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THE NEW MEDIUM OF EXPRESSION: INTRODUCING VIRTUAL REALITY AND ANTICIPATING COPYRIGHT ISSUES*

by GREG S. WEBER†

I. INTRODUCTION

The Copyright Act grants to authors the legal ownership of their original works which are fixed in any tangible medium of expression.[1] A medium of expression can be many things: canvass and paint, the written word, musical lyrics and composition, sculpture, film, or the audiovisual screen display generated by a computer program.[2] Clearly, technological innovation creates new art forms—fresh ways for people to express themselves; and innovation therefore broadens the field of copyright law. When new expressive mediums are developed, copyright law must bend, shift, stretch, reformulate, and evolve to provide authors working in the new medium adequate protection for their works.

Right now, an exceptional new medium of expression is being born. A burgeoning creative technology, known as virtual reality (VR), now in its embryonic developmental stages, carries unbridled promise for the future. This article offers a background on where virtual reality is today and how intellectual property rights in works created on and for VR systems will develop in the next century or earlier.

Part II of this article, Introducing Virtual Reality, probes the creation of this technology and reveals how it works, who are the pioneers in

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1. 17 U.S.C. § 102 (1988).

2. *See infra* note 92 and accompanying text for a discussion of the copyrightability of computer screen displays.

the forefront of the field, what are its uses, and whether the United States will be a world player in this emerging technology-based industry.

Part III, Anticipating Copyright Issues, explores whether virtual reality, which is a computer-user interface, is copyrightable subject matter, the application of the fact/expression dichotomy to virtual reality, and the difficulty in applying the traditional concepts of original authorship and fixation to interactive computing technologies like virtual reality.

II. INTRODUCING VIRTUAL REALITY

The New York Times published in 1989 a front page article on virtual reality that garnered enthusiastic interest and widespread public attention to the new technology.[3] In fact, that article represented only the beginning of a wave of public exposure to virtual reality which has yet to satisfy the public's curiosity. Numerous books, countless newspaper and magazine articles, and even a monthly newsletter—*Virtual Reality Report*[4]—have been published. The Public Broadcasting Station (PBS) documentary on computers, "The Machine That Changed the World," (1992) was enlivened by a virtual reality segment,[5] and public indoctrination continues: fully operational VR machines are installed as museum and gallery exhibits;[6] a fictional depiction of virtual reality, the "holodeck," appears regularly in the television show, "Star Trek: The Next Generation;" and the science fiction motion picture, "The Lawnmower Man" (1992), centers around VR technology "gone mad."

Real life virtual reality consumes the public via virtual reality arcades featuring "new wave" designed VR stations loaded with artfully created computer game software. W. Industries Ltd. (U.K.) launched the worlds first production VR system, called Virtuality, in November 1990.[7] By late 1992, there were ten Virtuality arcades dotted throughout the U.S., where patrons pay four to five dollars for a three and one-half minute immersion into computer games created by Spectrum Holobyte, Inc., a California-based entertainment software company.[8] Virtual World Entertainment, which develops virtual reality entertainment centers and operates an arcade in Chicago, licenses two facilities in Japan and plans

3. Pollack, *For Artificial Reality, Wear a Computer*, N.Y. TIMES, Apr. 10, 1989, at A1.

4. The newsletter is published by Alan Meckler. Rifkin, *Business Technology; PBS Series Will Stroll Into "Virtual Reality,"* N.Y. TIMES, Apr. 1, 1992, at D9.

5. *Id.*

6. Hagen, *Virtual Reality: Is It Art Yet?*, N.Y. Times, July 5, 1992, at § 2, p. 1.

7. Waldern, *Virtuality—The World's First Production Virtual Reality Workstation*, in VIRTUAL REALITY 91, IMPACTS AND APPLICATIONS: PROCEEDINGS OF THE FIRST ANNUAL CONFERENCE ON VIRTUAL REALITY (London, Meckler Publishing 1991) [hereinafter VIRTUAL REALITY 91 CONFERENCE].

8. Reilly, *Edison Bros. Plans a New Enterprise in Virtual Reality*, WALL ST. J., Sept. 25, 1992, at B5.

to open four centers in the U.S. in 1993.[9] Prophesiers in this newly-created field preach of how video game arcades preceded the PC explosion in the early 1980s.

As public propaganda and exposure to virtual reality significantly increase, numerous professional conferences verbalize its fullness and propagate its concept. Even a U.S. Senate subcommittee held a hearing to learn how Congress can legislatively assist this revolutionary and budding "American" technology.[10] Not surprisingly, the subcommittee hearing was chaired by high tech enthusiast, Al Gore, now Vice-President.

For those who have managed to escape the full fury of this hype onslaught, the next several pages provide a more comprehensive background: an introduction to how virtual reality works, the fledgling VR industry, research and development efforts, present and potential future uses, and American competitiveness in this technology.

A. How It Works

Virtual reality is a computer-generated, three-dimensional world where participants have the illusion of walking or flying, manipulating objects, and interacting in real time.[11] The feeling of immersion in a graphical environment and the ability to explore and navigate through this mysterious and floating atmosphere by using natural gestures, as if you were "really there," is what distinguishes virtual reality from other computer environments.

