

VIRTUAL REALITY

Empowering Environmental Conservation:

3D Virtual Reality Applications for nature

GUIDE ON VIRTUAL REALITY IN SCHOOL EDUCATION

FOR TEACHERS AND STUDENTS

Erasmus+ KA201 Strategic Partnerships for School Education

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01 Introduction

Designing an effective learning environment requires a keen focus on the dynamics of the teaching and learning process. This space should be organized in a way that facilitates the development of learning experiences, transcending the constraints of traditional, formal activities. By placing the student at the heart of the process, we emphasize learning experiences as pivotal moments that ideally lead to shifts in understanding, thought processes, or behavior.

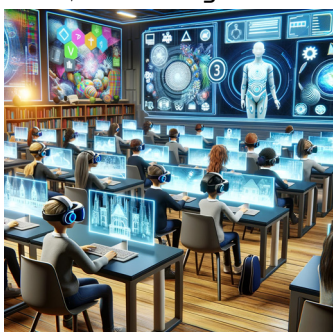
To foster this impact, learning experiences must be socially meaningful, actively engaging, diverse, cohesive, and relevant. When students are positioned as the primary agents in their learning journey, these experiences become actively transformative. They should impart practical knowledge and skills that enhance the learner's capability in real-world, workplace contexts. Therefore, teaching and learning transcend mere content acquisition, embodying a cycle of learning through reflective and active thinking.

Such learning experiences should not only motivate students but also challenge them appropriately, ensuring effective learning. This perspective underscores the importance of the educational interaction's purpose, rather than its location (like a school or classroom) or format (such as a course or program).

The vast array of methods through which students can learn and interact with educators, coupled with the level of autonomy they can exercise in their learning journey, is significant. Virtual reality is an exemplary tool in this context, supporting a diverse range of learning experiences and complexities, further enriching the educational landscape.

Main objective of the module

This module offers insights into the exciting potential of virtual reality technology, particularly focusing on its applications in educational settings. Within the framework of this Project, we have developed and curated a selection of VR learning experiences as examples. These samples showcase how virtual reality can be utilized to create immersive, engaging educational environments, enhancing both the teaching and learning processes.



General Description

This document aims to:

1. **Highlight the Importance of Designing Learning Experiences:** It's crucial for educators to comprehend the significance of crafting tailored learning experiences. This understanding is key to creating an impactful educational journey for students.
2. **Familiarize Teachers with VR Tools and Techniques:** We emphasize equipping teachers with knowledge and skills in using various tools and techniques. This includes both hardware and software components necessary for implementing VR in the classroom. Additionally, the module provides guidance on utilizing pre-developed VR applications for learning.
3. **Present Practical Use Cases:** To help teachers integrate VR technology effectively, we offer a range of use cases showcasing how VR can be applied in educational settings. These examples serve as a resource for teachers to understand the practical applications of VR in enhancing learning experiences.

The use of Virtual Reality in Education

Technological advancements are unlocking unprecedented opportunities to enrich educational experiences. In this chapter, we navigate through an array of applications and environments that have been developed to enhance active learning, a key focus of this project. We delve into Virtual Reality (VR) applications that utilize specialized hardware, including Oculus, HTC Vive, and Google Cardboard. Additionally, we explore the impactful role of smartphone-accessible applications in the educational sphere. The chapter culminates with an in-depth analysis of various methodologies currently being employed in classrooms. This discussion aims to provide insights into how these innovative technologies can be effectively integrated into educational settings.

Classroom experiments

The potential of Virtual Reality (VR) in enhancing educational experiences is vast, offering numerous innovative opportunities for learning. For instance, Gochman et al. (2019) designed a VR tool using Unity 2018 with SteamVR for the HTC Vive and Vive Pro headsets. Incorporating the Virtual Reality Toolkit (VRTK), an open-source script library, they enabled menu options and user teleportation within the VR environment. This particular VR experience allowed students to compare human vision with that of a Tarsier, a nocturnal primate known for its exceptionally large eyes. Assessed in secondary schools through questionnaires, this innovative VR simulation demonstrated the technology's capability to recreate scenarios that are otherwise impossible to experience in reality.





