Virtual-Web Energy Demonstration Construction Center (VEDCC) Live Online Broadcast

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Abstract

The latest addition to Virtual-Web Energy Demonstration Construction Center (VEDCC) project is the Live Online Video Broadcast. This feature enables live streaming video broadcast over the Internet from the VEDCC Construction Lab at the University Of Louisiana at Lafayette. This feature will also enable the general public with an Internet connection preferably a broadband Internet connection to view the classes and laboratories in real time through their Internet Browser equipped with the appropriate software. The public will be able to view an ongoing class over the Internet, through streaming media technology.

The classroom action is captured through a camera and a microphone. The audio and video signal from the camera and microphone is then encoded into the streaming format through the streaming media technology and then uploaded to multiple servers. This process is done simultaneously while the event is taking place. When a visitor decides to view a live event, a small part of the file is downloaded for the user to start watching the video immediately. The remainder of the file is streamed while the user is watching the video. The activities in the construction lab are captured through three wireless cameras placed in different corners of the virtual lab and each will cover a 120-degree angle of view to provide a full 360% coverage of the lab. A fourth camera is installed for occasional viewing of a particular section of the lab. Once the cameras and the video switcher are installed, the video output from the switcher will be the source for encoding the live streaming video. The encoded videos are served through the Microsoft Media Server. The streaming video content is provided to our Internet viewers through UL Lafayette's' Internet Backbone. The Virtual-Web Energy Demonstration Construction Center (VEDCC) website can be accessed at http://www.vedcc.org. This project is sponsored by the Louisiana Department of Natural Resources and Department of Energy contract number PVE29-01-09.

Introduction

This paper discusses the concepts and technical specifications on setting up a virtual construction laboratory at the University of Louisiana at Lafayette, to handle live streaming video broadcast over the Internet. Live streaming video broadcast over the Internet will enable the general public with an internet connection preferably a broadband connection to view the

classes and laboratories in real time through their Internet Browser equipped with the appropriate software [1].

The Virtual-Web Energy Demonstration Construction Center (VEDCC) at the University of Louisiana at Lafayette is sponsored by the Louisiana Department of Natural Resources and the United States Department of Energy. The goal of the VEDCC is to provide relevant information on energy and efficient building practices to targeted groups that live and work in Louisiana. Experiments and demonstrations are selected based on the people's needs/demographics of the State in the Virtual Construction Laboratory. The virtual lab is linked to construction sites, building materials manufacturers and suppliers, subcontractors on job sites, and to the center's virtual construction laboratory.

The main scope of a Live Online Broadcast is to enable the public to "see" an ongoing class over the Internet, through streaming media technology. The concept of streaming media is fairly new. In the past, Internet users had to download the entire audio or video files prior to being able to view them assuming that the video files are already encoded and available on the Internet for download. Non-streaming media files are typically huge and viewers with a standard dial-up Internet connection would wait hours for the files to finish downloading before viewing them. This prevents a live event broadcast from taking place [4].

With streaming media technology, the media files are first encoded, and then digitized. Encoded files are then uploaded to multiple servers. This process is done simultaneously while the event is taking place. When a visitor decides to view a live event, a small part of the file is downloaded and then the file is streamed while the user is watching the video. There is a 10-30 seconds lag time between the live event due to the encoding and buffering process. The video shown on a streaming media server has been highly compressed so that users with low speed Internet connections may view it quickly. Typically, three compressed versions of the video are made for each video. Each version is for a different Internet connection speed. The greater the Internet connection speed a viewer has, the better the quality of the video.

