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MODULAR TRAINING SYSTEM IN VIRTUAL REALITY ENVIRONMENT – MSEVR

Abstract

MSEVR is a system created for teaching of automated and robotic systems by means of new advanced teaching aids, including virtual reality. One of its constituents is also virtual laboratory that has been created as a specialized website. The presented paper acquaints with structure and performance of the virtual laboratory created by a work team at KVTaR Sjf TU at Košice. It is a laboratory that is segmented to a set of independent robots for learning basics of industrial robots and Modular system for experimentation in virtual reality. The Modular system has been designed for work with bigger, easily configurable workplaces.

1. INTRODUCTION

MSEVR is an education system designed for training at automated and robotized systems for employees of small and medium-sized enterprises as well as for professional trainers. One of its parts is a virtual laboratory, which is intended to teach in virtual reality environment. Created laboratory simulates real environment of workplace, where you can insert mechanical equipment and then makes experiments with it.

Basic building component for virtual laboratory is VRML language. By this language are created models that form 3D view of laboratory. Laboratory has a certain level of interaction. This feature is secured by using of VRML language sensors in cooperation with ECMA script (standard form language of JAVA script). This solution allows to retain ongoing events in virtual reality and respond to their processing in any way.

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Virtual laboratory can be run directly in VRML browser, or distributed through web site. In this case is VRML browser integrated as plug-in web browser. Created virtual laboratory has been developed and tested at configuration: Cortona3D Viewer v6 and MS Internet Explorer 8.

Virtual laboratory does not support a Mozilla Firefox of Google Chrome yet. At the beginning of the starting page is checked a configuration at client site to prevent an unresponsiveness of system. In case of inappropriate configuration of system follows next steps:

- If laboratory does not start at MS Internet Explorer browser follows a starting block.
- If client does not have a plug-in of VRML viewer Cortona3D from Parallel Graphics firm follows an instruction to download and half-automatic installation.

2. VIRTUAL LABORATORY

From the design point of view to virtual environment built through VRML language, which visually introduce a space of built workplace with empty feature of ground (see Fig. 1. basic view to environment system MSEVR). From the user design point of view is system before starting of experiment similar to status, when are finished building treatments of workplace and begins installation processes of mechanical equipments in real situations. In real situations is necessary at this moment proceed to buy, to import and to build all machines. In virtual environment we will follows similar steps, but without any costs and mainly much easier. Instead suppliers we have a gallery of machines, robots and equipments (see right part of Fig. 1). From it we can choose and move objects by drag & drop method to ground of workplace. Similarly we can edit properties of feature structure of ground workplace. For better orientation is possible to move textures, which have dimensions as an indicative lines from 1m x 1m to 0,1m x 0,1m.

Basic equipment MSEVR contains, (Fig. 2):

- models of robots,
- models of machines,
- models of transport equipments,
- models for trajectory optimization of robot,
- auxiliary models,
- textures for better orientation.

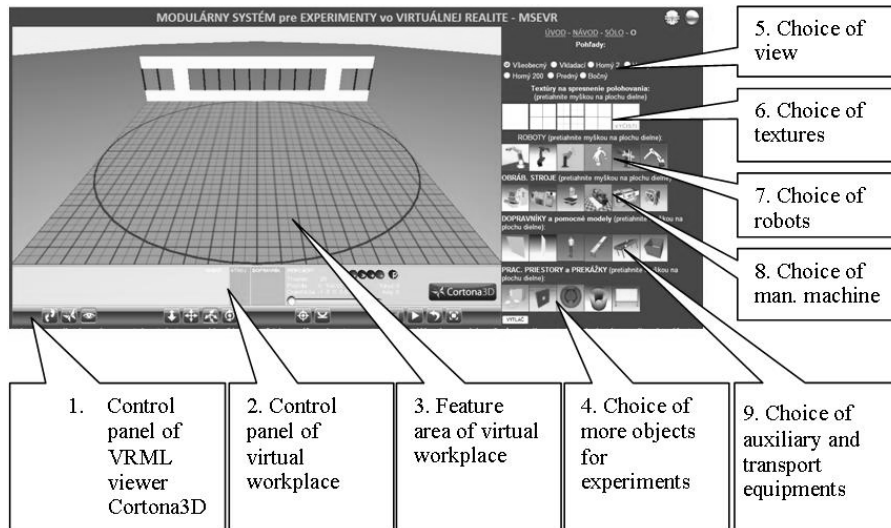


Fig. 1. Basic view to environment system MSEVR [source: own study]