In a similar vein, Akman and Çakir (2019) targeted elementary education with a VR game designed to teach mathematical fractions, a concept often challenging for students. Utilizing cardboard goggles, smartphones, and headphones, this game, developed in Unity 3D, was introduced in classrooms. Its effectiveness was evaluated using a qualitative approach, with guided interviews as the primary data collection method. The VR environment was assessed on various parameters including action-awareness integration, challenge-skill balance, clarity of goals, direct feedback, task concentration, control sense, reduced self-consciousness, time perception alteration, and the overall immersive experience.

Markowitz et al. (2018) employed a virtual reality environment developed in Worldviz's Vizard software to educate students about ocean acidification resulting from climate change. Applied in high school settings, the learning process was evaluated through an exam comprising six open-ended questions. This VR experience not only enhanced students' knowledge of marine science and the impacts of climate change but also, as reported by participants, led to a significant increase in knowledge and interest in learning about ocean acidification. In some cases, it even fostered a shift towards pro-environmental attitudes.

Multiplayer Education Use Cases

Effective education actively engages students in learning, fosters collaboration, and stimulates creativity. It nurtures in-depth discussions, aids in visualizing complex concepts, and supports students in identifying challenges and devising solutions. Virtual Reality (VR) is revolutionizing these aspects of education by offering experiential learning opportunities. As a natural progression in computer-based instruction, immersive technology provides unique experiences that traditional books or videos cannot.



This technology immerses students in their learning topics, making the experience more tangible and memorable. In VR, dynamic and interactive environments stimulate discovery and learning driven by curiosity and exploration. Additionally, VR offers a platform for peer collaboration, with teachers reporting increased student interaction in virtual settings.



VR also serves as a valuable tool in special education. It's being utilized to create personalized learning environments for students with special needs, helping to calm those experiencing sensory overload, and providing a medium for them to express their understanding, craft solutions, and showcase their creativity through 3D modeling and virtual creation.

Virtual Reality is not only a trending topic in consumer markets but also a burgeoning field in education. The practicality of using VR in classrooms, even where 30 students simultaneously wear VR headsets, is becoming a reality. Classrooms globally are increasingly adopting this technology, marking a significant step forward in educational methodologies.

02 Tools and APIs for VR

As Virtual Reality (VR) gains traction in mainstream applications, its value across various business sectors is increasingly recognized. This innovative technology offers a multitude of benefits across diverse fields:

1. **Enhancing Educational Experiences:** VR takes hands-on learning to an unprecedented level. It transcends traditional observation methods, allowing students and trainees to immerse themselves in performing tasks, rather than merely watching an instructor. This immersive approach can significantly improve the learning and training process.
2. **Revolutionizing Product Demonstrations:** For businesses that sell products, VR offers transformative potential. It enables consumers to virtually experience products, akin to a “virtual test drive.” This not only enhances the consumer experience but also aids in informed decision-making, as they can visualize ownership before making a purchase.
3. **Advancing Beyond 3D Modelling:** VR technology is not limited to visualization; it also allows for creation and interaction. Advanced VR tools enable users to develop, sculpt, model, paint, and construct tangible objects within a virtual environment. These tools provide an interactive experience with 3D models from any perspective, offering a new dimension to design and creativity.

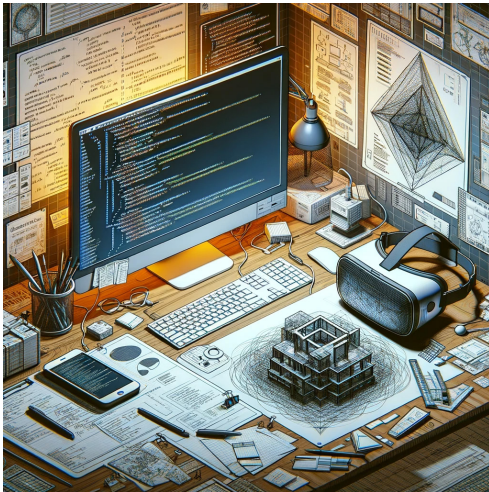
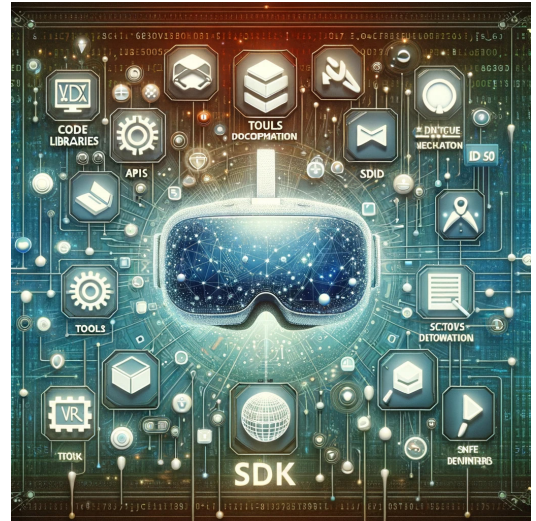
Types of Virtual Reality (VR) Application and Development Software

