Initial Report

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Abstract

1 Problem definition

Currently the environments that are simulated with head mounted devices do not support a lot of movement. This is mainly because users would need a large empty room or the developers only can create small virtual environments. So a lot of research is done to decrease the space users need to feel like they are really walking in a big virtual environment, while actually moving in a small room. This can be done by decreasing or increasing the angle when people are rotating. While doing this, the users feels like he is still walking straight, but in reality he is walking in circles as shown in figure 1 . In that way the amount of space an user need is decreased. The perceived reality by the users depends mostly on the user. We can really decrease or increase the angle to minimize the space needed, but then the user does not perceive the virtual environment as real anymore. So we need to find the points at which the user still perceives the virtual environment as real, but minimizes the space needed.

So the goal of our project is: We would like to minimize the space needed to walk the path that is shown in the virtual environment, while users still perceive that they actually walked the path in the virtual environment.

2 Virtual Reality Concepts

The Oculus Rift is a head mounted display and uses an *egocentric* viewpoint. The perceived viewpoint and orientation are that of the self. Using the head tracking functionalities of Oculus Rift, we can update the image in real time such that the participant believes she is physically present within the virtual world. This VR-concept is called *presence* and is very important for our experiment.

Using *Substitution* of real data by computer generated data we try to get the participants to walk a different path than what they think. For example the rotation degree of test subjects walking in a curve can be exaggerated in the virtual world resulting in subjects walking in a tighter curve in reality than in the virtual world. This influences the feeling of presence. It is likely that for very large differences between the physical world and the virtual world, test subjects will no longer accept the virtual world as real. They will no longer feel present.

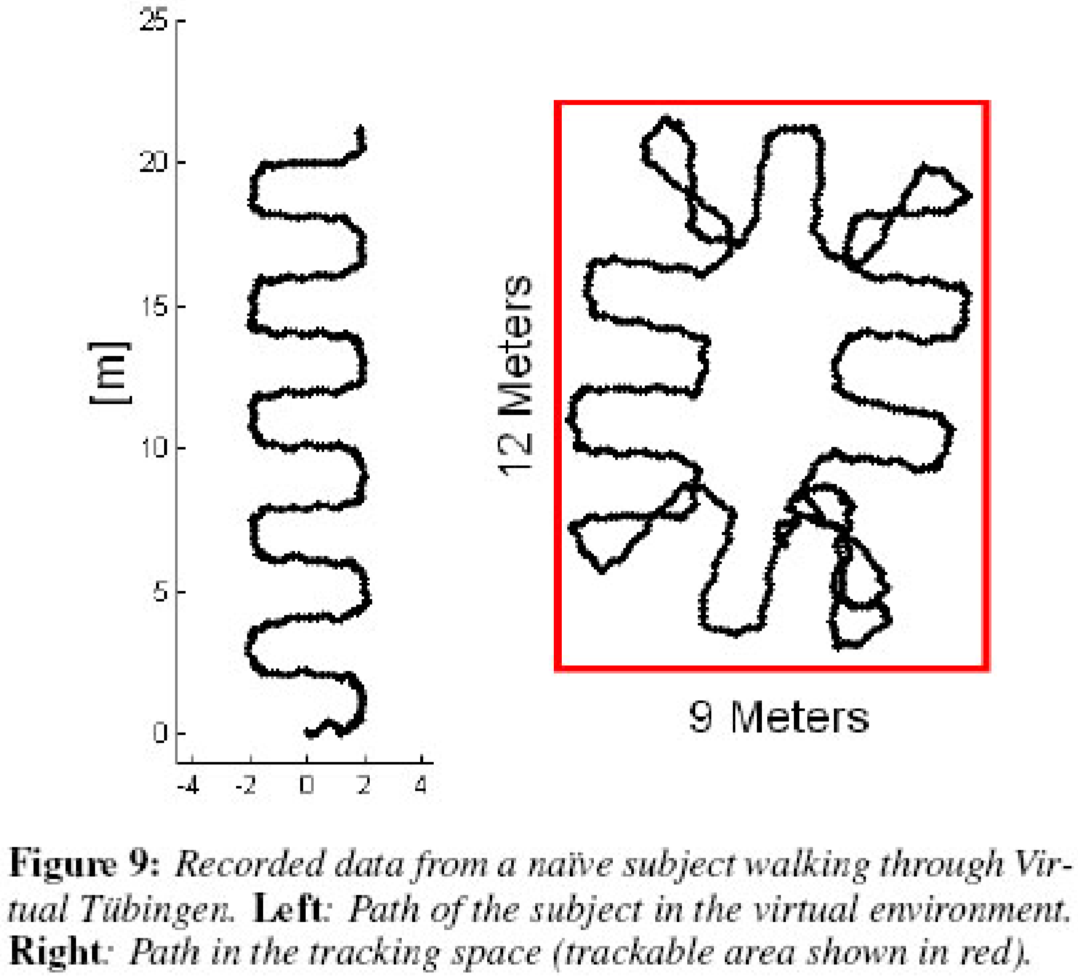

Figure 1: Decrease space needed by changing the angles of corners

The Oculus Rift claims to be "truly immersive virtual reality" and has a 110 degrees diagonal and 90 degrees horizontal field of view providing a stereoscopic 3D perspective. Head tracking has six degrees of freedom, meaning a user can rotate his head in any possible direction and the view will update in that direction. The resolution of the two screens (one per eye) are 640x800 pixels for a total of 1280x800 pixels.

3 Approach

As stated previously, we're planning to equip a number of test subjects with an Oculus Rift, and have them walk a path. The first step for us, is to create a virtual world. We need to bind the movements of the virtual world to the movements that the subjects make in real life. This will most likely require us to program using an Oculus Rift API, with the added possibility for us to change the rotation ratio, i.e. the amount of real world rotation in comparison with the amount of virtual world rotation.

A test subject will attempt to follow a path, with a given rotation ratio. Whilst running the test, the test conductor will actively follow and record the path the test subject has travelled in the real world. After completing his task, the test subject will be asked to draw the path he thinks to have traveled on a piece of pape. We can then compare the subject's perceived path to the actual path, and the virtual path, and as such determine the level of immersion. If the user's perceived path tends more to the virtual path, the level of immersion will be high, if it tends more towards the actual path, the level of immersion will be low. To achieve this, we will need to devise an algorithm to give a value to the level of immersion with the given data.

We will test several rotation ratios, having multiple test subjects per ratio, to reduce the chance of errors. Using the algorithm, we can then determine for which ratio the level of immersion versus the size of the room is optimal.

It might occur that we are not able to access an Oculus Rift at all times. Given to the fact that a large number of tests may have to be conducted, this might give rise to some logistic problems. To compensate for this, we have a backup plan. Like the Oculus Rift, most modern smartphones are also equipped with gyroscopic sensors. These can, and have, been used as a method of motion tracking. We might be able to get our hands on a head mounted smartphone holder, where the smartphone is placed in front of the eyes in such a way that one eye can only see half of the screen. We have found software that can stream a computer ran game to the smartphone wirelessly, whilst also converting it to 3d. This can act as a replacement to the Oculus Rift. This may also serve as an addition to our project, by comparing the level of immersion of an Oculus Rift to that of the head-mounted smartphone.