The Technologies Used in the Virtual Harlem Project

James Pyfer

The Virtual Harlem project is a collaborative effort between geographically dispersed classrooms. By utilizing contributions from various academic disciplines that include computer science, communication, English, history, and art, the project has become a fascinating and enriched educational phenomenon. Three advanced technologies help fuel the comprehensive project by offering an immersive virtual reality environment that simulates Harlem, N. Y., highly developed audio and visual equipment that permits classrooms to communicate over distances, and a specially designed website that creates a commonplace for course activity. Taken collectively, the Virtual Harlem Project employs a series of computer and communication technologies to facilitate greater learning.

CAVE

One enters into a dark and enclosed room at the Electronics Visualization Laboratory at the University of Illinois at Chicago and will be quite amazed by a high tech virtual reality. Fitted with special 3D glasses and a unique joystick, students are immersed in a recreated graphical environment that was once 1920's Harlem, New York. The environment is comprised of three large screens that enclose the student with projected video and graphics. While the student stands with peripherals in hand, residents can be seen moving up and down the streets, standing on corners, and enjoying entertainment. Individuals can use the joystick to explore the environment and interact with virtual tour guides. The most impressive experience is encountered when entering through the doors of the Cotton Club where Cab Calloway can be seen performing. The environment that represents Virtual Harlem is comprised of several interconnecting technologies that work harmoniously to provide an enriched atmosphere of sound, motion, and graphics to the user.

The most thrilling component of the Virtual Harlem project involves the use of a computer automatic virtual environment (CAVE). Originally developed at the University of Illinois at Chicago, the CAVE is a virtual reality environment that enables computer software to communicate with various computer hard-

the CAVE
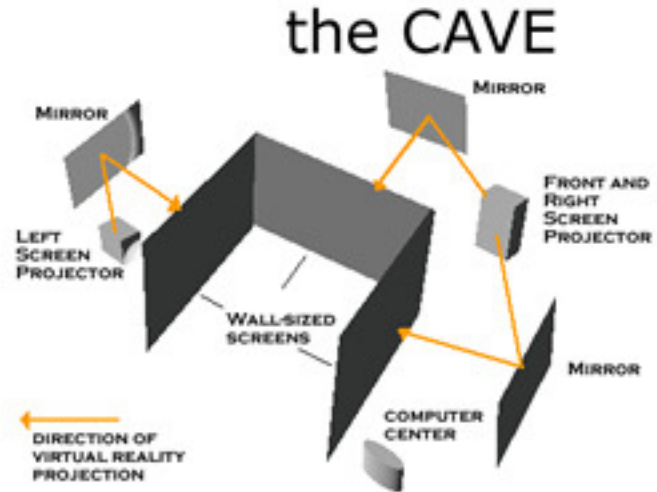
A 3 dimensional blueprint of the CAVE and its components - mirrors, projectors, screens, and computer center

ware components, rendering displays of 3D representations of virtual content to immersed users. The CAVE offers students an opportunity to experience highly enriched images via special 3D glasses. Created as an alternative educational environment, the CAVE serves as a highly developed instructional technology by allowing interaction between the student and virtually represented content that would otherwise be difficult to reproduce.

The CAVE utilizes five major technology elements to bring the highly graphical environment to life. The first major component delivers the video, graphics, and animation to the user, consisting of three wall-sized screens, four high quality projectors, and four corresponding mirrors. The second set of technologies are peripherals that permit viewing, control, and interaction within the CAVE. The third major part of the environment is the inclusion of specially designed sensors that acknowledge movement of the head within the CAVE and change the perspective of the user within 1920's Harlem. The fourth element consists of a computer control center that opens the Virtual Harlem environment and enables sound levels to be manipulated. Finally, the CAVE system is complete with a large network tower that connects the myriad of wires to all corresponding technology components, thus enabling the complex set of equipment to work together.

