Project Timetable:

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| --- | --- | --- | --- | --- |
| Tasks | Start | End (/2023) | Outcome | Completed |
| Research proposal   * Initial reading * Decide aims and objectives | 12/06 | 22/06 | I outlined a broad topic of research, including aims, objectives, related work, and methodologies. However, this did not narrow in on a particular focus area but summarised the research field with potential project purposes | Yes |
| Unity skill development   * Attend a virtual reality workshop * Use unity hub to develop basic game engine skills * Research unity in health care and rehabilitation | 3/07 | 9/07 | I attended a 2 day VR workshop, and developed my unity game engine skills by completing course provided by Unity | Yes |
| Project inspection   * Narrowing down to a more specific area of research * Prepare slides, and decide what devices will be used for the research | 10/07 | 13/07 | Completed a presentation, demonstrating the importance of my research, what challenges there will be and how I will overcome these challenges | Yes |
| Project focus   * Decide a focus point for my project (this was part of my inspection feedback) * Reading and discussion with supervisor/other professionals | 14/07 | 17/07 | Determined the focus point  Production of an immersive environment using forces to assist with upper limb rehabilitation | Yes |
| Project specifications   * Determine a project plan, including tasks, system requirements | 17/07 | 18/07 | Created a list of tasks to be completed to satisfy the system and project requirements | Yes |
| Creating a client sever architecture between unity game (server) and the haptic device (client) | 18/07 | 4/08 | Using UNET, or mirror.  This did not work as the communication wasn’t robust enough. We used DLL to communicate between game engine and haptic device | No |
| Using DLL import to access functions and classes from the force dimension SDK. This means I can use the force dimension delta in unity | 28/07 | 31/07 | The use of dynamic link libraries allowed me to establish a communication platform between unity and the force dimension delta device. This may cause issues in the future, and may need to re think communication strategy | Yes |
| Learn the force dimension SDK and start producing exercises using forces with unity | 31/07 | 4/08 | I produced an assistive forces interaction exercise that attracts the user to an object, and will produce resistive forces | Yes |
| Make a repelling force to act like a clinician training a patient in rehab | 31/07 | 4/08 | I created a repelling force that pushes the user away from an object | Yes |
| Design an immersive environment for virtual reality | 07/08 | 08/08 | I Produced an immersive scene, including objects to the user will have some orientation when using it in virtual reality | Yes |
| Rehabilitation game design   * Create an interactive game that will use forces to test a patients upper limb motor control and strength ability | 04/08 | 13/08 | My game design involved producing a force channel for a target to pass through that will repel or attract the end effector (user). The target will move randomly along sine calculated path | Yes |
| Experimental design   * Design an experiment for a quantitative user study | 14/08 | 18/08 | In discussion with my supervisor, I have designed an experiment that will use forces training to determine if kinematic accuracy of patients is improved when using haptic forces vs no forces | Yes |
| Implementation of experimental design   * Programming to implement the criteria of my experiment in unity | 21/08 | 25/08 | Creating a new script called ‘experiment manager’, this script sets up the experiment structure, and calls methods from the main script to provide forces during each trial | yes |
| User study   * Create an ethics form for use of virtual reality for participants | 23/08 | 25/08 | Ethics form has been designed and healthy participants can use my designed game | Yes |
| Project demonstration   * Design a presentation * Decide how I will present my experiment | 26/08 | 4/09 | Presentation covers aims, motivation, system overview, real world relevance, evaluation and demonstration with attractive and repelling forces | Yes |
| Statistical analysis   * Collect 20 trials data and analyse the data using statistical tests | 28/09 | 08/09 |  |  |
| Project report write up   * Create a structured plan for my write up * Give a detailed report about the system I have designed | 01/08 | 13/09 |  |  |

Problems ive faced:

* Implementing the force dimension device with unity
  + Couldn’t program a TCP or UDP connection as it wasn’t robust enough
* Ball movement
  + Using perloin noise algorithm however this was not predictable to create a force channel for the sphere to move around
  + Tried to create a random movement where a force cylinder would follow the target and rotate with its x axis using transform.lookat() method
  + Eventually went with a sine movement pattern
* Sine movement: this was good as it covers the whole work space available in curving motion
  + Getting the ball to move smoothly as it reached the target coordinate. Fixed this using lerp or catmanroll
  + Generating random movement along the x, y, or z axis
  + How to get the program to know when to spawn a new target position
* Force channel
  + Sine movement is predictable so able to activate and deactivate spheres along the sine path created
* Deigning the forces:
  + Creating a repelling force using negative force