Implementing Video Streamed Instruction for Deaf and Hard of Hearing Online Learners

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Abstract

Videotaped instruction has been an effective delivery tool for deaf online learners for many years, but it may soon be replaced by video streaming. Video streamed instruction delivered via the web has not become a stand alone viable option today for instruction of the deaf, but it is a valuable tool when used in conjunction with other instructional Internet tools. Video streaming is becoming more popular because more students are connected to the Web at higher access speeds at home, work or school. In order to achieve this success, a number of problems associated with the use of streaming video with deaf learners had to be overcome. These include the following: the speed at which some learners are connected; size of streamed video files vs. the clarity of the video which is to be streamed; readability of sign language if the video also includes a white board or projection from a computer monitor; cost and complexity of producing, digitizing, compressing and posting streamed video; size of the server where digitized streaming video files will be stored; captioning requirements of streamed video; and the necessity to interface with other software such as Flash™ for readable instructional modules.

NTID has successfully piloted video streamed modules in some of its online Visual Basic (VB) programming courses designed for remote deaf learners. This presentation will be followed by interactive discussions with the audience regarding this instructional delivery.

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Evolution from Video Tapes to Streaming Video

"In the mid 1960s a group of pioneering teacher educators at Stanford University in Palo Alto California began an experimental use of a new technology, video tape recording." (McCurrry) Since this time videotaped instruction with sign language, captioning, graphics and animations has proven itself as a viable option in the delivery of remote courses and as a supplement to traditional courses for deaf and hard of hearing students.

The National Technical Institute for the Deaf (NTID) has successfully developed and offered a number of both technical and non-technical courses for both on campus and remote delivery using videotapes as a primary delivery of instruction. When combined with online group conferencing and delivery software, video taping still works great today for this type of instruction.

Remote students are starting to demand a higher tech alternative to online instruction however. One negative of using videotapes is the requirement of physically keeping the videotapes with the student for accessing lectures and having a VCR to view them. If a remote student wants to access a lecture and has some time at work or is on the road traveling due to their career, they have to physically carry their video taped lesson with them in order to view their lesson. People don't often have VCR players with them at work but they have high-speed Internet access. Students want to be able to view their instruction "anytime, anyplace". Another negative associated with video taped instruction is the inability to index a lesson. The student has to fast forward or reverse their VCR to find a particular instructional unit. The alternative to videotapes is using a CD-ROM or DVD type of instruction. These also require physically carrying the media with the student, although CD-ROM's are readily available at most student's home or work place. The instructor in real time cannot also modify media that is carried by the students if there are any changes or additions to the lesson. Another challenge is instructional delivery to an international audience. Video tape players in the VHS format are not consistent even throughout the English speaking countries. An alternative to these instructional formats is to use streaming video.

Video streaming is just starting to become a viable option for supplementing instruction for deaf and hard-of-hearing students. Somewhat user friendly editing software, digital camcorders, higher broadband connection speeds for students at home and work, cost effectiveness of larger servers and the changing demographics of our student audience are all contributing towards this trend.

Student Audience

There is a remote adult population who needs to be trained or retrained and may not normally be inclined to take courses at NTID, such as geographically remote deaf adults with full time jobs and families, single working mothers, etc. A survey of approximately 2000 online RIT students, of which 50 were deaf, gathered a 10% response rate and found that 70% of these students had access to broadband Internet access at home, work or school. (Fasse) This shift in the access speed of the student population makes video streaming a more viable option.

Universities in general and more specifically educators of the deaf are slow to adapt the use of video streaming technology due to a variety of concerns. Morensen, Schlieve and Young

experimented on a limited basis with some streaming media with their hearing students at the Department of Technology at the University of North Texas. One of their comments was "One interesting question would be the minimum technical expertise of a student enrolled in a streaming media type of course. A student must be able to access the Internet, download the streaming media player, install the player, and perhaps configure his or her machine for optimal performance" (Morensen). This learning curve for streaming media players is not anticipated to be a problem with the computer programming audience taught by these courses as it is assumed that these students needed skills to use this streaming technology. This could be a challenge early on for some faculty and students in non-technical majors, but this technology will become more user friendly as it evolves.

