Final Report

Group: House Gryffindor (1)

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Viktor Wigmore	V.Wigmore@student.tudelft.nl	4279638
Magdalena Simidzioski	M.simidzioski-1@student.tudelft.nl	4383036
Maria Simidzioski	M.simidzioski@student.tudelft.nl	4381319
Matthijs Klaassen	M.klaassen@student.tudelft.nl	4273796
Wing Nguyen	t.n.nguyen@student.tudelft.nl	4287118

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1. Introduction

1.1. Preface

The goal of this report is to provide an overview of our project and to give insight into our product and working process during the project. This report consists of seven sections and each section gives insight to crucial parts of the workflow of the project and the developed product. The first section gives a general overview of the most important parts of our product. The second section gives more insight in the issues that we faced during this project. The third section gives a description of the structure of the product. The fourth section is about the Interaction Design. In the fifth section an evaluation of the developing process and the final product is given. The sixth and final section gives an outlook of the entire project where we will discuss potential improvements.

1.2. Problem description

The main problem we had to find a solution for, was the missing reality for psychosis patients in a Virtual Reality simulation. The needed functionality CleVR (the company we were working for) wanted, was the possibility to grab objects in a virtual scene with the Virtual Reality gloves (Manus VR) provided by them. This is the most important thing in the system because the psychosis patient needs to be convinced he is in a real world situation for the therapy to work.

1.3. Requirements

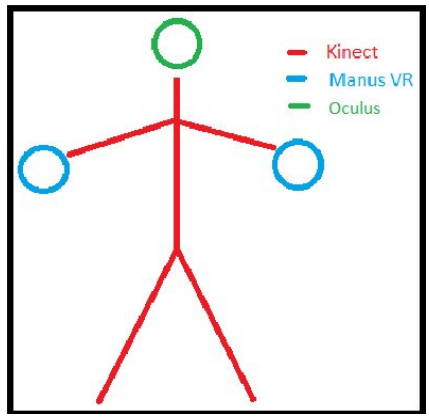
The main requirements our client wanted to have included in the system, are:

- Being able to pick up and put down an object in the virtual environment.
- Have a realistic representation of the user's body in the simulation which moves according to the user's movement.
- Have objects move realistically in the simulation, meaning objects cannot move through other objects.
- The implemented features should not create a bottleneck in the performance of the system.

The system also needs to be stable and reliable, so that the patients will have a comfortable and realistic experience while moving around in the simulation and picking up groceries.

2. Overview

We have implemented all must and should haves that we had defined in the beginning of this project. Our main focus was implementing the grab functionality and the possibility to let a user move in the scene.
The final product is a virtual scene in which a user can act. The objects in the simulation are physics based. This means that the user can interact with them as he would with real objects. He/She can pick up an object, put down an object, when the user touches an object the gloves vibrate and the user cannot put his/her virtual hand through objects.
The hardware that is used to make this functionalities possible are the Manus VR and the Kinect. We use the Manus VR to track the movement of the hand and fingers, while the Kinect is used to track the other body parts, specifically the hands/arms and legs. The Oculus is used to track the position of the head as well as the orientation.
With our product the simulation will be more realistic and stable and the patient will feel more comfortable and self-assured when using the supermarket simulation. This means that when CleVR integrates these features into their system, patients will respond better to the therapy sessions.



3. Reflection

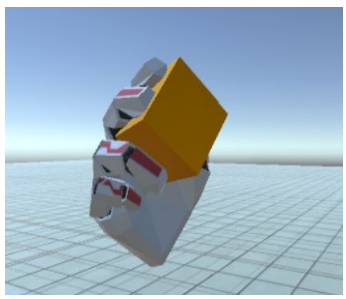
When reflecting upon the overall development process throughout the entire project, there were several bumps in the road.
The first problem we had to face was getting the hardware that we needed in particular the Manus VR and Kinect. Then we had to set everything up because without the hardware we could not really make any crucial progress. Working with the hardware itself, in particular the Manus VR was also challenging because we were given only one piece and we needed to share it with the other group that was working on the same project. Luckily the communication with the other group went very well and we never had a misunderstanding about who would get the Manus VR on which day.
A second issue was that we had to deal with and that we spent a lot of time on was testing our implementations. Since we had to make our project in Unity using C# scripts, we did a little research on which testing tool we could use and ended up using NUnit to make test cases. This didn't work out really well because the test cases could not be executed since the Unity Engine game objects can not be created outside of Unity. Next we tried using the NSubstitute Framework but it also did not work out because this framework only works with mocking interfaces. Eventually we found a way to test our code and now the only issue left was getting the test coverage. This also cannot be done in Unity, so we had to test everything manually to get an indication on how well we have tested our code.

