

Design of a Multimedia Lecture Hall for TeleEducation and Videoconferencing

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ABSTRACT

In the age of information and communication the employment of modern technology and the use of videoconferencing systems get more and more important, especially at universities. To meet the diverse requirements we established an advanced multimedia lecture hall at our institute. The main focus during the implementation was to create a user-friendly, multi-functional room for educational and classical videoconferencing purposes. The equipment includes a high-end videoconferencing system, an interactive electronic whiteboard as well as desktop PCs for the students.

In the first part of this paper we will describe the motivation to use modern technologies in education, especially the benefit of a multimedia lecture hall for TeleEducation. The second part points out some technical background for the design and the realization of a multimedia lecture hall.

Keywords:
Multimedia, TeleEducation, Videoconferencing,
Lecture Hall

1. INTRODUCTION

On the threshold of the information society to the knowledge community the learning and training habits are in a large change. So with the learning behavior also the learning methods have to be transformed to meet future challenges. Not only the implementation of new learning methods in traditional learning environments but also the necessity for lifelong learning increases the relevance to new information technologies for teaching and learning issues. An important area of research at the Institute of Communication Networks is therefore the development and testing of new techniques for teaching issues in educational environments, especially at the university.

Virtual universities – Technical possibilities and chances

So far the university as traditional learning environment offers frontal lectures, seminars and exercises in most disciplines. In the future the learning behavior will change temporally and

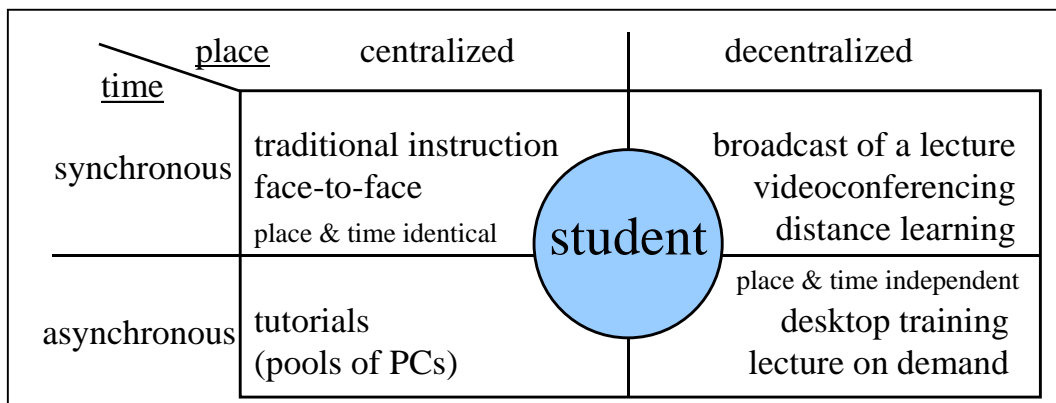


Figure 1: TeleEducation: Classification to time and place

spatially with the application of new technologies and the rising use of computers. New possibilities and scenarios for the basic and advanced education arise. As represented in Figure 1 future learning will take place not only at the traditional institutes (centralized) and at certain times (simultaneous / synchronous), but everywhere and at any time (decentralized, asynchronous).

The extension of the university boundaries provides a contribution to global information exchange and offers new chances for the knowledge acquisition. As a visionary scenario a virtual university develops with the target to offer highest possible spatial and temporal independence for the students. The medium of the future will be the personnel computer (PC) as a provider of teaching material, experimental environment, library and information terminal, as well as communication center.

For producing and storing the teaching materials also the conditions and equipment at the universities have to adapt to the new technology. Not only teaching habits have to change. Also important technical prerequisites of the virtualization have to be designed properly, like communication networks, which have to guarantee the fast transport of digital information data [1]. In addition to the temporal independence a main aspect is concerning the spatial constraints. In both cases the teaching place and its facilities are vitally important.

Therefore this paper focuses on the lecture hall, where special technical equipment has to be integrated to meet the requirements of TeleEducation.

This paper is structured as follows. First we discuss different scenarios of TeleEducation and we give some background of the technical aspects. Then we describe the design and the realization of the multimedia lecture hall at the Institute of Communication Networks at the Munich University of Technology. In chapter four we present some technical details. We conclude with examples and a short summary.

2. TELEEDUCATION: SCENARIOS AND TECHNICAL BACKGROUND

This chapter will introduce some different scenarios of TeleEducation and several technical items are mentioned concerning the transmission of data from the lecture hall to the remote place.