Companies and organizations are increasing the use of streaming media as a communication vehicle and offer closed captioning to deaf and hard of hearing individuals. "The market for streaming media applications is growing rapidly to now include Web-hosted events, investor relations and digital broadcasts of seminars, conferences and entertainment. The need to caption these proceedings and make them available to everyone is critical," (Solomon)

Terminology

If one was to do a literature search, the terms "distance learning", "online learning", "e-learning", "any time, any place learning" and "remote learning" are used interchangeably. There is not yet a standard labeling for this type of learning. The term online learning or distance learning is used in this paper to describe courses that are offered to both on-campus and to remote deaf students. NTID delivers four computer programming courses in an online format. Two of these courses teach C++ programming. Two of these courses teach Visual Basic programming and the lectures are being delivered via video streaming. This coming fall quarter the streamed video will be used for the first time as a primary instructional delivery. In the past videotapes, graphics and animations were used to deliver the lectures.

Video Streaming Definition

Video streaming can be thought of as a progressive downloading of a video file. Instead of waiting a long time for a movie to be downloaded to one's desktop all at once and then viewing it, the video is fed or "streamed" in small units of information at a time and is viewed as it is being downloaded. Streamed video is much more conducive to viewing large video files that may last from many minutes up to an hour or more. The video could be live or prerecorded and stored on digital media.

The ultimate goal is to develop a clear multi-image, synchronized instructional presentation. There are actually separate "streams" that exist in a streaming video, which needs to be synchronized, i.e. the audio must be in synch with the video, the computer display, and the captioning and the graphics. Having separate streams is a tremendous advantage trying to deliver instruction over the web with limited bandwidth. One stream could be the movie that included the instructor signing, one stream could be the audio, another stream could be the captioning and another could be the computer monitor projecting the programming code or object that the instructor is explaining.

Types of Video Streamed Files

The three most popular video files are Quicktime™, Microsoft Media Player™ and RealPlayer™. The advantages and disadvantages of each will be discussed below which led to the use of RealPlayer for the project described in this paper. "Synchronized Accessible Media Interchange (SAMI) and Synchronized Multimedia Integration Language (SMIL) are used in conjunction with Media Player and RealPlayer respectively for coordinating multiple clips of the streamed video which is also crucial for captioning on this type of project.

Although Quicktime, a ".mov" type of file, is very popular for standard movie downloads, it is not as proven as the other two mentioned products for streaming. Quicktime just recently entered the streaming market. Its performance on the PC depends greatly on the speed of the computer and the compression settings of the movie. Certain kinds of QuickTime Scripting work only on the Mac and not on the PC. Quicktime is easily embeddable into HTML documents.

Microsoft's Windows Media Player, an ".avi" type of file, works great in the PC environment but not on a Mac platform. It only works with the Internet Explorer Internet browser. It is easily embeddable into HTML. According to Microsoft, SAMI "is simply a format optimized for authoring captions (CC) and audio descriptions (AD) in a single document. SAMI is based on HTML to provide a familiar, user readable format." (Microsoft) SAMI coordinates the different video streams for this type of media player. SAMI does the same for windows technology that SMIL does for RealPlayer.

RealPlayer, an ".rm" type of file, became the streaming software of choice for this project. Real Player works on both Macs and PC's. It has a proven track record in the streaming video arena. It is complicated to embed into HTML. "To combine the two, an image needs to be embedded into the HTML document which is a link to the Real Video, which opens into a floating window and blocks the main page." (Technical Guide) When a RealPlayer streaming presentation contains multiple clips, such as sign language videos, computer screen images, captioning, etc., it needs to use the SMIL to coordinate the parts. SMIL is a simple but powerful markup language for specifying how and when clips play. A SMIL file is not required to stream just one clip. When multiple clips exist such as in this project, SMIL's markup language specifies how and when the clips play. After writing the SMIL file, the video is then ready to put on the RealServer and link to the Web page.

Creating the Video

The primary equipment needed to produce a streamed video are a video camcorder, a means of exporting the movie into the computer, and a server or device to store the video on so it can be accessed from the web. Capturing a video and digitizing it is relatively easy. Converting the video-to-video stream into Real Player format is the difficult part.

The easiest way to record a video is to have a camcorder that is digital and a connecting Fire Wire. This will allow the user to directly port the movie into the computer in a digital format. This movie can then easily be edited with a product such as Adobe Premier or other product. This would produce a high quality video product.

