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REALITY© AND VIRTUAL REALITY©

When virtual and real worlds collide

This article examines and probes the possibilities of an intellectual property regime in virtual reality (VR). It uses the example of Virtual Harlem, a VR project that recreates the history of Harlem, New York, during the Harlem Renaissance of the 1920s and 30s, to question the nature of, and need for, intellectual property protection in VR. It also discusses the consequences of existing intellectual property laws for projects such as Virtual Harlem that rely on multiple elements of intellectual property (audio and visual, but also trademarks and architectural plans and buildings). The crux of the issues expressed in the article reside in the increasing blurring of the boundaries between the real and the virtual. The argument is made that it is not too soon, nor too late, to use virtual environments like Virtual Harlem as a wedge with which to begin a reconsideration of intellectual property schemes in virtual reality. It should not be a given that existing schemes, originating and evolving in the non-virtual world, should automatically apply in virtual worlds.

Keywords virtual reality; VR; intellectual property; virtuality; Harlem

Can intellectual property exist in virtual reality? In those instances when virtual reality is constructed to imitate reality, which, if any, intellectual property laws should apply?

Those two questions have arisen in work related to the Virtual Harlem project and similar projects that seek to use virtual reality (VR) to recreate, study, and/or teach about cultural heritage and history. They will also come to the fore as virtual worlds (persistent ones in particular, ones people continually visit and re-visit) increasingly become a part of the digital leisure experience, a process that already has been occurring with various online and networked game environments. Unless we come to a better understanding of individuals' investments (of affect, time, labor) and experiences in VR, it is likely that intellectual property in it will mirror the existing copyright regime with all its consequences for creativity, communication, and work. The result is likely to be a virtual reality constrained by the same commercial and legal forces as the non-virtual world.

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Unlike its literary and filmic counterparts, the type of virtual reality (VR) discussed in this essay is not a figurative one or a fictitious one, nor is it one constructed from or with the aid of the imagination. Popular definitions of it (Elmer-Dewitt, 1995) do not apply. It is not analogous to 'cyberspace,' nor is it 'where you are when you are on the phone'. It is not a 'consensual hallucination'. It is not a textual reality produced by the exchange of text messages. It is instead an immersive virtual environment first given technological form with invention of the CAVE (CAVE Automatic Virtual Environment) in 1991 (Cruz-Neira *et al.* 1993). The CAVE's inventors distinguished it from the more common representations of VR:

> Howard Rheingold defines virtual reality (VR) as an experience in which a person is 'surrounded by a three-dimensional computer-generated representation, and is able to move around in the virtual world and see it from different angles, to reach into it, grab it, and reshape it'. [We] prefer a definition more confined to the visual domain: a VR system is one which provides real-time viewer-centered head-tracking perspective with a large angle of view, interactive control, and binocular display . . . . The CAVE, like Omnimax, represents a different visual paradigm: inside out instead of outside in.
>
> (Cruz-Neira *et al.* 1993)

Perhaps the simplest way to describe the type of immersive VR CAVE users experience is to say that it is as close to the 'Holodeck' popularized in the television series *Star Trek: The Next Generation*.

An interesting footnote in the history of the CAVE's development is that its inventors gave it a recursive acronym in part whimsically, but also in part because they wanted to make 'reference to 'The Simile of the Cave' found in 'Plato's Republic,' in which the philosopher discusses inferring reality (ideal forms) from projections (shadows) on the cave wall' (Cruz-Neira *et al.* 1993). The christening of the CAVE by way of a connection to Plato also connects the CAVE to one of the fundamental debates about copyright in the digital age: What is real, and what is a copy? As digital media technologies gradually (but increasingly) supplant their analog counterparts in the spheres of production, distribution, exchange, and consumption, these debates have intensified. Whether it be in the realm of music and sound (as in the case of audio sampling), in the realm of the visual image (as in the case of Andy Warhol's visual appropriations), or in the realm of network technologies and the internet (as in the case of Napster and peer-to-peer file sharing), questions concerning authorship and originality continue to vex the legal, commercial, and art worlds. Developments in VR promise to take further the technological and intellectual property issues with which we have been grappling ostensibly since Plato's time.