Fig. 2. Detail of MSEVR menu for select object at workplace [source: own study]

MSEVR allows to experiments in virtual reality quite simply through simply controlling of similar activities to real build of automated and robotized systems, see Fig. 3. So teacher can directly on lecture placed machines and equipments into feature ground of workplace with relative position and created automated and robotized systems from them. Students can saw not only results

of its work, but also watch its progress, that is mainly increasing of effectively education process. For creating workplace is available pre-prepared models, but system allows using also external models. Due to creating of workplaces from individual models MSEVR will laboratory provides follow functions:

1. Visual

- representation at 3D virtual reality,
- freedom in movement at 3D space,
- change the type of motion at 3D space,
- set of view (cameras),
- to record trajectory of movement and than to start movement in automatic mode.

2. Preparatory

- change textures of feature ground area – guides lines for better orientation,
- insert (also remove) individual objects (machines, fixtures and other equipment),
- multiple insert,
- insert the foreign objects with minimal requirements to their adaptation.

3. Implementing

- movement with models,
- rotation with models,
- through scaling to change dimensions of inserting objects (only at necessary models),
- measurement of feed movement (axis X and Y) also rotation of objects, (around axis Z) for accurate determining their position,
- to retrieve all functions of own machines.



**Fig. 3. Building phase of workplace in MSEVR system
(Mutual position setting of equipment) [source: own study]**

Except for those functions is possible for created virtual workplace also more functionality because each model by inserting to the workplace brings not only its own shapes, but also all properties, which were assigned during its creating including interactive properties. Some standard models of workplace brings to us possibility for control, for example, also performance technology movements, controlling of movement speed, programming by teach method, sound and visual effects, possibility for extended edit and manipulation with model and so on. Complete list of functions from created workplace is depended on using models and their functions. Algorithm for building of virtual workplace in MSEVR environment can be seen at Fig. 4.

