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## Virtual Reality: The Reality of Getting it Admitted, 13 J. Marshall J. Computer & Info. L. 145 (1994)

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## COMMENT

# VIRTUAL REALITY: THE REALITY OF GETTING IT ADMITTED

### I. INTRODUCTION

Twelve people watched Artie Mitchell walk from room to room as his brother Jim shot at him eight times.<sup>1</sup> They saw Artie crumble to the floor and die.<sup>2</sup> Yet there were no eyewitnesses to Artie's death.<sup>3</sup> How can this be? The twelve people were the jurors in Jim Mitchell's murder trial.<sup>4</sup> What they saw was a computer animated recreation of Artie's death.<sup>5</sup>

In a computer animation, a computer interprets data into an animated simulation that can be displayed in the courtroom.<sup>6</sup> In recent

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1. San Francisco porn-movie king Jim Mitchell was arrested February 27, 1991 for allegedly shooting his brother Artie eight times. *Is VR Real Enough for the Courtroom?*, BUSINESS WEEK, Oct. 5, 1992, at 99. The prosecution presented a computer animated recreation which depicted Artie Mitchell walking from room to room as red lines showed the trajectories of the eight bullets. Claire Cooper, *Computer Animation on Trial*, THE SAN DIEGO UNION-TRIB., Jan. 27, 1993, at E1.

2. *Id.* The computer animated recreation showed Artie Mitchell crumble to the floor as the seventh and fatal shot hit him. *Id.*

3. *Is VR Real Enough for the Courtroom?*, *supra* note 1, at 99.

4. *People v. Mitchell*, 12462 (Cal. Super. Ct., Marin Co., 1992).

5. SCIENCE AND TECHNOLOGY WEEK: Trial Computer, (CNN television broadcast, Feb. 29, 1992). Ballistics expert Alexander Jason created the computer animation using his personal computer and the Autodesk 3-D Studio program. *Id.* Jason used ballistic evidence to determine where Artie Mitchell was standing each time he was shot. *Id.* Text on the right side of the screen described the action taking place in the film and displayed the time elapsed. Cooper, *supra* note 1, at E1.

6. ELAINE M. CHANEY, Note, *Computer Simulations: How They Can Be Used at Trial and the Arguments for Admissibility*, 19 IND L. REV. 735 (1986). "A computer simulation is an artificially created extrapolation of an event represented by limited data or input that continues the event beyond the stated mathematical or factual basis; in other words, a simulation provides information about what would have happened or alternate theories of the accident." Kathlynn G. Fadely, *Use of Computer-Generated Visual Evidence in Aviation Litigation: Interactive Video Comes to Court*, 55 J. AIR L. & COM. 839, 842 (1990). "What computer animations can do is take you to impossible places, show you things that would normally be impossible to show, and possibly too dangerous." Paul Marcotte, *Putting Jury in Your Shoes*, A.B.A. J., July 1987, at 20, (quoting Robert Seltzer, president of Graphic Evidence). Letting jurors see and experience what you are describing helps win cases. *Id.*

years, computer generated animations have entered the courtroom in both civil and criminal trials.<sup>7</sup> For example, computer animations have been used in cases involving patent infringement,<sup>8</sup> disasters,<sup>9</sup> and industrial accidents.<sup>10</sup> Computer animation is becoming increasingly popular with attorneys because such visual evidence has a powerful impact on the mind of the finder of fact.<sup>11</sup> It may, in fact, have a much stronger impact on memory than any testimonial evidence offered on the same subject.<sup>12</sup> Given its powerful impact, one wonders what the future holds for computer animated evidence. According to many experts, the leading trend in the computer industry is a fascinating new technology called

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"If a picture is worth a thousand words, video in the courtroom can be worth millions of dollars." *Id.*

7. Vicki S. Menard, Note, *Admission of Computer Generated Visual Evidence: Should There be Clear Standards?*, 6 SOFTWARE L. J. 325, 325-26 (1993). See generally Perma Research & Dev. v. Singer Co., 542 F.2d 111 (2d Cir. 1976), cert. denied, 429 U.S. 987 (1976) (expert testimony based on computer simulation which showed anti-skid device could be perfected); Holland v. Dick Youngberg Chevrolet-Buick, Inc., 348 N.W.2d 770 (Minn. Ct. App. 1984) (computer simulated test offered to show truck could not perform at required speeds); Schaeffer v. General Motors, 360 N.E.2d 1062 (Mass. 1977) (computer simulation used to show alleged defect in product did not cause automobile collision); People v. McHugh, 476 N.Y.S.2d 721 (N.Y. Sup. Ct. 1984) (one and a half minute computer simulation admitted to show weather conditions and an open electric box, rather than drunk driving, caused accident).

8. A New York City jury recently awarded 5.3 million dollars to a plaintiff who claimed patent infringement on a complex mechanical device. Lauren Shay, *Animation in the Courtroom*, 77 A.B.A. J. 64 (1993). An integral role in the plaintiff's success was the ease with which he demonstrated to the jury the similarities between the inner workings of the two devices. *Id.* The plaintiff used a computer animation as demonstrative evidence to persuade the jury that the defendant had copied the plaintiff's design of the mechanical device. *Id.* The computer animation made such an impact that the court attached two copies of the animation to the appendix of its opinion. *Id.*

9. Computer animation has been recently used in disaster cases such as toxic spills, building collapses, shipwrecks, and other transportation accidents. Roy Krieger, *Now Showing at a Courtroom Near You . . . ; Sophisticated Computer Graphics Come of Age—and Evidence Will Never Be the Same*, A.B.A. J. Dec. 1992 at 92, 93.

10. Use of computer animations has become increasingly popular in industrial accident cases, especially where the plaintiff alleges that the subject machinery was operating incorrectly, designed incorrectly, guarded improperly, or maintained poorly. David W. Muir, *Debunking the Myths about Computer Animation*, 444 P.L.I. Ltr. 591, 595, (1992). The operation of the subject machine can be easily described to the fact finder by using a computer animation. *Id.* The computer animation shows the fact finder those areas of the machine that cannot be recorded on videotape or film because of physical limitations or restrictions of space. *Id.*

11. Robert F. Seltzer, *Preparation and Trial of a Toxic Tort Case 1990: Evidence and Exhibits at Trial*, 387 P.L.I. Ltr. 371, 376 (1990).

12. See Seltzer, *supra* note 11, at 375. According to Seltzer, "[f]or members of our society, information is highly dependent on visual stimuli. In fact, we retain 87% of the information which is presented to us visually. When information is presented to us through audio means, we retain only about 10% of what we hear. Thus, visual information does make an impact and is the most important way we learn." *Id.*

virtual reality (VR).<sup>13</sup> Simply defined, VR is an advanced computer animation in which the user interacts with an artificial environment.<sup>14</sup>

Imagine the above scene depicted using VR. In a VR demonstration, the twelve jurors actually stand inside Artie Mitchell's house. They can follow Jim and Artie from room to room. The jurors can even lean over Artie's body and examine the bullet wounds.

Some proponents of VR believe its use in the courtroom will become standard.<sup>15</sup> VR is a very powerful tool which allows the finder of fact to make decisions based on first hand observations and experiences.<sup>16</sup> However, VR in the courtroom raises some important legal issues. This comment addresses some of these issues and primarily focuses on the issue of whether VR is admissible as demonstrative evidence<sup>17</sup> under the Federal Rules of Evidence (FRE).

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13. Virtual reality is a "computer imaging technology that is developing systems that will enable observers to experience a simulated three-dimensional reality." ACADEMIC AMERICAN ENCYCLOPEDIA (1992). To experience this reality, the observer wears a complex head-gear and gloves or a suit equipped with sensors. Paul Saffo, *Virtual Reality is Almost Real*, PERSONAL COMPUTING, June 29, 1990, at 99. "Virtual reality is on its way to becoming the next major industry buzzword." William F. Zachmann, *Virtual Reality in the Real World*, PC MAGAZINE, March 17, 1992, at 107.

14. See Saffo, *supra* note 13, at 99.

15. "It's clear courtroom presentations like virtual reality and computer-generated reconstruction will be a standard thing used by both sides in a case." Jim Meyer, *The Future of the Law Firm, Technology 2001*, 77 A.B.A. J. 66 (1991). "You'll see the knife slip." *Id.* "You'll see the chemical reaction." *Id.* "You'll see the cars crash right in front of the jury." *Id.*; See also Susan Watts, *Almost Anything is Possible: Virtually*, THE INDEPENDENT (London), Mar. 29, 1992, at 8. Alexander Jason, the ballistics expert who created the computer animation in Jim Mitchell's murder trial, says VR will one day be commonplace in court. *Id.* Jason argues that VR simply replaces paper diagrams. *Id.* Anne Belli Gesalman, *The Digital Lawsuit; Computer-Generated Graphics and Videotaped Reenactments are Helping Lawyers Win Big Money Injury Cases. How Far Can They Go?*, THE DALLAS MORNING NEWS, Sept. 19, 1993, Dallas Life at 8. Windell Turley, a prominent Dallas attorney who regularly uses video technology in the courtroom, envisions VR in the courtroom "allowing jurors to sense they are a part of an accident." *Id.*

16. Thomas Furness, director of the University of Washington's Human Interface Technology Laboratory, says the difference between analyzing information by immersion in a VR world and analyzing it using text or numbers "is the difference between looking at an aquarium and putting on your scuba gear and diving in." Joan O'C. Hamilton et al., *Virtual Reality: How a Computer-Generated World Could Change the Real World*, BUSINESS WEEK, Oct. 5, 1992, at 97-8.

17. The term demonstrative evidence refers to those tangible items not directly involved in the litigation occurrence but later obtained by the parties to illustrate factual contentions or help the jury understand the case. GRAHAM C. LILLY, AN INTRODUCTION TO THE LAW OF EVIDENCE §13.1 (2d ed. 1987). Generally, there are five purposes for using demonstrative evidence: to educate, to explain something, to persuade your audience of something, to dissuade your audience of something, and to reinforce something your audience already believes. MARK A. DOMBROFF, DOMBROFF ON DEMONSTRATIVE EVIDENCE, §1.2 (1983).

This comment will briefly discuss the history of demonstrative evidence. It will next define the innovative technology called VR and discuss its current uses. This comment will then discuss the reasons VR will appeal to litigating attorneys, enter the courtroom and become more popular than computer animation as demonstrative evidence. It will next discuss the requirements for admitting VR demonstrations as a form of demonstrative evidence. Finally, this comment will conclude that VR will be admissible as demonstrative evidence so long as its proponents follow certain recommended guidelines.

