

CyberEdge® JOURNAL

The World's Leading Newsletter of Virtual Reality

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January/February 1994

Application: Hubble Repair Mission Trainer

Howdy, Hubble!

This past December was a milestone in space history. During December, NASA mounted one of its most ambitious efforts since the Moon landings, the Hubble Telescope repair mission. As anyone who has been on Earth for the past few months probably knows, this mission required six EVAs (extra-vehicular activity) of more than six hours each. In two person teams, astronauts removed, replaced and repaired many components of the Hubble Telescope. What interests us about this mission is that it was the first time that VR was used as a significant part of mission training, both for flight crew and ground-based team members.



Mission specialist Jeffrey Hoffman, in the HMD, is training on Hubble EVA procedures. Fellow STS 61 crew members Thomas Akers, Kenneth Bowersox, Claude Nicollier, Richard Covey and Kathryn Thornton practice maneuvering the robot arm with Hoffman perched at its end.

We first reported on the Hubble Mission Trainer in our November/December 1992 issue. At that time, Bowin Loftin and his team working in the Software Technology Branch at the Johnson Space Center (Houston, Texas) had just finished their first prototype of the system. We found it exciting and innovative. During the last months of 1993 the system was put into operation. NASA

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1993 Virtual Reality Product of the Year

CJ Finalists Announced

I like writing this article! Each year, in January, I get to tell the world which products are finalists in the *CyberEdge Journal* Virtual Reality Product of the Year Award (the CJs) selection. This year we have by far the largest field ever, and that is extremely encouraging, as it shows, perhaps better than any other measure, the growth and increasing strength of the VR industry. This year we have 39 finalists!

This is the third year of the CJs, making them the oldest and most important recognition in the VR world. Past winners have included *Virtuality*, *WorldToolKit* (twice), *Legend Quest*, *Wheelchair VR*, *RealityEngine*, *ProVision*, and *FasTRAK*. There is no pre-determined number of

awards, in the first year we bestowed three, last year five.

Advancing the State of the Art and Industry

Awards are given in two categories, *Hardware* and *Software and Applications*. The criteria are simple: the product must have been introduced in the previous year, and must have made a substantial contribution to the art and industry of Virtual Reality. New versions of previously released products are eligible for consideration. All of our finalists meet those criteria. The very best will win the coveted 1993 CJs. Congratulations to everyone involved in the development of these fine products.

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CyberEdge Journal is dedicated to this mission:

To provide an information channel for those involved in advancing the state of the art of human-computer interaction.

To promote the open and free exchange of ideas and information related to the role of cybernetics in the future.

To encourage the synthesis and growth of new ideas and devices.

To assist in the development of commercial products incorporating these new concepts and technologies.

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Coming Up

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Ghent, Computer Links
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Virtual Environment Products:

Avoiding Product Liability Suits

By Paul E. Paray And James P. Jenkins, © 1994

Mention the words "products liability" to a virtual reality product manufacturer and you might get a blank stare in return. Many virtual reality product manufacturers are simply not in tune with the broad brush devastation this theory of law can inflict on a growing company's overhead. Some creative lawyers and inventive expert witnesses have generated a cottage industry by using pseudo-science to influence juries. With proper due diligence, virtual reality product manufacturers can avoid having to waste time defending lawsuits and waste money in increased insurance premiums.

Three important tests

The law of products liability is generally easy to understand but difficult to apply. Under the law of most states, one who manufactures, distributes, or sells a product in a defective condition unreasonably dangerous to the user is subject to liability for physical harm caused by the product if 1) the seller is engaged in the business of selling such a product and 2) it is expected to and does reach the user without substantial change in the condition in which it is sold. Lawsuits can be pursued against the seller of the product even if the seller has exercised all possible care in the preparation and sale of the product and the user or consumer of the product has not bought the product from or entered into any contractual relation with the seller. Simply put, the manufacturer, distributor or seller is strictly liable to the consumer for all injuries sustained from use of the defective product after the product has entered the stream of commerce.

