# Equal study: Lecture based automated video recording system for all

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## Abstract:

*This paper presents a system, which (in one piece) captures the necessary video and sound equipment, interactive streaming video technology and virtual hypermedia environment into a new web based learning environment. In several steps a lecturer can prepare a video supported lecture, which is automatically synchronized with additional media (material, subtitles). Students can watch these lectures live or on demand. Later on additional form of subtitles can be simply added into the video and sound - for deaf and hard of hearing persons and for blind and weak sighted (audio subtitles). The paper also answers whether the lecture based automated video recording system evaluation is suitable for the needs of teachers and students with special needs.*

# 1 Introduction

The information and communication technology (ICT) has been gaining popularity on both sides – providers and users. The popularity is a result of rapid development of broadband connections. It is well known in e-learning that participants need beside passive way of learning, which is typical for traditional learning, a possibility to get additional information. For better comprehension of the content which they were getting in traditional face-to-face class in the past, students were receiving this additional information by reading literature and attending extra live lectures, if they were available.

A question arises now, how can we provide additional information for immersing deeper knowledge with the help of ICT to students? One possibility is to give students an online video supported educational system, with feasibility of live streaming video and video on demand. Although the automated idea is fascinating, it is not easy to implement. First we have to record a lecture, next handle and synchronize it with the presentation material, and finally stream it on a website.

Therefore, there is a strong need to accomplish fast and simple video streaming lectures either live or on demand with all additional information (presentation material, documents and transcriptions eventually).

Currently there are some webcast systems available, which enable video streaming together with a presentation material, for example the Microsoft Producer, Virage and GoodMoode, but these products require additional equipment and personnel for direct video streaming and later also the streaming of the materials to server. Moreover, these equipments do not consider entirely requirements for persons with special needs; only in rare cases (Horizon Live) they at

least provide subtitles, which are suitable for deaf and hard of hearing persons. For blind or weak sighted persons a proper solution does not exist yet.

For this reason, we designed a lecture based automated video recording system. With its simple usage we tried to eliminate the necessity for extra personnel, which would have to be present during the lecture.

In this article we will focus on the following points:

- A detailed illustration of lecture based automated video recording system. As an example, the hardware and proper implemented software will be presented, which enables fast recording of lectures and transmission into a database of lectures.

- An explanation how we have taken into consideration the needs and demands of people with special needs (deaf, partially deaf and blind or weak-sighted) and hereby enabled them accessibility to these video e-materials.

- A presentation of possible evaluation tools, which are of vital importance for examination of the user-friendliness of video based educational system. Since these evaluations are of online courses, we have used evaluation methods on the basis of other studies, e.g. Squires and Price [2], Ardito et al [3], Dringus [4] and Holzinger [5] and adjusted them considering the evaluated object. This includes the evaluation of: the user-friendliness of the e material, the usefulness of the whole system for people with special needs, accessibility and the effectiveness of the entire system.

# 2 Our innovative solution

All today's webcast systems provided by different manufacturers (for instance, Virage, Noterik, HorizonLive and GoodMood) offer mainly the same functionalities; that is a streaming video and sound, presentation slides, table of contents (TOC) and a system with interactive questions. The realization of additional services, such as simultaneously streaming the video interpreter and vocal subtitles (for blind and weak-sighted people) has not been provided yet. Additionally, these systems are expensive.

The idea of extended streaming video has been developed under the scope of project EQUAL which besides classical streaming medium enables additional functionalities (Figure 1). Our innovative solution includes the following:

- audio subtitles for blind people with additional information about visual perceptions (for example, what holds a lecturer in his hands);
- video of sign language interpreter;
- subtitles for deaf and heard of hearing people (additional sound information, for example »peaceful music« or »menacing music«).