The CAVE experience is enriched through the simultaneous display of 3D content that projects out from all of the screens. The three large screens encase the front, left, and right sides of the student, creating a sense of closure that adds to the sense of immersion. The front and right screens of the CAVE display the front and right perspectives of Virtual Harlem, supplied by high quality pro-

jectors in back of the screens (figure 1a). In addition, the left projector (figure 1b), as well as a floor projector, display the left perspective scenes and cobblestone ground. The projectors are hidden from site and use mirrors to bounce the images through the back of the wall-sized screens, rendering viewable scenery to visitors. The use of mirrors helps to correct confinements in space, which would otherwise restrict the placement of the projectors, and creates a simple interactive experience by removing the producing technologies from view. With content now on the screens, by using the peripherals that control movement within the environment, visitors are immersed in

Figure 1a: front and right screen projectors.

Figure 1b: left screen projector

a cityscape.

The 3D glasses and joystick (figure 2a) are employed to further engage the user within Virtual Harlem. By wearing the 3D glasses, depth is added to the scenery providing a sense of reality by enabling objects and people to appear off of the screens and in front of the student. The joystick offers mobility to the user by facilitating a means to move in all directions. In special instances the joystick can be used to interact within the environment, such as picking up and carrying objects around the city. Used collectively, the eyewear allows students to see people, buildings, and objects that appear when navigating down streets and into theaters via the joystick. Furthermore, the 3D perspective reveals an avatar (graphical representation of the interacting user) within the environment. For instance, the students can look down to see a graphical portrayal of their arm and hand moving in sync with the joy-

figure 2a: the CAVE peripherials - joystick and 3d glasses

Figure 2b: a CAVE user with onlookers

stick. [Figure 2b].

One of the more complex technologies employed within the environment is that of the motion sensors. The motion sensors, dubbed Flock of Birds, sit atop of the three screens (figure 3a) and relay information to the processing computer via hubs (figure 3b). The sensors recognize movement of the head and instruct the projectors to display the directional perspective of the immersed student. For example, if a student is currently viewing the distant south side of Virtual Harlem and decides to look east, the scenery will adjust to present the previously unviewable east side of Virtual
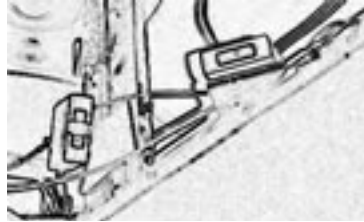

Figure 3a: motion sensors that capture head movement

Figure 3b: motion sesor hubs

Harlem to the user.

The fourth component, the computer control center, serves as the brain of the CAVE system. The computer control center (figure 4) houses the Virtual Harlem program, processes the display of the environment, and can manipulate sound levels that emit within the 1920's Harlem. The computer control center works in conjunction with the fifth component, the wire-networking hub. The wire hub (figure 5) acts in a similar manner as the nervous system of the body

Figure 4: the computer control center

Figure 5: the wiring hub

by connecting all of the crucial elements of the CAVE together. The countless wires each connect one technology device to the entire system, enabling all CAVE components to work concurrently.

The Virtual Harlem Project

becomes a sensory enriched educational environment for students through use of the CAVE. Each element of the virtual reality scenario is critical to its functionality and adds uniqueness to the experience. Four projectors bounce scenery off of mirrors, through the back of the screens, to display left, right, front, and ground dimensions of the environment. The 3D glasses provide depth to the students' perception, as well as allow the illusion of objects and people moving off of the screens. Exploration within Virtual Harlem becomes possible through the joystick and its interactive abilities. The Flock of Birds sensors detect movement from the user's head to create a seamless perspective shift on the wall-sized screens. In addition, the control center serves as the mediator of the environment, instructing the various technology elements to work conjunctively. Finally, the system becomes complete with the connection of all the equipment's wires. Collectively, the technology works in harmony to immerse students within the exceptional graphical representation of the city of Harlem, New York more than 80 years ago.

The CAVE amalgamates complex computer technologies to work together in order to produce a highly sensory appealing adventure. The next technology used within the project offers a means of enriched communication. The videoconference room enables students and professors to work together on the Harlem Renaissance, regardless of their locations.

