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Recollections on *Presence* Beginnings, and Some Challenges for Augmented and Virtual Reality

Editors' Note: To celebrate Presence*'s 25th year of publication, we have invited selected members of the journal's original editorial board and authors of several early articles to contribute essays looking back on the field of virtual reality, from its very earliest days to the current time. This first essay comes from the journal's founding Co-Editor-in-Chief, Tom Sheridan.*

The Beginning of *Presence*

The idea for *Presence* began on the beach in Santa Barbara. Nat Durlach and I thought it would be fun to get some of the key programmers and engineers already doing VR and graphics software for computer gaming, film, and TV together with engineers from NASA, the military, and the aviation industry who had long been developing flight simulators and now were concerned about remote control and telepresence. We saw a close relation between VR and teleoperation, as depicted by Figure 1. To the extent that the computer-generated reality and the telepresence feedback from an actual teleoperator are both of sufficiently high quality, from the human operator's viewpoint the mental model of the task and the interactions at the computer interface should be the same. In 1991 this sameness was clearly a stretch for many reasons, but it was clear that there was much we could gain from sharing ideas, and to the best of our knowledge there had been minimal interaction to date between those two communities.

We knew that the free-thinking, long-haired, tee-shirt and sandal-wearing community of VR software, such as Jaron Lanier, would provide a wonderful and provocative contrast to suit-wearing, brief-case-carrying engineers and government officials, and figured this mix of people would be great fun for everyone. So we pitched the idea to NASA, as best I recall, and they said yes and came up with support for such a meeting. A hotel on the beach at Santa Barbara, California seemed like an ideal venue.

There was also the feeling that the technology of both displays and software were bound to increase at a rapid rate, and that no journal was then available for researchers to publish scientific findings regarding the psychological and physiological aspects of VR—beyond the hardware and software technology.

The meeting was a great success, in our opinion, and we all went away enlightened. So then we suggested to MIT Press that this might be a topic for a journal. They liked the idea, and so it began. The first issue of *Presence: Teleoperators and Virtual Environments* was published as "Winter 1992." Thomas Furness and I were listed as Co-Editors-in-Chief and Nathaniel Durlach as Managing Editor.

Presence has fulfilled its mission and then some. The emphasis has been heavier on VR than on teleoperation.

Augmented Reality for Driver Training

One problem with driver training, whether it is with adults or teenager trainees, is that they never come close to experiencing crashes as part of their training. The best the driving instructor, whether a professional or a parent, can do is to make admonishments about what might happen if they go too fast or are not paying sufficient attention to the scene ahead. Initial driver training is currently done, appropriately, by keeping to very slow

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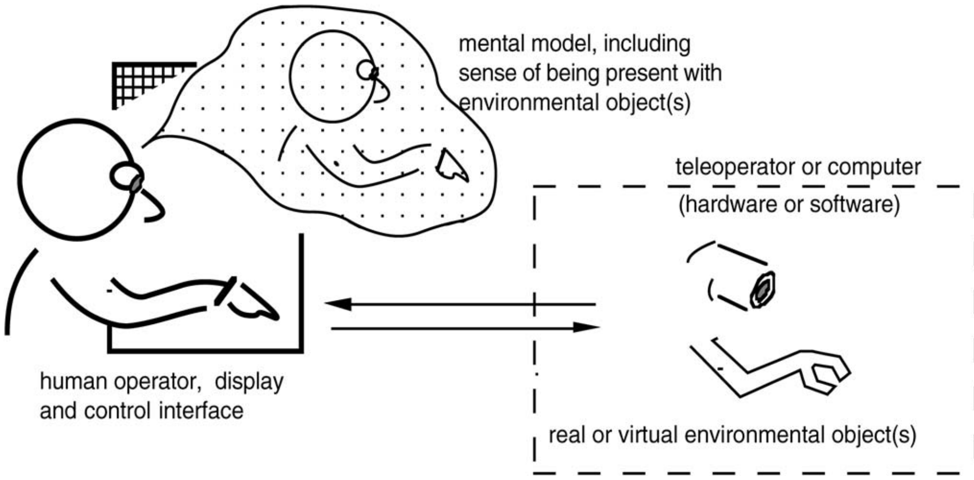

Figure 1. *How VR and telepresence are related.*

speeds. When the students are sufficiently adept at steering and braking, they go out on the road with and engage in normal driving. Near misses are likely never to occur, or at least the instructor is ready to grab the wheel if they do. Near-miss situations can be simulated in fixed-base driving simulators, of course, but to provide sufficient realism in both vision and motion cues, access to a simulator of sufficient fidelity is both inconvenient and costly. High-fidelity driving simulators that provide wide-angle high-resolution viewing as well as valid motion cues are not accessible to the great majority of driver trainees (they are used by government and automobile manufacturers for research, and in any case can be far too expensive to justify for training purposes). Simple PC-based simulators are just perceived as games, and users mostly perform crashes merely to have fun.

Augmented reality in conjunction with driving a normal car can fill in this gap. Computer-generated images can be superimposed on the real scene observed through the windshield, provided the display technology (head-mounted or otherwise) is adequate, both in resolution and field of view. To make this work properly, it is imperative to synchronize the moving computer-generated images with the real-world coordinates. If, for example, the image of the potential crash obstacle is another vehicle, that vehicle must appear to stay on the road, and move or turn properly in relation to the vehicle the subject is driving.

But how to provide motion cues that are consistent with what is going on visually? That can be accomplished by having the subject trainee drive an actual automobile, preferably on a roadway with little traffic, or even on a test track. In that way all the motion cues are the real thing, and so are the steering and braking controls.

An experiment with this approach was conducted by the author and his students at MIT fifteen years ago (Sheridan, 2007). At that time computer graphic technology and vehicle models were quite good, but augmented reality display technology was extremely crude. Figure 2 shows two images from a video recording of what was provided in a crude head-mounted display of a truck seeming suddenly to emerge from the right. Otherwise the scene is a video of the real world that the driver observed through the HMD. The technology to superimpose the truck model on the video was quite satisfactory, but providing an AR display was problematic at the time. The experiment has not been repeated at this time (the author is retired), and this article is an open invitation for anyone to carry the idea forward.

Use of VR in "Policy Flight Simulators"

The future implications of alternative public policies tend to be complex and difficult for analysts to comprehend, and certainly much more difficult for managers, policymakers, and the general public. There are multiple

Figure 2. *Two images of a video showing superimposition of computerized truck images on an actual driver's view in a test drive on a country road. White objects are fiduciary markers to enable continuous geometric correspondence of the AR image to the real world.*

reasons for this complexity: the implications tend not to be static but rather dynamic and nonlinear. They depend on the interaction of many parameters. There are costs and benefits that accrue differently to different stakeholders. Policy analysts try to agree on who the stakeholders are, what the key variables are, and what the costs and benefits are to each set of stakeholders as a function of the parameters of any given policy. They then might try to develop a computer-based simulation to represent these relationships: how the cost and benefit results play out in time for each stakeholder group as a function of the attributes of a given policy.

A *policy flight simulator* is a metaphor for a means by which a person can interact with a simulated dynamic implementation of a policy. This method requires some explaining. The term is metaphorical in that the human observer is not literally flying in physical space, but rather the person is "flying" though the simulated implications of some assumed policy based on certain variables and parameter assumptions (Rouse, 2014).

In a simplest case, the user ("pilot") can adjust certain independent parameters of a policy (e.g., by moving sliders on a computer-graphic dashboard) and then the pilot can observe a display of how some dependent variables (e.g., benefits or costs in dollars) will change. This change can be displayed, for example, as a set of bar graphs or as plots as a function of time. The simulator can easily be adjusted to display the changing variables on any desirable time scale, or the simulation can be frozen at some future point in time, so that further adjustments can be explored to determine their implications for that future time. Because a large number of computer simulations can be run almost instantly relative to a human's time scale of observation, there are almost endless ways the data can be presented.

Assuming such policy flight simulators will be more prevalent in our future, it seems that virtual reality technology could play an important role. It can allow the "pilot" to fly the "viewpoint" to any location in a hyperspace of multicolored graphical representations of policy implications. The policy flight simulator might even have some "autopilot" modes. For example the simulator might have certain parameters systematically scan through the ranges of some parameters, or "hill climb" to guide the "flight" toward optimal outcomes under certain assumptions.

References

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