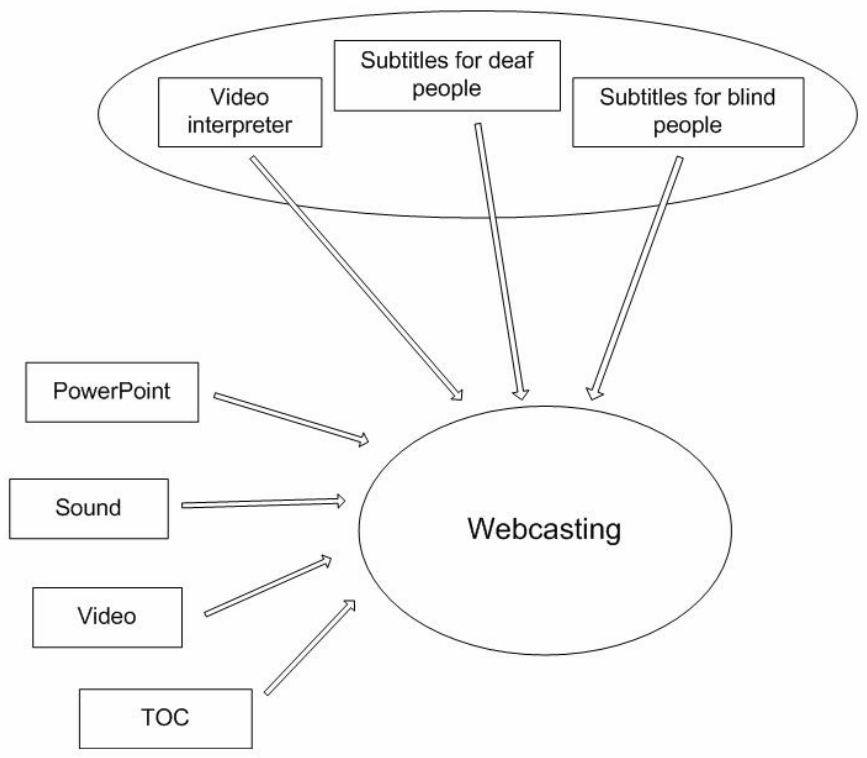


Figure 1: Extended webcast system

This idea is substantiated by the proposal of European Broadcasting Union (EBU), which precisely defines recommendation for persons with special needs [1]. The European Broadcasting Union is the largest association of national broadcasters in the world. However, the EBU recommendations are designed for television. We have taken them into consideration and implemented several functionalities in our webcast system.

In the Faculty of Electrical Engineering and Computer Science, University of Maribor we have developed the automated video recording system for recording, webcasting and receiving lectures. We had two aspects in mind: simple usage with the possibility of eliminating any additional personnel and special dedication to people with special needs.

# 3 System's infrastructure

The infrastructure of the automated video recording system includes a mobile interactive system, with excellent video and audio equipment, an interactive streaming video technology and a virtual hypermedia study. All these technologies are integrated into a new learning environment. Besides the necessary video and audio equipment, the system uses an appropriate hardware and software. A student can attend live lectures or one can listen and observe lectures later, on demand. Additionally, subtitles can be added to the video and audio.

A trolley (Figure 2) is the core element of the system's infrastructure. It is composed of high speed computer (Figure 2 – 1), LCD monitor (Figure 2 – 2), keyboard and mouse (Figure 2 – 3), wireless router (Figure 2 – 4), wireless microphone (Figure 2 – 5) and a digital video camera (Figure 2 – 6) mounted on a robotic PTZ (pan/tilt/zoom) holder (Figure 2 – 7). Listed parts are built into a solid aluminum framework placed on four wheels (Figure 2 – 8), which enable portability and can easily be shifted from one room to another.

