Final report on Eye Tracking in Oculus Rift

BACKGROUND

The NHTV has produced a number of virtual environments for research and industry applications. The most well-known and well-developed of these is the Virtual Supermarket, a life-like rendering of the average Dutch supermarket, including aisles, check-outs and several thousand products for purchase. This environment is ideally suited for the academic or commercial study of the effect of visual design on people and their behavior.

The supermarket was developed for use in our CAVE, a Computerized Virtual Environment with four back-projected screens which gives the user an impression of really walking inside the virtual world. The CAVE has several key advantages, but it is not easily transportable due to its size and technological complexity.

The Oculus Rift DK1 is a popular prototype of virtual reality goggles that are mounted on the head, obstructing the view of the outside world and presenting an immersive view of the game world. Head movements are tracked in real time, so when the participants turns around, the illusion of a virtual world is carefully maintained. Oculus has released a number of prototypes until now, some of which were for sale and sold over 50,000 units. A large-scale commercial release is expected within 1 to 2 years, at at 300USD price point or lower.

We have ported the virtual supermarket to the Oculus Rift DK1 with great success. The major drawback is that instead of moving through the supermarket by walking, a game controller is necessary. However, large-scale (commercial) testing of visual design, routing, and product arrangements are much easier to accomplish with the Oculus because we can use multiple units in parallel and we can move them around easily.

Many commercial research questions about a supermarket ask for eye tracking: So called 'hot spots', which will be seen by most users, are of great commercial interest. Similarly, academic studies have used eye tracking to determine what strategies users use to gather information facing such an overload of stimuli.

IMPLEMENTATION

The aim of this project was to provide large-scale commercial-style eye tracking in the Oculus Rift. The project researched a number of avenues to this goal, using electrical potentials from eye muscles (EOG) and more traditional use of infrared cameras. The EOG method was tried and rejected, as it was too prone to noise. The camera method brought on a host of problems and difficulties, from the very small space in the Oculus to the amount of heat produced by the cameras.

Because the cameras are so close to the eye, they provide only limited viewing of the eye. This was solved by using multiple cameras and writing software for compositing their images so the eye tracker could work with them. Additional problems were encountered with the illumination: Because the infrared light sources are so close to the eye they tend to cast shadows, which confuse eye trackers. On the other hand, EU health directives limit the total amount of infrared that is emitted into the eye.

Several software packages were tried for the processing of the camera images, and after rejecting two other candidates, Pupil Labs was chosen. This package is free for research and commercial licenses are available. Pupil was modified in several ways to suit our needs.

A hurdle that has not been fully cleared yet is the variety in physiology: The position of the eyes in the eye sockets and the fit of the Oculus goggles over the nose and bony edge of the forehead differs greatly from person to person. We wanted to obtain a solution which required no adjustments, but so far this has proven elusive. While most contact lenses do not interfere with the eye tracking, glasses

cannot be worn inside the Oculus and this excludes an additional group of people. Finally, some people get disoriented and nauseous from the Oculus experience.

CONCLUSION

Eye tracking in the Oculus Rift is possible and has been obtained. The resolution is sufficient for commercial applications relating to furniture placement and routing. There are some limitations in applying the technique to the general audience, which we think can be overcome by further development.