The user wears a special helmet, or head-mounted display (HMD), containing two small liquid crystal display (LCD) screens, one for each eye. The illusion of 3-dimensions is created by a technique called stereoscopy. Slightly different views of the same image appear on each screen so that each eye sees only the images appropriate to a left or right eye view.[12] A sensor mounted on the helmet keeps track of the position and orientation of the user's head. As the head turns, the images on the screens shift accordingly.[13] Because the computer must continually redraw the appropriate image, a sufficiently large amount of computing

9. *Who's News: Disney Heir Acquires Firm in Virtual Reality Business*, WALL ST. J., Dec. 8, 1992, at B9.

10. New Developments in Computer Technology: Virtual Reality, Hearing before the Subcomm. on Science, Technology, and Space of the Senate Comm. on Commerce, Science, and Transportation, 102nd Cong., 1st Sess. (1991) [hereinafter Subcommittee Hearing].

11. Ravo, *House-Hunting by Interactive Computer*, N.Y. TIMES, Nov. 22, 1992, at § 10, p. 1.

12. H. RHEINGOLD, VIRTUAL REALITY 14 (Simon & Schuster 1991).

13. Pollack, *supra* note 3.

power is necessary.[14] The computer to which the HMD and various other components are attached is typically called a reality engine.

One component common to many systems is the wired glove, which is threaded with fiber optic sensors and enables navigation through a virtual environment and interaction with virtual objects.[15] A navigational standard which has developed in many systems is pointing with the gloved hand in order to fly in that direction.

Different systems have used various other devices to produce gestural input, including a steering wheel, a treadmill, and a stationary bicycle whose virtual analog takes off into the air when it is pedaled fast enough.[16] Some VR systems include a small microphone attached to the head-mounted display for speech input. Through the developing technology of speech recognition, the computer responds to simple voice commands.[17] These and several other interactive devices are known as sensors, which monitor the user's movements and commands, and effectors, which provide sensory stimulation to the user.[18] Because many of the devices contain both input and output functions, they are often referred to simply as effectors.[19]

Virtual Reality machines—reality engines, software and effectors—are sometimes referred to as cyberspace decks. Cyberspace is a term that is often paired with virtual reality and it has many definitions. Loosely, cyberspace refers to any computer environment, especially those that can be accessed or entered by a number of users, including networks, bulletin boards and virtual worlds.[20] The idea of users being able to meet and interact in a virtual space is one of the driving concepts behind the development of virtual reality. In fact, one of the first machines

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14. Lag time between head movements and image readjustment has been a problem in some machines. *Id.*; H. RHEINGOLD, *supra* note 12, at 144-45. The problem is surmountable, however, as chip technology increases computing power. The amount of power necessary varies with the degree of image detail.

15. K. PIMENTAL & K. TEIXEIRA, VIRTUAL REALITY: THROUGH THE NEW LOOKING GLASS 284 (McGraw Hill 1993). VPL Research, Inc., which pioneered the development of this device, calls its product the DataGlove.

16. Walser, *The Emerging Technology of Cyberspace*, in VIRTUAL REALITY: THEORY, PRACTICE AND PROMISE 38 (S. Henzel & J. Roth eds. 1991) (Meckler Publishing); H. RHEINGOLD, *supra* note 12, at 113.

17. H. RHEINGOLD, *supra* note 12, at 147.

18. Walser, *Elements of a Cyberspace Playhouse*, in S. HELSEL & J. ROTH, *supra* note 16, at 57-58.

19. K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 66, 284.

20. For alternative definitions and a more complete discussion of cyberspace, see CYBERSPACE: FIRST STEPS (M. Benedikt ed. 1991) (MIT Press). "Cyber" comes from the Greek word kybernan, which means to steer or control. The term cyberspace was coined by science fiction novelist William Gibson in his book NEUROMANCER (Ace Books 1984). Gibson's cyberspace referred to a globally networked virtual space accessed by millions of users.

demonstrated, RB2 (Reality Built for Two), is capable of multiple participants.[21]

B. The Reality-Industrial Complex and Real and Imagined Uses

Howard Rheingold, in his critically praised book, *Virtual Reality*,[22] uses a concise term for the network of academic, commercial, and governmental research and development projects and entrepreneurial ventures striving to expand into a technology-based industry: the reality-industrial complex.[23] Although several important R&D projects remain at universities and governmental agencies, the stars and adventurers of virtual reality development are elsewhere and maybe everywhere. "The real innovation is happening at the grass-roots level. The Silicon Valley myth of starting a business out of a garage and growing it into a successful company is still alive and well at VPL Research, Sense8, Fake Space Labs, Greenleaf Medical Systems, Virtual Research, and more."[24]

No single company is more identified with virtual reality than VPL Research, Inc., founded in Redwood City, California. VPL was the first company to focus on the development and manufacture of VR products.[25] Because of his off-beat physical appearance and provocative visions of virtual reality, the young founder and chief scientist of VPL, Jaron Lanier, has become a media magnate and the guru for virtual reality.[26] In *The New York Times*, Lanier "envisions forms of virtual intimate interactions. 'You and your lover trade eyes so that you're responsible for each other's point of view,' he mused. 'It's an amazingly profound thing.' "[27] Early VPL innovation materialized through the company's close association with the NASA Ames Research Center. By the late 1980s, VPL was successfully selling VR components, like its DataGlove and EyePhones, to researchers piecing together their own VR systems. In 1990, VPL claimed 500 customers worldwide, including purchasers of its full, quarter million dollar, high-end system. VPL's customer list includes premier technology labs in Japan, Europe, and the U.S.[28]

