

Introduction to use virtual reality visualisations in the exploitation and virtual testing of machines

K. Foit*

Institute of Engineering Processes Automation and Integrated Manufacturing Systems,
Faculty of Mechanical Engineering, Silesian University of Technology,
ul. Konarskiego 18A, 44-100 Gliwice, Poland

* Corresponding author: E-mail address: krzysztof.foit@polsl.pl

Received 20.04.2007; published in revised form 01.12.2007

Analysis and modelling

ABSTRACT

Purpose: Purpose of this paper: Due to quick evolution of virtual reality systems, this technology is more often used in processes of prototype's design. On the other hand it could be also effective in others applications like virtual manuals, help systems, catalogues, education, visualisation, testing and virtual prototyping. The aim of this paper is to show some properties of the selected virtual reality systems, which could be used in the exploitation and virtual tests of machines.

Design/methodology/approach: All software tests have been provided on Windows platform using selected ActiveX plugins for browsers.

Findings: Creation of presentations, virtual manuals or catalogues is not a difficult task. It can be done using widely available software. However, virtual prototyping and testing are harder to manage and requires more knowledge about computer simulation. EON/EonX and Cortona software are rather presentation than simulation tools, but there is still possibility to create interaction with other application or external hardware.

Research limitations/implications: In described tests only selected software have been used. All results and conclusions are related to EON/EonX and Cortona applications.

Practical implications: The use of ActiveX technology gives a possibility to use a ActiveX control in almost any modern Windows application that supports it. Windows platform is also often used in handheld devices and industrial applications, so it is possible to create a virtual manual or a presentation, which could be displayed directly on machine interface.

Originality/value: VR technology is worldwide used in many areas. EON software creates new possibilities in the field of virtual reality by handling special interfaces and display features. In the paper it is shown that the software can be used for more conventional purposes, like creation of virtual manuals or interactive 3D presentation.

Keywords: Engineering design; Virtual reality; Simulation; Virtual manuals

1. Introduction

Virtual reality technology has been designed to allow an user to interact with simulated environment, which is displayed on the computer screen or presented in a special manner, using stereoscopic

displays, caves etc. The aim of a VR system is to create an illusion of immerse into a virtual world. Due to high cost of presentation and haptic devices, most of applications do not use high-end equipment, but simple stereovision solutions or no equipment at all, displaying the picture on a normal, flat screen. So there are two dominant ways of evolution in field of virtual reality: the first one is connected with

designing of new devices and intensify the effect of immerse, and the second one which is dedicated for everyday use and do not require any special equipment. Sometimes very realistic effects are desirable, like for example in medical training, ergonomics testing etc., however in many cases it is enough to examine a virtual environment presented on a monoscopic display (manuals, part catalogues etc.). Some of the fields of engineering, where virtual reality is used are automotive engineering, material engineering [1-7], medical equipment and training [8-10], industry automation and robotics [11-13], architecture and building industry.

Sometimes it is a good idea to mix a real environment with the one created by computer. This method can enhance the overall effect of environment perception. Depending on mutual degree of participation of the real and virtual world in the mixed reality, it could be called augmented reality (the real world prevails) or augmented virtuality (the virtual world dominates).

The aim of this paper is to show some properties of the selected virtual reality software, which could be used in subsidiary engineering tasks, during creation of technical documentation, manuals and service sheets. Some aspect of this issue will be discussed in the further part of the paper.

2. Short description of used software

In the research two brands of software have been tested. The first one is Cortona VRML plugin from ParallelGraphics, and the second is EonX plugin from EON Reality. Both are distributed free of charge and are dedicated to use with web browser. In this case the Internet Explorer has been used, because it supports ActiveX technology and EON recommends it to use with EonX plugin.

2.1. VRML and Cortona plugin

VRML is the abbreviation stands for Virtual Reality Modelling Language. It is a standard format for representing interactive, three-dimensional virtual world on a computer display. It has been designed particularly to realise 3D interaction in web browser window, so it is represented in a text form, in a manner similar to HTML. VRML file can be created from most of 3D modelling programs or CAD software. Simple models can be created by hand, using any text editor.