## II. BACKGROUND

### A. THE HISTORY OF COMPUTER ANIMATIONS AS DEMONSTRATIVE EVIDENCE

The use of demonstrative evidence has a long history in the courtroom.<sup>18</sup> In its earliest form, courts restricted demonstrative evidence to diagrams, maps, and charts.<sup>19</sup> The photograph was the next visual tool at the disposal of the litigating attorney.<sup>20</sup> With the advent of the motion picture, the filming of accidents and injuries took the photograph's place in the courtroom as a powerful source of demonstrative evidence.<sup>21</sup> The decreasing cost of videotape eventually made the motion picture obsolete in the courtroom.<sup>22</sup> Computer generated animation is the most

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18. See *State v. Knight*, 43 Me. 11, 132 (1858), (permitting witness to present diagram "merely to explain his meaning and not as an infallible test of truth"); see also *Ordway v. Haynes*, 50 N.H. 159, 164 (1870), (drawing distinction between hand-chalked drawing and drawing in medical book); *State v. Whitaker*, 3 S.E. 488, 489 (N.C. 1887) (stating that notice of illustrative diagram not required).

19. See *Muir*, *supra* note 10, at 592. Early courtroom demonstrations featured an expert standing at a marked chalkboard and illustrating to the finder of fact just how the event in question occurred. *Id.*

20. See *Fadely*, *supra* note 6, at 839. The trial attorney has known for years that "a picture is worth a thousand words." *Id.* He has been using photographs as demonstrative aids before juries for more than a century to communicate what happened in an accident and to persuade the finder of fact to conclude that his version of the facts was more probable than the other party's. *Id.* See also *Muir*, *supra* note 10, at 591. Photographic blow-ups and drawings of accident scenes have also been used as demonstrative aids for many years. *Id.*

21. See *Muir*, *supra* note 10, at 591. When motion picture became affordable to the litigator, his expert began filming everything from accident sites to the destroyed vehicles, planes, or buildings that led to the lawsuit. *Id.*

22. See *Muir*, *supra* note 10, at 592. As video became cheaper, videotape replaced film as the litigator's choice of demonstrative evidence. *Id.* Videotape's high quality, coupled with its low price, led to the virtual extinction of the motion picture film in the courtroom. *Id.* See also *Fadely*, *supra* note 6, at 839. With the advent of video technology, the video tape became a movie played before the jury on a courtroom television monitor. *Id.* This created a sense of realism and trustworthiness. *Id.*

recent, innovative form of demonstrative evidence.<sup>23</sup>

Courts separate computer generated visual evidence into two categories:<sup>24</sup> 1) simulations;<sup>25</sup> and 2) animations.<sup>26</sup> Courts further separate computer animations into two distinct categories: 1) scientific evidence<sup>27</sup> and 2) demonstrative evidence.<sup>28</sup> This comment will only address the use of computer animations as demonstrative evidence. Courts have set fairly clear guidelines for determining the admissibility of computer animations as demonstrative evidence.<sup>29</sup>

Computer animations have many uses in the courtroom.<sup>30</sup> They illustrate important expert testimony on direct examination,<sup>31</sup> improve cross-examination of opposing experts,<sup>32</sup> help reveal subtle evidentiary

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23. See Muir, *supra* note 10, at 592. "Over the last fifteen years, computer generated simulations and graphics have also entered the courtroom, for much the same reason that video did." *Id.* Computer generated visual simulations and animations can analyze the data collected for an event and turn it into graphics that accurately depict the analyses of the expert witness. *Id.* Computer simulations and animations allow the expert to illustrate his or her opinion both economically and rapidly. *Id.*

24. See Robert Reagan, *The Admissibility of Computer Simulations as Novel Scientific Evidence: An Analysis Under the Frye and Relevancy Standards*, 1991 WL 330753, Jan. 1991. Computer simulation should not be confused with animation. *Id.* Although animation and simulation are often used interchangeably, there is a difference. *Id.*

25. See Fadely, *supra* note 6, at 842. A computer simulation is defined as "an artificially created extrapolation of an event represented by limited data or input that continues the event beyond a mathematical or factual basis; in other words, a simulation provides information about what would have happened or alternate theories of the accident." *Id.* A discussion of computer simulations is beyond the scope of this comment.

26. See Reagan, *supra* note 24. Animation is the redrawing of an image repeatedly with slight changes in the image. *Id.* When the images are projected in succession at a rapid pace, the result is an illusion of movement from one point to another. *Id.* Animated images have characteristics of size, shape, and color. *Id.* A simulation differs from an animation in that it adds mathematical characteristics like mass, velocity, acceleration, and friction to the visible characteristics already inherent in an animation. *Id.*

27. See Menard, *supra* note 7, at 326. Computer generated visual evidence as scientific evidence is substantive evidence which forms the basis of an expert's opinion. *Id.* Scientific evidence refers to evidence that has its basis in science or related mathematical principles. LILLY, *supra* note 17, § 12.4. Scientific evidence is usually presented by an expert witness who can explain the relevant scientific principles to the finder of fact. *Id.* A discussion of computer generated visual evidence as scientific evidence is beyond the scope of this comment.

28. See BLACK'S LAW DICTIONARY 432 (6th ed. 1990); See also Menard, *supra* note 7, at 334-335. The admissibility requirements of demonstrative evidence are much less stringent than for scientific evidence. *Id.* This is true because demonstrative evidence is only used to illustrate whereas scientific evidence is offered to prove a point which is at issue. *Id.*

29. See Menard, *supra* note 7, at 326.

30. See generally Krieger, *supra* note 9.

31. See Krieger, *supra* note 9, at 94.

32. *Id.*

relationships,<sup>33</sup> explore theories of the case,<sup>34</sup> examine alternate scenarios of an event without the cost of physical re-creation,<sup>35</sup> and enhance arguments.<sup>36</sup>

Computer animation is the most powerful means of demonstrative evidence available to the litigating attorney today.<sup>37</sup> There are three primary reasons for the recent upswing in using computer animations as demonstrative evidence. First, we are a visual society.<sup>38</sup> Second, we retain much more of what we see than what we hear.<sup>39</sup> Finally, recent technological advances and price decreases are bringing computer animations within the client's budget.<sup>40</sup> Furthermore, today's computers

33. *Id.*

34. See Krieger, *supra* note 9, at 94.

35. *Id.*

36. *Id.*

37. See Reagan, *supra* note 24. Animations are most often used as demonstrative evidence illustrating the opinion of an expert witness. *Id.* On the other hand, simulations are most often used to form the basis of expert opinion and are called scientific evidence. *Id.*

38. See Seltzer, *supra* note 11, at 372. Considering that today we live in a computer oriented society, our culture is becoming increasingly more sophisticated in finding new and different visual ways to present all sorts of information. *Id.* Television is the foremost source of visual learning and information in today's society. *Id.* "It has been estimated that upon graduation, the average high school student has completed 11,000 hours of classroom education while viewing over 15,000 hours of television." *Id.* See also Bernard J. Hibbits, "Coming to our Senses": *Communication and Legal Expression in Performance Cultures*, 41 EMORY L.J. 873 (1992). Hibbits states:

Almost from the moment we are born into a writing culture, we are trained to be visually oriented. Our education is almost entirely dedicated to teaching us how to understand and to communicate visually through reading and writing. In such an environment, our basic thoughts and values quickly come to be expressed in visual terms and metaphors. We have already encountered the ubiquitous modern expression 'I see.' To this might be added 'seeing is believing,' 'I know it when I see it,' and 'what you see is what you get.' Our opinion frequently is our 'point of view.' We conceive of knowledge as 'enlightenment.' We call intelligent people 'bright' and deride the not-so-bright as 'dimwits.' *Id.* at 885.

39. See Krieger, *supra* note 9, at 94. According to many neurophysiologists, more than one-third of the human brain is devoted to vision and visual memory. *Id.* "A study entitled the 'Weiss-McGrath Report' found a 100 percent increase in juror retention of visual over oral presentations and a 650 percent increase in juror retention of combined visual and oral presentations over oral presentation alone." *Id.*

40. See Krieger, *supra* note 9, at 94. Within the last few years, technological advances and lower cost in computer hardware and software have brought computer graphics and animation within the litigation budget of practically all litigating attorneys. *Id.* Litigants can produce a large percentage of computer animations and graphics at home on a desktop computer or, even in some cases, on laptop computers. *Id.* These computers require sophisticated hardware systems and cost anywhere from \$3,000 to \$8,000. *Id.* Software programs for these computers can be purchased over the counter for \$200 to \$600. *Id.* Even some "photo-realistic" quality animations now can be produced on today's computer workstations for about \$15,000. *Id.* See also, Muir, *supra* note 10, at 592. The cost of computer animations vary widely, depending mainly on their complexity and their quality. *Id.* Sim-

project animations from multiple angles and levels which give the finder of fact a better understanding of the subject matter being presented.<sup>41</sup>

In the near future, VR will fall within at least some litigation budgets.<sup>42</sup> However, it will have an even stronger impact on the trier of fact than do computer animations.<sup>43</sup> Therefore, VR will replace the computer animation as the tool of choice for presenting complex issues to fact finders.

## B. WHAT IS VR?

VR allows its users to enter a computer generated 3-dimensional world and interact with the objects in that world.<sup>44</sup> There are two types of VR systems.<sup>45</sup> Both VR systems require powerful computers with sophisticated graphics capabilities.<sup>46</sup> Both systems allow the user to control his movement within the virtual environment.<sup>47</sup> However, the systems differ in the method by which the user controls his movement.<sup>48</sup>

The first and most commonly known type of VR is "immersion" VR.<sup>49</sup> In an "immersion" VR system, a programmer enters data into the com-

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pute two-dimensional animations depicting simple motion and very little detail in the models sell for approximately \$5-6,000. *Id.* The more complex animations cost about \$25,000 to produce. *Id.*

41. See Muir, *supra* note 10, at 592. Computer animations have some great advantages in their use because there are no physical restrictions to the graphic images which the computer assembles. *Id.* "The viewpoint can be moved from an overall view of an entire machine down to the molecular level with little or no difficulty." *Id.* Furthermore, the computer can take the viewer inside the combustion chamber of a working engine in order to explain the inner workings of such a complex piece of machinery. *Id.* The flexibility of the computer animation is what makes it such a powerful explanatory device. *Id.* Once an accident or an event is animated and stored in the computer, "the viewpoint can be easily moved to another vantage point, whether it be that of a witness, the pilot of a plane, or simply one that gives the viewer a better understanding of what happened." *Id.*

42. See *infra* notes 79-116 and accompanying text.

43. See *infra* notes 117-134 and accompanying text.

44. Harvey P. Newquist, *Virtual Reality's Commercial Reality*, COMPUTERWORLD, Mar. 30, 1992, at 93. The virtual reality user can interact with objects in the virtual world through sight, sound and touch. *Id.*

45. Caroline Halliday, *Is it Real or is it Virtual Reality?*, SHAREWARE, Jan./Feb. 1993, at 14, 16.

46. Hamilton et al., *supra* note 16, at 98. The computer system and external hardware used to create the VR system are referred to as the reality engine. KEN PIMENTEL & KEVIN TEIXEIRA, *VIRTUAL REALITY: THROUGH THE LOOKING GLASS* xiii (1993). The reality engine must be very powerful because, within a period measured in milliseconds, it must process input about the user's movement, perform calculations, and generate a new image for the headgear to display. *Id.*

