
Main Objective:
Improve and combine and evaluate an automatic grasping system to enhance the manual interaction in virtual reality.

Background:
The hands are important for immersion in Virtual Reality. Some gloves have been produced to track accurately the fingers with reduced latency. However, there is no glove with an affordable and efficient haptic feedback system. Hence, we need to find a way to manipulate virtual objects without any haptic feedback. Most of the finger tracking system uses some metaphor to interact with these object. Thus, the visual feedback of the grasping does not seem natural and can break the immersion. That is why, we want to combine an automatic grasping system with the input obtained from a virtual glove to produce more natural manual interactions. This approach is similar to the one used in the game like Lone Echo although we have a richer input than the oculus Touch used in that game (see the video): https://www.youtube.com/watch?v=CyP3LZNa_IA).

Assisted grasping for Virtual Reality has already been explored in the past (R. Boulic 1996) (Rezzonico n.d.). We have already begun to implement a grasping system based on this previous work and we want to improve and evaluate it.

Project Idea:
In the laboratory, we have gloves called Manus VR. They work with Vive Tracker and the lighthouse system which is a new tracking system made by Valve. We use these gloves to track the hand and the finger to reproduce their position in a virtual world. To this end, an automatic grasping has already been implemented where all the fingers wrap around the virtual object without any interpenetration. However, this system is limited to a certain number of shapes and types of manipulation. Therefore, we need to extend our system to new shape and way to interact with the object and evaluate this new system thanks to a user study. One useful concept to start with is the one of “smart object”
where the objects present in the virtual environment are enriched with the additional information of the set of possible grasp postures to use them correctly (Kallmann 1999). One possible track would be to use a neural network to learn such predefined grasp postures and to recognize which one is closest to the current user hand posture. (Tian, Wang and Xinyu 2018). Our previous system can still be used to adjust the fingers around the objects or to improve the interaction with the object (Rezzonico n.d.) (R. Boulic 1996). In this project you will first determine the best approach and extend the previous grasping system. Then, you will have to establish a protocol in order to evaluate this system and compare it with the previous grasping system.

For a Master project, you will have to conduct a user study to assess and compare the current and the proposed approaches in terms of interaction efficiency, embodiment and presence.

**Goal:**
- Extend the current automatically assisted grasping system.
- Design a protocol to evaluate our current system and the new proposed approach.
- Master project: Compare the two systems in terms of efficiency, embodiment and presence through a user study.
- Provide a Unity plugin

**Requirements:**
- Unity (scripting in C#/DLL in C++)
- 3D geometry and quaternions (Vectors, cross products, rotations)
- Matlab/R (statistical tool).
- Neural Network (basis)

**Information, materials and resource:**
*Unity3D game engine*: http://unity3d.com/learn
*Vive Tracker*: https://www.vive.com/eu/vive-tracker/
The project of our previous system (Unity project and Notice) will be given

**References**

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