
Main Objective:
Evaluation of different ways to integrate some part of the real environment that surrounds the user immersed in a virtual world without breaking the sense of presence.

Background:
The ZED mini is a new generation of depth and motion sensing camera. The camera can build a geometric map of the environment in real time and even produce a photogrammetric environment from the world surrounding the user; see the video: https://gfycat.com/fr/gifs/detail/GrotesqueAllArabianwildcat.

We have used it to implement an application able to generate a map for a game in real-time from an indoor environment.
The new Windows Mixed Reality headset is a new Virtual Reality (VR) headset, which uses two cameras mounted on the front of the headset to locate it in space. Thus, if we combine this headset with a computer backpack, we can imagine going everywhere without any limit.

Project Idea:
Since the user is equipped with a computer backpack and is able to move with no constraint in any environment, s/he needs a way to avoid any unwanted collision. For the current consumer headset, the system displays a grid to delimit the safe area. However, this grid can break the sense of presence during a VR experience. On top of that the area delimited by the grid needs to be free from any physical object. Instead of removing all physical objects from the tracking area we rather opt for an approach that includes the real world surrounding the user inside the game. Indeed, the zed camera can scan the environment in order to generate a mesh in real time inside the application. This mesh is then used to create the virtual world (a real surface like a table becomes a virtual surface in the game). In the present project, we just want to use the mesh previously generated to add extra information in a game already existing. It will be like an overlay that will draw some element where there is an actual obstacle in the game to warn the user about its presence. These elements can be represented
in different ways in our virtual world and one goal of this project is to identify the most appropriate ones to minimize generating Breaks in Presence.

Then, these different representations will be evaluated and compared in order to find the one improving the best the user experience in a VR experience. In the case of an overfilled tracking area, it will prevent the user from any accident without restricting the boundaries of its game area (the area where the user can move physically with the headset). For this purpose, a protocol has to be developed in order to find the proper criteria for our evaluation.

Goal:
- Design a protocol to evaluate and compare the proposed representations.
- Design different representations of the real elements in VR.
- Conduct a user study.
- A Unity plugin ready to use has to be produced.

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

Information, materials and resource:
Unity3D game engine: http://unity3d.com/learn
Zed API: https://www.stereolabs.com/documentation/overview/spatial-mapping/using-mapping.html
The project with the ZED camera (Unity project and Notice) will be given

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