Scenarios in TeleEducation:

Normally three different types of learning scenarios are distinguished, shown in Figure 2:

- Scenario 1: Lecture hall to lecture hall
- Scenario 2: Home learning
- Scenario 3: Tele seminar

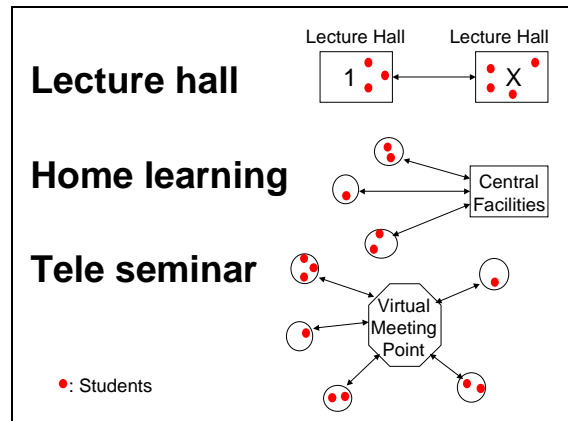


Figure 2: Classification to the way of learning

The first scenario describes a traditional lecture hall scenario, with the improvement, that someone can join a lecture also at a remote place (remote lecture hall “X”). The scenario 2 allows students to participate in a lecture of their interest online (live) or offline (asynchronous) via their computers. In this example the student is sitting in front of a Multimedia PC at home or at a PC pool at university and benefits of central facilities. In the online case some interaction with the professor should be possible. Emails, newsgroups or other groupware tools should support the interaction between the students and the teacher or among the students at any time, particularly in the asynchronous mode. Scenario 3 has probably the most advanced characteristic forming a virtual learning community in the network (virtual meeting point). With the assistance of video conferencing systems and groupware management tools like shared whiteboards the students cooperate PC-based in a team.

In order to get the information the participants may ideally use the Internet, for example to attend a “Lecture on Demand”, which took place some time before and has been stored at a special content server at university.

To conclude, all of these scenarios need at least partly a multimedia lecture hall as a basic instrument to arrange the original event, for example a lecture, which will be transmitted to a remote place (scenario 1) or be edited and stored on a content server to give a possibility to participate the event at a later date (scenario 2). Further the multimedia lecture hall may offer the facility to establish a multipoint videoconferencing session to support a Tele seminar (scenario 3).

Technical Background

The main aspect in TeleEducation is the distance between the place of the original event and the participants somewhere at remote locations. As shown in Figure 3 the students in our case have the possibility to join the lecture (event) via two different transmission techniques, based on a IP-network (Internet) or via a dedicated ISDN-connection. The reason for choosing the circuit-switched network is e.g. the quality of service (delay, jitter, loss rate...) that is very important to get high quality audio/video-transmission, especially if the student is participating from a remote place outside the Intranet of the university. One reason to choose the IP-network might be the cost factor, because normally it is much cheaper to be connected via the Internet.

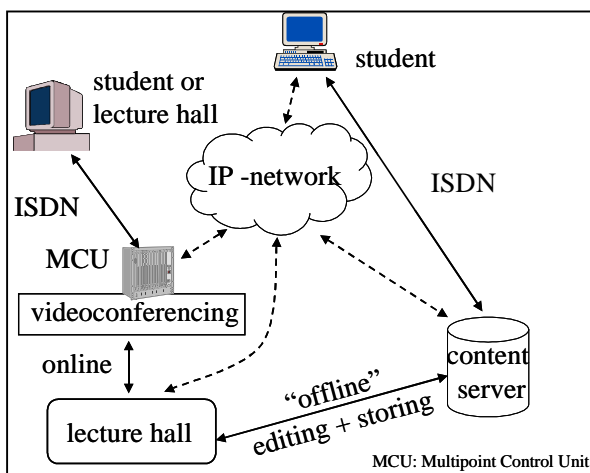


Figure 3: Technical Configuration

As mentioned before there are two different transfer modes:

- Online mode (live transfer):
The student is joining the lecture live. For real-time transmission the delay should not be more than some milliseconds. Only in that case the students can interact with the teaching person during the lesson. If Quality of Service is needed it would be the best to connect via a high speed broadband communication network. Especially if the lecture is broadcasted to another lecture hall (scenario 1), where a group of participants is joining the event, the connection quality is crucial.
At the moment it is advisable to use ISDN in this case (e.g. 6-ISDN-channels). In the future a high quality IP connection could be sufficient.
- "Offline" mode (asynchronous):
The student is connecting to a content server after the event has finished. Because of the time difference the recorded data could have been edited, so that the content may even been

modified or prepared in a special way for the students. Moreover the transmission is no more timecritical, because there is no interaction. For this reason a mean connection quality (IP or ISDN) should suffice.

