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A Review on Virtual Environment using Unity Software

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Abstract: Users of Geographic Information Systems (GIS) have two options for obtaining 3D virtual reality: either in the form of a 3D or 2.5D software like Skyline software as a development platform, or in the form of a 2D professional platform like ArcGIS software to generate the virtual reality through secondary development. The virtual reality development tool used in Unity3D, a platform often used for game production. Initially, the study area divides the territory into four layers: landscape, buildings, vegetation, and transportation using a hierarchical geographic information system procedure. In addition, GPS measurements are used to collect the raw data for the terrain layer. Second, using AutoCAD and 3ds Max software, all geographical elements connected to various layers are transformed into 3D models. Thirdly, in order to create Game objects and Scenes, the 3D models are imported into Unity3D and programmed using Javascript in the Visual Programming Language Editor. The Scenes are then combined and posted on the network. The study area may be accessed by downloading the ActiveX component, which updates the scene 60 times per second. The viewer is thus subliminally drawn into the virtual environment, encouraging spontaneous observation and investigation. With an extensive customizable mode of operation, users may select how they want to explore and engage with the virtual world. Users can also utilize the keyboard's allocated keys to fully express their creativity without having an impact on other users. In this paper features of Unity is analysed and compared with other software's.

Keywords: Virtual Reality, Unity3D, Geographic Information Systems (GIS), ActiveX Component.

I. INTRODUCTION

3-D near-eye displays and pose tracking are two techniques used in virtual reality (VR) to create a simulated environment that gives the viewer a sense of immersion. Virtual reality has applications in business (virtual meetings), education (medical or military training), and entertainment (video games, in particular). Additional unique forms of VR-like technology are mixed reality and augmented reality, which are sometimes called extended reality or XR, though terminology is still being worked out because the field is so young.[1].

These days, creative solutions are put forth quickly, and being able to use these technologies to their fullest potential is essential. The influence of Industry 4.0 fosters the perfect atmosphere for these applications. In numerous industries, including aerospace, manufacturing, staff training, process simulation, and manufacturing systems visualization, virtual reality (VR) is gradually becoming a reliable technology. Prior to implementation, testing the suggested solution in a virtual environment can be very important, especially given the current trends that emphasize continuous cost reduction. Furthermore, before a real-life implementation, potential flaws and hazards can be captured in virtual simulations. That allows businesses to prioritize employee physical health while focusing on raising production rates and overall quality, while highlighting the workers' physical well-being. Virtual reality has the potential to emerge as a leading educational tool. When educational institutions use this technology, virtual reality may even replace traditional mass media. Employee virtual reality training programs are becoming more and more common [2].

However, understanding the fundamentals of building a VR-capable environment is necessary in order to properly incorporate the technology into chosen solutions. In order to guarantee that a VR user is sufficiently immersed, it is critical to construct a virtual environment that is identical to its real-world counterpart and includes every element. This is a difficult task because accurate replication of the real environment necessitates simulating its components, activities, and objects. Using the Unity 3D game engine, the methodology that is being presented suggests a standardized process for building a virtual workplace. The methodology focuses on producing an immersive virtual reality experience and includes techniques and principles to guarantee a smooth workflow and minimize errors [3,4].

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Unity is a cross-platform game engine that is widely used for building virtual reality (VR) and augmented reality (AR) experiences. Using Unity, developers can create immersive VR experiences by building 3D environments and adding interactive elements, such as audio, video, and animations. Unity supports VR development for a wide range of VR devices, including the Oculus Rift, HTC Vive, and PlayStation VR [5].Unity can offer a lot of the crucial built-in features that are necessary for a game to function. That means things like:

- Physics.
- 3D rendering.