Videoconference Room

An additional technological component of Virtual Harlem is the videoconference room. The room is comprised of five crucial elements that function collectively to facilitate long distance communication. Advances in picture quality and data transmission speeds have permitted audio to be coupled with video and shared in a real time fashion between classes. In a manner similar to the way a telephone allows conversation to be shared between individuals, the videoconference room improves communication by permitting an entire classroom of students to converse and view remotely located classrooms of students. The videoconference room aides communication between classrooms through technologies that capture, send, and receive the audio and visual makeup of the room. The room contains three plasma television screens, a video camera, a microphone, a control center computer, and seats for the students to sit.

The three plasma television screens (figure 6) are flat and large in size. Each screen is capable of displaying different video streams or images depending on the preference of the instructor. For example, one screen can display the video of the students received from the remotely located classroom, while the second and third screen can display the contents of a presentation given by the distant connected classroom, and the video of the students captured by the local classroom. In addition, each screen is able to display multiple types of content concurrently (figure 6a). The plasma television

screens are designed to exhibit video and images at levels of high resolution and quality that are clearly viewable. As mentioned above, the screens can display the content supplied from local or far-away locations, however a video camera is first needed to

Figure 6: three plasma screens sit at the front of the room

Figure 6a: different content shown on each screen

record the actions within the rooms.

The video camera (figure 7) captures the activities of the classroom much like a camcorder does. It possesses similar features to a traditional camcorder such as zooming technology, but it differs in its ability to respond to the environment. The video recorder used in the videoconference room is motorized, allowing its lens to rotate in directions around the room. In addition, the camera can be used in sync with the microphone (figure 8) to focus in directions where sound is emitted. For instance, if a student located in the left side of the classroom begins speaking, the camera with focus on that area of the room and then automatically rotate to focus on a student responding from the right side of the room. Once the camera begins recording activity in the room and the microphone picks up the sound, it is processed and transmitted

Figure 7: the motorized video camera

Figure 8: the directional sensitive microphone

through the control center computer.

The control center computer (figure 9) uses software to control the video and data transmissions between locations. The computer is capable of manipulating which video is displayed on which screen. In addition, the computer regulates the flow of digital information by sending captured video and sound to the remotely located classroom. For instance, the control center creates a connection over high-speed networks to other control centers. The

high-speed network permits the bulky-sized data created by the camera and microphone to stream smoothly and quickly across distances. Once the data is sent, it can be received in real time – enabling communication to occur much like it would if two classes were conversing in the same room.
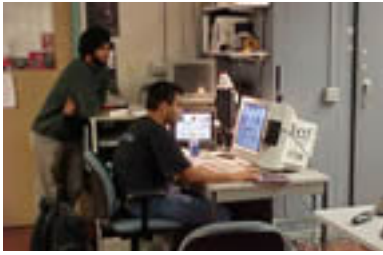

Figure 9: the computer control center

Videoconferencing enables participants to engage in communication from remote locations via high-speed computer networks. Advanced technologies enrich the collaborative experience by transmitting audio and video between sites in real time. A motorized video camera captures action within the room while a microphone records sound and directs the camera lens. The produced video and sound is manipulated and broadcasted between locations through the control center computer while media content is displayed upon the plasma televisions. Taken collectively, the technologies employed within the videoconferencing room allow geographically dispersed classrooms to collaborate on Virtual Harlem. The next technology used within the Virtual Harlem project acts as central location for coursework. Established as a virtual presence, the CourseInfo website allows students to find, collect, and share information regarding the Virtual Harlem project.

CourseInfo

Another significant technology of the Virtual Harlem Project enables classroom materials to be shared and used by students. A web-based program called CourseInfo, incorporates classroom activity and organization on the Internet. This technology was developed by Blackboard, Inc. (http://www.blackboard.com) to foster participation and structure within the classroom. Acting as a central hub of information, CourseInfo can be accessed via web browsers to notify students about assignments and deadlines, as well as recent announcements. The customizable web site can be constructed to the preference of the professor, allowing almost any content to be displayed or accessed by a uniform resource locator (URL or web address).

The CourseInfo website serves as an electronic supplement for Bryan Carter's English 4680 class: African American Literature. This acts much like a syllabus with hypertext links to actual readings and quizzes. The Central Missouri State University based class, as well as other participating classes, can view classroom content from any location that has access to the Internet. While the electronic instructional supplement offers information geared toward African American Literature, it also offers several tools that the stu-

dents can use to communicate with each other.

