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tele-TASK – Teleteaching Anywhere Solution Kit

Christoph Meinel, Volker Schillings
FB IV – Informatik, Universität Trier
D-54286 Trier, Germany
email: {meinel, schillings}@uni-trier.de

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Volker Schillings
Universität Trier
FB IV – Informatik [3]
D-54296 Trier, Germany
(+49) 651 - 2012832
schillings@uni-trier.de

Christoph Meinel
Universität Trier
and
Institut für Telematik [1]
Bahnhofsstr. 30-32
D-54290 Trier
meinel@uni-trier.de

ABSTRACT

With the help of the new developed system tele-TASK - Teleteaching Anywhere Solution Kit - [2] [7] a new, drastically simplified entrance technology for on-line lectures is reached. Out of the apartment or the office each PC user with a suitable Internet connection can follow online lessons comfortably. Even an interested layman is able to access the courses. Not only content of teaching are delivered, which are presented to the students in the lecture-room by either a whiteboard or a video beamer, but simultaneously also video and audio of the lecturer. Navigation bar for accessing different parts in the recorded lecture are included. Tele-TASK supports all usual platforms, different net bandwidths, arbitrary presentation programs and needs no special software installations, configurations and no precognition of the end-users. For the first time, the system was deployed for recording, transmission and archiving of the computer science lecture "Information security in open networks" at the University of Trier in the summer semester 2002. High access numbers are expression of the perfectly problem-free and easy possibilities of using.

1. INTRODUCTION

The 21. Century is defined by a rapid, medial based development of our communication culture and our knowledge- and information-organization. Against the background of the described developments, also a change of the forms of knowledge transfer as well as acquirement carries out itself. Multimedia based arrangements supplement increasingly traditional training forms. Thereby the self-study will become very important in the future. Today, after school or university, people are not able to avoid further studies. Lifelong learning is getting inalienable. Parallel to the occupation, people have to do their further studies. By using teleteaching systems like the here presented tele-TASK, those people could be reached. Not only students at university are becoming independent of the course schedules and lecture-rooms, but transmission of the courses via Internet generally opens the possibility for home working. High specialized courses could be followed by the students again. Especially for exam preparation the recorded lessons are very helpful. In particular students from abroad or employees, who are not able to study at university parallel to their professional activity can profit from teleteaching. Last but not least, we have to refer to the group of handicapped people who are locally reduced. They are also potential of a teleteaching system.

We are introducing the new "easy to use" internet based teleteaching package tele-TASK which accomplishes all requirements to modern teleteaching systems.

2. TELETEACHING – A REQUIREMENT PROFILE

At the University of Trier, at the chair "Theoretical concepts and new applications in computer science" [3], a new teleteaching concept has been developed and tested, which grants an entrance to on-line lectures to the user in the simplest way.

Past teleteaching systems limit operators and users to various ways. On operator's side the lecturer is often rigidly bound to an operating system or to necessary bandwidths. Also widely spread is the restriction in using special presentation systems, e.g. PowerPoint, which finally leads to the lecturer's degradation to a slide commentator. Today good computer science lectures presuppose dynamics, which have to allow to transmit arbitrary other contents. Apart from PowerPoint slides and graphics, computer animations or demo programs as well as program descriptions or arbitrary information from the WWW rank with these contents. An unrestricted use of all usual operating systems is also desirable.

On the users' side, students and other interested persons, who want to retrieve courses via the Internet, should not be subjected to a torture of complicated installation and operating steps. In the winter semester 2001/2002 at the local chair teleteaching systems were tested and used for the first time. All applied systems were very difficult to install and to use, because of the need for Java or other software packages. A lot of programs were very instable, too. The experience showed that even computer science students were not able to furnish and operate such special software packages correctly. Proceeding from these observations, we improved the development of a less limited applicable and at the same time more efficient teleteaching software system. Apart from the requirement of a simple use, a transmission of the lecture should be possible down to the modem speed, since not every student has a wide-band Internet connection. The use of standards, the permission of any operating system and any presentation software are also required for the development of a new teleteaching system. Tele-TASK represents itself as a result of these considerations and developments. The experiences in the field use in the summer semester 2002, the reactions of the users and the high access numbers confirm the quality of our concept.

