Virtual Reality Applications in the Construction Industry

Firuz Oev[1], Sherif Attallah[2], Tarek Mahfouz[3]
[1](Information Systems and Operations Management / Ball State University, USA)
[2,3](Construction Management and Interior Design / Ball State University, USA)

Abstract

The purpose of this paper is to give an overview of Virtual Reality also known as VR to the reader including the history of its development, the technological solutions offered by adapting to VR, , how virtual reality is achieved and why it is used. The paper will also cover the different applications that the VR technology is currently most popular in, future trends and advancements of the VR world. This paper will then cover the different ways Virtual Reality is being used in the construction industry. Finally, the ways the construction industry is being transformed and benefits from adapting to VR in safety solutions and in education will be discussed.

Introduction

The term Virtual Reality is derived from combining two words "virtual" and "reality" and it is used to describe a man-made digital world where an individual is submerged. The machine generated virtual world is three-dimensional and allows the guest to use almost all his senses to interact with this world, by means of seeing, hearing, in some cases smelling, touching and moving objects by performing a sequence of motions (VRS, 2017). The technology comes in a form of wearable accessory over the users face and has headphones, widely used gloves and other forms of clothing and platforms to stand or move.

Although the term and the technology may seem new, the first attempts at achieving the effects of being pulled into another world by taking their entire field of vision were undertaken by the painters in late 19th century in the form of panoramic paintings also known as 360-degree murals, an example of which is shown below.

Battle of Borodino, 181
Image retrieved from: https://www.vrs.org.uk/virtual-reality/history.html

The first stereoscope, which used twin mirrors to project a single two-dimensional image from each eye into a single three-dimensional object was invented in 1838 by a researcher named Charles Wheatstone. William Gruber patented the concept in 1939, which had then evolved to be named the View-Master and it is still in production to this day (FI, 2018). Edward Link created the first commercial flight simulator in 1929, patented in 1931, which allowed pilots to learn to fly in realistic conditions without risking their lives. This was a considerable breakthrough which molded today's world of aviation (Roberson Museum and Science Center, 2000). Since then Virtual Reality has been evolving with technology, and the modern world of VR owes a great deal to the pioneers who had put a strong foundation into mesmerizing world of virtual reality.

Virtual Reality Today

The term Virtual Reality was coined by Jaron Lanier in 1987, who was a founder of the visual programming lab (VPL) – the first company to sell VR products (VRS, 2017). Today's advanced VR sets require considerable investment on users' part, the best available technology requires a headset and a computer with a powerful graphics card. Modern VR can include 4 out of 5 senses as mentioned earlier including vision, hearing, touch and in some cases smell (Mullis, 2016). This makes the VR experience way more realistic for the user.

There are a number of ways medical VR is changing healthcare, both patients and doctors are benefitting from this technology. For the first time in medical history in April 14, 2016 Ahmed Shafi, a cancer surgeon, performed an operation wearing a virtual reality camera, which allowed medical specialists and students alike witness the operation as if they were wielding the scalpel (Davis, 2016).

Dr. Ahmed Shafi performing a surgery while wearing VR camera. Photograph: Medical Realities/PA
Image retrieved from: http://www.wired.co.uk/article/wired-health-virtual-reality-surgery-shafi-ahmed

According to medical futurist, medical VR is also used to calm chronic patients, helps children feel like they are at home. It is currently being used by physicians to experience different scenarios, such as aging as well as speeding up recovery for patients who have had a stroke (Medicalfuturist, 2018).

VR is widely used in the entertainment world as well. It has revolutionized the gaming industry and has opened new horizons for game developers and gamers alike. VR is used in a setting of theme park rides and VR movie theatres as well as augmented reality TV (Reality Technologies, 2016). Along with healthcare and entertainment, other industries such as sports education and professional training are benefitting from adopting the technology and using it to sharpen their skill sets.