This essay will begin with an overview of the Virtual Harlem project and of some of the key issues related to intellectual property that have arisen during and after its development. With that as background, it will then discuss the singular characteristics of immersive virtual reality in relation to intellectual property. The deployment of intellectual property as a means of aural and visual control involves it in attempts to deploy particular 'versions' of material reality and/or history. In most instances intellectual property is believed to be valuable in relation to future, anticipated uses. Copyright, patent, and trademark holders are as much, probably more, interested in using the rights they hold to earn royalties from future uses of a creative work or invention as they are in using those rights to prevent others from using their work. In the case of Virtual Harlem, however, intellectual property is particularly valuable for its link to the past, and in conclusion it will be argued that in VR intellectual property in its present legal configuration cannot, and should not, account for new forms of creative work, many of which arise from the experience of VR without intent to be 'creative'.

Virtual Harlem

Virtual Harlem was conceived by Bryan Carter at the University of Missouri[1] as an attempt to employ virtual reality (VR) technology to build a re-creation of Harlem, New York, during the neighborhood's Renaissance of the 1920s and 1930s. Virtual Harlem's goal was to provide a visual context to the existing histories, literature, and music of the Harlem Renaissance, so that students might understand something of the physical environment in which the literature and music were created. By seeing and interacting with the environment and characters within it, Carter hoped students would gain additional insight into the works and into history. Carter also was hoping that students would become interested in the technology and contribute to Virtual Harlem by adding images, sounds, and interactive elements.

Virtual Harlem was originally built as a '2D' environment using the common Virtual Reality Markup Language (VRML), to make the environment accessible via the Web. In 1998 Carter's work came to my attention thanks to my colleague at the University of Illinois at Chicago, James Sosnoski. It was immediately clear that Virtual Harlem was suited to a 3D immersive VR environment, and I enlisted colleagues in the university's Electronic Visualization Laboratory (EVL) to assist with its re-creation in the CAVE® Automatic Virtual Environment.[2] The lab had recently engaged in VR cultural heritage projects (*Shared Miletus*, a tour of an ancient Greek city, and *Silk Road Cave Shrines*, a tour of caves along the ancient Silk Road), but there had been no project to that time involving more recent history.

FIGURE 1 A typical daytime street scene in Virtual Harlem.

Carter and others began using Virtual Harlem in courses on African-American literature, regularly using the CAVE's networking capabilities to meet classes in Virtual Harlem's virtual world. The reception from teachers and students generally was positive, as were learning outcomes, and interest quickly developed in building virtual worlds based on other places' history; projects such as Virtual Montmartre, Virtual Bronzeville, and Virtual Hull House thus were planned. As collaborations began with scholars from various disciplines on those projects, issues began to emerge that directly engaged matters of intellectual property.

Fact and/or fiction, virtual and/or real?

One issue that quickly arose concerned the nature of virtual reality itself. Although it is 'virtual,' can it be, is it supposed to be, used for re-creating reality? Of course it could be, and a large part of the motivation for developments in VR research stems from efforts to make VR 'as real as real' (Hillis 1999). However, the more interesting examples of VR are those that use it to create entirely new or alternative realities. In Virtual Harlem's instantiation of the New York City neighborhood for example, to make it easier and quicker for learners to navigate from one important historical site to

another, a couple of buildings originally a few blocks apart were brought much closer together. Historians who became familiar with the project were, of course, aghast. But part of Virtual Harlem's reason for existence is learning, and allowing students to move quickly and easily between important historical sites was a consideration in the environment's design. Not only is the environment 'skewed' for that reason, but so too are the interactions. They can be randomized by adding some degree of artificial intelligence to them to correlate with user behaviors, or they can be scripted and standardized for every visitor, almost as if taking place in a museum. No matter the means by which they are made to occur, they remain by and large fictionalized accounts of the kinds of interactions that *might* have occurred in Harlem. There are no known recordings that illustrate well the everyday interactions that took place throughout Harlem in the 1920s and 1930s.

This fictionalization raises an important additional point. Unlike most any other medium, the crux of the experience of immersive virtual reality comes from its employment of a viewer-centered perspective. Three-dimensional scenes are drawn for the individual user based on her or his position within the CAVE and relative to the scene. In short, virtual reality is continually being drawn and redrawn in interaction with the user. Thus virtual reality, in this instance, is not pre-recorded reality (as might be the case in a movie, with its camera- or director-centered perspective). In immersive virtual reality it is difficult, largely impossible, to pre-record 'reality' and use it in a scene.