47. Halliday, *supra* note 45, at 16.

48. *Id.*

49. *Id.*



puter, describing a fictional landscape.<sup>50</sup> The computer then creates a 3-dimensional world which corresponds to that data.<sup>51</sup> The "immersion" VR user wears a special suit or gloves which are attached by fiber optic sensors to a computer workstation.<sup>52</sup> While wearing the gloves, the VR user is able to interact with the virtual environment by picking up virtual objects and moving them around.<sup>53</sup> Researchers are even working on methods for providing tactile sensation which would allow the user to feel these objects as well.<sup>54</sup>

The user also wears a pair of goggles or head gear which contains video screens<sup>55</sup> and audio attachments.<sup>56</sup> This headgear allows the user to see and hear the virtual world.<sup>57</sup> Cables attached to the VR equipment send information about the user's movement to computer worksta-

50. Hamilton et al., *supra* note 16, at 97.

51. *Id.*

52. PIMENTAL & TEIXEIRA, *supra* note 46, at 74. The gloves or suits contain fiber optic, resistive, or mechanical sensors. *Id.* These sensors monitor movement by measuring the bend and flex of the fingers and hand. *Id.*

53. *Dressed for Success*, COMPUTERWORLD, Mar. 30, 1992, at 94. When the user wears the glove, the virtual hand mimics the movement of the user's hand. *Id.*

54. Thomas B. Sheridan & David Zeltzer, *Virtual Reality Check*, TECH. REVIEW, Oct. 1993, at 20, 26-27. For example, Margaret Minsky, a researcher at MIT, is working on a force feedback joystick that will allow its user to feel textures on a virtual surface. *Id.* However, providing tactile feedback is the most difficult challenge facing scientists. *Id.* Human fingertip receptors can perceive a bump as small as one millimeter and vibrations of up to 500 cycles per second. HOWARD RHEINGOLD, VIRTUAL REALITY 321 (1991). As of yet, no output device even approaches such capability. *Id.*

55. Newquist, *supra* note 44, at 93. Most VR companies use a Star Wars-like helmet attached by cable to a computer workstation. *Dressed for Success*, *supra* note 53, at 94. In order to create a realistic 3-D effect, these headpieces contain one small video screen for each eye. *Id.* Often, these headpieces also contain motion or balance sensors which convey the position of the head to the workstation. *Id.*

Other VR companies use a viewing screen mounted on a boom. *Id.* The user looks at the screen and moves it around using two handles. *Id.* Yet another possible type of headgear is the heads-up display (HUD). PIMENTAL & TEIXEIRA, *supra* note 46, at 70. This type of headgear uses transparent lenses with half-silvered mirrors and lays the virtual image over the real world. *Id.* The focus of this setup is to enhance the user's view of the real world rather than to make him believe he is in another world. *Id.* This system would be helpful for surgeons who could view virtual diagnostic screens while performing operations. *Id.*

56. Sheridan & Zeltzer, *supra* note 54, at 24. Several companies presently offer VR systems that present sound corresponding to the action taking place in the virtual world. *Id.* These sound system devices allow the VR user to perceive where a sound is coming from and how it is moving. *Id.*

Sound in the virtual environment can be used as a substitute for tactile sensory cues. PIMENTAL & TEIXEIRA, *supra* note 46, at 71. For example, if you bump into an object in the virtual world, you might hear a noise. *Id.* Also, if you run your hand over a virtual surface while wearing a wired glove, different sounds could indicate the texture of the surface. *Id.*

57. Sheridan & Zeltzer, *supra* note 54, at 22.

tions.<sup>58</sup> The computer then modifies the graphics in the model to correspond to the user's new position.<sup>59</sup> The computer immediately sends this information back to the user's headset.<sup>60</sup> The user can then respond to this new information.

The second type of VR is "desktop" VR.<sup>61</sup> "Desktop" VR presents 3-dimensional images on high resolution computer screens.<sup>62</sup> In a "desktop" VR system, the user controls his movement and alters his view within the virtual environment by using a keyboard, joystick, or mouse.<sup>63</sup>

Sources disagree as to which VR system will be more widely used in the future.<sup>64</sup> Currently, however, "desktop" VR has three advantages over "immersion" VR.<sup>65</sup> First, "desktop" VR presents better quality

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58. Newquist, *supra* note 44, at 93. The two most popular versions of the gloves and suits contain fiber optic sensors located at the joints. PIMENTAL & TEIXEIRA, *supra* note 46, at 129. When the user moves his finger, for example, the cable bends, which reduces the amount of light passing through the cable. *Id.* A photo detector measures the varying light output and communicates the information to a controller, which sends it on to the computer. *Id.*

59. Newquist, *supra* note 44, at 93. For example, if the user looks to the right, the computer shifts the images on the screen to the left. *Id.*

60. *Id.*

61. Halliday, *supra* note 45, at 16.

62. Watts, *supra* note 15, at 8. You do not have to own a costly computer to get a sample of VR, though. Halliday, *supra* note 45, at 17. The following computer games are actually VR systems: Wolfenstein 3-D from Apogee Software Productions; Moraff's World, from MoraffWare; Ancients I: The Deathwatch, from FARR-WARE; and Corncob 3-D from Pie in the Sky Software. *Id.*

63. *Id.* The following is a description of how the user controls his movement in Wolfenstein 3-D, a desktop VR computer game:

You look at the screen through the eyes of the fighter. The inside of the castle is full of corridors and rooms shown in perspective. Objects, such as furniture or guards, that are farther away appear smaller on your screen than close objects.

You move around the corridor by moving the mouse or pressing keys. You are able to directly interact with the environment. The keyboard interface is not as realistic as the mouse because you have to use the arrow keys to indicate movement. But with a mouse or joystick, the action is more literal.

As you swing the mouse around, your view of the rooms and corridors changes accordingly and incredibly fast. You are unaware of a time lag problem because the image is updated as soon as you move the mouse. If you move the mouse rapidly, you move quickly. The mouse action is not completely natural because your view is always as if your head is completely upright. We tend to tip our heads as we look around and move.

*Id.*

64. Some believe that desktop VR will replace "immersion" VR, which requires cumbersome paraphernalia and causes "simulator sickness." Watts, *supra* note 15, at 8. Others claim that "immersion systems are definitely the way of the future." Halliday, *supra* note 45, at 16.

65. Watts, *supra* note 15, at 8.

images than "immersion" VR.<sup>66</sup> "Desktop" VR also eliminates the time lag found in "immersion" VR.<sup>67</sup> Finally, "desktop" VR is less expensive than the costly "immersion" VR systems.<sup>68</sup>

Whichever VR system becomes the way of the future, VR's potential uses are limited only by the imagination. In the last few years, VR has gone from being "an obscure scientific toy" to being praised as the future of computers.<sup>69</sup> Its current uses include entertainment,<sup>70</sup> mili-

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66. *Id.* The tiny screens inside "immersion" VR helmets cannot produce the quality images necessary to make the virtual world convincing. *Id.* In proper light, the human eye can discern details of one half inch from 100 yards away. Sheridan & Zeltzer, *supra* note 54, at 24. The liquid crystal displays (LCD) used in many VR headsets, however, only show details equal to five inches at 100 yards. *Id.* Miniature cathode ray tubes used in some VR headgear can show details of three and one half inches at 100 yards, but do so at the expense of color. *Id.*

67. With "immersion" VR there is a time lag between the time when the user changes positions and the time the computer responds with a new image. Halliday, *supra* note 45, at 16. This lag is caused by the time it takes the computer to draw the image to correspond to the user's new position. PIMENTAL & TEIXEIRA, *supra* note 46, at 69.

The time lag varies from 3 milliseconds to over 100 milliseconds. *Id.* Studies have shown that lags of over 50 milliseconds affects performance in the virtual world. *Id.* Time lags can also cause "simulator sickness," a combination of nausea and eyestrain. Watts, *supra* note 15, at 8. Therefore, the VR user can only use the headgear for short periods of time. *Id.*

Henry Fuchs, a researcher working with VR at the University of North Carolina, stresses the importance of the time lag problem. RHEINGOLD, *supra* note 54, at 34. The lag problem, for example, comes across in popular articles as an artifact of today's systems that will probably be solved by some chip one day soon. It isn't that easy. You really have to spend a few years trying to beat the lag to get a feeling for how big the difference feels between 100 and 200 milliseconds.

*Id.* at 34-5.

68. Watts, *supra* note 15, at 8. A minimum hardware set up for "immersion" VR costs around \$45,000. Halliday, *supra* note 45, at 16. VPL Research, currently the principal supplier of VR headsets and gloves, sells headsets for \$10,000-49,000 and gloves for \$8800. Gene Bylinsky, *The Marvels of 'Virtual Reality'*, FORTUNE, June 3, 1991, at 138, 139. The VPL system requires a powerful computer for each eye, so the entire VPL system can easily cost over \$250,000. *Id.*

In contrast, the more expensive desktop VR systems cost only tens of thousands of dollars. Halliday, *supra* note 45, at 17. An entire PC-based VR system could be assembled for under \$20,000 in 1992. PIMENTAL & TEIXEIRA, *supra* note 46, at 93. However, one could easily spend up to \$100,000 creating a desktop system by adding more powerful graphics hardware, wired gloves, and higher resolution displays. *Id.* at 95.

69. *Id.* at xiii. Dozens of conferences and hundreds of articles about VR have appeared seemingly overnight in the United States, Japan and Europe. *Id.* For example, a recent SIGGRAPH conference in Las Vegas highlighted VR applications. Regina A. Gore, Note, *Reality or Virtual Reality? The Use of Interactive, Three-Dimensional Computer Simulations at Trial*, 19 RUTGERS COMPUTER & TECH. L.J., 459, 467 (1993). Those attending the conference were able to travel through the molecular structure of a protein or wander through the solar system. *Id.* Also, in March, 1992, a major London conference examined the applications of VR. Watts, *supra* note 15, at 8.

tary research,<sup>71</sup> medical research,<sup>72</sup> and scientific research.<sup>73</sup> For ex-

70. Chicago's North Pier mall contains a virtual reality arcade game called BattleTech Center, which has sold over one hundred thousand tickets since it opened in 1990. Andre Bacard, *Welcome to Virtual Reality*, HUMANIST, Mar./Apr. 1993, at 42. BattleTech players pay from \$7 to \$10 to sit in enclosed control pods where they battle one another in futuristic war zones. *Id.* Nintendo sells a virtual reality-type video-game piece called a 'Powerglove' for about \$99 that lets video-game players use hand gestures to control the players. *Id.* See also Bylinsky, *supra* note 68, at 138. "Mattel's Power Glove allows its user to play virtual handball on a virtual court against a virtual opponent. Mattel has sold a million of the gloves since it introduced them in 1989." *Id.* At Bloomington, Minnesota's Mall of America, patrons line up to play games at a virtual reality arcade called Virtuality. Michael Antonoff and Dawn Stover, *Living in a Virtual World*, POPULAR SCIENCE, June 1993, at 82. At Virtuality, four circular platforms are each occupied by a person wearing a head-mount display and holding a two-button joystick. *Id.* The players are oblivious to their real surroundings. *Id.* The cybernauts, as they are called, "jerk their bodies around as if they're in pursuit—or being pursued." *Id.* The players wear a waist-high ring built onto each platform which keeps them from falling off. *Id.* The players pay \$5 each for five minutes games at Virtuality to experience a virtual reality game called Dactyl Nightmare. *Id.* See also D'Arcy Jenish and Ric Dolphin, *Fantastic Voyages*, MACLEAN'S, Dec 14, 1992, at 42. Jenish describes Dactyl Nightmare after experiencing the game at Toronto's Sherway Gardens Cyber Centre:

[T]he player, immersed in a three-dimensional world, sees a brightly colored platform with staircases leading up to other levels. Outside the platforms and staircases, the background is solid black. At unpredictable intervals, a giant bird resembling a prehistoric pterodactyl swoops toward the player, who can shoot at it by aiming with the Spacestick and firing with a thumb button at the top of the device. As the player moves his arm, a computer-generated image of a hand and a gun makes corresponding movements. *Id.*

71. See Bacard, *supra* note 70, at 42. The most prevalent use of virtual reality is the flight simulator used by airline companies and the military to train pilots. *Id.* This virtual reality system combines graphics (manipulable computer images of clouds, airports, mountains, and so forth) with a database (stored computer details about flight patterns, landing gear, radar readings, and the like). *Id.* "The final product is a cubicle in a warehouse that looks, feels, and operates as if it were an airplane cockpit." *Id.*; see also Antonoff and Stover, *supra* note 70, at 82. The United States military uses virtual reality to train tank commanders in a simulated battlefield. *Id.*

72. See Antonoff and Stover, *supra* note 70, at 82. Virtual reality is being used to improve medical and surgical techniques. *Id.* Physicians are now using virtual reality to help deliver babies. *Id.* The doctor wears a head mounting display and sees ultrasound images as he scans a pregnant woman's uterus. *Id.* "Video cameras or see-through windows may be placed on both sides of the HMD so that the ultrasound images of the fetus are superimposed on the external view." *Id.* The result is that the physician can virtually see through the patient into the womb instead of having to frequently look up at a monitor. *Id.*; see also Jenish and Dolphin, *supra* note 70, at 42. Dr. Richard Satava, a surgeon at the Silas B. Hayes Army Hospital, conducted a gall bladder operation on a computer-generated image of a human torso. *Id.* He wore a headset and DataGlove. *Id.* As he moved the glove, he manipulated a hand within a computer generated environment, making the necessary incisions to open an abdomen and remove a gall bladder. *Id.*

73. See Antonoff and Stover, *supra* note 70, at 82. NASA's Ames Research center in Moffett Field, California, is using virtual reality technology in its Mars probe experiments. *Id.* At Ames, data from a Mars probe was fed into a computer and a three-dimensional

ample, some of the country's top medical schools are using VR surgical programs to train students and doctors.<sup>74</sup> In Japan, Matsushita Electric Works is using VR to design and sell kitchens.<sup>75</sup> With VR currently being used in locations ranging from the game room<sup>76</sup> to the operating room,<sup>77</sup> some say it will soon appear in the courtroom as well.<sup>78</sup>

### III. ANALYSIS

#### A. REASONS A LITIGATING ATTORNEY WILL SOON CHOOSE VIRTUAL REALITY OVER COMPUTER ANIMATION

##### 1. *VR Will Soon Become More Advanced And Affordable To The Litigating Attorney*

For many of the same reasons as the computer did, VR will pervade

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virtual reality generated model was created for Earth-based exploration experiments. *Id.* Users put on a head mounting display and the program generates a Mars landscape onto screens that enveloped your entire vision. *Id.* See also Tim Studt, *Virtual Reality: from Toys to Research Tools*, R & D, March 1993, at 18. Scientific researchers are using virtual reality programs for various applications, from "machining bar stock to exploring planetary surfaces, to looking at galaxy clusters." *Id.*

74. Stanford Medical School, working with NASA, has developed a VR software prototype for simulating surgery. *Simulated Surgery*, COMPUTERWORLD, Mar. 30, 1992, at 95. Doctors and medical students wear VR gloves and headsets while operating on virtual bodies. *Id.* Unlike cadavers, which have lost resilience and vital fluids, the virtual bodies accurately represent the movement of muscles, organs, and so forth. *Id.*

Joseph Rosen, an associate professor of surgery at Dartmouth, has created a "surgery rehearsal" system. Jeffrey Hsu, *Virtual Reality: Reality - What a Concept!*, COMPUTE, Feb. 1993, at 101, 104. Surgeons use virtual scalpels and other virtual instruments to learn how the body will react to a procedure before performing it on a real patient. *Id.*

75. Bylinsky, *supra* note 68, at 142. Matsushita has a showroom virtual kitchen which allows customers to walk around their new kitchen before buying anything. *Id.* The customer tells a salesman what dimensions, appliances, cabinets and so forth he wants. *Id.* The salesman then enters the information into the computer which creates the corresponding virtual kitchen. *Id.* The customer can then put on a headpiece and gloves and test out the new kitchen, right down to setting the virtual table. *Id.*

76. Roger McGrath, *Virtuality Puts Retailer on New Plane*, ADVERTISING AGE, Feb. 22, 1993, at 25. Edison Bros. Stores, a fashion and footwear retailer, has opened arcades with Virtuality arenas in Cincinnati, New Jersey, and St. Louis. *Id.* Virtual World Entertainment operates a virtual reality game center in Chicago and plans to open four more. *Id.*

Virtuality, developed by Cyberstudio and marketed by Spectrum Holobyte, offers some of the most realistic VR game simulations available. Hsu, *supra* note 74, at 102. "You can fight a space battle in Battle Sphere, go into an elf and wizard fantasy world in Legend Quest, and smash up some cars in the virtual demolition derby Total Destruction, or go hang gliding in HERO." *Id.*

77. Hamilton et al., *supra* note 16, at 98. VR is being used to create 3-D models which help surgeons plan procedures or assist in a surgery taking place miles away. *Id.*

78. See Meyer, *supra* note 15, at 66; see also Cooper, *supra* note 1, at E1. David Muir, senior vice president of Forensic Technologies, predicts that VR will reach the courtroom within five years. *Id.* He says the exact timing will depend on technological advances, finding the right case and "a judge who's open-minded" enough to admit VR. *Id.*

society and ultimately enter the courtroom in the near future.<sup>79</sup> There are three primary reasons for this inevitable occurrence.

First, many major companies are currently spending large amounts of money on research and development of VR.<sup>80</sup> Approximately seventy-

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79. While the powerful impact of visual evidence on the finder of fact has long been known, it was not until the early 1980s that computer generated visual evidence entered the courtroom. See Craig Murphy, Comment, *Computer Simulations and Video Re-enactments: Fact, Fantasy and Admission Standards*, 17 OHIO N.U.L. Rev. 145 (1990). Computer use in the courtroom was a natural outgrowth of the computer's intended purpose. See Muir, *supra* note 10, at 591. Computers in the 1970s were primarily large mainframe computers designed to help engineers model various objects or components of machines. *Id.* As technology became more sophisticated, engineers saw the need to develop new ways to analyze their data. *Id.* They designed computer graphic systems to help solve this problem. *Id.* Original graphics were just still pictures and took many hours to produce. *Id.* Several start-up companies saw the potential market for such computer graphics and, within the course of a few years, developed color computer graphics with motion to aid the engineer in his plight. *Id.* By the mid 1980s, computer animations could be produced both efficiently and economically. *Id.* As the engineer was the primary expert witness for disaster cases, it was only natural that he would bring this technology into the courtroom with him to help explain his otherwise incomprehensible testimony. *Id.*

Prior to the mid 1980s, computer animations and simulations were either too expensive, too technologically crude, or both. See Cooper, *supra* note 1, at A1. Recent technological advances have slashed the cost of three-dimensional computer animations. *Id.* Today, most litigators can afford to use computer animations to persuade juries by showing them computer cartoons from any angle on a two-dimensional screen. *Id.*

The cost to produce a computer animation or simulation was so exorbitant that it was not until 1985 when the first "high-tech" computer generated animation reached the courtroom. See Krieger, *supra* note 9, at 93. *Id.*; see also Muir, *supra* note 10, at 591. The first wave of computer graphics were very simple productions and were quite crude by today's standards. *Id.* In the mid 1980s, computer animation research and development began to flourish, the result being a gradual decrease in production cost coupled with an increase in resolution and speed of the animation. *Id.* "Today, an image that would have taken hours to produce as recently as 1985 can be produced on a machine the size of a PC [personal computer] in a few minutes." *Id.*

The personal computer of the late 1970s was quite slow by today's standards. See Antonoff and Stover, *supra* note 70, at 82. Furthermore, it did not perform many complex functions and was prone to frequent breakdowns. *Id.* It was at this time that the computer industry began to change. Muir, *supra* note 10, at 591. Many large technology producing companies, realizing the vast commercial potential of the computer, allocated large amounts of capital for its research and development. *Id.* The result was that competition in the industry forced a simultaneous increase in technological advancement and decrease in price of the computer to the consumer. *Id.*

80. Over the next few years, virtual reality technology will advance as large companies, realizing the untapped potential of virtual reality, expend huge amounts of money on research and development. Walter Lowe, Jr., *Adventures in Cyberspace*, PLAYBOY, April, 1992, at 104. Advances will be made in the fields of industry, biomedicine, entertainment, and education. *Id.* See Bacard, *supra* note 70, at 42, (Chrysler and IBM join forces and invest in virtual reality to design autos better and cheaper); see also Antonoff and Stover, *supra* note 70, at 82, (Matsushita is investing in virtual reality for development of design alternatives; NEC Corp. is using virtual reality to develop prototype ski training system); see generally Studt, *supra* note 73; Karen J. Ohlson, *Real Funding for Virtual Reality*,

five percent of the \$50,000,000 allocated for spending by non-military VR companies went to research and development in 1992.<sup>81</sup> Sega,<sup>82</sup> Nintendo,<sup>83</sup> MCA,<sup>84</sup> Motorola,<sup>85</sup> Chrysler,<sup>86</sup> and IBM<sup>87</sup> all have recently delved into VR research and development. These companies believe that they will eventually be able to use VR to help design products and train employees much more cost-effectively than with current methods.<sup>88</sup>

Second, recent technological advancements have made VR more realistic and efficient.<sup>89</sup> The two main complaints about VR arcade games,

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MACUSER, July, 1993, at 53, (Motorola invests undisclosed amount of money in virtual reality design system); Meyer, *supra* note 15, at 66, (MCA is investing large sums for development of virtual reality theaters); Bylinsky, *supra* note 68, at 12, (Boeing, Agouron, Caterpillar and Eastman Kodak are all investing in virtual reality); Jenish and Dolphin, *supra* note 70, at 42, (Fiat is using virtual reality to train workers in the operation and maintenance of sophisticated robotics systems used in car assembly plants). See Sandra Sugawara, *Nintendo Fashions a 'Monster' Alliance: Team Plans Virtual Reality*, THE WASH. POST, August 24, 1993, at C1, (Nintendo and Silicon Graphics, Inc. are joining forces and using virtual reality to create revolutionary new video game); *Sega Creating Amusement Parks with Rides into Virtual Reality*, SACRAMENTO BEE, July 5, 1993, at E1, (Sega is spending many millions on new virtual reality theme parks with backing from Apple, IBM, Sony, Matsushita, Tele-Communications, US West, and Hollywood studios); Patricia Apodaca, *Iwerks Pins Its Theater Plans on Stock Offering*, L.A. TIMES, Sept. 14, 1993, at B4, (Iwerks Entertainment, Inc. makes \$20,000,000 stock offering to raise capital to fund development of virtual reality theaters); *IBM Creates Software for Virtual Reality*, S.F. CHRON., March 19, 1993, at D2, (IBM develops VR [virtual reality] Toolkit; allows users to develop their own virtual reality system); Patricia Zengerle Reuter, *Virtual Reality Gets Serious: Researchers Find Uses for New Technology - from Car Sales to Egyptology Computers & Technology*, S.F. EXAMINER, August 22, 1993, at E16, (Ford Motor Co., Apple Computer, Inc., and Intel Corp. are financing a virtual reality research group at Carnegie Mellon University for developing applications in education, industry, and pop culture).