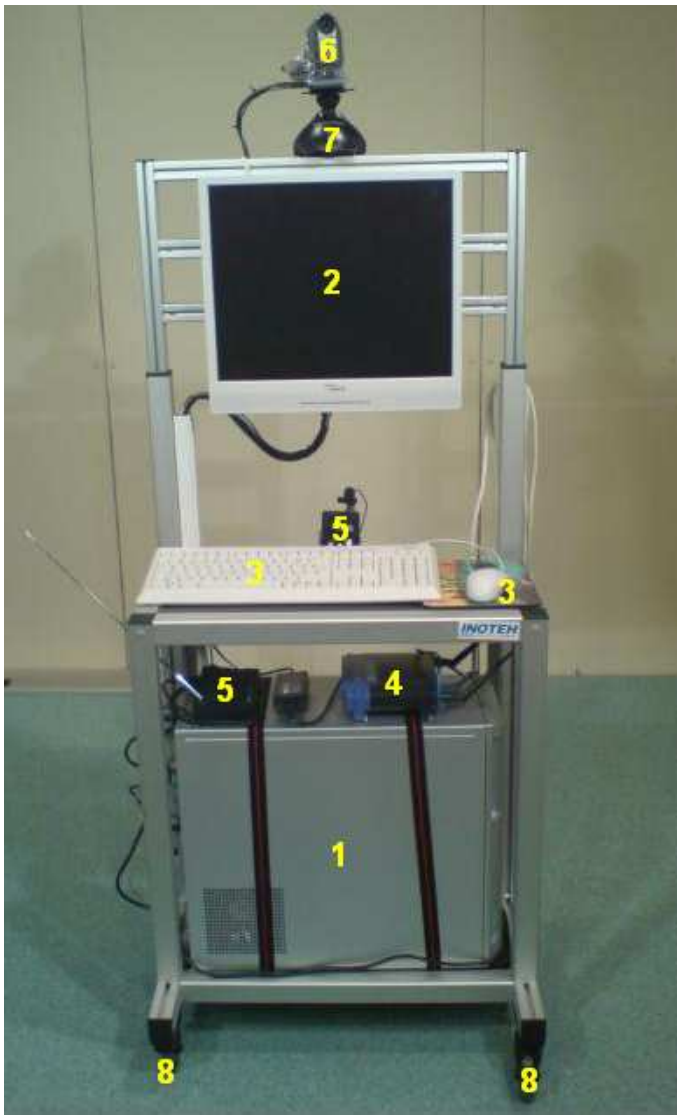

Figure 2: Portable video recording system - trolley

A goal of the trolley is to stream lectures. In general the lecturer comes to a lecture room and turns on the trolley with one press on the power switch. The system automatically initializes itself and the application pops up on the monitor. Lecturer decides between two modes of streaming: live video streaming and video streaming on demand. He enters data and optionally loads additional materials. This is the first part of the procedure and can be done by one person.

In the second part, he walks to the presentation computer and loads another application. After that the lecturer selects initialized lecture and picks out the presentation slides, adjusts the digital camera and if everything is set, recording starts. PowerPoint presentation opens automatically and the lecturer starts to lecture. Recording of the lecture ends at the end of the slide show or with an ESC key. By watching the monitor the lecturer is checking the centric position.

As above mentioned, there are two modes of streaming. In live streaming mode, users can watch transmitted lectures on the web portal. If they miss a live lecture or do not have time for it, they can watch it later, on demand. These functionalities are feasible on the web portal. A snapshot of recorded lecture is illustrated on Figure 3. On the top we have lecture's title and

lecturer's name. Video and sound is transmitted with Windows Media Player. Subtitles can be seen in live streaming mode with the help of typewriter, or they can be added additionally in on-demand mode of recording lectures. Table of contents is generated automatically from the presentation slides.

