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# VR PC BUILDING SIMULATOR

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**Abstract -** *Vr pc building simulator is a virtual reality application designed to provide immersive training in computer hardware and networking. the system comprises two modules: a pc building simulator, enabling users to assemble and disassemble components such as cpu, gpu, ram, and storage devices, and a networking devices viewer, allowing interactive exploration of routers, switches, and hubs. by simulating real-world tasks with vr headsets and hand tracking, vr simulator offers guided instructions, real-time feedback, and safe, cost-effective practice. This platform enhances engagement, knowledge retention, and accessibility, making hardware and networking education more interactive for students and professionals*

***Key Words***: Virtual Reality, Computer Hardware Education, Networking Training, Immersive Learning, Simulation

## 1. INTRODUCTION

In the modern era of digital transformation, Virtual Reality (VR) is revolutionizing the way humans learn, interact, and experience information. VR technology allows users to immerse themselves in a simulated 3D environment that replicates real-world scenarios or creates entirely new worlds that are otherwise impossible to experience physically. Unlike conventional learning methods—such as textbooks, lectures, or even 2D simulations—VR enables learners to engage with complex systems in a highly interactive, safe, and repeatable manner.

This technology has found applications across numerous fields, including healthcare (surgical simulations), architecture (virtual walkthroughs), automotive design, entertainment, and education. Educational institutions in particular are increasingly adopting VR to enhance student engagement, improve retention of knowledge, and offer practical exposure to otherwise expensive, dangerous, or inaccessible environments.

When it comes to computer hardware and networking education, one of the major challenges students face is the lack of adequate hands-on experience. Physical laboratories often require significant investment in components such as motherboards, processors, network switches, and routers. These labs also involve regular maintenance costs and the risk of accidental damage due to improper handling by beginners. These barriers prevent many students from truly understanding how hardware components fit together or how networking devices function internally.

The VR PC BUILDING SIMULATOR Project is an innovative solution that addresses these challenges by providing a virtual hardware and networking laboratory. Built using Unity, Blender, and Oculus SDK, it creates an immersive environment where learners can assemble and disassemble PC components, open virtual routers and switches, and explore their internal structures—without the risk of physical damage or additional cost.

## 2. RELATED WORK

Virtual Reality (VR) has been widely studied as an emerging tool for education and training. Researchers have highlighted its ability to create immersive environments where learners can interact with concepts in ways not possible through traditional methods.

Radiant et al. (2020) studied the impact of Virtual Reality on engineering education and concluded that VR applications significantly improve spatial visualization skills, technical understanding, and learner engagement. Their work highlighted that immersive environments are especially useful in subjects where real-world practice is limited by cost or safety issues.

Friona and Ott (2015) carried out a survey on immersive learning in STEM fields and reported that VR tools increase motivation, concentration, and knowledge retention among students. They noted that the interactive nature of VR helps learners to connect theoretical concepts with practical applications more effectively than traditional methods.

The development of “PC Building Simulator” (2018) demonstrated how virtual environments can be used for hardware education. The simulator allowed users to assemble and disassemble computer parts such as CPUs, GPUs, RAM, and storage

devices in a virtual setting. This work showed that VR can be a cost- effective alternative to physical hardware labs.

Pinho et al. (2019) explored the use of VR in networking education, where students could virtually inspect routers, switches, and hubs. Their study indicated that VR-based visualization provided deeper insights into internal structures of devices compared to diagrams and static illustrations.

From these research efforts, it is clear that VR plays an important role in bridging the gap between theory and practice. The VR project builds upon these works by combining PC assembly and networking device visualization into a single platform, creating a reusable, safe, and interactive educational tool.

## SYTEM ARCHITECTURE

The workflow diagram below illustrates the architecture and working flow of the system. Fig.1 represents how user actions are processed by the VR application and transformed into immersive visual feedback. The system is built in a layered structure, consisting of three core layers inside the VR application: User Interaction, Simulation Engine, and Visualization & Rendering.

### User Inputs

The workflow begins when the user interacts with the system using a VR headset and motion controllers. These inputs include physical actions like grabbing, rotating, placing, or disassembling virtual components. These gestures are tracked using the Oculus headset or any compatible VR hardware.

### User Interaction Layer

This layer captures user inputs and translates them into virtual actions. It handles gesture recognition (e.g., pick, place, rotate) and allows users to manipulate objects in the 3D space. It also provides visual cues such as highlights or arrows to assist the user with the correct placement of components.

### Simulation Engine Layer

The simulation engine acts as the logic center of the system. It verifies whether the components are correctly assembled or placed. For example, it checks whether the CPU is oriented properly, or the RAM is inserted into the right slot. If errors occur, it generates real-time feedback such as “Incorrect Placement” or “Rotate 180°.”