Procedure: Setting Up The Laboratory

A.   Live Internet Broadcast Concept

The concept for this live online video broadcast setup has been implemented with success in the past years. It resembles a typical TV studio. There is a stage, cameras, a host and audiences. The stage in this case is the virtual construction laboratory. The host is the instructor of the class or laboratory and the audiences are the online participants viewing the show on their computers through the Internet.
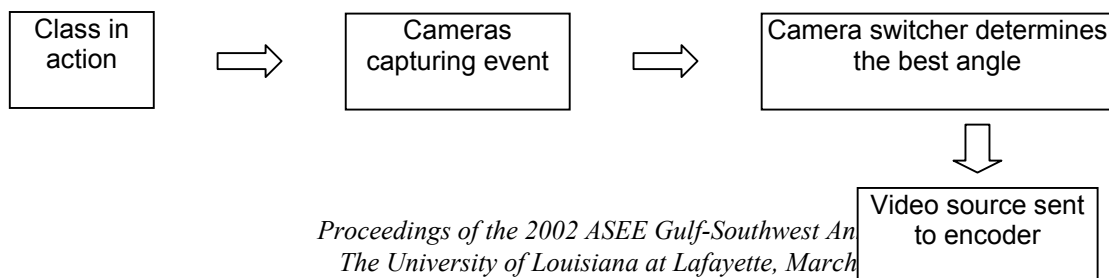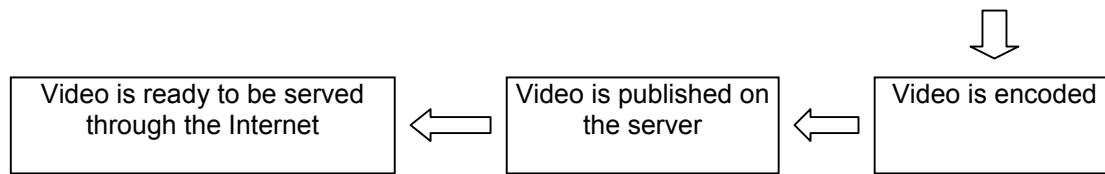
Figure 1: General Process Overview

B. Camera Setup

There will be three wireless cameras placed in different corners of the virtual lab and each will cover a 120-degree angle of view. This placement is necessary to cover the entire 360-degrees of the virtual construction lab. Also, a fourth camera will be installed for occasional utilization of a particular section of the lab. Please refer to Figure 2.

The cameras shall be connected to a main video switcher that can be operated by a wireless controller device that will activate the specific cameras on demand. Please be aware that this setup can only allow one video source from one camera to be active at any given time. This setup basically enables the instructor to select the angle in which he wants the viewers to see.
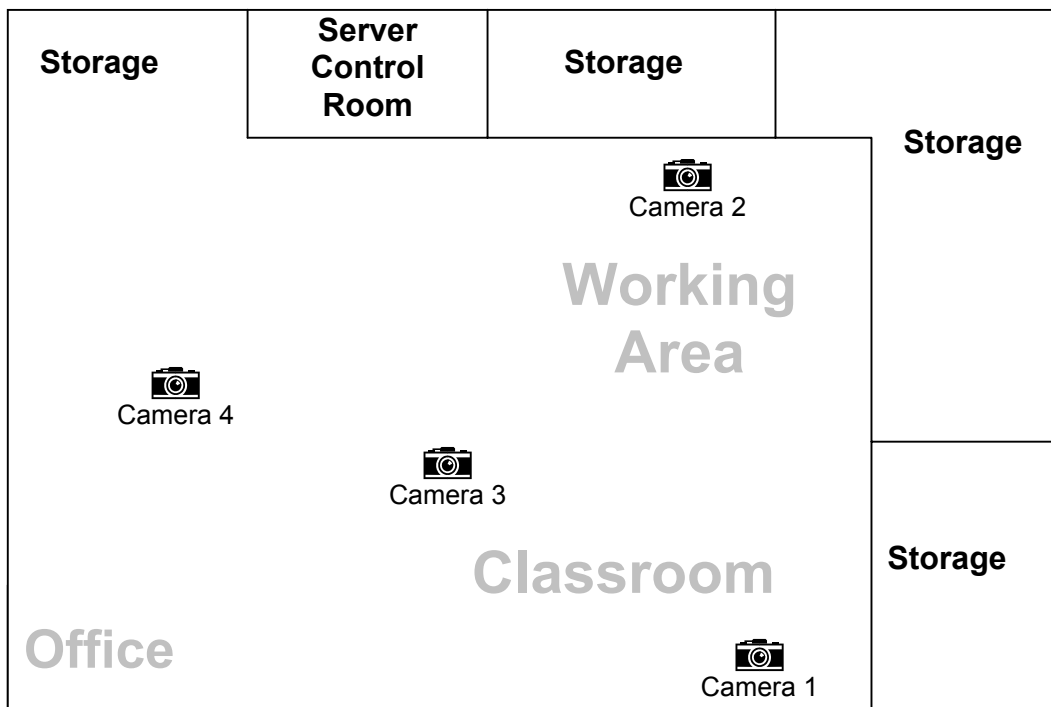

Figure 2: Construction Lab Layout

C. Encoding

Once the cameras and the video switcher are installed, the video output from the switcher will be the source for encoding the live streaming video. The video source will be encoded in the Microsoft Windows Media Format using the Microsoft Windows Media Encoder. Windows Media Format is a single, secure, inter-operable format that is the standard for Internet audio and video data distribution. Numerous Internet companies have adopted Windows Media as a format for secure streaming and downloading of audio and video data.

