Technology behind Video Lectures for Biomedical Engineering

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***Abstract*—The main advantage of video lectures is being able to break spatial and temporal constrains when disseminating information. We briefly present the system used for recording and diffusing video lectures over the Internet. The process of recording and diffusing video lectures may be divided into 5 main steps: prepare, record, edit, produce, and share. Video for the educational purposes creates new technical boundaries. Thus, boundaries can be surmounted or diminished by considerate technology analysis and design.**

***Keywords*— Video lectures, record, edit, produce, share**

Introduction

Nowadays video is one of the most important media for communication and entertainment. Video is a combination of moving images and accompanying sound; these are essential for full understanding and communication. Recording video lectures becomes a common practice also in education. Video as educational media can provide knowledge, which is difficult to achieve through text or verbally. There are many examples [1-5] showing that video lectures become more and more diffused over the Internet. The main advantage of these lectures is being able to break spatial and temporal constrains when disseminating information. There are several different systems in use for recording and diffusing the lectures [6-8]. They are similar in principal, but differ in technical details. How to choose the system which suits your needs and resources?

With this paper we briefly present one of the systems used to record and diffuse video lectures over the Internet.

Materials and methods

The process of recording and diffusing video lectures may be divided into 5 steps (Fig. 1).

Fig. 1 Steps for recording and diffusing video lectures

Prepare

We started by considering predominant factors. What is the purpose of video lectures and who is going to watch them? We came to the conclusion that the purpose of video lectures is to provide possibility to revise and review course materials at any time, place, or pace. The aim of video lectures is to give opportunity for those who do not have access for learning in the classroom. For this reason we focused on recording live video lectures in a traditional classroom environment instead of studio-based environment. We defined three types of potential users of video lectures:

- Students, who study for university degree, seek just in time information, are international students interested in virtual studies, ne(x)t generation students who study mainly outside the classroom, students with work or family commitments, students due to heath problems or disabilities are not able to attend traditional classroom lectures.
- Educators and instructors, who are willing to share and reuse learning materials.
- Industry members, who need focused and immediate scientific information.

Predominant factors boosted further questions. Where video lectures will be posted so that they are accessible for all potential users? What output format is needed? What is maximum file size or bandwidth requirement? What dimensions of video lectures should be? Small video dimensions mean small file size but poor visibility. Larger dimensions

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might not fit well for smaller screens without scrolling or scaling the content. Should video lectures include narration, PowerPoint Presentation slides or PDF document, and video stream? How to combine all that data? Unnarrated video lectures do not require setting up audio equipment. Video lectures without secondary video channel ease the whole process. Thus, verbal information and visual cues combined are more effective [9]. What software programs are needed? How to set recording technique and environment? Preliminary solutions were found and tested.

Record

We decided to combine and synchronize three elements in one application: presentation slides, video and audio data. Presentation slides, as primary visual channel, are important elements in the lectures; they carry essential information, e.g., graphs, relevant pictures, samples of code, etc. Recorded live lectures were integrated as secondary visual channel and narration – as audio channel (Fig. 2). Recorded live lectures include humor, personal examples, questioning and gestures. Employing these techniques in teaching situations reduces complexity and supplies more cues for understanding the matter [10]. Audio narration allows avoiding overloading of visual channels and makes the learning process more effective [9].

Presentation slides, video and audio data were integrated using optimization principle; presentation slides take 2/3 of the frame and provide important visual information; recorded live lectures take 1/6 of the frame and provide sense of presence; dynamic and synchronized table of content take 1/6 of the frame and allows to navigate within the material.

In order to record original presentation slides, we used screen capturing technology. It allows recording computer's desktop activity. The recording can be in the form of full motion video, still image, demonstration or program application on lecturer's computer while projecting it to the classroom audience. We recorded slides from lecturer's computer screen while giving the real presentation. This required installing additional software to the computer. Screen capturing software comes in various forms, e.g., as commercial and open software [11]. We selected Camtasia Studio by TechSmith [12]. Screen capture was saved in .camrec file. In this way, data for primary visual channel was obtained.

Sometimes it cannot be possible to capture screen and save its records. In that case .PPT or .PDF documents can be converted to graphic file formats, e.g., JPEG.

In order to record lecture and narration, we used camcorder with AC power supply, wireless microphone system, batteries, cables, headphones and tripod. Recordings were stored to DVD tapes and later transferred to digital .AVI or .WMV files format using basic video creating and editing software, i.e., Windows Movie Maker. It was important to check battery power, white balance, image stabilization, zooming, focusing, sound, lighting, tape, tripod lock-down etc., before video recording. Related problems can damage the whole recording process. Few notes were made in order to achieve higher video and audio quality: camcorder should be directed so that subject's eyes are on or above an imaginary horizontal line drawn one-third of the way down from the top of the frame (a rule of thumb); unnecessary movements of camera should be avoided; lecturer should not walk too much during recording; it is recommended to use wireless microphone, and to avoid movement of cables; a short break should be taken every hour in order to change video tape. More recommendations for video recording are available elsewhere [13].

