Combining Streaming Media and Collaborative Elements to Support Lifelong Learning

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Abstract. This chapter presents the educational value of streaming media combined with asynchronous collaborative learning and describes the particular characteristics and the limitations of the supporting Asynchronous Multimedia Collaborative Systems (AMCL). Then CELSIA, an innovative AMCL system, is described as an example of new trends in AMCL systems that come to address the limitations of the current systems and to enhance the educational value of streaming media!

1 The Use of Streaming Media in Education

According to cue summative learning method [1] the use of various channels of communication and stimuli helps in the retaining of knowledge and in the acquiring of new knowledge and skills. Audiovisual material can be a great resource for education thus the last decades we have witnessed a lot of research and various attempts to utilize it in classrooms and generally in education. Several research educational studies since the beginning of the 20th century found that films, videos and moving pictures are very helpful in: [2]

- attracting learners' attention,
- the presentation and clarification of complicated issues of a course subjects (e.g. natural phenomena via experimental demonstrations),
- the retaining of information,
- the motivation of learners for subjects connected to everyday life (e.g. news).

Bowie in an analytical review of studies that concern the educational use of films argued that audiovisual material:

- It is effective in discovery learning
- It can be used for demonstrating the solution of a problem
- It's appropriate for developing skills of attention and observation of details
- It can influence positively learner's self efficacy
- It improves creativity, imagination and aesthetics [3].

T. Daradoumis et al. (Eds.): Intel. Collaborative e-Learning Sys. & Applications, SCI 246, pp. 19–36.
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Yet beneath the apparently unproblematic appeal of streaming media, there is a counterargument which states that these media -and video in particular- is a passive educational mean which creates passive learners. The conclusion of a relevant research was that audiovisual material wasn't successful in classrooms [4], except of foreign languages.

In a first attempt to avoid passiveness, lecture material was broadcasted via TV to remote students while any questions or comments were posed to the instructor using usual telephone technology. This attempt was successful since many studies showed that students can learn as much from such broadcast lectures as from live classroom attendance [5], but suffers from a great problem. It is a synchronous model which means that everybody must meet at an appointed time and date. This model suffers from the fact that students cannot participate on-demand which means that it is more complex. Except from this, if the number of students that are watching the same lecture at the same time is big then the collaboration and as an effect the education value of the broadcasted lecture between them is reduced.

In order to avoid these problems we can use an asynchronous model of communication. In an asynchronous model students can participate on-demand and the number of students who are watching the lecture simultaneously is reduced.

This chapter is focused on the idea of *Asynchronous Multimedia Collaborative Learning* (AMCL), which is a relatively new concept although its origins can be found in a European funded Socrates ODL project, called SHARP: Shared Representation of Practice [6].

AMCL could be said to be a mixture of asynchronous collaborative learning with streaming multimedia content resources. AMCL combine the richness of multimedia representation and demonstrations of practice with the flexibility in the use of time for communication. The AMCL is a rather new education medium and philosophy, still unexplored.

The AMCL systems almost look like the web-based discussion fora, with the addition that the user:

- can post messages that are videos, audios (i.e. not only texts) which can be delivered via streaming technologies (like video on demand)
- can annotate-comment on specific "frame" of the message (e.g. when a specific term was explained).

Currently there are just few AMCL systems, most of them created for research purposes within universities. Some of them are quite difficult to use, luck of important functions or are specialized and limited in certain aspects. This is why there is a need to design and develop AMCL systems that could meet the requirements of end users.

The structure of this chapter is as follows. First we will give an overview of the reasons why we need to combine Streaming Multimedia technologies with collaborative learning techniques. Then the current state of the art in the domain of AMCL systems giving emphasis on their added value in education as well as on their limitations will be presented. Furthermore, two learning scenarios will be described in order to show the importance of the AMCL systems in education and the need to be enriched with new functionality. Based on these scenarios the new

trends in AMCL systems that come to address the limitations of current AMCL systems will be analysed.

2 Combining Streaming Media with Collaborative Learning

Video is considered to be by many scientists as an instructional medium that has a great educational value especially for visual and auditory learners.

Video can create excitement, emotions, and help students to keep attention to the lesson. For example consider a group of students in a classroom that are studying china for the lesson of geography. They can view a video that describes china, listen to the Chinese language and traditional songs and "visit" great attractions in few minutes! The students will be more excited and motivated to learn and it will be easier for them to understand things that otherwise they had to imagine. In addition the video will enhance their retention since students visualize important information and transfer abstract concepts into concrete and easier to remember objects.

Several attempts to use video in education have been made especially at the 80s and 90s mostly with the use of videotapes, television digital video and CD ROMs. According to [7] the very early attempts were mostly used as part of instructional pedagogy while at the 90s we have witnessed many constructivist paradigms especially with the use of digital desktop video and the upcoming streaming video technologies that emerged at the late 90s.

