DATA VISUALIZATION ON DISTRIBUTED DISPLAY FACILITIES IN A PROFESSIONAL DISTANCE LEARNING SYSTEM

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Abstract

The architecture of the software and hardware system for audiovisual data control and output in distance learning is described. This system is an efficient tool for visualization control, development of multi-variant scenarios for study sessions, and operational control of the equipment for distributed nodes of educational material transmission. The system makes it possible to combine information flows from various software and hardware sources and render them on the distributed display system in a flexible and efficient way.

Keywords: engineering education; visualization; distance learning; research situation center

1. Introduction

Modern education encounters serious challenges associated primarily with the rapid development of technology and increased data flows affecting the mind of both students and teachers. This requires the development of new competencies and shifts the very approach to education.

Employers are largely interested in qualified specialists with higher education and multi-skilled workers who have the abilities to quickly adapt to new working conditions, efficiently use modern technologies, and learn quickly [1]. In this case, the business is ready to spend substantial finances on personnel retraining within specific qualifications, but it shows a complete unwillingness to finance 3–6-year training courses that can be mastered in a few months. In this context, new approaches to distance learning for the personnel become of particular significance. As known, a breakthrough in some educational paradigm occurs quite often due to the shift to a new technology of presentation, “packaging”, and “transportation” of information and knowledge. At present, the distance learning technologies that are based on information, computer, and Internet concepts have received a new impetus in their development; however, the development of distance learning scenarios and, consequently, the data display at remote broadcasting points remain the most difficult. These processes require a large number of concerted actions for the control of hardware and software tools as well as display and switching devices [2]. In addition, it is often required to be able to create and demonstrate several variants of display scenarios depending on the course of the interactive educational process.

Here, it is needed primarily to differentiate the volume and depth of educational data presentation for different groups and even for individual students. This educational individualization can be based both on the results of initial or intermediate diagnostics and on the learning extent that is assessed dynamically.

2. Software and Hardware System for Visualization Control

To solve all the problems mentioned above, we can use in distant learning a unique system that is an efficient tool for visualization control, development of multi-variant learning scenarios, and operational control of software and hardware tools. The hardware and software system "Consistent Information Display" (CID) is designed for controlling the data output and supporting the training sessions in distributed and distant education centers as well as in specialized auditoriums, for holding conferences, meetings, and activities in educational and research situation centers, etc. (see Fig. 1).

Fig. 1. Data output on the distributed display system.

The CID for data visualization on the system of distributed display facilities generally makes it possible to:

- visualize data received from different software and hardware sources (such as texts, tables, graphics, maps, videos, and web-portals) on shared display devices (screens) in such a way that its perception is as convenient, efficient, and timely as possible;
- receive data directly from the database (or data warehouse) and display it in a way that is vivid and accessible for comprehensive analysis due to the built-in modules designed for generating business graphics;
- provide a quick and simple control of data visualization modes from an arbitrary number of different sources on an arbitrary number of display facilities both in real time and following a previously given scenario;
- produce and store nonlinear scenarios for training activities and videoconferences, including the state of all hardware and software tools at each time; ensure that the scripts can be quickly invoked and edited;
- broadcast video streams from any of the system outputs to distant nodes.

3. Hardware

The system hardware layer consists of the following main components (Fig. 2):

4. Software

The system software is a scenario-oriented service with a web-interface that makes it possible to store data on the state of the system at any given time as separate scenes, which were used to generate demonstration sequences (scenarios of education sessions). The scripts are created by the editor or a group of editors in the multi-user mode with the possibility of an earlier configuration of the user access rights. Using an appropriate interface of the CID, the editors can place information on the screens, preset, and generate operating modes of hardware and software system (Fig. 3). The “software” data sources can include office documents (DOC, XLS, PPT, DOCX, XLSX, PPTX), images (JPG, JPEG, BMP, GIF, PNG), video files (AVI, MPEG, WMV, 3GP, 3G2, MOV, MPG, MP4, FLV, MKV), web pages, web applications and video streams from IP-cameras (RTSP, H.264), remote desktops (VNC Viewer), PDF documents, graphical outputs of Windows applications (EXE), playlists (AVI, MPEG, WMV, 3GP, 3G2, MOV, MPG, MP4, FLV, MKV).

Fig. 3. Selection of content for data display on the video wall.

During the data preparation and placement on screens, the CID gives recommendations to the editor on the optimization of graphical windows, font sizes, line thicknesses, and other parameters that are important for the correct presentation of data to the educational session participants. The editor can preview the scripts simultaneously on all displays before the demonstration. The sequences can be nonlinear and describe a variety of options for the evolution of situations. In the case of nonlinear scenarios, one can set transition conditions depending on the situation; here, the switching between options can occur both automatically and manually by an instruction received from the console operated by a teacher, an educational manager, or an operator. An additional feature is the ability to control the “non-visual” equipment (such as lighting and air conditioning systems) as well as to monitor the state of the technical tools for the remote nodes that broadcast educational materials, implementing a unique interface for controlling all subsystems. The program interface is organized in such a way that the teacher can set in the real-time mode the sequence of software and hardware sources (scenes) to be displayed; in this case, the teacher is not required to have special programming skills and an understanding of the hardware structure.

The remote consoles for operational control of the educational process can be represented by both standard workstations and hardware-based touch-screens. Here, the console of each user receives only those functions that are required for treating his individual tasks and consistent with his technical training level [8].

Most modern software data sources do not have visualization tools optimized for screens of collective use; therefore, the CID includes tools for automated processing of input data and preparing them for visualization in a form that is optimal for perception and operation. These tools make it possible to visualize large arrays of numerical data as business graphics that is convenient for comfortable data perception by all participants of the educational process as well as to separate important data from unimportant ones. In this case, the data visualized from databases or other sources are updated automatically in real time, ensuring the relevance of displayed data.

5. Conclusion. Implementation and Prospects

The implementation of the CID software into the system of higher professional education will provide a substantial increase in the operational efficiency due to the optimization of the visual software support processes, the development of data display scripts, the intuitive operational control of scenarios and display modes, and the demonstration of different analytical and media data in a form that is convenient for students in perceiving and handling of data.

The CID software has successfully demonstrated its capabilities in the distance learning system for retraining of personnel at the Russian State University for the Humanities (RSUH) and in a number of its regional branches. Together with CJSC Polymedia, a leading system integrator in the field of data visualization, the RSUH is active in the the development implementation of relevant systems into the educational system based on the experience of practical use of similar complex and large-scale projects in different organizations of the Russian Federation.

The operation experience of these CID based systems in training and situation centers has shown their effectiveness. It has been reflected in improved quality of media contents in the composition of distance learning courses, reduced time for the preparation and updating of these courses. Also the flexibility of the contents transfer and interaction with students has significantly increased, especially in the context of individual approach requirements.

This experience also makes it possible to identify the fields for further activities aimed at the development of the CID system:

- extending the list of supported formats of software and hardware data sources for a more flexible use of the system in different applications;
- integration with special-purpose systems designed for the educational support, requiring efficient real-time visualization of different distributed sources, such as those with distributed network robot groups;
- expanding the use of prospective visualization systems, such as virtual and augmented reality (VR and AR) systems and three-dimensional real-time virtual studios.

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7. References

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