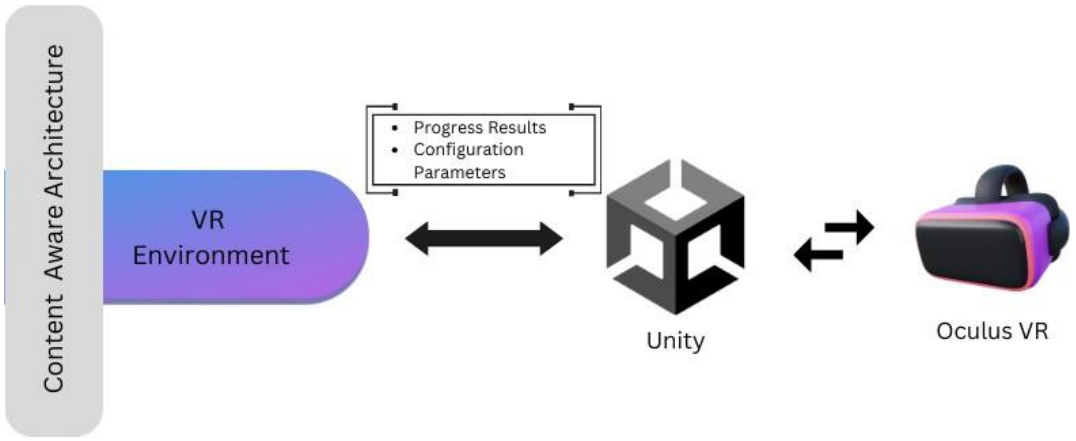

Fig. 1 Unity VR Building Blocks

This virtual reality environment was created using the Unity 3D platform and the "Dotween" plug-in for animation. Direct chain structure coding is also extremely quick, but it requires cooperation programs or loop updates to prevent object control in the code. To increase rendering efficiency, LOD and occlusion culling technologies are also available. The game logic portion of Unity requires the use of C#, which is the script language, to write code, control memory allocation, memory management, and life cycle, and become proficient in the use of fundamental logic components like navigation, UGUI, and Macanim all of which are very useful for creating a set of backpack systems[6].

A user can interact with a computer-simulated environment through virtual reality (VR) technology. According to Michael Heim (1994), there are seven distinct concepts associated with virtual reality (VR): artificiality, simulation, full-body immersion, telepresence, simulation, and network communication. Because of its easy to use interface and intuitive visuals, virtual reality is now widely employed in both industry and public service. One of the most well-known virtual reality tools is Unity3D, a cross-platform game creation program that is now completely compatible with Windows XP, Vista, and 7, in addition to Mac OS X. Three scripting languages are supported by Unity3D: JavaScript, C#, and a variant of Python known as Boo. All three can utilize the underlying.NET libraries, which support databases, regular expressions, XML, file access, and networking, and they are all equally fast and interoperable. Despite the common misconception that scripting is constrained and slow, Unity3D scripts are compiled to native code and operate almost as quickly as C++. For someone who enjoys scripting languages, it is simple to understand the quick iteration times and user-friendliness. These three languages can also be used in combination in game development projects. The Windows operating system, C#, VB.net, VB6, and other programming languages are also supported by Unity3d. Because the Unity3D development environment and game engine are tightly integrated, it offers a very powerful [7].

II. LITERATURE SURVEY

Tools

1. Unity

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Worldwide Developers Conference as a Mac OS X game engine. The engine has since been gradually extended to support a variety of desktop, mobile, console and virtual reality platforms. It is particularly popular for iOS and Android mobile game development, is considered easy to use for beginner developers, and is popular for indie game development [8].

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The popularity of computer games and applications is rising, according to research findings, and the opportunities for making them are getting easier and more expansive (small studios and independent developers can now create games and applications). But with so many options available to inexperienced developers, it can be difficult to decide which tool is best for making games and apps and which techniques to use [9, 10].

The decision of which 3D editor and game engine to employ for developing objects that will be used in the generated game or application is also crucial. Research of software packages for three-dimensional modeling has demonstrated that, despite the fact that each of them has its own set of features that determine the field of use. All of them are appropriate, in theory, for making a character in a video game. The selection of a specific software is primarily determined by the author's or organization's personal preferences. If the package you've chosen doesn't come with a certain set of tools, you can always employ a highly specialized third-party program[11].

Advantages

1. **Popularity and accessibility:** Unity is extensively supported and utilized. When working on VR projects, developers can find resources, tutorials, and assistance more easily thanks to its large community and comprehensive documentation.
2. **Cross-platform Compatibility:** Oculus, HTC Vive, PlayStation VR, and other VR platforms are supported by Unity. Developers can produce VR experiences for multiple platforms without having to start from scratch for each one thanks to cross-platform compatibility.
3. **Asset Store:** Developers can save time and effort by utilizing the abundance of assets, plugins, and tools available in Unity's Asset Store, which can greatly accelerate development.
4. **Ease of Use:** Developers, even those with no experience with VR development, can create immersive experiences relatively easily thanks to its drag-and-drop functionality, visual editor, and user-friendly interface.
5. **Performance:** With Unity's strong performance optimization tools and features, developers can make VR experiences that run reasonably smoothly.