Indeed, it is important to recognize the difficulty in pre-recording (either video or audio) material for use in immersive virtual reality. Though one could take a 3D video and show it in a CAVE, to do so would result in little more than an IMAX-like film experience. 3D video certainly would not provide interaction with the environment; it would turn it into a more passive experience in which the visitor is simply shown images. Instead, in the CAVE the environment is continually re-drawn for the user, and this feature of immersive VR has consequences for how the technology should be understood as a medium in contrast to other media. For the moment, however, it is important to point out that by requiring environments to be composed of computer-generated graphics, immersive VR scenes like Virtual Harlem are literally and figuratively 'drawn from reality' for all intents and purposes. Unlike photographs or video recordings, which record and 'fix' light from a real environment, in the case of Virtual Harlem no capture of light is required. Instead a computer places pixels in the environment as instructed by the artists who created Virtual Harlem. The effect is similar to the technique of using a matte, such as in modern special effects filmmaking (the *Star Wars* and *Lord of the Rings* trilogies are excellent examples), in which an actor is placed before a screen (usually blue) and images are drawn later to surround the actor in the scene. In the case of Virtual Harlem, however, the actor is the user, and the

screen is not blue. Instead the images are drawn in real-time and in direct relation to the user's actions.

Copyright and photorealism

One might say that in the evolution of virtual reality development there can be found a spectrum ranging from 'real image' on one end to 'designed image' on the other, with points in between. On one end the work, the labor, that goes into the image, is largely that of those who capture the image with a camera. On the other end the work that goes into the image is largely that of the person who re-creates the objects drawn using artists' tools (whether paper-based or digital).

Cameras, still and motion, that take 3D images are available, and can be used to record images from which virtual environments can be built. Such images are in fact less useful than wire frames, however, because although they are photorealistic, they tend to be less interactive. That is, once the dimension of time is added to the dimension of space, the environment becomes more fixed than when it is anchored only to space. With a wire frame one can manipulate the object at will, as it consists entirely of data and is a computer-generated image. With an image captured by a camera the computer must break the image down into pixels, and re-interpret, manipulate, and re-express those for every interaction, for every moment the environment is changed. This creates obvious computational challenges (which can be overcome by faster computers, networks, graphics cards, and related devices) and it also creates constraints for environment designers who, no matter how fast a computer may be, are less easily able to tie contingent actions to environmental spaces.

As technological development has proceeded and computers have become faster, bandwidth greater, and graphics richer, it is entirely likely that, unlike in the present when most virtual reality environments are drawn and computer-generated, in the future photographed images (still or motion) will form the basis from which the computer will generate images. Already it is not difficult to take photographs and 'wrap' them around a wire frame, making them seem three-dimensional. That process, while technically different than audio recording, is nevertheless conceptually similar to taking a monophonic audio source and creating a stereo soundscape from it.

I use the audio analogy deliberately, for the development of the means of taking two-dimensional images and turning them into three-dimensional environments (and further turning them into images with which one can interact) will create vexing issues, perhaps akin to those that arose when audio and digital sampling became prominent musicians' and artists' tools in the 1980s. Indeed, were one to consider the means by which a photograph of a

building might be used as a texture to create its exterior 'skin' in a virtual environment, one would have a reasonably good visual analog to audio sampling. While architectural details and even blueprints can be, and are, copyrightable, US copyright code (Title 17, Section 120) specifically allows photography of architectural works:

> The copyright in an architectural work that has been constructed does not include the right to prevent the making, distributing, or public display of pictures, paintings, photographs, or other pictorial representations of the work, if the building in which the work is embodied is located in or ordinarily visible from a public place.
>
> (Copyright Law 2003)