### Visualization & Rendering Layer

This layer is responsible for rendering high-quality 3D visuals. It uses models created in Blender and manages textures, lighting, shadows, and object animations. It also supports additional viewing modes such as exploded view or cross-section to allow users to understand internal structures clearly.

#### Visual Output

Finally, the processed simulation is displayed as visual output inside the VR headset.

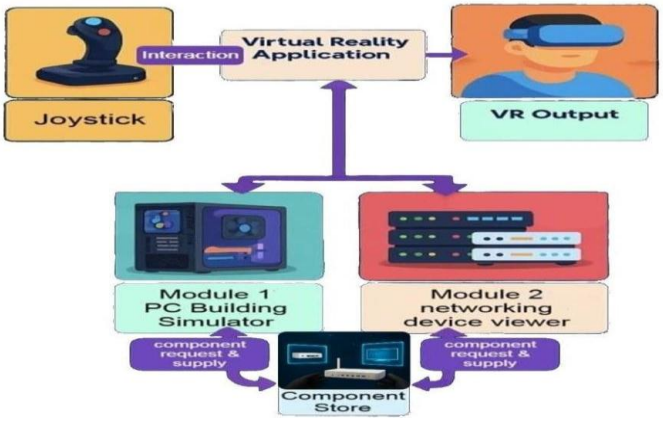


**Fig 1: Block Diagram**

## 3. METHODOLOGY

This module outlines the step-by-step process used to create the proposed VR PC assembly system. It begins with setting up the necessary hardware and software environment, followed by the creation of the Unity project and organization of project assets. The module continues with enabling VR functionality, designing the player rig and interactive environment, prototyping grabbable components, and implementing snap sockets with part compatibility logic. Finally, the system integrates a simple world- space user interface for feedback and allows testing within the Unity Editor. Together, these steps demonstrate the development of an immersive and interactive virtual PC assembly experience that can validate part compatibility and provide real-time feedback to users.

**Prerequisites:** Before starting the VR PC assembly project, ensure you have the necessary hardware and software. A VR-ready Windows PC and a compatible headset are required. Install Unity Hub with Unity 2022/2023 LTS, including the Windows Build Support and Android support modules. Visual Studio with the "Game Development with Unity" workload is necessary for scripting. Optional tools such as Blender for modeling and Git for version control are recommended. Finally, configure your VR runtime settings according to the platform you are using.

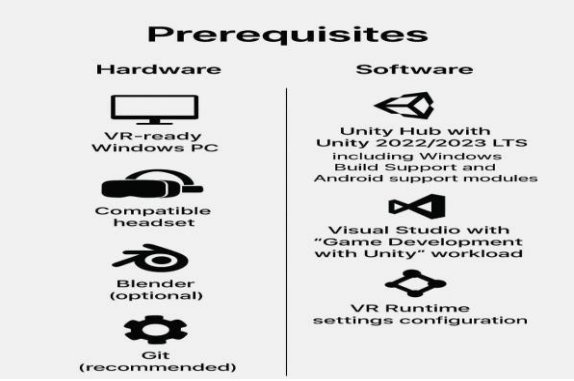


**Fig 2: Prerequisites**

**Create the Project:** Begin by opening Unity Hub and creating a new 3D project using the URP template. Name the project VR_PC_Builder and create it. This will serve as the foundation for your VR PC assembly environment. The next step is to organize the project files for clarity and maintainability.

**Enable VR (XR)** : To enable VR, necessary Unity packages must be installed and configured. This includes XR Plugin Management, the XR Interaction Toolkit, and the Input System. In the project settings, switch the active input handling to the new input system. Open XR should be enabled for the target platform, and appropriate controller profiles such as Oculus Touch, Valve Index. Starter assets and sample input actions can optionally be imported to streamline development.

**Add a VR Rig and Basic Environment:** The VR environment begins with a player rig as shown in fig.3, which represents the user within the scene. A floor should be added for the player to stand on, along with basic elements like a table to hold parts. This initial setup allows for early testing and ensures that the VR camera and tracking are functioning correctly with the headset. Lighting can be left at default settings initially.

