Real Fun, Virtually: Virtual Experience Amusements & Products in Public Space Entertainment

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Abstract

Ask most amusement industry analyst what technology seems to define next generation amusement systems and they will probably tell you "virtual reality." Ask them what it means and you may get a different answer from each person you ask.

This paper begins with an examination of what is virtual reality, and explores how and why virtual reality technologies are being increasingly incorporated in public space amusement products and attractions. Included are specific discussions of relevant consumer trends, virtual experience attractions in malls and theme parks, and near and long term emerging product trends.

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- Character animation
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- Real Time Computer Simulation
- Implementation of Virtual Space
- Art and entertainment

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Introduction

In Star Trek: The Next Generation, the crew of the Enterprise often find respite and solace from the drudgeries of intergalactic travel in the "Holodeck," a room which transforms their oral instructions into completely realistic, three-dimensional people, places, and things. Many crew members use the Holodeck to take strolls in forests or to ride horses along mountain trails. Medieval feasts complete with pheasant and dark beer are another popular selection. Data, the ship's trusted android, once used the Holodeck to learn humor from a comedian in a 1980s comedy club.

The Holodeck is perhaps the ultimate manifestation of "virtual reality" in a public space entertainment. And while the technology it encompasses may be a century or so away, many forms of Virtual Experience Amusements & Products are in use today in public spaces, primarily malls and theme parks, and more sophisticated versions will soon be available.

What is "Virtual Reality?"

There is not yet a standard definition for virtual reality. Most technical definitions describe virtual reality (VR) as an environment and/or technology which provide artificially generated sensory cues sufficient to engender in the user some "willing suspension of disbelief." In other words, you believe you are doing what you are doing, even though what you are doing may be artificially created. The popular press often implies that virtual reality is interactive computer generated, 3D graphics which are delivered via headmounted displays.

As the academic definition implies, it is probably most appropriate to focus on *experience* as "virtual reality" rather than a specific set of *technologies*. Of course, with a focus on experience, whether a product or environment provides *virtual reality experiences* is completely subjective and is ultimately defined by the user, participant, or observer of these products/environments (or the author, as is the case with this article). Therefore, implicit in any description of a "VR" product or amusement is that the provider of the definition (whether this be the author of an article or the manufacturer of the product/attraction) believes that the product or attraction provides an experience that is virtually real or at least realistic.

Sophisticated VR systems are often interactive and usually simulate real world phenomenon – sight, sound, touch – with some combination of computer-generated input to users' eyes, ears and skin. Using head mounted displays, gloves, and even "bodysuits," or large projected images in simulator cabs, users can "enter" and interact with virtual or artificially generated environments. Since multiple people and even large groups can potentially share, and interact in, the same environment, VR can be a powerful medium for communication, entertainment, and learning.

Types of VR. There are currently three major implementation types of VR – *immersion, desktop/vehicle, and third person* – which define three different organization principles that most VR systems reflect in their designs and operation.

1. **Immersion VR** describes a system which "immerses" or surrounds the participant in an environment. In W Industry's Virtuality system

and in a similar system developed at the University of North Carolina, for example, users wear goggles with small monitors in front of their left and right eyes which display stereo images (3D) that change depending on where the user is looking. UNC's system allows you to "walk" through a computer-generated, 3D representation of the University's computer science building. If you look up, you see the building's ceilings, look left or right, you see walls, look down, you see the floor, walk (you are on a treadmill) and you move through hallways and rooms. RB2 also includes head mounted displays and even provides gloves and bodysuits which track and project (through computer animation) your hand and limb movements , allowing you to "grab" and manipulate objects. As a result, you actually perceive that you are *inside* an environment. Immersion VR systems are the most demanding types of VR systems in terms of the technology required to offer the appropriate system response and graphics display rate.

2. **In Desktop/Vehicle VR,** users view and interact with an environment through a portal or "window" much as a sailor might view the world through a submarine periscope. Flight simulators are perhaps the most developed examples of desktop/vehicle VR and appear in two forms: desktop simulators and simulator "cabs." Both varieties use real time graphics (10-60 frames per second) to simulate the movement of planes, ships, tanks, trucks, and even cars. Flight simulator cabs often include full vehicle instrumentation, motion bases with two to six degrees-of-freedom (measures of movement), and powerful spatial positioning sound systems. So sophisticated are these simulators, in fact, that military and commercial aviation pilots often spend more time training in them than they do in actual aircraft.