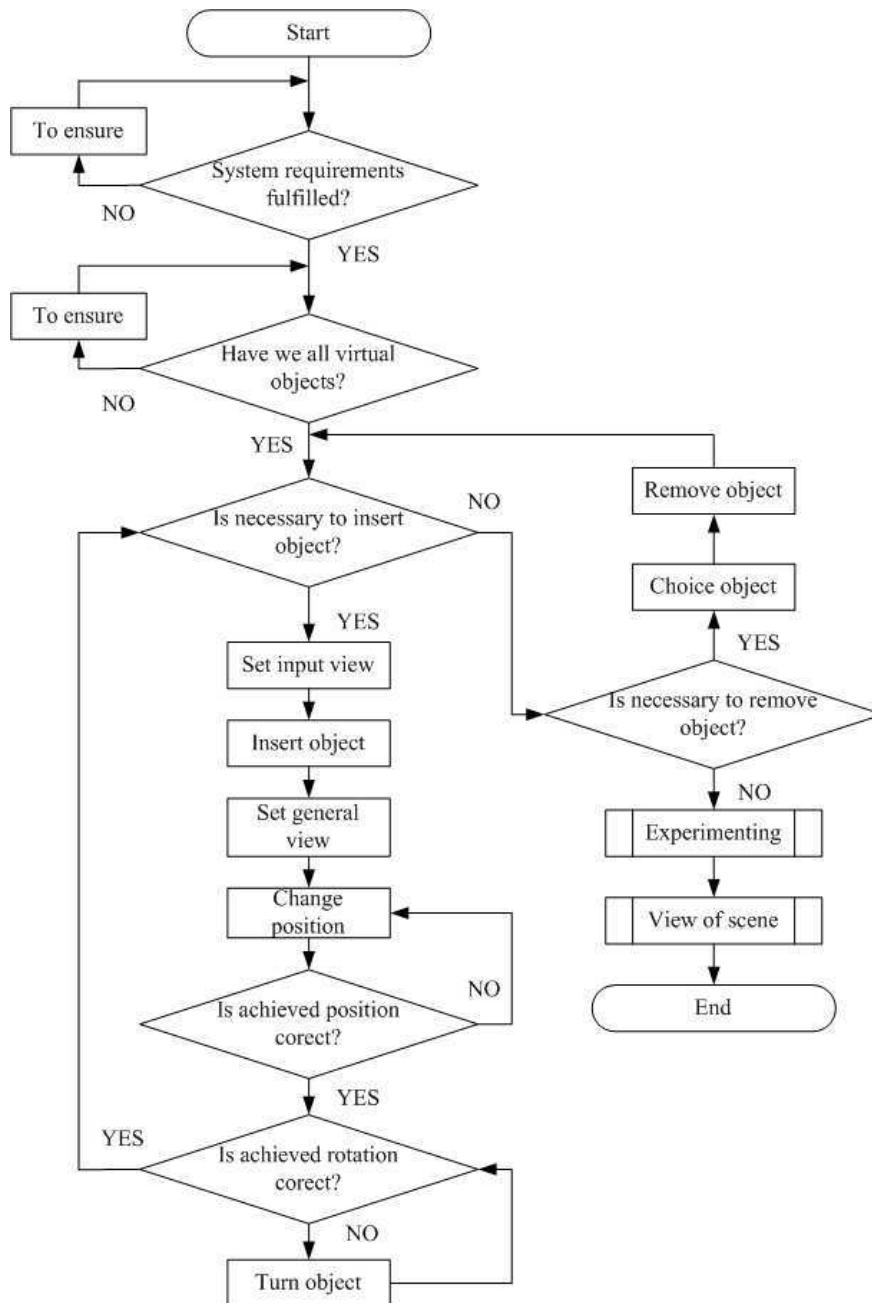


Fig. 4. Algorithm for building of virtual workplace in MSEVR environment [source: own study]

If we want to optimize the layout of machines is convenient to will be visualized some of them, because in real situation is not visible some spaces. Most of them are envelopes of machines, what is the reason how we can without any problems solve situation if are input / output places in its range. Visualized envelope is technically realized similarly as standard model, for example models of machines. Due to this we are able to their edit similarly as for standard models. Only different is their transparency set. It depends on the user, which invisible envelopes (in real situation) to display (in virtual reality) and for what purpose we use them. For us are preferred to display not only working envelopes, but also security zones and creating some fixtures to built virtual reality. MSEVR models have also dynamic characters. Working movement is animated, manually scheduled and controlled by program. All this cases were experimented. The use of dynamic properties allow to accurate optimization at layout of workplace. Fig. 5 shows virtual workplace built during development of MSEVR system. MSEVR system allows addition of modules, which brings some new properties, so it is possible to their adapt at however implementation, if is virtual reality deployed. In its early it was tested to implementation in education process and optimized to automated and robotized systems. By most of verification experiments were confirmed our assumptions. In next we show our researched possibilities for MSEVR system:

- dispositional solution of workplace,
- use of animation on technological movements,
- use of visualization of security and technological envelopes,
- optimizing of robot trajectory for circumvent obstacles.



Fig. 5. Example of virtual workplace in MSEVR system [source: own study]

3. CONCLUSIONS

Virtual laboratory brings virtual reality into education process, what changed to better quality. Its interactive components allow to teacher and students are active part same as persons in real practice. This form of education process is in maximum volume similarly to real situation, and all costs for its realisation are negligible in compare of real reality. Due to the fulfilment of targets, which were set before its design, still exist the scope for its next improvement. Here is also possibility to insert free available models from different internet sources. Their disadvantage is necessary adaptation for inserting to MSEVR system for more effectively way as its own creating, because some firms that produce industrial robots (for example, ABB, KUKA, MOTOMAN) provides 3D models their products as support for designers without any conditions.

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