Distance Education and Multimedia Information Systems

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Abstract: Distance-learning material, i.e. the digital textbooks, the interactive textbooks with multimedia and hyper-media and video are preferred by many students. Even though many research projects show that the greatest benefit from the new learning material is evident for ordinary students and those who don't have enough time for traditional learning. The production of distance learning material requires highly skilled professionals. But it is not the end. What happens when we face another bigger question how can we store, retrieve, update, process and archive all this learning material. The multimedia information system for education is an answer. There are some information systems that can handle multimedia material but they do not satisfy our needs. Therefore we need to make the requirement specification for multimedia information system for education. In the article the requirements that would suit the needs are specified and extent to the very new approach to learning with the simulation is made. The simulation and virtual learning environments can be used in many areas of education, especially in medical training, to learn complex procedures and techniques.

Key-Words: Information system, distance learning, virtual learning environment, streaming media

1 Introduction

The aim of today's civilization is faster and more efficient educational system. Humans are not designed to acquire information at any desired speed. The speed at which we can learn is so low that we need to find some new approaches. Computers are very good in retrieving of data and still very poor in general reasoning. If we can include information technology into the learning process and speedup learning all the humanity will gain something. Therefore being a teacher is not only a job but also the constant search for improving the efficiency of teaching and applying the new techniques as soon as they become available. On the other hand there are no proofs that every new technology will also have desired effect on learning [1].

With applying the new technology we need new technique too. Streaming media [2] [3] is one of the new technologies that we know have a great impact in the past to the learning process. Video and TV have been proven to have positive effect on learning as supplement learning material. Since the streaming media is the successor of video and TV we think we can use it in the same manner. On the other hand, virtual learning environments are increasingly popular in many areas of usage, especially in different topics of educational approaches. We will shortly discuss in Section 3 the combination of virtual environment with the real world, where some streaming media has to be transferred between the visitors of the virtual worlds.

1.1 Streaming Media

With the introduction of fast computer and operating system that could handle the multimedia programs, the streaming media becomes reality. Technology enables us to distribute audio on demand with low cost computers and relatively small communication bandwidth. Only slow Internet connections still prevent us to watch the video over the Internet in the sufficient quality.

Today we have the following forms of streaming media:

- audio,
- video,
- videoconferencing (two ways video & audio) and,
- interactive video. [4]

By the technology we can separate streaming media into: multicast and unicast [5].

The best way to explain the difference between multicast and unicast transmission is graphical presentation. In both ways multiple users can utilize the stream at the same time with a little difference.

In the multicast case (Fig. 1) only one stream is distributed to all computers on the communication channel. In the unicast case for every user PC own stream is generated. Even if we can see that broadcast

distribution is better because it requires smaller portion of communication channel it has certain drawback. It cannot be utilize outside local area network. Multicast in most cases cannot go beyond active network elements (routers, switches, gateways). On the other hand unicast distribution is capable to be distributed everywhere.

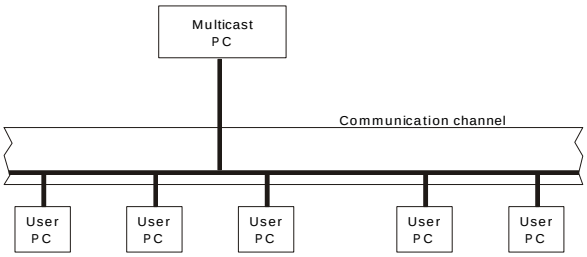

Fig. 1: Multicast distribution

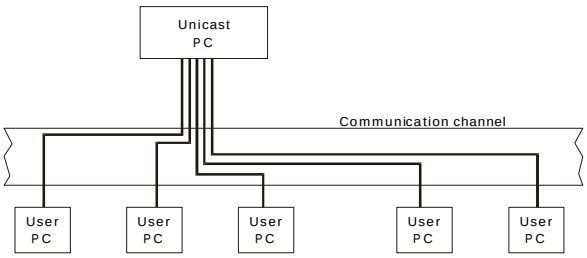

Fig. 2: Unicast distribution

2 The project of using the streaming media for education

The problems of streaming media are large files and handling the large files, as well as the fact that it is the time-based media. If we are satisfied just with the broadcast we don't need any additional information system. We just broadcast the learning material as the TV stations do. But for education purposes we need on demand access to the learning material. The student should get learning material when he/she needs it. Here lies the problem. Let suppose that hundred of students needs the specific learning material the unicast system would probably severely degrade the throughput of the network but each student would get its information. If thousand of student require the same information a very costly system with redundant servers and multiple network is needed or the system would crash. It is known that universities do not have so much money to build such systems. But they still have to solve these types of problems.

