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Exploring Oculus Rift: A Historical Analysis of the 'Virtual Reality' Paradigm

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Although many consider Virtual Reality to be a relatively new concept, it is more appropriately defined as a long-standing ideology subject to continuous transformation and several varying iterations throughout time depending on the advents in technology. Peter Stearns, a renown modern historian, once wrote an article sharing a similar historically oriented disposition claiming that "the past causes the present, and so the future. Anytime we try to know how something happened… we have to look for the factors that took shape earlier… only through studying history (a proper historical analysis) can we begin to comprehend the factors changing the field so rapidly." In essence, understanding the historical legacy associated with virtual reality is a critical first step in developing a solid foundation on the topic as a whole. With that being said, this paper will first provide background information about Virtual Reality in order to better analyze its development throughout history and into the future. Next, this essay begins an in-depth historical analysis of how virtual reality has developed prior to 1970, a pivotal year in Virtual Reality history. Followed by an exploration of how this development paradigm shifted between the 1970's and the turn of the century. The historical analysis of virtual reality is concluded by covering the modern period from 2000-present. Finally, this paper examines the layout of the virtual reality field in respect to he history and innovations presented. Although gaining a better understanding of the vast history associated with virtual reality may not necessarily enable us to predict the future layout of the field or its applications, ultimately it

remains an essential building block to developing a greater understanding of the present layout of the field of and how to properly navigate and apply the various VR functionalities.

Through careful analyzation of the relevant information presented in this paragraph, Virtual Reality and its associated paradigms can be better understood throughout history and into the future. Virtual reality is a type of computer-based technology that utilizes headsets or multi-projected environments, sometimes in combination with physical environments or props in an effort to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment. A person using virtual reality equipment is able to survey the artificial world in high-quality reality move around in it and interact with virtual features or items. The effect is commonly created by virtual reality headsets consisting of a head-mounted display with a small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. Virtual reality systems that include transmission of vibrations and other sensations to the user through a game controller or other devices are known as haptic systems. This tactile information is generally known as force feedback in medical, video gaming and military training applications. Virtual reality also refers to remote communication environments which provide a virtual presence of users with through telepresence and teleexistence or the use of a virtual artifact. The immersive environment can be similar to the real world in order to create a lifelike experience grounded in reality or sci-fi. Augmented reality systems may also be considered a form of virtual reality that layers virtual information over a live camera feed into a headset or through a smartphone or tablet device. In 1938, Antonin Artaud described the illusory nature of characters and objects in the theatre as "la réalité virtuelle" in a collection of essays, Le Theatre et son double. The English translation of this book, The Theater and its Double, is the earliest published use of the term "virtual reality".

Virtual reality shares some elements with "augmented reality". Augmented reality is a type of virtual reality technology that blends what the user sees in their real surroundings with digital content generated by computer software. The additional software-generated images with the virtual scene typically enhance how the real surroundings look in some way. Some augmented reality systems use a camera to capture the user's surroundings or some type of display screen which the user looks at. All modern virtual reality displays are based on technology developed for smartphones including gyroscopes and motion sensors for tracking head, hand, and body positions; small HD screens for stereoscopic displays; and small, lightweight and fast processors. These components led to relative affordability for independent virtual reality developers, and lead to the 2012 Oculus Rift kick starter offering the first independently developed virtual reality headset. In contrast, photogrammetry is increasingly used to combine several high-resolution photographs for the creation of detailed 3D objects and environments in virtual reality applications. The given information in this paragraph helps put many of the more complicated paradigms into perspective.

Next, this paragraph will provide the foundation of an in-depth historical analysis of how virtual reality has developed prior to 1970. Prior to the 1950's, the exact origins of virtual reality remain disputed, primarily due to the difficulty associated with formulating a solid definition for the concept of an alternative existence. Nonetheless, elements of virtual reality did, in fact, appear as far back as the 1860's. French avant-garde playwright Antonin Artaud believed "illusion was not distinct from reality…spectators at a play should suspend disbelief and regard the drama on stage as reality" (Abulrub, 753). With that being said, the first references to the more modern concept of virtual reality came from science fiction. Stanley G. Weinbaum's 1935 short story "Pygmalion's Spectacles" describes a goggle-based virtual reality system with a