The idea to combine Streaming Media (especially digital video) with collaborative learning techniques is based on the 3Is (Image, Interaction, Integration) framework shown in table 1 [7].

Table 1. The pedagogic framework 3I [Source: 8]

Value	Technology	Control
Image	Film, Television, video	Educator
Image + Interaction	Multimedia CD-R	Student
Image + Interaction + Integration	Streaming media	Student + Educator

According to table 1 when talking for Film, Television and video the added value to education is "Image". Students can benefit from the visual richness of video since it enhances attraction, aids retention and recall and is explanative when verbal forms are not enough.

In addition to this Goodyear & Steeples note that video can provide vivid descriptions to articulate tacit information and knowledge difficult to articulate through text and verbally [6]. When the value of video is "image" then the educator has the control of the teaching procedure. Film, Television and video of course are very important in education but they are very passive means since there is no interaction between students and these media.

Streaming Media have another added value except from “Image” and “Interaction”. Streaming media can be linked with other supporting elements such as related videos, texts and resource links. According to the 3Is framework [7] this added value is called “Integration”. It is very easy to understand that all these elements enhance the learning experience, since students can have access to more information if it is necessary. Although streaming media are excellent tools for educational purposes they are still passive educational means since there is no collaboration and communication between the educator and students.

The combination of collaborative learning and streaming media can be the answer to the communication and collaboration problem since the web enable various types of synchronous and asynchronous communication and collaboration such as discussion forums, chat and media sharing. We will focus in Asynchronous communication since it has some advantages over synchronous communication, the most important one that both Students and Educator participate in the educational process regardless of distance and time. The AMCL systems are designed to combine streaming media with asynchronous collaborative tools and so are ideal to enhance the learning experience and avoid passiveness.

It is also widely known that students do not interact among them if there is no certain reason or motivation. Thus collaborative learning must be enhanced with other activities, in order to develop interaction, information exchanging and opinion and experience sharing.

A first scenario that is commonly used concerns the presentation of pre-recorder lectures and the ability to study and comment these lectures by students and educators that are geographically distributed. For example Dr. Latchman, University of Florida uses slideshows of pre-recorder lectures with synchronized narration [8]. The students can use email, chat or forum in order to communicate with the educator, to oppose an opinion or discuss for a certain subject proposed by the educator and related to certain parts of the slideshow.

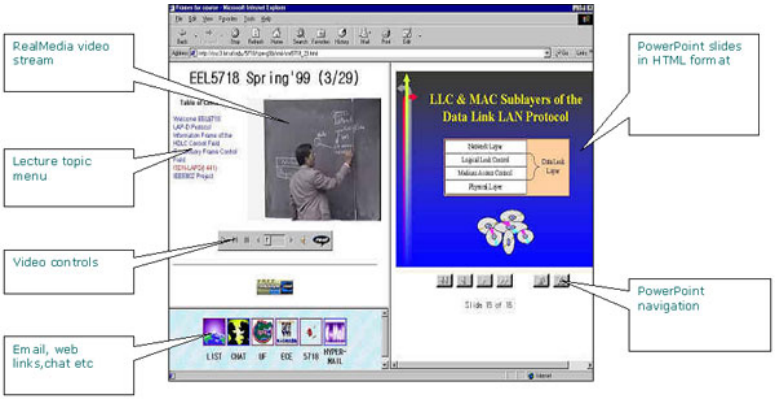

Fig. 1. Presentation of pre-recorded lectures with synchronized narration [Source: http://www.clickandgovideo.ac.uk/]

Another way that we can combine streaming media with collaborative learning is to collaboratively annotate streaming videos. For example consider the scenario where a group of medical students use an AMCL system that supports video annotations to analyze and annotate a heart surgery video. At first the educator can create annotations (e.g. text, graphical or audio) representing tasks in order to enhance motivation and develop interaction among the students! In order to complete their tasks the medical students can use various tools supported by the AMCL system in order to communicate, express their opinion and interact with each other.

3 An Overview of the Existing Asynchronous Multimedia Collaborative Systems

AMCL systems combine the richness of multimedia representation and demonstrations of practice with the flexibility in the use of time for communication. The AMCL is a rather new education medium and philosophy, still unexplored. A well designed AMCL system supports functions specially designed for viewing and manipulating the audiovisual streaming material for the needs of performing collaboration learning activities and in addition the usual administration functions. Some of the functions that these systems support are:

- Support of three at least types of users (Student, Teacher and administrator)
- Conference management. This includes creation, deletion and modification of a conference by an authorized user usually the administrator or teacher.
- Playback of audio-visual content for the current conference.
- Annotating a certain frame of the audio-visual content. Annotations may be text, audio or drawings.
- Support of a "user portfolio" where the user can store important or personal messages.
- Advanced video and audio processing.
- User and message statistics such as number of posted messages, types of messages etc.