Disadvantages

1. **Performance Issues:** Despite Unity's strength, producing VR experiences with extreme optimization can be difficult. To keep a fluid and immersive experience, virtual reality (VR) needs high performance, which can require a lot of optimization.
2. **Learning Curve:** Although Unity is user-friendly, it can take some time and effort to get the hang of it and figure out how to use its features for virtual reality, especially for novices or those who are not experienced in game development.
3. **Resource Intensiveness:** VR development can require a lot of resources, particularly when using Unity. Strong hardware is frequently needed for creating virtual reality experiences, and expensive physical VR gear is also needed for testing VR apps.
4. **Licensing fees:** Although Unity has a free version, some of its more sophisticated features and tools call for subscriptions or licenses that are paid for, which could raise the total cost of development.
5. **Platform Restrictions:** Although Unity is compatible with a number of VR platforms, some features or optimizations might perform better on a particular platform than another. It may be difficult for developers to guarantee a consistent user experience on various devices.

2. Virtual Reality Toolkit (VRTK)

The Virtual Reality Toolkit (VRTK) is a cross-platform, open-source toolkit that makes it simple to create virtual reality (VR) experiences by offering simple fixes for common user issues.

VRTK provides a multitude of solutions for these common problems by concentrating on two key areas of assistance for developers: interactions and locomotion techniques.

Users of the open-source VRTK codebase can drag and drop features. Because it's open source, anyone can, at the very least, cut down on setup time and start modifying assets and the source code to make their ideas come to life in Unity for quick prototyping[12].

VRTK offers the following solutions:

- Movement in virtual space.
- Touching, grabbing, and using objects as part of interactions

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- Using touch or pointers to interact with Unity3d user interface components
- Physics of the body in virtual space
- Button, lever, door, drawer, and other 2D and 3D controls.

Advantages

1. **Rapid Development:** VRTK streamlines VR development, saving time and effort by providing a toolkit with pre-built functionalities.
2. **Cross-Platform Compatibility:** VRTK supports various VR platforms, enhancing the reach of your VR applications.
3. **Community Support:** A strong user community offers resources and assistance, aiding developers in problem-solving.
4. **Extensibility:** VRTK's modular architecture allows for easy customization and expansion of VR experiences.

Disadvantages

1. **Learning Curve:** Beginners may find VRTK complex, requiring time to grasp its features and capabilities.
2. **Limited Features:** Some advanced VR features may require custom implementation, as VRTK may not cover all use cases.
3. **Compatibility Issues:** Occasional conflicts with VR platform updates may result in stability problems.
4. **Performance Overhead:** Extensive use of VRTK features could impact VR application performance, necessitating optimization efforts.

3. Photon Engine PUN2

Multiplayer Unity packages use Photon Unity Networking (PUN). Players placed in rooms where objects can synchronize over the network thanks to flexible matchmaking. Among the features are RPCs, Custom Properties, and "low level" photon events.

Clients do not need to connect one to one because the dedicated Photon server(s) handle the quick and (optionally) dependable communication [13].

Advantages

1. **Simple Multiplayer Integration:** PUN2 speeds up development time by making it easier to integrate multiplayer features into Unity games.
2. **Cross-Platform Support:** It makes multiplayer gaming across multiple platforms smooth and easy, increasing the player base for your game.
3. **Active Community:** A sizable user base provides resources, assistance, and an abundance of documentation to help in problem-solving.
4. **Scalability:** Photon Cloud architecture manages growing player loads to guarantee dependable and scalable multiplayer experiences.
5. **Flexibility:** While PUN2 allows for adaptations, more coding may be required to meet complex requirements, which would delay development.

Disadvantages

1. **Cost:** For independent creators, Photon's cost structure can be prohibitive, especially when there are a lot of players.
2. **Limited Offline Play:** Since offline or single-player elements are less common, the game's main focus is online multiplayer.
3. **Network Lag:** Careful optimization and synchronization are necessary to avoid negatively impacting player experiences due to network latency.
4. **Dependency:** Games created with PUN2 are dependent on Photon Cloud services, which may pose a risk in the event of service interruptions.
5. **Learning Curve:** For developers who are unfamiliar with networking and multiplayer game creation, mastering PUN2 may take some time and effort.