holographic recording of fictional experiences, including smell and touch (Abulrub, 755). In between 1950-1970, significant improvements were made in virtual reality. In the 1950's, Morton Heilig wrote of an ‘Experience Theatre' that could "encompass all the senses in an effective manner, thus drawing the viewer into the onscreen activity" (Packer, 74). The term "virtual" has been used in the computer sense of "not physically existing but made to appear by software" since 1959. In 1962 he went on to build a prototype, along with five short films to be displayed in it while engaging multiple senses of this vision, called the Sensorama. Seeing as this predated digital computing, the Sensorama was actually a mechanical device. Heilig also went on to develop another advancement in the field of virtual reality with his "Telesphere Mask". The patent application described the device as "a telescopic television apparatus for individual use...The spectator is given a complete sensation of reality, i.e. moving three-dimensional images which may be in color, with 100% peripheral vision, binaural sound, scents and air breezes" (Packer, 76). Towards the end of the decade in 1968, Ivan Sutherland, along with the assistance of his student Bob Sproull, created what is widely considered to be the "first head-mounted display system for use in immersive simulation applications" (Abulrub, 757). A major defect with the primitive HMD came terms of user interface and realism. In fact, the HMD was so heavy that it had to be suspended from the ceiling. The graphics comprising the virtual environment were only composed of simple wire-frame model rooms. Nonetheless, the formidable appearance of this device inspired its name, The Sword of Damocles. Prior to 1970 virtual reality was making important first strides in terms of mechanical and physical implementation.

This historical analysis continues with a look into how virtual reality has developed between the 1970's and the turn of the century. Perhaps one of the most notable advents within

virtual reality systems came in 1978. It was known as the Aspen Movie Map created at MIT in 1978 as a crude virtual simulation of Aspen, Colorado in which users could wander the streets in one of the three modes: summer, winter, and polygons. The first two modes were based on photographs – the researchers actually photographed every possible movement through the city's street grid in both seasons. The third mode was a basic 3-D model of a city. Finally, by the 1980's, Atari founded a research lab specifically for virtual reality in 1982, but the lab was closed after two years due to Atari Shock. However, its hired employees, such as Tom Zimmerman, Scott Fisher, Jaron Lanier and Brenda Laurel, kept their research and development on virtual reality-related technologies. By the 1980's, the term "virtual reality" was popularized by Jaron Lanier, one of the modern pioneers of the field. Lanier founded the company VPL Research in 1985. VPL Research has developed several virtual reality devices like the Data Glove, the Eye Phone, and the Audio Sphere. VPL licensed the Data Glove technology to Mattel, which used it to make an accessory known as the Power Glove. While the Power Glove was hard to use and not popular, at a cost of $75.00, it was certainly an early affordable virtual reality device. The virtual reality industry mainly provided virtual reality devices for medical, flight simulation, automobile industry design, and military training purposes from 1970 to 1990. However, in 1991 Carolina Cruz-Neira, Daniel J. Sandin and Thomas A. DeFanti of the Electronic Visualization Laboratory created "the first cubic immersive room, The Cave" (Abulrub, 763). Developed as Cruz-Neira's Ph.D. thesis, it involved a multi-projected environment, similar to the holodeck, allowing people to see their own bodies in relation to others in the room. In 1992 researcher Louis Rosenberg created the Virtual Fixtures system at the U.S. Air Force's labs using a full upper body exoskeleton, enabling a physically realistic virtual reality in 3D. The system enabled the overlay of physically real 3D virtual objects registered with a user's direct view of

the real world, producing the first true augmented reality experience enabling sight, sound, and touch. The 1990s saw the first widespread commercial releases of consumer headsets. In 1991, Sega announced the Sega virtual reality headset for arcade games and the Mega Drive console. It used LCD screens in the visor, stereo headphones, and inertial sensors that allowed the system to track and react to the movements of the user's head. In the same year, Virtuality launched and went on to become the first mass-produced, networked, multiplayer virtual reality entertainment system. It was released in many countries, including a dedicated virtual reality arcade at Embarcadero Center in San Francisco. Costing up to $73,000 per multi-pod Virtuality system, they featured headsets and exoskeleton gloves that gave one of the first "immersive" virtual reality experiences. In 1991, Computer Gaming World predicted "Affordable virtual reality by 1994". By 1994, Sega released the Sega VR-1 motion simulator arcade attraction, in SegaWorld amusement arcades. It was able to track head movement and featured 3D polygon graphics in stereoscopic 3D, powered by the Sega Model 1 arcade system board. Also in 1994, Apple released QuickTime virtual reality, which despite using the term "VR", was unable to represent virtual reality, and instead displayed 360 photographic panoramas. The Virtual Boy was created by Nintendo and was released in Japan on July 21, 1995, and in North America on August 15, 1995. Forte released the VFX1, a PC-powered virtual reality headset in 1995, which was supported by games including Descent, Star Wars: Dark Forces, System Shock, and Quake. From 1970-2000, many advances were made on the interfaces and technology implemented with virtual reality systems.