Another significant player, Autodesk, Inc., a successful software company, was established by John Walker in 1982 with the single vision of developing an inexpensive computer aided design (CAD) program for the PC.[29] In 1988, Walker began the "Autodesk Cyberspace Initiative,"

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21. RB2 was introduced by VPL Research at a trade show in 1989.
22. H. Rheingold, *supra* note 12.
23. *Id.* at 132.
24. K. Pimental & K. Teixeira, *supra* note 15, at xiv.
25. *Id.* at 52.
26. *Id.*
27. Pollack, *supra* note 3.
28. K. Pimental & K. Teixeira, *supra* note 15, at 53-54.
29. *Id.* at 56.

with the goal of developing a more affordable system and components than VPL Research. In 1989, Autodesk introduced the first PC-based VR system.[30] One of the applications for that cost-effective system involved the first virtual reality racquetball game. Pat Gelband, the creator, was aware she was following historical precedent set by Pong, the first video arcade game, which also involved bouncing a ball off a wall with a paddle.[31]

VR developers Pat Gelband and Eric Gullichsen left Autodesk in 1989 to form Sense 8 Corporation of Sausalito, California. Their goal was to more quickly turn their research into commercial products.[32] The company is successful at developing all purpose software and hardware tools useful in multiple applications.[33]

This description of some of the more prominent companies in the Northern California VR scene should not give an impression that it is an easy ride to the top.[34] Despite the large amount of innovation taking place at small companies, there are many ups and downs and no assurances of ultimate success, even for premier firms. VPL Research has reorganized after some setbacks and Mr. Lanier has left the company.[35]

However, one truth is gospel in this nascent industry. The comeback of the "technopreneur," a species that went into hiding in the Silicon Valley after the pioneering days of the PC revolution, is upon us. With virtual reality, these living room inventors, garage scientists, gadget tinkerers, and hobbyist-entrepreneurs are resurfacing.[36] For homespun R&D to really soar, the price of equipment must continue to fall, and the small start-ups must continue to develop marketable products. At this point, it is estimated that a low-end system can be built for $20,000, and a desktop computer can be turned into a low fidelity reality engine for between $2500 and $5000.[37]

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30. *Id.* at 57.

31. *Id.*

32. *Id.* at 58.

33. *Id.* at 59.

34. Nor should it give an impression that the companies described are the only outfits developing this technology; although they are among the most talked about. A directory in K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 274-78, lists sixty-two companies and research groups worldwide. A directory of companies and individuals in S. HELSEL & J. ROTH, *supra* note 16, at 123-29, contains sixty-three entries.

35. Zachery, *"Virtual Reality" Patents Gained by French Firm*, WALL ST. J., Dec. 7, 1992, at B1.

36. H. RHEINGOLD, *supra* note 12, at 336.

37. *Id.* at 337, 340. The chapter, "Desktop VR," in K. PIMENTAL & K. TEIXEIRA, *supra* note 15, presents the building blocks for designing a VR system using a desktop computer. These authors also estimate that a complete PC-based system can be assembled for approximately $20,000. *Id.* at 93.

While the energetic "technopreneurs" have made the most noise, they are not the only ones working to develop virtual reality. The Human Factors Research Division at the NASA Ames Research Center in Mountainview, California, has accomplished much in legitimizing VR.[38] Its Virtual Environment Display (VIVED) system was the first to combine a wired glove (VPL's DataGlove) with a head-mounted display.[39] The glove allows the user to physically manipulate virtual objects. Several virtual worlds have been created at NASA, including a graphic model of a hemoglobin molecule, the space shuttle, and the NASA lab itself.[40]

One of NASA's primary visions for virtual reality is telepresence (or telerobotics), which uses virtual reality technology to operate remote machinery. Whereas traditional virtual reality shuttles the user into a computer-generated environment, telepresence uses VR equipment to allow the user to seemingly occupy a real place that is remote to the user. For example, a head-mounted display was hooked up to a camera on an unmanned submarine launched in a glacial lake in Antarctica. The camera moved according to the user's head movements and the camera's view became the user's view. NASA hopes to use a similar arrangement to explore lunar and planetary surfaces.[41] If a gloved hand were hooked up to control a robotic arm, the user's movements could become the robot's. NASA, in this way, hopes to utilize telepresence for maintenance work on the proposed space station.[42]

Any environment that requires exploration where it is dangerous or impossible for technicians to function would be a probable application for telepresence. One example is the cleaning-up of toxic waste sites.[43] Dr. William Bricken of the Human Interface Technology Laboratory (HIT Lab) at the University of Washington, Seattle, can think of a few others. With telepresence,

> [w]e can apply virtual reality interaction and hardware techniques to explore anywhere we can place a probe. We can inhabit a remote undersea vehicle . . . We can swallow a miniaturized transmitter and explore our own stomach. We can build artificial bees with fiber optic visual links and micromoters for dancing and rubbing antennae. We can then

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38. H. RHEINGOLD, *supra* note 12, at 143.

39. *Id.*

40. *Id.* at 142.

