A VR based safety training in a petroleum refinery

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Abstract

We present the prototype omVR, which is a Virtual Reality based safety training system in a petroleum refinery. It provides an advanced technique for personnel safety training and allows users to navigate through the training setup and interact with parts of the refinery. By using a head mounted display a high degree of immersion is achieved. omVR is the implementation of a training scenario, which is too dangerous, difficult, or expensive to be performed in real life. In our system the trainer has the possibility to control the scenario from a remote trainer module which communicates with the VR simulation program.

Keywords: virtual reality, virtual environment, safety training, refinery

1. Introduction

In virtual reality, safety training truly becomes alive and gives the trainee the feeling of being involved in the virtual training world [2,3,4,7]. Traditional training, like courses, seminars, etc. suffer primarily from two problems: On the one hand they tend to focus on theoretical issues rather than on practical training. On the other hand practical training in hazardous environments increases training costs due to safety considerations and related production stops.

2. Application

The *omVR* application was developed at the Johannes Kepler University of Linz (Austria). The goal was the implementation of a prototype to show and investigate the advantages of a VR based safety training system for refineries (see Fig. 2).
omVR has been designed to foster natural interactions in the training environment by a maximum transfer of training skills. The historic methods of field training, which entail high costs and dangerous situations, can now be performed within the safe and economical *omVR* environment.

One goal of *omVR* was the simulation of the employee's behavior in the case of H_2S emissions during the daily check. Moreover, the trainer has the possibility to control the VR scenario by using a remote application and thereby simulate different scenarios. *omVR* provides training exercises and simulated refinery environments for training specific tasks, situations, and environments that would not be feasible due to limited resources, time concerns, and hazards in usual training setups.
Finally, it is possible to train appropriate behavior and decision making under stressful conditions posed by scenarios that represent extreme risk situations [8].

Figure 1: *A training session with omVR*

3. Implementation

The *omVR* architecture consists of two different modules (see Fig. 1 and Fig. 2):

- The *omVR* trainee module, implemented on a graphics workstation, runs the virtual reality simulation (see Fig. 3).
- The *omVR* trainer module allows the trainer to control the 3D refinery scenario.

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Our application uses a head mounted display (HMD), which results in a high degree of immersion. The simulation application is based on the IRIS Performer 2.2 graphics library [5] and on MR Toolkit 1.5, which provides the interface to the tracking device [6]. The trainer module was written in Java and has two main functions: First, it allows the trainer to control the VR scenario. Second, it creates a protocol for each session.

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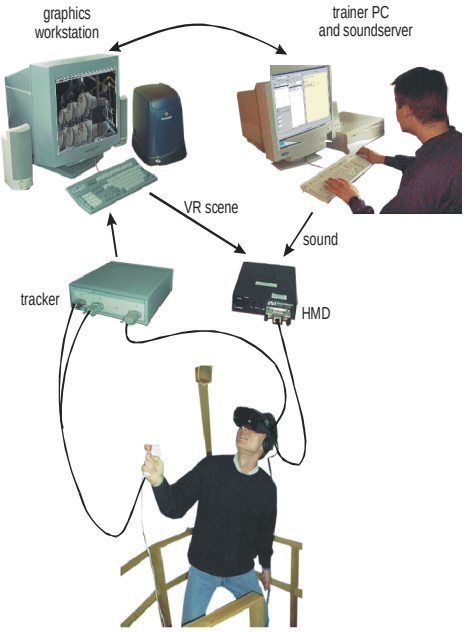

Figu
re 2: *The topology of the omVR training system*

4. Benefits and advantages of omVR

Beginners are typically overwhelmed by the amount of information and the complexity of the task to be trained. As a result the trainees often do not react in the right way. In our virtual environment users are able to skip advanced training sections, which enables them to concentrate on the essential parts of the lesson. Hence the motivation of the trainee increases and thereby training efficiency is improved.

At the moment, the *omVR* application is under examination by Austria's biggest oil refinery, named OMV [1]. The company tested it with many employees and it has been accepted with big enthusiasm as a new training system.

