THE INTERNATIONAL CONFERENCE OF THE CARPATHIAN EURO-REGION SPECIALISTS IN INDUSTRIAL SYSTEMS
6th edition

VIRTUAL REALITY MODELING LANGUAGE APPLICATIONS IN DESIGN OF MANUFACTURING SYSTEMS

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Abstract: *Virtual Reality Modelling Language (VRML) is description language, which belongs to a field Window on World virtual reality 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. 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. Interesting application of VRML is in area of manufacturing systems presentation.*
Key words: *virtual reality, virtual reality modeling language*

1. INTRODUCTION

Virtual Reality is technology for presentation of complicated information, manipulations and interactions of person with them by computer. Method of dialogue of person with computer is named interface and virtual reality is newest of row this interfaces. 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 automotive and air industry in this time. Virtual projecting as very perspective method must by using in area of projecting of manufacturing systems, too.

2. VIRTUAL REALITY

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.

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

1. Window on World Systems (WoW).
2. Video Mapping.
3. Immersive System.
4. Telepresence.
5. Mixed reality.

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

3. VIRTUAL REALITY MODELLING LANGUAGE

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.

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.

4. APPLICATION OF VRML IN DESIGN OF MANUFACTURING SYSTEMS

Computer system ROANS is a software package on PC base created for 3D simulation and programming of automated workplaces, robots and other peripheral devices. ROANS offer to user all needed tools for robots creating and simulation. After designing of workplace subsystems and their placing in space, is able to create control program for all workplace is working in multitasking mode. For minimalization of mistakes in program and for simple programming is added program editor. ROANS with help of integrated postprocessor program generates control code for specific robot language. PC hardware enables ROANS to communicate straightly with robot.

Integrated dynamic and driving modules, which are able to analyse subsystems of robot enables to design by dynamic inversion method. This method is used for creating mechanical and driving subsystems of robots and other peripheral workplaces. The advantage of ROANS is its low requirements on hardware. This is the reason why ROANS is often used in laboratory conditions and in school laboratories. The sample of automated workplace with robots created in software ROANS and displayed in wire and shade regime is on Fig. 1.

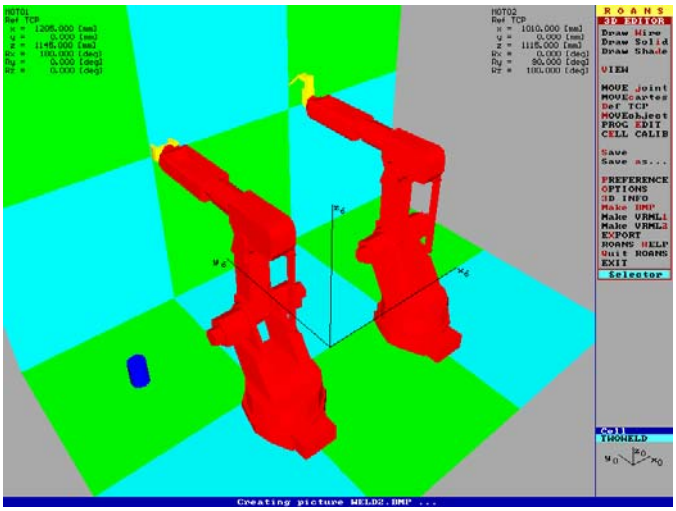

Fig. 1 Robot workplace in ROANS

Before initiation of VRML implementation into system ROANS is needed to identify difference between structures in ROANS system and in VRML. This difference mainly comes

from used program languages. ROANS were created in program language PASCAL. When the data are writing into the file they are indexed with rising value from number 1.

VRML language was created in C++ language and data writing to file uses abilities of this language. Data are indexed with rising value from number 0.

Differences in describing of points in ROANS system and VRML are in points indexing and in dimension units. Millimetres and indexing by rising value from 1, 2, 3, … are used by ROANS. Meters and indexing by rising value from 0, 1, 2, … are used by VRML.

Differences in line defining in system ROANS and VRML are in colour indexing and indexing of points which are needed to line defining. Line colours has their own identification number in ROANS system. Identification number of a colour depends on order of colour defining in knots, which give a colour.

