Streaming Multimedia Content: Digital Course of Artificial Neural Networks

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ABSTRACT: The aim of this paper is to present the possibilities offered by Internet and current multimedia tools to delivery high quality courses with cost effectiveness and a low complexity infrastructures. It covers topics of interest relative to the streaming multimedia content from different points of view, such as the hardware/software infrastructure required, the steps involved in creating multimedia content, and the description of a particular case of design implemented for a course of Artificial Neural Networks. The paper is addressed to educators and educational administrators interested in developing and using these new mediums for technology enriched and enhanced teaching and learning.

KEYWORDS: Multimedia Streaming, Neural Networks, Internet Broadcast, Broadband Applications, e-Learning, On-Line Education, Asynchronous Learning, Distance Learning.

INTRODUCTION

The future technological advances will create substantial changes in the educational system [1] including new roles for teachers, new roles for schools, and finally, centralization of curriculum and instructional development. The new technologies in multimedia content over Internet are upon today's society. In particular, streaming media is creating a new concept for teaching-learning process in higher education environments. Universities such as Stanford [2] and Washington [3], and many others have adopted the video delivery of lectures over Internet based on streaming systems.

The next step in streaming multimedia educational content is to improve the quality offered by the delivery of lectures; this requires generation of the class content with a new form, different from the traditional lecture format. It assumes to use the computer as the main tool to create content, as well as many software packages. There are many utilities to facilitate the multimedia generation. The final product can be an enhanced course material which grabs the interest and the attention of students and also, it is accessible from any location in the world.

The future of streaming media is being materialized and the constraints are eliminated. Streaming media isn't limited to computer monitors and desk-bound audiences: the technology is spreading everywhere, from hand-held devices like PDA's and cell-phones, to set-top boxes and next-generation gaming consoles, Internet appliances, and even automobiles.

STREAMING ON EDUCATION

Streaming media started in 1995 with RealAudio, the Internet's first streaming player to receive audio; the first streaming video player appears the same year but with a small size and poor quality; in 1997 different multimedia leaders such as RealNetwoks and Microsoft released competing audio-video. The multimedia content distributed and played over the Internet begun the transition from the direct download towards the streaming multimedia.

Streaming is considered as the ability to play multimedia contents (audio, video, images, text, data) directly over the Internet without downloading the entire file before play begins. Moreover, streaming offers the ability for interactive client response.

The Internet multimedia delivery opens many opportunities in the areas of business, commerce, entertainment and also in the area of education; on-line education is a reality today in many universities and the use of multimedia streaming, both live and pre-recorded, has become an important tool in the learning and teaching process. There is a set of course design tools and support services that facilitates faculty members the creation of courses in a format for delivery over the Internet.

The main obstacle to widespread use of streaming technology in on-line education is the bandwidth requirements not available to students in general; however the domestic slow speed of the modems is being substituted by high-speed connections through cable modems and digital subscriber lines(DSL). By 2006, the best estimates indicate that 40 million homes will have cable modems and 25 million DSL connections in U.S. with access rates of 1.5 Mbps [4]. Moreover, on-line education has the advantage of Internet 2 with access rates of Gigabits, and the K-20 Initiative extend the Internet 2 to innovative educational sectors outside the Internet 2 community such as community colleges and universities which are separated into regional, national and international efforts [5].

The elements necessary to implement the idea of multimedia content delivery over Internet includes: Authoring, Encoding, Delivering and Playing. These technology infrastructures are basically provided by three different manufactures: RealNetworks, Microsoft and Apple.

In our case [6] , [7] we have used the Real Platform based in RealSystem Server, Producer and Player. The RealSystem Server is a streaming media server software. It distributes audio, video, and other media to client computers via unicast or multicast delivery. To deliver content, RealSystem Server works in conjunction with RealSystem Producer, which compresses or encodes the audio and video feed in real time and passes it to the RealSystem Server to delivery to the network. The new RealPlayer called RealOne is more than a simple player, it is the first interactive, multimedia platform to support e-learning and communications implementations [8].

Moreover, this platform supports the Synchronized Multimedia Integration Language (SMIL), a simple but powerful markup language that allows streaming presentation with multiple clips (video, images, text, etc.) simultaneity, as RealNetwork's streaming multimedia formats, RealText and RealPix, that help to create multimedia at narrowband delivery rates.

There are many aspects to be considered in implementing a successful streaming solution, and the IT departments should value the different alternatives, such as a client/server streaming system or a server-less system, type of hardware and operating system for server, manage the bandwidth, upgrade the network or IP multicasting and the cost of the streaming multimedia site.