3. tele-TASK – CONCEPT AND IMPLEMENTATION

A Streaming server of Realnetworks [4] is used so that contents can be called up with the help of the well-known Realplayer. Thereby all installation problems can be avoided for the final user, since the Realplayer is preinstalled on most computers. Besides, its integration in web pages is very simple. Users can start lectures directly from the appropriate web page. Further on, the Realplayer is available for all usual operating systems. Fig. 1 clarifies the

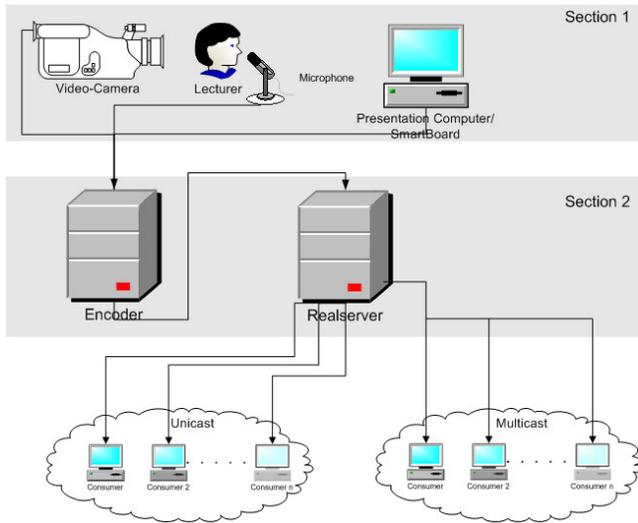


Figure 1. Server-side infrastructure

structure of the server-lateral infrastructure:

3.1 Installation in the lecture room

Section 1 of the diagram shows the installation in the lecture-room.

- *Transmission of the video picture and the audio*
An usual standard camera records the lecturer in a total view. At the same time audio is recorded via microphone. The video and audio signal are sent over a radio-link or by cable to a computer, which computes the Streaming data.
- *Complete transmission of the Desktop*
The recording of the completely presented computer screen content is of great importance. A camcorder video recording of the whole beamer-screen is not applicable due to the bad image quality. Therefore the complete screen content is sent loss-free with the help of a SSL secured VNC [5] to the encoder. At the same time this method underlines the advantages of tele-TASK. The lecturer can use his own Notebook for the presentation. Just the VNC software must be installed. VNC is free and for all usual platforms available. Windows, Linux, Apple Desktops and others can be transferred problem-free. Further, all applications or animations can be taken up and transferred.

- *Employment of an electronic board*

As projection board we use a touch-sensitive board (SmartBoard). The screen contents are transferred with the help of a video beamer to the Smartboard. The lecturer is now able to control the computer interactively via the projection board. Electronic pencils can be used, in order to use the board exactly like a conventional board. Notes or additions can be added on the slides. Even mathematical proofs can be written down in traditional form problem-free. We consider the recording of the lecturer in combination with the contents presented on the SmartBoard as a great advantage. The learner always sees the part of the slide just being discussed. In the video panel he sees the small picture of the presenter's screen together with the presenter himself. In another bigger panel, he is able to view the large desktop (see fig. 2). In addition, the electronic board could be replaced by a graphic pad.

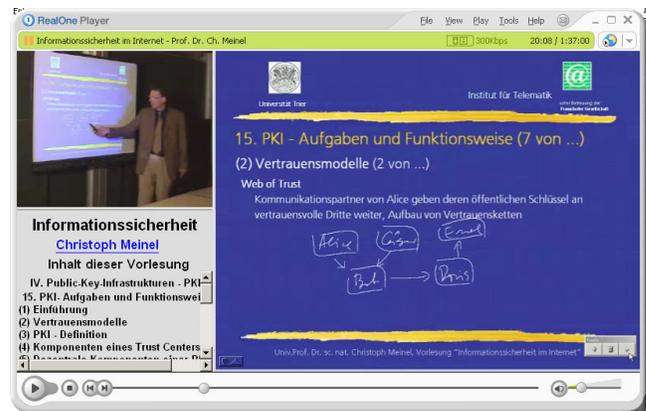


Figure 2. Interaction between lecturer and desktop

3.2 Communication layer of tele-TASK

Section 2 clarifies the communication layer of tele-TASK:

