VIRTUAL REALITY TECHNOLOGIES AND VIRTUAL MANUFACTURING

Jozef Novák-Marcinčin
Faculty of Manufacturing Technologies of the Technical University of Košice
Bayerova 1, 080 01 Prešov, Slovak Republic

Abstract: *After applications of virtual reality in area of computer games are rise need to exercise this technology in industry. Main areas of using of virtual projecting and prototyping are automobile and air industry in this time. Method of dialogue of person with computer is named interface and virtual reality is newest of row this interfaces. Virtual Reality is technology for presentation of complicated information, manipulations and interactions of person with them by computer.*
Key words: *Virtual Reality, Virtual Technologies, Virtual Manufacturing*

1. INTRODUCTION

Historically, virtual reality has entered into the public awareness as medial toy with equipment „helmet-glove“, which was preferentially determined for wide public and the price of this system had also to correspond to this fact, so price could not be very high. As follows, the producers of virtual reality systems have aimed at developing and providing of the systems for data collecting and analysing and systems supporting economic modelling. It is obvious that, from among areas, where virtual reality systems can be most frequently used are applications based on 3D-space analysing and physical dimension visualisation. Virtual reality with ability to show data 3D and attach sounds and touch information increases extraordinarily data comprehensibility. Along with increasing the number of data are increased the effects from virtual reality too [2, 10].

2. VIRTUAL REALITY TECHNOLOGIES

After the first applications of Virtual reality (VR) in the field of flight simulators and computer game creating, arisen the need to implement the virtual technologies into industry. Product design and virtual prototyping is one of the greatest successes of VR applications in industry. The main attention in the field of VR system applications in the technical practice is given to CAD/CAM/CAE systems of higher level. It is for the cause of realisation of export in format VRML (Virtual Reality Modelling Language). The newest versions of these systems could aid both existing formats VRML 1.0 and VRML 2.0 (97). The cost of a VR system is very specific problem. The real cost of an effective system can only be assessed in relation to the benefits it brings to a company. Such hardware and software is so expensive that only large corporations could afford to build virtual environments. One of the possible ways to solve the problem is to implement a VR format to a lower systems with aim actively utilise systems of Computer Integrated Manufacturing [1].

VR systems could be divided by ways of communication with user to such groups [11]:

1. *Window on World Systems* – for displaying the virtual world are used conventional computer monitors. This system is also called Desktop Virtual Reality, but usually it is called as Window on World (WoW).
2. *Video Mapping* – This system is modification of WoW system, where the siluetes of human body could be displayed in 2D. User could see himself or herself on monitor in interaction with environment.
3. *Immersive Systems* – basic VR systems, which enables user to be in virtual environment. The feeling to be in is created by Head Mounted Displays (HMD). This HMD could be with or without limitation of moving. Example of HMD application is on Fig. 1. On Fig. 2 are presented special gloves with sensors for VR.

Fig. 1 Special Head Mounted Display for VR

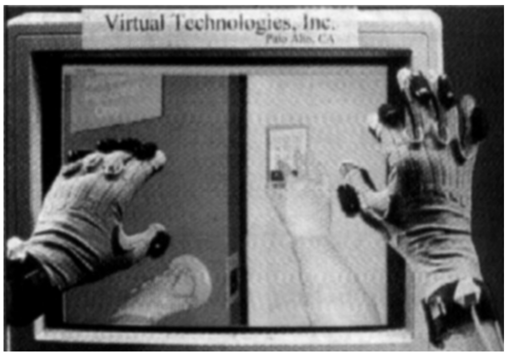

Fig. 2 Gloves with sensors for VR

4. *Telepresence* – Attached to a high – speed network, VR takes telepresence to next level. Participants can be thousand of kilometres apart and yet feel as if they are all standing in the same virtual office or laboratory, with their product, design, or experiment right in front of them not only talking about it, but interacting with it, change it etc. This technology connects sensors, which are apart in real world. All the sensors could be placed on robot or on presented tool.

5. *Mixed reality* **–** This system is created by connecting of telepresence and Seamless Simulation Systems. Computer generated data are connected with telepresence entries and with user sight on real world.
6. *Fish Tank Virtual Reality* - System created in Canada. It is a combination of stereoscopic monitors and tracking system measures position and orientation of a hand.