Virtual reality, as an evolving technological field, is seeing the emergence of various subcategories. These subcategories represent the different aspects and applications of VR technology. Some prominent ones include:



VR Game Engine and WebVR: This category encompasses software tools essential for crafting VR video game experiences, as well as WebVR experiences. These engines provide developers with the resources needed to bring virtual gaming worlds to life, combining immersive graphics and interactive elements suited for the web.

VR Software Development Kits (SDKs): SDKs are fundamental in the VR development process. They serve as the foundational framework for designing, building, and testing a wide array of VR experiences. In essence, VR SDKs are the building blocks that enable the creation of diverse virtual environments and interactions.



VR App Software Development: This software streamlines the process of creating VR applications. It features user-friendly interfaces that simplify the integration of data within virtual environments. These tools are particularly valuable for visualizing analytics, providing users with a comprehensive understanding of data in an immersive and intuitive manner.



VR Game Engine and WebVR



Unity 3D

Unity stands as a pivotal tool in contemporary VR development, renowned for its versatility and accessibility. It offers both free and professional versions, catering to a broad range of platforms including consoles, desktops, and web interfaces. The free version supports major mobile operating systems like iOS and Android, as well as Windows, while the Pro version extends its capabilities to gaming consoles such as PlayStation and Xbox 360.



Fundamentally, Unity is a game engine. Its standout feature is a direct VR mode, which allows developers to preview their work in a Head Mounted Display (HMD). This feature significantly enhances productivity by enabling VR design within a virtual environment. Unity boasts a comprehensive suite of editing tools accessible through plugins, and it supports a vast array of asset formats, making it a highly adaptable tool for VR development.

Unity's quick prototyping capabilities and user-friendly interface are rapidly making it the go-to tool for VR developers. It is surrounded by a robust community, offering an abundance of resources, tutorials, and documentation for learning and development. Additionally, Unity provides a marketplace for 3D assets, which facilitates swift project initiation. For those acquainted with C# or JavaScript, scripting within Unity is relatively straightforward. The platform's support for all major HMDs and its ability to export projects to virtually any platform further solidify its position as a leader in VR development tools.



Unreal Engine (UE4)

Unreal Engine, a formidable competitor to Unity 3D, stands out as a comprehensive platform for VR development. Developed by Epic Games, it powers numerous high-octane games, renowned for their extraordinary detail and graphics. The engine is not just a tool for game development; it also encompasses an asset store and extensive documentation, making it a robust resource for VR integrations.



Unreal Engine boasts one of the largest developer communities in the field, providing unparalleled support to those venturing into VR game creation. This community plays a crucial role in ensuring regular updates and troubleshooting, offering solutions and advice to user inquiries.

Unreal Engine's compatibility is extensive, supporting major operating systems including Linux, PS4, and Oculus, among other technologies. It offers a complete suite of tools necessary for 3D game development, including full source code access, bug fixing, and customization options. While its learning curve is comparable to that of Unity, Unreal Engine is often lauded for its more advanced and realistic graphics. It provides excellent performance, coupled with the advantages of a modern editing environment. Although UE4's export capabilities cover most platforms, they are somewhat more limited compared to Unity's extensive range.



WebVR Browser API

The WebVR API is a specialized interface designed to connect VR hardware with web browsers, enabling developers to craft immersive and user-friendly VR experiences directly within a web environment. This API empowers web pages, through JavaScript, to access and utilize the orientation and position data of a VR headset and its controllers. Leveraging this data, WebVR can generate appropriate stereoscopic views for VR headsets using WebGL.