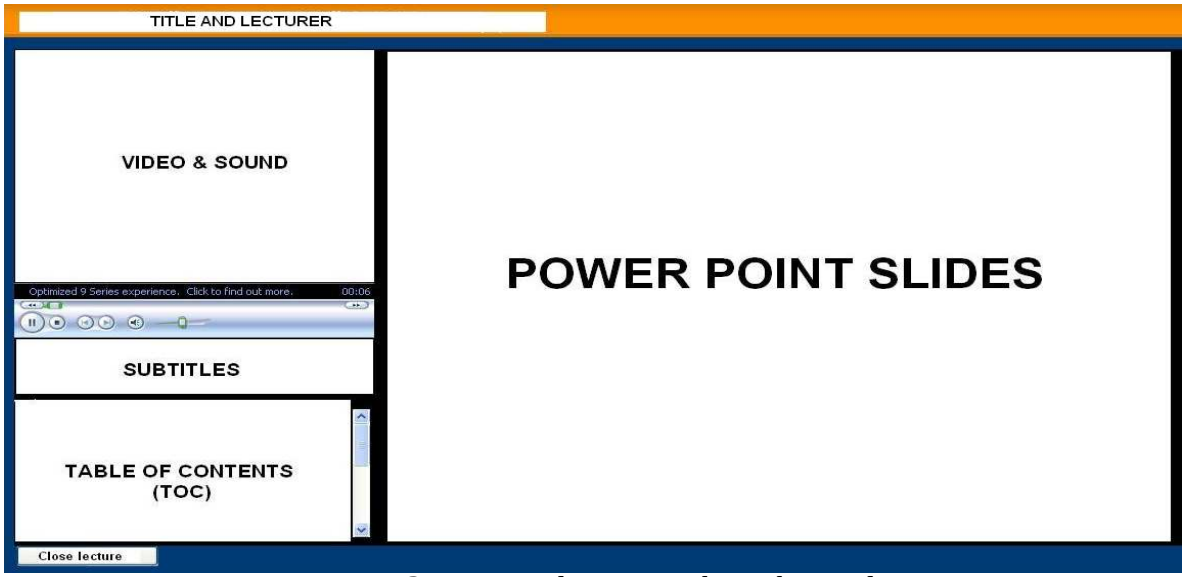


Figure 3: Viewing lecture on the web portal

# 4 Proposal of system's usability evaluation

## *4.1 Usability in general*

Design methodologies in human computer interaction (HCI) aim to create functional user interfaces (e.g. computer applications). Therefore usability is an important factor for the evaluation of our webcast system. Despite recent advances of electronic technologies in e-learning, a consolidated evaluation methodology for e-learning applications is not available [3]. The question what usability is has several answers as the term itself has many meanings and definitions.

According to ISO 9241-11 [9] usability may be defined as a measure to which a product (e.g. software) can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Therefore in computer science there is a strong relationship between quality and usability.

Usability is a quality attribute that assesses how user interfaces are usable. The word "usability" also refers to methods for improving the ease-of-use during the design process.

Nielsen [17] defined usability with five quality components:

- Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
- Efficiency: Once users have learned the design, how quickly can they perform tasks?
- Memorability: When users return to the design after a period of not using it, how easily can they re-establish proficiency?
- Errors: How many errors do users make, how severe are these errors and how easily can they recover from the errors?
- Satisfaction: How pleasant is it to use the design?

There are many other important quality attributes. One of the most important is “utility” which refers to the design's functionality: Does it do what users need? Usability and utility are equally important since it matters little if something is easy to work on but does not do what we want. Neither does it help if the system has the potential to perform a task but the user is unable to reach it due to an inappropriate interface. To study design utility the same user research methods can be used as for improving usability [6]. The term “effectiveness” can be used instead of “utility” as the Oxford English Dictionary [7] defines effective as “producing a desired or intended result”. The other quality components, e.g. learnability, memorability and errors, have great impact on user satisfaction.

The need for usability has been recognized in web site design literature as a crucial quality when determining user satisfaction in such systems. Therefore it can be argued that the usability of e-learning application can significantly affect learning [12].

### *4.2 Selected usability methodologies*

There are several methods for studying usability that are suitable for testing on-line courses for students. Table 1 presents selected methods that we are going to conduct: heuristic evaluation [8] [10], SUMI questionnaire [13] and interviews [8]. These methods are in the process of evaluation, therefore we will only describe each method, but the results will not be presented yet.

