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RESEARCH ARTICLE

PRODUCT SIMULATION USING VIRTUAL REALITY

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Abstract

In a world of constant evolution, various industrial actors need to be reactive in order to remain to conquer the competitive and new market trends. In order to achieve this, they are constrained to mend their way of industrial management, both at the strategic level, to adapt and follow technological progress market trends. At a strategic level, They allows manufacturers to inspires, update and optimize their methods of production management and improving the performance of manufacturing processes and also reducing production deadline to deal with the arrival of new products and of course new competitors. This paper present information about Virtual Reality (VR), its challenges, simulation of product via virtual reality.

Keywords: Virtual Reality, Oculus Quest, Approach

Introduction

Nowadays it becomes possible even for an average user, to move into the world of computer graphics. This fascination with a new reality often starts with computer games and lasts forever. It allows to see the surrounding world in other dimension and to experience things that are not accessible in real life or even not yet created. Moreover, the world of three-dimensional graphics has neither borders nor

constraints and can be created and manipulated by ourselves as we wish we can enhance it by a fourth dimension: the dimension of our imagination. But not enough: people always want more. They want to step into this world and interact with it – instead of just watching a picture on the monitor. This technology which becomes overwhelmingly popular and fashionable in current decade is called Virtual Reality (VR).

Virtual reality is considered to have begun in the 1950's but it came to the public's attention in the late

1980's and 1990's. This can be attributed to pioneering computer scientist Jaron Lanier who introduced the world back in 1987 to the term 'virtual reality'. Research into virtual reality continued into the 1990's and that combined with the appearance of films such as The Lawnmower Man helped to raise its profile.

Most virtual reality environments are primarily visual experiences, displayed either on a computer screen or through special stereoscopic displays. Virtual reality may also include auditory stimulation through speakers or headphones. Users can interact with the virtual environment through the use of devices such as a keyboard, a mouse, wired glove, or via handle controllers.

The history of virtual reality has largely been a history of attempts to make an experience more real. The majority of historical examples are visual and to a lesser extent, auditory. This is because of all the human Probably 90 percent of our perception of the world is visual or auditory.

Virtual reality (VR) provides a computer-generated environment for product design or manufacturing process simulation. VR integrates technologies of computers, information, image processing, communication and control with features of immersion, interaction and information intensity. VR technology has been successfully applied in a wide area including entertainment, product development, space exploration, health care and military simulation. Engineering is an important field of VR applications. The traditional iterative product analysis leads to a long product development time and a high cost. Usually, an important product design is not finished until after a series of life-sized wooden mock-ups are built and reviewed. For example, when NASA designed the space shuttle, it had to create an entire wood and plastic life-sized model of the ship to see what it would be like. VR utilizes advanced computer and visual technologies to provide a virtual environment for product development, by which product design and manufacturing can be considered simultaneously. As a result, users can minimize the use of expensive physical mock-ups and shorten the period for the product development (Peng and Chung,

2007). VR has been identified as new opportunities for industry to increase the efficiency of product design and manufacturing. VR application examples include computer-aided design (Cera *et al.*, 2002), robotics (Ahrens and Pageau, 2002), assembly planning (Chung and Peng, 2006), manufacturing layout (Yaman, 2001), manufacturing simulation (Peng and Chung 2007) and product maintenance (Chung and Peng 2006). VR has shown it's powerful for the need of large number of simulators, for interactive visual fields and for the analysis systems of both technical and human senses, vision provides by far the most information followed by hearing.

Immersive interactive experience that simulates a real-world scenario in virtual mode, this technology is used in various fields such as: medical, nuclear, mechanical simulation, and computer industry etc.

Oculus quest

The Oculus Quest VR headset launched in 2019, and has since become one of the most popular VR devices in the modern world. It was developed by company Oculus VR, which is currently under ownership of Facebook.

The standard Oculus Quest system consists of a VR headset (head-mounted display) and 2 controllers to be held in hands. You can use it to play games, work, study, and engage in numerous life-imitating and imaginative simulations.

Oculus Quest 2, an improved version of the original headset, was released in 2020. Since the Oculus Quest 2 launch in 2020, 4.6 million units have been sold worldwide as of Q1 2021.



Fig. 1 Person using Oculus Quest.

In the above figure a person wearing oculus quest and operate it. It is very easy to operate and easy to carry.

Nowadays Oculus quest are available in the market as a commercial product. With a number of developer kits have been made performance.