Distribution of VR systems by hardware equipment is in these levels. Some levels are not strictly kept, mainly in VR systems of higher levels.

1. *Entry Systems* – Takes a capacity of personal computers and workstations for implementation WoW systems. They are usually based on IBM compatible computers or Apple Macintosh. Computers contain mainly graphic display, 2D entry devices – mouse joystick or trackball and keyboard.
2. *Basic Systems* **–** Involve basic interacting and innovated display resource. A resources of interactivity can be stereographic spectacles, entry control devices like data – gloves, multidimensional (3D, 6D) mouse or joystick.
3. *Advanced Systems* **–** Are marked by better aiding of graphic (render accelerator, frame buffer), or parallel processors for hand entry. Systems can be equipped by sound card for mono, stereo or 3D output.
4. *Immersion Systems* **–** systems like HMD or multidimensional multiple displays. These systems also could be based by touch feedback.
5. *Cabin Simulators* **–** virtual world is displayed on monitors or on screen. Simulators can be placed on moving base, what can evoke imagination of multimoving. Typical representatives are flight simulators, car simulators, fighting vehicles etc.

3. VIRTUAL REALITY MODELING LANGUAGE (VRML)

VRML is description language, which belongs to a field Window on World System. The file, which is in VRML format, can be interpreted by VRML explorer in three-dimensional scene. VRML was created with aim to represent virtual reality on Internet easier. Development of 3D graphic is connected with Silicon Graphic Corporation. This corporation creates expanded Open GL library. Under this library was proposed the format Open Inventor, which is the base for creating VRML 1.0. Official specification of VRML 1.0 was finished in 1995. In autumn 1995 arise independent expert group - VRML Architecture Group (VAG), which aim was co-ordination of other advance, to map user requirements for developing of new VRML format.

VRML 1.1 was only as working proposal. The new format VRML 2.0 was approved in 1996 as ISO/IEC standard and became as international standard VRML 97 [9].

Format VRML 1.0 is the same format like Open Inventor, which is used by SGI. It is created for describing of static 3D scenes and enables connecting with URL. VRML 1.0 scene is presented by ASCII text file format. File VRML 1.0 has WRL suffix (world).

VRML 2.0 (VRML 97) is accurately new language than only expansion of VRML 1.0. Against the version VRML 1.0 has lots new abilities and simultaneously take off or make some properties from proceeding version, easier. VRML 2.0 is the file format for describing interactive 3D scenes and objects. It can be used in collaboration with www, can be used for 3D complex representations creating of scenes, products or VR applications VRML 2.0 enables represent static and animated objects too. Enables connection with sound, films, and pictures. Basic elements of VRML 2.0 correspond with usually used 3DAPI (Open GL, Direct 3D). The scene in VRML 2.0 is also described by ASCII text file with WRL extension [8].

4. VIRTUAL MANUFACTURING

The most advanced current farm of the computer aiding of manufacturing is Virtual Manufacturing (VM) based on Virtual Reality (VR). The concept of Artificial Reality appeared already in the 1970s (by Miron Krueger) and the notion of Virtual Reality was introduced by Jaron Lanier (1989). In 1990 the concepts of Virtual Word and Virtual Environments appeared. Virtual reality is defined as a computer generated interactive and immersive 3D environment simulating reality.

VR representation techniques are widely used which means that they develop rapidly. In product manufacturing techniques and organization, Virtual reality has become the basis of virtual manufacturing aimed at meeting the expectations of the users/buyers of products, also as to their low cost and lead time. Virtual manufacturing includes the fast improvement of manufacturing processes without drawing on the machines' operating time fund. It is said that Virtual Manufacturing is the use of a desktop virtual reality system for the computer-aided design of components and processes for manufacture.

There are many definition of Virtual Manufacturing (VM). Iwata defines VM as follows: "A virtual manufacturing system is a computer system which can generate the same information about a manufacturing system's structure, states and behaviors as we can observe in real manufacturing systems".

The report from the 1994 Virtual Manufacturing User Workshop includes an in-depth analysis of VM and its definition: "Virtual Manufacturing is an integrated synthetic manufacturing environment exercised to enhance all levels of decision and control" was annotated extensively to cover all the current functional and business aspects of manufacturing. Also the practical side of manufacturing virtuality is highlighted in this useful analysis. A comprehensive and thorough survey of literature on VM problems relating to production design and control can be found in a study done at the University of Maryland.

