INTRODUCTION OF THE VIRTUAL LOGISTICS LABORATORY OF THE UNIVERSITY OF MISKOLC

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Abstract: The paper gives a detailed introduction of the equipment and the software installed in the Virtual Logistics Laboratory of the Department of Materials Handling and Logistics, at the University of Miskolc. The primary aim of this new laboratory is to help the development of the various applications of VR (Virtual Reality) technologies in the field of logistics, moreover to spread the related knowledge among the students and various professionals. In accordance with these goals, the paper not only gives a detailed introduction, but it also shortly describes the possible utilization of the presented tools and equipment of the facility. This also prepares the way for a future work, which will summarize the gathered experience and the specific research goals related to the Virtual Logistics Laboratory.

Keywords: virtual reality, development trends, logistics research

1. Introduction

In July 2011, the Department of the Materials Handling and Logistics of the University of Miskolc successfully opened its new Virtual Logistics Laboratory, which was installed on the second floor of the building of the Regional Adult Education Center. The main partner in the development of the laboratory was the Otto Von Guericke University of Magdeburg, which provided essential support during the entire development process. The new equipment serve as excellent tools for getting in touch with the latest technologies in VR, moreover for studying the utilization of these technologies in the area of logistics.

The upcoming introduction aims to present the main systems of the new laboratory in a relatively detailed manner, moreover to summarize the main areas of utilization of these systems. Later, it is planned that a more detailed introduction of the experiences gathered with the new systems will follow in a separate paper.

2. Introducing the installed equipment in the laboratory

The main equipment of the laboratory is an interactive display systems that is capable to provide a stereoscopic 3D image. This system makes possible the visualization of interactive virtual environments, which can also be freely manipulated with the help of the device. The display is connected with a dedicated workstation, which runs the software called "Virtual Development and Training Platform", an application which was created by the Fraunhofer IFF and serves as the core of the entire system.

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The hardware of the interactive display is composed of the following elements:
- 2 projectors,
- frame for the projectors,
- projection screen,
- 2 x polarisation filters (glass),
- 25 stereo glasses (plastic, linear polarisation),
- PC for graphics,
- Tracking-System (2 cameras, Tracking Software, Controller (PC), 1x sizing set, 1x Standard-Target for stereo glasses, 1x Standard-Target for tracking, 1x Set marker, 1x compatible interaction device („FlyStick3), 1x "RumbePad", 1x "SpaceNavigator", 1x "WiiController", 1x "GyroMouse").

The working principle of the display system is built on linear polarization: the images of both projectors are polarized but with a 90 degree difference between their planes of polarization (this is realized by the two polarization filters before the projector-lenses), while the individual lenses of the stereo glasses only allow one of the beams to pass through, which allows the separation of the images for the user. The two projectors provide slightly different views of the same virtual environment, which are naturally combined together by the user to form a single 3D image. The interactivity, the other element of the VR is realized with the help of the tracking sensors mounted on the top of the frame of the display. These cameras detect the "targets" (the marked stereo glasses, the "Flystick", etc.) with the utilization of the so-called „motion capture" technology, thus creating the connection between the movement of the user and the simulated virtual environment. Besides the previous, radio-frequency connection based devices ("GyroMouse", "RumbePad", "SpaceNavigator", "WiiController") are also available for interaction.

Four additional workstations are also provided with the display system, mainly for helping the testing and development of new virtual environments. These workstations also use the same "VDT-Platform" software that is on the main computer, thus making the development process much simpler. The technical specifications of the workstations are:
- CPU: Pentium Core 2 Quad,
- Video card: high-performance nVidia Graphics Card with 1 GB RAM
- Memory: 4GB RAM,
- Hard-disk drive: 250GB (7200 revolution/minute),
- Bluetooth,
- DVD-reader/writer,
- TFT display,
- wireless keyboard and mouse,
- 2.1.-loudspeaker

Besides the interactive display system, a special visualization device, a so-called "light field" display was also installed in the laboratory. This equipment was manufactured by the Hungarian firm "Holografika" and has the designation "HoloVizio128WLD" (it is the first member in a line of such displays manufactured by this company). In a very simple form, the working principle of the device can be described in the way that it tries to give back as many samples as possible of a single image in the same time, with respect to the individual focus points of each sample. This is done with the help of "voxels", building units of the

screen that can "emit light beams of different intensity and color to the various directions", thus creating an "autosterescopic" visual effect that is very similar to the natural 3D view and doesn't require the use of additional equipment.

Picture 1. The 3D Interactive Visualization System (Right)
and the Holovízió 128WLD display (Left)

The 32" sized screen of the device is ideal for general PC applications, while its 50 degree viewing-angle allows utilization by multiple users in the same time, even by a small working-group. Using conventional nomenclature, the 3D image is created with the use of 9,8 million pixels and the software environment allows the utilization of standard 3D applications in the image-generation process. However, this system alone can't provide the possibility of natural interaction with a given VR-environment, moreover its dimensions are significantly smaller than that of the main system. Because of these circumstances, the two devices can be considered as complementary systems of each other. The main parameters of the HoloVizio128WLD are:

- 3D resolution: 9.8 Mpixel,
- Screen size: 672mm x 420mm, 32" (792 mm) diagonal,
- Aspect ratio: 16:9,
- Color: 16 million (24 bit RGB),
- Viewing angle ~ 50° horizontal,
- Dimensions (W x H x D): 944mm x 602mm x 445mm,
- Weight: 55 kg,
- Nominal voltage: 230V@50Hz, 115V@60Hz
- Power Consumption: 600W, 3 pole power cable
- Light source: LED array.