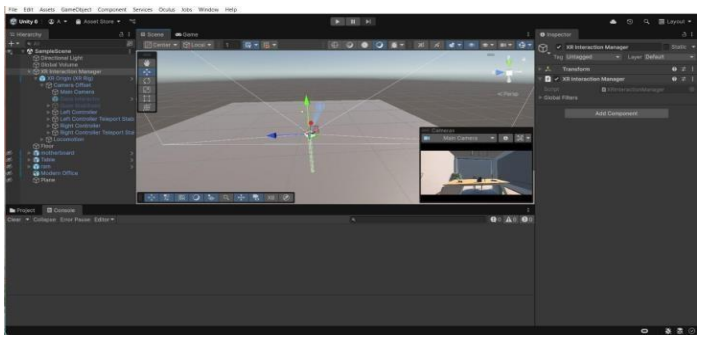

**Fig 3: Vr-rig**

## 4. SYSTEM MODULE DESCRIPTION

The VR system consists of several integrated modules that work together to create an interactive and educational virtual environment for learning computer hardware and networking concepts. The system includes a PC Assembly Simulator where users can handle 3D components such as the motherboard, CPU, RAM, GPU, and power supply. Each component is designed with realistic dimensions and textures, allowing learners to understand the appearance and placement of actual hardware. Users can pick, rotate, examine, and position parts correctly through the VR controllers, making the learning experience both practical and immersive. The system also provides on-screen guidance and visual cues that help users follow the correct sequence of assembly without the risk of damaging physical components.

In addition to PC assembly, the system includes a Networking Devices Viewer that enables users to explore the internal structure of routers, switches, hubs, and other networking equipment. Instead of only seeing the outer casing, learners can view internal circuits, ports, chipsets, and layouts that are normally difficult to access in real devices. This improves their understanding of networking hardware and supports theoretical learning with visual 3D representation. The system's interaction environment is supported by VR-based movement controls, object manipulation features, and collision detection, ensuring that users can move naturally within the virtual lab. A simple and user-friendly VR interface allows easy navigation between modules, instructional panels, and menus, making it accessible even for beginners.

All 3D assets and models used in the system are carefully optimized to maintain smooth performance. Assets created in Blender are exported with reduced polygon counts and efficient textures to ensure stable rendering inside the VR environment. The virtual lab environment is designed to feel realistic and distraction-free, with proper lighting, shadows, and spatial arrangement to support an immersive training atmosphere. Together, these modules form a complete VR-based learning system that enhances technical understanding, improves engagement, and provides a safe and repeatable platform for practicing hardware-related tasks.

## 5. RESULT

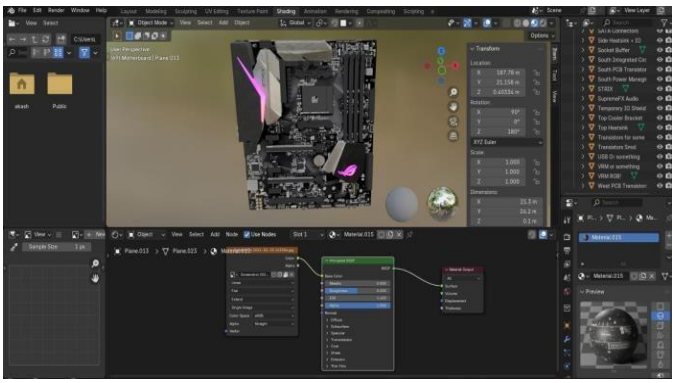

**Fig.4: 3D Model in Blender**

**Fig.5: 3D Ram Model**

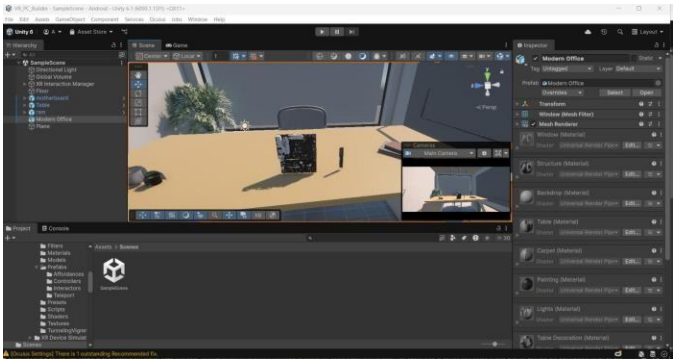

**Fig.6: Visualization and Rendering**

## 6. CONCLUSION

The VR project successfully demonstrates how Virtual Reality can be used as an effective learning platform for teaching computer hardware assembly and networking concepts. By combining interactive 3D models, VR controls, and an immersive environment, the system allows students to practice assembling components and exploring networking devices without the need for physical equipment. This reduces the risk of damaging real components, provides unlimited practice opportunities, and improves conceptual understanding through visual and hands- on engagement. The development process also offered valuable experience in Unity development, 3D modeling, asset optimization, and VR interaction design, contributing significantly to technical knowledge and practical skills.

Overall, the system achieves its goal of providing a realistic and user-friendly virtual lab experience. Students who tested the application reported that it made learning easier and more engaging compared to traditional classroom methods. While the current version is fully functional, the system has the potential to grow further with advanced features such as collaboration, AI guidance, networking simulations, and haptic interactions. With continuous improvements, VR can become a complete, scalable, and modern solution for teaching hardware and networking subjects in educational institutions.

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