This API also encompasses tools for developing WebVR compatible content in various browsers, including Chrome and Firefox. Additionally, it's adaptable to mobile devices. Most smartphones can be integrated with the WebVR-polyfill. When positioned horizontally, they switch to a dual display mode. This feature is compatible with simple VR solutions like Google Cardboard and Samsung VR, as well as other headsets designed to work in tandem with smartphones. This versatility of the WebVR API demonstrates its pivotal role in making VR experiences more accessible and diverse, bridging the gap between high-end VR hardware and everyday devices.



VR SDK, Google VR API

In the classroom, the use of smartphones offers a simple and cost-effective method for students to delve into the immersive world of virtual reality. Platforms like Google Cardboard and Google Daydream stand out as some of the most accessible and affordable VR solutions, compatible with both Android and iOS devices.



Google facilitates VR development on its platforms through the provision of the Google VR SDK. This SDK is available for native Android and iOS platforms, as well as for Unity, making it versatile for various development needs. It encompasses a comprehensive set of APIs that cater to the essential needs of VR developers, including input handling, controller support, and graphics rendering. These tools are instrumental in creating new VR experiences for either the Daydream or Cardboard platforms.

One of the key features of this SDK is its ability to create immersive VR experiences by integrating data from the phone's sensors. This integration accurately predicts the user's head movement, seamlessly blending real-world orientation with the virtual environment. Such capabilities ensure a more engaging and realistic VR experience, making it an ideal tool for educational VR applications.

03

3D Virtual Reality Learning Outcomes of the Project:

Our project is focused on developing cutting-edge 3D virtual reality applications specifically tailored for educators and students, aiming to facilitate immersive and realistic experiences of diverse environmental scenarios. This endeavor is rooted in the creation of innovative VR applications designed to transport users into accurately simulated environmental settings. These applications are crafted to not only replicate real-world conditions but also to enhance understanding and engagement with environmental issues.

This project is a collaborative effort led by the Tokat Provincial Directorate of National Education, in partnership with Tokat Gaziosmanpaşa University, Lusofona University in Portugal, De Creatieve STEM in Belgium, E-Code from Slovakia, and IES Padre in Spain. The project's activities designed around four central themes: clean water and healthy food, renewable energy, preventing environmental pollution, and combating global warming. As part of this initiative, a variety of educational materials and resources have been meticulously developed.

At its core, the project addresses critical issues of environmental degradation and climate change. It seeks innovative solutions to pressing global challenges, such as pollution, the necessity of clean water and healthy food, and the shift towards sustainable, clean energy. To facilitate a deeper understanding and learning about these environmental concerns, the project integrates STEM (Science, Technology, Engineering, and Mathematics) methodologies, E-Content, and 3D virtual learning environments. These tools are particularly focused on highlighting the pressing issue of global warming.



Greenland Ice Melting Virtual Reality Application:

Greenland Ice Melting Virtual Reality Application: Global warming, a critical issue of worldwide concern, is significantly disturbing the planet's equilibrium, particularly evident in the rising temperatures of glaciers. In response to this pressing challenge, a 3D virtual reality application has been developed, available in multiple languages - Turkish, English, Portuguese, Spanish, and Slovak. This application is dedicated to shedding light on the unique aspects of polar seas and lakes, monitoring their ongoing changes, and visualizing possible future conditions. Utilizing the power of Unreal Engine, it offers students an immersive 3D learning environment, allowing them to gain a thorough understanding of these critical environmental issues. Furthermore, the application is conveniently accessible on personal computers, ensuring broad and easy reach for educational purposes.





From Fire to Green

This immersive virtual reality experience, aptly titled 'From Fire to Green: Shift from Hell to Heaven,' guides users through the dramatic metamorphosis of a ravaged landscape into a flourishing, verdant ecosystem. It symbolizes the profound shift towards environmental restoration and sustainability. As participants traverse this virtual journey, they witness first-hand the stark contrast between ecological devastation and the rejuvenating power of green initiatives.