Figure 3: *The trainer sets the values of the instruments.*

The relationship between the trainer module and the simulation of the virtual world becomes the heart of the educational system and the trainer module carries an automatic score table. Thus there exists a list of all the possible events and tasks in the scenario. The trainer can give orders, activate events and control objects in the 3D world, such as the values of instruments (see Fig. 3). According to the actions of the trainee, he/she will be awarded with bonus points or penalized with minus points.

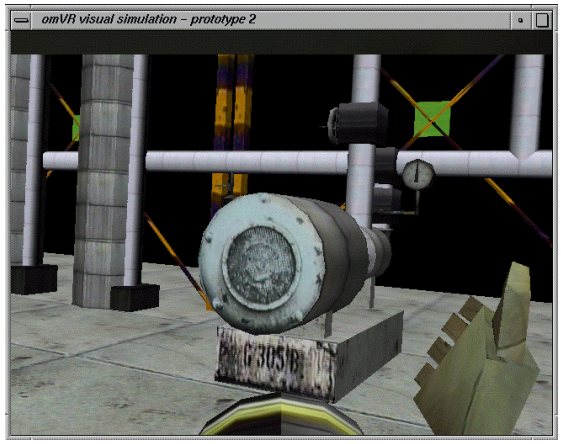

Figure 4: *The trainee has the feeling to be involved in the virtual world.*

The benefits and the advantages of the *omVR* training system are:

- It allows the training of situations that would otherwise be too dangerous.
- Scenarios can be realized, which are too complex for conventional teaching methods.
- Trainees get a better understanding of the operation sequence.
- The focus is on *learning by doing* – learning from mistakes.

Employees are able to explore the effect of their decisions without risk.

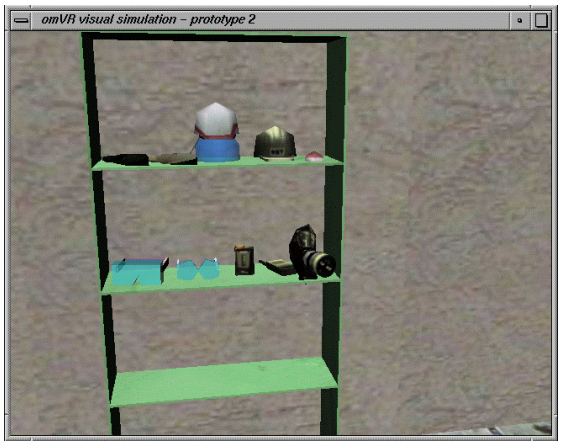

Figure 5: *The equipment of the trainee is located in a cupboard.*

In virtual reality, employees have a first hand experience of the inherent dangers of their working environment and of how to react correctly.

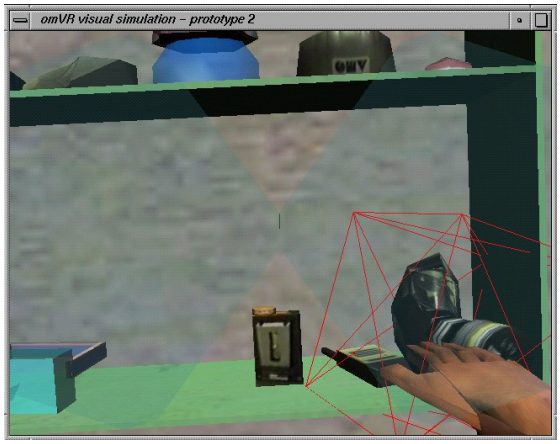

Figure 6: *The trainee picks up the gasmask before he performs a dangerous task.*

The virtual environment resembles the real world working area. Using saftey equipment and performing tasks with care and in the correct order should soon become a matter of daily routine.

5. Current and future work

A CAVE version is currently under development (see Fig. 7). Although the training setup described above is more suitable for our scenarios, a CAVE version could aid in building a scenario. Multiple persons can enter the virtual space and discuss the functionality and layout of the environment.
The final HMD application will utilize faster hardware for more detailed models, improved interaction mechanisms and an enhanced software architecture that will allow users to easily create new scenarios or modify existing ones.

Figure 7: *A CAVE version is under development.*

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