3. **In Third Person VR,** users *view themselves or objects they control* immersed in a three dimensional environment. The Mandala System from Vivid Effects is one of the best examples of third person VR. In the Mandala System, users stand in front of a video camera which captures their image and body movements and sends the information to a computer that composites the images with computer and laserdisc based imagery. Users then view the resulting images – their body as seen through the video camera, computer graphics, and laserdisc imagery – on a monitor in front of them. With this process, users are able to "play" instruments, simple sports exercises, and education games, by manipulating with their hands, feet, and body the computer generated objects they see in the monitor.

Delivery mediums. VR systems can be deployed in a variety of delivery mediums. Some of the more popular mediums:

1. **Desktop.** Desktop systems, like the desktop implementation type previously described, provide their virtual experiences through a monitor. SimGraphics' Assembly Modeler, which allows Northrop engineers to test airframe assembly components, is an example of a desktop VR system.

2. **Cab.** Flight simulator cabs, as previously mentioned, include projected graphics, motion bases, and realistic instrumentation.

3. **Headmounted displays/gloves.** Immersion systems use headmounted displays for input/output. Some systems also make use of special gloves and body suits.

4. **Theater.** New types of theaters, some of which include 70mm projection and motion seats, offer VR-types of experiences to large groups of people.

History. Flight simulator were the earliest application of some of the more common VR technologies – interactive, real-time, 3D graphics. Ivan Sutherland and Navy Commander George Hoover were both pioneers in the development of flight simulator (desktop/vehicle VR) technologies. Tom Furness and his group at Wright-Patterson Air Force Base developed one of the first immersion VR systems, the "SuperCockpit", which allowed pilots to fly planes without copilots. As previously mentioned, both UNC and VPL have developed sophisticated immersion systems. Mattel's PowerGlove for Nintendo, developed with Abrams/Gentile Entertainment, was the first consumer implementation of VR, and allowed users to control a computer generated, 3D "hand" with their own hand. SimGraphics' developed the first 2D, 3D control and navigation input device, the Flying Mouse, for Northrop's Assembly Modeling System, an interactive, 3D CAD design and manufacturing verification program used to design and test airframe assembly parts.

Virtual Experience Amusements & Products (VEAPs)

Flight simulators have already verified that VR can be powerfully effective for learning/training

applications. For some of the same reasons, VR is proving to be as effective in entertainment applications, most of which are currently located in public space venues. Fed by an enthusiastic and growing consumer interest, there is now an emerging set of Virtual Experience Amusements and Products (VEAPs) which strive to offer consumers "virtual reality", "simulation", or "extrasensory" experiences.

What are Virtual Experience Amusements & Products? VEAPs are multisensory attractions, exhibits, or products for the home and public spaces which include realistic visual and sound capabilities and any one or more of the following technologies – motion control, tactile feedback, olfactory generation, 3D imaging, large format (70mm), 3D sound, networking. This arbitrary definition encompasses only amusements which, by design, offer virtual reality and extrasensory experiences, such as Star Tours, Battletech, Sega's R360 simulator (see below), and 70mm IMAX theaters, and excludes those that offer traditional experiences such as a standard amusement ride, 35mm film theater, or videogame experiences.

As an acronym and term of organization, Virtual Experience Amusements and Products may be more appropriate than Virtual Reality Amusements and Products because VR, as previously mentioned, though still amorphous and subjective, is increasingly used to describe immersion and desktop-based interactive entertainment systems. However, there are many simulator and 70mm theater based attractions and products which do not bill themselves as VR, but which offer some of the same types of technology and multisensory experiences (usually passive). Therefore, VEAPs is an appropriate term to describe both the VR and the multisensory, "VR-like" attractions and products.

VEAP Trends. Several general trends are responsible for VEAPs proliferation in public space entertainment. In general, the public seems to like VR and its technological derivatives: 3D graphics, interactivity, motion, etc. Led by the popularity of Nintendo, 900 numbers, and VCRs, there is a general trend to develop *interactive* entertainment, where consumers have the ability to define or control their entertainment experience. Another major trend is towards entertainment which provides for group participation. In Atari's "Final Lap," for example, up to four players compete against each other in a simulated race. Consumers rate multisensory theme park attractions which combine film and motion as among their favorite rides. Star Tours, one of Disneyland's most popular attractions, combines a flight simulator motion base (for physical stimulation) with a movie (for cognitive stimulation) which together give "riders" the impression that they are taking a three and a half minute trip to the "Moon of Endor." Based on the success of Star Tours, most major existing theme parks, and almost all new theme parks, feature simulator-based rides as one of their primary attractions.

