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DEVELOPMENT OF VIRTUAL REALITY APPLICATION FOR DESKTOP COMPUTER ASSEMBLY

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Abstract: Both hardware and software technologies offer their advantages in helping to facilitate student learning activities. Virtual reality technology allows users to interact directly with the virtual reality environment, giving the effect of a pleasant learning sensation because it provides direct experience for students to actively do desktop computer assembly practicum independently and guided. This research is R & D (Research and Development), which aims to produce a product as a desktop computer assembly virtual reality learning application. This research procedure adapts the Lee & Owens development model. The subjects of this research were students at the Open University, Makassar State University, and Lambung Mangkurat University. The results showed that using Virtual Reality in desktop computer assembly can provide extraordinary experiences to users, bridging the gap between the real and virtual worlds. This is achieved through specially designed hardware to create a virtual environment that resembles the actual reality or even creates an entirely new reality.

Keywords: desktop computer; assembly; virtual reality

Abstrak: Teknologi perangkat keras (hardware) maupun lunak (software) menawarkan keunggulannya dalam membantu memfasilitasi aktivitas belajar dan pembelajaran mahasiswa. Teknologi virtual reality memiliki kemampuan bagi penggunanya untuk dapat melakukan interaksi langsung dengan lingkungan realitas maya, memberi efek sensasi pembelajaran yang menyenangkan karena memberikan pengalaman langsung bagi mahasiswa untuk aktif melakukan pratikum perakitan computer desktop secara mandiri maupun terbimbing. Penelitian ini adalah R & D (Research and Development) yang bertujuan untuk menghasilkan suatu produk yaitu berupa aplikasi pembelajaran virtual reality perakitan computer desktop. Prosedur penelitian ini mengadaptasi model pengembangan Lee & Owens. Subjek penelitian ini adalah mahasiswa pada Universitas Terbuka, Universitas Negeri Makassar, dan Unibversitas Lambung Mangkurat. Hasil penelitian diperoleh bahwa penggunaan Virtual Reality dalam perakitan computer desktop mampu memberikan pengalaman luar biasa kepada pengguna, menjembatani jurang antara dunia nyata dan dunia maya. Hal ini dicapai melalui penggunaan perangkat keras yang dirancang khusus untuk menciptakan lingkungan virtual yang menyerupai realitas sebenarnya atau bahkan menciptakan realitas yang sama sekali baru.

Kata kunci: computer desktop; perakitan; virtual reality

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INTRODUCTION

In the 21st century, the development of technology and information has been widely optimized in various sectors of industry, tourism, economy, business, health, military, and automotive [1]. It is even widely used for educational needs from early childhood to students in university. Various efforts are made by educators using technology and its development to facilitate the learning process and improve student performance [2].

Learning in higher education is directed at achieving high-level learning outcomes (Higher Order Thinking Skills) with several 4C skills that students must have, namely the ability to think critically (critical thinking), communication (communication), creative thinking (creative thinking), and collaboration (collaboration) [3]. These skills are the introductory provisions for students to meet the needs of work in the industrial era 4.0 and prepare them to face challenges in the era of society 5.0. The provision of 4C skills began to be realized through structuring the conditions of the learning environment by paying attention to learning objectives, study field characteristics, constraints during learning, student characteristics, learning organization strategies, learning delivery strategies, management strategies, learning effectiveness, learning efficiency and learning attractiveness [4].

Both hardware and software technologies offer their advantages in helping to facilitate student learning and learning activities [5]. Technology can be developed and utilized as a learning media by design to facilitate the delivery of learning messages through facts, concepts, procedures, and principles [6]. Learning media is developed based on the needs and characteristics of students as users. Appropriate media will affect the improvement of student learning outcomes [7].

Based on observations at the Open University, Lambung Mangkurat University, and Makassar State University, especially in the Educational Technology and Computer Engineering study programs, learning activities are carried out online through e-learning and offline (face-to-face) directly in the classroom. This is the case at the Open University in the Computer and Learning Media course (IDIK41010). There are obstacles during the learning process, namely (1) the unavailability of some hardware that supports student learning, such as the limitations of the type of PC (personal computer), main-board or motherboard, processor (CPU), hard disk (HDD), RAM (random access memory), optical drive (CD / DVD), VGA Card, (2) limited time and laboratory space for practicum activities with a large number of students, (3) no tutorial/simulation learning media has been developed for self-learning/ collaboration that can be used repeatedly according to the learning speed of each student. Therefore, effective and efficient problem-solving is needed, along with alternative solutions, to develop virtual reality (VR) learning applications.

Virtual Reality (VR) learning application for desktop computer assembly was developed because it considers the advantages of VR technology in delivering conceptual and procedural learning messages. VR is a computer-generated simulation technique that provides a sheltered learning environment that allows participants to experience virtual scenarios almost like in real life [8].