To conclude this historical analysis of virtual reality we recount the recent history leading up to present day 2017. By 2007, Google introduced Street View, a service that shows panoramic views of an increasing number of worldwide positions such as roads, indoor buildings, and rural

areas. It also features a stereoscopic 3D mode, introduced in 2010. In 2010, Palmer Luckily designed the first prototype of the Oculus Rift. This prototype was actually built on a shell of another virtual reality headset and was specifically capable of rotational tracking. This device boasted a 90-degree field of vision that was previously unseen in the consumer market at the time. This initial design would later serve as a basis from which the later designs came. In 2013, Valve discovered and freely shared the breakthrough of low-persistence displays which make a lag-free and smear-free display of virtual reality content possible. This was adopted by Oculus and was used in all their future headsets. In early 2014, Valve showed off their SteamSight prototype, the precursor to both consumer headsets released in 2016. It shared major features with the consumer headsets including separate 1K displays per eye, low persistence, positional tracking over a large area, and Fresnel lenses. On March 25, 2014, Facebook purchased Oculus VR for $2 billion. This purchase occurred before any of the devices ordered through Oculus' 2012 Kickstarter had shipped. In that same month, Sony announced Project Morpheus, a virtual reality headset for the PlayStation 4 video game console. Google announces Cardboard, a do-it-yourself stereoscopic viewer for smartphones. The user places their smartphone in the cardboard holder, which they wear on their head. Currently, Facebook has 400 employees focused entirely on virtual reality development. Additionally, Google, Apple, Amazon, Microsoft, Sony, and Samsung all had dedicated Augmented Reality and virtual reality groups. On April 5, 2016, HTC shipped its first units of the HTC VIVE SteamVR headset. This marked the first major commercial release of sensor-based tracking, allowing for free movement of users within a defined space. In early 2017, a patent filed by Sony showed they were developing a similar location tracking technology to the VIVE for PlayStation VR, with the potential for the development of a wireless headset. Use Video games several virtual reality head-mounted

displays were released for gaming during the early-mid 1990s. These included the Virtual Boy developed by Nintendo, the iGlasses developed by Virtual I-O, the Cybermaxx developed by Victormaxx and the VFX1 Headgear developed by Forte Technologies. Other modern examples of narrow virtual reality for gaming include the Wii Remote, the Kinect, and the PlayStation Move/PlayStation Eye, all of which track and send motion input of the players to the game console somewhat accurately. Commercial tethered headsets released for virtual reality gaming include the Oculus Rift and the HTC Vive. Systems in development include Sony's PlayStation VR, requiring a PlayStation instead of a PC to run; the StarVR; FOVE; and the Magic Leap. making it potentially the first persistent online world with native support for a consumer virtual reality headset. Since 2013, there have been several virtual reality devices that seek to enter the market to complement Oculus Rift to enhance the game experience. One, Virtuix Omni, is based on the ability to move in a three-dimensional environment through an omnidirectional treadmill. On April 27, 2016, Mojang announced that the popular sandbox video game Minecraft was playable on the Gear VR. A separate version was released to the Oculus Store for use with the Gear VR, similar to the Pocket Edition of Minecraft. Some companies are adapting VR for fitness by using gamification concepts to encourage exercise. others use an AR headset in combination with a lightsaber for a Star Wars augmented reality game Cinema and entertainment Films produced for VR permit the audience to view a 360-degree environment in every scene. Production companies, such as Fox Searchlight Pictures and Skybound, utilize virtual reality cameras to produce films and series that are interactive in VR. Pornographic studios such as Naughty America, BaDoinkVR, and Kink have applied virtual reality into their products since late 2015 or early 2016. The clips and videos are shot from an angle that resembles POV-style porn. In September 2016, two announcements were made for the broadcast