Nevertheless this section of US copyright law has not precluded efforts by various public authorities to prohibit photography. In early 2005, for example, the Chicago *Reader* reported that the City of Chicago claims a copyright on public images in and of the city's new Millennium Park. The claim is based, the city said, on 'a licensing agreement with the artists that gives it the exclusive right to peddle images of Millennium Park. In other words, only the city gets to make a buck selling pictures of Millennium Park' (Joravsky 2005, p. 9). Terrorism and heightened security have amplified such concerns about photography and copyright in public settings. In early 2005 the Metropolitan Transit Authority of New York City proposed a ban on photography and video recording on property owned by the New York Transit Authority. The proposal claimed that a terrorist risk could be averted by such a ban. And in other cases building owners have resorted to trademark law to give back what copyright law had taken away, namely by claiming that a building or grounds that someone wishes to photograph and reproduce are critical to the public's awareness of a trademark and to its owners' use of said trademark for business purposes. One notable example of this kind of argument is the claim by the Rock & Roll Hall of Fame and Museum in Cleveland that it holds a trademark on its building, on the basis of which it sued a professional photographer who was selling posters with the museum's picture on them (Murray 1999).

Along these lines, inasmuch as corporate entities have taken over enormous swaths of real estate in Harlem, one has to ask whether development may have impacts not only on physical history (by, for example, leading to buildings being razed or outwardly changed) but also on historical re-creation. The high-resolution images with which virtual reality environments can be built are simply not available in most photographic archives, and so despite possessing the means of turning 2D images into 3D ones, there is still a need for new photographs or video to be taken. There also is need for detailed images of multiple facets and textures of an environment. In these processes, what property rights might extend to previous and current real estate owners,

FIGURE 2 The marquee at the Apollo. Note the names on the marquee. Audio files of period performances (musical and oral) are used throughout the Virtual Harlem environment.

and to architects and designers, whose work would be transferred to the virtual realm? Are there rights in individual elements of an environment (the placement of buildings, landscape elements, or textures on a building) that could be 'sampled' and added to different environments than those into which they were designed? To push the virtual/real connection further still, to what extent is the transference of real estate into the virtual realm a form of trespass, perhaps?

Thus far only the largely static elements of Virtual Harlem primarily have been mentioned. What about the interactions that take place within cultural heritage virtual environments? In an article exploring the adequacy of existing laws in relation to virtual reality, Joseph Beard (1999) writes, 'there remains the issue of whether dynamic data, facial animation and body movement, are copyrightable' (p. 1194) and concludes that at most a recorded interaction might qualify as an audiovisual work. In the case of Virtual Harlem and other virtual environments like it, however, the point is entirely *not* to record interaction, but instead to have it occur in real time, 'on the fly,' and to be unique at every visit. While means exist with which to record interactions in virtual environments, the playback of such recorded interactions for those who visit the environment, while perhaps interesting for observational purposes (as when a teacher may want to point out particular past actions, or a designer

may want to point out interactive elements), is completely beside the point. They are visiting in order to interact with the environment themselves and not to watch the interactions of those who had visited before them. They may wish to record their own interactions, perhaps as a memory aid or souvenir. I would argue, however, that even in such a case they would be complicit legally in the creative act and considered in some sense an 'author'. If nothing else, the users' actions could be considered a form of dramatic work and thus copyrightable.

There are additional, complicated, intellectual property issues that arise in relation to VR. If one is to re-create a 1920s scene in one of Harlem's most famous music venues, say, the Cotton Club, it would be hard to imagine doing so without using a piece of music from that era. To do so, however, even with claims of an educational purpose, requires permission from rights holders. (Were it not for the Sonny Bono Copyright Term Extension Act of 1998, however, creative works from the 1920s would have passed by now into the public domain.) The same would be required if one were to use passages from the literary texts of the time, from books, newspapers or magazines (perhaps for phrases spoken by characters in the environment, or as virtual replications that could be picked up and read by users), or even from the historical accounts that could be used to create dramatizations illustrating the people and

FIGURE 3 A scene inside the Cotton Club. Notice that 'on stage' Virtual Harlem's designers chose to use a film clip of a performance from the era.

the types of activities and events that took place. The need to secure permission is driven in part by the possibility that Virtual Harlem is an unknown quantity in intellectual property terms, as are other virtual environments. Such cases are cropping up in other types of virtual environments, such as the online game *Star Wars Galaxies,* in which players' 'characters play pretend, virtual instruments like the slitherhorn, ommni box or the nalargon, but are limited to a handful of canned tunes,' because '[l]awyers at Sony Online Entertainment and LucasArts envision a legal nightmare if musicians were to re-create music copyrighted in the physical world' (Dean 2005).