During most of the normal videoconferencing sessions a point-to-point interconnection would be established. But especially in TeleEducation scenarios it is sometimes very useful to have point-to-multipoint connections. To do this at the same time with the ISDN-technology it is necessary to use a Multipoint Control Unit (MCU), a digital videoconferencing hub, which allows several systems to be part of the same conference. Further details on the principles of data transmission are explained in [2].

3. REALIZATION OF A MULTIMEDIA LECTURE HALL

This paragraph describes the design and the realization of a multi functional lecture hall. From the beginning we decided to combine the equipment in such a way that the multimedia room could support the different requirements of

- a classical videoconferencing session,
- and a TeleTeaching lesson.

Normally in industry there are special conferencing rooms equipped with commercial videoconferencing systems. At universities on the other hand a TeleTeaching lecture is given generally in special high tech lecture halls. During the TeleLecture several persons (engineers and technicians) have to assist the professor with the complex techniques. Our aim was to design the multimedia lecture hall in such a way that it would be possible to use it without additional (personal) expense. In this way we achieve to take the advantages of the both scenarios, classical videoconferencing and TeleLecture, and by the intelligent combination of commercial equipment, software and little "tricks" we realised a

- extremely user-friendly (for the teachers and students) and
 - highly scalable for different scenarios and applications
- multimedia lecture hall.

Before we can discuss the different features and technical details, we want to give some information about the room and the multimedia equipment. Figure 4 shows the construction of the lecture hall.

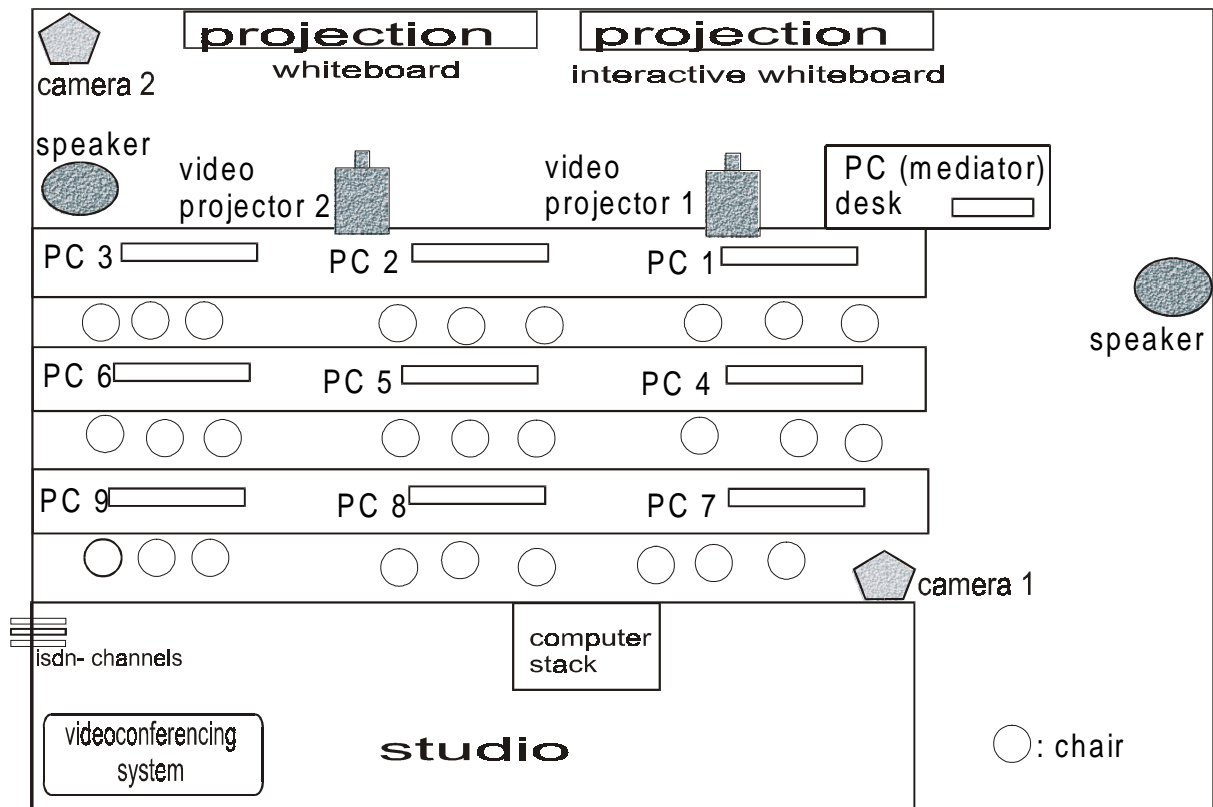


Figure 4 Lecture Hall: Schematic diagram

The equipment ranges from an high-end videoconferencing system, an interactive electronic whiteboard to the desktop PCs for the referee as well as for the audience to do some interactive tutorials.