The definition of VM given by a Bath University project team deserves attention. According to this definition: "Virtual Manufacturing is the use of a desktop virtual reality system for the computer aided design of components and processes for manufacturing - for creating viewing three dimensional engineering models to be passed to numerically controlled machines for real manufacturing". This definition emphasizes the functions aiding the machining process.

It is unquestionable that virtual manufacturing aids real manufacturing processes and systems and it is perfected as the information technologies, the manufacturing systems and the business demands develop. In this context, Virtual Manufacturing should be recognized as an advanced information structure of Real Manufacturing Systems which integrates the available information tools and the virtual environment's immersiveness to achieve business-manufacturing goals [5].

5. CONCLUSION

The present development of manufacturing systems is closely connected with the advances in knowledge about the manufacturing of machines and technological faci1ities, in the computer aided design of products, processes and whole manufacturing systems and in their control at all levels on both a local and a global sca1e. The more complex products, the processes of their manufacturing and business conditions become, the more vital role the computer support of them plays in increasing the productivity of industrial plants, reducing the production costs and shortening the manufacturing cycles. The complex tasks of manufacturing process computerization require great computing power but its cost has been steadily decreasing while the speed of processing has been dramatica1ly increasing.

6. ACKNOWLEDGEMENT

Research Grant Agency of the Slovak Minister of Education supported this work, contract No. 1/0405/03: "Computer Aided Process Planning in the Area of Disassembling Processes".

7. REFERENCES

[1] Austakalnis, S. - Blatner, D.: Real about Virtual Reality. Jota, Brno, 1994 (in Czech).

[2] Havrila, M. et all: Analyse and Synthese of CA Production Technologies Methods and their Influence on Production Ecology. Scientific Works VEGA No. 1/4352/97, 1997-99.

[3] Horbaj, P.: Structure of norms ISO 9000 and ISO 14000. In: Proceedings of the conference New trends in machines operation. FPT, Prešov, 1998, pp. 275-282.

[4] Hrubina, K.: Informatics, information systems and possibilities of information technologies using. AT&P journal, č. 1, 2000, s. 69-70.

[5] Jedrzejewski, J. - Kwasny, W.: Remarks on state-of-the-art virtual manufacturing. In: Proceedings of Workshop on supervising and diagnostics of Machining Systems. Karpacz, 2001, pp. 5-14.

[6] Kárník, L.: Application of the Virtual Reality Technologies in Technical Practice. In: Proceedings of the Conference COMTEP'98 - Computers in theory and practice. FME TU, Prešov, 1998, pp. 121-124 (in Slovak).

[7] Knoflíček, R. - Mezník, L.: Roboted technological workplace for manipulation with packs of briquets. In: Production Systems with IR, Ostrava, 2000, pp. 23.

[8] Křižovič, M. - Šponar, P.: Virtual prototype. Silicon World (Information systems, Computer graphics), No. 18, 1998, pp. 33-34 (in Czech).

[9] Lederer, G.: Virtual Manufacturing - Manufacturers Challenge of the 1990s. CIME - Computer Integrated Manufacture and Engineering. Vol. 1, No. 2, 1996, pp. 44-46.

[10] Marcinčin, J. N.: Use of the Virtual Reality Technologies in Design of Manufacturing Systems. In: Proceedings of the Conference on „Automation of Technological Preparation of Production“. TU, Zvolen, 1998, pp. 64-68 (in Slovak).

[11] Moravčík, M.: Virtual reality: expectations are infilled. PC REVUE, Vol. 5, No. 11, 1997, pp. 30-32 (in Slovak).

[12] Neaga, I. - Kuric, I.: Virtual Environments for Product Design and Manufacturing. In: Proceedings „CA Systems and Technologies“. Žilina, 1999, pp. 60-65.

[13] Pavlenko, S.: Evolutional environment of generate routines for carving of developed forms. In: Proceedings of the Conference COMTEP'98 - Computers in theory and practice. FME TU, Prešov, 1998, pp. 139-142 (in Slovak).

[14] Zajac, J. - Miškovičová, M. - Miškovič, V: Cutting facilities of new type of came cutting material. In: Proceedings of the conference PPTO, Košice, 1995, pp. 138-139.

Reviewer: Ivan Kuric - ŽU Žilina