In order to display VRML files, it is needed to install proper software. Among many applications available on the market, there is the one named Cortona VRML Client. It can be installed in a simple manner, using installation program or directly from the browser (Internet Explorer only). Additionally it supports ActiveX automation technology, what means that application can be embedded in any other program window, which supports ActiveX controls. The main features of Cortona are [14]:

- support for DirectX and OpenGL,
- complete support for VRML 97 standard,
- advanced rendering,
- Macromedia Flash support,
- customisable interface.

Cortona has simple to use interface, which allows navigation in virtual 3D space. Additionally there is possibility to use sound and video, URL links, buttons etc. in VRML files. An example window with a simple object is shown in Figure 1.

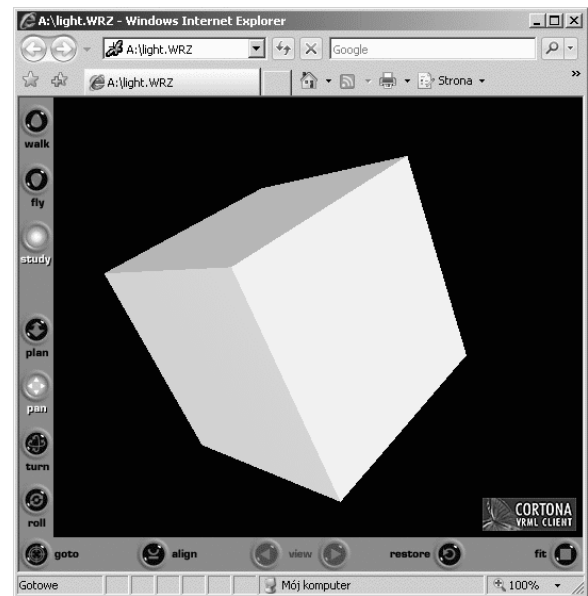


Fig. 1. Cortona plugin running inside Internet Explorer

2.2. EON software and EonX plugin

EON from EON Reality is another virtual reality oriented software. It consists of some modules i. a. EON Studio and EonX plugin. The virtual reality applications are created in EON Studio, then it could be displayed either in this program or in the EON Viewer, which uses EonX to display virtual world. EON studio is not a 3D modelling application – it is rather the visual programming environment. A 3D model must be created in external application, then it can be imported to EON Studio, where final preparation tasks are performed and interactivity is added. Anyone who knows VRML/X3D standard could quickly learn how to handle this software, because EON studio uses similar terminology to describe virtual world. Moreover, it offers rich libraries of predefined nodes and prototypes, can use script language (JavaScript, VBScript or other installed on operating system level) and has a wizard for creation of web applications [15]. The strongest point of the software is a possibility to cooperate with special equipment, like stereoscopic display systems, 3D input interfaces, gloves etc.

Files created in EON Studio can be viewed in EON Viewer software, which could be obtained free of charge from EON Reality website [15]. This plugin offers the same functionality like built-in EON Studio display module, but additionally could be embedded as an ActiveX control in any application that supports it. Figure 2 presents EON Viewer window with simple object displayed.

3. Possibility of use of the virtual reality in the exploitation and virtual testing of machines

In this section selected possibilities of use of the virtual reality in mentioned topic will be shown. It should be noted that this is description of general concepts, not real applications.



Fig. 2. EON Viewer application

3.1. Virtual manuals and virtual catalogues

A Web-based virtual manual is a good way to present any kind of knowledge. Because of interactivity, user can quickly select interesting part of document, display schemes, play instruction video. Such a manual could be installed for example on a CNC machine system and could help the staff to overcome simple defects or damages. Adding 3D interactivity could increase efficiency through displaying 3D machine's model with hyperlinks. Selecting any part, user can navigate to deeper level, select the next part and so on, until desired detail has been reached, then the proper service instruction can be displayed.

As it was mentioned earlier, both EonX and Cortona could be used in web browser windows, so they could be used as a part of a virtual manual. Figure 3 shows EonX running inside Internet Explorer.