There are as yet no means by which to easily copyright immersive virtual worlds, for they are not 'recorded works' *per se*. That is not to say that they cannot be copyrighted, only to note that there is not a clearly defined category of works into which they fit, nor is there a simple means by which to deposit them with the Library of Congress should one wish to do so. And, if they could be copyrighted, might they also then not be licensed or sold? Might portions of them (perhaps the more valuable ones, for example in Virtual Harlem, the Cotton Club) be sold piecemeal and incorporated into other environments? Such is already the case in some sense, as game designers routinely swap code for particular environments, actions, and agents. Such swapping now occurs between media, as game designers and movie special

FIGURE 4 The entrance to the Cotton Club.

effects programmers find themselves engaged in the same sort of work using the same sorts of hardware and software. In VR the trading, sharing, and sampling of environments, particularly those with non-virtual origins, is another example of the virtualization of real estate.

Virtual intellectual property?

The most interesting aspect of intellectual property law in relation to virtual reality is not in whether designers of virtual environments must obtain permission and/or licenses to use copyrighted or trademarked materials in their constructions. Rather, it will be in whether or not virtual environments and the works that occur and are created within them can themselves be copyrighted. If the answer to that question is 'No,' then we will need to determine whether or not the former issue (use of copyrighted/trademarked materials in the environment) is moot, for what we are at least tacitly acknowledging with the negative answer is that virtual environments are worlds of their own, in which legal (and cultural and other) systems may also be their own. The negative answer may come from a recognition that, although there is work that goes into the creation of the environment, the activities that take place therein are themselves a different and distinct form of original work, too.

But if the answer is 'Yes,' that creative work within a virtual environment is subject to intellectual property laws just as is work occurring in a real environment, then we encounter complications already vexing intellectual property law in relation to digital media. Prominent among these are concerns over jurisdiction. Will the location of a server or a user, for example, affect which laws apply, or will virtual space become a jurisdiction of its own?

Rarely, however, is an important distinction such as the one determining the nature of intellectual property in virtual worlds answered with a simple yes or no. The blurring of these boundaries is already evident in virtual gaming worlds, where trademarked brands are promoted in virtual settings (McLeod 2005, p. 195). Whether those trademarks can be enforced in a virtual environment should someone appropriate them has not yet been put to the test. As has been the case with most every new electronic technology, the deployment of commerce into virtual worlds has not paused to wait for legal clarity.

To return to a point concerning authorship, while it is true that virtual environments have authors, creators, who design the environment's basic elements, there is a need for a philosophical and practical distinction between the development *of* the initial environment and subsequent development *to* it, and of the interactions and activities that take place within it. Users and inhabitants of a virtual world may alter the environment and create works of

art, music, and literature in it. In the non-virtual world designers and builders of buildings are not entitled to any rights in work that happens to be created in the spaces they have built, if only because their work is almost always considered 'work-for-hire'. Nevertheless, as can be seen in the Chicago Millennium Park example (and countless other less exaggerated instances), property owners can and do make claims to rights in works created on their property. Indeed, real estate (by the very nature of its naming) and urban planning, too, are inherently biased toward property rights, relying on the discrete commoditization of both property and, more recently, experience (Sternberg 2000). Any tourist, or for that matter any citizen, who has been charged for or denied access to a public space knows this, and the examples go beyond Chicago to New York's Battery Park City, or to seemingly public spaces that are in fact private (such as a shopping mall) as well as to gated communities. If existing non-virtual copyright laws are used by those who hold intellectual property rights to creative works or real estate to constrain the representations possible in a virtual environment, not only will we then witness the incursion of real estate into the virtual world, but we also will find that virtual worlds will be driven increasingly away from representations of non-virtual environments out of concern for infringement. The consequence will be a virtual reality in which the non-virtual (its sounds, sights, experiences) will be controlled by those who hold non-virtual rights. VR creators can either attempt to gain permission for non-virtual elements they wish to incorporate in their virtual worlds, or design worlds without reference to the non-virtual world, except for cases in which the copyright has lapsed or in which copyright is not held. In either case it is likely that the ability of creators and users to experience alternative realities will be diminished, just as the ability of music fans to hear alternative interpretations of a song is diminished when the holder of rights to the song denies someone else permission to record it.