Various AMCL systems have already been developed and tested especially for learning environments. Some examples are stated below:

3.1 Project Pad

Northwestern University developed a project called "Project Pad" in order to build a web-based system for media annotation and collaboration for teaching and learning and scholarly applications. It consists of various tools such as the "Image Tool", the "Transcript Tool" and the "Video and Audio Tools". The "Video and Audio Tools" lets you attach comments to time segments of Flash FLV video and MP3 audio streams. The tools can be used by instructors and / or student teams to critique student-produced video and audio or to provide a way for students to analyze scientific, historic, or artistic recordings.

The tools feature a timeline that you can zoom in to mark detailed events or zoom out to annotate larger segments. Annotations are represented by markers that

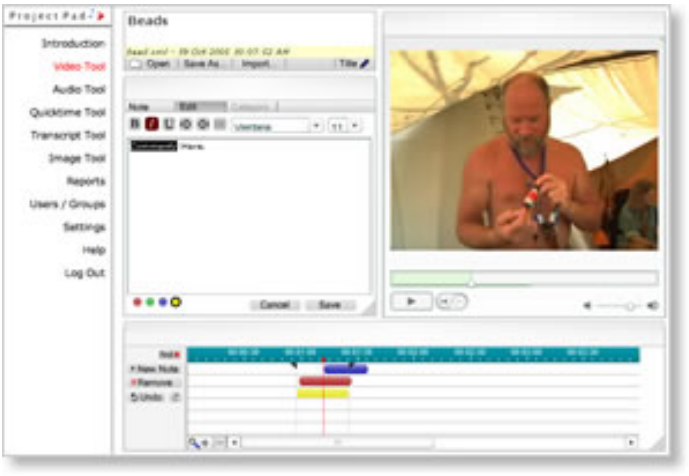

Fig. 2. The "Video and Audio Tools"
[Source: http://dewey.at.northwestern.edu/ppad2/09road_map.html]

you can drag and re-size with the mouse. Attached text can include multiple fonts, font sizes, and styling.

3.2 VAnnotea

VAnnotea is a Collaborative Video Annotation tool that supports Collaborative indexing and annotation of audiovisual content over broadband networks [http://dewey.at.northwestern.edu/ppad2/09road_map.html].

The tool was developed by the School of Information technology and Electrical Engineering of the University of Queensland in Australia.

VAnnotea has a lot of features including browsing through existing online multimedia repositories using the embedded Internet Explorer Browser, viewing a wide variety of media formats such as MPEG-1, -2 and -4, WAV, MP3 and QTVR through embedded media players such as the Quicktime Player, Windows Media Player and Video Lan Client and annotating the media files by highlighting regions and attaching personal notes, questions, remarks, links and relationships to other resources, terms from ontologies or controlled vocabularies, ratings and local files such as images, or PDF documents.

Vannotea's flexible design and metadata architecture allows it to be used within many other application domains, including: Biology (Integrative Biology VRE), Oceanography and Marine biology etc.

3.3 XMAS

The MIT University has developed a video annotation system called XMAS in cooperation with Microsoft in order to support the study and comparison of Shakespeare texts, images and films. Learners and practitioners were able to

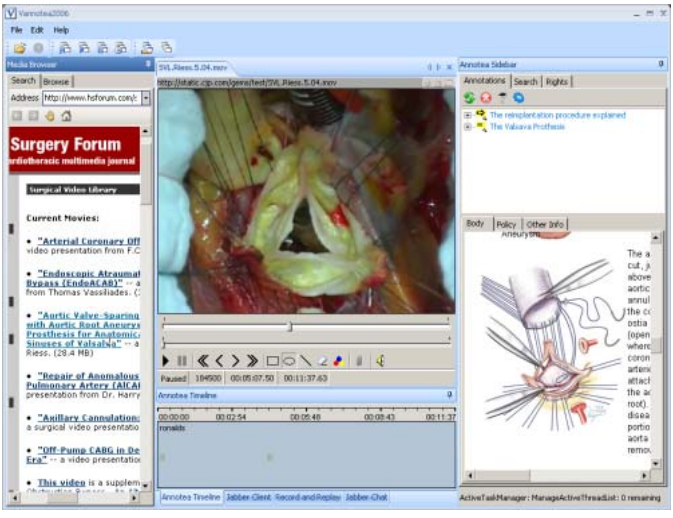

Fig. 3. VAnnotea - A collaborative Video Annotation tool
[Source: http://dewey.at.northwestern.edu/ppad2/09road_map.html]

watch video clips of theatrical plays, analyze them and participate in asynchronous discussion through discussion forums.