Amusement/mall developers appreciate VEAPs because they have relatively small real estate requirements (flight simulator versus a roller coaster, for example), and they can be easily reconfigured to offer new experiences. Doran's SR2 is a pay-per-play flight simulator cab located in malls and arcades, with a motion base, seating for fourteen, and a variety of short, passive, filmed "rides" in various vehicles (cars, planes, dune buggies, New York taxi cab, etc.). New films are distributed regularly in order to encourage repeat visitation.

VEAP Classifications. As with general systems, VEA can be organized according to the three major implementation types – immersion, desktop/vehicle, and third person. There are two other methods to further classify these systems, both of which focus on the nature of the experiences the systems' offer. The first method concerns the following general categories:

1. **Passive or interactive.** Interactive systems give users some degree of control over their experience. For example, they can shoot at targets, steer their vehicles, or control their speed. Passive systems offer no control. As a movie, "Star Tours" cannot be controlled or altered by the audience; it is always the same ride.

2. **Level of interactivity.** Systems with limited interactivity only allow users to, for example, shoot a target or control speed; they cannot alter their vehicles' course. Most video games offer moderate interactivity; users can control their vehicles or characters within a certain predefined course or track. Fully interactive systems, such as flight simulators and RB2, place few constraints on users; there are no

predefined tracks or courses. Users are free to fully explore their environments.

3. **Individual, group.** There are individual and group passive VR systems, and individual and group interactive systems. A theater with motion seats (see below) is an example of a group passive VR system because the audience cannot alter the movie they view. An aircraft flight simulator is an example of an individual interactive VR system.

Four more specific classifications for VEAPs:

1. **Passive rides.** Amusements which offer short, passive experiences that combine film or video imagery with motion. Simulator rides such as Star Tours and SR2 are the best examples of passive ride experiences.

2. **Interactive games.** Multisensory videogames which offer the same kind of interactive, computer generated experiences found on traditional videogames, but which include other types of sensory input such as motion or networking. A few examples: Sega's R360 which combines a standard videogame with a 360 motion base or Atari's Final Lap, which links up to four players in the same race.

3. **Interactive exhibits.** Multisensory educational exhibits which offer a variety of sensory stimuli. The Exploratorium's Tour of San Francisco, which allows users to view and navigate through a projected, aerial database of San Francisco, is a good example of a multisensory interactive exhibit.

4. **Interactive movies.** Interactive movies are longer form interactive experiences, more diverse and complex than interactive games, which include the same kind of character development, story, and cinematic elements that are currently found in film. First generation interactive movies are being introduced on the new consumer multimedia computers. ICOM Simulations recently introduced a CD-based "interactive movie" which allows users to help Sherlock Holms to solve murder mysteries. The game includes both video and computer generated imagery.

Survey of Current Systems

Note: Although there is no standard classification, many VR "technologists" would not consider all the products/attractions listed below as examples of VR technology. However, they all include important elements of VR technology and they all seem to reflect the publics' acceptance, and interest in, VR.

Desktop. Most desktop/vehicle systems offer interactive games and are designed for individuals. Video games such as Atari's "Hard Drivin'" offer realistic graphics and "force feedback" steering wheels which shake and vibrate when the users' car wrecks. Mattel's "Super GloveBall" allows participants to play a computerized form of handball using the PowerGlove. Lucasfilm Games' "Habitat" is an example of a group-based, interactive system. Linked via phone network, players create and interact in a fictitious world.

Theater. 3D theaters may be the earliest application of passive, group-based VR technologies. Disneyland's "Captain EO" is a theater which includes sophisticated 3D projection, special lighting, lasers, and atmosphere generation (fog and cold air). "Mission to Mars", another Disneyland attraction, includes two screens and motion seats which take the audience on an ill-fated trip to Mars. Showscan, Omni Films, and Ridewerks all have introduced 70mm movie theaters which include motion seats that move according to the action on the screen. These theaters, which provide passive ride experiences, are proving to be extremely popular with audiences, and are being installed in theme parks, malls, and museums around the world.

Cab. As previously mentioned, the public seems to enjoy flight simulators; six years since its introduction, Disneyland's "Star Tours" continues to be one of the park's most popular attractions. Universal Florida's "Back to the Future" attraction also utilizes simulator cabs (designed to

look like DeLoreans), with motion bases which take participants "back to the future." Doran's SR2 and a similar product from Super X are pay-per-play cabs with motion bases and are extremely popular in video arcades and family amusement centers. Several video game developers have introduced video games with small cabs and motion bases. Sega's "Galaxy Force", for example, offers three degree-of-freedom movement and high quality 3D graphics. All of these products offer passive ride experiences.