Encoding is a time-consuming, CPU intensive operation. In addition, each of the delivery formats has methods for packaging different bit rates into one stream for more efficient delivery. For this project, we shall have to implement variable rate encoding. This enables the video source to be encoded into multiple streaming rates for particular bandwidths, such as 100k for a broadband connection, and 56k for a dial-up connection. Multiple rates give the viewer the flexibility to choose the best rate for their connection. Encoding will take place in the Media Server that will run on a Microsoft Windows NT Server [3].

D.   Content Serving

The encoded videos will be served through the Microsoft Media Server, which will only operate on a Windows NT Server. The following are the minimum requirements to run a Microsoft Windows Media Server [3].

- Intel® Pentium II, 266 megahertz (MHz) or better
- 128 megabytes (MB) of RAM or more
- Ethernet card
- 500 MB disc space for content storage
- Microsoft® Internet Explorer 5.0 or later; Microsoft® Windows NT® Server version 4.0 with Service Pack 4 (SP4) or later
- High Performance Video Capture Card for Analogue Video Input.

E.   Bandwidth

In the beginning of the project, the streaming video content will be provided to our Internet viewers through UL Lafayette's' LA.net Ethernet Backbone. Considering the fact that the UL Lafayette Internet backbone serves the entire campus, bandwidth problems will be encountered. UL Lafayette's' Internet backbone does not have the routing capability to stream the media around congested public and private exchange points on the Internet. These exchange points are the primary cause of latency and packet loss, resulting in the streaming media being disconnected.

The routing technology implemented must have the capability to route the network traffic over all Internet backbones in a faster, more reliable, and efficient manner. Currently, UL Lafayette's' Internet Backbone is presently incapable of providing the requirements of this system. The optimal solution to this problem would be to seek an external service provider to serve the streaming video content [2].

Activity

Summary of instructions to view the live video over the Internet when a class is on session are as follows. The website can be accessed at http://www.vedcc.org. The Audio/Video section is included in the menu.
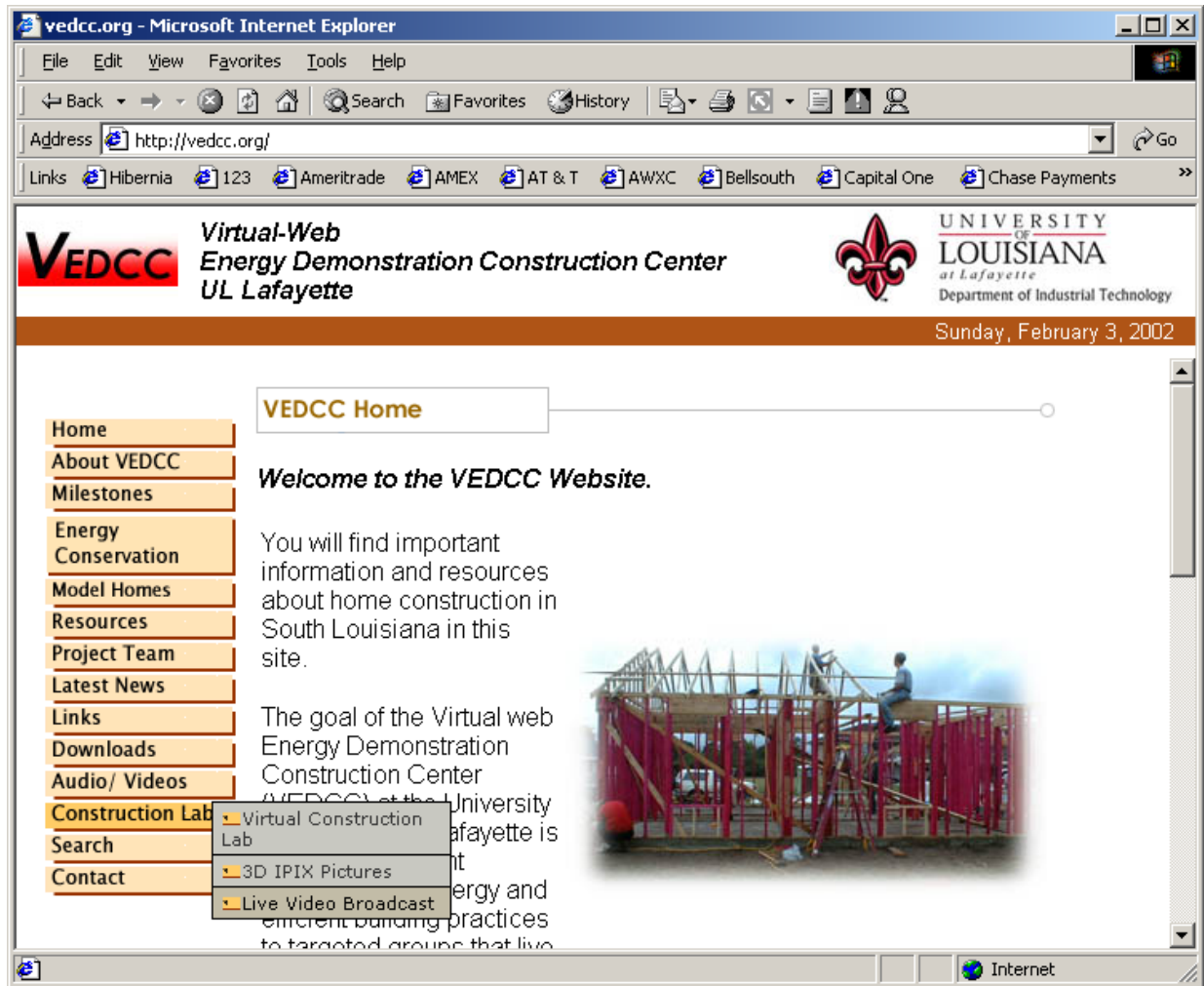

