Desktop Video Conferencing for Remote Tutoring/Teaching of Deaf Students

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Abstract

Desktop Video Conferencing (DVC) is a widely available, low cost, practical technology that can be used in synchronous, online tutoring/teaching sessions. Although the throughput on the web does not make DVC always practical as a primary instructional tool in online courses, it has been useful as one means of tutoring remote deaf students when used in conjunction with Microsoft Netmeeting™'s chat session and white board.

DVC is often too slow for fluid sign language conversation, but it allows the sharing of some sign language, gestures, facial expressions and body language. This real-time interaction significantly enhances chat sessions and white board viewing of instructional material such as programming code. Netmeeting also allows the use of highlighting and drawing on top of instructional materials, which can easily be posted on the online white board.

NTID surveyed a variety of students and faculty members to gather opinions on the usefulness of this technology. In this session, the results of student and faculty opinions will be discussed in this paper in addition to the results of DVC implementations through various network topologies and connections.

These findings will be presented, followed by an interactive discussion with the audience regarding how this delivery system would be appropriate for remote learners.

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Need for DVC

After teaching multiple remote "distance learning" or "online" programming courses to both deaf and hearing adults, it was found that both synchronous and asynchronous types of online instruction are necessary for most students to have a successful learning experience. The asynchronous aspects include using groupware communication tools such as First Class™ or Blackboard™, web based materials, video, etc., to satisfy the diverse needs of a typical classroom population. These instructional tools seem to work fine for most of the deaf and hard-of-hearing students in a typical remote, online classroom.

For some struggling students in a remote class, however, one-to-one synchronous communication or interaction needs to occur with their instructor. The scope of this paper focuses on using a QuickCam™ Desktop Camera in conjunction with Microsoft's NetMeeting™ as an asynchronous tool for tutoring and clarifying concepts with one deaf student and one teacher. This is often referred to as point-to-point video conferencing, where only two people can talk and see each other at a time. Although this hardware and software can easily incorporate group conferencing of remote students by the instructor, the scope of this paper includes only one-to-one student tutoring with the instructor. The students selected were tutored on an individual basis in a credit-bearing online course in Visual Basic Programming.

There is a remote student population who needs to be trained or retrained and may not normally be inclined to take courses at a traditional institution, such as geographically remote deaf adults with full time jobs and families, single working mothers, etc. In the past, distance learning with two-way video was out of reach for many remote students and institutions. Recent innovations in telecommunications have lowered equipment and transmission cost, making two-way desktop video feasible for small colleges, businesses, classrooms, libraries, and even homes. Access to this videoconferencing technology, however, does not guarantee a valuable learning experience for remote deaf and hard-of-hearing students.

Desktop Video Conferencing (DVC) is becoming a viable tool for online learning, especially for deaf and hard-of-hearing remote learners who otherwise only have email or Telecommunication Device for the Deaf (TDD) as the sole means of communication with their teacher. As a stand-alone tool, DVC is not yet adequate for communication via remote sign language due to the low throughput on the web, especially if the user is connected via local phone lines and shared, heavily loaded local networks. DVC is adequate, however, for adding a "personal touch" to online tutoring. It allows gestures and facial expressions to be incorporated into a remote tutoring or teaching session.

Affordable broadband connections and technologies such as the Integrated Services Digital Network (ISDN™), the Digital Subscriber Line (DSL™) and Road Runner™ at home, work and school are rapidly growing. These high-speed connections will change the capability of carrying large amounts of text, voice and video data over existing telephone and cable lines. A survey of 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 our student population makes video streaming a more viable option.

Videoconferencing systems now incorporate compressed digital video. " This technology makes the transmission of video less costly by reducing the size of the video needed to be transmitted. Before compressed digital video, only a handful of educational institutions operated small analog-based closed-circuit television networks." (Walsh)

What is DVC?

Desktop Video Conferencing (DVC) is one of many different types of conferencing tools. The DVC components include a video conferencing camera, such as the QuickCam™ camera used for this paper (see Figure 1), an Internet telephony application, a microphone, and speakers mounted to the local computer (the microphone and speaker built into a laptop computer were found to be adequate). DVC links two or more participants at different sites by using computer network(s) to transmit data. DVC is based on Codec (compressor-decompressor) technology. A Codec works via a mathematic computer algorithm to compress and decompress digital data. The data can be video, audio, or text based. A Codec is an important part of any Internet telephony application such as Microsoft's Netmeeting™.

