

Defining Virtual Reality: Insights from Research and Practice

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Abstract. Virtual reality (VR) technology is an increasing portion of the consumer technology market. VR technology is being used to treat PTSD, to create virtual worlds for users to explore, and to help teach students advanced visual concepts. Further, VR is a fruitful area for the focus of information science research. Researchers have begun to explore running simulated laboratory experiments in VR and conduct virtual usability tests. Prior work has typically considered “virtual reality” to be any experiences that are created by a tool, marketed as a VR product. However, such product-driven definitions of virtual reality may limit our ability to study and innovate within this field. As such, in this poster we present a work-in-progress study in which we extract information regarding the advancement of goals for VR, components of virtual experiences, and definitions of VR obtained from a body of academic literature and marketing materials for VR products from the 1960s through today. We use an affinity diagramming analysis to distill a comprehensive set of definitions for VR from this data. In future work, we will collect users’ definitions of VR to further empirically inform our understanding of what makes up a VR. Such an understanding can serve as the foundation for future research and innovations in VR.

1 Introduction

An increasing body of research in Information Science has been exploring Virtual Reality (VR). Recent work has emphasized using VR for conducting experiments [12], using VR for crowdwork [6], using VR to treat medical conditions [13] and studying what users think about this new technology [1].

This prior research considers “virtual reality” specifically within the context of a particular headset or consumer implementation. Furthermore, there has been seldom research developing new technological affordances or studying how people feel about VR. This work has been more theoretically founded. However, a number of academics have been discussing and theorizing about what makes up a virtual reality or virtual experience since the 1960s [16]; and users have been dreaming of virtual reality since at least 1935, when the idea first appeared in the short story “Pygmalion’s Spectacles” [8].

In the past, information science researchers have made theoretical and empirical contributions by researching and defining emerging technologies (e.g., the Internet, social media) and the properties users desire them to have – at times before such affordances existed [7,9] – rather than focusing exclusively on the technologies and affordances that were already created by a particular company. Such research enabled the design of platforms better calibrated to user preferences, rather than corporate decisions. Such “aspirational” and “theoretical” definitions can thus prevent us from restricting the development potential of a new technological concept.

In this work, we take the first steps toward creating a theoretically-grounded definition for VR: we explore how researchers and technologists define VR, including their expectations for virtual experiences. Specifically, we present a review of the past 80 years of theory on VR (Section 2) and VR products from which we draw a set of literature- and practice-based definitions, which we then analyze using affinity diagramming [3] to create a work-in-progress framework for defining VR.

In future work, we will iterate on this framework, including user definitions of VR that we will solicit via surveys. By carefully defining VR based on theory, practice (existing technologies), and user beliefs, we can better tailor our research and innovation to match user expectations and create positive, user-centric virtual worlds that go beyond the bounds of current technologies (e.g., headsets). Such a synthesized definition of VR will allow for greater consistency in interdisciplinary research, unifying the focus of researchers from different fields.

2 A Brief History of VR Technology

Although VR only began to gain mainstream popularity in the past few years, the idea of VR has existed for a long time. As early as 1950, scientists and researchers have been attempting to build devices that would allow users to experience different environments. Since then, head mounted displays and other technology necessary to create a fully immersive experience have continued to advance.

Nintendo and Sega both experimented with VR in the 1980s and 1990s, [10] with Nintendo being the first to release a commercially memorable VR headset dubbed the Nintendo Virtual Boy in 1995. The Virtual Boy was priced at \$180.00, slightly less than many home gaming consoles but significantly more than the mobile consoles it was competing with [4]. Nintendo did its best to keep costs down by limiting the display to the two cheapest colors, red and black [11]. The limited color set prevented production of real-world authenticity and along with various other problems the system failed to provide users with a fully immersive experience. The Virtual Boys lack of success in the marketplace caused the industry to take a much more conservative approach when releasing future generations of consoles.

It wasn’t until 2006 that the format of game consoles changed, when Nintendo released the Wii. The Nintendo Wii controllers used accelerometers and infrared

sensors to create new ways of input. Accelerometers allowed wireless controllers to sense movements such as running or lifting, while infrared sensors allowed users to interact with the interface by moving their entire arm instead of just their fingers. Technologies similar to the Nintendo Wiis were then incorporated into the Playstation Move Controllers and Xbox Kinect. Although the Nintendo Wii, Playstation Move Controllers, and Xbox Kinect were not head mounted devices their technologies are the core foundation necessary for VR.