81. See Antonoff and Stover, *supra* note 70, at 82. According to one market research firm, 75 percent of the nearly \$50 million spent last year by virtual reality-related firms for non-military applications went into research and development. *Id.*

82. See *supra* note 80 and accompanying text; see also Antonoff and Stover, *supra* note 70, at 82. Sega invests large sum to develop "Sega VR," home computer game which will sell for about \$200. *Id.*

83. See *supra* note 80 and accompanying text; Nintendo announces Project Reality, a three-dimensional, 64-bit (microprocessor with graphics co-processor chip) video game system that should be available for home use by 1995 with approximate cost of \$250. Sandra Sugawara, *Nintendo Fashions A 'Monster' Alliance: Team Plans Virtual Reality*, THE WASH. POST, August, 24, 1993, at C1.

84. See *supra* note 80 and accompanying text.

85. See Ohlson, *supra* note 80, at 53. Motorola invests undisclosed amount of money in Virtus, creator of Virtus Walkthrough (3-D architectural computer program). *Id.*

86. See Bacard, *supra* note 70, at 42. Chrysler and IBM are jointly investing in virtual reality for automobile design program. *Id.*

87. *Id.*

88. *Id.*

89. See Antonoff and Stover, *supra* note 70, at 82; see also Christopher Barr, *Virtual Reality Goes Mainstream*, PC MAGAZINE, April 28, 1992, at 31; Sheridan and Zeltzer, *supra* note 54, at 22; *Researchers Expanding Virtual Reality*, SACRAMENTO BEE, July 5, 1993, at

like Pterodactyl Nightmare,<sup>90</sup> which arrived at shopping malls a few years ago,<sup>91</sup> were that they burdened users with heavy head gear<sup>92</sup> and frustrated them with poor graphics.<sup>93</sup> Today, one company has acquired a thirteen ounce head mounting display<sup>94</sup> from military researchers which is due to be part of a VR arcade game in California malls.<sup>95</sup>

Graphically, new eye tracking devices<sup>96</sup> are attracting a great deal of attention in the industry.<sup>97</sup> The main problem with VR graphics is that the human eye can discriminate details from as far away as 100 yards while the liquid crystal displays<sup>98</sup> used in VR head sets have only about one tenth the resolution of the human eye.<sup>99</sup> With eye tracking devices implanted into the head mount displays, the computer knows exactly where the eyes are looking on the display screen.<sup>100</sup> The computer will then focus on the area viewed leaving only the peripheral area of vision at low resolution.<sup>101</sup> Such a device will reduce the computational burden on the processor, increase response time, and basically function much like the human eye.<sup>102</sup>

Another company is taking this approach one step further and developing a device that will project three-dimensional images directly onto the human eye's retina.<sup>103</sup> This lightweight device will mount directly onto a pair of eyeglasses and offer the user a full-color, high-resolution,

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E4; Dean Takahashi, *Visions of Profits: Virtual Reality Firm to Test Illusions in O.C.*, L.A. TIMES, September 10, 1993, at B1; Tom Schmitz, *Intel's New Power Chip Unveiled*, SAN JOSE MERCURY NEWS, March 23, 1993, at 1A; Sebastian Moffett Reuters, *Sega Outlines Game Plan for Virtual Reality Parks*, DAILY NEWS OF L.A., September 20, 1993, at B10.

90. See Jenish and Dolphin, *supra* note 70, at 42

91. *Id.*

92. *Id.*

93. *Id.*

94. See Bacard, *supra* note 70, at 42.

95. See Takahashi, *supra* note 89, at B1. Visions of Reality will use a new 13 ounce head mount display in it's new virtual reality arcade enterprise in California. *Id.*

96. See Sheridan and Zeltzer, *supra* note 54, at 24. An eye-tracking device connects the human eye to the computer and directs the computer according to the movements of the eye. *Id.* See also *Researchers Expanding Virtual Reality*, *supra* note 114, at E4.

97. *Id.*

98. See Sheridan and Zeltzer, *supra* note 54, at 24. Liquid crystal displays (LCDs) are images composed of individual pixels (the many light-dark dots on the screen). *Id.*

99. *Id.*

100. *Id.*

101. See Sheridan and Zeltzer, *supra* note 54, at 24.

102. *Id.*

103. See *Researchers Expanding Virtual Reality*, *supra* note 89, at E4. The University of Washington's Human Interface Technology Lab is working on a system that projects 3-D images directly onto the retina of the human eyeball. *Id.* "The technology is meant to offer a realistically clear, depth of field view into lifelike worlds that exist only as computer data." *Id.*



panoramic view of the computer environment.<sup>104</sup> The virtual retina display,<sup>105</sup> as it is called, is only a few years away and is projected to sell for only a few hundred dollars.<sup>106</sup> Overall, experts believe that recent advances in processing power and liquid crystal display technology will make VR livelier, more fluid, and easier to confuse with the real world.<sup>107</sup>

Finally, the cost of producing VR has decreased significantly.<sup>108</sup> The crude virtual arcade games of a few years ago cost about \$200,000.<sup>109</sup> The head mount displays alone originally sold for approximately \$50,000<sup>110</sup> and data gloves sold for around \$9,000.<sup>111</sup> Today, the same VR system can be purchased for \$20,000.<sup>112</sup> Customized desktop computers can now handle VR software thanks to Intel's Pentium computer chip.<sup>113</sup> A VR enthusiast can even set up his own computer environment at home for under \$3,500.<sup>114</sup> Most experts agree that VR equipment will decrease further in price as technology and public interest increases.<sup>115</sup> As society embraces the marvels of VR, it will follow in the footsteps of computer animation and fall well within the litigation budget.<sup>116</sup>

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104. *Id.*

105. *Id.*

106. *Id.*

107. See Reuters, *supra* note 89, at B10.

108. See Bacard, *supra* note 70, at 42; see also Antonoff and Stover, *supra* note 70, at 82; Wendy Taylor, *Virtus's Incredible Walkthrough: Virtual Reality Based Drawing*, PC-COMPUTING, Sept. 1993, at 60; Ric Dolphin, *On the Edge of Reality: An Innovator Invents a New World*, MACLEAN'S, December 14, 1992, at 48; Bylinsky, *supra* note 68, at 138; Lowe, *supra* note 105, at 104; Mark Potts, *Virtual Reality: Sci-Fi Technology on Verge of Billion Dollar Boom*, THE WASH. POST, August 16, 1992, at H1; Kara Swisher, *Noted with Tact: See Me, Feel Me, Touch Me, Um, Peel Me. Virtual Reality's Dirty Little Secret*, THE WASH. POST, July 11, 1993, at F1; Sanjeev Bery, *Video Games: Nintendo Sheds Light on Future*, DAILY NEWS OF L.A., October 7, 1993, at L12.

109. See Potts, *supra* note 108, at H1. The price tag on a sophisticated virtual reality system has dropped from \$200,000 a couple of years ago to about \$20,000 now. *Id.*

110. See Bylinsky, *supra* note 68, at 138.

111. *Id.*

112. *Id.* "The consensus among technologists is that steady improvements in computing power and graphic capabilities and steadily declining costs have put virtual reality on the cusp of something big." *Id.*

113. See Schmitz, *supra* note 89, at 1A. The Pentium's power gives it the ability to run complex software systems which produce full-motion video, voice recognition, imaging, and three-dimensional virtual reality-type animations. *Id.* The Pentium chip offers more computer muscle at lower cost. *Id.* Intel expects that over one million chips will be sold in 1994. *Id.*

114. One company (VPL) is about to offer a complete home virtual kit for under \$5,000. Robin Stacy, *Interactive Universe Created Virtual Reality: A Three-Dimensional Smorgasbord*, SACRAMENTO BEE, March 16, 1992, at C2. Included in the package will be a \$200 data glove, \$1,300 stereo glasses, and a virtual reality chip board for less than \$2,000. *Id.*

115. See *supra* note 79 and accompanying text.

116. See *supra* note 108 and accompanying text.

2. *VR Will Have a Much Stronger Impact on Jurors Than Computer Animations*

Computer demonstrations have an extremely powerful impact on the jury.<sup>117</sup> This is true because people have a natural tendency to accept as true that which they see.<sup>118</sup> When an attorney presents information to a jury in visual form, it becomes not only believable, but virtually unassailable.<sup>119</sup>

A recent ABA study on "juror retention levels" concluded that jurors retain 100 percent more information when it is presented visually rather than orally.<sup>120</sup> The study revealed that technical issues and complex fact patterns left jurors bored, confused, and frustrated.<sup>121</sup> The study also revealed that jurors were overwhelmed by the incredible volume of information conveyed at trial.<sup>122</sup> As a result, jurors reported difficulty in remembering critical facts and important issues.<sup>123</sup> However, when a visual presentation is coupled with oral testimony, such as a scientific expert using a computer animation to illustrate his testimony, there is a 650 percent increase in juror retention over the presentation of oral testimony alone.<sup>124</sup>

The bottom line is that jurors pay attention to what they like.<sup>125</sup> Visual evidence, when presented in an appealing way, such as in the form of a computer animation, grasps the juror's attention causing him to pay much closer attention to it than to traditional testimonial evidence.<sup>126</sup>

VR as demonstrative evidence will have a stronger impact than computer animations do on the mind and memory of fact finders. Unlike the viewer of a computer animation, the VR user is immersed inside this demonstrative evidence.<sup>127</sup> He cannot turn away from nor be distracted from the evidence as he can when he is presented with a computer animation. This is true because the VR program can constantly bombard the user with computer generated stimuli from all angles within the environment.<sup>128</sup> Furthermore, as all external stimuli are blocked-out of

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117. See *supra* notes 11-12 and accompanying text.