Many of the intellectual property conundrums that will arise from development of immersive virtual worlds will have at their root the position of the subject in law and the definition of the virtual subject. In virtual reality it is difficult to limit one's understanding of the subject to the particularly Western (and bourgeois) legal preoccupation with the individual. In virtual reality we cannot readily ascertain subjects or subjectivity. Is my avatar myself? Who am I in a virtual environment? Is the computer that is interacting with me by means of the algorithms coded into the environment's people and places also a subject? Such questions are interesting enough in virtual environments that have no real analog, but in those environments that rely on or seek to re-create reality, they are more than simply interesting; they are crucially important to future immersive VR development.

Part of what is at stake in any virtual reality project that takes as its base some semblance of pre-existing reality is ethics, as well as an ethics of VR, an

ethics of design of an environment's apperceived qualities (rather than in the behavioral realm, as discussed by Brey (1999)). The reason ethics is at stake is that unless one is attempting entirely to replicate reality in a documentary fashion, one's decisions have to have some basis, some guiding principles (true enough even if one is attempting a documentary), during the creative process. In the case of virtual reality the decisions are myriad – godlike, one might say. On what is one to base them? Much like a documentarian or a historian must make decisions about how best to represent reality, so too must the designer of a virtual environment make decisions about how best to code reality.

In VR, however, a particular ethics operates that is different from that of the documentarian or historian. There is a way in which the creation of a cultural heritage project in an immersive virtual reality environment feels, to its designers, as a literal re-creation of reality, down to its last detail, or at least down to the level of aural and visual detail permitted by time, technology, and other resources. Unlike the documentarian who uses film, video, or photography, there is no frame, no decision determined by what the medium would allow to be included in a 'shot'. The issue is not one of fidelity, but of inclusivity. By its very nature immersive VR is, like reality, unframed by anyone or anything but the viewer.[3] There is no necessary reason to 'translate' or 'convert' what is seen to fit the dimensions or frames of a visual, aural or print medium. Narrative can be decoupled from visual framing, as decisions about where to look and where to go are left to the user rather than to an environment's creator.

Instead, decisions must be made about how to create boundaries (e.g. how far out from Harlem do we continue to build, and for what reasons?) lest the design work become infinite. One of the interesting elements of cultural heritage projects in immersive VR environments is that the building of them can, in a sense, never end. For example, on the 'macro' side of the spectrum, in Virtual Harlem one could always add areas adjacent to Harlem if for no other reason than to add context to the environment. Or, on the 'micro' side, one could always add additional detail to portions of the existing virtual environment.[4]

Every detail in the environment is ultimately a decision about a particular historical moment and place. History, however, is generally not likely to provide many details, and thus the process of creating an environment like Virtual Harlem is in some ways both an inventive and an interpretive process. For example, as a group of scholars at the University of Illinois at Chicago began to meet to discuss the prospects of creating a Virtual Hull House, they discovered that the available historical records (surveys, maps, insurance records, photos) all differed by at least several feet regarding the location of some of the neighborhood buildings. How to choose? To which ethical principles does one adhere and in what ways are those principles embedded in the historical record and in the interpretation of that record? How will such

choices be affected by intellectual property constraints that are imposed by copyright, trademark, and patent laws that assume a particular, bounded, mode of production of historical recreation?

It may ultimately be up to legal scholars, lawyers, and the courts to answer the question and to determine the full extent of the law's reach into virtual worlds, or to determine that there can be a form of virtual intellectual property. However, the likely outcome leaving it to those forces is the chaining of intellectual property in virtual worlds to the precepts developed in a non-virtual world, an outcome that strikes at the very heart of the notion of virtual reality. We are already witnessing the difficulties existing intellectual property law has with digital media. Virtual worlds give us an opportunity to entirely reconsider both 'real' property and intellectual property, and in fact to allow the inhabitants of those worlds to themselves determine both the meaning and value of intellectual property. It would be a shame to take such possibilities away from the future by claiming non-virtual intellectual property law applies in virtual worlds.