Under the law of most states, the existence of a "defect" or unreasonably dangerous condition is a prerequisite to recovery. A product may be in a defective condition, or unreasonably dangerous to the user, by virtue of a manufacturing defect, a design defect, or inadequate warnings or directions. Whether a product has a "manufacturing defect" can be determined by comparing it with other units from the same assembly line. A product with a design defect is not reasonably fit, suitable or safe for its intended purpose.

Some states provide that a manufacturer or seller is not liable for any injuries to a user if

at "the time the product left the control of the manufacturer, there was not a practical and technically feasible alternative design that would have prevented the harm without substantially impairing the reasonably anticipated or intended function of the product." Because this "state-of-the-art" defense is based on the state of the scientific knowledge, it tends to expand faster than its assimilation by industry.

Lastly, a product may be unsafe if it fails to adequately warn foreseeable users as to dangers inherent in the use of the product. Sound business practice requires virtual reality product manufacturers to fully explore current technology and potential liability issues before products are marketed for public use.

Radiation risk?

Virtual reality product manufacturers should be concerned with the perceived possible physical effects of HMDs and electromagnetic tracking devices placed near the body. Most of the tracking devices on the market employ an electromagnetic sensor technology. These tracking devices generally operate at over 100 Hz, and they are placed near users for only short periods of time. Whether the short term exposure to fields generated by electromagnetic tracking devices can cause harm to users has been given little mention in the virtual reality literature.

Although ionizing radiation such as x-rays or gamma rays are able to knock-out electrons from atoms and cause damage to DNA and tissue, non-ionizing radiation such as ELF-EMFs do not displace electrons as they pass through tissue. Evidence is inconclusive that human exposure to ELF-EMF electric and magnetic fields can increase the risk of cancer and leukemia. (See "Extremely Low Frequency Electric and Magnetic Fields and Risk of Human Cancer, 11 *Bio-Electromagnetics* 91, 92 (1990)). Indeed, a good deal of research indicates that there is no danger due to extended ELF-EMF exposure. For example, a study conducted by Southwest Research Institute that was reported in the September 1993 *Industrial Health & Hazards Update* indicates that exposure to 60 Hz electric and magnetic fields on non-human primates did not cause signifi-

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Job Mart

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Positions Offered

Engineering firm needs contractors: **VIRTUAL WORLDS DESIGNERS**. Immediate openings for experienced contract virtual worlds designers in a UNIX/Mac/PC environment. Position requires knowledge and experience in the following areas: * Visual simulation database development (desired) * GIS SW (ARC/INFO)

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Avoiding Liability Suits

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cant problems. Notwithstanding this research, the fact remains that the choice of which exposure parameters constitute a proper safety zone is difficult to measure.

Which risk is greater, lawsuits or radiation?

Paul Brodeur, in a series of *New Yorker* magazine articles and two books, the latest one titled *The Great Power-Line Cover-Up: How the Utilities and the Government are Trying to Hide the Cancer Hazard Posed by Electromagnetic Fields*, has created a cottage industry by speculating as to the dangers of extremely low frequency electromagnetic fields (ELF-EMFs). These fields are in the 30-300 Hertz (Hz) range. Although commentators in the August 5, 1992 issue of the *Journal of American Medical Association* state that any conclusion of human health risk due to ELF-EMF exposure is premature, the fact remains that there are vocal groups seeking to exploit any ambiguities in the medical literature. One such group is a nation-wide group of lawyers who collectively call themselves the Electromagnetic Radiation Case Evaluation Team (EMRCET). EMRCET

seeks out ELF-EMF cases in order to create legal precedents for subsequent cases. In other words, they generate business by using the popular media to sensationalize phantom dangers and exploit fears. Several courts have recently rebuked such tactics. For example, Pennsylvania Public Utility Commission Administrative Law Judge Hubert Smolen ruled in September of 1993 that evidence of dangers associated with ELF-EMFs "taken as a whole remains inclusive".