Today, several researchers are working on projects for the integration of VR into design tools and simulation of industrial systems. VR is a technology that combines software tools and other equipment to set up an its potential within the context of virtual reality for construction applications. For developer of such application, we are using a number of different visualization toolkits. The Oculus Quest development kit is supplied with an out of the box integration module for Unity3D™, which is facilitating rapid prototyping.

Oculus Capability

Both Oculus Quest virtual reality headsets are based on Android OS. They allow you to enjoy different VR applications in the fields of games, multimedia, training simulations, etc. These applications can be bought in the official store, or you can order the development of a custom application for special needs. Let's look at how each of these models works to understand the difference between them (<https://programace.com/blog/oculus-quest/>).

How Oculus work

Oculus Quest works autonomously, without a wired connection. It's a multifunctional device for entertainment and education that immerses its user in a virtual environment.

When you put on the headset, the functionality allows you to look around the outside world to understand exactly where you are before immersing yourself in the virtual world. You can play games or browse multimedia even on the go. In addition, you can participate in interactive training in a virtual environment (<https://programace.com/blog/oculus-quest/>).

You don't need a computer to configure the device; you can do this using a headset or a device that

supports the Oculus mobile application. You can also stream your game available, which has facilitated some early software prototyping, enabling us to explore you create a personal account in the Oculus system to upload and use content in virtual reality. The headset consists of a head-mounted display with four built-in cameras and Oculus Touch hand controllers. You can also use the Oculus without controllers utilizing the motion tracking feature. Not sure if you need a PC for Oculus quest 2? The answer is no; the Oculus Quest 2 needs only an existing Facebook account to operate the system. Nevertheless, users can connect to a computer to use the same game library as the Oculus Quest.

It might not be obvious what the difference between Oculus Quest 1 and Quest 2 is, but it's not only in device appearance. The Oculus Quest 2 has stronger specifications that translate to a better user experience (<https://programace.com/blog/ocular-quest/>).

Approach comparison

The typical problem with the representation of a simulation of a manufacturing system is to understand the simulation results. These results are generally understood only by experts. Although there are tools to represent them with 2D data visualization, to understand these results remains a lot of works of industry expertise, and the research works conducted by (Dangelmaier 2005) allow the implementation of a virtual reality system for 3D visualization of the complex results. The VR also allows simulating the configuration of machine installation, and the studies conducted by (Lindskog 2013) show that industrial model VR can be used as a visual system when modeling and reconstruction of production systems and even testing the various setup configurations of the virtual model before the real installation of the system. Today, the 3D imaging methods and tools, i.e. the or media to your TV or phone so that others can watch your virtual world.

The standard set includes two touch controllers equipped with sensors. Many users ask what do Oculus Sensors do? The term may refer to the sensors equipped to the headset, controllers, or even a

separate accessory sold for Oculus Rift models. Sensors help the device track your movements and translate to in-app visuals (<https://programace.com/blog/oculus-quest>).

The design of a VR system that includes a flow simulator discrete event, which is generally a tool for the design and control of the production processes, and the optimization of production systems. This approach of VR allows us to develop an abstraction layer between the techniques of simulation flow and the actors concerned with the exploitation of complex data resulting from this simulation. The advantage of this layer is to have certain invisibility on different methods and techniques for the flows simulation that requires expertise in this industrial area. Indeed, this layer allows mastering of flow simulations through the VR tools, as well as to immerse the user in a scene integrating process upstream and downstream of workstation. It also allows us to have an experience feedback on the decision from the exploitation of the design. In conclusion, the simulation assisted by VR seems to us to be one of the most interesting approaches to simulate and model the production systems.

The Simulation of Discrete Event System

The simulation of discrete event systems precludes a continuous simulation. In this type of simulation time is cut into equal portions without which we cannot distinguish events. At each slice or time interval, we analyze the state of the system. According to (Claver *et al.*, 1996), the simulation is an activation of the model interactive virtual reality simulations appear in industrial activities, especially in project design or implementing CAD models "Computer Aided Design" in industrial production (Sren *et al.*, 2006; Jayaram *et al.*, 2007) which is also the case for different industrial activities related to automotive and aerospace, etc.

The originality of this research is based on experiments on this model in order to evaluate different control strategies and to understand the operation. The flow simulation allows to reproduce the dynamic behavior of a real process of a software tool, without any risk of loss and saving time with the

speed execution of the simulation, and answer type questions "What happens if ...? ".