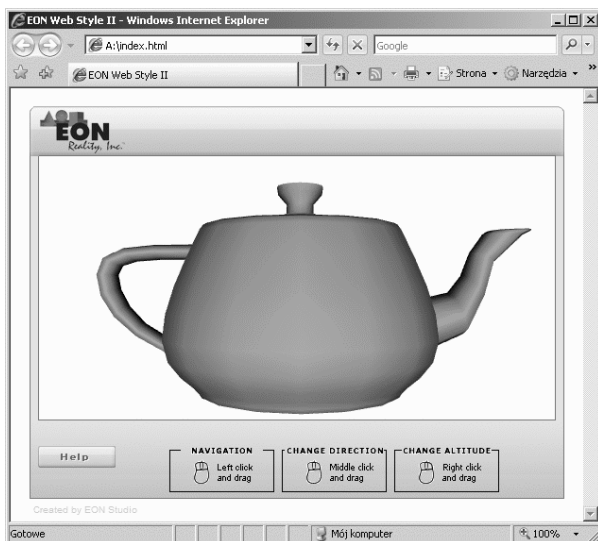


Fig. 3. EonX running inside Internet Explorer

A virtual manual written in HTML format often contains many separate files. This form can be comfortable during edition process, but distributing and installing of such a package could be complicated. One of the best method to avoid this situation is a compilation of a whole manual to the *.CHM format. It requires some effort to correctly prepare source files, but the final effect is worthwhile. Using the Microsoft HTML Help Workshop, which is free software, it is possible to turn all HTML and other companion files to one compressed package. It is usually smaller and easier to distribute. Because HTML Help using Internet Explorer as a rendering engine, all web standards are available, including ActiveX controls and scripting. In this manner the described virtual reality plugins can be used. It should be noted that older versions of HTML Help Workshop could not parse correctly HTML files containing some types of controls. In Figure 4 EonX embedded in help window is shown.

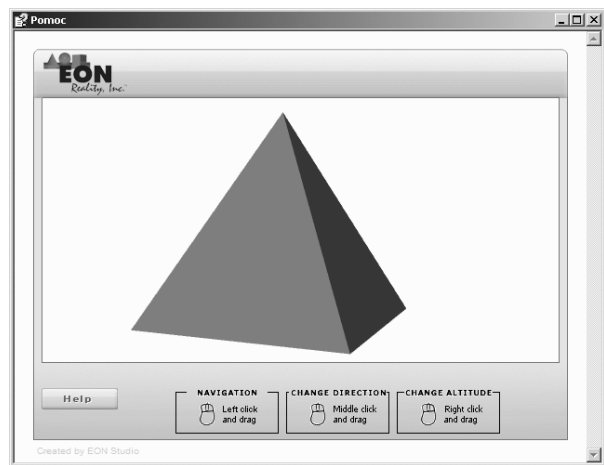


Fig. 4. EonX displayed inside the Microsoft Help window

Similar products to virtual manuals are virtual catalogues. Having the same functionality, they have different idea. The main property of virtual catalogues is to systematise information according to some pattern.

3.2. Simulation and visualisation of a mechatronic system in the virtual reality environment

Although EON software is dedicated mainly for visualisation purposes, it has modular structure. This property can be used to develop new add-in libraries and enhance abilities of the program. At present days EON Studio has not have advanced computational engine and is equipped only with simple dynamic simulation module (the Professional version). The software has also interesting feature called events, which is an interface between the EON visualisation and the external environment. Because EON supports ActiveX technology it is possible to send and receive signals from a host application. This feature allows simulating complex control systems in external applications. In the next stage, EON application could receive signals from a real control system. Abilities of managing large size display systems

allow visualising objects of control in 1:1 scale. Moreover, the use of the VR devices can enable an user to operate the virtual model like the real device [11-13].

In order to use communication abilities of the EonX, a simple interface has been built, using Excel and EonX control. The interface allows simple navigation and changing some properties of virtual object, like scale, colour etc. The application is shown on Figure 5.