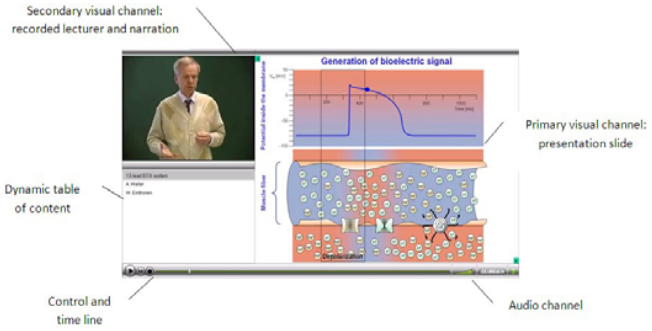

Fig. 2 Elements of video lecture

Edit

Different software can be utilized for editing recorded audio and video data [14-15]. After primary editing, data can be combined and synchronized. We applied Camtasia Studio software. It allows adjusting primary, secondary and audio channels (Fig. 3), i.e., as video, pip and audio tracks. Depending on the quality of data, editing can be quite much time demanding manual process. The process is faster when presentation's slides are available as records, but not in a graphic file format, e.g., JPEG. Lectures can be segmented into time intervals based on the topics. When the lecture is too long and there are too many topics, it distracts the viewer. Also files size becomes too large. The markers for tracking certain slides can be placed on the time line. Software includes more features to enhance video lectures, e.g., dynamic table of content, callouts, captions, zooming, flash quizzes and surveys. More guidance for using software is available elsewhere [12].

Produce

Adobe Flash player is widely distributed multimedia and application player. It uses vector graphics to minimize file size and create files that save bandwidth and loading time. Flash has become a common format for animations and videos embedded into web pages [8]. Flash player is built into recent version browsers or available as plug-in, e.g., in Mozilla Firefox, Opera, Safari, or Internet Explorer browsers. Flash is visible on Macs, Linux and Windows machines. For these reasons we selected .FLV file format for video lectures. Camtasia Studio allows choosing this format for the final output of the production.

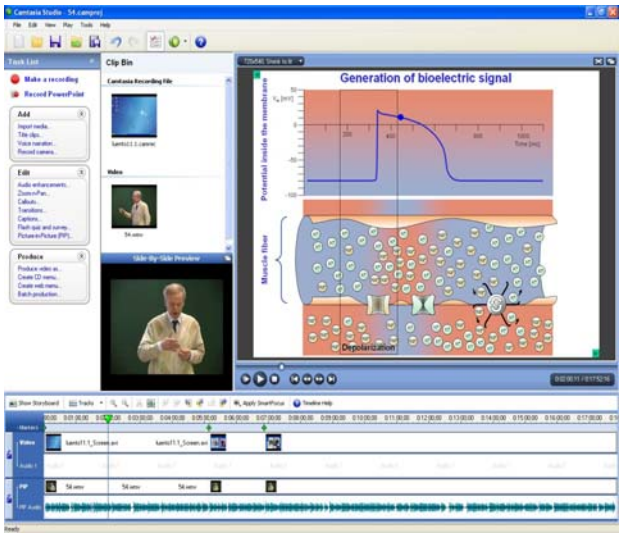

Fig. 3 Editing window for video lecture, Camtasia Studio

The dimensions for video lectures were selected so that they fit different computer screens and do not require scrolling or scaling the content too much (Table 1).

Table 1 Dimensions of video lectures

Elements of video lectures	Dimensions (in pixels, height and width)
Total	1040x595
Primary video channel (slides)	720x540
Secondary video channel (video record)	320x240

The number of pixels of common computer screens usually varies between 640x480 to 2048x1536 pixels [16].

Presets for distributing video lectures on the Internet were selected. In the final production file (of each video lecture) we got Flash file and ten supporting files. The files size averaged from 20 to 100 MB, i.e., about 20 minutes of video lecture is 80 MB. Flash and supporting files were placed on the server in order lectures are accessible via the Internet.

Share

Viewers may not be technology-savy and set-up might hinder their capability to see video lectures. Thus video lectures should put as few technical constrains to the viewers as possible. The minimum bandwidth is 350 Kb/s, thus recommended is 1 Mb/s in order to watch lectures without buffering pauses. A larger bandwidth is becoming more and more available (e.g., DSL technologies), but still this might be true only for certain countries. Using the global broadband speed test [17] we obtained following data e.g., in Finland average available bandwidth is 6,8 MB, in Europe - 5,5 MB, global – 4,8MB, whereas in Asia, e.g., Bangladesh (Dhaka city) - 0,42 MB. Not every browser on every operating system is able to correctly decode video stream. The recommended browser is Mozilla Firefox for video lectures. Another issue to consider is the bandwidth problem on the source site – what will happen to the server if it gets hundreds concurrent requests for videos? We placed video lectures on the university server and did not experience related problems so far. Also it is possible to upload videos on external server [18], [5].

Another way to reduce bandwidth is to reduce video resolution; thus this may end up in low quality that video lectures are not used any more. These choices could be defined at the beginning of video sharing and not modifiable; or dynamic – adjusted in response to the time and needs. We considered how video lectures can be further utilized. Streaming requires constant Internet connection. It is possible to make a downloadable zip file containing lectures to be played later locally on the viewer's computer. Transferring zip file can happen at lower speed but when it is downloaded it can be played multiple times and does not require Internet connection. Another alternative is distributing videos on DVDs.

We produced MPEG-4 files with one visual channel and audio channel, i.e., recorded presentation slides and narration. In order to make video lectures independent of one device, i.e., computer, they can be downloaded to the personal video players [19]. We used iPod players with 320x240 screen resolution to watch video lectures. Power and capability of mobile devices is increasing every day. In addition, we experimented with media-cell- phones by producing and uploading 3GP format files. Nowadays there are

different audio and video conversion software, which allows achieving various compatibility files formats [20]. When producing video lectures it should be considered which modality is important and can be used for certain case?

Conclusions

Applying technology advancements we were able to transform traditional lectures to video lectures. Video for the education creates new technical boundaries. Thus, boundaries can be surmounted or diminished by considerate technology analysis and design. We strongly believe that the main focus is the content of the video lectures and different technologies can support it.

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