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X3D EDUCATIONAL ENVIRONMENT FOR AVIATION STUDENTS[1]

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ABSTRACT
In this paper we present educational environment in the form of virtual classroom or lab for aviation students (3DEEA). This lab is part of virtual university system for distance learning and assessment. Most students admit that flying in a virtual environment approaches reality. These are the reasons, beyond lower costs and increased safety, for train in highly sophisticated virtual environments. Laboratory is modeled and implemented using Web3D technologies. Smart tutorial and self-testing are essential part. Sense of other users presence and concurrent work has been realized through avatars. System is evaluated quantitatively and qualitatively.
Keywords: X3D, Virtual classroom, Aviation, Simulation, Education

1. INTRODUCTION
The information technology based on computer network is promoting changes in manufacturing industry. Virtual product design and manufacturing network are supported by computer technology, simulation technology, virtual reality technology and information technology. The design and manufacturing processes of new products advance towards the direction of digital, integration and network [1].

Three–dimensional (3D) models are digital representations of objects that can be processed by computer applications. The objects themselves may exist either in the physical or virtual world. Virtual Reality (VR) is environment which allows the user to interact with computer-simulated or virtual environment (VE). VEs are becoming places where participants can meet and interact [2]. These environments, where users can work together, are called Collaborative Virtual Environments (CVEs).
Virtual design is application technology based on VR technology. It is application technology of design, analysis, simulation and evaluation, facing principles, structure and performance of products. Virtual design makes the whole process of the product to virtual on the computer, from concept design to using the products, which will be achieved in the virtual environment constructed by computer [1].
Much of the attention has been in the creation of virtual environments, with the aim of building shared communities on the web. Another area of application has been scientific visualization in three dimensions. The main characteristics of 3DEEA are accomplishing those requirements, and they are: communication with video, voice and text chat; using the same space in order to achieve collaboration by concurrent users; using avatars; sharing resources through integrated virtual and real environments.

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2. RELATED WORK

Multi-user 3D environments have seen tremendous growth. Not only they affect large number of participants, (Second Life [3] boosts over 10 million accounts at a growth rate of 120 additional servers per week), or hosts big number of VE (Active Worlds [4] hosts Universe of over 1000 3D virtual reality worlds) but the emphasis on interpersonal communication, participation in the joint construction, and development of 3D content is also enabled.

There are lot of examples from papers [5], [6], [7], [8], [9], [10], [11], [12] of environments which provide facilities to enable modeling, displaying and collaboration. It could be a classroom for educational purposes or room for design or development. There exist many technologies, which enable to present 3D data on the Internet [13]. In accordance to the main focus, which are 3D multi-user collaborative VEs and in relation to our solution, we compared main 3D Web technologies [14].

Web3D standards are web-based, royalty free for any use and freely published. These standards are ratified as ISO and provide data durability, interoperability, integration, portability, efficient programming, and easy code modification [15]. The basic standards are Virtual Reality Modeling Language (VRML) and its successor eXtensible 3D (X3D). X3D employs scene graph, specifies a declarative geometry definition language, a run-time engine, and an API (Application Programming Interface) that provide an interactive, animated, real-time environment. Due to flexible XML encoding, files are simply formatted lines of code which enable displaying inside a browser and construction of VEs that stably incorporate the latest advances in graphics hardware capabilities, file compression, and data security.

3. THE 3DEEA MODEL

The process of 3DEEA development is a complex activity including several software tools for different purposes. Activities are considered with development of 3D model environment and development of different virtual machines to be used in real and virtual environment.

The 3DEEA collaboration consists of client and server. Client plugin unit is X3D-based virtual reality browser plugin. It is used for presenting information of virtual reality scene and server side, receive all kinds of action interaction from users and virtual environment, and return the various operations, interactions and communications of users to the server side. Participants can help each other and cooperate to accomplish a task commonly as well as share their virtual experience. Laboratory model also contains 3D model as a main interface for on-line participants. That model is developed in 3D Studio Max [16] and its functionally is defined in X3D-Edit [17].

The 3DEEA provides virtual prototyping and communication features for synchronous collaboration between geographically distributed designers. Concurrent design reviews on large scale objects, such as aircraft fuselage. The users could operate directly the X3D model, performing usual actions such as navigation, exploration, moving objects, communicating with each other, and many other actions previously defined (fig. 1). Communication is part of X3D scene. The existence of such virtual environments enables real time interaction using various resources (software and hardware) through the integration of virtual and real environments.

