



Andrew Johnson and Jason Leigh
University of Illinois at Chicago

Bryan Carter
Central Missouri State University

Jim Sosnoski and Steve Jones
University of Illinois at Chicago

Virtual Harlem

In the early 1900s, particularly in the 1920s, African-American literature, art, music, dance, and social commentary began to flourish in Harlem, a section of New York City. This African-American cultural movement became known as The New Negro Movement and later as the Harlem Renaissance. The Harlem Renaissance transformed African-American identity and history, but it also transformed American culture in general. Never before had so many Americans read the thoughts of African-Americans and embraced their African-American community's productions, expressions, and style.

We wanted to convey the importance of this movement to students. We therefore developed Virtual Harlem,¹ a collaborative virtual reality (VR) tour of Harlem in which participants can travel back 80 years to see and hear historical figures, speeches, and music from that period. We designed it to help students experience the neighborhood's life and culture on both visual and critical levels. (For a description of what it's like to be immersed in Virtual Harlem, see the sidebar "Virtual Harlem Experience.")

Virtual Harlem is a learning environment that lets students experience the Harlem Renaissance of the 1920s and 1930s as a cultural field trip.

Development

Bryan Carter originally conceived the Virtual Harlem project in 1998 at Central Missouri State University. He initiated the first prototype with Bill Plummer at the Advanced Technology Center at the University of Missouri. This version was shown at Siggraph 1999.² A year later, the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago (UIC) translated the Harlem experience to a fully immersive environment—the Cave Automatic Virtual Environment (CAVE).

We built this new version of Virtual Harlem on top of a high-level VR scripting framework called Yggdrasil.³ Yggdrasil is written in C++, on top of SGI's Iris Performer graphics library, CAVELib VR library, and the Cavern-Soft G2 networking and collaboration library.⁴ It's focused on building the behaviors of virtual objects from

reusable components and on sharing an environment's state through a distributed scene graph mechanism. Yggdrasil constructs dynamic and interactive virtual worlds, so in addition to the basic graphical data used in

Virtual Harlem Experience

As you step onto the streets of Virtual Harlem, a trolley car full of people passes by, moving through a street filled with Model-Ts. Straight ahead, the Lafayette Theater is an obvious attraction, with an all-black cast playing in the version of *Macbeth* produced by Orson Welles. You can hear the sounds of dogs barking in the street and people laughing and walking by. Taking the trolley and getting off at the LaFayette stop (Figure A), you can hear a portion of *Macbeth's* infamous monologue as he holds his bloody dagger, while the cast practices during the day.

Taking the trolley is the fastest way to get around Harlem, but walking will take you into the clubs to watch live performances of jazz, blues, ragtime, and classical music. The Bamboo Inn, home of jazz improvisation, and the Corner Bar, which was an interracial club, are among the many establishments and visible landmarks. Walking through the streets by day, you notice the entrepreneurial life of the city streets. You can pass street vendors selling their wares, and as you approach one, he will start to call out his jingle, "the meat pie man is a mighty fine man." These jingles or street chants were a popular form of entertainment and are the origin of the commercial jingle. Walking also lets you explore Harlem's alleyways, where you might happen upon two men playing checkers or telling *hoodoo* stories (the US version of voodoo) and involve the sharing of herbal recipes, love potions, trickster tales, or other kinds of spiritualisms. As students hear these stories, the instructor can tell them of the history of hoodoo as a kind of folklore developed by slaves to accommodate their new surroundings.



A Virtual Harlem is a reconstruction of 10 square blocks of Harlem, New York in the 1920s and 1930s. Visitors can either walk or take a trolley around the area.

You can also pass the Peace Mission of Father Divine, a cult figure who was enormously popular on the Eastern Seaboard and the West Coast for more than five years. As you pass, you can hear Father Divine describing himself as the “Lord God in bodily form” as the followers cry out, “peace be to Father Divine.” Nearby is the largest African-American church of the time—Abyssinia Baptist Church—where you can hear the Reverend Adam Clayton Powell deliver a portion of the *Creation* sermon as recorded by the poet James Weldon Johnson.