Immersion. W Industries recently introduced "Virtuality", the first immersion VR system (headmounted display, gloves). The system is designed for arcades and has already been deployed in several locations around England. Horizon Entertainment is now distributing the system in the United States. Virtuality offers a variety of interactive games.

Current Developments

Spurred on by consumer acceptance of "Star Tours" and other simulator attractions and by the attractive economic opportunities simulators offer (cost -v- real estate requirements), theme park and mall developers are developing more sophisticated group, simulator-based attractions which offer passive ride experiences. EPCOT recently opened "Body Wars", a simulated tour through the human body. Sanrio Puroland in Japan offers "Journey to the 4th Dimension", an attraction that integrates 3D 70mm projection, motion seats, olfactory generation, and wind. In "Earthquake", an attraction at Universal Studios, participants actually experience a simulated 7.2 earthquake while riding their tram through a San Francisco subway set.

One new trend in VEAPs combines interactivity and group participation. Virtual World Entertainment's BattleTech Center is a video arcade for adults where two teams of eight battle in a simulated world of the year 2025. BattleTech utilizes a network of individual cabs, each of which has detailed instrumentation, videogame quality graphics, and sound. Video companies like Sega and Atari are developing more powerful video games that include multiple views, motion, and tactile feedback.

Future Developments

Next generation systems will include powerful 3D graphics, 3D sound, cabs with motion, and more sophisticated group and individual experiences that are designed to appeal to more than just males under the age of 30 (the target market for video games).

SIMNET, a network of 250 tank, helicopter, and plane simulators which allows Army personnel to train in a realistic, simulated battle environment, has already verified the feasibility and effectiveness of large capacity, group simulator networks. BattleTech has shown that these same technologies can work effectively in an entertainment venue. Within the next three years, complexes which offer sophisticated, *interactive movies* will open and will provide experiences that appeal to an increasingly more diverse audience – eventually reaching the same major market segments for which movies are designed. These theaters will offer a variety of different interactive movies: short, long, competitive, educational, individual, and group. MCA and VPL have announced plans to build in interactive theater at Universal Studios, Los Angeles which will allow audience members to participate in 15 minute "voomies" (virtual movies).

Just as theatrical movies moved home through video, so, too, will interactive movies migrate home when the proper platforms are available. Home consumers may be able to tour the human body in "cell mobiles", explore the solar system, or wander through the streets of ancient Rome. Home participants may even be able to link into these systems through their phones.
Several home gaming entertainment companies are actively developing immersion home gaming and learning systems.

Real-time character animation is a new technology that holds great promise for public space entertainment applications. SimGraphics recently introduced the Performance Animation System (PAS), a technology which provides for the creation of high resolution, computer generated characters and objects in real-time. With the PAS, users, wearing specially designed face, body, and/or hand armatures, can control computer generated characters with their own movements.

Working with PAS, SimGraphics developed the Mario In Real-time (MIRT) System for Nintendo, an application which allows an operator to control a huge, computer generated model of Mario, Nintendo's best selling software character. MIRT is the first application to use a face armature, a special device which tracks a users head, face,

and lip movements, allowing him or her to control the corresponding features of Mario. MIRT made its public debut as a "host" to Nintendo's pavilion at the Winter 1992 Consumer Electronics Show in Las Vegas. Other potential applications for real-time performance animation include live stage venue events, where actors control projected, computer generated characters, product promotional events, such as the MIRT System, and as theme park attractions.

Conclusions

These kinds of advances will make the Holodeck more and more of a reality. In addition to character animation systems, a few companies have even introduced computers which create 3D holograms in real-time. This means that, within the decade, immersion VR systems will actually present users with very realistic 3D characters and environments. You will be able to stroll through forests and walk mountain trails. Unfortunately, medieval banquets with pheasant and dark beer will take more time; researchers have yet to develop reliable ways of creating realistic computer-generated smell, touch, and taste.

About the Author...

Steve Glenn is a Vice President of SimGraphics Engineering Corporation and is responsible for the company's Adventure/Entertainment Group. SimGraphics is a software development and systems integration firm specializing in the development of virtual reality and visual simulation solutions for engineering, training, and entertainment. The Adventure/Entertainment Group at SimGraphics focusing on the development of virtual reality-based entertainment applications for home and public spaces, and has completed design and development projects for Nintendo, Osaka Gas & Electric, Abrams/Gentile Entertainment, and Texas Instruments. Prior to SimGraphics, Steve was a Marketing Manager at Apple Computer, and before that, Vice President of Marketing and Sales for Clearview Software, a company he co-founded and sold to Apple. Steve received a BA in psychology from Brown University, studied urban planning at the Harvard Graduate School of Design, and completed the Coro Fellows Program.