- *Processing the Streams*
The encoder consumes altogether three streams (video, audio and desktop). The developed tele-TASK software package combines the three input streams. Video and audio are synchronized to each other and treated then as one stream. The synchronisation between audio, video and Desktop is thus guaranteed. A text stream can contain additional information in the form of e.g. links or tables of contents. The operator of this software can position the streams freely (see fig. 3). Usually the video stream is put in field 1, the desktop stream in field 2 and the text stream in field 3. The composition of the streams is done by SMIL (Synchronized Multimedia) [6]. By the aid of the software beginning and ending points as well as cut points can be set, so that later cutting of the recording can be carried out automatically.

Field 1	Field 2
Field 3	

Figure 3: Joining the synchronisation elements

- *Dispatching the Streams*

Simultaneous to the encoding the compound ensemble is sent to the Real-Server. Afterwards, the Real-Server dispatches the data live to the clients by UDP unicast and multicast packages. The stressed bandwidth is reduced by use of multicast. To realize an almost loss-free transmission of the desktop, the video and audio is delivered at 300 kBit/s.

- *Processing for Modem and ISDN Speed*

To make an access via modem and ISDN possible, we have to do post processing of our streams.

It is our goal to offer with only approx. 5KB/s a video, a Desktop and Audio to the consumer. Realnetworks offers a program [8], which allows the recording of PowerPoint presentations. Therefore, the PowerPoint presentation is pre-processed. For each slide a screen photo is provided. Together with the static slides, the lecturer's video and audio is recorded.

We refused this solution, since we did not want to limit tele-TASK regarding to the presentation programs. A further disadvantage is that annotations of the lecturer with the electronic pencils would not be taken up. We have developed a Client/Server program, which can be installed on the lecturer computer and controlled remotely. This program scans the screen systematically for changes. The desktop is divided into manually adjustable rectangles (see Fig. 4). If contents of such a rectangle change, a photo of the area is provided automatically. The photo is stored together with a relative time mark and also the coordinates. With JPEG compression we need 1200 rectangles for 1,5 hours of PowerPoint presentation inclusive annotations. In case of a screen resolution of 1024*768 pixel four Megabytes are consumed. But for a liquid modem transmission this is too much.

In a further processing step the rectangles are made smaller. Identical rectangles are also searched. For identical rectangles the picture is saved with several time marks and coordinates. By this processing step it is possible to reduce the number of pictures to 700-800. The consumed space reduces to 700-800 KB.

The Realplayer permits updates of certain screen sections at fixed times by Realpix. A Realpix definition file with all screen updates is thus provided automatically and made available. Video and audio are processed with lower bit rate and built up together with the desktop by the help of SMIL [6].

The processing and supply functions run fully automatically. In practice it has appeared that a smooth playback is even possible with modem speed.

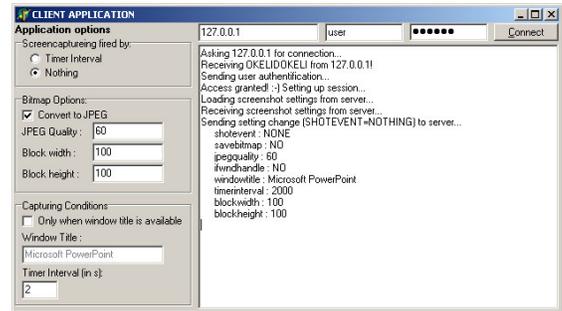


Figure 4: Capturing tool for modem and ISDN speed

- *Generating Table of Contents*

If the lecturer uses PowerPoint, tele-TASK offers a tool for generating tables of content automatically. During the presentation, a VBA Script checks the PowerPoint slides for headlines and saves the time marks for a new chapter. Afterwards a table of content file is generated and is included into the online-lecture (compare Figure 3, field 3 and Figure 2).