It is not too soon, therefore, to consider the nature of ownership in virtual worlds, and to consider who will own the worlds in which we may play, work, and in one sense or another live (at least part of our lives). It may well not be traditionally recognized legal authorities or copyright holders who will continue to wield power in virtual worlds as they do in non-virtual ones. There already has been the creation of markets, trade, and commodities in virtual gaming worlds like *Ultima Online* and *Everquest*, and in virtual social words like *Second Life* and *There*. In those environments, however, the worlds that are created are a fantasy, and it is quite rarely that the real world intrudes explicitly into the environment. If virtual reality is to flourish as a spatial practice and experience it ought not be constrained by practices external to it or by conceptions of property that are conceived without regard to any notion of virtuality.

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Notes

1 An excellent overview of Virtual Harlem is Bryan Carter's and James Sosnoski's (2005) book *Configuring Virtual Experiences of the Past: The VERITAS Project*.

2 For information about the CAVE, see http://www.evl.uic.edu/pape/CAVE/. One of its most important characteristics, beyond the degree of bodily immersion in a virtual environment that, to date, only it affords among all VR technologies, is that CAVEs can be networked together and environments shared at a distance.

3 One of the CAVE's inventors, Dan Sandin, described viewer-centered perspective in an interview (Breitsameter 2002): 'There . . . is a tracking system that essentially knows where your eyes are in the environment, so that it generates your point of view of the universe, it's called viewer-centered perspective. So that you can actually walk around objects and they appear to stay static, as you walk around them, and when you are behind them, you see their back, and when you are in front of them, you see their front. That viewer-centered perspective is the first re-definition of perspective since the Renaissance. It is a very profound change, and in addition to the viewer centered perspective and being surrounded by images, there is no frame, no frame edges, except the peripheral edge of your vision in a sense'.

4 Indeed, one of the early comments concerning Virtual Harlem was that it lacked sufficient detail in street scenes – the streets were not dirty enough!

References

Beard, J. J. (1999) 'Clones, Bones and Twilight Zones: Protecting the Digital Persona of the Quick, the Dead and the Imaginary'. *Berkeley Technology Law Journal* 16(3): 1165 – 1271.

Breitsameter, S. (2002) 'Interview: July 2002, Dan Sandin in conversation with Sabine Breitsameter' [online]. Available at: http://www.swr.de/swr2/audiohyperspace/engl_version/interview/sandin.html

Brey, P. (1999) 'The ethics of representation and action in virtual reality', *Ethics and Information Technology*, vol. 1, no. 1, pp. 5–14.

Carter, B. & Sosnoski, J. (2005) *Configuring Virtual Experiences of the Past: The VERITAS Project*, Peter Lang Publishing, Inc., New York.

Copyright Law of the United States of America and Related Laws Contained in Title 17 of the *United States Code* (2003) [online]. Available at: http://www.copyright.gov/title17/92chap1.html#120

Cruz-Neira, C., Sandin, D. J., & DeFanti, T. A. (1993) 'Surround-Screen Projection-Based Virtual Reality: The Design and Implementation of the CAVE' [online]. Available at: http://www.evl.uic.edu/EVL/RESEARCH/PAPERS/CRUZ/sig93.paper.html

Dean, K. (2005) 'Music Muffled in *Star Wars* Game', *Wired News*, 6 Jun. [online]. Available at: http://www.wired.com/news/digiwood/0,1412,67720,00.html

Elmer-Dewitt, P. (1995) 'Welcome to cyberspace', *Time*, vol. 145, no. 12, Spring, pp. 4–9.

Gee, J. P. (2004) *What Video Games Have to Teach Us About Learning and Literacy*, Palgrave Macmillan, New York.

Hillis, K. (1999) *Digital Sensations: Space, Identity and Embodiment in Virtual Reality*, University of Minnesota Press, Minneapolis.

Joravsky, B. (2005) 'Pork in the park', *Chicago Reader*, 11 February, pp. 8–9.

McLeod, K. (2005) *Freedom of Expression®: Overzealous Copyright Bozos and Other Enemies of Creativity*, Doubleday, New York.

Murray, T. (1999) 'Rock hall poster puts focus on bigger picture', Cleveland *Plain Dealer*, 11 April, p. 1H.

Sternberg, E. (2000) 'An integrative theory of urban design', *Journal of the American Planning Association*, vol. 66, no. 3, pp. 265–278.