Differences in surface defining in system ROANS and VRML are in points indexing and in order of points, which describes creating of surface. Every surface has 2 sides. Feature in which surface is drawn in one or other side of object depends on order of point defining. ROANS system uses opposite principle for point defining like VRML. That is why the program for VRML creating needs to write this indexing in opposite order like in ROANS. Adjustment of menu in ROANS is obvious from Fig. 2 and Fig. 3.

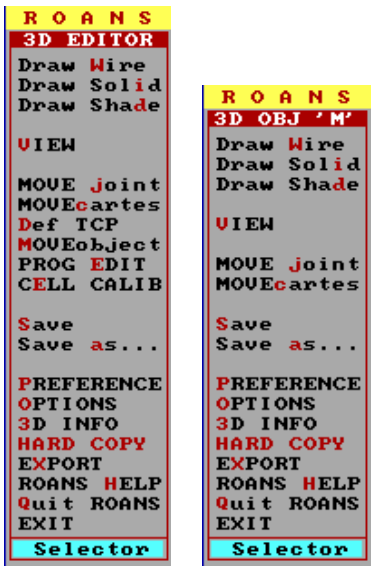

Fig. 2 Original menu of ROANS system

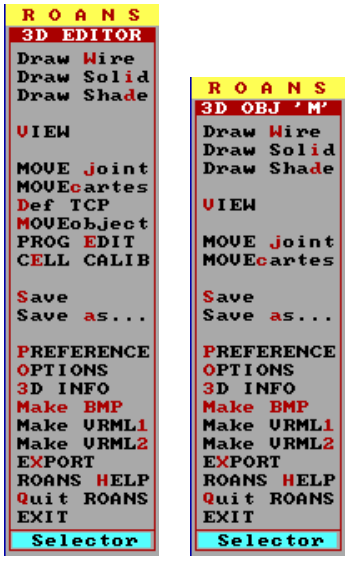

Fig. 3 Adjusment of menu in ROANS

The program for export ROANS data to VRML language is solved as part of ROANS system. In this case there are some changes in ROANS menu. The changes are: 3D Editor for Object structure, 3D Editor for Cell Structures, 3D Anim for Cell Structures.

Created program works with data, which are saved in memory of computer. This is the reason why displaying of workplace is not needed for exporting into VRML.

By activating of item MAKE VRML1 (stand with cursor on this item and than press ENTER, or right click of mouse, or pressing of hot key "1") is initialised activity of program. After this step you need to set the name of file in which will be result of export saved. It is needed to enter the name without extension, which will be automatically added. After file creating, starts export of data. First are exported header and preparatory knots (Info, BackgroundColor, ShapeHints, Material Binding, and Material). After this are exported data of points (Coordinate3) and depending on displaying regime are exported data of lines (IndexedLineSet) and surfaces (IndexedFaceSet). After ending of export is exported file closed and it is possible to work in ROANS system like before.

Activity of making VRML 2.0 is similar like in VRML 1.0. It is initialised from menu by activating MAKE VRML2 item (stand with cursor on this item and than press ENTER, or right click of mouse, or pressing hot key "2"). After this procedure follows set of file name without extension WRL, which will be added automatically. After file creating, starts export of data. First are exported header and preparatory knots (WorldInfo and Background). After this, all data are exporting in dependence of displaying regime. Export of lines (Shape - for lines) and surfaces (Shape - for surfaces). In no visible shapes regime is process of points writing arranged. This is made in the case that some points are written twice and than they are marked with name "pts". When a points and surfaces are defined they are extended by name ("pts"), which were defined in lines. After ending of export is exported file closed and it is possible to work in ROANS system like before. On the Fig. 4 we can see displaying of automated workplace in VRML environment.

Fig. 4 Robot Workplace in Netscape Navigator Environment

5. CONCLUSION

After implementation of VRML maker into the ROANS system it is possible to represent all 3D automated workplaces with robot created in ROANS system by VRML browser, and it is not needed to have a license for ROANS. This enables companies, which use ROANS system, to communicate better without personal contact even they are thousand kilometres apart. This could safe financial resources and expressively decreases time of workplace designing expressively. VRML maker is integrated part of ROANS and do not increase hardware even software requirements on system. Paper was prepared in time of realization of applicated research project No. aAV/1107/2004 and KEGA project No. 3/2236/04.

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Reviewer: Prof. Dr. Ing. Ivan Kuric