XMAS is currently optimized for use with commercially available DVDs as video source. XMAS allows users to rapidly define segments of film which can be replayed by clicking on automatically created links that can be saved in a list or dragged and dropped into discussion threads or online essays.

3.4 Video Traces

The Video Traces system is another system that enables users to use video in a collaborative way. The system allows audio annotations on specific video frames and in addition supports video processing functions like adjustable video speed, pause, rewind and fast forward.

The annotations are listed in a different window and can be sorted by title, author, date and time. The resulting product (video+ annotations) is called a "video Trace". A video trace can be further annotated for a variety of teaching and learning purposes or exchanged with other users.

The system was used in various educational scenarios like an undergraduate choreography class at the University of Washington.

3.5 iVAS

The iVAS system is a system that enables users to associate any video content on the Internet with annotations. The system was developed by Nagoya University in Japan and supports a lot of features such as text annotations, impression annotations, automatic evaluation method of annotation reliability, video simplification, and video-content-based community support.

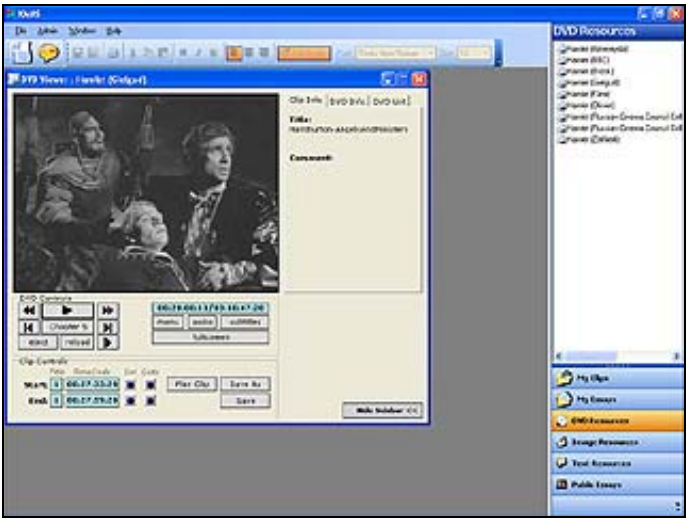

Fig. 4. The XMAS Video Annotation System
[Source: http://icampus.mit.edu/projects/xmas.shtml]

Fig. 5. The Video Traces annotation tool
[Source: http://depts.washington.edu/pettt/projects/videotraces.html]

In order to evaluate the iVAS system's usability and data collection, an experiment with 30 college students was performed. They used 5 minutes long video clips with various content such as news, drama, variety, and cooking program. The college students had to use the system to annotate the videos and then answer a questionnaire concerning the AMCL system.

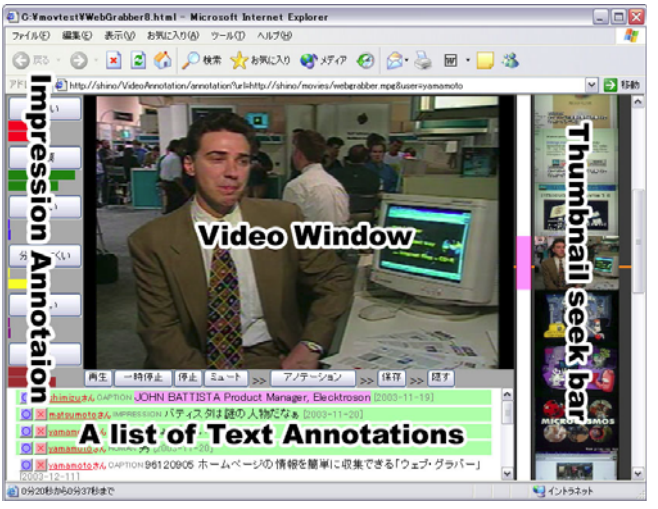

Fig. 6. The iVAs system
[Source: http://www.nagao.nuie.nagoya-u.ac.jp/ivas]

3.6 ISEE

ISEE is another AMCL system that is specifically designed for low bandwidth network users [9]. ISEE supports the usual video playback functions, as also and video annotation functions. A full version of ISEE contains a video player, an interactive chat room, a built-in web browser, and a story board.

When a user starts writing a note in the input box the system freezes the video and it continues when he press the submit button. The user can also apply time stamps that link the notes to video segments.

The system was tested by university students. The students had to comment their colleagues' presentations using the annotation and the playback functions.

3.7 KMI's Stadium

Another very interesting approach is the Stadium system of the UK Open University's KMI. The system is based on Webcasting technologies and allows the users to send short messages (similar to sms) during the video playback. Several companies used Stadium to train their employees [http://cnm.kmi.open.ac.uk/projects/stadium].