3.3 tele-TASK in practice

3.3.1 Operators side

Tele-TASK is a complete program suite for providing high quality teleteaching. The package consists all necessary programs and tools for generating streaming material web interfaces and methods for post processing. Fig. 5 shows the web page of lectures provided at the University of Trier.

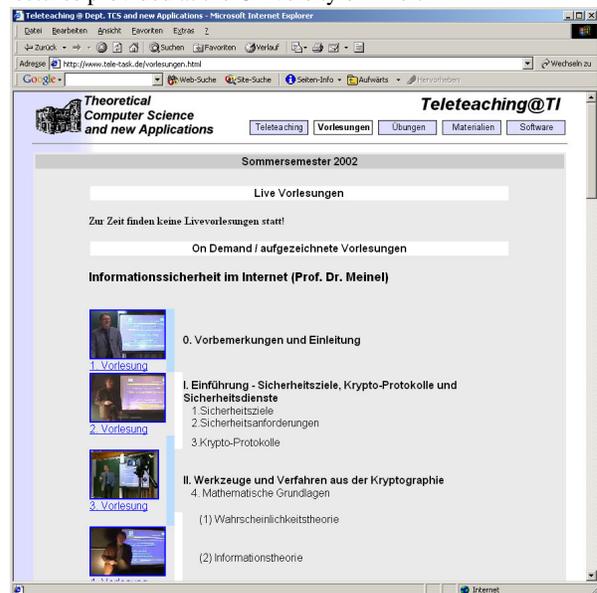


Figure 5: Automatically generated web page for online lectures

By clicking on the images of a lecture, the Realplayer starts automatically and plays the lecture. The whole system works like a one push button automat. It takes less than one hour for setting up tele-TASK and the technical environment. In order to run tele-TASK you need a fast computer for encoding, a computer for serving the streams to the internet, a video camcorder and a standard microphone. The complete equipment fits into only one small car, so that it is possible to offer teleteaching anywhere you are. In practice, the server computer is not at the same place like the encoder.

Once tele-TASK is installed, nearly every lecture can be recorded. A lot of universities are speaking about offering tele-lectures. But if you want to find something in the web, you will have to prepare for a long search. With a system like tele-TASK a university or an institute for further education can allow the students to access and replay all courses they want to see. Also, it is very easy to make the lessons offline available. Only one CD-ROM contains about 6 hours of recorded courses including video, audio and the desktop of the lecturer.

The intuitive use of tele-TASK makes it not necessary to train the lecturers. Even the use of the Smartboard is problem-free. At the University of Trier in summer semester 2002 a lecture about cryptography was recorded and delivered into the internet. For this kind of lecture a lot of annotations and hand written mathematical proofs were needed. The quality of the recorded lessons was such high, that lots of students all around the world joined the lessons via the internet.

Another big advantage for the lecturer is the kind of copyright on his lectures. By making scripts of a lesson online available, the copyright trademarks are not protected. Everyone can copy and paste the text to his own documents. With streaming data, it is much more complicated to do this.

3.3.2 Viewers side

Comparing to fig. 5 tele-TASK makes a calling up for the consumer very easy. By clicking on the corresponding link the player starts up automatically and plays the lesson. In comparison with other teleteaching systems, tele-TASK is very easy to use. Even laymen are able to access the lectures through the internet. The experience with other teleteaching software, which were complicated to use on operator and viewer side, taught us to provide a "as easy as possible" technology even for the consumer side. The positive feedback and the high access numbers (about 10.000 calls on the online lectures in three months) shows the effectiveness of tele-TASK.

4. CONCLUSIONS

With tele-TASK it is possible to provide high quality teleteaching without a large technical and financial expenditure. The use of the Realplayer makes an access of contents everywhere and each time very simple. The past users emphasized the simple applicability of the system. Even the high-quality and the smooth transmission of the Desktops speak for an expansion of the employment on the range of the further training (e.g. training courses for Linux, Word, or other programs). Two big advantages let tele-TASK be very useful for further education. Online courses can run separate and simultaneously to traditional forms of courses. The number of potential attendees increases dramatically. Further, after a course CDs with the recording can be given to the participants.

Today, we are developing a complete web-based e-learning environment including course management and tele-lecturing. Functions for searching a complete course archive for keywords will also be included.

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