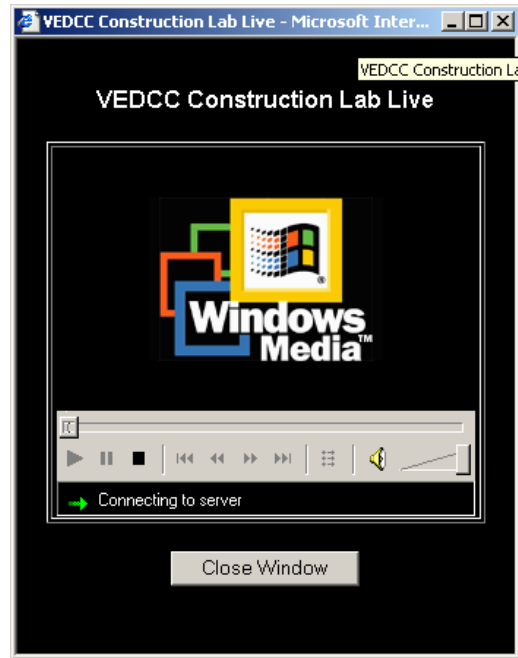Figure 3: www.vedcc.org Main Page

Figure 4: VEDCC Live Broadcast Window

When you click on the Construction Lab Live section, a second window will pop up. It will look similar to the window in figure 4. The pop up window is favorable as it enables viewers to visit other page without terminating the live video.

Recommendations

Although this fully functional system is ready to broadcast video over the Internet, it is not suitable for a mission-critical environment. Hence, the VEDCC Construction Lab will not broadcast videos on a 24-hour basis. This is mainly due to the fact that there are no classes held after office hours. Hence, broadcast will only take place when there is a class-taking place.

This system can be further improved to accommodate four live cameras broadcasting at the same time to enable viewers to choose the angle of their choice. In order to achieve that goal, the wireless cameras used would have to be upgraded and more advanced video switching systems have to be installed.

With the amount of video broadcast quadrupled, the amount of bandwidth is of concern. In order to broadcast vast amount of video over the Internet, more bandwidth is needed. This can be achieved through a third party data services provider.

Conclusion

When the live online broadcast for the VEDCC Construction Lab is launched, it is the VEDCC team member's goal to attract the public attention in the field of construction. Though the use of Streaming Media Technology is fairly new, it will enable the public to "see" an

ongoing construction class over the Internet. Generally, people aren't willing to log on and watch live videos at low frame rates on their computer screens. For those used to broadcast television on a large screen, streaming media has a long way to go to be a really satisfying experience. However, streaming, combined with a Web-based content management application, offers many advantages that broadcast can't. For more information, please visit the Virtual-Web Energy Demonstration Construction Center (VEDCC) website at http://www.vedcc.org.

References

1. Black, A. B., Lau, C. P. Lau, Smith, A. E., Massiha, G.H. Virtual-web Energy Demonstration Center, Proc. ASEE/GSW Annual Conference, March 2001, TX.

2. H. Peter Alesso, e-Video: Producing Internet Video as Broadband Technologies Converge, Addison Wesley 2000.

3. Microsoft Corporation. (2000, October). Setting Up Your Windows Media Server for a Live Video Feed. MSDN Library. Retrieved from http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnwmt/html/tvlive_server.asp

4. Yehuda Shiran, Ph.D. (2000, March). Streaming Media File Formats. Internet.com. Retrieved from http://www.webreference.com/js/tips/000309.html

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