But the most exciting time to be in Harlem is at night, and students (or teachers) may choose when night will fall in Harlem, after they have had enough of the daytime sights. At night, the city comes alive with the flashing lights of marquee signs and the faint glow of the lampposts. You might choose where to go by reading the bills posted on billboards outside the bars, which we created from photographs of actual bills of the time period. You might instead stroll the streets, peering in windows to decide what interests you most. At the Nest Club, waiters are setting up for a fancy dinner, while across the street, people are eating at a more casual doughnut shop. Passing one club, you can hear Bill “Bojangles” Robinson tap dancing inside and reminiscing about the time that he tapped five miles down Broadway on his 60th birthday followed by more than 500 well wishers.

What most people want to experience, however, is Harlem’s famous Cotton Club, where African-Americans couldn’t enter as patrons. The gold- and wood-crafted doors of this club are unmistakable, and as they open, you have a sense of entering a world of wealth, exoticism, sensuality, and illusion (see Figure B). Designed to be reminiscent of old plantation life, the interior strikes you as a combination of the Old South and an exotic island jungle. There are palm trees everywhere, and the room is filled with laughing guests in evening gowns and tuxedos. If you stay long enough, the curtains will part, and actual footage of a filmed performance of the Duke Ellington Band will play on stage as dancers tap in the foreground as an introduction to singer Freddie Washington.

Virtual Harlem is an experiment in urban archaeology. We plotted out the surface of historical Harlem and created an immersive world from its topography. At various locations we dug deeper into its history to obtain a closer look at the



B Visitors to Virtual Harlem can walk inside the famous Cotton Club.

development. While some buildings are no more than facades to mark the space they occupied at a particular moment in history, we can explore others in more detail. As the project develops, you will be able to visit the Hot Cha Club where Billie Holiday got her start, or the famous Savoy Ballroom where dances like the Charleston and the Lindy Hop were popularized. Tonight, the Chick Webb Orchestra and the Jimmy Lundsford Band are playing in the “Battle of the Bands,” an all-night concert that goes on until one band quits or the sun comes up. You can stay and listen, or just watch dancers perform the Lindy Hop or the Jitter Bug. Small’s Paradise is nearby, where Langston Hughes frequently visited. Meanwhile, down the street, Myra Johnson is singing at the Apollo Theater as part of amateur night. What’s fascinating to show about the clubs in Harlem is the diversity of the clientele, from the “all-white” Cotton Club to the interracial men’s club called Barron’s Cabaret or the predominantly gay and lesbian audience of Edmund’s Cellar.



1 When a live tour guide isn't available to take visitors through Virtual Harlem, those visitors can walk through the streets and play prerecorded annotations. (a) Bryan Carter and Janice Lively rehearsing before recording an annotation in the CAVE. (b) An avatar appears on the street to reenact one of these annotations.

Performer, its scene graph nodes can have behaviors attached to them.

Another major enhancement we made to Virtual Harlem is the inclusion of an annotation tool. Annotations are typically used to highlight sections of text and make interpretive remarks to aid memory. We can similarly use annotations in a virtual world to highlight areas or events of interest that occur within the environment, letting students or instructors leave retrievable annotations throughout the virtual space.

Virtual annotations are recordings in VR that capture people's hand and head gestures, as well as their voices. When the annotations are played back, an avatar appears in the virtual world to reenact the annotation.⁵ All virtual annotations are saved in a persistent database server with headers that include the author's name, annotations name, time and date the annotation was left, and the location of the annotation in the virtual environment (VE). Thus, it lets users query the list of annotations by author name, region, or date.

In our current application, we place 3D avatar models in the VE to show the annotation's location and author. Users can listen to the annotations by placing their virtual hand close to this annotation marker. They can stop a virtual annotation any time while it's playing, or the playing of the annotation can fade out as users moves further away from it (see Figure 1). Users can record a new annotation anywhere in the VE, but only the annotation owner can remove it.