Request of the technical configuration of a multimedia lecture hall

Following main components have been integrated:

- Multimedia computer with video conferencing capabilities, wireless keyboard and wireless mouse (and integrated capture card)
- Videoconferencing system (PictureTel Concorde 4500 [3]) with several "Look-at-me" buttons (storing possibility for selected places)
- Two video cameras: Follow-me-camera for recording the speaker and another camera for the board
- Two video projectors
- Audio system: wireless microphones, audio mixer, feedback destroyer, amplifier and speakers
- Whiteboard (electronic)
- User-friendly operating desk for the referee with control monitor and connection possibilities (video, audio and Internet) for external notebook with automatic signal switching
- Video recorder
- Several links for the integration of further devices

- Internet and ISDN (6 channels) support of the Teleteaching system
- Computers in the lecture hall for the participants
- Central activation and deactivation of the monitors (necessary during lessons !)

Figure 5 shows the use of the multimedia room during a lesson.



Figure 5: Picture of the Multimedia Lecture Hall

4. TECHNICAL DETAILS

As mentioned before, the multi functional room supports a classical videoconferencing as well as a Teleteaching lecture. Both scenarios may use the same equipment, but with different emphasis.

For the **classical videoconferencing** the room offers the following equipment:

- Transmission with up to 6 ISDN-B-channels (384 kbit/s)
- Inband Netmeeting
- Outband Netmeeting via the internet
- Cooperate work with the electronic whiteboard
- Additional presentaion possibilities
 - desktop content of PC
 - video recorder
- Recording capabilities
 - by video recorder (classical)
 - with streaming media encoding on the PC (Microsoft or Real Networks)

In the case of **Teleteaching** the room supports the following facilities:

- Transmission
 - with up to 6 ISDN-B-channels
 - IP-based via the Internet
- PC for interactive simulations
- Electronic whiteboard as “great touch screen”
- Usage of the video recorder
- Recording capabilities
 - by video recorder (classical)
 - with streaming media encoding on the PC (Microsoft or Real Networks)
- Providing the content
 - Live
 - Via streaming media server (lecture on demand)
- Practice possibilities
 - At desktop PCs (locally)
 - Remote

To point out the complexity but also the flexibility of the configuration of our advanced lecture hall we want to list just a selection of the possible features.

As shown in Figure 6 all the nine desktop PCs of the participants are linked to the referee’s monitor (here also called “mediator”) via the Virtual Network Computing (VNC), a remote display system software by AT&T [4]. In this way it is possible to view a computing desktop environment not only on the machine where it is running, but also from the “mediator” desktop, and thenceforth at the projection

wall. This means, that it is even feasible to control the “remote” PCs (1 to 9) at the interactive whiteboard.

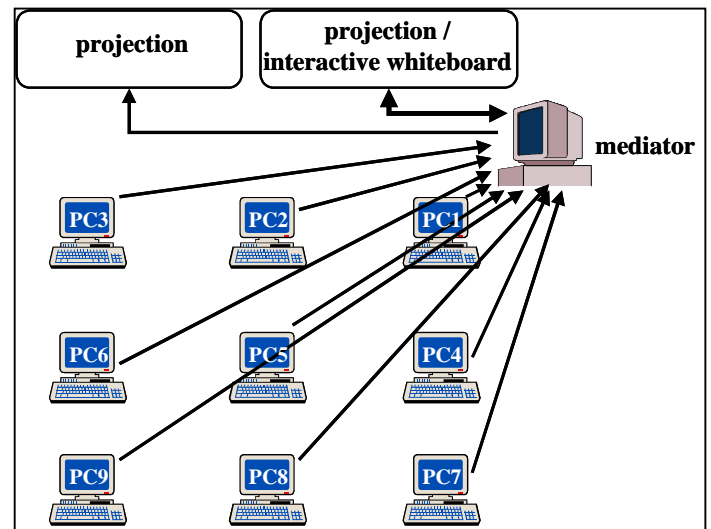


Figure 6 Virtual links of the PCs with the "mediator" via the VNC software

Further a lot of additional connections are merged to and from the videoconferencing system (Figure 7). For realizing Netmeeting “in band” the ISDN-videoconferencing, the referee’s PC (“mediator”) is connected directly to the videoconferencing system. For the same reason the video recorder has a link not only to the video projector 2 (for presenting a video locally), but also to the videoconferencing system. In addition all necessary connection possibilities (video to projector 2, audio and Internet) for an external notebook are provided at the operating desk with an automatic signal-switching device.

