

Design and Set-up of an Automated Lecture Recording System in Medical Education

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Abstract. In classroom lectures with huge groups it is still time consuming for students to follow the teacher and accumulate all the information given on various media. Scripts provided in advance may support the learning and understanding process, however, this is – for various reasons - in many cases not done or done too short before the start of the lesson. So far we provided eLectures which contained the slides and the voice of the teacher. They were produced on an individual basis causing a lot of efforts. On our new Medical Campus we decided to provide a fully automated lecture recording system which is easy to operate by the teachers and provides a maximum of flexibility for the students. We introduce a concept and the implementation of this recording system which enables students to receive to full HD streams of the PC output and the whiteboard, which can be scaled to their individual needs.

Keywords: Automated lecture recording · Lesson streaming · Video streaming portal

1 Introduction

In many classroom lectures with huge groups it is still a tedious task for students to follow the teacher and accumulate all the information given on various media such as PC/projector, visualizer and white board in an appropriate way. Scripts and/or power point slides provided in advance may support the learning and understanding process, however, this is – for various reasons - in many cases not done or done too close before the start of the lesson. That's why we started at the Medical University of Graz to offer so called eLectures [1–3] which are slides with animations in connection with the voice of the teacher. This concept was well accepted by the students and we received good evaluation results. Since eLectures were produced on an individual basis together with the teachers they had the clear advantage to contain all the information and wishes of the teachers which content has to be shown to the students. This included also complex learning objects such as animations and virtual microscopes [4]. The disadvantage was the – depending on the complexity of the content - quite high effort it took to produce eLectures and that they could not be produced automatically or on live classroom lectures.

Since currently a new Medical Campus is built for our university which will be ready by October 2017 we decided to introduce a new concept for lecture recording in the teaching rooms which allows to record classroom lectures automatically and during their live presentation to the students. So students can have access on the material shortly after the lesson and can use it for preparation of the exam. Furthermore not only the PC/projector and the voice of the teacher shall be recorded but optionally also the whiteboard and/or the teacher himself talking and maybe showing essential objects or experiments. Last but not least the system shall be easy to use by the teachers by giving them as much flexibility as needed but as little technical details as possible. So teachers with no technical background should be able to use the recording system without the necessity of time intensive trainings and/or reading tons of manuals. Furthermore we want to provide a video portal solution to our students which enables them to comfortably watch the lessons according to their needs.

2 Related Work

Looking at the market someone can find many providers offering automated and fully integrated lecture recording systems including Extron, Panopto, Epiphan and StreamAMG. The Extron [5] solution was at the time we started the design (2016) not fully ready, meaning that there was no native software solution in order to store and manage the produced streams. Panopto [6] and StreamAMG [7] with its product Stream LC offer a software solution for recording and managing self recorded videos in connection with slides and a streaming portal solution. It does not natively offer recording hardware for lecture rooms but provides certified partners. Epiphan [8] provides hardware for live video production and streaming, but no software for management, organisation and broadcast of the recorded material.

3 Technical Approach

Having no experience so far with the various products on the market we decided to take the following approach for the design: we applied for a research project at the Austrian government together with two universities in our city (Karl Franzens University and University of Technology Graz), where the University of Technology in Graz already had an automated lecture recording system in place and hence had years of experience with the hardware, software and the technical and organisational workflow. That's why we decided to go for the Epiphan hardware solution in combination with Opencast Matterhorn [9], an open source lecture capture and streaming software.

The technical implementation mainly shall consist of two main steps: first step is the set up of the hardware recording solution, the second step is the set up of the content organization and streaming portal.

3.1 Set-up of Recording Hardware

The lecture classrooms will be equipped with a camera capable of filming the whiteboard and/or the teacher at the lectern. Furthermore the PC output/projector output can be recorded. Both streams shall be recorded in full HD resolution. The transmission will be done in a single stream containing both videos (PC output/projector, whiteboard) and the voice of the teacher. This is done due to easy and full synchronization of the PC output/projector and the video of the teacher/whiteboard. When transmitted in two streams experience showed that synchronization is always an issue and this is critical, because if e.g. the slides and the voice of the teacher are not synchronously students won't be able to understand the content anymore. Within the teaching rooms Crestron control units are provided with record and stop buttons in order to provide teachers an easy possibility to start/stop the recording. Furthermore we provide the teachers four recording pre-settings. The first setting will record PC output/projector and the whiteboard and the lectern, the second setting will record PC output/projector and the whiteboard, the third setting will record PC output/projector and the lectern and the fourth setting will record whiteboard and lectern but not the PC output/projector. These easy to understand recording scenarios together with the record and stop button will be the entire interface for the teachers in order to fully automatically record their lessons.

3.2 Set-up of the Content Organization and Streaming Portal

The second step is the set up of the video portal VITAL (Video Portal of Med Uni Graz), which we just started. As a software we decided to take OpenCast Matterhorn. We plan two main access possibilities for the students: first students shall be able to login via the video portal and access all recorded lessons directly. Second students can access the recorded lectures directly via our learning management system Moodle where also other virtual content can be found. Recorded lectures will be directly linked to the appropriate content. Technically we plan to utilize the LTI (Learning Tools Interoperability - a specification developed by IMS Global Learning Consortium) interface [10] of Moodle in order to directly access the lectures stored on OpenCast server.

4 Technical Workflow

All steps in connection with preparation, recording and playout will be integrated in an overall technical workflow consisting of 5 major steps – Pre-processing, data recording, data transmission, post processing and playout - which we will describe in more detail in the next sub chapters.