Virtual Reality in the Construction Industry

The use of virtual reality in the construction industry is continuing to grow and, for some companies, it plays a vital role in the beginning stages of their projects. Construction companies rely on virtual reality because of its versatility as a tool and its different application in a variety of areas in a construction project. Three-dimensional modeling is one of those areas, where virtual reality is being recognized for its capabilities in building information modeling (BIM), by enhancing it with 3D laser scanning and drone collected imagery (Construction World, 2018). BIM software gives specialists the ability to create a model of the construction project on a computer before the project commences in real life. It allows the engineering professionals to

transform their drawings, plans, blueprints, and PDF files into detailed BIM models (Dy Buncio, 2016). The photo below exemplifies an application of virtual reality in the design phase of a project where the stakeholders can visualize the design in a 3D environment through their VR glasses and the use of BIM.
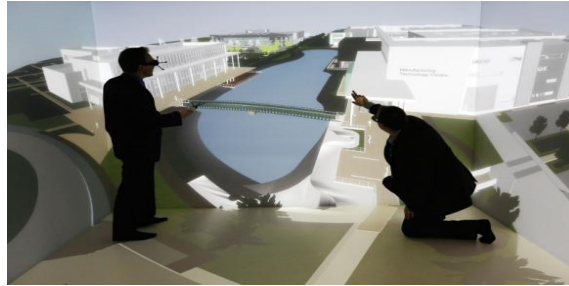

Image retrieved from: http://www.midlandsbusinessnews.co.uk/vitality-reality-delivers-major-benefits-for-construction-projects/

The three-dimensional models are then used by the designers, developers and architects to give virtual tours of the office buildings, skyscrapers or homes to the potential customers. The use of 3D and VR technology for presenting the interior and the exterior of the project to the buyer or the owner allows the designer to make immediate changes to the features of the building and give realistic preview of the model (Potts and Catledge, 1996). It is fascinating how a set of VR glasses and rendering technology can bring these 3D models to life and allows users to immerse themselves into the completed project and have a preview. Like the interaction between the developer and potential customer, virtual reality has all the capabilities to be used as a collaboration tool for design personnel, architects and the owners of the project. Virtual reality gives the client plenty of room and flexibility to provide feedback and share their thoughts and visions and alterations to the professionals who can make these changes in their 3D rendered images beforehand. This tool could be used to avoid any future misunderstanding or conflicts between the contractors and the owner about the details in design. Below is another photo showing a project team discussing details of the building elevation where traditional 2 D drawings can be misleading to people who are not familiar with blueprints like many project owners.

Image retrieved from: https://www.bdcnetwork.com/virtual-reality

In addition to the benefits of using 3D modeling in the initial stages of the project, virtual reality can have a number of advantages during the construction process. It is easier to detect errors, accidents or conflicts in these 3D models which then can be avoided in real life environment (Basso, 2017).

Virtual reality and 3D image rendering is also being used in educating new specialists in different fields where a number of researchers have employed the VR as a pedagogical tool for teaching and training such as the game technology based visualizing safety assessment for safety & health training (Lin et.al., 2011). The increased use of virtual reality technology to improve the quality of education has been welcomed by the industry. Increasing number of studies on VR for construction education such as a virtual interactive construction education (VICE) incorporating advances in simulation, modelling, and software engineering show the improvements in quality of education (Ho and Dzeng, 2010).

Conclusion

As of today, VR is being utilized only by some companies in the construction industry and only in the initial stages of the projects. It is being deployed mainly in the beginning stages as a design and demonstration tool despite being highly useful in providing highly accurate projections during a construction project. The skepticism and the pushback might be originating from several aspects, one being the VR technology's roots, which is the gaming industry. Another aspect of the pushback is the slow adaptation of veteran construction specialists and difficulty in changing their perception towards new technologies like virtual reality. Therefore, it is essential that the growing number of younger specialists, who, by their nature, are far more

eager to innovate and revolutionize the industry, can start implementing the VR and 3D imaging related software programs, applications and solutions to the construction industry in various stages. This is expected to have a positive impact in the future as the technology advances with the construction industry and its specialists.

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