In 2012, Oculus raised almost \$2.5 million from a kickstarter campaign for the Rift, their first head mounted VR display. Oculus was later purchased by Facebook. Soon after in 2014, Google launched Cardboard, a reference design platform that allowed manufactures or users to create a VR headset that could be used with a phone. Cardboard used the phone screen, processing power, touch input, and gyroscope to create a cheap but quality VR unit. Samsung used Cardboard and partnered with Oculus to launch their own headset in 2015, named Gear VR.

Finally, HTC, a Chinese technology company, and Steam, a games platform and software company, collaborated to create a device similar to the Rift, known as the HTC Vive (now just Vive). The Vive was one of the first devices to offer full 3D room tracking capabilities, but to run, it must be connected with a high-end gaming PC.

VR has a long history. This long history has led many to wonder whether this will really be the time when VR is finally able to become mainstream. Regardless, the technological advancements will be used in other devices like mobile devices and TVs.

3 Methods

Three researchers searched for *theory* (academic literature) related to virtual reality using the terms “virtual reality”, “definition”, “theory”, and “history” in three academic databases (ACM Digital Library, Academic Onefile, and Google Scholar).

Two researchers searched for *practice* information (marketing materials, news articles, consumer websites, documentation) related to virtual reality products using a combination of the terms “virtual reality”, “headset”, “technology”, “platform”, and “device” using Google.

One researcher searched for different names of Virtual Reality headsets to understand how companies were positioning their Virtual Reality headsets – some search terms included “Oculus”, “Virtual Boy”, and “Google Cardboard”.

Each researcher searched independently – in order to better ensure exhaustive coverage of the literature – and selected relevant definitions from the articles they found, considering work published in – or products released in – 1965 through today.

Six researchers then analyzed the extracted definitions (practice definitions were placed on using affinity diagramming [2], each iterating over the diagram at least twice until consensus was reached on appropriate categorization.

4 Results

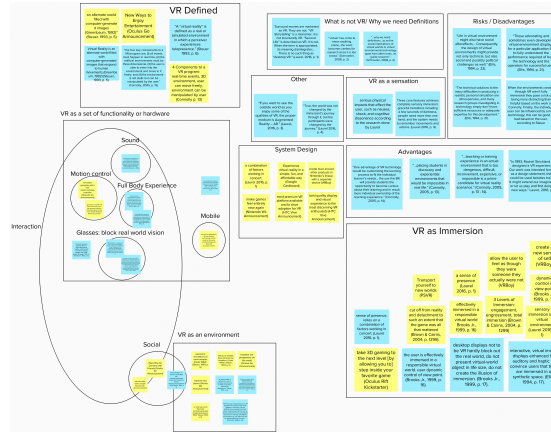


Fig. 1. Affinity diagram of definitions.

Figure 1 summarizes the results of our affinity diagramming process, which we describe in more detail below.

VR as an environment. Many definitions we considered, defined VR as a technology that can create a complete environment or world for the user to experience: “an alternate world filled with computer-generated images” [15]. These definitions were permitted either realistic or imaginary environments as valid VR environments. That is, Coates et al. say that VR is an “electronic simulation of [an] environment”, any environment [15]. The environments had certain technical components, for example to be 3D or to be interactive in different types of ways.

VR as a form of interaction. Many people fail to see how VR can help people connect with others and how interactions with one another can take place even when people are miles apart. However, the goal of the Oculus Go headset is to “connect with other people” [17]. Using motion sensitive controllers, people can see others moving their arms and bodies in a virtual space. Controllers can create an environment that “will take users away from the gamepad interface and make game control more intuitive” [14]. VR provides a unique interaction space where users can perceive a different reality.

VR as Immersion. Total immersion allows users to feel as though they are “cut off from reality and detachment to such an extent that the game was all that mattered.” [5] goal of a VR headset is to “allow the user to feel as though they were someone they actually were not” [4]. Our research has yielded that there are many different levels to immersion. We plan to research this further in the future.

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