Apparently, these aspects seem to have created an obstacle in the adoption of streaming media. However getting started is not difficult: the different vendors provide evaluation products of the infrastructure necessary to provide service to Internet users. Moreover, initially one can begin with an streaming system based on the server-less model which does not use server software; instead it works solely on HTTP streaming. In this case, one simply encodes a file and then places it on a web server where one normally puts other HTML pages and web images. Obviously a streaming system based on the model client/server is the most scalable solution and the most popular. The streaming server software is installed onto the web server to manage and distribute the requested files, but this model is the most complex, most difficult to implement and the most expensive; it is recommended for high traffic video network because gives the most control over who is watching and what is being sent supported by new streaming protocols as RTP and RTSP.

GENERATION OF MULTIMEDIA CONTENT

The steps in the process of creating and delivering streaming video on-line are the following: a) preparing and developing the source material b) capturing the audio/video c) editing and adding effects d) encoding and e) delivery. This means to create audio/video content, capture a digital signal in the computer with a capture card and then store it on a hard drive; editing is the assembling of the different pieces of the video and the addition of transitions and effects. The last two steps are a function of the streaming solution adopted.

The first step plays an important role because the final quality will depend of the original audio/video quality. It requires analog or digital cameras, controlling the camera and subject movement and many aspects of TV production. In our previous experience, the lecture event in the classroom was recorded by a set of cameras. An operator selected the appropriate video input based on the activity of the professor. An additional video signal was obtained from the instructor's monitor to provide access to his notes or his use of computer programs in class. This kind of audio/video creation required an important infrastructure (cameras, operator, classroom, etc.), however the final video product, once it was resized and encoded, did not offers an image quality according to the efforts realized. Simply putting lecture videos online was not the adequate answer to online teaching. The quality was enhanced by the addition of the images of whiteboard's notes synchronized by SMIL language.

The previous experience allowed us to emphasize the main aspect of the video quality degradation, such as the analog to digital conversion required to capture on the computer the analog video recorded in the classroom. Why not use the video digital quality directly? For this the solution is to use the computer as the only and main creator of the source content. The computer allows the use of any application available in the market without restrictions, such as applications for graphic design, mathematical calculus, simulators, word processor, whiteboard, media players, etc.

This decision assumes the generation of content in a new form different than the traditional form based on a face-to-face presentation. For this purpose is necessary a software product that records screen activity as videos, edits the clips, and publishes the finished presentation in standard formats.

There are many authoring and edit tools for create and product streaming content based on the screen capture software [9]; they are widely available, easy to use and highly efficient. The software product choose Camtasia™ [10], is a screen camcorder and video production tool. It includes basically two tools to record and produce videos: Camtasia Recorder and Camtasia Producer.

Camtasia Recorder is used to record screen activity as a moving desktop video. The selection of the capture input options (screen, window, region or fixed region) before recording allows us to define the area and type of video capture. Recorder saves the action as an AVI file. This is a series of frame captures that record all movement and actions on the computer screen; also it can add sound with a microphone as the recording is performed. Moreover, for broadcasting live events Recorder can also act as a software camera feed to live productions.

Next, Camtasia Producer (see Figure 1) can open the AVI files to remove unwanted frames, change the sequence of events or timing, and splice together the pieces into a longer presentation. Producer also allows to save the video file in the final output form (standard AVI, Microsoft Windows Media, or RealNetworks RealMedia).
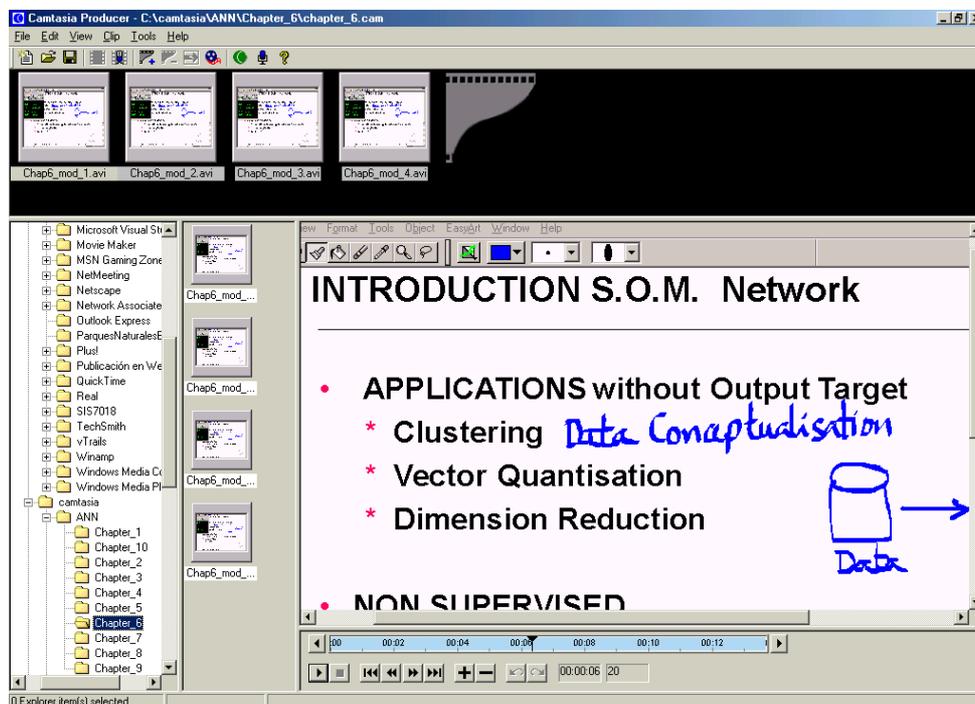