We showed this version of Virtual Harlem at I-Grid 2000 in a collaborative session between a CAVE in Yokohama, Japan; the Advanced Technology Center in Missouri; and a CAVE in Chicago. Students in Jim Hall's African-American Studies class at UIC acted as remote virtual tour guides for visitors to the CAVE in Yokohama, who asked them questions about the Harlem Renaissance. In late October 2000, the MOBE (Marketing Opportunities for Black Entrepreneurs) group of African-American business persons, whose convention

was in Chicago, held their conference opening reception at UIC to view Virtual Harlem.

Because Virtual Harlem is a large space and annotations can be left anywhere, we needed to create a tool to locate particular annotations—perhaps all the annotations left on a certain day, or left by a certain user, or left in the neighborhood of a particular place. We have found, over the past decade of developing CAVE applications, that 3D virtual menus are extremely difficult to operate for novice users, as it takes a high degree of dexterity to select menu items in 3D. For Virtual Harlem we chose to use a personal digital assistant (PDA) with a wireless local access network (LAN) connection to the CAVE—currently an iPaq Pocket PC.

The PDA provides two ways to access the annotations. First, it provides a list of all the annotations. Second, it provides a map of Harlem and the location of all the annotations. The list view lets students (or teachers) access the annotations by name, creator, or date/time. The map view provides feedback on where students are currently standing in Virtual Harlem and their location relative to the various annotations. Students who are proficient in navigating in the virtual space can use the CAVE's wand to move around. Alternatively, students who are less skilled in navigation can click on one of the annotations on the PDA screen and they'll be automatically shuttled to the annotation where it will begin to play (see Figure 2).

Because a CAVE is expensive, we wanted to provide a more economical way of experiencing Virtual Harlem without sacrificing the experience. As all the components of Virtual Harlem can run on a Linux machine as well as an SGI machine, we next ported Virtual Harlem to the AGAVE (Access Grid Augmented Virtual Environment, pronounced ah-gah-vay). The AGAVE⁶ provides passive polarized stereoscopic 3D graphics using low-cost projectors. Students wear inexpensive polarized 3D movie glasses to view the immersive content. We can incorporate an additional 3D tracking system and pointing device

to support 3D interaction or use a simple joystick or mouse. A complete AGAVE system without tracking costs \$15,000 with an additional \$10,000 if we use a good tracking system. The AGAVE was designed to augment the Access Grid (a multisite videoconferencing platform developed by Argonne National Laboratory) by letting immersive content be shared collaboratively over high-speed networks. (To learn more about Access Grid, visit <http://www.accessgrid.com>.)

In spring 2001, Jennifer Brody from UIC's African-American Studies department and Bryan Carter at Central Missouri State University coordinated their English literature courses (The Harlem Renaissance at UIC and African-American Literature at CMSU) about the Harlem Renaissance. The courses met at the same time and the course syllabus and materials were shared between the two classrooms. The students and instructors interacted with each other through Polycom videoconferencing in the classroom, as well as in Virtual Harlem using the CAVE and the AGAVE (Figure 3). More details about this experience can be found elsewhere.^{1,7}

Learning about the Harlem Renaissance

A majority of colleges and universities around the nation offer courses in African-American studies. These are usually taught as surveys, representing a broad time span. Students who take courses in a number of departments may be exposed to a correlative number of political movements, artists, historical events, and personalities. More often, students take only the courses in their own departments and thus miss significant aspects of African-American culture because of the length of the period that must be covered within a semester. To compound this problem, students are usually enrolled in large lectures and required to complete an exhausting amount of reading during the semester.

With all these constraints, current instructional practices often reinforce the passive learner mentality that students learned in secondary school. The frustration that students sometimes have because of the way large survey classes are scheduled is increased when they're asked to research on the Web and find the task daunting even if they have easy access to the Internet. For exam-



2 While visitors tour Virtual Harlem they can see a map of the area and their current location on a handheld device. The device also shows the location and information about all the annotations, letting the visitor instantly move to any place in Virtual Harlem and play the annotation there.

ple, there exist hundreds of search engines with links to sites pertaining to African-American culture—and a dazzling number of Web-based resources may or may not be valid from a research viewpoint. This can make students' experience of the Harlem Renaissance disjointed and fragmented.