41. Ryan, *Go Anywhere! But Don't Leave Your Chair*, SAN FRANCISCO CHRONICLE, Mar. 21, 1993; PARADE MAG. 18.

42. H. RHEINGOLD, *supra* note 12, at 148.

43. K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 177; Subcommittee Hearing, *supra* note 10, at 63.

> put our bee-selves into the physical hive and interact with real bees in their home environment. I can hardly wait.[44]

In the field of industrial design, virtual reality is touted as having enormous potential because it enables engineers to clearly see and experience their creations before building them.[45] Virtual prototyping saves the time and expense of building and rebuilding detailed models.[46] Because of prohibitive costs, engineers often have the opportunity to examine in detail only two or three designs. With virtual reality, more radical designs can be explored as dozens of concepts can be virtually prototyped at significantly less expense.[47] Engineers can experience what they are building before committing to a final design, and also better communicate their visionary design to clients and colleagues.[48] It is possible to experience being inside a virtual model of a proposed new automobile and to observe the lines of visibility out the rear window without having to build a full scale model, which is the current approach.[49] The Boeing Corporation in Seattle, Washington, in conjunction with the HIT Lab at the University of Washington, is developing VR simulations of aircraft cockpits in order to experience and evaluate design ideas before constructing models.[50] Boeing is committed to completely developing its next generation of commercial aircraft using computers. The Computer Interface Group at Boeing is identifying dozens of applications for virtual reality, including concept development and design, manufacturing, maintenance, and in-flight uses.[51]

Virtual Reality can benefit architecture in the same manner as it is helping to modernize industrial design. The Computer Science Department at the University of North Carolina in Chapel Hill utilized VR in the design of a new research facility in the mid 1980s. A VR system with a treadmill and handlebars allowed architects to experience their design by walking through a virtual building. As a result, improvements in the blueprint plans, like removing a cramped lobby wall, were implemented.[52] Clients exposed to simulated designs provide valuable feedback before any concrete is poured. A VR model of a subway station in Berlin was produced on a VPL Research system before the design was finalized.[53] And at the Matsushita shopping center in Tokyo, consumers

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44. Bricken, *Virtual Reality: Directions of Growth*, in VIRTUAL REALITY 91 CONFERENCE, *supra* note 7, at 3.
45. Zachery, *supra* note 35.
46. K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 184-87.
47. Subcommittee Hearing, *supra* note 10, at 5.
48. *Id.* at 6.
49. *Id.* at 7.
50. Bricken, *supra* note 44, at 2.
51. K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 4.
52. *Id.* at 44.
53. Subcommittee Hearing, *supra* note 10, at 6.

design their own virtual kitchens in order to select their desired set of appliances.[54]

Along with architectural modeling, UNC is at the forefront of molecular graphics. Researchers there use a VR system to experiment with "docking" different combinations of molecules in the search for new drugs.[55] Molecular docking seems to have promise on virtual reality systems. It allows biochemists to visualize their data and to actually feel, by wearing a wired-glove, molecules resisting attachment or coming together.[56]

The medical field, already blissfully wedded to high technology, is poised to utilize virtual reality. Surgeons from a hospital in Boston are working with scientists at General Electric to develop ways to use VR technology in surgery. The International Society for Simulation Surgery held its inaugural meeting in Tokyo in 1992.[57] One proposal is that surgeons may use simulated virtual patients to perform pre-operation planning and patient analysis. Surgical simulations could also be used to train medical students (just as flight simulators are utilized to train jet pilots).[58] Anathesiologists complain that they are unable to constantly observe patients because life-and-death medical information appear on an apparatus behind or to the side of them. That medical problem may be solved by what is known as augmented reality.[59]

Augmented reality is the use of VR goggles to project data, diagrams, animation, video, or text onto a person's real world view. Boeing is exploring this technology for use by aircraft mechanics. Mechanic's glasses could display schematic diagrams, parts lists, illustration, and text superimposed on the mechanic's view of the real-world engine.[60]

Telecommunications is another likely field to be effected by virtual reality. One of NASA's goals for its Virtual Interface Environment Workstation (VIEW) project (VIEW followed the VIVED project mentioned earlier[61]) is to create a system whereby two or more users can participate and interact in a shared virtual environment. This would allow collaboration between scientists in different locations, or between astronauts in the space station and scientists on earth.[62] A similar idea is

54. Ravo, *supra* note 11.

55. H. RHEINGOLD, *supra* note 12, at 14, 19.

56. *Id.*

57. Naj, *Virtual Reality Isn't a Fantasy for Surgeons*, WALL ST. J., Mar. 3, 1993, at B1.

58. Fisher, *Virtual Environments: Personal Simulations and Telepresence*, in S. HELSEL & J. ROTH, *supra* note 16, at 108.

59. Subcommittee Hearing, *supra* note 10, at 27, 30.

60. K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 11, 16.

61. *See supra* note 39 and accompanying text.

62. Fisher, *supra* note 58, at 109.

the "corporate virtual workspace," which workers access through their home VR systems.[63]

Business uses of virtual reality predominantly involve the fields of data visualization and information management. NASA's VIEW system can create a display environment in which tasks are organized in virtual display space around the user. Through interaction with a virtual control panel, the worker can call up or delete information windows and reposition them in 3-D space. The virtual control panel is reconfigurable for different tasks and responds to input gestures made with the user's gloved hand.[64]

Through the pictorial representation of data, virtual reality has the potential of allowing people to rely on their perceptual faculties, a more natural process than the conceptual interpretation required by numerical data.[65] The financial community envisions programming investment portfolios as three-dimensional objects which can be felt and manipulated within a virtual environment. One researcher foresees "cybernautic brokers of the future who zoom through landscapes that are 3-D depictions of marketplaces as reported through global electronic transaction systems, in real time."[66]

The often used cliche, "experience is the best teacher," suggests the natural applicability of virtual reality to the field of education. The technology to fly uninhibited through a virtual model of the solar system at awesome speeds, exploring first hand the heavenly bodies, is present today.[67] Whether VR models will be constructed for use in the relatively unprofitable area of education is another question.[68]

This section merely highlights a small sampling of the present and potential uses of virtual reality; there are dozens more. Although the border between nonfiction and science-fiction can be fuzzy in this area, specific applications for VR have been contemplated or executed in such fields as medicine, military, education, entertainment, research, design, space and earth exploration, business, finance, data visualization, information management, robotics, science, pharmaceuticals, retail, real estate, architecture, recreation and fitness, environmental clean-up,

63. *See* Pruitt & Barrett, *Corporate Virtual Workspace*, in BENEDIKT, *supra* note 20.