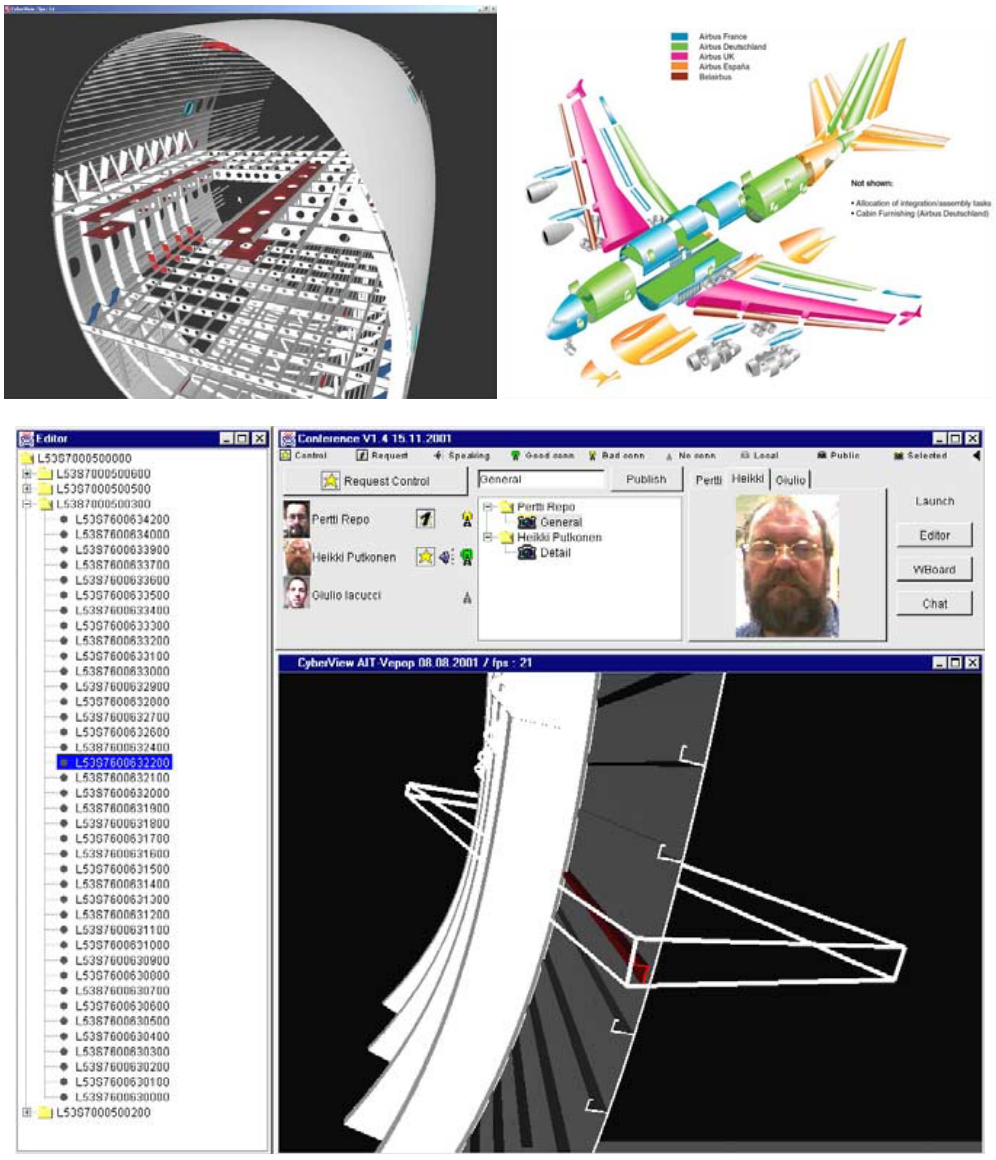

Figure 1. The 3DEEA model

4. EVALUATION

System efficiency is measured by comparing the final results of people who accessed 3DEEA through the virtual and physical interface. As most objective abilities to analyze the efficiency of virtual environments in practical use were identified by comparing results of people who used real and virtual environment. Results of this statistical analysis are compared. These are very important for our further work. Absence of statistically important difference in results of control and treated groups, when using confidence interval of 95 percents, proves usability of this concept.

5. CONTRIBUTION, CONCLUSION AND FUTURE WORK

We are developed 3DEEA, virtual environment for aviation students. Specifically, this environment:

1. Relies on special process of learning in theory and practice, which is unique in the field of aviation. System integrates exercising, practical work, and visualization of final project;
2. Provides support for effective interactions by using a group communication system as communication platform and by integrating the remote participants into a unified virtual environment;

The use of a 3DEEA connecting all participating teams would greatly improve communication in concurrent and distributed engineering. The benefits are reduced failure-rates as well as iteration loops and shorter lead-time respectively, faster availability for product data, design information and explicit design objects. Including knowledge and experience in the field of sensor networks and increasing the number of haptic devices, will give us the opportunity to implement a system which could imitate as many natural movements of the avatar's represent as possible.

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