The goals of the Virtual Harlem project include the development of materials that incorporate advanced visualization and interactivity techniques to facilitate greater comprehension by integrating and contextualizing a period or a text. Instead of experiencing the Harlem Renaissance as a tangle of information, students experience it as a kind of field trip to a cultural past where various figures and artifacts fit into a setting as familiarly coherent as the settings of their daily lives. By incorporating VR technology into their courses, project members recreate the historical setting of the texts they're teaching. Hence, they can supplement the humanities content with realistic images, music, speeches, and so forth.

One of the primary reasons for incorporating VR in



3 (a) Jennifer Brody's Harlem Renaissance class at UIC interacts with Virtual Harlem on the AGAVE screen, and (b) Bryan Carter's African-American Literature class at Central Missouri State University through a Polycom videoconferencing system.



4 Virtual Harlem isn't simply an architectural reconstruction. Visitors can meet and hear important people such as (a) Marcus Garvey as well as everyday people on the streets. (b) A visitor meets Langston Hughes in the CAVE.

humanities curricula is to engage students on a visual and critical level. Students can better understand and evaluate a historical movement like the Harlem Renaissance within African-American culture when they enter into a realistic simulation of the environment that inspired the artists, educators, musicians, authors, politicians, and economists they're studying. Through simulation, educators can encourage students to explore the formation of multiple meanings from experience, effectively demonstrating the concept of the social construction of reality.⁸ The cross-disciplinary aspect of this VR project encourages students to explore relationships within a particular period even though independently taught courses in its music, art, literature, psychology, and history are their primary information sources.

Learning with Virtual Harlem

We believe that learning environments such as Virtual Harlem provide settings wherein students have the opportunity to be both critical and creative. Students can walk down the streets of Harlem and see the shops, homes, theaters, churches, and businesses the writers of that period experienced in their daily lives. They can hear the music of the time, listen to political speeches of figures like Marcus Garvey, or enjoy a poetry reading by Langston Hughes. This experience augments the materials that are available to the students in the form of books, photographs, audio recordings, or film. Unlike conventional subject matter, Virtual Harlem is a locale that has to be experienced, albeit virtually, as if you were a tourist visiting Harlem via a time machine.

The quality of any tour is often based on the quality of the tour guide. If Bryan or another expert in the Harlem Renaissance is physically present, then he can lead a group into the CAVE and take them on a tour of Harlem pointing out the interesting features, meeting the various figures in the environment, making comments, and prompting for questions. If an expert isn't present, but is available at a site with compatible hardware and a good network connection, then he or she can lead the same kind of tour as an avatar with a real-time audio connection. Because experts aren't always available, we've also

recorded Bryan and others (using the annotation system) talking and gesturing about the various important locations and people in the space. For the students' first exposure to the space, we prefer to use a live, in-person tour guide (preferably their course instructor) so that the students aren't overwhelmed by the technology. However, first-time visitors are still often more engaged by the technology than by the content. It's important to give the students multiple opportunities to explore the space at their own pace so the technology fades into the background and the content comes to the foreground.

Any view of the past is an interpretation. We don't claim that Virtual Harlem offers a real experience of the past; it's an interpretation that engages students through lived experiences that model the past. These virtual experiences aren't actual experiences but they do engage the visitors cognitively in a way that elicits emotions and psychological reactions.

We want Virtual Harlem to be much more than a reconstruction of the physical environment of Harlem. We want the students to learn about the lives of famous people of the period as well as the regular people. To do this, we recruited creative writers to provide dramatic presentations of the history of the Harlem Renaissance. We built scripts of daily life into the presentation to dramatize the historical events, and then actors act out these scenes, which the annotation system records. Students can then interact with figures that live in Virtual Harlem and whose character and behavior are as historically accurate as we can make it. Although such experiences are fictive by definition, the dramatizations are governed by an effort to interpret what it felt like to live in Harlem during the 1930s and to encounter the many great artists who worked there (see Figure 4). Students' own interpretations can be elicited by educators using Virtual Harlem as a teaching tool, discussed and debated among students, and further examined and analyzed in comparison to the histories and analyses of Harlem already extant.

