Integrating hardware in VR training simulations

Author: E. M. Frentrop

Company: Twinsense 360

Programme: Industrial Design BSc, University of Twente

This bachelor assignment, provided by Twinsense 360, was proposed to improve VR training simulations. Twinsense 360 is a company that specializes in the creation of AR- and VR-apps, for both mobile and stand-alone devices, and now want to expand into VR training simulations.

With the current state of technology, it is possible to show a virtual environment to a user. This provides new opportunities, like using VR to create a VR training simulation. However, the realism of VR training simulations must be improved before it is viable to use for actual training purposes. A major improvement would be the possibility to control the VR training simulation with hardware that is used in the real-world situation. At the moment it is not yet easy to integrate hardware in VR simulations. There are game controllers that can be used, but for hardware integrations, the interface has to be developed for every integration.

There are several advantages of using VR training simulations over regular training simulations. VR training simulations depend less on locations to provide training and have less of an effort to set up the training. In the case of a fire simulation on an oilrig, repeating costs could be reduced, planning training simulations would be easier, since there is no need to hire and go to an oilrig, and there is no need to create artificial fires for the simulation. It is also possible to train situations that would normally be too dangerous, too expensive to train, or could only be trained under specific circumstances. With VR training simulations, it is possible to train operations, without the possibility that valuable equipment will break down, injuries occur, or high costs are involved when a situation or equipment is handled poorly by the trainee. It is also possible to recreate situations that normally would be impossible, or near-impossible, to recreate without endangering people, or depending on external factors.

To improve the realism of VR training simulations, physical objects and interactions need to be added that correspond with the real-world situation. How the objects and interactions are used and displayed in VR should correspond with the hardware that is used to control this VR simulation. To increase the usability of VR training simulations, Twinsense 360 wants to control VR simulations by using hardware that is used in the real-world situation. Because developing a hardware integration from the ground up for every project would take a lot of time, Twinsense 360 is interested in the development of either one interface that can be used for every hardware integration, or the development of a framework that can be used to develop new hardware integrations.

In order to accomplish this, the following goals are composed:

- Analysis of methods to send signals from external equipment to the VR simulation;
- Developing a method to integrate hardware in VR training simulations in

order to control these simulations with the real-world hardware;

- Implementing this method to add extra interaction to the firehose in the (existing) VR fire extinguisher simulation;
- Implementing this method to create a VR demo on controlling a crane with a real-world control panel.

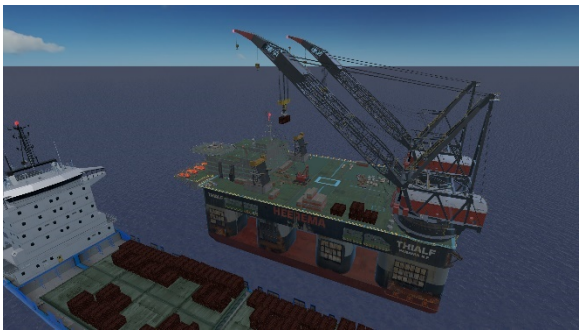

Figure 1: The VR-scene that is used for the two implementations.

After research on methods to send signals from external equipment to a VR simulation, research was done on different ways of getting data from hardware. Since VR training simulations can be created for anything that requires training, big differences in the hardware that is used can be expected. Because of these differences, getting data from the different hardware are going to be different for other projects as well. This means developing one interface for all integrations is not viable. Research and several tests were conducted for different kinds of interfaces, and these findings were compiled into a framework for developing a hardware integration. This framework does not provide one simple solution for hardware integrations. It does provide directions in what area solutions can be created.

For the implementation of extra interaction to the firehose, a Vive Tracker was used. This removes the need of a microcontroller to detect interactions. It detects whether the firehose is closed or not, and sends this information to the VR simulation. The simulation then turns the firehose on or off.

Figure 3: The firehose with detection for the handle.

For the implementation of the crane control panel, several manufacturers of control panels were contacted. In collaboration with the manufacturer Hetronic, a design has been made of the control panel and components that will be used. A separate transmitter is used to send the data to the VR simulation, and this data is used to control the crane.

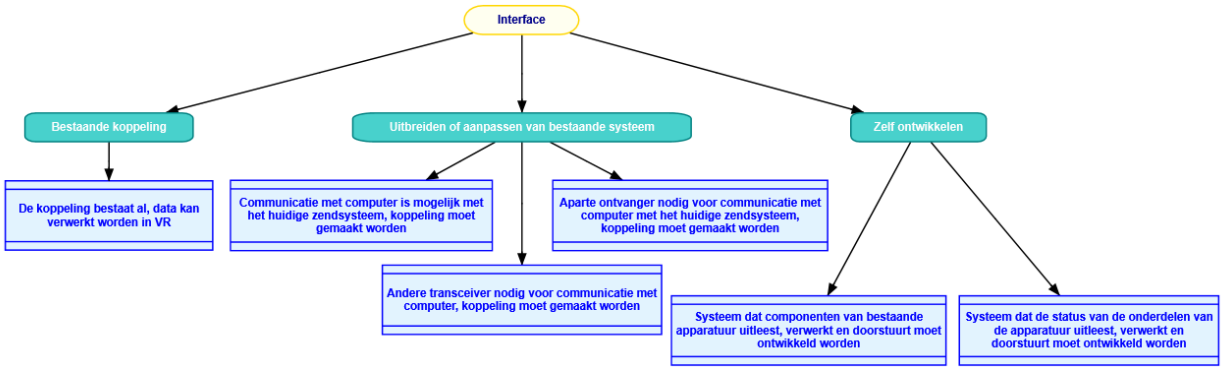

Figure 2: The three major possibilities of developing a new interface.

Figure 4: The control panel that is used to control the crane.

Positional tracking of the equipment is done with Vive Trackers. To improve usability of the VR simulations, a Leap Motion has been added to provide hand tracking.

Figure 6: The Vive Tracker.

Figure 5: The crane control VR simulation in use at a convention.

The developed interfaces work without any real hiccups in office environments. However, at conventions, the quality of the signal depends on environmental factors. Interferences within the spectrum that is used to send the data to the VR simulation can cause stability issues that have not yet been solved. Further development and tests are needed to improve stability. Another solution could be to use another frequency to transmit data to the VR simulation.