118. See Murphy, *supra* note 79, at 145.

119. *Id.*

120. See Krieger, *supra* note 9, at 93.

121. *Id.*

122. *Id.*

123. *Id.*

124. See Krieger, *supra* note 9, at 93.

125. See Seltzer, *supra* note 11, at 375.

126. *Id.*

127. See Antonoff and Stover, *supra* note 70, at 82.

128. *Id.*

the user's sensory perception,<sup>129</sup> his ability to concentrate on the images presented is much higher than if he were simply viewing a computer animation from a television monitor. In essence, the VR program forces the user, or juror, to pay attention.<sup>130</sup>

However, the juror will not have to be forced to pay attention to the VR demonstration. Based on the ever-increasing popularity of the VR entertainment complexes throughout the world, the public has already shown that this form of entertainment appeals to their senses.<sup>131</sup>

Furthermore, as already discussed, the next wave of software presently under development will make VR livelier, more fluid, and easier to confuse with the real world.<sup>132</sup> These increased technological advancements will offer the VR user a much more realistic perception of what he is viewing.<sup>133</sup> As a result, what he is viewing actually appears to be taking place right before his very eyes.<sup>134</sup>

These same advances which will make VR more appealing to the litigating attorney, though, may present problems in getting a VR demonstration admitted. The trial court judge might determine that a VR presentation, because of its life-like quality, is too prejudicial or misleading to be shown to the jurors. Consequently, VR will be harder to admit for demonstrative purposes than its computer animation counterpart. Given VR's potential prejudicial or misleading effects, the prudent attorney will have to take precautions to get a VR demonstration admitted.

#### B. THE ADMISSION OF VIRTUAL REALITY AS DEMONSTRATIVE EVIDENCE

VR presentations used in the courtroom will be created using witness testimony and other real evidence<sup>135</sup> from the case. However, VR will merely be used to visually present this other evidence and, thus, it should be treated as demonstrative evidence.<sup>136</sup> Demonstrative evi-

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129. *Id.*

130. See Jenish and Dolphin, *supra* note 70, at 42.

131. See *supra* note 70 and accompanying text.

132. See *supra* note 96-102 and accompanying text.

133. See Reuters, *supra* note 89, at B10.

134. *Id.*

135. Real evidence is "evidence furnished by things themselves, or view or inspection, as distinguished from a description of them by the mouth of witnesses." BLACK'S LAW DICTIONARY 1264 (6th ed. 1990). The term "real evidence" is often used to refer only to tangible things which were involved in the litigated occurrence. LILLY, *supra* note 17, §13.1. The term "demonstrative evidence" is then used to describe tangible items which were not involved in the litigated occurrence. *Id.*

136. Presenting virtual reality as demonstrative evidence is also an effective method of avoiding a hearsay objection. Menard, *supra* note 7, at 350. Hearsay is testimony by a witness relating "not what he knows personally, but what others have told him, or what he has heard said by others. A statement, other than the one made by the declarant while testifying at the trial or hearing, offered in evidence to prove the truth of the matter as-

dence is "that evidence addressed directly to the senses without intervention of testimony."<sup>137</sup> It serves a secondary purpose at trial: to explain or clarify previously introduced evidence.<sup>138</sup> Courts have treated demonstrative evidence inconsistently.<sup>139</sup> Some courts treat demonstrative evidence substantively and allow the jury to view it during deliberations.<sup>140</sup> Other courts admit it for demonstrative purposes only and exclude it from jury deliberations.<sup>141</sup>

Consequently, while VR demonstrations may be prohibited from jury deliberations, they should be allowed in the courtroom. As discussed earlier, VR is a more technologically advanced version of computer animations, which have been admitted as demonstrative evidence.<sup>142</sup> Courts have generally admitted computer animations where the proponent can demonstrate the accuracy and reliability of the computer program and the resulting product.<sup>143</sup> Additionally, the prejudicial effect of the animation must not outweigh its probative value.<sup>144</sup>

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serted." BLACK'S LAW DICTIONARY 722 (6th ed. 1990). While a VR presentation will be an out of court statement, as demonstrative evidence, it will be used to clarify other evidence rather than to prove the truth of the matter asserted. Menard, *supra* note 7, at 349-50.

137. BLACK'S LAW DICTIONARY 432 (6th ed. 1990). The most common types of demonstrative evidence are: in court demonstrations, re-creations or experiments; models and other tangible objects; maps, diagrams and charts; photographs, movies and videotapes; jury views; and computer generated simulations and animations. Robert D. Brian and Daniel J. Broderick, *The Derivative Relevance of Demonstrative Evidence — Charting its Proper Evidentiary Status*, 25 U.C. DAVIS L. REV. 957, 970 (1992).

138. *Id.* at 959. Demonstrative evidence's true value is that it brings at least two of the juror's five senses into play at once. Thomas A. Heffernan, *Effective Use of Demonstrative Evidence — Seeing is Believing*, 10 AM. J. TRIAL ADVOC. 109, 110 (1987). This increases the juror's exposure to the evidence, which raises the likelihood the juror will remember the evidence. *Id.*

When used appropriately, demonstrative evidence will increase the comprehension of the trier of fact, illustrate the unknown or unimaginable, allow the trier of fact to digest large amounts of information, and add dramatic effect to a presentation. DOMBROFF, *supra* note 17, §1.2.

139. Brian & Broderick, *supra* note 137, at 965.

140. *Id.*

141. *Id.* Still other courts admit demonstrative evidence for "limited purposes" but nonetheless allow the jury to use it in deliberations. *Id.*

142. See *supra* note 7 and accompanying text.

143. See Seltzer, *supra* note 11, at 375. In regards to computer animations, courts will consider the accuracy of the exhibit in determining whether a proper foundation has been laid. *Id.* Seltzer comments that utilization of a test program with known results would be helpful in demonstrating the computer system's accuracy. *Id.* Other factors to consider are the following: 1) the flow of information into, through and out of the computer system; 2) steps in the processing and storage of information; and 3) program verification and safeguards which eliminate the potential for error. *Id.* Finally, a witness must testify that the final result is a fair and accurate portrayal of his testimony. *Id.*

144. See Menard, *supra* note 7, at 334-35. Menard comments that the "desire to provide the jury with the best possible understanding of the testimony presented often outweighs

Also, both computer animations and VR presentations can be considered in the same light as posed photographs.<sup>145</sup> While some courts have been hesitant to allow posed photographs as demonstrative evidence,<sup>146</sup> posed photographs have generally been admissible where their proponent can show they are relevant and that they are an accurate and reliable depiction of the scene they re-create.<sup>147</sup> It is important to note that with posed photographs, as with all forms of demonstrative evidence, the trial judge has wide discretion in admitting or refusing to admit the evidence.<sup>148</sup> Considering their similarity to posed photographs and computer animations, VR demonstrations should be admissible as demonstrative evidence provided they meet the necessary requirements. The basic requirements for admitting all forms of demonstrative evidence, including a VR demonstration, are essentially the same.<sup>149</sup> This comment will discuss these requirements as codified by the Federal Rules of Evidence. Three essential requirements must be met. First, the demonstration must be relevant.<sup>150</sup> Second, the probative value of the demonstration must not be substantially outweighed by danger that it will unfairly prejudice or mislead the jury.<sup>151</sup> Third, a proper foundation must be laid which illustrates the demonstration's authenticity.<sup>152</sup>

While a proponent of VR should be able to show its relevance to the case, he may encounter difficulty satisfying the other necessary require-

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the concern that such evidence may be prejudicial." *Id.* Furthermore, as trial courts prefer simple explanations of issues, they will have a tendency to admit computer generated visual evidence for demonstrative purposes. *Id.*

145. *Brennan v. Leshyn*, 201 N.E.2d 167 (Ill. App. Ct. 1964), quoting *GARD, ILLINOIS EVIDENCE MANUAL*, 407 (1963).

"The posed photograph may be compared with the drawing which the witness makes in the course of his testifying, upon which he places the various objects and persons at the places he remembers them to have been at the time of the occurrence as he observed them."

*Id.*

146. See generally *Richardson v. Gregory*, 281 F.2d 626 (D.C. Cir. 1960); *Brennan v. Leshyn*, 201 N.E.2d 167 (Ill. Ct. App. 1964).

147. See generally *State v. Kendig* 666 P.2d 684 (Kan. 1983); *Hunt v. Wooten*, 76 S.E.2d 326 (N.C. 1953); *State v. Beck*, 785 S.W.2d 714 (Mo. Ct. App. 1990).

148. See *U.S. v. Gaskell*, 985 F.2d 1056 (11th Cir. 1993); *State v. Dillon*, 161 N.W.2d 738 (Iowa 1968); *Eiland v. State*, 203 S.E.2d 619 (Ga. Ct. App. 1973).

149. *David Siegal and Brian Pass, High Technology at Trial: Use It or Lose It*, 444 P.L.I. LIT. 605, 607 (1992).

150. *FED. R. EVID.* 402.

151. *FED. R. EVID.* 403. See generally *U.S. v. Gaskell*, 985 F.2d 1056 (11th Cir. 1993) (holding that slight probative value of substantially dissimilar demonstration was overwhelmed danger of unfair prejudice); *U.S. v. Hitt*, 981 F.2d 422 (9th Cir. 1992) (refusing to admit photograph of gun where probative value was "exceedingly small" and photograph was "fraught with the twin dangers" of prejudicing and misleading); *Petty v. Ideco*, 761 F.2d 1146 (5th Cir. 1985) (finding trial court did not err in admitting evidence of a prior conviction even when the balance between prejudice and probativeness was close).

152. *FED. R. EVID.* 901.

ments. First, there is a danger that the VR will prejudice the jury by invoking emotion or mislead the jurors by causing them to attribute undue weight to the VR presentation. Second, VR, by its very nature, allows great opportunity for manipulation of data and thus presents authentication problems. However, by following some suggested guidelines, the VR proponent can help ensure its admissibility.

1. *Is VR Relevant?*

First, in order to be admissible as demonstrative evidence, VR must be relevant.<sup>153</sup> Under FRE 401, evidence is relevant if it tends to make more or less likely any material fact which will affect the outcome of the case.<sup>154</sup> Courts generally consider evidence relevant when it persuades the finder of fact that a fact in controversy does or does not exist.<sup>155</sup> Therefore, in order to meet the relevancy requirement, a VR demonstration must indicate that material facts at issue in the case do or do not exist. Since the proponent of the VR demonstration will use testimonial and real evidence from a case to create the demonstration, the trial judge should find that it is relevant.

2. *Does VR's Prejudicial or Misleading Effect Substantially Outweigh its Probative Value?*

Ensuring that VR's prejudicial or misleading effect does not substantially outweigh its probative value is more difficult. Under FRE 403, relevant evidence can be excluded if the probative value of the evidence is substantially outweighed by the likelihood that the evidence will prejudice, mislead, or confuse the jury.<sup>156</sup> In determining whether to admit the VR demonstration, a court must weigh the danger that the demon-

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153. "All relevant evidence is admissible, except as otherwise provided by the Constitution of the United States, by Acts of Congress, by these rules or by other rules prescribed by the Supreme Court pursuant to statutory authority. Evidence which is not relevant is not admissible." FED. R. EVID. 402. Relevance is the threshold test of admissibility under evidentiary rules. LILLY, *supra* note 17, § 2.1.

154. "Relevant evidence" means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence." FED. R. EVID. 401.

155. See Chaney, *supra* note 6, at 753. See also *United States v. Shomo*, 786 F.2d 981, 985 (10th Cir. 1986) (evidence is relevant if it tends to make existence of a material fact more or less probable); *Rhodes v. Michelin Tire Corp.*, 542 F. Supp. 60, 61 (E.D. Ky. 1982) ("[t]o be relevant it is sufficient that evidence has a tendency to make a consequential fact even the least bit more probable than it would be without the evidence." (quoting S. SALTZBURG AND K. REDDEN, *FEDERAL RULES OF EVIDENCE MANUAL* 85 (3d ed. 1982))).

156. "Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence." FED. R. EVID. 403.

stration will prejudice or mislead the jury against the probative value of the demonstration.<sup>157</sup>

There is a strong chance that the VR demonstration will prejudice the jury. Evidence is likely to unfairly prejudice the jury if it unduly suggests that the jury base its decision on an improper basis, such as emotion.<sup>158</sup> The very name "virtual reality" should suggest the device's potential for prejudicing or misleading the jury. VR is designed to immerse the user in a 3-dimensional model of reality.<sup>159</sup> The more realistic VR is, the more likely it will lead jurors to decide issues based on emotion or some other improper basis.

VR allows its users to actually enter another world and interact with it through sight, sound, and touch.<sup>160</sup> It is true that even the most sophisticated VR systems in operation today do not come close to accurately depicting the real world.<sup>161</sup> Nevertheless, even these primitive versions of VR are realistic enough to make United States soldiers curse and sweat while participating in VR battle simulations.<sup>162</sup>

Imagine the effect on a juror who, instead of just watching a video of a car accident, is actually a passenger in a virtual reality-created car. While VR systems have the capability of allowing the finders of fact to

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157. See generally *United States v. Yahweh*, 792 F. Supp. 104 (S.D. Fla. 1992) (weighing the probative value of enlarged autopsy photographs against the danger of unfair prejudice); *United States v. Jamil*, 707 F.2d 638 (2d Cir. 1983) (weighing the probative value of a prior conviction evidence against possible prejudice).

158. FED. R. EVID. 403 advisory committee's note.

159. *Newquist*, *supra* note 44, at 93.

160. *Id.*

161. *Sheridan & Zeltzer*, *supra* note 54, at 22. Today's VR systems do not truly allow the user to forget he is using a simulation and experience the VR world as if it were real. *Id.*

162. *Hamilton et al.*, *supra* note 16, at 97. The soldiers were participating in a VR simulation at the Institute for Defense in Arlington, VA. *Id.* They performed the same maneuvers that the 2nd Armored Cavalry performed during a battle in the Persian Gulf War. *Id.* Encouraged by positive results of such simulations, the U.S. military hopes to spend \$500 million on simulations over the next few years. *Id.*

Journalist Dale Dauten described his first VR experience, which quickly changed him from skeptic to believer, as follows:

Next, Morrison gave me the control that let me move forward and backward. Things got a bit eerie, as I moved along the hall, floating, I looked right and flew through a cartoon door.

Then came The Moment. Morrison instructed me to move forward to the end of the room. There I found a plank over a shaft. I leaned forward and looked down at what appeared to be a drop of two or three stories. Morrison suggested that I move out onto the plank. I couldn't do it.

There I was, a grown man in a business suit, standing on the carpeted floor of a one-story office building, my nervous system warning me that I was about to tumble to my death. The dean urged me on: 'Go ahead, see what happens' he said, merrily. I could not.

Dale Dauten, *Get Set to Step into Virtual Reality*, CHI. TRIB., Oct. 18, 1993, §4 at 7.

take turns driving the car,<sup>163</sup> it is doubtful this will ever happen. Courts have found that juror participation in demonstrations is improper.<sup>164</sup> Even jurors who merely witness such VR demonstrations, though, are likely to come away with feelings of anger or sympathy for one of the parties.

Even if a VR demonstration does not invoke emotion in the jurors, it may still lead them to decide the case on an improper basis.<sup>165</sup> The high quality and realistic appearance of a VR presentation may mislead jurors into according the presentation undue weight. Computer animation creator Jerry Eubanks says "[j]uries tend to be very much influenced by animation . . . . It's like they saw it on TV, and they're used to accepting [as true] what they see on TV."<sup>166</sup>

VR goes a step further than computer animations. With a VR demonstration, the jury will relive the event rather than just watch it.<sup>167</sup> As a result, VR demonstrations will strongly influence jurors and they will be inclined to accept what they see and hear in the virtual world as being true.<sup>168</sup> Thus, jurors may come away from the presentation with the impression that it is the truth rather than just an explanation of some other testimony.

The finder of fact is particularly likely to accept the VR demonstra-

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163. Lance Frazer, *Courtroom of the Future: Virtual Reality is Just Around the Corner*, BARRISTERS, Fall 1992, at 31, 31. The problem with this scenario is that each of the twelve jurors would experience something different. *Id.*

164. See *Schaffner v. Chicago & N.W. Trans. Co.*, 541 N.E.2d 643, 655 (Ill. 1989) (holding it was improper, although not reversible error, for juror to participate in experiment demonstrating gyroscopic action of bicycle wheel); *Gray v. L-M Chevrolet Co.*, 368 S.W.2d 861, 866 (Tex. Ct. App. 1963) (affirming trial court's refusal to allow juror to feel bumps on plaintiff's back); *Vance v. Monroe Drug Co.*, 149 Ill. App. 499, 507 (1909) (finding it was improper for trial court to allow juror's to manipulate plaintiff's hand to determine its degree of mobility).

One reason jurors should not be allowed to participate in demonstrations is that personal contact between the jurors and counsel or witnesses for one party may place the counsel or witnesses in a favorable or unfavorable light with the jurors. *Schaffner*, 541 N.E.2d at 655. Additionally, participating in a demonstration offered by one party may, in effect, turn the juror into a witness for that party, yet the opposing party cannot cross examine the juror as to his findings. *Id.*

165. Gore, *supra* note 69, at 482.

166. Buck BloomBecker, *The Power of Animated Evidence: Computer Graphics Can Make Your Case More Compelling*, CAL. LAW., May 1988, at 47, 49.

167. Gore, *supra* note 69, at 475.

168. *Id.* at 475. "The familiar declaration, 'I saw it with my own eyes,' typifies the deeply-rooted tradition of placing credence in what one sees." *Id.* at 475 n.78. The phrases, "a picture is worth a thousand words" and, "seeing is believing" further demonstrate the value of a visual presentation. DOMBROFF, *supra* note 17, at § 1.2.



tion as the truth if the case involves complex data or technical issues.<sup>169</sup> Jurors become bored and confused with complicated issues and evidence.<sup>170</sup> Computer graphics increase their ability to retain and analyze such information.<sup>171</sup> Therefore, if watching the VR demonstration is the only way the jury can comprehend the information, jurors will most likely accept the demonstration as true.<sup>172</sup>

While VR poses a great threat of prejudicing or misleading the jury, VR's proponent can reduce this threat by confining the finder of fact to a spectator status, leaving out inflammatory material, and requesting a limiting instruction.

First of all, the party presenting the VR demonstration should control its use.<sup>173</sup> The party should only allow the finder of fact to observe rather than to actually participate.<sup>174</sup> This will allow the finder of fact to remain more objective.<sup>175</sup>

Second, in order to reduce the likelihood of unfair prejudice, VR's proponent must leave inflammatory material out of the presentation.<sup>176</sup> For example, a VR demonstration depicting a car accident should not include the sound of the cars crashing or the passengers screaming.<sup>177</sup> Similarly, a VR presentation should show only enough detail to convey the nature of an injury to the finder of fact.<sup>178</sup> Too much graphic detail can actually hurt the party presenting the VR demonstration by angering or upsetting the jury.<sup>179</sup> By eliminating or reducing inflammatory material, VR's proponent will increase the presentation's chances of admission.

Finally, in order to ensure the jury is not misled into believing the VR presentation is necessarily true, VR's proponent should propose that the court issue a limiting instruction advising the jury that the demon-

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169. Jurors understand complex or specialized subjects better when they are explained visually. Jeanette Borzo & Kelley Damore, *Low Cost 3-D Animation Earns its Day in Court; Makes Evidence Come Alive For the Jury*, INFOWORLD, Sept. 13, 1993, at 1, 20.

170. Krieger, *supra* note 9 at 92. "If these guys start to talk about the laws of physics and construction, the jury's eyes would glaze over," says Dan Briggs, president of California based Digital Design Simulations. Borzo & Damore, *supra* note 169, at 1. "With animation, you can show the bolts or the beams breaking and attract the jurors' attention." *Id.*

171. Krieger, *supra* note 9, at 92.

172. Menard, *supra* note 7, at 351.

173. Gore, *supra* note 69, at 477. See also *supra* text accompanying note 164.

174. *Id.*

175. *Id.* at 479.

176. See Muir, *supra* note 10, at S1.

177. *Id.*

178. Gesalman, *supra* note 15, at 8.

179. *Id.* Fred Misko is an attorney at a well known personal injury firm in Dallas that specializes in high-tech trials. *Id.* "We need to see the reality," Misko says, "[b]ut I am confident that if you step over the line, not only does it not help your case, but it hurts." *Id.*

stration is not an actual re-creation of the event.<sup>180</sup> When balancing the prejudicial or misleading effect of evidence against its probative value, the court should consider whether a limiting instruction can effectively reduce such dangers.<sup>181</sup> An instruction which informs the jury that the VR presentation is merely an illustration of evidence, rather than a re-enactment, should decrease the possibility of the finder of fact according undue weight to the VR demonstration.<sup>182</sup>

Following these three precautions increases the probability that the court will admit VR by decreasing the likelihood that VR will prejudice or mislead the jury. However, because evidence is only excluded under FRE 403 if the likelihood of prejudice substantially outweighs the probative value,<sup>183</sup> courts must also weigh the danger of prejudice against VR's probative value.

Evidence has probative value if it tends to prove an issue.<sup>184</sup> VR will be especially probative in cases involving technical issues or complex fact patterns.<sup>185</sup> VR's probative value is based on the fact that "visualization is the very soul of comprehension."<sup>186</sup> A recent ABA study showed that technical issues and complex fact patterns bored and confused jurors.<sup>187</sup> Another study showed that jurors retain visual or combined oral and visual presentations much better than oral presentations

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180. In determining whether to exclude evidence on the grounds of unfair prejudice, the courts should consider the probable effectiveness or lack of effectiveness of a limiting instruction. FED. R. EVID. 403 advisory committee's note.

181. *Id.* See generally *United States v. Smith*, 685 F.2d 1293, 1294 (11th Cir. 1982) (trial court issued a limiting instruction restricting jury's use of prior insurance claim evidence and stating there was no indication of fraud in the previous claims); *United States v. Guerrero*, 803 F.2d 783, 787 (3d Cir. 1986) (trial court, having admitted evidence that the defendant threatened a co-conspirator, issued limiting instructions immediately after testimony and during jury charge).

182. *Gore*, *supra* note 69, at 479-80.

183. FED. R. EVID. 403.

184. "Evidence has 'probative value' if it tends to prove an issue." BLACK'S LAW DICTIONARY 1203 (6th ed. 1990).

Lilly says whether or not something has probative value is a "common-sense determination." LILLY, *supra* note 17, § 2.2. The test is whether certain events or conditions are causally connected with other events or conditions. *Id.*

185. *Menard*, *supra* note 7, at 345. In determining whether to use VR, an attorney should consider the following factors: whether the event or object to be depicted is difficult to visualize; whether the factor of time is critical in the case; whether the event is incapable of physical re-enactment; whether the event is technical and difficult for the average person to understand; and whether critical facts in the case are in question. *Fadely*, *supra* note 6, at 845.

186. *Krieger*, *supra* note 9, at 92. Neurophysiologists estimate that one third of the human brain is devoted to vision and visual memory. *Id.*

187. *Id.* Jurors reported they had difficulty remembering facts and deciding critical issues because of the sheer volume of information. *Id.*

alone.<sup>188</sup>

By allowing its users to see, hear, and feel, VR enables those users to experience previously hidden relationships in complex sets of data.<sup>189</sup> Through VR, its users absorb, manipulate, and interpret information more quickly and completely.<sup>190</sup> Furthermore, VR will allow jurors to focus their full attention on the evidence before them by immersing them in a distraction-free virtual world.<sup>191</sup> Therefore, VR has strong probative value. It will help the finder of fact remember and interpret evidence relating to material issues in the case.

The danger that VR will prejudice the jury may be strong. However, such prejudice will not substantially outweigh VR's probative value if the previously mentioned precautions are taken. Accordingly, VR should not be excluded under FRE 403.

### 3. *Can VR be Authenticated?*

If the VR demonstration is relevant and its prejudicial or misleading effect does not substantially outweigh its probative value, it must meet one final requirement. It must be authenticated.<sup>192</sup> This requirement is met by "evidence sufficient to support a finding that the matter in question is what its proponent claims."<sup>193</sup>

FRE 901(b)(9) states that the matter in question can be authenticated by evidence describing the process used to produce the result and showing that the result is accurate.<sup>194</sup> However, FRE 901(b)(9) alone is insufficient to authenticate the VR. The contestant will attack the accuracy of the program used and the final result. Additionally, the contestant will also attack the qualifications of the expert who creates the demonstration and the data used.

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188. Krieger, *supra* note 9, at 185. The "Weiss-McGrath Report" showed that jurors retain visual presentations 100% better than oral presentations and combined oral-visual presentations 650% percent better than oral presentations alone. *Id.*

189. Hamilton et al., *supra* note 16, at 98.

190. *Id.*

191. Gore, *supra* note 69, at 469. "VR suspends disbelief and distractions" by immersing the user in another world. *Id.* With VR, the computer becomes invisible and leaves the user free to concentrate on the tasks, ideas, and problems in the virtual world. PIMENTEL & TEIXEIRA, *supra* note 46, at 7-8.

192. "(a) General provision. The requirement of authentication or identification as a condition precedent to admissibility is satisfied by evidence sufficient to support a finding that the matter in question is what its proponent claims." FED. R. EVID. 901(a).

193. *Id.*

194. (b) Illustrations:

By way of illustration only, and not by way of limitation, the following are examples of authentication or identification, conforming with the requirements of this rule:

(9) Process or system. Evidence describing a process or system used to produce a result and showing that the process or system produces an accurate result.  
FED. R. EVID. 901(b)(9).

Therefore, proponents should take additional steps to authenticate the VR presentation. As a guideline, the VR proponent should follow four requirements suggested for authenticating computer generated visual evidence.<sup>195</sup> First, the proponent should demonstrate that the expert who created the VR demonstration is qualified.<sup>196</sup> This will require not only a showing of computer expertise, but also expertise in the field with which the demonstration deals.

The proponent can meet this requirement by showing that the demonstration was created by one person who is an expert in several fields or, more likely, by a team of experts collaborating. For example, Alexander Jason created the computer animated simulation used in Jim Mitchell's murder trial, mentioned in the opening lines of this comment.<sup>197</sup> Jason was both a computer programmer and a ballistics expert.<sup>198</sup> In addition, he conferred with a criminologist while constructing the animation.<sup>199</sup>

Second, the proponent should prove the reliability and accuracy of the computer hardware and software used to create the VR demonstration.<sup>200</sup> This requires that the proponent allow the court and opposing party access to the program to test its accuracy.<sup>201</sup> As VR becomes more advanced and more common, certain programs on the market may welcome well known and accepted. As long as such programs are accepted in the scientific community, they should qualify for use in creating courtroom demonstrations.<sup>202</sup>

The third requirement for authenticating a VR demonstration is the most important and the most vulnerable.<sup>203</sup> The proponent should verify the input data used.<sup>204</sup> After all, even a VR demonstration created by a properly functioning computer program is only as accurate as the data entered into it.<sup>205</sup> The opposing party will point to any data that cannot be proved conclusively and claim it makes the VR demonstration inaccurate.

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195. Muir, *supra* note 10, at S1.

196. *Id.*

197. See *supra* notes 1-5 and accompanying text.

198. Watts, *supra* note 15, at 8.

199. Borzo & Damore, *supra* note 169, at 1.

200. Muir, *supra* note 10, at S1.

201. *Id.* Muir suggests that the hardware and software which will be used to produce computer animation should be fully investigated before the animation is begun. *Id.* Due to the high cost of VR (see *supra* note 37), this suggestion is especially applicable to VR.

202. *Id.*

203. *Id.*

204. Muir, *supra* note 10, at S1.

205. See Murphy, *supra* note 79, at 152. A computer's product is only as accurate as the data input. Leonard J. Nelson, *Garbage In, Garbage Out: The Need for New Approaches to Computer Evidence*, 9 AM. J. TRIAL ADVOC. 411, 414 (1986). "[B]est kept in mind is the adage 'garbage in, garbage out.'" *Id.*

rate.<sup>206</sup> Therefore, the less assumptions made when creating a VR demonstration, the more likely the court will admit it. Finally, the proponent must establish the accuracy of the demonstration itself.<sup>207</sup> FRE 901(b)(1), which provides for authentication of evidence by testimony of a witness with knowledge, applies here.<sup>208</sup>

Witness testimony is frequently used to authenticate photographs.<sup>209</sup> In *U.S. v. McNair*, for example, two bank tellers authenticated photographs from a bank surveillance camera by testifying that the pictures accurately represented the robbery and participants.<sup>210</sup> The court held that this was sufficient to authenticate the photographs.<sup>211</sup>

Similarly, in order to authenticate VR, a witness with knowledge of the scene or event depicted must testify as to VR's accuracy. Since a VR demonstration may depict a large area, such as an accident site, the proponent may need to present more than one witness to verify its accuracy.<sup>212</sup> Due to the very real possibility of tampering with VR, a VR demonstration should not be admitted without such testimony.

To review, the proponent should demonstrate that a qualified expert created the VR demonstration using an accurate program and equip-

206. Menard, *supra* note 7, at 346, n.144.

207. Muir, *supra* note 10, at S1.

208. "(b) Illustrations. By way of illustration only, and not by way of limitation, the following are examples of authentication or identification conforming with the requirements of this rule:

(1) Testimony of witness with knowledge.

Testimony that a matter is what it is claimed to be." FED R. EVID. 901(b)(1).

A witness can establish the accuracy of a VR simulation by testifying he has first hand knowledge of the scene and/or events depicted and that the VR presentation accurately represents it. Gore, *supra* note 69, at 488-89.

209. Christine A. Guilshan, Note, *A Picture is Worth a Thousand Lies: Electronic Imaging and the Future of the Admissibility of Photographs into Evidence*, 18 RUTGERS COMPUTER & TECH. L.J. 365, 368 (1992). Courts generally admit photographs under two separate theories. *Id.* Under the pictorial testimony theory, a person having "knowledge of [the matter] depicted in the photograph testifies [as] to [its] accuracy." *Id.* Under the silent witness theory, the photograph is "a 'silent witness' which speaks for itself and is substantive evidence of what it portrays independent of a sponsoring witness." *Id.* at 369.

210. *U.S. v. McNair*, 439 F. Supp. 103, 105 (E.D. Pa. 1977), *aff'd* 571 F.2d 573 (3d Cir. 1978), *cert. denied*, 435 U.S. 976 (1978).

211. *Id.* See also *United States v. Wilson*, 719 F.2d 1491, 1495-96 (10th Cir. 1983) (bank employee's testimony was sufficient to authenticate photographs of robbery scene where employer had seen robber for several minutes); *United States v. Oaxaca*, 569 F.2d 518, 525 (9th Cir. 1978), *cert. denied*, 439 U.S. 926 (1978) (an FBI agent, who was present when comparison photographs were taken, testified to authenticate the photographs).

212. For example, more than one witness may be needed to authenticate a VR simulation depicting an automobile accident at a major intersection. Perhaps, the witness who saw the accident is not familiar with the intersection. This witness could only testify as to the accuracy of the accident itself. The party presenting the VR simulation must then present a second witness who is familiar with the intersection and can testify the simulation accurately portrays the placement of traffic signs, etc.

ment. The proponent should also show that all data used to create the demonstration was accurate and that no unfounded assumptions were made. Lastly, the proponent must present witness testimony to verify the accuracy of the final product.

#### IV. CONCLUSION

No aspect of society remains untouched by the computer revolution. The law is no exception. As society advances technologically, courtroom issues are becoming increasingly complex. Litigators must seek new forms of demonstrative evidence to illustrate these complex issues to a jury entertained, educated, and socialized by means of video stimulation.

"Demonstrative evidence represents the biggest change in the way cases are tried in American courts since the court recorder was a scribe using a quill."<sup>213</sup> In the past, attorneys turned to posed photographs, motion pictures, and videotape to illustrate complex evidence. Today, many attorneys are using computer animation. In the near future, VR will be ready for use in the courtroom, providing the litigating attorney with a powerful new tool.

VR has the potential to revolutionize the way evidence is presented. It will allow the trier of fact to view first hand the events or objects at issue in a case. This will be an invaluable tool in helping the jury retain and analyze information.

Opponents of VR, however, may claim it is inadmissible because it poses a substantial threat of prejudicing or misleading the jury and allows great room for tampering. Nevertheless, VR's proponent can carefully prepare the VR presentation using precautions to minimize any prejudice or inaccuracies. By showing its relevancy, demonstrating that its prejudicial effect does not substantially outweigh its probative value, and adhering to authentication guidelines, the VR proponent will likely ensure the presentation admission as demonstrative evidence under the FRE.

A creative attorney, coupled with a willing judge, will soon establish legal history by breaking the ice and introducing VR presentations to the courtroom. In the future, one can envision a courtroom replete with VR apparatus, a jury box equipped with twelve light-weight head mount displays, and a witness giving his account of how an event occurred. This is the courtroom of the future.

*Mary C. Kelly & Jack N. Bernstein*

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213. Fred Setterberg, *Roger Rabbit Goes to Court: Computer Graphics Specialists are Producing Dazzling Demonstrative Evidence Using PC Software and Lots of Imagination*, CAL. LAW, Feb. 1990, at 70, 75 (quoting Oakland Municipal Court Judge Carol A. Corrigan).