Advantages of DVC

The authors have found DVC inexpensive and easy to implement for both the instructor and the student. DVC significantly enhanced remote tutoring sessions by making remote interactions more personal. Communication with the deaf and hard-of-hearing relies heavily on facial expressions, body language and gestures. DVC, when combined with the other tools mentioned in this paper, provided an adequate environment for successful remote tutoring sessions.

Reed and Woodruff feel that DVC "Establishes a visual connection among participants. Since a teacher can see and hear remote learners in real time, he can use conversation and body language to enhance communication. Frequent interaction increases understanding and encourages more personalized instruction. Interactive teaching strategies such as questioning and discussion can also help engage and motivate learners by making them active participants." (Reed) They also bring out the point that DVC "Supports use of diverse media. Photos and color graphics look great on video and can help convey a difficult concept or simplify instructions. Room-based systems usually include an attachable document camera that allows transmission of a high-quality still image. This feature can be used to show objects as well as photos and graphics, and many instructors also project 'slates' -- simple text displays with a few sentences (usually instructions). Slates are an easy way to shift learner focus from the video screen to a learning activity." (Reed)

Challenges and Solutions Using DVC

The biggest challenge initially with DVC was due to two major factors, compatibility and bandwidth. These problems are fading away due to rapid broadband implementation and developing Internet standards. The compatibility challenge existed because manufacturers used their own unique individual standards for hardware and software. These unique standards often made them incompatible with other vendor's products. The creation of the H.323 (Internet telephony

application) set a standard that helped alleviate this problem. The bandwidth problem was due to most local phone company's Plain Old Telephone Services (POTS) providing 28.8 kbps bandwidth, which is extremely slow when utilizing multimedia functions.

Reduced bandwidth causes choppy video images, "ghosting", image softness, synchronization problems and poor image quality. Choppy video results in jerky delays of human sign language or moving objects, making it difficult for viewers to communicate or follow a moving object. "Video 'ghosting' or 'image softness' is the codec's way of compensating for rapid information flow. One way the codec compacts information is by reducing frame rate (number of video images per second), which can make rapid motions appear jerky. The codec also drops resolution to compress information, which can make an image fuzzy or chunky. To reduce these effects, reduce the amount of visual information flux. Avoid rapid motion, wear plain clothing, and hang a pastel curtain behind participants to reduce extraneous visual information." (Reed)

Synchronization problems can cause voices to be heard without the mouth moving, making it difficult to lip-read for a deaf or hard-of-hearing individual. Poor image quality due to a low-resolution image that is hard to see makes it difficult to view an image, especially when a deaf or hard-of-hearing individual has to read lips or sign language. "Audio delays can occur because it takes about a second for information to compress, travel, and decompress. Videoconferencing novices usually experience a few awkward crossed 'go ahead' conversations due to this time delay. Since there's no way to prevent the delay, learn to finish thoughts in a single statement with an obvious conclusion. Listeners should avoid interrupting and use visual cues (like nodding) instead of verbal affirmations (like 'uh huh')." (Reed)

Working With Human Factors

"Another part of understanding two-way compressed video is understanding how it is perceived by its users and how these perceptions influence interaction within this medium. Try to keep the following human factors in mind as you explore telelearning via two-way video.

Videoconferencing etiquette must be established by the users. Most people have not experienced videoconferencing and do not communicate as they would in a face-to-face situation. In a recent videoconference, for example, a designer presented his work to a remote pair. In the middle of his carefully prepared demonstration, a remote viewer broke into conversation, interrupting and ignoring the designer. Would she have interrupted a local demonstration this way? If she had, it would have been considered rude. Unfortunately, we're just not accustomed to conversing with a television image, and two-way video etiquette has yet to be refined.

Two-way videoconferencing is unlike one-way television, but many people have a difficult time changing ingrained habits and preconceptions produced by years of experience with television. Not only do we tend to 'tune out' what's on a television screen; we also expect to be entertained by it. We expect broadcast quality video, slick graphics, and a quick pace to keep us engaged. And if we're not fascinated, we quickly change channels to something more interesting. The behaviors we associate with television -- channel surfing, 'spacing out,' 'vegging' -- are not optimal learner behaviors. Teachers who use two-way video must challenge basic learner preconceptions and set new expectations to maximize learning. Fortunately, good two-way video instructional strategies are also good classroom instructional strategies. " (Reed)

DVC Hardware

To use Desktop video conferencing, the student and instructor both need to have a computer, a camera, and an Internet connection to send and receive the video.