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III. COMPARISON OF DIFFERENT SOFTWARES

S.NO	Aspect	Unity	Amazon Sumerian	Unreal Engine 4 (UE4)	Blender
1.	Primary Use	Game development, AR/VR, 2D/3D applications	VR/AR experiences, Web-based applications	Game development, VR experiences, Film/TV production	3D modeling, animation, rendering, sculpting
2.	Programming	C#, UnityScript, Boo	Sumerian Host (visual scripting), JavaScript	C++, Blueprints (visual scripting), C#	Python, C, C++, and its own scripting language
3.	Platforms	Supports multiple platforms (PC, mobile, consoles, AR/VR devices)	Web-based, VR headsets, mobile devices	Multiple platforms (PC, consoles, VR)	Compatible with multiple platforms (PC, Mac, Linux)
4.	Ease of Use	Beginner- friendly, intuitive interface, vast asset store for resources	User-friendly, browser-based environment, built-in templates and assets	Offers a learning curve, but provides powerful tools and features	Offers a learning curve, extensive documentation, active community
5.	Cost	Free version available, tiered subscription model, fees for pro features	Pay-as-you-go pricing model for resources	Free to use, royalty fees upon release	Free and open-source, no licensing fees

IV. SUMMARY

Unity is a flexible game creation engine with a user-friendly UI, various platform compatibility, and a large asset store that is appropriate for both novices and pros. While Amazon Sumerian is focused on web-based and VR/AR experiences, it does provide a browser-based environment with built-in assets, but it may have limits when compared to the robustness of other engines.

Unreal Engine 4 (UE4) is noted for its high-quality visuals, C++ support, and numerous tools, making it appropriate for professionals, despite a steep learning curve. Blender is a strong open-source programme that specialises in 3D modelling, animation, and rendering. It is backed by an active community and abundant documentation, making it a great choice for content creators.

V. CONCLUSION

The study of virtual worlds created with Unity, VRTK, and Photon Engine PUN emphasises the variety of tools available for generating immersive experiences. Unity serves as a fundamental platform with various features, while VRTK broadens accessibility by reducing the complexity of VR interactions. Photon Engine PUN provides strong networking technologies, allowing for easy multiplayer integration.

A comparison chart displays each tool's benefits and weaknesses, allowing developers to make educated judgements depending on project needs. This study emphasises the need of knowing these tools' features in order to fully utilise their potential in generating appealing virtual worlds that cater to a wide range of demands in the realms of game development and simulations.

Finally, the convergence of these technologies creates opportunities for innovation and development, promoting the ongoing evolution of virtual experiences.

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REFERENCES

[1]. https://en.wikipedia.org/wiki/Virtual_reality
[2]. Gabriela Gabajová Department of Industrial Engineering – University of Žilina,Univerzitná 8215/1, 010 26 Žilina, Slovakia, gabriela.gabajova@fstroj.uniza.sk (corresponding author) 2021.
[3]. TREBUŇA, P.: Experimental modeling methods in Industrial Engineering, Acta Montanistica Slovaca, Vol. 14, No. 4, pp. 335-340, 2009.
[4]. TREBUŇA, P., POPOVIČ, R., PEKARČÍKOVÁ, M. KLIMENT, M., MARKOVIČ, J.: Virtual Commissioning in the digital factory, Průmyslové inženýrství, Plzeň: Západočeská univerzita, pp. 150- 155, 2015.
[5]. https://www.queppelin.com/virtual-reality-in-unity/
[6]. Research on roaming and interaction in VR game based on Unity 3D Juan Wu ShanDong Women's University No. 2399, Daxue Road Changqing University of Science and Technology Park Jinan City Shandong Province China, 2020.
[7]. Sa Wang, Zhengli Mao, A New Method of Virtual Reality Based on Unity3D, The Key Lab of Resource Environment and GIS, Capital Normal University, Beijing, China & Department of Surveying and Urban Spatial Information, Henan University of Urban Construction, Pingdingshan, China, 2010.
[8]. https://en.wikipedia.org/wiki/Unity_(game_engine)
[9]. S.U. Sharma, D.J. Shah, "A Practical Animal Detection and Collision Avoidance System Using Computer Vision Technique," IEEE Access, vol. 5, pp. 347-358, 2017.
[10]. Wei Zhao, Wenping Ma, Licheng Jiao, Puhua Chen, Shuyuan Yang, Biao Hou, "Multi-Scale Image Block-Level F-CNN for Remote Sensing Images Object," IEEE Access, vol. 7, pp. 23969-23978, 2019.
[11]. The Development of 3D Object Modeling Techniques for Use in the Unity Environmen Ilsiyar Bikmullina Kazan National Research Technical University named after A. N. Tupolev - KAI KNRTU-KAI Kazan, Russia elsiyar-b@yandex.ru 2020.
[12]. https://sumit-kr-sharma.medium.com/virtual-reality-toolkit-an-open-source-framework-introduction-setting-up-environment-b11817cb8927
[13]. https://doc.photonengine.com/pun/current/getting-started/pun-intro#