Besides these problems, the scrum part and development process of the project went very well. The communication between the members was very good, with no late reactions and no arguments. We divided the tasks very well and it was clear for everyone what had to be done and when everything had to be finished. We helped each other when someone had a problem, answered questions very rapidly and always reviewed each other's code. This went very smooth and fast because we would always meet up and work together on the project instead of communicating via communication apps. As end result we have delivered a reasonably well functioning product. The grabbing, throwing and moving of objects works as it is supposed to and the user can see everything around him while moving in the simulation.

4. Description

The virtual body is controlled with use of the Kinect, a camera device that tracks the user's body and maps the movement to the virtual body. With using the Kinect we make it easier for the user to move in the supermarket simulation and add the picked up groceries to the basket or remove the unwanted groceries from the basket. When the user is at a predetermined distance form the desired item (in a certain proximity), the item is highlighted so the user can recognise it fast and easy and pick it up. The items have different physical properties and the user can easily push away or throw an undesired item. More specifically, the developed functionalities are as follows:

4.1. Object grabbing

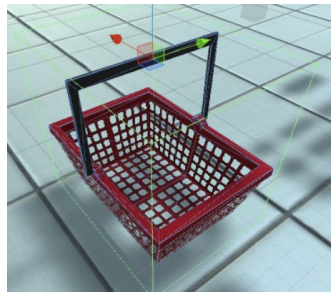


We have added functionality for interacting with physics objects such as being able to move them around, rotate them and throw them. Gestures are implemented to make the control of the virtual body easier and more user-friendly. Gestures look at which fingers are stretched or bend and based on the received information they move the user' virtual body forward or backward, or rotate the user. When an object is picked up, the hand does not go through the grabbed object, instead the hand is neatly placed around the object. An object is grabbed if the thumb and one other finger are touching each other. When no finger is touching the thumb, the open gesture is triggered and object is dropped.

4.2. Haptic Feedback

Feedback is given to the user when the user touches an object which can be picked up by using the vibration motors of the Manus-VR gloves. This simulates the stimulus from the nerve in the hand the brain receives when something in the real world is touched.

4.3. Shopping Basket



There exists a shopping basket in the scene, which als can be picked up and move around. We added this feature to enable the users to add/ remove groceries to/from the shopping basket to make the supermarket simulation more realistic. The patient can hold the shopping basket in one hand and put items in it with the other hand. Like all other pickup objects, the shopping basket also has to be tagged as a pickup object and it has to contain a rigidbody component and a collider component so it can be used properly.

5. Interaction Design

5.1 Personas

In this paragraph, a few personas used in the scenarios will be described. For the personas, there are three different types of people, the patient, the therapist and the developer (CleVR).

Persona 1

Name: Reinier Bennigh
Birthday: 18th April 1987
Type: Patient
Reinier is 29 years old and has studied Computer Science at Delft University of Technology. He used to work as a computer programmer at Microsoft. He has worked at Microsoft for the past two years, before this, he was employed as a traffic controller. While working as a traffic controller, he has always thought about working for a big software company. After working a year for Microsoft, he started to get stress related problems. He was working on multiple projects as a scrum master and the people he had to work with were not achieving their maximum productivity. Because of this, deadlines were not met and Reinier 's supervisor started to pressure him to work harder. After a couple of months working in this toxic environment, Reinier started to develop symptoms of psychosis.

Persona 2

Name: Arnold Schwarzepepper
Birthday: 30th July 1947
Type: Therapist
Arnold is 68 years old and is one of the most renowned therapists in the field of treating psychosis patients. Arnold always tries to keep up with the latest developments in his field. After reading a couple of papers on Virtual Reality Exposure Therapy, he is willing to try it out on his patients, since this should reduce the costs of treating patients with psychosis. Because of his old age, Arnold does not have a lot of experience with computers, so he is worried he might not understand how to use it.

Persona 3

Name: Paul Jobs
Birthday: 25th December 1975
Type: Lead Developer
Paul is 40 years old and single. He has a background in Electrical Engineering and Computer Science and has revolutionised the mobile phone market. With his 15+ years of experience in digital systems, he is eager to work with Virtual Reality hardware. Paul is currently working as lead developer for CleVR.

5.2 Scenario

The following scenario describes how the different personas are related to each other and how the system should work.