The computer should be a Pentium-based PC running on Windows 95, 98, NT or Windows 2000. The faster the processor speed the better the video will run. The user should have at least 32 MB RAM, although more memory will be better, especially if the user plans to have other applications open when using DVC. The PC should have enough hard disk space for file swapping; at least 20 MB would be a minimal requirement. A video capture card is also necessary.

The Internet connection should be as fast as possible. It is recommended that both users be connected at speeds much faster than the POTS 28.8 kb per second. A LAN connection with roadrunner, DSL, ISDN or T1 would be optimal. Temasek Polytechnic does an excellent job of laying out system requirement and step-by-step instructions on how to set up DVC on their website. (Temasek)

The camera chosen should be a desktop type of camera that easily interfaces with the computer. Although the QuickCam had many features for storing photographs, it was the video feature of the DVC and the low price (see Figure 1) that was the most appealing for the project discussed in this paper. The QuickCam camera is capable of recording video at up to 30 frames a second.

Figure 1. QuickCam Camera used for DVC

Netmeeting Use in Industry

Netmeeting, which was a key tool used in the remote tutoring session with deaf and hard-of-hearing students, is also widely used in industry by both deaf and hearing, especially for sharing information across different countries.

Paul Filipiak, Information Technology Project Manager for Eastman Kodak stated the following about Netmeeting: " As an IT Project Management professional coordinating the creation, implementation, and management of custom software solutions for our corporate partners in Hong Kong, Singapore, Korea, Thailand and other Pacific Rim nations, I have found the Net Meeting product to be a crucial part of my PM tool kit. We use Net Meeting during our conference calls/project status meetings because it helps us cut through the cultural roadblocks that a phone call cannot overcome. Despite what our native language may be or how far removed from each other we may physically be, Net Meetings' ability to share a common document in itself has helped us avoid costly rework because of miss-communication issues. When you combine that with the video

aspect of this product, it is great for building strong globally dispersed project teams." P. A. Filipiak (personal communication, May 23rd, 2001)

DVC As a Tool in an Online Classroom

In the Applied Computer Technology Department at NTID/RIT, DVC was used successfully with selected students in a remote, online Visual Basic Programming course in a synchronous remote tutoring session. The speed of the video was never at the required 15 frames per second as desired. To get a legible video signal for sign language to be understood in real time the speed would have to be at least 15 frames per second.

Figure 2 shows a remote tutoring session with a deaf student. Figure 2, Frame 1 shows the Video aspect of the QuickCam which was too slow to be able to use sign language communication, but it was great for eye contact and for viewing the student's or teacher's expressions and also for gesturing. This screen capture of the remote tutoring session was taken from the instructor's computer. The student, Stephanie Chester, is shown in the larger video frame and the instructor James Mallory is shown in the smaller frame. The names of the participants can be seen at the bottom of Figure 2, Frame 1. Figure 2, Frame 2 shows NetMeeting's white board. On this white board is posted some VB code that the student was struggling with. This particular topic had to do with arrays and loops. Figure 2, Frame 3 shows the conversation that was taking place. This functions similar to a chat session since sign language was not an option due to the slow speed of the QuickCam video.

