apply machine learning techniques to adjust the exercise routine for the patient. The development of the VR application is pivotal for this study.

If the project is successful, where would you consider publishing the results?

Open Access journals will be considered as they will help distribute the knowledge to a larger community.

Draft Project Timeline:

Week 1

Introduction to the project

Week 2

Selecting the implementation technique

Week 3

Developing the system (avatar and the basic application)

Week 4

Developing the system (add all the exercises)

Week 5

Developing the system (add challenges and tracking of the workouts)

Week 6

Developing the system (add challenges and tracking of the workouts)

Week 7

Testing and verification

Week 8

Testing and verification

Week 9

Report writing

Week 10

Report writing

Student Experience and Supervision:

How often will you meet with the student over the 10-week period?

Once per week

Your work desk location and the location of student desk

314 or 207 project lab

Student Attributes:

Please indicate any preference for student's academic discipline or field of study

Electrical Engineering, Computing, and Computer science background. Familiar with VR development software such as Unity, Unreal, or keen to learn.

What competencies are required to start this project

Beginner - Unity Programming (C# coding, animation syntax, debugging, problem-solving)

Beginner - Unity Virtual Reality Development (rendering pipelines, scene content design, interaction)

Do you have any other student attributes you think are important to the project?

Keen to learn and work in a team.