The CourseInfo website is designed in a frames setting that permits a navigation bar to be displayed simultaneously along side linked content. The navigation bar (figure 10) lists the categories of the class content. In the example of English 4680, students can view announcements, course information, staff information, course documents, assignments, communication tools, external links, and student tools. Each link corresponds with a secondary set of links that becomes viewable in the right frame of the browser window (figure 11). Each link within the website serves a critical function.
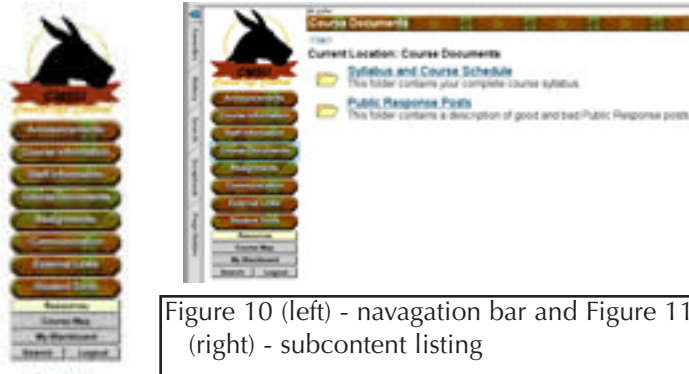

Figure 10 (left) - navagation bar and Figure 11 (right) - subcontent listing

The first link on the navigation bar allows the professor to post announcements. Once clicked, the announcements from the last two weeks appear by default. The second link directs users to the course information. Here students can view general information about the class, the course goals, materials, grading policies, study exams, and surveys. The third link offers such contact information as office hours, email address, and phone number of the professor. The fourth link, course documents, is comprised of the syllabus and course schedule, including public response posts that allow students to make comments on their readings. The fifth link directs users to the assignments page where students can view a printable HTML (hypertext markup language) document of instructions and due dates.

The communication center can be accessed via the sixth link (figure 12). The communication center enriches the collaborative efforts within the classroom through six tools. Here students can send e-mail to each other or the entire class. A student roster allows users to see the names and email addresses of all participating students. A discussion board is used by students to share comments, questions, and ideas regarding the course readings and activities. The discussion board acts much like an electronic tack board. Students post text and reply to text that can be viewed by others in the class. A virtual classroom tool permits student to chat with each other in real-time. A student pages tool allows class members to view each other's personal websites. A group pages

tool works in a similar manner to the student pages. If class members were to form groups, they could view and publish materials here.

Figure 12: the communication center links

Figure 13: the student tools

The seventh link on the navigation bar directs users to a list of external links. This may serve as an electronic bibliography to additional electronic content. Professors can publish links to various website articles or pictures here. The eighth and final navigation link directs users to the student tools. Students are then directed to a subcategory listing of the six student tools (figure 13). The student drop box can be used by individual students to receive information or feedback from the professor. Another tool allows students to change their personal contact information by clicking the "change your information link". Students can also construct personal web pages through the "edit your homepage" link. A calendar can be accessed through the student tools, permitting individuals to input information into their personal calendar. There is also a link to a student manual that describes the functionality of the CourseInfo program. The final student tool can be clicked to show individuals their course grades and progress through out the semester.

Comprised of course content and communication tools, the CourseInfo website enables students to participate in an enriched electronic environment. Two design features include a navigation bar that remains viewable in the left window frame while subsequent links are listed in the right window frame. The website is accessible by remotely located students and serves as a central collaborative point. This technology is yet another component that contributes to the Virtual Harlem Project.

Each technology component presented here contributes to a robust and comprehensive Virtual Harlem project. The CAVE is a virtual reality environment where students can experience 3d graphical representations of 1920's Harlem, New York. The video-conferencing room allows visually enhanced communication between remotely located classrooms. In addition, a course website creates a common virtual location for students of the class to exchange ideas and complete assignments. Overall, the Virtual Harlem project merges the work of otherwise independent disciplines to produce a unique, high tech learning experience.