Overview

VR/AR technology is on the rise, and along with it is the gaming experience. Moreover, with the current pandemic, we could see the high demand for this kind of technology. Some of the reasons why this kind of technology is in need are to enhance the experience of interacting and communicating with other people digitally; to escape reality for relaxation or immerse yourself in another world. And since our team is composed of gamers, we have decided on our project idea to be a VR suit ( or haptic suit).

Motivation

Our central motivation for this project is for gaming usage. However, this technology could be used in many ways. For example, medical rehabilitation, the suit pulse could provide valuable feedback for restoring the movements of a patient. Furthermore, the doctor could also collect data from the suit to provide better treatment for the patient.

## Aims

Our aim for this project is to finish phase 1 (or parts of it), which is the full-body motion detection function. Currently, most VR technology only allows the user to use their upper body (hands and head). Because of that, our main goal is to develop a suit that allows the user to move freely in the virtual world while wearing it (upper-body and lower-body). And to achieve this goal, we would have to divide our project into sub goals.

Goal 1: First and foremost, we will need to decide what kind of motion detection method we want to use. The reason this goal is significant to the project is everything we are going to develop will be based on which path we took. There are several types of method that big companies are using, like VR tracking with Optic, placing sensors around the user environment, and use trackers to track user motion (like Vive Cosmos and Oculus Rift); or Non-optical VR tracking, use electromechanical sensors such as gyroscopes to track motion (the PS4 controller) or Myo armband which tracks electrical impulse from the muscles.

Goal 2: After we have decided which method, we want to base our project on, we will start to develop the arm and upper body motion detection. Whichever method we choose to use, our aim in this goal is to use that motion detection method and detect our arm motion. And since arm motion detection is the most basic function in all the methods, it will be beneficial for us to achieve this goal early on. Moreover, it would also help us to familiarize ourselves with the technology we choose.

Goal 3: Our third goal is to develop the lower body component of the suit and connect it with the upper body component. The reason this goal seems longer than the previous goals is the extra step of connecting to the upper body component. Moreover, this task could be a bit challenging since we have to make sure that the lower component works smoothly (no misinterpretation, no conflict) with the upper component. Furthermore, assuming we have already achieved the previous goals, the motion detection function of the lower body component will be just like the upper body component.

Goal 4: Our fourth goal is to develop the hand gesture detection function. Because of how many gestures our hand can produce, this would probably be one of the most challenging components. Furthermore, our hand is the most important tool on our body, so this function must run smoothly and accurately.

Goal 5: Our final goal is to make sure that everything will work smoothly with each other. Before we can move on to the next phase of our project, we want to make sure that the motion tracking function of the suit is working as intended. However, we are going to refine our motion tracking function to an extent as not everything will work perfectly, and we cannot work on it forever. Therefore, the goal is satisfied when there are not any major glitches.

The goals are organized by their priority in phase 1 of the project. If things do not go as expected, we will try and finish, at least, the second goal. Because of how fundamental and beneficial to finish the second goal is, it is our top priority. If we successfully achieve the second goal, we would also acquire the knowledge to do part of the third goal.

## Plans and Progress

### What is our project

Our project came into fruition after we watch the 2018 movie "Ready Player One" in which the main character wore the suit to play his game more immersive. Moreover, because all of our team members are gamer, we were super motivated and inspire by that concept. As the name suggested, our project lets you fully interact with the virtual environment while wearing the suit. What makes the suit special is that it can track your every movement more accurately than the normal VR controller. Furthermore, ideally, if more time and resources are permitted, our suit would also have sensor feedback just like in the movie.

### Description

A haptic suit is composed of components that lets the user experience the VR world more immersive. The suit would have some kind of motion sensors on it for tracking the user movements. Furthermore, the suit would also have a feedback mechanism that lets the user feel the virtual objects. One of the ways the sensors work is to detect the electrical activity of the user's muscle and link it to a specific motion. Or we could have different detection points on the suit and have the motion sensor surround the user like current Vive or Oculus technology. Moreover, the haptic suit would also be some kind of technology to generate the sensation of feeling on the user's skin. We do not think this technology existed yet, but we think we could assemble something related to it by using heat pads or a pain stimulator (turn down) to stimulate the pain. Or we could also use technology like the kinetic mirror , with many dots, to simulate the touch feeling. Another approach is we can make a layer of the suit to be inflatable to simulate pressure. Next, we would need a mini processor to process all the raw data from the suit and output it to a receiver. Moreover, the processor would also house some kind of AI to process all the movement and manage the suit function.