Understanding VR Development

VR application development is no longer an unknown area. Today we have the tools, approaches and techniques to help us get started with the lowest entry point. Here we'll describe the main steps in creating a VR project with the tools and skills you need.

BASIC VR DEVELOPMENT REQUIREMENTS

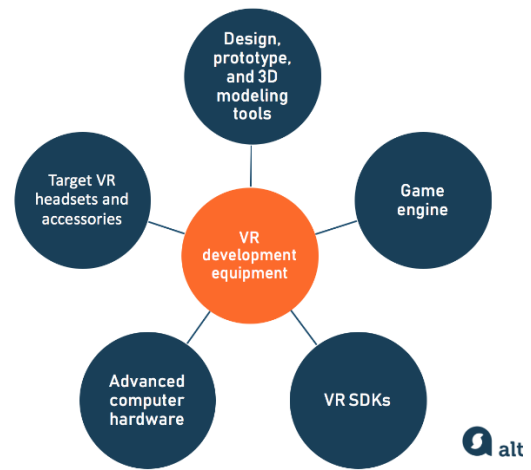


Fig. 2: Requirement of VR Development

Studied in time, based on the rules of evolution or assumptions that we want to validate. The simulation is a technical description of the model over time, in order to know the dynamic behavior of the real system and even to predict the effect of different parameters or scenarios on the model. (Gogg and Mott 1993) defines simulation as the art and science of creating a representation of a process or system in order to test and evaluate (Pegden 1995 specifies that the modeling and simulation of flow presents a process of creating a model for a real system and conduct additional effort. However, for custom experiences, 3D modelling is a must-have. So, what will you need?

Design, prototype, and 3D modeling tools

Similar to most software engineering projects, VR development usually starts with design. We say

usually because sometimes, for prototyping or educational purposes, this step is skipped and coders use assets from community-run libraries. You also can download ready-made objects, backgrounds, or textures – they save a ton of time and can often improve your project without any unlike Autodesk products is available for Mac OS.

Unity.

Considered the mandatory tool for beginning VR engineers, Unity supports all main VR devices and file formats used by different 3D building applications including Cinema4D, 3D Max, Maya, and more. It uses C# – object-oriented scripting language – to write commands for game objects and the overall logic of your virtual world. One of Unity’s biggest pros is the huge community-based asset store for free and paid 3D objects, textures, and audio files. The product is also free until you start earning over \$100k a year from your app. Finally, the community is unmatched with over 50 percent of games across mobile, PC, and console being made with Unity.

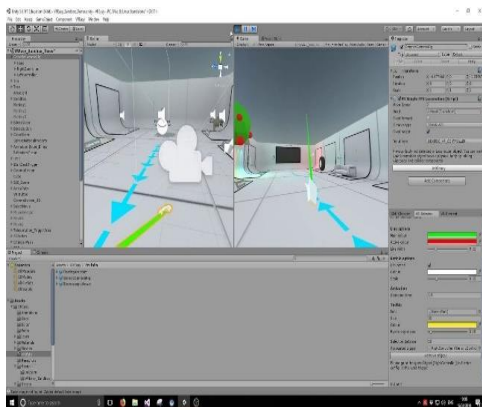


Fig 4: Unity Interface

5.2. Platforms and SDKs

With cross-platform engines such as Unity and Unreal, you can tap into any market, but any development requires you to pick the starter SDK to shape your experience around. SDK is a plug-in that you add to your chosen engine. It includes engine- and platform-specific assets, content, and techniques that shape the overall native experience for each device. Among many community-provided APIs and

tools, you probably should start with each brand’s official SDK.

Oculus SDK

As Vive’s biggest competitor in VR experiences for PC, Oculus started the global VR adoption with its Kickstarter campaign in 2014. Apart from the Steam platform, you can distribute applications in the Oculus store. Today, the company sells one headset – Oculus Quest 2 – yet its rooms or spaces where these limitations are less visible. Before VR devices become mobile and compact and can be easily accessed anywhere, the adoption will keep staggering along.