Of course, also the two video cameras are directly connected to the videoconferencing system. For the support of the teacher the data is also displayed on a preview monitor at the desk.

On the other hand the PictureTel system is displayed on the projection wall 2. For electronic recording the video signal is connected to the “mediator”, where a streaming media encoder is installed, or to the video-recorder to store the conference data on a conventional videocassette.

Also the audio signal has to be connected to the different devices similar to the video data. As mentioned before, the audio system consists of wireless microphones, an audio mixer, one feedback destroyer, an audio amplifier and the speakers (two normal loud speakers and a special one for the video conferencing system). The control system is initialized in an optimized way, so in general it is not necessary to tune the controller.

One of the last technical advances in the design of the hall is the wireless activation and disconnection of the desktop monitors of the nine PCs in the lecture hall.

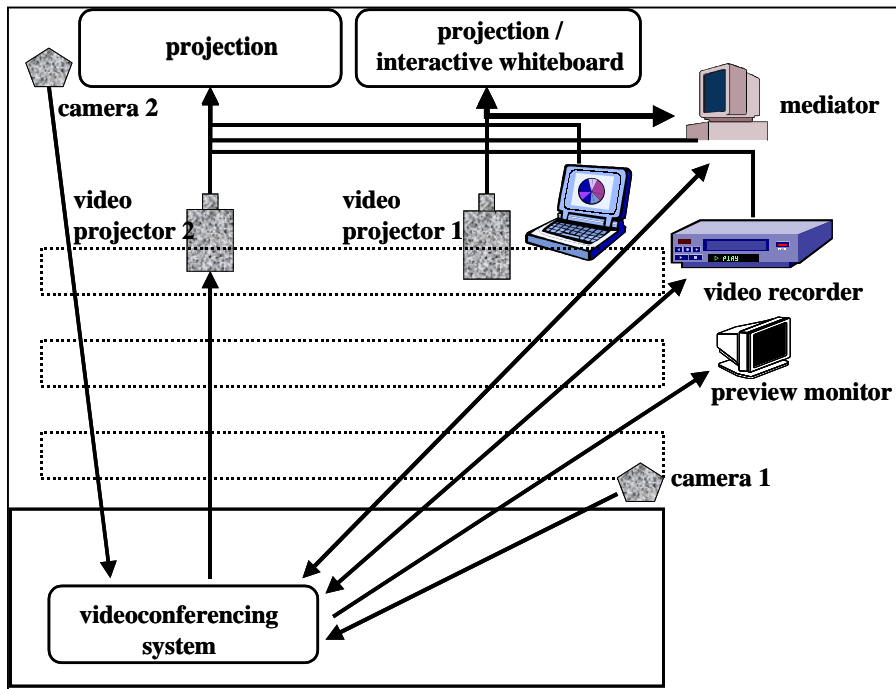


Figure 7 Connections of the videoconferencing system

Thus the teaching person can easily regulate during which time the students should (and especially can) work with the computers, otherwise the computer may draw off the attention of the students.

Examples

Though the design and realization of our multimedia lecture hall is not yet finished, it is frequently used. During the summer term a main lecture of the master program, the course on "Simulation in Communication Networks", has been given in this room (a mixture of a traditional lecture and a simulation tutorial). Furthermore a lot of discourses take place in our modern lecture hall by using the new technologies, e.g. the electronic whiteboard, and also the diploma students abroad make their interims reports via videoconferencing.

As the room is suited for normal videoconferencing as well, several research groups are also using the equipment just for project meetings with external partners.

5. CONCLUSION

This paper points out some technical background for the design and the realization of a multimedia lecture hall for TeleEducation and Videoconferencing. At the beginning some motivation for using an advanced lecture hall has been presented and insights in the facilities of a multimedia lecture hall have been given.

The last chapters describe the equipment of a multi functional lecture hall exemplarily by the configuration of the lecture hall at the Institute of Communication Networks at the Munich University of Technology.

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