**Table 1:** Proposed evaluation methods for usability testing of e-learning content.

| | **Heuristic evaluation** | **SUMI** questionnaire | **Semi-structured interview** |
|---|---|---|---|
| **Purpose** | Usability testing | Usability testing | Usability testing |
| **Project Phase** | Design | Final testing | Final testing |
| **Object** | E-learning contents | E-learning contents | E-learning contents |
| **Population** | Experts | Users | Users |

#### *4.2.1 Heuristic evaluation*

Heuristic evaluation is the most popular informal inspection method in usability evaluation. For a specific area experts define if the elements of the user interface are according to heuristic rules – heuristics. They seek for errors and problems. Discovered problems are noted down with appropriate heuristic and the severity rating. To eliminate biases, it is important that experts identify problems (descriptive or visual) in isolation. In the end of the evaluation a group discussion follows. Experts collectively report about detected problems. The result of heuristic evaluation is the final heuristic report, which also contains (besides determined problems) recommendations for improvement of the user interface.

#### *4.2.2 SUMI questionnaire*

SUMI evaluation is a consistent method for assessing the quality of use of software products. It is backed by an extensive reference database embedded in an effective analysis and report generation tool. SUMI has been hailed as the de facto industry standard questionnaire for

analyzing users' responses to software. It is a commercially available questionnaire for the assessment of the usability of software which has been developed, validated, and standardized on an international basis. SUMI consists of 50 statements to which the user has to reply with either “Agree”, “Don't Know”, or “Disagree”. SUMI gives reliable results with at least 10 users [11].

The usability scales assessed by SUMI are:

- Efficiency (user's feeling that the software is quick and economic)
- Affect (user's emotional feeling that the software is stimulated and pleasant)
- Helpfulness (user's perception that the software communicates in a helpful way)
- Control (user's feeling that the software is responding in a normal and consistent way and assists him when errors occur)
- Learnability (user's feeling to become familiar with the software, has a tutorial, handbooks etc.).

### *4.2.3 Semi-structured interview*

Interviews can be seen as a “conversation with purpose”. As in conversations the questions in interviews should be answered. Four main types of interviews exist: structured, unstructured, semi-structured and group interviews. Semi-structured interviews combine characteristics of structured and unstructured interviews and have open-ended and close-ended questions. In comparison to questionnaires, both give participants a set of questions and record their answers. Interviews involve an examiner who reads the questions to participant and then records the answers. In questionnaire participants fill out the answers by themselves. Interviews are flexible, since the examiner can explain or rephrase difficult questions. The struggling part is the analysis of results, which requires a lot of time. During evaluation examiners have to be cautious, not to give any help or hints. For this reason they have to remain neutral.

### *4.3 Present situation*

Regarding system’s usability evaluation we have proposed three methodologies (heuristic evaluation, SUMI questionnaire and semi-structured interviews), which we are momentarily conducting and are not finish yet. Because the heuristic evaluation was iteratively performed from the first phase of the system’s development life-cycle, we can state something here. Five experts were included in the process. According to Nielsen [10] about 75% of all problems will be (in our case) identified. For noting down the problems we used Google Docs & Spreadsheets, a centralized Web-based application. Other two methodologies, SUMI questionnaires and semi-structured interviews, are going to be conducted additionally in the future.

## 5 Conclusion

The presented automated video recording system incorporates effective usage of technologies for video, audio and presentation material. For successful webcasting the appropriate software and hardware equipment is needed and also a proper infrastructure with qualified personnel.

The advantage of our system lies in its simplicity and swift usage. The webcasting lectures can easily be done only with one person only. Moreover, the system enables new possibilities in education. It offers a way to study equally for all participants, including people with special needs. For this reason, our system is designed and built in an innovative way, enabling elements for persons with special needs (visual subtitles for deaf people, audio subtitles for blind people and the video interpreter for sign language).

This system will also bring new troubles and questions regarding authors' rights. Because of the psychological factor of lecturers, some authors do not want to be recorded, but we think this obstacle will disappear over the time, when they become more use to it.

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