For example the Wytch Farm Bp Company located in Dorset England used Stadium to train their employees for security issues concerning oil pumping. Several company employees watched a pre-recorded audio-visual content in their offices located in different places in the world such as Bogotá, Houston, London and Aberdeen. At the end the employees were very pleased with the whole idea and found the system and content very interesting and helpful for their work.

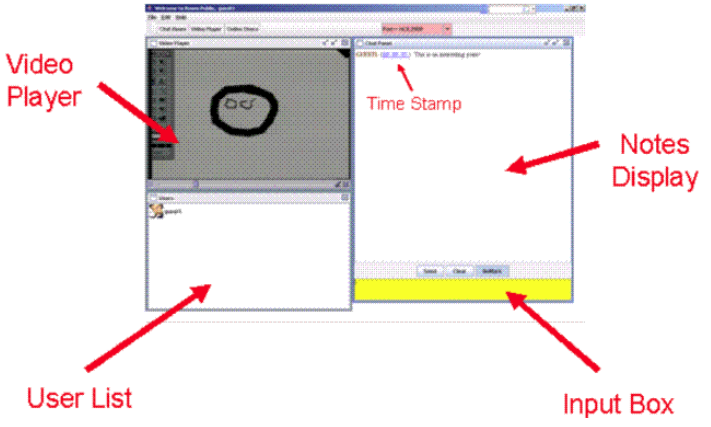

Fig. 7. The ISEE AMCL system [Source: 9]

4 Comparing the AMCL Systems

Although the presented systems have unique functions and are valuable for AMCL they support only some of the required functions of a well designed AMCL system. Some of them are specialized in video annotation and do not or partly support collaboration or administration functions such as threaded discussions and message management respectively while some others do not support video annotation at all. Some of the most significant limitations of most of the systems are stated below:

- Limited collaboration features
- Poor support for Audio, Text and Graphical Annotation features
- Streaming technologies are partly supported or not supported at all
- Limited playback and video analyzing features
- Multilanguage support is partly supported or not supported at all
- In most cases these systems support only Windows Platforms
- Luck of Vector Graphics support
- High hardware and software Requirements
- They support only some of the major video formats
- Require users with advanced computer skills
- Poor Help support

In Table 2 we can see a comparison between some of the current AMCL system and a desired AMCL system. The comparison is based on five feature categories: Video Analyzing, Annotation, general and miscellaneous features. Many of the desired features were derived through hypothetical usage scenarios of AMCL systems in various research areas. Two of these scenarios are described later on this chapter in order to derive important service and functional requirements.

The following use case diagram (Fig. 9 in Section 5.2) gives a graphical overview of the functionality needed by the desired AMCL system in terms of actors, their goals, and any dependencies between those use cases.

Table 2. Comparison of features between AMCL systems

Feature	Desired AMCL System	Project Pad	VAnnotea	XMAS	Video Traces
Video Analyzing					
Media Format	Most Important media types e.g. Avi,mpeg,flv,mp3,wav	FLV,Mp3,WAV	Mpeg 1 -2-4, Mp3	DVD	Mpeg 1 -2-4 , AVI
Playback Functions	Play, Pause, Stop, Frame by Frame Seek, Jog wheel , seeking bar, Loop	Play, Pause	Play, Pause, Fast Forward, Rewind	Play, Pause, Stop, Fast Forward, Fast Rewind, Rewind	Play, Pause, Stop, Fast Forward, Fast Rewind, Rewind
Looping	Yes	No	No	No	No
Volume Functions	All Volume functions (Up, Down, Mute)	Volume slider	Volume slider	Volume slider	Volume slider / Mute
Segments	Yes	Yes	Yes	Yes	No
Skip (Jump) Segment	Yes	No	No	No	No
Zoom In / Zoom Out	Yes	No	No	No	No
Move Frame	Yes	No	No	No	No
Seeking Methods	Advanced seeking functions (Jog wheel, Seeking bar, Shortcuts etc)	Seeking bar	Seeking bar	Seeking bar	Slow / Fast Motion
Layered Style timeline	Yes	Yes	Yes	No	No
Annotations					
Type	Text, Audio, Graph, URL, Metatags, File Attachment	Text	Text, Graph, URL, File Attachment, Metatags	Text , File Attachment (Image & Text	Audio
Actions	Add, Delete, Edit, Goto	Add, Delete, Goto	Add, Delete, Goto	Add, Delete, Goto	Add, Goto
Load Annotations	Automatic / Manual (Import XML file)	Automatic	Automatic	Automatic	Automatic
Merge Annotations	Yes	No	No	No	No
Annotation Access Rights	Yes	No	Yes	No	No
Sorting by	Type, Author, Title, Time	?	?	?	title, author, date and time
Collaborative Annotation	Asynchronous	Asynchronous	Synchronous (Jabber) & Asynchronous)	Asynchronous	Asynchronous
Output Format	Various (XML,TXT etc)	?	?	?	?
Graph. Annotations	Supported	Not Supported	Supported	Not Supported	Not Supported
Shapes	Free hand, line, circle, box, curve, triangle	Not Supported	Box, Circle, Line	Not Supported	Not Supported
Functions	Draw / Clear drawing / Edit Drawing/ Resize / Undo / Fill	Not Supported	Draw/Clear drawing / Undo/ Fill	Not Supported	Not Supported
Num of Colors	Multiple	Not Supported	?	Not Supported	Not Supported