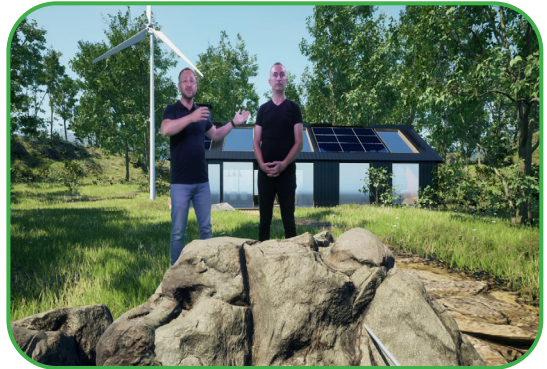


This narrative vividly underscores the importance and impact of transitioning to eco-friendly practices and a greener way of life.



Renewable Energy Lake House:

This virtual production offers a detailed representation of a lake house that is fully powered by renewable energy sources. It serves as an illustrative example of sustainable living practices. Through this digital depiction, users can explore how renewable energy can be seamlessly integrated into residential architecture, emphasizing the practicality and effectiveness of eco-friendly energy solutions in everyday life. The virtual lake house not only showcases the aesthetic appeal of sustainable design but also educates on the various aspects of green living, from solar panels to energy-efficient appliances, highlighting a harmonious balance between modern living and environmental stewardship.



These application are compatible with both Windows and Unreal Engine, requiring a highly equipped computer for optimal performance.



Installation and Usage

This application is compatible with both Windows and Unreal Engine, requiring a highly equipped computer for optimal performance.



Unreal Engine is a robust game engine widely used for creating professional-grade games. This guide provides a step-by-step walkthrough for installing Unreal Engine on your computer.



You can watch this video for more information.

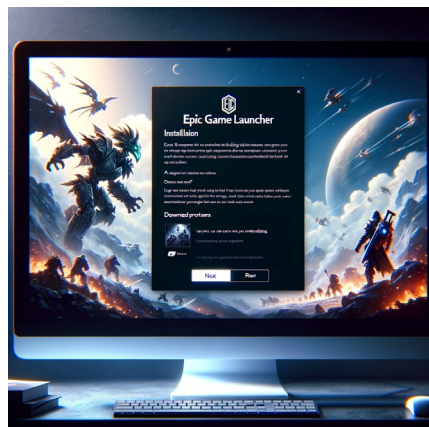
<https://youtu.be/KWSIBSxCUhs>



Downloading the Epic Games Launcher: To initiate the download and installation of Unreal Engine, you must first use the Epic Games Launcher. This can be accessed through the official website of Epic Games. Once there, select the version suitable for your system and begin the download process.



Installing the Epic Games Launcher: Upon completing the download, proceed with the installation by running the downloaded file. The installation typically involves a straightforward process, often requiring just a few clicks. During this stage, you may be prompted to either create a new Epic Games account or log in with an existing one.



3

Downloading Unreal Engine: After successfully installing the Epic Games Launcher, navigate to the 'Library' tab. Here, you will find Unreal Engine. Begin the download and installation by clicking on the 'Install' button. Although there are various versions available, it is advisable to select the latest version for the most up-to-date features.



4

Finalizing the Download and Installation: Ensure a stable internet connection throughout the download and installation process of Unreal Engine. The duration of this process will depend on the file size and your internet connection speed. Once the download is complete, you can launch Unreal Engine by clicking the 'Launch' button, thereby starting your journey into professional game development.



The installation of Unreal Engine, facilitated by the Epic Games Launcher, is a straightforward process. Once installed, Unreal Engine becomes accessible for use with the provided project file and VR glasses. This particular application is crafted to visually demonstrate the extent of glacier melting, offering a profound educational experience. To cater to a diverse audience, the application is available in five languages: Turkish, Portuguese, Spanish, English, and German.

Upon launching Unreal Engine, you will have the opportunity to customize various aspects of your project. This includes specifying the type of application you're working on, adjusting graphics settings, and making other project-specific configurations. Additionally, you will be prompted to select a suitable location on your computer to save the project file. This step is crucial for organizing and managing your VR project effectively.



Multiplier VR Application of EU Energy Efficiency:

This interactive experience is designed to illuminate the diverse energy efficiency standards and environmental practices implemented throughout the European Union. It serves as an educational resource, enabling users to delve into various environmental features and sustainable initiatives present in cities globally. Beyond the project's participating countries, this material offers insights into environmental practices in different regions of the world, thereby fostering a broader understanding of global sustainability efforts.