VR has become more accessible in recent years, not only in terms of experience but also in terms of design. Various cameras, editing software, and head-

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sets are available to create and view VR environments. VR simulations have been used for years for war and medical simulations, providing a safe way to gain experience in high-risk situations [9].

Virtual reality technology allows users to interact directly with virtual reality environments, giving the effect of a pleasant learning sensation because it provides a direct experience for students to actively carry out desktop computer assembly practicum independently or guided. Some tools related to VR can provide interactive learning environments that enrich ease of use, flexibility, and effectiveness [10]. The implementation of this Virtual Reality application only requires a smartphone with a Virtual Box.

In addition, VR has been described as a 21st-century learning tool. A study showed that students retain more information and can better apply what they have learned after participating in VR exercises [11]. There are additional perspectives regarding the positive effects of VR and its influence on learning outcomes. The studies reviewed in their work show that learners who use immersive head-mounted displays (HMDs) are more engaged, spend more time on learning tasks, and acquire better cognitive, psychomotor, and affective skills [12].

METHOD

This research is an R&D (research and development) that aims to produce a product such as a desktop computer assembly virtual reality learning application. This research procedure adapts the Lee & Owens development model. The reason for choosing this model is that it is a model that is dedicated to developing multimedia [13]. This development model is procedural because the sequence of steps in the process is systematically arranged, and each development step has an arranged sequence of development steps. The research and development procedure in the Lee & Owens model consists of five stages, namely (1) assessment/analysis, which includes need assessment and front-end analysis, (2) design, (3) development, (4) implementation, and (5) evaluation.

The steps of the model can be depicted in the following chart:

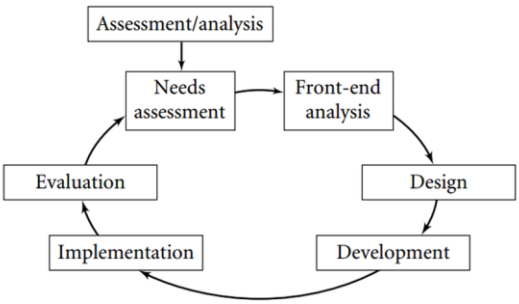

Image 1. Lee & Owens Development Model [13]

The object of this research is a virtual reality-based learning application for learning purposes in desktop computer assembly skills. The subjects of this research are students at several universities. The samples in this research are one-to-one or individual trials, small-group co-tests, and large-scale trials. In the early stages of development, the analysis phase was separated into need assessment and front-end analysis. Need assessment is a scientific activity that involves various data collection techniques from various sources of information to determine the gap between the situation that should occur (ideally) and the situation that has occurred (reality). The needs analysis includes normative, felt, expressed, or demanded, comparative, and anticipated or future needs. Next, conduct a front-end analysis which includes: 1) audience

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analysis, 2) technology analysis, 3) situation analysis, 4) task analysis, 5) issue analysis, 6) important event analysis, 7) goal analysis, 8) media analysis, 9) data analysis, 10) cost analysis.

After the analysis, the second step was the design stage. At this stage, the researcher makes a project schedule, project team, media specification, lesson structure, and configuration control review cycles. The third stage is product development, which translates product specifications into a physical form, namely VR applications. This development stage includes making storyboards and learning scenarios and conducting reviews or improvements needed so that the product can later be feasible to be implemented in the learning process.

The fourth stage is implementation. At this stage, media and material experts validate the product. After experts declare it feasible, the product is tested on students through individual, small-group, and large-group trials. The final stage of this activity is the evaluation stage. At this stage, researchers only conduct formative evaluations to determine the quality of the media that has been developed. The evaluation stage is carried out based on expert validation and product trial results. The results obtained are considered to improve the product's overall development.

RESULTS AND DISCUSSION

Virtual Reality Assembly Components

1. **High Resolution and Graphics**
   High-quality graphics play a vital role in maintaining immersion in the VR assembly experience [14]. High resolution provides clear and sharp visual details, like real-world experiences. Users who enter a virtual environment with stunning graphics tend to be more emotionally and psychologically engaged in the experience. Graphical enhancements also produce more realistic representations of objects, textures, and environments [15]. This creates a more immersive atmosphere and makes users feel like they are in the virtual world. For example, when viewing beautiful natural scenery or details in objects, the high resolution ensures that the experience feels vivid and real. Advanced rendering technology can also produce more realistic light and shadow effects, increasing immersion and delivering a more immersive visual experience.