Table 2. (*continued*)

Audio Annotations	Supported	Not Supported	Not Supported	Not Supported	
Record Sound	Yes (From Input Device)	Not Supported	Not Supported	Not Supported	Yes (From Input Device)
Playback	Yes	Not Supported	Not Supported	Not Supported	Yes
Audio Format	Mp3 / WMA / WAV	Not Supported	Not Supported	Not Supported	WAV
General					
User Authentication	Yes	No	No	Yes	No
Bandwidth Detection	Yes	No	No	No	No
Customized Shortcuts	Yes	No	No	No	No
Vector Graphics	Yes	Yes	No	No	No
Streaming Technology	Progressive Download, Real Streaming	Progressive Download	Real Streaming	Not Supported	Not Supported
Upload File	Yes	No	Yes	Yes	No
Attach URL	Yes	No	Yes	Yes	No
Attach File	Yes	No	Yes	Yes	No
Portfolio	Yes	No	No	No	No
Multilanguage Support	Yes	No	No	No	No
Export to Learning Object	Yes	No	No	No	Video Traces (Media + Annotation)
Export Log File for Data Analysis	Yes	No	Yes	No	Yes
Misc					
Application Type	Multiplatform System	Windows 95,98,XP,MacOSX,Linux	Microsoft Windows XP	Microsoft Windows Xp	Windows 95,98,XP
Requirements	Minimum	Flash 7 plug in	Microsoft .NET Framework Version 2.0 Windows Media Player 10 QuickTime 7.1	512MB Ram, DVD Rom, DSL (Min 384 Kbps)	Windows Media Player Classic

5 Learning Scenarios for Extracting Requirements for AMCL Systems

In order to design and develop an AMCL system that does not suffer from the limitations described before we can consider the following authentic scenarios. These scenarios could help us derive all the necessary functionality and service requirements of a well designed AMCL system. The first scenario concerns the "Microteaching" technique. According to [10] Microteaching is a simulation technique which enables us to create or modify a desirable or undesirable type of the instructor's teaching behavior. The main goal of Microteaching is to give instructors confidence, support, and feedback by letting them try out among friends and colleagues a short slice of what they plan to do with their students.

Usually for the needs of microteaching, teachers give lectures which are videotaped, reproduced and discussed by an evaluation team which consist the instructors and a teaching consultant. This traditional type of Microteaching can be transformed into a new form if we use AMCL systems and audiovisual content to create a new flexible environment for instructors distance training.

5.1 Microteaching for Civil Engineers

In this scenario we will demonstrate a usage scenario of an AMCL system which can be used to train civil engineers about the basic features of AutoCAD. For the needs of the instructional scenario, we assume that the civil engineers are organized in groups of four. Firstly the educator uses **a GUI** (Web Interface) in order to **search for a Streaming server** responsible to store and stream educational video clips and a **File Server** responsible to store other files such as text documents, images etc. This is possible through a **search engine** for distributed services. He also uses an **upload service** to upload a pre-recorder video clip in streaming format containing a tutorial for AutoCAD's basic features and a text document (containing other important information related to AutoCAD functionality) on the **Streaming Server** and the **File Server** respectively. He requests and uses a **video processing service** in order to **convert** various formats such as (avi, mpeg, etc) into streaming format.

In the next step he/she uses the AMCL system to **login** as "Educator" through an **authentication service** in order to create (**write**) three new annotation points that represent three tasks (one for each group). The AMCL system creates automatically an annotation file that contains such as "Type of annotation", "Time Position", "Description" etc and was also uploaded by the educator on the file server.

Each group uses the AMCL system to log in as "Learner" enabling them to have certain **File Access Rights**. They also request the **list of available video clips** in order to select and watch the uploaded video clip and **read the annotation points** containing text and graphical information about their task. They also use some advanced processing features to reprocess and analyze the video clip, to mark, comment and pose questions on selected frames of the video clip. In order to get more information related to AutoCAD's features, they use the text documentation uploaded by the educator.