Figure 1: Camtasia Producer Main Window

ANN COURSE

The e-course 'Artificial Neural Networks and their Applications' has been designed using as a reference course imparted in a bimodal mode (in the classroom and over Internet) at the School of Engineering of Bilbao. The table of contents describes the field of neural computation as a serious alternative method in those applications where the classical computational methods do not achieve success results. In this sense, it requires leaving out areas of interest included in more comprehensive programs of other universities [11].

The generation of the multimedia content has been performed in the faculty's office with the following hardware elements: lap-top, electronic tablet and a microphone. The software applications are Camtasia, Neural Networks [12], a whiteboard program and windows operating system.

Recording options are summarized as follows: video format (1024x768, 16-bit colours, 5 frames/second), audio format (PCM, 11.025kHz, 8 bit, Mono) and the Production options are the following : size 800x600, target audience corporate LAN and 256DSL/Cable, audio format voice only, colors 16-bit, frame rate 3. Camtasia supports two streaming file formats for RealOne Player : Camtasia for RealPlayer (*.camv) and RealMedia (*.rm), the different between both is the codec used for streaming the video, recommended the first where the highest quality is required.

The e-course is integrated in one of the most popular online learning environment (OLE) for facilitating the delivery of online education such as WebCT [13]. The WebCT environment allows the customization of each course with the tools that the teacher consider necessary for the course. The tools selected for e-course ANN are grouped in the following areas: a) course materials, b) communications, c) evaluation and d) video-lectures.

The video lectures are organized by chapters or modules with two access rate, and the student access them by clicking in the corresponding arrow of the HTML page as is indicated in the Figure 2. Previously, all the streaming files should be stored in a regular web server (sever-less system) or in a RealSever (client/server model).

MODULE	TOPIC	LAN	ADSL
Module-00	Presentation	⇨	⇨
Module-01	Introduction to the Neural Computation	⇨	⇨
Module-02	Fundamentals of Artificial Neural Networks	⇨	⇨
Module-03	Neural Networks Selection	⇨	⇨
Module-04	First Artificial Neural Networks	⇨	⇨
Module-05	Backpropagation Network	⇨	⇨
Module-06	Self Organizing Map & Counterpropagation Networks	⇨	⇨
Module-07	Hopfield & Bidirectional Associative Memory Networks	⇨	⇨
Module-08	Adaptive Resonance Theory Network	⇨	⇨
Module-09	Artificial Neural Networks Applications	⇨	⇨
Module-10	Fuzzy Logic & Artificial Neural Networks	⇨	⇨

Figure 2: Modules of ANN Course in HTML format

The design of the lecture video screen includes two parts, index menu and class window, as illustrated in Figure 3. This design is based on a HTML page with frames where the left frame shows the class index divided in sections and the right frame shows the embedding presentation in the web page, rather than launching RealPlayer as a separate application.