Figure 2. Screen Capture of a Remote Asynchronous Tutoring Session

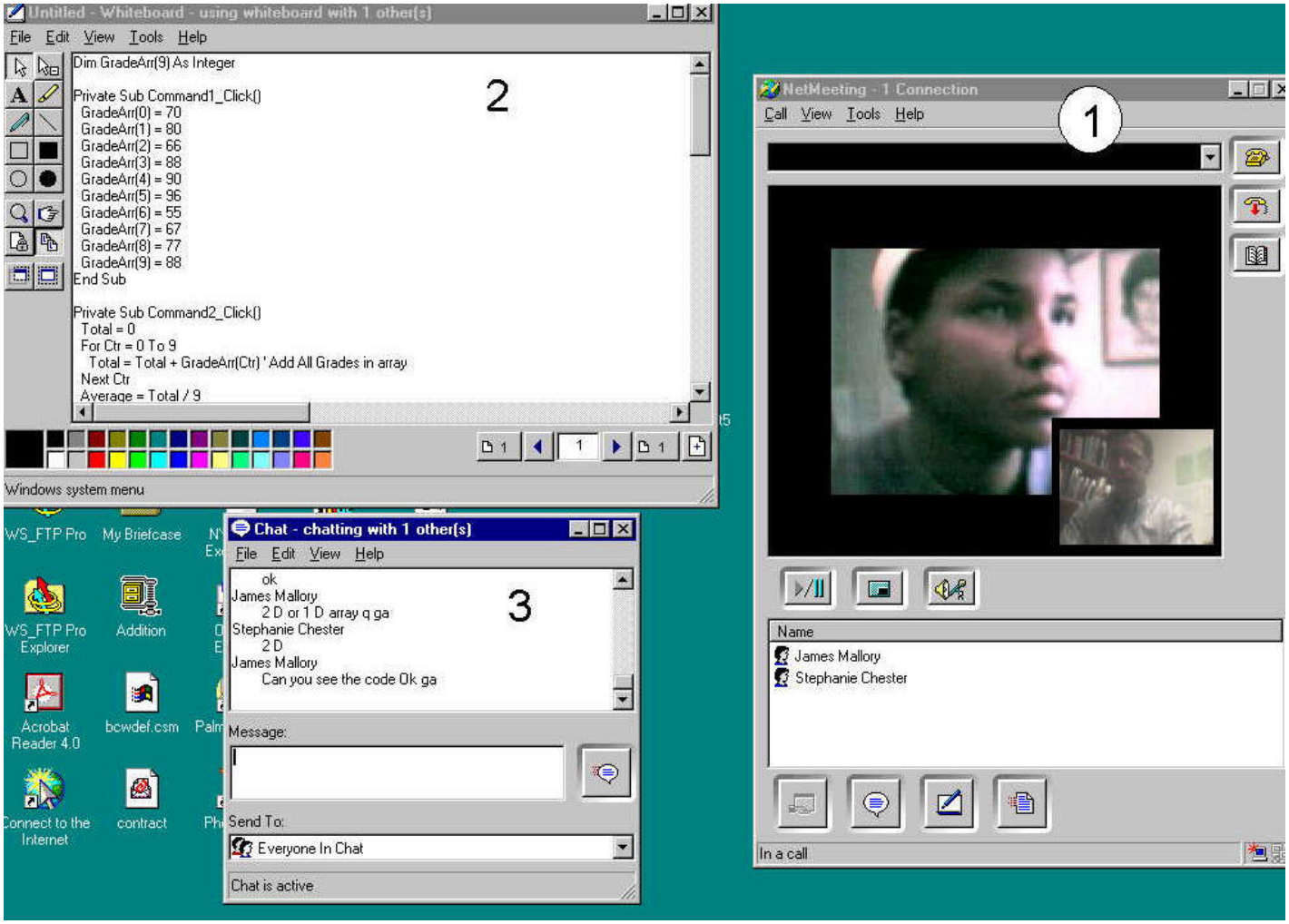

Figure 3. Screen Capture of a Remote Asynchronous Tutoring Session

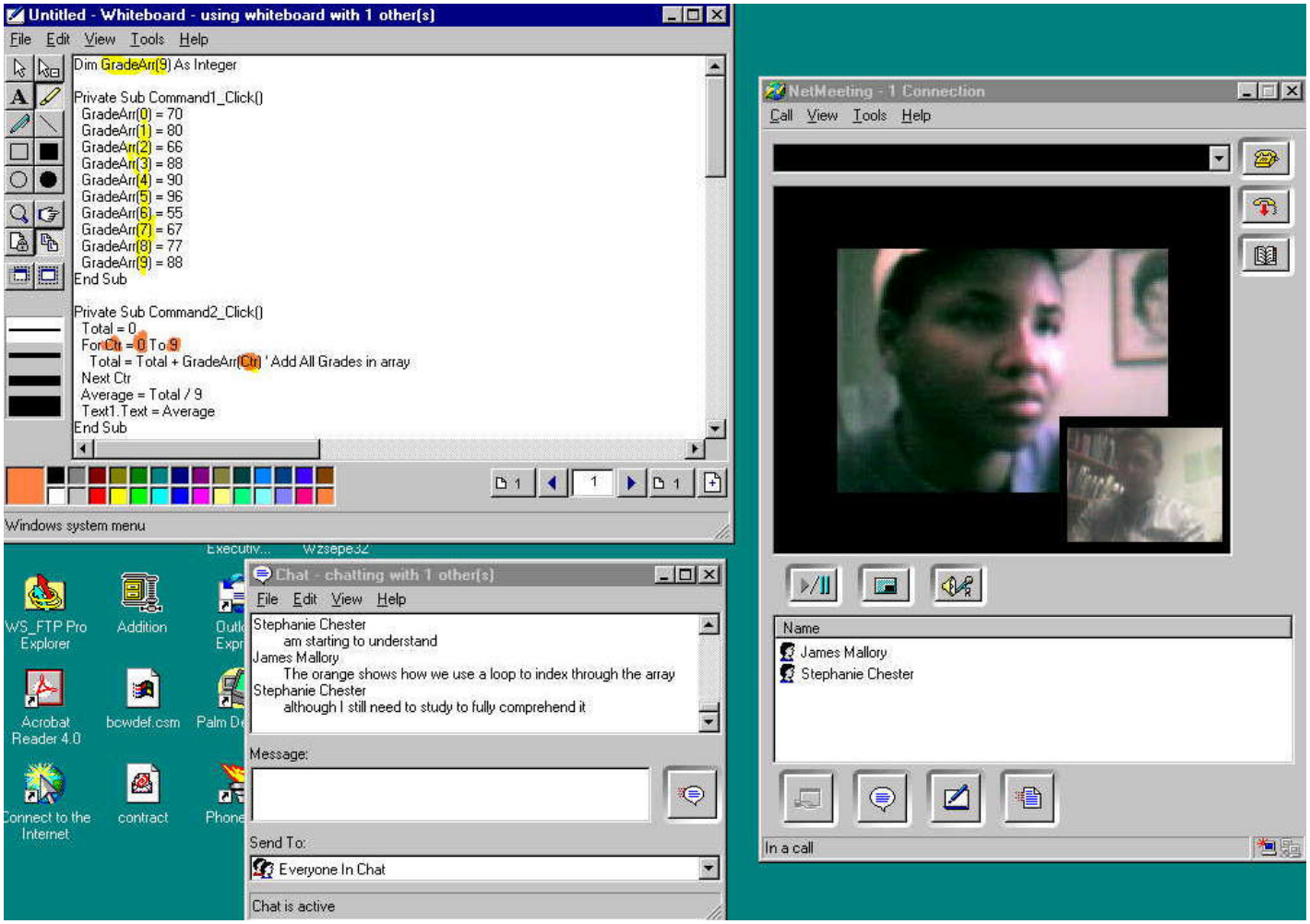

Figure 3 shows the same session later in the remote tutoring process. The white board has features exactly like Microsoft's Paint program which are intuitive and allow the student or the instructor to draw, paint or highlight anything that is posted to the white board. On the white board, yellow was used to highlight each element in the array to help explain how the array index works. Orange was used to highlight and explain how the loop control variable increments the count in the loop and points to each array index while summing the array's contents. Notice that the text conversation in the chat session seems out of sequence. The student was just finishing up explaining that she was starting to understand the array assignment when the instructor's explanation of the array was seemingly interjected in between her comments. This is common when using any type of chat session due to the delays that are inherent in these types of communication tools. This tutoring session was very successful. The student was frustrated with this concept before the tutoring session but had a fundamental understanding of the concept after the tutoring session. The tutoring session lasted approximately 35 minutes.

Student Evaluation of the DVC System

The main objective of a Master of Science (MS) Information Technology project at RIT was to evaluate DVC with various configurations of Cisco 2505 routers in an intranet. With Windows 98™ and Windows NT™ 4.0 operating systems, along with Cisco Interoperable Open Standards (IOS®), it was determined whether DVC was an effective communication tool under various configurations and loads. Data was gathered from 34 participants (4 hearing and 30 deaf and hard-of-hearing) in the form of a questionnaire. Data also gathered but not included in this paper included computer and network bandwidth information and packet transmission from one node to another node.