The content is specifically crafted to assist educators in imparting environmental knowledge. It features multiplayer functionality, allowing for collaborative exploration and learning within the virtual environment. Optimized for the Oculus Quest Engine, this tool is an ideal platform for both students and teachers to engage interactively, enhancing the educational experience through immersive virtual technology.



This application is designed to be compatible with Oculus Quest 2 and newer models. You can upload the app to your phone for the Google Cardboards, but joysticks are required for its use.

Since Oculus Quest 2 operates fundamentally as an Android device, users can install Android Debug Bridge (ADB) on their respective platforms and use commands to download content.



You can watch this video for more information.

<https://youtu.be/tau63RyAl0c>



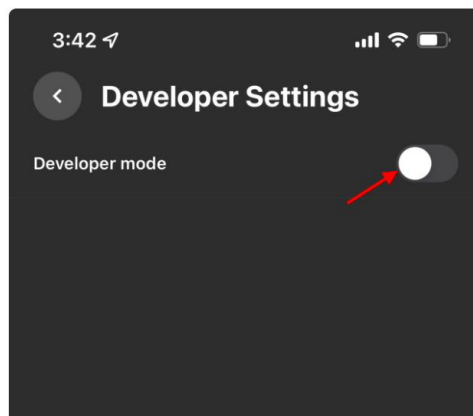
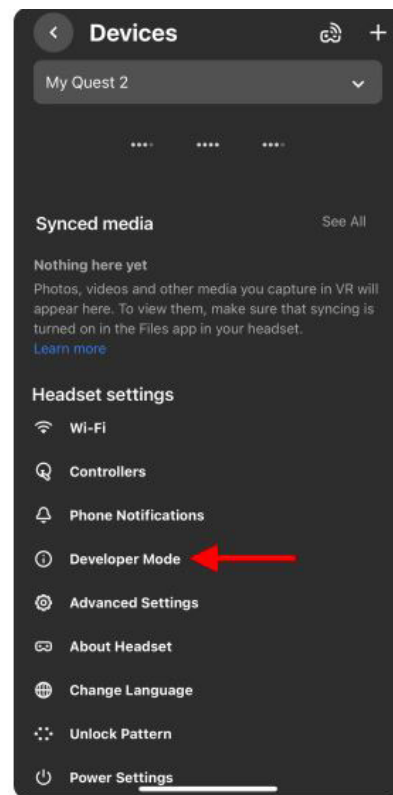
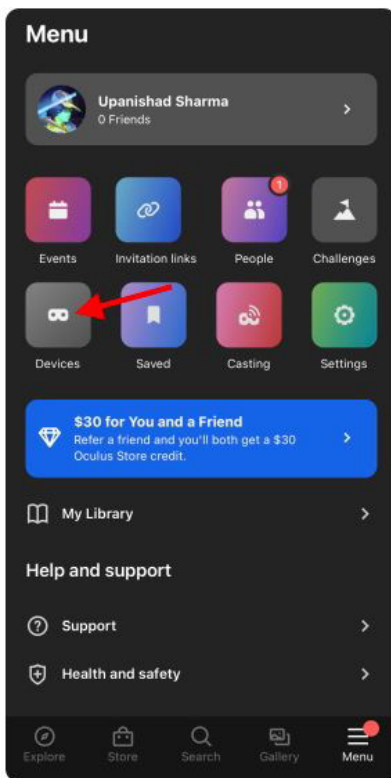
Download and Install SideQuest: To begin, the official software required for this process is SideQuest. Download and install SideQuest on your computer. This program will manage the necessary USB drivers during installation, saving you significant time. Once the installation is complete, you can return to this guide and continue.

2

Register as an Oculus Developer: To upload content to the Quest 2, the device must be in developer mode. To enable this, you first need to register as an Oculus developer. This process is simpler than it might seem. Navigate to the Oculus toolbar, enter any name in the organization field, and click 'Accept'. Remember to use the same Facebook/Oculus account that is associated with your Quest 2.

3

Activate Developer Mode on Quest 2: After registering as a developer, the next step is to activate the actual developer mode on your Quest 2. This action can only be completed using the Oculus mobile app. If you haven't installed the app yet, it's available for free on both Android and iOS and is straightforward to set up. Once you have the Oculus app, open it and follow these steps to enable developer mode on your Quest 2:



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