### Plan

For the first three weeks, all group members worked together to brainstorm and develop the project idea. This will ensure that everyone will get a saying in the project and find out who is best leader for each phase of the project. Furthermore, since we do not have enough time, we will only be focused on one of the core functions of the project, which is the motion tracking function.

Moreover, because we want to keep track of the progress of the project, we will be using our goals as anchor points and project map. Moreover, using our goals as anchor points will also ensure our project stay on track and prevent any ‘project creep’.

Goal 1: Decide what kind of motion detection method we want to use.

Duration; 1-2 weeks Feasibility

For our first goal, we want to spend some amount of time to choose the appropriate technology and tracking method we will be using. This is, undoubtedly, the most important step in our project, since each technology will have a different implement method. The main problem we would have in this step is the availability of other VR technologies like the Myo armband or the Vive Tracker for us to test. Furthermore, to compare each technology equally, we would also have to make a test to measure the result. For example, this test could be about the motion tracking accuracy of each method or the response time of each technology. The technology we will choose to use would have to fulfill some requirements like strong code community and customizable

Goal 2: Develop arm and upper body motion detection

Duration: 3-5 weeks

For this step, for the first couple of weeks, we will be designing and making our prototype of the arm and the upper body motion detector. By this point, we would have already decided on which kind of technology we want to use and so we will build our prototype base on that. After we are satisfied with the prototype, we will begin to build our first version of the arm and the upper body motion detector. Furthermore, before moving onto the next step, we would also have to ensure that the component work properly and only have some minor errors.

Goal 3: Develop lower body motion detection and connect it to upper body component

Duration: 3 - 5 weeks

For the first part of this step, just like the previous step, the first couple of weeks would also be for designing and making a prototype. However, we predict that it will be faster than the previous step since we only have to make remakes the technology a bit. After we are done with the prototype, we will also be making the first version of this component and test it for bugs and errors. We will be moving onto the next part after most major bugs have been fixed.

The second part of this step is to ensure that two components (upper and lower body) can work smoothly with each other. For this part we have two potential methods that could work: connect both parts to a microprocessor or connect them directly into the computer. The latter could put a lot of loads on the user computer CPU.

Goal 4: Hand gesture detection

Duration: 2-3 weeks

For this step, we will develop a type of gloves that can detect which hand gestures you are making. Just like the previous step, the first week would also be for prototyping. There are some methods we are considered using: a glove with sensors on the joints of each finger or implement the technology use in the Myo armband. The first method is more straightforward than the second, but it could increase the processing time of the suit with all the added sensors (14 sensors/hand). The latter method will be a hybrid between two motion detection method, where we implement the Myo armband into our suit.

Goal 5: Refinement.

Duration: 1-2 weeks

In our final step, we will continue to test all the components to see how well it work together. We will design and conduct some tests on the suit accuracy and response time to further fine-tune it. The main goal for this step is to find and fix all the major bugs that might have arisen when we put all components together.

### Roles

Lead Developers: This is role will work hand-in-hand with the technical designer since our project have software and hardware component. He/she will coordinate and lead the team to ensure we will not go off the track when developing for the project.

Technical/ Product designer: He/ She will be responsible for the overseeing the production and implementation of the technical aspect of the project. They will also act as the technical expert on project (tools, documentation, etc.). Moreover, they will also help designing test cases for each of the components of the product and help with the debugging process.

In addition to the two main roles above, our team would have to wear many hats and interchange weekly base on the members knowledge about the that current step. Furthermore, the two main roles above would be also responsible for testing each component of the project since we do not have a dedicated tester.

### Skills and Job

Product Manager

Quality Assurance

Lead Developer

Firmware engineer