The previously introduced device also requires one or more connected workstations for its operation, which are able to convert the images of many different applications into the appropriate format for the "light field display", thanks to the use of a special software provided by "Holografika". The appropriate number of workstations can be between 1 and 3, but this largely depends on the situation and the converted application. As we tried to create a general-purpose configuration in the laboratory, one that serves both for education

and research purposes, therefore we decided to install two workstations for the device, both provided by "Holografika" as well.

Picture 2. Workstations for the "VDT-Platform" software

The technical parameters of the two graphical-computers are the followings:
- Motherboard: Gigabyte GA-Z68X-UD3-B3,
- CPU: Intel Core i5-2400 3,10 GHz6MB cache,
- Video Card (GPU): 2x NVIDIA GTX560 1GB,
- Memory: 8GB DDR3 1600MHz,
- Hard Disk: 2TB 3,5" SATA 5400rpm,
- SSD (only in the first workstation): 120GB 2.5" SATA,
- power supply: 850W.

Picture 3. The projectors for the visualization system

The two workstations together are able to provide sufficient performance for almost all possible tasks (it needs to be noticed that the necessary computational performance for calculating the parameters of a "light field" is exceptionally high). This is important

because although the device is not the best solution for the visualization of an interactive VR environment, however it is compatible with almost all of the important 3D design software in the various industries and it can put the image of these applications directly in real time onto its screen, thanks to the special software of "Holografika". This feature could be highly advantageous in many different fields, not just in logistics and in other engineering disciplines, but also in areas such as air traffic control, medical visualization, geology and in the search of various natural resources, etc. It is needless to say that it is also highly valuable from an educational perspective as well.

3. Introduction of the „Virtual Development and Training Platform"

Although the physical visualization of the VR environments is made possible by the display system introduced in 2.1., it is needless to say that a dedicated software-development tool is necessary for supporting the visualization process. This is software is the previously introduced "VDT-Platform", which makes possible the creation and the running of custom VR "scenarios". In other words, the application serves both as a development and a user environment at the same time, which is quite beneficial during the testing phase of a recently created scenario.

The main advantage of the "VDT-Platform" is that it allows the import many different types (formats) of 3D models, which then can be customized and animated with the scenario-building tools (the software supports most of the widespread 3D formats, but till this time, mostly VRML and FBX files were imported with our system). In accordance with the previous, the development process usually starts with the creation of a static 3D environment, typically with one of the generally used CAD applications. After this phase is completed, the file then can be imported into the "VDT-Platform", where different interactive functions and the related animations can be created with the numerous scenario-building tools. This process is represented schematically in the diagram below, which shows the hierarchy between the various elements of a scenario, starting from the static 3D geometry made by a design-software.

The types of the different scenarios range on a wide scale, starting from the completely pre-defined film-like animations to the almost limitless, so-called "exploration mode" scenarios (it has to be noted that a single scenario can support various user-modes in a single environment as well, though it necessarily requires more development work on the file). The possible utilizations of the scenarios can be very diverse, ranging from the preliminary development process of prototypes to the complex simulation of various industrial process (logistical or any other type), but also including other application fields such as training, examination of safety-critical processes, virtual tourism, interior design, etc. It could be said that it is common in almost all application forms that they examine the operation of man-machine interfaces in various forms.

The Department of Materials Handling and Logistics and the Department of Descriptive Geometry started a close cooperation to exploit the possibilities of the above presented system for the purpose of scientific research and industrial utilization. The first step of this collaboration will be the completion of an interactive simulation of the integrated materials-handling system owned by our department (this project is currently under development). The experiences that have been already gathered during this work will have a significant contribution to other industrial projects, while they can also be incorporated into the

educative-materials as well. All of these subjects will be supposedly covered in another paper, with the detailed introduction of the work that has already been done on the simulation.
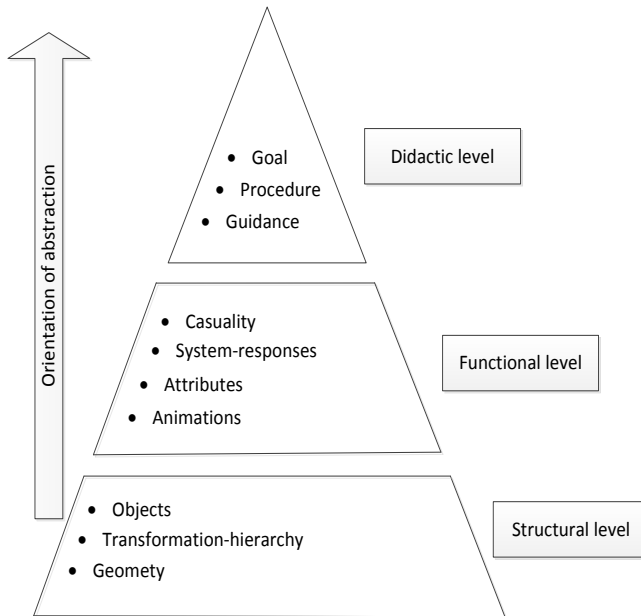

Figure 1. The hierarchical levels of abstraction in the „VDT-Platform"

4. Summary

In the publication, the Virtual Logistics Laboratory of the Department of Materials Handling and Logistics of the University of Miskolc was introduced, including the detailed description of both the hardware and software elements of the system. It was a basic aspect during the introduction that the possible areas of utilization should also have been highlighted, providing an overall picture of the potential of the system. The paper also gives an insight into the development trends of the current VR technologies, which can be particularly useful from the different fields of engineering, as such VR tools are starting to appear in the inventory of the larger research centers at an ever increasing rate.

Literature

[1]   Fraunhofer IFF: *Documentation Interactive Visualization System, VDT – Virtual Development and Training (PDF)*
[2]   *www.holografika.com*