The solution is multicast distribution on demand. While one performance is transmitted requests are send to the multicast station for the next transmission. Sound simple but hard to do unless you have the system that enables you this. Such system is the aim of our project.

In the Faculty of Education we are trying to apply streaming media for education. As a part of national program "Computer Literacy" in the project "Didactical views of applying computer in education", we are preparing project documentation and we are doing some test examples for applying streaming media.

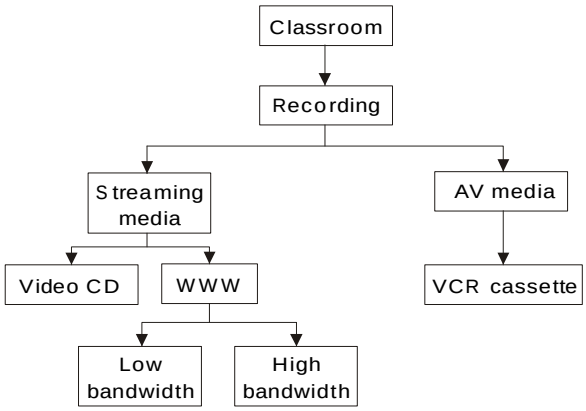

Fig. 3: Schematically presented project

On Fig. 3 we can see that in the near future almost all lectures will be recorded and available to students in different media form. Video CD and VCR cassettes are off-line media but low and high bandwidth streaming over the Internet can be available all the time [6] [7]. We have the technology that enables us to transmit streams in postproduction or in the real time.

3 The virtual learning environment – requirements

In Faculty of Electrical Engineering and Computer Science the Virtual Delivery Room (VIDERO) was developed [8]. The whole educational approach is intended for students of medicine at Stanford University where they try to learn from the virtual training environment. In this case the students can meet some rare and dangerous situations virtually, so that they are prepared to deal with them in every day practice.

Many original contributions were made during the preparation of the prototype: the graphical models of important medical equipment and the virtual baby were created, a few improvements to the VRML language were introduced, the complex dynamics to the static representation of the baby and medical monitors were added, a support for user-created scenarios and actions is provided and a module for replaying the recorded training sessions was designed. As well, a support for Polhemus

tracking device was done and a real-time audio communication system between visitors of such virtual training environment was added [9].
The whole prototype was coded in Java and Javascript languages and is therefore platform independent and is implemented like a web page. Of course, several client-server modules are included to solve the problem of security restrictions of applets: a) the navigation server which communicates with the tracking device; the student and the mentor navigation clients running in the web browsers; b) the real-time audio communication server and c) the replay server.
Both modules, the student (Fig. 4) and the mentor module, run on two different computers, connected through the network what enables the geographically distributed participants of the virtual medical training.