64. Fisher, *supra* note 58.

65. Krueger, *Artificial Reality: Past, Present, and Future*, in S. HENZEL & J. ROTH, *supra* note 16, at 25.

66. Rothman, *Virtual Reality*, N.Y.L.J., Dec. 17, 1991, at 2.

67. Fisher, *supra* note 58, at 109.

68. For a discussion of the potentially extraordinary use of virtual reality for educational purposes, including an explanation of how the technology is well suited to achieve the distinctive cognitive processes that make up an educational event, *see* Traub, *Simulated World as Classroom: The Potential for Designed Learning Within Virtual Environments*, in S. HELSEL & J. ROTH, *supra* note 16.

telecommunications, manufacturing, marketing, media, and art. As Al Gore emphasized at the outset of a U.S. Senate subcommittee hearing on virtual reality, "This kind of radical technology is likely to be applied in ways that we cannot even guess right now."[69]

C. American Competitiveness

One of the principle reasons for the hearing on virtual reality before the Senate Subcommittee on Science, Technology, and Space was to "make sure the Federal Government does all that it can to stimulate the development of innovative and truly important new technologies like virtual reality."[70] A sincere concern of those already toiling in the industry is VR, like the VCR, may become another technology created in the U.S. but exploited and eventually totally taken over by other countries.[71] "It is an old story applied to an exciting new technology," stated then-Senator Gore.[72]

Virtual reality has been developing and growing in the U.S. for over two decades, especially as an offshoot of flight simulator technology and cockpit response and control systems developed by the U.S. Air Force. There have been foreign contributions to the technology only since the late 1980s. Nevertheless, the majority of users of VPL Research's high-end products, which are used largely in researching applications, are in Japan, Germany, and France.[73] Developing applications for technologies originated in the United States, and otherwise bringing discoveries out of the laboratory and into practical use, is said to be a weakness of this country.[74] Due to the superior planning, investment, and organization in other countries—especially Japan—there is a definite danger of America surrendering this new technology-based industry. According to Jaron Lanier, who testified at the U.S. Senate subcommittee hearing, the Japanese believe they will overtake the U.S. and dominate the virtual reality field. A less competitive Japanese plan indicates U.S. firms will create the software while Japanese companies produce the hardware.[75]

What is Japan doing that the U.S. is not doing? The Ministry of International Trade and Industry (MITI) formed a commission in 1990 on what they call artificial reality. Many of the largest companies in Japan—Nintendo, Sharp, Fuji and Matsushita—are committed and involved. Contrastingly, in the United States, most of the work in the

69. Subcommittee Hearing, *supra* note 10, at 2.
70. *Id.*
71. *See* Zachery, *supra* note 35.
72. Subcommittee Hearing, *supra* note 10, at 3.
73. *Id.* at 6.
74. *Id.* at 3.
75. *Id.* at 9.

technology is being done at small start-up companies.[76] In Japan, virtual reality is supported by centralized funding,[77] while American firms have had to rely on overseas foreign investment.[78] In Japan, telecommunications, electronics, and computer companies, like Nippon Telephone and Telegraph (NIT), Nippon Electronic Company (NEC), Toshiba, Hitachi, and Fuji are pledged to the development of VR.[79] In the United States, major corporate involvement, like that of Boeing, is the exception; or it takes place on the very fringes of the organization.

There is also a level of private-government planning in Japan that is unmatched in the United States. In the late 1980s, studies were conducted in Japan on the long-term implications of virtual reality. Funding was then made available and several consortia of companies were formed to develop the technology.[80] There is also an enthusiastic level of communication and cooperation among industry, research, and the government.[81]

Critics of the way technology is developed and commercialized in the U.S. see virtual reality as a stark example of the failures of American industrial policy. One observer states,

> In Japan, virtual reality is integrated into the high-level plans Japanese industries have for future computer interfaces, communications media, and entertainment products. . . . The key distinction between virtual reality in Japan and the U.S. . . . is that virtual reality is integrated into Japanese industrial policy, and the U.S. does not have an industrial policy.[82]

Vice-President (then Senator) Gore shared that frustration:

> it is another technology invented here but perfected and marketed by someone else, but there is still time to change it, with this technology. There is still time . . . if we have a proactive technology policy, not the tired, laissez-faire approach advocated by too many in the [Bush] administration. In today's world, laissez-faire is simply not good enough.[83]

III. ANTICIPATING COPYRIGHT ISSUES

A. Copyrightable Subject Matter and the Ultimate User Interface

> The history of copyright law has been one of gradual expansion in the types of works accorded protection . . . [S]cientific discoveries and tech-

76. *Id.* at 3.
77. *Id.* at 9.
78. *See* Zachery, *supra* note 35.
79. H. Rheingold, *supra* note 12, at 221.
80. Subcommittee Hearing, *supra* note 10, at 39.
81. *Id.*
82. H. Rheingold, *supra* note 12, at 294.
83. Subcommittee Hearing, *supra* note 10, at 3.