of sporting events in virtual reality. Agon announced that the upcoming World Chess Championship match between Magnus Carlsen and Sergey Karjakin, scheduled for that November, would be "the first in any sport to be broadcast in 360-degree virtual reality." This title was taken by Fox Sports' Fox Sports VR, a series of virtual reality broadcasts consisting mainly of Fox College Football broadcasts. The telecasts were made available through smartphone apps and head-mounted displays, through a TV Everywhere paywall. The first virtual reality telecast, which featured Oklahoma hosting Ohio State, took place September 17. Since 2015, virtual reality has been installed onto a number of roller coasters and theme parks, including Galactica at Alton Towers, The New Revolution at Six Flags Magic Mountain and Alpenexpress at Europapark, amongst others. The Void is a virtual reality theme park in Pleasant Grove, Utah that has attractions where, by using virtual reality, AR and customized mechanical rooms, an illusion of tangible reality is created by the use of multiple senses. Researchers have used the immersion of virtual reality to investigate how digital stimuli can alter human perception, emotion and physiological state, and how it has transformed social interaction, in addition to studying how digital interaction can enact social change in the physical world. Altering perception, emotion and physiological state Studies have considered how the form we take in virtual reality can affect our perception and actions. Each of the technologies outlined show how the advances in VR technology have dictated the current layout of the VR field and how to access these resource.

Finally, this paper discusses how understanding the past of virtual reality helps us the future of virtual reality. Considerable achievements and applications have been created in the last few years alone. It is finally safe to say that virtual reality is not only just here but it is here to stay. Continued research has demonstrated its effectiveness both from the evolutionary

perspective of providing a better user interface and from the revolutionary perspective of enabling previously impossible applications. Examples of applications areas that have benefited from virtual reality technology are virtual prototyping, simulation and training, telepresence and teleoperation, and augmented reality. Virtual reality has thus finally begun to shift away from the purely theoretical and towards the practical. Nonetheless, writing professional virtual reality applications remains an inevitably complex task, since it involves the creation of a software system with strict quality and timing constraints dictated by human factors. Given the goals of virtual reality, this complexity will most likely always be there. The marketing situation of virtual reality is very fluid. This means that the technology while being ready for professional applications is not at the stage of settling definite standards and definite reference points in all perspectives, including possible leading manufacturers, compatibility specifications, performance levels, economic costs and human expertise. This uncertainty should not be confused with lack of confidence on the promising outcomes of the technology, but instead with the rapid mutation and evolution that characterizes the field, perhaps even more than for other information technology markets. From the hardware point of view, while full fidelity of sensory cues is still not achievable even with the most advanced and expensive devices, there exists now a variety of research and commercial solutions successfully usable for practical applications. For a large number of application domains, the major limitation is now provided by software since, at the current state of the art, no single system supports satisfactorily all the aspects of the creation of a virtual reality application. Most of the time, different packages have to be combined, and ad-hoc solutions implemented to integrate them into a working application. In particular, the creation of appropriate time-critical multimodal virtual reality architectures is an open research topic. Further research and development on actual hardware and software issues

associated with virtual reality would benefit the technology in the future.

Thus, after gaining a much more complete understanding of the history associated with virtual reality we still may not necessarily be able to predict the future of Virtual Reality with great certainty. However, the knowledge obtained is an essential building block to developing a greater understanding of the present layout of the field of and how to properly navigate and apply the various VR functionalities. Virtual reality will only continue to play a more important role in our lives. we can say that given the complexity of virtual reality, the importance of human factors, and the lack of standard solutions, the secret of successfully implementing professional virtual reality applications is to set realistic expectations for the technology.

Works Cited

Abulrub, Abdul-Hadi Ghazi: "Virtual Reality in Engineering Education: The future of Creative Learning" International Journal of Emerging Technologies in Learning (IJET) 2011. Print. p 751-777.

Educating Engineers for the 21st Century: The Industry View: a Commentary on a Study Carried out by Henley Management College for the Royal Academy of Engineering. Royal Academy of Engineering, 2006.

Faisal, Aldo. Computer science: Visionary of virtual reality. Nature Publishing Group. 551. 298. Web. 15 November 2017.

Häfner, Polina & Häfner, Victor & Ovtcharova, Jivka. Teaching Methodology for Virtual Reality Practical Course in Engineering Education. Procedia Computer Science. 25. 251-260. Web. 31 November. 2013.

Huizinga, Johan. *Homo Ludens: A Study of the Play-Element in Culture*, 1955. Print.

Packer, Randall, and Ken Jordan. Multimedia: from Wagner to Virtual Reality. W.W. Norton, 2002.

Sherman, Wiliam R. UNDERSTANDING VIRTUAL REALITY: Interface, Application, and Design. MORGAN KAUFMANN, 2017.