Health issues

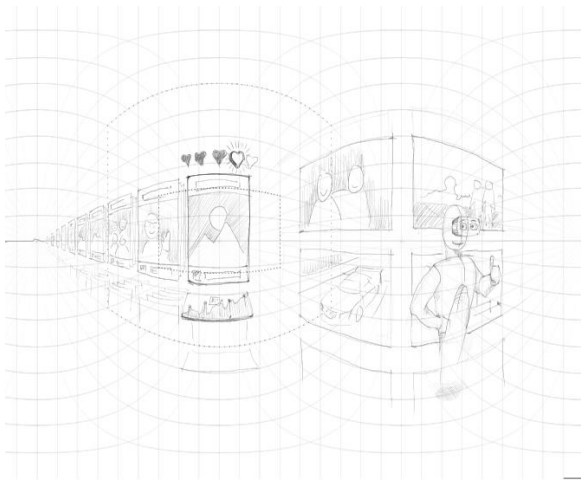
PlayStation and Oculus don’t recommend using headsets for children under age 13. Pregnant and elderly people, those suffering from heart or psychiatric conditions should consult a doctor before trying the VR experience. People are also at risk of having seizures, dizziness, headaches, eye strain, or even blackouts during virtual reality gaming. It’s important to point out that most of these issues are also applicable to regular gaming and even watching TV. The cases of severe problems are, however, rare and preventable. The biggest problem with engaging people in VR experiences is taking this responsibility and preparing for possible dangers.

Yet, many of those concerns can soon be alleviated. Modern headsets are becoming more affordable and compact. The market’s leader Oculus Quest 2 costs \$299, compared to its predecessor’s \$399 at its release. The device also doesn’t require extra computer equipment to run and can be used virtually anywhere. And as technology improves (and it will with the upcoming release of next-gen PSVR 2, Apple’s AR/VR headset, and Meta’s very own Project Cambria, which will also be a standalone device), we can expect that other issues will also be solved.

Pen and paper

Although the 360-degree world is different from traditional rectangular screen dimensions, you still need to prototype and create 2D wireframes for

the UI part of your project. Some experienced designers even created printable templates that can be converted into virtual sketches: Check out this 360 panorama grid and a VR storyboard template.



Blender

This free and beginner-friendly product will help you create great custom 3D models for your first VR project. Any visual designer from your team can get the hang of it with online tutorials and a bit of practice. Blender objects can be easily imported into any game engine.

3ds Max and Maya

These Autodesk products are standards in modeling, sculpting, animation, lighting, and visual effects. Many if not most game and movie elements are designed using one of them. Which is both a blessing and a curse since their robust nature makes them challenging to learn. They are not exactly cheap and require a true master to put them to work effectively. Consider them when you have time and money to spare.

Cinema 4D

Another advanced tool, Cinema 4D, while not as widely used, has a ton of plug-ins and a milder learning curve when compared to Maya, for example. It's popular among small teams and single artists, and previous devices are still in use. Namely, on Steam alone, almost 40 percent of VR is viewed via their main headset with its no-longer-produced model as

Oculus Rift S remains in third place with around 15 percent.

OpenVR SDK.

Not an SDK for any specific type of platform, OpenVR is an API for accessing any attached headset, be it Oculus, Vive, Index, or Mixed Reality. Provided by Valve, it basically communicates with SteamVR and any device supported there. While this may be a handy option, since you don't have to rely on any specific SDK, it doesn't have detailed documentation, so it might be not the simplest solution. But if you're planning to reach Valve Index's vast audience of almost 16 percent VR users on Steam, this is your only option **Windows SDK**. There's no separate SDK for Windows Mixed Reality development, so you would be using Visual Studio with Windows SDK. WMR headsets include devices both for AR and VR, and its VR products are Samsung HMD Odyssey+, HP Reverb, Acer OJO, and more. Overall, they comprise 5.69 percent of SteamVR userbase.

Challenges in adoption

Virtual reality examples are impressive but scarce.

Financial and technical demand.

Today, VR users are no longer considered early adopters. Yet, it remains the prerogative of those who can afford the hardware. If a user decides to build a computer considering Oculus or HTC minimum requirements, this will likely cost them a few thousand dollars. And that's only the consumer side. Developers also need to have high-powered hardware to manage 3D modeling and VR engineering tasks. The lack of implementation also leads to the public viewing VR more like a toy than a practical investment.

Physical discomfort

Many VR sets today are heavy, restricting, and still don't meet our expectations of highly immersive and convenient goggles. For the best VR experiences, users often dedicate separate.

Conclusions and further work

Virtual reality has become an important and useful tool in science and engineering. VR applications cover a wide range of industrial areas from product design to analysis, from product prototyping to manufacturing. The design and manufacturing of a product can be viewed, evaluated and improved in a virtual environment before its prototype is made, which is an enormous cost saving. This paper introduced the experience of teaching a VR course for engineering graduate students. The course materials and lab projects are presented.

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