> nological developments have made possible new forms of creative expression that never existed before. . . . [I]t is impossible to foresee the forms that these new expressive methods will take. The bill does not intend to either freeze the scope of copyrightable subject matter at the present stage of communications technology or to allow unlimited expansion into areas completely outside the present congressional intent.[84]

This legislative history of the 1976 Copyright Act suggests a key question: Is virtual reality a natural extension of works now protected by the Act or is it completely outside congressional intent?

The Copyright Act protects "original works of authorship fixed in any tangible medium of expression, now known or later developed . . ."[85] Section 102 lists seven broad categories which the concept of "works of authorship" is said to "include." The use of the word "include," as defined in section 101, makes clear that the listing is "illustrative and not limitative,"[86] and that the seven categories do not necessarily exhaust the scope of "original works of authorship" that the Act is intended to protect.[87] The categories are literary works, dramatic works, pictorial and graphic works, motion pictures and audiovisual works, and sound recordings, among others. Except for the "feel" of virtual objects that a wired glove can create, the virtual reality experience is essentially audiovisual. For the most part, the experience can be broken down into elements that fit into the enunciated categories of protectable subject matter. For example, the user sees moving pictures on the screens inside the head-mounted display and may hear a variety of sound recordings at different intervals. It would seem that virtual reality is basically a natural extension of works now protected and should be covered by the present Act. The more radically new elements of the virtual reality experience, like tactile sensation, will likely require a revision of the Act in order to be protected.

The sounds, images, and sensations of virtual reality are computer-generated and run according to computer programs. The Copyright Office has been granting copyrights for computer programs since 1964.[88] In 1978, the National Commission on New Technological Uses of Copyrighted Works (CONTU) issued its final report recommending that the Copyright Act be amended "to make explicit that computer programs . . . are proper subject matter of copyright."[89] In 1980, Congress responded

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84. Copyright Law Revision, H.R. Rep. No. 94-1176, 94th Cong., 2d Sess., 51-58 (1976).

85. 17 U.S.C. § 102.

86. *Id.* § 101.

87. *Supra* note 84.

88. *See* Cary, *Copyright Registration and Computer Programs*. 11 BULL. COPYRIGHT SOC'Y 362 (1964).

89. National Comm'n on New Technological Uses of Copyrighted Works, Final Report 1 (1978).

by amending the Copyright Act to include a definition of "computer program" to section 101: "A 'computer program' is a set of standards or instructions to be used directly or indirectly in a computer in order to bring about a certain result."[90] Since that time, computer programs have been considered "literary works" under the Copyright Act.

In 1986, the Court in *Broderbund Software, Inc. v. Unison World, Inc.*[91] held that "the overall structure, sequence and arrangement of the screens, text and artwork (i.e. the audiovisual displays in general) are protected under the copyright laws . . ."[92] In other words, a copyright in the computer program (i.e., the literal code) covers the screen displays. The Copyright Office takes the position that

> all copyrightable expression owned by the same claimant and embodied in a computer program, or first published as a unit with a computer program, including computer screen displays, is considered a single work and should be registered in a single application form. . . . Ordinarily, where computer program authorship is part of the work, literary authorship will predominate, and one registration should be made on application Form TX [for literary works]. Where, however, audiovisual authorship predominates, the registration should be made on form PA.[93]

Fierce battles have raged in the past few years over the extent to which a copyright of the literal code protects the program's nonliteral elements. How much protection should be given the structure, sequence, and organization (SSO) of a program, the program's "look and feel," screen displays, and other aspects of the graphical user interface (GUI)? There has been some narrowing of protection since *Broderbund* and this area of the law is still up for grabs.[94]

Although there is argument over degrees, at this point it is pretty well established that copyright protection generally extends to user interfaces.[95] Given that, as one practitioner states, "There is little question but that copyright protection will extend in some form to virtual worlds."[96] For virtual reality represents the ultimate user interface.

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90. Act of Dec. 12, 1980, Pub. L. No. 96-517, § 10, 91 Stat. 3015, 3028, *codified in* 17 U.S.C. § 101.

91. 648 F. Supp. 1127 (N.D. Cal. 1986).

92. *Id.* at 1135.

93. Registration and Deposit of Computer Screen Displays, 53 Fed. Reg. 21, 817, 21818 (1988).

94. Given the disagreements among the federal circuit courts, many in the field are anxiously waiting for the Supreme Court to settle some of the open questions. Gates v. Bando, before the Tenth Circuit Court of Appeals at the time of this writing, may present the opportunity.

95. User interfaces are protectable as nonliteral elements of the computer program, *see* Broderbund, *supra* note 91, or as separate, distinct subject matter, *see* Manufacturers Technologies, Inc. v. CAMS, Inc., 706 F. Supp. 984, 993 (D. Conn. 1989).