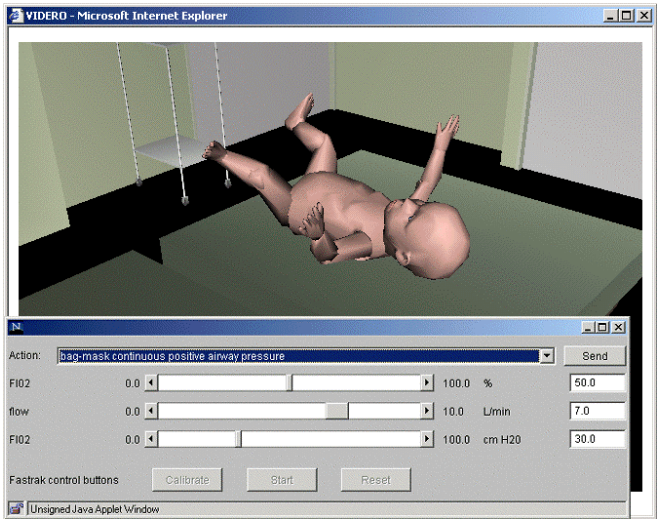

Fig. 4: The graphical interface of student's module

Of course, every part of the virtual training environment and its modules has to be saved in the multimedia information system. First of all, different VRML objects like the model of the virtual baby have to be saved in the database. Next, different training scenarios of baby's behavior are constructed and have to be saved into the database. When the mentor loads this scenario file from the database, all baby's parameters are changed through time according to the scenario. Changes are transmitted from the mentor's to the student's module in order to preserve consistency, and to the replay server where they are saved in the database. The student will perform different actions in order to resuscitate the baby. According to his actions the baby's vital signs will change (heart rate, color of the skin, chest movement, extremities movement, etc.). Also this actions have to be transmitted to the replay server and further to the multimedia information system.
During the virtual training session, different people can join and contribute to the happening. They can talk to each other, the baby will cry or grumble and all the sounds have to be properly transmitted between all participants and also recorded through the replay server to the database.
The special module is responsible for the proper handle of the real-time audio streams. The audio stream is encoded into MPEG format before it is stored to the multimedia information system. But beside the audio data also the exact time to start the replay of the separate voice has to be saved together with the positional information of all participants. Their positions are necessary to provide the spatial sound between them inside the virtual world, what is one of the characteristics built in our prototype.
In the continued development of the VIDERO prototype the support for force-feedback and haptic interfaces is planned. This will introduce some new requirements for the multimedia information system, because it will have to be able to save the features of the haptic devices and to feed the force-feedback mechanisms with appropriate data. Also the prevention of the collision between the objects of the virtual world and the humans inside them (avatars) will be build into the prototype with some new real-time limitations.
We are dealing with the time-based media, like audio is, and with the time-based simulation, where correct timing of doctor's intervention is very important. In the current version of the prototype, the only way to consider the time of intervention is by using relative changes of baby's parameters over the time. More sophisticated support for time-dependent actions is planned to be added in the future and should be considered in preparation of the multimedia information system.

4 Multimedia information system for education

For handling the access and distribution of large amount of data we need multimedia information system. The model of the multimedia information system (MMIS) for education is presented on Fig. 5. Bare in mind that not only streaming media will be inside this system.

As we can see on Fig. 5 the MMIS will use multimedia layer to store and retrieve data. First group of modules is for MMIS but second group of modules extends MMIS to the education area. Table 1 presents the specification of the functions of modules. In the Producer module the web function requires additional translator. This translator scans the HTML files and translates their hyper-links to the addresses that are used as links inside the database.

This is very important for importing the already made web pages.

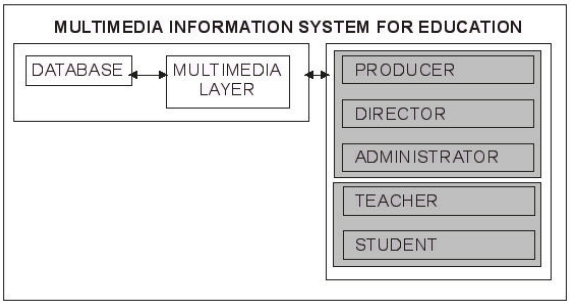

Fig. 5: The schema of MMIS for education

The real price of this model is hidden in the director module. This module will handle requests and distribute video streams. Conjunction with the student module we will have the statistics of the access to some material and we could easily perform evaluation of the learning material. If some of material is not attractive we can distribute questioners and receive answers. We could incorporate questioners at the end of transmission and receive immediate feedback.

Table 1: MMIS modules and functions

MODULE	FUNCTIONS
Production module	audio, video, web (translation), any file
director module	request handling, scheduling, timeline, real-time presentation, exception handling
administration module	operation & maintenance
teacher module	authoring tool, test preparation, statistics, communication, scheduling (meetings/lectures)
student module	knowledge retriving, tutorials, test system

5 Conclusion

Streaming media can be very successful addition to the learning process. It will enable that all the students get the same high quality learning material. It has advantages and disadvantages. The disadvantages are mostly related to the education system and maintenance. Once this type of learning will be recognized as good addition and get financial support it will thieve. The research confirms the need for the multimedia information system in the area of education. It is necessary to build simple, powerful and robust environment for handling the multimedia material and multimedia information system because education system cannot spend a lot of money on maintainance. In the time being the prototype of the multimedia information system is being explored, but in the near future this system will be totally implemented and used throughout the University of Maribor.

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