Admittedly, this is an unconventional form of history telling. However, we're making every effort to give students an experience of the past that matches scholars'

interpretations. The governing genre in this endeavor is history, not fiction. The fictive elements arise from the absence of video or audio documentation. Whereas it's possible to write sentences such as "residents of Harlem could purchase the *Crisis* at a local newsstand, a dramatization of that event requires a specific figure to approach the news stand and ask for a copy of the *Crisis*. Because we don't have photographs of that event or recordings of what was said, that figure in Virtual Harlem can't represent an actual person who lived in Harlem at the time. Yet, dramatizing the historical generalization (residents purchased the *Crisis* at local newsstands) doesn't entail the genre of fiction. That is, the choices about how to represent Harlem are rooted in historical, rather than fictional, narrative.

We also want to strongly encourage the students to contribute materials to augment Virtual Harlem. The students can imagine that they're writers or artists in the Harlem of the 1920s or 1930s and create a poem, political speech, piece of music, painting, or photo of their own and add it to Virtual Harlem for others to see. The students not only do interdisciplinary research on the time period but also see its results incorporated into Virtual Harlem itself, providing new dimensions to their understanding of the Harlem Renaissance. We anticipated that by placing users in the context in which a work of art or literature was created so that their research will be more comprehensive. We also hoped that from students' interaction with and contribution to Virtual Harlem they'll begin to learn to interrogate history and historiography.

Once students experience Virtual Harlem they're encouraged to form their own opinions on the things they saw and heard in the VE and leave their own annotations upon which other students can further comment. A key goal of these virtual annotations is to provoke this kind of feedback loop. Through this process, students and instructors can spur discussion and debate in the classroom or in the VR world. Another feedback loop can be created for students who contribute materials to Virtual Harlem. By observing others' interactions with the environment, they can learn about interpretation and learn to better direct their creation of future contributions to Virtual Harlem.

Current plans and future work

An important aspect of the project is that it produces many versions of Harlem, allowing for alternative views of Harlem during its renaissance. Constructing *the definitive* Harlem isn't our goal. Instead, we want to show Harlem's past as one that has been constructed by its citizens and display the variety of perspectives that have been used in interpreting the Harlem Renaissance. Each perspective is, in effect, a comment on other perspectives. Each requires a defense, which makes explicit the points of view involved. It's important to recognize that we can easily move from one model to another in an electronic environment. We can, technically speaking, go on demand from daytime to nighttime, or from the 1920s streetscape to the 1930s streetscape to Harlem in 2001. Similarly, we can move from the rather sanitized Harlem of the present construction to a seedier version

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of Harlem. Such multifaceted perspectives built into Virtual Harlem will eventually allow the construction of particular interpretations of the Harlem Renaissance by showing what they emphasize, include, and exclude. A multivalent model of Harlem is the ultimate goal of the Virtual Harlem project.

Currently, Virtual Harlem consists of roughly 10 square blocks of Harlem. Virtual Harlem's environment isn't, at this point, an exact replica of the Harlem landscape. Many of the cultural landmarks such as the Savoy Ballroom, the Apollo Theater, and the Theresa Hotel weren't within easy walking distance, so they were moved closer to each other. We plan to revise the current environment to move the buildings back to their correct locations.

Virtual Harlem is an amalgamation of several different years during the Harlem Renaissance and not a true representation of any particular date. We plan to show the historical changes in Harlem from the 1920s to the mid-1930s through a series of cityscapes set at more specific time periods. We intend to show the periods within the Harlem Renaissance that correspond to those changes by indicating the development or demise of movements and periodicals, the migration of artists and musicians, and the changes in the character of the neighborhood.