96. Russo & Risch, *New Frontiers*, NAT'L L.J., Oct. 12, 1992, at S1.

Software designers continually strive to produce increasingly user-friendly interfaces. Virtual reality is the utmost fulfillment of that end. Instead of users being forced to learn computer language, the VR system responds to the natural gestures of people. In the words of Thomas Furness, Director of the HIT Lab at the University of Washington, "Instead of making the human computer-like, which is what we have done in the past with this invention of the devil, the keyboard, what we need to do is exactly the opposite. And that is to make the computer human-like."[97]

Because it is essentially a user interface, the degree to which VR will be protected is largely dependant on the resolution of the conflict over the strength of user interface protection. The lack of clearly formulated, uniformly applied principles able to provide for a sufficient degree of predictability has hurt the software industry. Confusion can be expected, to some extent, whenever new technology forces an evolution in the copyright law. By the time VR technology comes into its own, it is hoped that the fracas over user interface protection will have settled.

B. The Fact/Expression Dichotomy Applied to a New Technology

The unremitting strength of copyright law and what allows it to evolve with technological innovation is the soundness of its underlying principles. As the law changes under diversified circumstance and different aspects of the law receive greater or lesser emphasis in the inevitable reformulations of the law, the underlying principles guide the way.

One of the significant principles of copyright law is that facts are not copyrightable; only the expression of facts is proper subject for copyright. Although copyrightable, factual works—instruction manuals, technical writing, text books, diagrams, maps, etc.—receive relatively weak protection compared to more creative works like novels and paintings. This is true because of the utilitarian nature of factual works. For example, the purpose of a high school algebra text is to convey in the clearest manner possible the basics of algebra. There is little stylistic variation between different algebra texts because there is only a small amount of protectable expression. In other words, the author's major concern is for what is being expressed, which is not copyrightable, rather than the expression itself. On the other hand, novels are much more expressive than factual works and therefore receive stronger protection.

The fact/expression dichotomy will likely operate in the same way in the virtual reality context. Virtual worlds can be characterized by the nature of the visualization being depicted. It can be based in reality, or it can be an imaginary environment in which the laws that govern the real world are modified, suspended, or contradicted. The former would be a

97. Subcommittee Hearing, *supra* note 10, at 27.

simulated reality while the latter would be an alternative reality.[98] It stands to reason that "factual" simulations, which strive for the closest possible reproduction of reality, will receive weaker protection than an "imaginary" environment, which is more expressive than factual.

The fact/expression dichotomy, which results in varying strengths of copyright protection, is a time-honored principle in copyright law that has a logically foreseeable role in the virtual reality context. The application and logic of the fact/expression dichotomy will not likely undergo significant alteration. The application of other principles of copyright law to virtual reality will not be as smooth but will require significant reworking. The next section explores some of this area.

C. Effect of Interactivity on Authorship and Fixation

> *The most important fact of our product is that our customers can make up their own virtual worlds.*[99]
>
> —*Jaron Lanier, VPL Research*

At the Computer Museum in Boston, a virtual reality exhibit called Artroom introduced the public to VR. One of its creators, Patrice Gelband, describes it:

> You control a wand . . . the wand leaves a trail of tiny colored triangles, which light up and gradually fade away, just like waiving a soap bubble wand that leaves a trail of bubbles in the air. As they light up, the triangles weave a trail of musical tones. Wave the wand around you. You can compose with it to make a kind of musical sculpture.[100]

Is the musical composition copyrightable? What about the visual elements? If so, who is the author, the programmer or the user? Who owns the copyright?

Brenda Laurel, cofounder of Telepresence Research, describes how the old framework of author/spectator is breaking down:

> A piece of computer software is a collaborative exercise between the imagination of the program's creator and the people who use it. It's never finished because it only comes alive when someone uses it and each use is slightly different. . . . Traditional ideas of authorship are leading toward a train crash. . . . Our traditional notions can't come with use. . . . We are in a region where the authorship of the experience is about [the programmer] collaborating with the user in real time.[101]

98. Spring, *Informing with Virtual Reality*, in S. Helsel & J. Roth, *supra* note 16, at 8.

99. Subcommittee Hearing, *supra* note 10, at 48.

100. K. Pimental & K. Teixeira, *supra* note 15, at 6.

101. *Id.* at 155-56. *See also* Woolley, Virtual Worlds: A Journey in Hype and Hyper-reality, 153, 155 (Blackwell Publishers 1992). Woolley agrees that the classic author/reader paradigm is losing its validity.

VR insiders agree that with this technology, the user becomes a co-creator of his or her experience. In another area of interactive computing, desktop publishing, a buyer of a clip-art software package needs written permission to incorporate illustrations from the program into the buyer's publications.[102] Will users be required to sign waivers or enter into licensing agreements before using VR machines?

It should be noted that different VR programs involve various levels of user creativity. Virtual environments vary as to the extent to which the user is creating his own virtual space or merely exploring a predesigned world. Perhaps there needs to be a distinction between programs designed as tools and those designed to be viewed or explored. For example, one idea for a VR entertainment program is a three-dimensional paint system in which users create their own virtual environments for others to explore.[103] Copyright analysis for this type of program will likely be quite different from how more passive programs are analyzed. A virtual-art world on exhibit at the National Gallery of Canada in Ottawa allows the user to explore a spiritually vibrant Native American scene.[104] The user explores a world created by the artist/programmer but does not actively contribute to the creation of the setting. Of course, even in passive, explorational settings like this one, the user controls the perspective from which she arbitrarily views the object or scene. The user therefore controls the screen displays. Even in the least user-creative programs, the user exercises interactive control over copyrightable material.

The high degree of interactivity inherent in virtual reality challenges our traditional conception of authorship. In addition, with virtual reality, the fixation requirement of copyrightability is likely to become an area of debate. The ideas of authorship and fixation deserve closer attention if the issues surrounding copyright protection of virtual reality are to be better understood.