The index menu in the left side, allows the student to address the section of the lecture desired avoiding sequentially access. Each section has associated an streaming file that it will be present in the class window. The large window on the right corresponds to the class zone where the students see and hear the multimedia content based on the screen

activity performed by professor. At the bottom of the window some control buttons are added to provide control to the viewer. Moreover, the web browser integrated on the RealOne Platform can present any web based learning element and be controlled by either user behavior or the information designer.
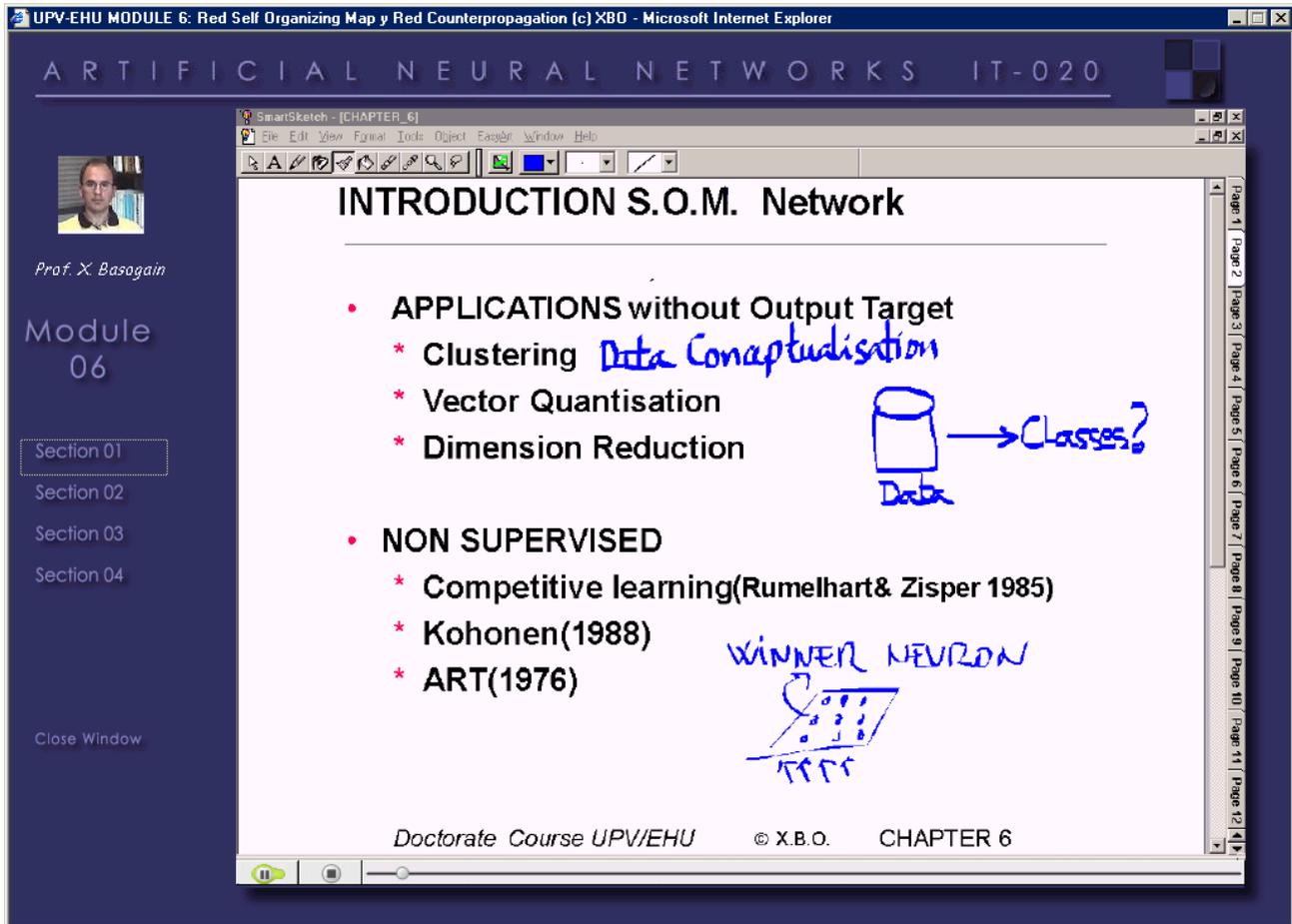

Figure 3: Lecture Video Design

CONCLUSIONS

The streaming media is a reality that improves on-line education; trends in new technology advances and the upgrading of communication networks in domestics and institutional environments point towards successful results. This paper describes the work relative to the e-course "Artificial Neural Networks and their Applications" offered by the School of Engineering in Bilbao. The e-course is based on the streaming multimedia contents generated originally in a digital form using software packages running on a personal computer. Once the streaming systems are implemented, the transition from the conventional video lectures delivery to the digital multimedia is easy and the course quality is enhanced.

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