The results of the survey found that considering only the QuickCam video portion of the DVC, 40.8% thought the QuickCam video was excellent, 29.8% thought the QuickCam video was good, and the remaining 29.4% found the QuickCam unit was at par and lower. The results of the survey determined that the DVC was an effective communication tool under all of the loads and operating systems studied in this project. When considering the DVC integrated tools such as file transfer, chat, and white board applications, 59.8% of the participants considered the DVC communication tool to be "excellent" as a communication tool. (Laury)

Summary

"For years now, computer networks such as the Internet have been carrying text-based messages around the world. Most often, these messages take the form of electronic mail, though real-time chat programs are also used. As the quality and speed of computer networks increase, so do demands for higher levels of interaction that include voice, graphics, and video exchange in real-time. This growing trend toward richer communications via computer is known as Internet Conferencing." (Microsoft)

The hardware, software, and Internet connections are now available to provide a complete Internet conferencing solution such as DVC. DVC incorporates the use of desktop cameras and software that can provide an adequate environment to perform remote, synchronous tutoring for deaf and hard-of-hearing students. A survey of NTID students, faculty, and staff determined that the DVC video by itself was found to be too slow for fluid sign language communication. When the DVC video was combined with Microsoft NetMeeting's other features, however, the total package was found to be an excellent communication and instructional tool.

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