An original work of authorship fixed in a tangible medium of expression is proper subject matter of copyright.[105] In the past, the fixation and originality requirements were not areas of significant controversy. Original authorship refers to the requirement that the work originate with its creator and is not copied from another source. Fixation means that the work is "sufficiently permanent or stable to permit it to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration."[106] For example, the broadcast of a baseball game

102. P. MAGGS, ET. AL., COMPUTER LAW 387 (West 1992).

103. Fisher, *supra* note 58, at 109.

104. K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 234.

105. 17 U.S.C. § 102.

106. *Id.* § 101.

is a copyrightable audiovisual work so long as it is being recorded as it is broadcasted. Otherwise, the fixation requirement is not met.

The fixation and originality requirements were at issue in a group of computer game cases in which the defendants argued that the plaintiff's screen displays were uncopyrightable because they were neither fixed nor original works authored by the programmer since each game was different depending on the moves of the player. In *Stern Electronics, Inc. v. Kaufman*,[107] the Second Circuit observed that while

> the entire sequence of all the sights and sounds of the game are different each time the game is played, depending upon the route and the speed the player selects for his spaceship and the timing and accuracy of his release of his crafts, bombs and lasers . . . many aspects of the sights and the sequence of their appearance remain constant during each play of the game.[108]

In a similar case, *Williams Electronics, Inc. v. Artic International, Inc.*,[109] the Third Circuit, citing *Kaufman*, also rejected the fixation/originality defense:

> Defendant also apparently contends that the player's participation withdraws the game's audiovisual work from copyright eligibility because there is no set or fixed performance and the player becomes a coauthor of what appears on the screen. Although there is player interaction with the machine during the play mode which causes the audiovisual presentation to change in some respects from one game to the next in response to the player's varying participation, there is always a repetitive sequence of a substantial portion of the sights and sounds of the game, and many aspects of the display remain constant from game to game regardless of how the player operates the controls. Furthermore, there is no player participation in the attract mode which is displayed repetitively without change.[110]

The concepts of fixation and original authorship emerged from relative obscurity and were at issue in the video game cases because video games are interactive. Interactivity between the computer program and the user determine the content of the copyrighted audiovisual work, i.e., the screen displays. Although the Second and Third Circuit courts dismissed the fixation and originality defenses in relatively short order in these cases, both courts emphasized the repetitive nature of the screen displays. Fixation and original authorship are likely to become increasingly important concepts as interactive computing generally, and virtual reality specifically, become more prevalent and users are able to exert greater control over the computer-generated environment.

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107. 669 F.2d 852 (2d Cir. 1982).

108. *Id.* at 856.

109. 685 F.2d 870 (3d Cir. 1982).

110. *Id.* at 874.

VI. CONCLUSION

Due to the tremendous hype surrounding virtual reality, some noteworthy insiders shudder and fear the inevitable: will we kill the goose that laid the golden egg? Brenda Laurel warns, "If we do not deliver, and deliver soon, on all the implied and stated promises, VR runs the risk of falling into the same credibility, funding, and profile nightmare as AI [artificial intelligence]—only much more quickly."[111] Laurel recommends less hyperbole and more strategic planning.[112] Other observers, however, refuse to cringe at the AI comparison, indicating "VR does not require a major breakthrough in software or how the brain works . . . all the major components of VR already work."[113] Pipe dream or the next technological explosion? Many scientists, researchers, and technical wizards are working to make virtual reality a part of our everyday reality.

VR enthusiasts have interesting and varied ways of expressing the current developmental status of this nascent technology. Howard Rheingold explains that in 1974, science magazines advertised the first PC, the Altair. The Altair's input mechanism was a series of switches. A row of lights was the output. Ten years later, the first Macintosh PC was introduced. "Today's virtual reality is not quite at the Altair stage," he pronounces.[114]

Henry Fuchs, professor of Computer Science at the University of North Carolina and VR developer, simply states, "Fundamentally, we're still at the Wright Brothers stage. But we may have transcontinental travel in a few years."[115]

Because virtual reality technology is still very young, this article's exploration of copyright issues was necessarily anticipatory and somewhat general. However, one thing is certain. Intellectual property attorneys frustrated by the large degree of confusion over user interface protection should prepare for continued developmental changes in the law. Copyright law has a history of adjusting to new technology as new means of expression are invented. In this computer age of rapid technological advancement, future adjustment in the law is bound to be a little unraveling.

The new technology of virtual reality is perhaps the greatest challenge yet to the law. Interactivity blurs the line between author and audience and therefore threatens the paradigm under which copyright law was conceived. The hope of virtual reality, of course, does not rise or fall

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111. Laurel, *Virtual Reality Design, A Personal View*, in S. HELSEL & J. ROTH, *supra* note 16, at 98-99.

112. *Id.*

113. K. PIMENTAL & K. TEIXEIRA, *supra* note 15, at 242.

114. H. RHEINGOLD, *supra* note 12, at 22.

115. Ryan, *supra* note 41.

on whether traditional copyright principles can be successfully molded to fit this unusual technology. However, when intellectual property protections are unclear or ambiguous, excessive legal fighting can drain resources that could otherwise be used more productively. In contrast, the straightforward formulation of balanced legal protection provides predictability, stability, and helps clear the way for innovation to take place. This is the challenge.