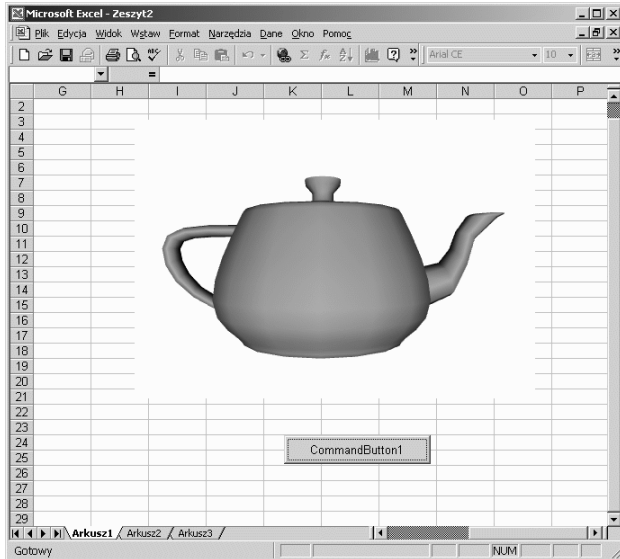


Fig. 5. EonX running inside Excel

4. Conclusions

Presented applications of the virtual reality in exploitation and virtual testing of machines are becoming standard procedures in product design and testing process. Moreover, using virtual reality visualisations could help the machine operator to cope with some simple problems and defects.

The software described in this paper has been chosen among other due to popularity and potential. The EON application is evolving dynamically and pretends to become a standard. The EON Reality cooperates with manufacturers of software and hardware to gain the potential of using the hardware acceleration and software compatibility.

In the future research it is planned to create a dedicated application providing communication between EonX and other software. The next step is to realise data exchange with a real PLC device. It is also planned to create interactive model and operate it in virtual environment using advanced display and control systems.

References

- [1] T.S. Mujber, T. Szecsi, M.S.J. Hashmi, Virtual reality applications in manufacturing process simulation, *Journal of Materials Processing Technology* 155-156 (2004) 1834-1838.
- [2] W.B. Lee, C.F. Cheung, J.G. Li, Applications of virtual manufacturing in materials processing, *Journal of Materials Processing Technology* 113 (2001) 416-423.
- [3] Q. Peng, F.R. Hall, P.M. Lister, Application and evaluation of VR-based CAPP system, *Journal of Materials Processing Technology* 107 (2000) 153-159.
- [4] Y.D. Gong, B. Wang, W.S. Wang, The simulation of grinding wheels and ground surface roughness based on virtual reality technology, *Journal of Materials Processing Technology* 129 (2002) 123-126.
- [5] M.A. Bossak, Simulation based design, *Journal of Materials Processing Technology* 76 (1998) 8-11.
- [6] L.A. Dobrzanski, R. Honysz, Development of virtual light microscope for a material science virtual laboratory, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 571-574.
- [7] B. Korves, M. Loftus, Designing an immersive virtual reality interface for layout planning, *Journal of Materials Processing Technology* 107 (2000) 425-430.
- [8] T.P. Grantcharov, Virtual reality simulation in training and assessment of laparoscopic skills, *European Clinics in Obstetrics and Gynaecology* 2 (2006) 197-200.
- [9] V.M. Tronnier, A. Staubert, M.M. Bonsanto, C.R. Wirtz, S. Kunze, Virtual reality in neurosurgery, *Der Radiologe* 40 (2000) 211-217.
- [10] L. Zhang, B.C. Abreu, G.S. Seale, B. Masel, C.H. Christiansen, K.J. Ottenbacher, A virtual reality environment for evaluation of a daily living skill in brain injury rehabilitation: reliability and validity, *Archives of Physical Medicine and Rehabilitation* 84/8 (2003) 1118-1124.
- [11] J. Świder, K. Foit, G. Wszolek, D. Mastrowski, The off-line programming and simulation software for the Mitsubishi Movemaster RV-M1 robot, *Proceedings of the 12th International Scientific Conference "Contemporary Achievements in Mechanics, Manufacturing and Materials Science" CAM3S'2006, Gliwice-Zakopane, 2006*, 391-394.
- [12] J. Świder, K. Foit, G. Wszolek, D. Mastrowski, The off-line programming and simulation software for the Mitsubishi Movemaster RV-M1 robot, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 499-502.
- [13] K. Foit, J. Świder, D. Mastrowski, The project of an off-line, remote programming system for Mitsubishi Movemaster industrial robot, *Proceedings of the XIII International Scientific and Technical Conference "Machine-Building and Technosphere of the XXI", Sevastopol, Ukraine, 2006*, 252-255.
- [14] Cortona VRML client.
- [15] www.parallelgraphics.com/products/cortona.
- [16] EON Reality Inc., www.eonreality.com.