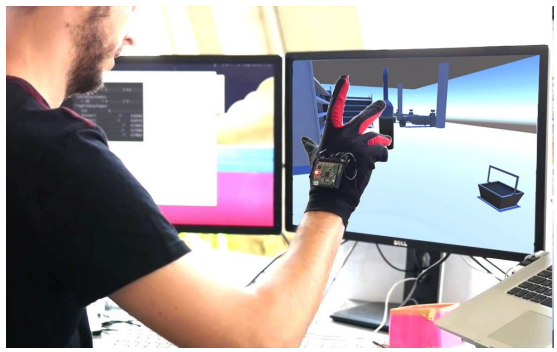
Paul has finished the Supermarket simulation and is about to deliver it to Arnold. After Arnold has received the hardware and software from CleVR, he starts it up for the first time. This because he wants to make sure everything is working and he understands how to use it. He puts on the gloves and the Oculus and starts the simulation. He is standing inside a supermarket in which he can pick up items from the store. After finishing the simulation, Arnold invites Reinier for a treatment session. When starting the simulation, Reinier experiences the virtual world as if it were real. While being in the simulation, Reinier starts picking up several groceries and puts them into his shopping basket. After a couple of sessions, Reinier is a bit more comfortable in social situations.

5.3. User testing

We decided to test our system with a group of 23 potential users. Before testing we prepared a questionnaire for the persons who had completed the test.
It consisted out of 9 questions:

1. The objects in the simulation behave in a natural way.
2. The virtual hand feels as my own.
3. The simulation is stable.
4. I immediately know which objects I can pick up.
5. I don't mind that my body is invisible.
6. According to me this simulation is realistic.
7. I find it easy to pick up objects in the simulation.
8. I feel dizzy after having completed the test.
9. The vibration that I feel during picking up an object really helps me.

After this, we created a dedicated scene for these tests in which users had to perform predetermined tasks, such as picking up an onion and putting it in the basket. While performing these tasks, we asked them to think out loud during the test.



5.4. Results

Most of the people had no health issues after testing our product, which suggests that the performance and optimisation of the system is up to standards. They indicated that the hand vibrations caused by the gloves while touching objects in the simulation helped them determining whether they could grab an object.
However, the grabbing of an object didn't go that well at first, for almost all people it took a couple of minutes to understand how to use their hand again for grabbing. But after a couple of minutes into the simulation, they were able to perform the tasks presented to them. We used this feedback to improve the grabbing of objects and made it a little bit more intuitive.

6. Evaluation

In the final version, our product contains all must and should haves from the initial requirements. The initial users of this product are the CleVR developers, but the end users are the psychosis patients. The final functionality of our product is consistent with our initial plans and thoughts about it. In the process of developing this product we tried to make it as stable and easy to understand as possible.

We mainly focused on the CleVR developers because they will eventually use our product to add functionality to their product which will be used to treat psychosis patients. The only requirements that we did not manage to implement are some of the could haves that we had defined at the beginning of this project such as:

- The patient could push other "people" in the environment.
- The patient should be able to buy the selected products by the cash register.

But after a couple of weeks into the project it became apparent that this functionality was not needed for the CleVR developers.

7. Outlook

After eight weeks of working hard on this project we are pleased with our end product. However, not everything was perfect so we do see possibilities for improvement and extension of certain features.

7.1. Improvements

In future projects we certainly will make the planning better. We did more work in the second half of the project, relatively to the first half, but that was also a bit because things were not always clear, especially in the first couple of weeks when we didn't really know what was actually expected from us. With a better planning there can also be a better distribution of the work that has to be done over the weeks and maybe there can be implement some could haves or other extension with the time that is gained when working with a better prepared planning. There are no improvements to be made on the communication and teamwork of our team. The cooperation was especially pleasant and fun. It was never a problem when it came to decision making and splitting tasks among all team members. The ambiance in the team is very nice but also very productive. We had a lot of meetings at which we would work together and eventually it all worked out.

7.2. Extensions

There are lots of extensions that can be added to make the product more realistic, intuitive, user-friendly and fun to use. A possible extension/improvement would be smoothing the movements of the body tracked by the kinect. That way the user would be more aware of how he moves in the simulation. Another thing that would be interesting to add is a shopping cart and also going to counter and actually buying the items that the users has collected in his/her shopping basket. Interaction with other patients or random people that walk around in the supermarket simulation could be added such as talking to other people, giving them a handshake or pushing them.

Other extensions of our product would be to let the therapist talk to the patient while the patient is in the supermarket simulation and make the groceries in the supermarket more realistic looking and add different sound effects to everything.