We currently use a PDA to give random access to the various annotations in Virtual Harlem. We'd also like to use larger hand-held devices, such as tablets, as auxiliary displays within Virtual Harlem. This would give the user better access to printed materials and supplemental information while touring Virtual Harlem. For example, if users hear Marcus Garvey giving one of his speeches on the street, we can simultaneously make the entire text available on their tablet.

Presently, all the visitors to Virtual Harlem are treated the same, even though people in Harlem at that time weren't all treated the same. During the Harlem Renaissance, blacks reconfigured themselves by passing as whites. In the future, Virtual Harlem will let users choose who they will be in the virtual world and the characters in the virtual world will react according to their chosen race, sex, and occupation.

The people that you meet in Virtual Harlem are either static 2D images taken from photographs or articulated avatars created through the annotation system. The articulated avatars use static texture-mapped faces. However, we're now moving toward using video avatars⁹ in the next version that will map prerecorded video onto the heads of the avatars to improve the realism.

Virtual Harlem is a work in progress. For further information please visit <http://www.evl.uic.edu/cavern/harlem>. ■

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References

1. J. Sosnoski and B. Carter, eds., *Works and Days 37/38* (special issue on the Virtual Harlem Project), vol. 19, nos. 1 and 2, fall 2001.
2. B. Carter, "Virtual Harlem," *Proc. Siggraph 99 Conf.*, ACM Press, New York, 1999, p. 103.
3. D. Pape, *Composing Networked Virtual Environments*, PhD dissertation, Dept. of Computer Science, Univ. of Illinois at Chicago, 2001.
4. K. Park et al., "CAVERNsoft G2: A Toolkit for High Performance Tele-immersive Collaboration," *Proc. ACM Symp. Virtual Reality Software and Technology*, ACM Press, New York, 2000, pp. 8-15.
5. T. Imai et al., "Overcoming Time-Zone Differences and Time Management Problem with Tele-Immersion," *Proc. Int'l Networking Conf. (INET)*, 2000, CD-ROM.
6. J. Leigh et al., "AGAVE: Access Grid Augmented Virtual Environment," *Proc. Access Grid Retreat*, 2001.
7. K. Park et al., "Distance Learning Classroom Using Virtual Harlem," *Proc. 7th Int'l Conf. Virtual Systems and Multimedia (VSMM 2001)*, 2001, pp. 489-498.
8. P. Berger and T. Luckmann, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*, Doubleday, Garden City, N.Y., 1967.

9. V. Rajan et al., "A Realistic Video Avatar System for Networked Virtual Environments," *Proc. Immersive Projection Technology (IPT)*, 2002, CD-ROM.



Andrew Johnson is a member of the Electronic Visualization Laboratory and an assistant professor in the Computer Science Department at the University of Illinois at Chicago. His research focuses on educational immersive environments from elementary school through college, specifically how to integrate this new form of representation into the classroom and the curriculum.



Jason Leigh is a senior research scientist at the Electronic Visualization Laboratory at the University of Illinois at Chicago. His areas of interest include developing techniques for interactive, remote, visual data mining of terascale data sets over high-speed gigabit optical networks; developing techniques for supporting long-term collaborative work in amplified work environments; and scalable commodity graphics for large-scale immersive data visualization.



Bryan Carter is an assistant professor in the English and Philosophy Department at Central Missouri State University. His area of specialty is American Literature with a concentration in African-American Literature of the Harlem Renaissance. He has a secondary area of emphasis in visual studies. He received his PhD from the University of Missouri-Columbia.



Jim Sosnoski is a professor of communication at the University of Illinois at Chicago. He has published numerous essays on instructional technology, computer-assisted pedagogy, and online collaboration. Currently, he is working on configuring a study of virtual reality as a learning environment.



Steve Jones is a professor, head of communications, and research associate in the Electronic Visualization Lab at the University of Illinois at Chicago. He also serves as a senior research fellow for the Pew Internet & American Life Project and is cofounder and president of the Association of Internet Researchers.