In the last step the groups submit a text file containing a report of their conclusions and comments about the procedure they followed to complete their tasks. At the end the educator and the practitioners discuss and analyze each group's report and suggest other possible solutions. The educator has also posed questions concerning the system and asked practitioners to give feedback and any suggestions they may have.

5.2 Collaborative Basketball Training

In this scenario we will demonstrate the usage of an AMCL system in order that a coach, the technical manager and the players of a basketball team to collaboratively analyze and annotate various videos from previous basketball games. They want to watch this video material in order to decide about the system (tactic) that the team will follow during the next matches, to improve their playing and to reduce turnovers.

To begin with the administrator of the system uses an **upload service** to upload the pre-recorder video clips and other important documents related with basketball tactics on a **Streaming Server** and the **File Server** respectively. He also uses a **video processing service** in order to prepare the video for streaming!

In the next step the coach and the technical manager login as "Educator" through an **authentication service** in order to create new annotation points that represent new tasks (A question, a comment etc) in order to motivate the players to start an asynchronous communication, exchange of information and experience and to start analyzing the important scenes during the games!

The players use the AMCL system to log in as "Learner" enabling them to have certain **File Access Rights**. They also request the **list of available video clips** in order to select and watch the uploaded video clips and **read the annotation points.** They also search frame by frame the videos using advanced video editing features in order to find important scenes such successful gaming, defense systems and turnovers. After that they can use the video playback features in order to annotate the selected scenes. The AMCL system enables users to create various types of annotations such as text, audio and Graphics. Graphical annotations can be created using special tools for drawing such as free hand drawing, drawing shapes (boxes, circles, curves, and lines), and clear drawing in order to successfully annotate an important scene. For example they can annotate a scene where the famous "pick & roll" tactic is successfully.

Finally they can choose to create Text or Audio Annotations in order to comment scenes and express thoughts about their team. After the end of the analyzing and annotation procedure the whole team will watch the annotated video and the technical team will explain the systems that the team must follow in the next games.

In both aforementioned scenarios a streaming server containing the streaming content (video and audio), an application server where to store the AMCL system and an annotation server to store annotations are needed. The AMCL system interacts with a database for the user authentication process and uses the streaming technologies to deliver the audiovisual content. Users communicate and annotate

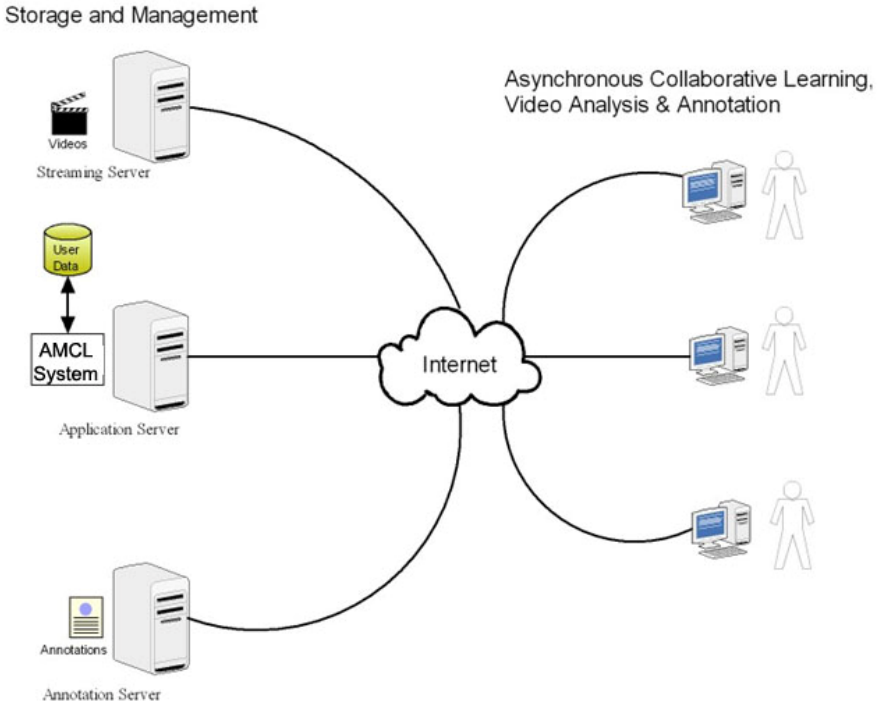

Fig. 8. General architecture of an AMCL system based on the service and functionality requirements

the audiovisual content in a collaborative way and so they enrich audiovisual content with semantic information and enhance the learning activity. Figure 8 illustrates the general architecture of an AMCL system.

The Functional requirements from an AMCL system, as extracted from the scenarios, are the following:

- Support of three at least types of users (Student, Teacher and administrator)
- Conference management. This includes creation, deletion and modification of a conference by an authorized user usually the administrator or teacher.
- Playback of audio-visual streaming content for the current conference. This also includes Advanced playback functions such as play, stop, frame by frame search, loop.
- Annotating a certain frame of the audio-visual content. Annotations may be text, audio or drawings.
- Support of a "user portfolio" where the user can store important or personal messages.