Even without the medical evidence, there are ELF-EMF products liability lawsuits being filed and there is money being spent defending these suits. According to an article in the November 2, 1993 *Wall Street Journal*, more than a hundred lawsuits and regulatory disputes involving EMF complaints have been filed nationwide. Because present virtual reality technology relies heavily on electromagnetic tracking devices, safety concerns and preventive litigation techniques should be analyzed while the industry is in its infancy.

An ounce of prevention...

Although there is no reason to believe the electromagnetic tracking devices are anything but safe, there is still no available talisman to ward off groups such as EMRCET and the circulation-driven media. Accordingly, there are three business strategies virtual reality product manufacturers can employ to better the likelihood that a jury will determine a product is safe.

First, virtual reality products manufacturers should obtain a basic understanding of the proper use of warnings. A product may be unsafe if it fails to adequately warn foreseeable users as to dangers inherent in the use of the product. This duty to warn is a continuing one. It requires a manufacturer to provide warnings of dangers that the manufacturer discovered or reasonably should have discovered after the product left its control. Courts use an objective standard to determine the adequacy of a product warning. An adequate warning is "one that a reasonably prudent person in the same or similar circumstances would have provided with respect to the danger, and that communicates adequate information on the dangers and safe use of the product, taking into account the characteristics of, and the ordinary knowledge common to, the persons by whom the product is intended to be used..."

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Avoiding Liability Suits

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Simply put, a product warning must illuminate the mind of the reasonable user by explaining risks not reasonably appreciated when a product is in use. A manufacturer's liability for failure to warn is always contingent upon proof that the missing warning was indeed the proximate cause of a plaintiff's injuries. And, the issue of proximate causation turns on whether proper warnings by the manufacturer would have prevented the harm. For example, in order to warn against the possibility of physical injury due to movements made while navigating in cyberspace, it would be prudent to offer a potential user an instruction leaflet or present a video demonstration warning the user not to make sudden wide-ranging motions while navigating in a virtual reality system. There is a rebuttable presumption that a plaintiff would have followed such a warning if it had been given.

Adequate warning

Determining whether warnings and instructions are adequate is not an easy task. For example, because a clear understanding of all potential hazards and consequences of injury must be had before any warnings or instructions can be created, it is difficult to determine safety standards until a suitable institution or governmental agency imposes some safety parameters. After such information is obtained, several important questions must be asked. Does the warning or instruction describe how to avoid the hazard? Would the warning or instruction make a difference?, *i.e.*, would anyone bother to heed the warning or follow the instructions? It may even be advisable to liken a virtual reality systems experience with an amusement park ride and to list those persons who should not "ride" in cyberspace.

Second, virtual reality product manufacturers should openly discuss safety issues and pool health and safety information now that the industry is still in its infancy. Shared safety research would benefit all segments of the industry. Indeed, the common goal of building a customer base for virtual reality products would be furthered if manufacturers pooled their resources.

Third, the formation of a Virtual Reality Technology Business Consortium would be a cost-effective means of dealing with these vir-

tual reality product safety issues. Associations such as the Product Liability Prevention and Defense Group in Falls Church, Virginia already help manufacturers of machinery improve their defense against litigation. Commensurate with their ability to pay and their percentage of activity in developing virtual reality products, qualifying start-up companies could even join this consortium.

Unacceptable risk

Virtual reality product manufacturers are urged to address these issues in a straightforward, practical manner before waves of lawsuits are given a chance to materialize. Although it certainly does not make any sense to begin preparing for a specific lawsuit before it is filed, virtual reality product manufacturers are urged to consider implementing the above measures in order to prevent the first suit from going to trial. Similarly, it is also a good idea for manufacturers to meet with the loss controls representative of their insurance carrier to discuss methods for evaluating possible risks of loss before any claims are made. Simply put, although entrepreneurs are by definition "risk takers," there is no reason to gamble on the ingenuity of groups such as EMRCET.