2. **Spatial Audio**
   The audio aspect is also a key element in creating a mesmerizing assembly [16]. Spatial audio allows users to experience sound from different directions, adjusting to their movement and position in the virtual environment. This gives the impression that sounds are coming from the right direction within the environment, adding a dimension of depth and realism to the experience. When audio is synchronized with the user's movements and interactions, it provides a more unified experience between the visual and auditory. For example, in-game simulations and accurate and timely sound from various sound sources can enhance the user's emotional response and anxiety. High-quality audio devices and advanced sound-processing technologies ensure that the sound effects produce sound naturally and follow real-time environmental changes, thus enhancing the user's immersion in the VR experience.

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3. User Interaction

An equally important aspect is user interaction within the virtual environment. Controllers and motion sensors are crucial components that allow users to interact directly with objects and environments within the virtual world [17]. With the help of specially designed controllers, users can manipulate objects, move within the virtual space, or even communicate with the environment. Motion sensors play a vital role in tracking the user's movements, enabling precise responses from the virtual environment according to the movements made by the user. This creates a strong sense of presence, reinforcing the feeling that the user is engaged and in the environment. In addition to controllers and motion sensors, other interaction technologies, such as voice recognition or gesture recognition, are also starting to be used in VR. This expands how users interact with the virtual environment, creating a more intuitive and immersive experience.

4. Effect of these Components on VR Assembly

Together, these three components create a genuinely amazing VR assembly experience. High-resolution graphics provide a deep visual foundation, while spatial audio adds a powerful sensory dimension and user interaction provides unparalleled engagement. When these three components work synergistically, they create an overall experience that is convincing, breathtaking, and truly mesmerizing. The immersion generated by the combination of great graphics, realistic audio, and seamless user interaction can lift users out of their everyday reality and transport them into a whole new world. The success of VR technology also largely depends on how these components are integrated into the user experience [18]. Hardware and software capable of seamlessly integrating graphics, audio, and user interaction will provide a more satisfying VR experience [19].

5. Challenges in the Development of VR Assembly Components

Although these components contribute significantly to the level of VR immersion, there are several challenges to overcome in their development. For example, achieving higher graphics resolution in VR devices without compromising hardware performance and reliability is one of the main challenges [20]. In terms of audio, while spatial audio technology has advanced rapidly, there are challenges in delivering truly realistic sound in terms of quality and responding to changes in the environment quickly and accurately. In addition, user interaction also faces challenges in creating more advanced controllers and motion sensors to enable more intuitive and responsive interactions, as well as finding new ways to expand how users interact with the virtual environment.

6. Development Results in Virtual reality for Desktop Computer assembly

Assembling a computer is a process that involves several steps to connect hardware components physically [21]. The components generally needed include the motherboard, processor, RAM, graphics card, hard drive or SSD, power supply, casing, and cables. The results obtained from the development of VR for desktop computer assembly show that users can learn how to assemble a desktop computer

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without worrying about having to experience damage to the hardware, even a short circuit. In this VR, users can also see the value they get from their activities.

The steps that users can take when using the VR that has been developed are:

1. Prepare a clean and spacious work area. Ensure the table or work surface has enough space to assemble the computer. It is feared that users can be disturbed by the surrounding environment, which can cause injuries.
2. Use an Oculus developed with a desktop computer assembly application program, then activate the application.
3. Attach the processor to the motherboard. Open the processor socket on the motherboard and place the processor according to the guide on the motherboard. Then, lock the processor carefully.

Image 2. 3D view of motherboard installation

4. Attach the RAM to the motherboard. Look at the available RAM slots on the motherboard and gently insert the RAM module into the slot. Press the RAM until it locks into place.

Image 3. 3D view of RAM installation

5. Install the graphics card. If you use a separate graphics card, locate the appropriate PCIe slot on the motherboard and gently install the graphics card. Make sure the graphics card is securely locked in the slot.

Image 4. 3D view of graphics card installation

6. Install the hard drive or SSD. Place the hard drive or SSD into the tray provided in the computer case. Ensure the SATA cable is well connected to the motherboard and storage device.

Image 5. 3D view of SSD installation

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7. Install the hard drive or SSD. Place the hard drive or SSD into the tray provided in the computer case. Ensure the SATA cable is correctly connected to the motherboard and storage device.

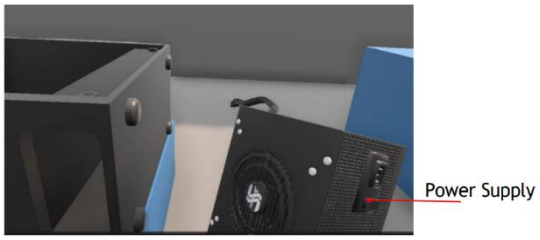

Image 6. 3D view of power supply installation

8. Connect the cables. Connect the cables from the power button, indicator LED, and USB to the motherboard according to the instructions provided with the motherboard. