Virtual Reality: A Definition History - A Personal Essay

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ABSTRACT

This essay, written in 1998 by an active participant in both virtual reality development and the virtual reality definition debate, discusses the definition of the phrase “Virtual Reality” (VR). I start with history from a personal perspective, concentrating on the debate between the “Virtual Reality” and “Virtual Environment” labels in the late 1980’s and early 1990’s. Definitions of VR based on specific technologies are shown to be unsatisfactory. I propose the following definition of VR, based on the striking effects of a good VR system: “Virtual Reality is the use of computer technology to create the effect of an interactive three-dimensional world in which the objects have a sense of spatial presence.” The justification for this definition is discussed in detail, and is favorably compared with the dictionary definitions of “virtual” and “reality”. The implications of this definition for virtual reality technology are briefly examined.

Subject headings: Virtual Reality

1. Preface

I wrote the essay below in 1998 in response to a discussion of the definition of virtual reality in a virtual reality interest group run by Linda Jacobsen. This essay found its way into an online “Omnibus Lexicon Definition Supplement” on a now defunct website by the Fourth Wave Group, under the title “Virtual Reality: A Definition History”. Because this web site is no longer available, and there are at least 13 citations to this essay in the literature according to Google Scholar, I am providing this essay here. This version is lightly edited from the original for clarity and to remove discussions specific to the virtual reality interest group. Major new comments are inserted in square brackets: [].

It is my opinion that the definition of virtual reality presented in this essay has stood the test of time.

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2. Virtual Reality: A Definition History (written in 1998)

I would like to add to the discussion on definitions in virtual reality (VR), as my position on this has evolved through more than a decade of watching, and participating in, the “VR definition wars”.

2.1. History

First I’d like to review some of the history. If I can be allowed a moment of nostalgia, I fondly recall sometime in 1985 or ’86 talking to Jaron Lanier on the phone (I worked for him at the time at VPL Research), and him telling me about the lunch he’d had that day with Scott Fisher then of the NASA Ames Virtual Interactive Environment Workstation (VIEW) lab. [The VIEW lab was one of the first multi-modal virtual reality implementations, incorporating wide-field, head-tracked stereoscopic display, hand and gesture tracking and three-dimensional sound rendering supported by 30 Hz three-dimensional rendering and workstation-class computation.] They were talking about what to call what Scott was doing in the VIEW lab when Jaron coined the term “virtual reality”. Jaron told me that he thought it was an accurate description of what Scott was doing. Scott and others at, e.g. the University of North Carolina, had already been calling it virtual environments (VE): VIEW stands for Virtual Interactive Environment Workstation, and was the follow-on to Michael McGreevey’s Virtual Visual Environment Display (VIVED) project at NASA Ames (Fisher, et al., 1986).

I’m happy to say that I joined Scott’s VIEW lab in 1988.

For the next several years there was a battle between the “virtual reality” and the “virtual environment” camps over appropriate nomenclature, with the academics tending towards VE and the hacker/commercial/press sectors tending towards VR. [The VE side generally expressed that the phrase “virtual reality” was too vague and somewhat oxymoronic. Though I tended to agree with this judgement at the time, as described in 2.2 I have since decided that “virtual reality” is actually precise and not at all oxymoronic.] At about this time the phrase “artificial reality” was popular in Japan. VR became generally accepted in the 92-93 time frame, as signified by:

- the creation in 1992 of the National Academy of Sciences/National Research Council Committee on Virtual Reality Research and Development (though the resulting 1995 NAS/NRC report (Durlach and Mayor, ed. 1995) was ambivalent on the VR/VE issue),
the creation of the Virtual Reality Annual International Symposium (VRAIS) conference and the IEEE Symposium on Virtual Reality Research and Development in 1993,

• perhaps most importantly, Fred Brooks finally agreeing to the VR label.

I feel that VR won by sheer volume: every time we said “VE” we had to explain that we meant “VR” as everyone had heard of VR even if they didn’t know what it meant. As I’ll explain below I’ve completely come to peace with the VR label through the analysis of definitions.

In the meantime there were very many attempts to define VR/VE. Agreement on definition was elusive. We all knew that what we were doing was special, but expressing just what was special proved surprisingly difficult. Most of these attempts tried to define VR through the technology used to achieve this unique effect, but this approach tended to lead to debates over whether this or that technology was “required” for VR. In the meantime it seemed that the point was lost, and in any case such a definition is uninformative to those who have not themselves experienced the technology in action. Simply saying “head tracking” does not convey the power of a head-tracked display in action.

In the meantime VR was being used to describe everything from three-dimensional photo-realistic rendering through non-graphical simulation to artificial intelligence. And this does not even count what was happening in literary and artistic circles where “virtual reality” was being used in very creative ways. It was clear that Jaron had picked a phrase which ignited something in people, though it is not clear that Jaron intended the effect to be quite this broad. It became apparent that VR was in danger of being so broadly used as to lose meaning entirely. This was one of the primary arguments against VR used by the VE camp. So it became critical to many of us to come up with a good definition of VR. By this time defining it in terms of technology was completely untenable, because those who were using the term more broadly could simply disagree.

2.2. A Definition of Virtual Reality

It was clear that we had to base our definition on the effects of VR: after all it was primarily the (promised) effects, and only secondarily the technology which seemed to make people most excited. Where I ended up was defining VR in terms of its cognitive effects: creating a sense of spatial presence, possibly a sense of immersion, a sense of interaction with objects. We then had to clarify the difference between VR and telepresence, where remotely
sensed objects are presented to our senses. Combining these observations I have settled on the following definition:

**Virtual Reality is the use of computer technology to create the effect of an interactive three-dimensional world in which the objects have a sense of spatial presence.**

I want to examine this definition piece by piece:

- “Computer technology” is required to distinguish VR from telepresence and other remote sensing approaches. This requirement is driven by the ability to use computer programs to create interesting and novel tailor-made environments, which is where I think a lot of the popular interest in VR comes from.

- “Effect” rather than “illusion” because I feel that it is a cognitive effect that is achieved (more on this later), rather than an illusion. Saying “effect” rather than “illusion” also undercuts the presumption of “fooling” the user.

- “Interactive” to distinguish VR from conventional animation. I also think that it is the ability to interact with the virtual world which is behind much of the popular excitement.

- “Three-dimensional world” to exclude text-based environments and to limit discussion away from 1D and 2D programs (which would encompass essentially all of interactive computer graphics).

- “Objects have a sense of spatial presence” means that the objects seem to have a spatial location independent of both the user and the display technology. This is, I feel, at the heart of what is special about VR.

I shorten this definition to the buzz phrase “interaction with things, not (possibly animated) pictures of things.”

By now I’m sure you’ve noticed the absence of “immersion” in the definition. I take “immersion” to mean “being surrounded”, and so a sense of immersion would require a sense that I am surrounded by the environment: things can be behind me and if so I’ll see them when I turn around. Initially my definition included immersion, but having worked with such non-immersive displays such as the responsive workbench [Cutler, et al. 1997](#) or the immersadesk [Czernuszenko, et al. 1997](#), it is clear to me that all the power of VR can happen without any sense of immersion whatsoever. So I dropped “immersion” as a requirement.
Also absent from this definition is a requirement that the virtual environment mimic the real world either in terms of content or in terms of interface. I feel that such requirements miss the point and tend to limit the creative development of effective virtual environments.

This definition is tentative, but is the best I’ve been able to do to date.

In the meantime I was meditating on the phrase “virtual reality” itself. Most people react to it as an oxymoron but I always had a sense that Jaron was exactly right in choosing this phrase. So one day I went to several dictionaries and looked up “virtual” and reality” There were several definitions of each, but the ones that stood out to me as appropriate to our purposes were the following:

- Virtual: to have the effect of being such without actually being such

and

- Reality: the property of being real
- Real: the property of having concrete existence.

Putting these together, “Virtual Reality” means “to have the effect of having concrete existence without actually having concrete existence”. I think this is an impressively accurate description of what is special about what we are doing in VR.

Now of course once you accept the above definition of virtual reality, it has real implications about the technology required. When your display is visual or auditory, head tracking is clearly required to maintain a sense that objects have an independent spatial presence as you move your head. The desired effect is that the virtual object stays put (assuming it’s not moving) as you move around. My catchphrase for this when using a visual or auditory display is: “if you move your head and nothing happens it ain’t VR”. Whatever your modality, “near-real-time” (or whatever you want to call it) performance is again required for spatial presence. Also the relationship between the user and virtual objects is critical to providing the effect of spatial presence, so something about the user must be tracked in all cases. Note that visual fidelity is not required (for a visual display) in this definition: the 100x100 monochrome display in the 1988 VIEW lab had terrible fidelity (not to mention Ivan Sutherland’s original display from 1967), but it provided a strong sense of spatial presence which deeply impressed those who tried it.

The above helps clarify the problem with definitions based on technology: I have yet to see a technology requirement beyond “near-real-time” performance and user tracking which
must be in every system anyone can mention which clearly (intuitively) is a VR system. But clearly not all fast systems which track the user are VR systems: the results of the tracking can be used in a way that have nothing to do with spatial presence or immersion.

REFERENCES

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