4.1 Pre-processing Steps

When planning the next semester all teachers will be contacted by E-mail in order to state if they want to record lessons and if yes they have to specify which ones. All these data will be collected by our technical Virtual Medical Campus team and integrated in

one comprehensive recording calendar. Based on this calendar the team knows when recordings will take place and when they have to provide technical assistance and post processing.

4.2 Data Recording in Lecture Room

The data recording in the lecture room can be solely started by the teacher by selecting the preferred recording format from the four pre-settings (as described above) and by pressing record, i.e. no further technical assistance should be necessary. At the end of the lecture the teacher has to press the stop button.

4.3 Data Transmission

Recorded lessons are locally stored at the Epiphan storage and will be automatically transferred to a storage server for further processing. The Epiphan storage is a ring storage, when it is full the oldest data is deleted. Of course the storage is huge enough to store several recordings. Since data is usually immediately transmitted after the end of the recording to the storage server this storage is also not critical.

4.4 Post Processing

The post processing is triggered by the recording calendar. Hence each time a recording is expected the technical team checks whether data has arrived. If the stream is available the first step is a cropping. We transmit both videos in one stream, as visualized in Fig. 1.

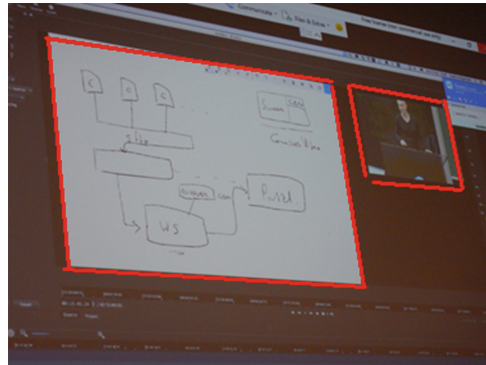


Fig. 1. Transmission of two videos in one stream

This is done in order to keep synchronization between the speaker/whiteboard video and the PC output stream. Hence in the first step we crop out the two streams. Then we enhance the audio by utilizing the OpenCast functionalities. Next we add an intro and check roughly the quality. Finally the video will be placed on the OpenCast server and linked with the appropriate lecture in Moodle.

4.5 Playout and Student View

At the student side we will provide a video portal solution. Students shall be able to easily search and view recorded lessons they need for learning. It is a clear objective that the video portal shall enable students full control over the arrangement and video size of the two recorded streams. Hence if there is at some stages shown something interesting on the whiteboard, students may view this stream in a large format on their screens. The planned student view is visualized in Fig. 2 which is an example taken from the existing video portal from the University of Technology, Graz.

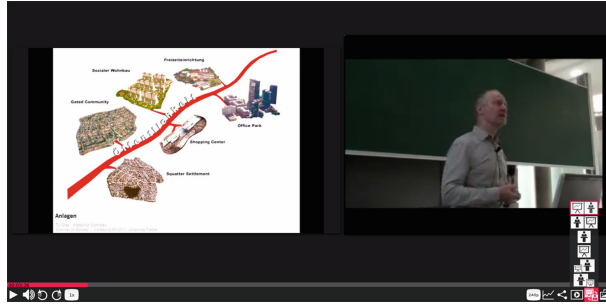


Fig. 2. Planned student view of recorded lectures

The same shall be true if the interesting content is shown on the PC. Furthermore there shall be an easy way to automatically structure the content (e.g. by slides) and to search the content (e.g. by automated OCR of the slides). Since most of the content is copyright protected and not freely public available the video portal will be only accessible by students and affiliates of the university.

Technically this is planned to be realized by the Paella player, a HTML5 multi-stream video player capable of playing multiple audio & video streams synchronously which is specially designed for lecture recordings with Opencast Lectures developed and provided as open source by the university politecnica de Valencia [12].

5 Summary and Conclusions

With the full automated recording solution in place we expect a significant improvement for students to prepare for the examinations. They also can now recap certain parts of their study later on when they happen to need it again. Additionally the recording also provides more flexibility to students in terms of time, in case a lesson cannot be attended due to e.g. children caring activities the content still is available for them and they can still get the most important information.

We introduced a concept and a technical workflow for automated lecture recording at a medical university. However, this concept is not restricted to medical education but can be applied at any higher education institution. The software solution is based on

open source software in order to save costs, the hardware solution is based on many years of experience of a partner university.

We proposed to take advantage of the experience of a partner university who has already experience with lecture recording and initialized a funded research project in order to transfer the knowledge and exchange ideas, which will help also themselves to further improve their existing system.

The system will be applied in two stages. Stage one is the hardware based recording solution which is mounted into the lecture rooms (camera and recording hardware with storage). Stage two is the management software for the recorded lessons and the streaming solution for the students. The recorded lessons will be additionally seamlessly integrated in our open source LMS Moodle where they are linked to the appropriate modules and can be directly viewed by the students.

Furthermore we provide now an easy possibility even for teachers who are not affine with technical equipment. Every teacher shall now be able to record lessons without the need of time consuming technical trainings and reading manuals.

The student view will provide two HD streams of the PC output and the speaker/whiteboard. Students will have full control of the interface by scaling and moving the videos according to their needs.

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Teaching and Learning in a Digital World
Proceedings of the 20th International Conference on
Interactive Collaborative Learning - Volume 1
Auer, M.E.; Guralnick, D.; Simonics, I. (Eds.)
2018, XX, 968 p. 304 illus., Softcover
ISBN: 978-3-319-73209-1