Figure 9 shows these requirements in a more illustrative version by using the UML use case diagrammatic notation.

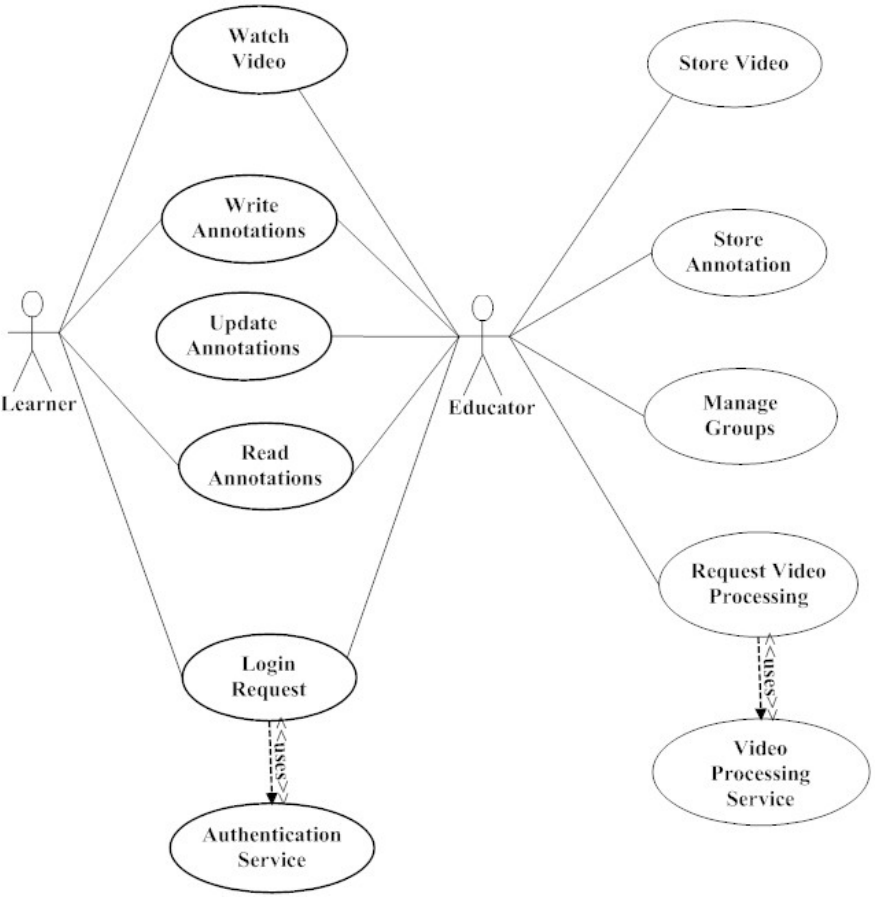

Fig. 9. Use case diagram for both "Learner" and "Educator

6 New Development Trends in the Domain of AMCL Systems

The previous analysis of the current AMCL system and the two learning scenarios showed us that there is a need for new functionality & architectural decisions. AMCL systems must be developed in a different way, supporting of course a wider range of functionality, collaboration and video annotations. AMCL systems must be developed with state of the art technologies, supporting latest streaming technologies and taking advantage the high bandwidth on internet connections that we enjoy nowadays. They should support asynchronous discussion and exchange of viewpoints about vivid representations of practice in the form of video or audio clips.

Furthermore, they could support textual, graphical or audio annotations on specific frames of the presented audiovisual material. Powerful annotation mechanisms are very important to be integrated into the AMCL systems because they

will enable learners, teachers and other practitioners to explain issues, share opinions, mark important frames and pose questions, over time and anywhere in space.

Other specialized features which could facilitate the collaboration among students could be offered by AMCL systems such as:

- Support of a portfolio where the student can store, view or delete video clips, annotations on the video clips as well as specific comments/messages made by users during the online discussion.
- Presentation of statistics where the student can see how many messages have been posted by how many users as well as the number of the different types of messages (text, videos, audios, still images).

7 Conclusions

In this chapter we described the importance of using streaming media for collaborative learning purposes. We also stated various research and development achievements in this domain focusing on AMCL systems. Nowadays new systems are starting to appear which try to eliminate the usability problems of the existing systems as well as offer new set of features that will enable students collaborate more easily. This domain though in its infancy is fast growing. We are living an era where videos are easy to be created, found and shared among peers. Sites like YouTube are proofs of this statement.

Educators and educational technologies have the challenge of creating systems like AMCL that will make students become active consumers of digital audiovisual learning content.

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