An analog camcorder could be used with the standard Audio Visual (AV) ports and a video capture card on a computer. Using this method requires more steps, because the movie has to be converted from analog to digital by going through the AV port and back. This method would work, but the video quality would degrade.

Streaming the Video

Streaming is the most difficult part of this process. The goal is to code the streamed video onto a web page. The developer needs to know the name of the server and where to put the video file. Streaming software needs to be used at this point. RealPlayer worked fine for this project. The basic version is free, but it will allow up to a maximum of only 25 users. Realplayer can be downloaded from www.real.com.

Fundamental Steps to Stream a Video

1. Use a camcorder to record the instructional video(s), including instructor's signing and explanations, graphics, computer monitors, etc.

2. Transfer the video(s) from the camcorder to the local PC.

3. Edit the video(s) on the local PC.

    a. Separate the audio and video streams.

    b. Create a caption text file using a text editor.

    c. Create all other streams necessary (instructor's signing and explanations, graphics, computer monitors, etc.). Create a SMIL file to synchronize all streams and create the final layout.

4. Set up the web server – this serves as the web page host. *

5. Set up the RealPlayer server. * This is an application that handles the streaming and synchronization of the audio/video/captioning/monitor image into one package.

6. Transfer the video from the local PC to the RealPlayer server.

7. Create a web page on the web server pointing to the final SMIL file on the RealPlayer server.

8. Test all files to ensure that they are downloadable and receivable by the student audience.

* indicates this should be performed by individual with computer expertise.

Size vs Clarity of Streaming Video Files

The clearer the movie file is to view, the larger its file size will have to be. There is a trade off between what file size is adequate to be able to understand sign language and the instruction

when it is streamed to the user's desktop and what is a practical file size to store and stream video over a broadband connection. For video by itself, 15 frames per second throughput is normally fine to adequately view on the web. When combining multiple streams as previously mentioned, however, throughput of 30 frames per second is recommended for the best clarity. The signal will tend to degrade after the various streams are combined and posted on the web.

Streaming Video Software

There is various PC Video editing software available, Adobe Premier runs on either platform and was chosen for this project. There is also another Mac based video editing software named iMovie which is very popular.

Streaming Video Servers

A large capacity server needs to be used for video stream hosting. A good "rule of thumb" to use is video typically consumes one megabit per minute for an average video. The server described in this paper used Redundant Array of Independent (or Inexpensive) Disks (RAID) to build in redundancy. RAID collectively act as a single storage system, which can tolerate the failure of a drive without losing data, and which can operate independently of each other.

Although the video is stored on the server, CD-Roms and Digital Video Devices (DVD's) are also used for two purposes. First, the addition of CD's and DVD's gives more options to students who do not have high-speed Internet access. These students can now view the clips while away from faster network connections. A DVD can store up to 1.6 Giga Byte of video while a CD can store up to 650 Mega Byte of video. Future technology will increase this capability multi-fold. Secondly, having multiple DVD's and CD's incorporated into the Server will allow all the video streams sorted by particular class and session time/date. By providing multiple media access on the server itself, seek times for specific files will be much more responsive. For instance, if there are multiple students accessing the same files on the server at the same location simultaneously, the server will only be able to address one request at a time. If these same students are making the same request to multiple CD's or DVD's, the response time will be increased by the dedicated access time each student will be receiving. The goal is to provide the most flexibility allowable to students at the fastest possible throughput, regardless of location, anywhere, anytime.

Technical Expertise for Creating Streaming Video

Minimal technical expertise other than a learning curve using the editing software is required when producing the video. Captioning can be done using a common text editor. The difficult part is actually converting the video to the streamed format and posting this on a web server. Someone with computer expertise would need to help with this part of the process.

Final Remarks

Although streaming video with captioning is not quite perfected and is not yet widely used on the web yet as a stand-alone instructional tool for the deaf and hard of hearing audience, it will be soon. Capturing and streaming a video with a person using voice, sign language and incorporating captioning is not difficult to do. When also incorporating instructional media such as

computer monitors, white boards, text and graphics, the streaming process becomes incredibly challenging and complex due to a variety of issues previously discussed. NTID has had some early success with this process and will continue to forge ahead with this new technology for the benefit of deaf and hard of hearing individuals across the globe.

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