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Job Mart

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Interface Technologies has two openings: Software Engineer: 5+ years experience in industry, government, or academia and comfortable working under an aggressive schedule. Will have primary responsibility for software development, and integration of virtual environment systems. Responsibilities will include integrating proprietary software, third-party software, hardware components such as head-mounted displays, spatial trackers, other displays and controls, and user interfaces. The basic qualifications include experience with: C or C++ (5+ years) UNIX operating system object-oriented design / object-oriented programming, designing and writing modeling and simulation software, designing user interfaces. Experience with virtual environment systems development and integration is a benefit. A B.S. in Computer Science or a related field is required; an M.S. is preferred. Excellent oral and written communication skills required.

Human Factors Engineer: 2+ years experience in industry, government, or academia, with aggressive scheduling. Will have primary responsibility for managing the laboratory, and for research on virtual environment system

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07452 USA, 201 612-9772, FAX: 201 652-1785, CIS: 73624,1520.

Paul Paray is a litigator with experience in complex commercial, product liability, and computer law matters. He has written several articles for the Uniform Commercial Code Law Journal concerning the judicial treatment of damages exclusions negotiated in custom software licenses. He is admitted in New Jersey, New York and District of Columbia courts.

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The opinions set forth in this article are solely those of the authors and do not represent official NASA policy on any issue discussed.

¹⁾ Restatement (Second) of Torts § 402A(1) (1993)

²⁾ Restatement (Second) of Torts § 402A(2) (1993)

Money in VR

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point of view. Patricoff was an early investor in VPL Research, having put in US\$50,000 in 1986, and is part of the group which recently brought the Virtuality Group public. His presentation was a primer in funding, tempered by as much experience as any investor has had in the VR business, which is, he said quoting Jaron Lanier, a bit "like surfing in an avalanche of boulders".

Bottoms sees a tremendous potential for VR, which he expects to be the preferred interface for simulation, communication, artificial intelligence and multimedia applications. The success of the VR industry will be driven by its ability to reduce cost, improve interfaces, and implement efficient programming methods, he cautioned. Bottoms identified six areas of immediate opportunity for entrepreneurs and investors in VR:

- Sensors
- Telemetry
- Display technology
- Graphics engines
- Software development tools
- Programming/Applications

Patricia E. Glovsky, of the Polygon Capital Group, started off by polling the audience.

³⁾ N.J.S.A. 2A:58C-3a(1). See also, Colo. Rev. Stat. § 13-21403(a); Ky. Rev. Stat. § 411.310(2); Tenn. Code Ann. § 29-28-105(b).

⁴⁾ Given the fact that their products are placed so close to the body, manufacturers of HMDs and electromagnetic tracking devices should be particularly mindful of products liability issues. It should be stressed that both AMLCD HMDs (having high energy backlights) and CRT HMDs may actually produce higher density EMF fields than electromagnetic tracking devices.

⁵⁾ A Hz is equivalent to one cycle per second.

⁶⁾ See N.J.S.A. § 2A:58C-4.

⁷⁾ Although IEEE C95.1-1991, *Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz* is a step in the right direction, even the IEEE suggests that further research be conducted. See "Research Needs in Health Effects of Power Frequency Electric and Magnetic Fields", IEEE U.S. Activities Board Entity Position Statement (1991).

The show of hands indicated that 20% were already running a VR company, 10% were looking for funding and 5% were investors. She discussed the objectives of large funders: a 1000% or greater return in 5-7 years, and stressed the importance of a business plan that demonstrates that income potential. One way to provide that return is a public offering, the strategy taken by Virtuality Group, Division, and Virtual Universe in the past year. While this may be lucrative, it imposes significant up front expense and ongoing regulatory burdens on the company, and needs to be considered carefully. Glovsky's talk meshed well with Patricoff's to provide a good foundation for budding VR capitalists.

We were impressed with this show. Once again, the Meckler organization and conference chair, Sandra Helsel, did a good job of providing solid organization and valuable information. The show floor was bustling, and many of the vendors with whom we have spoken told us they did good business. The two evening sessions were not well attended, and probably need either more promotion, a scheduling change, or to be dropped, but that was a minor flaw in what was otherwise a worthwhile show.

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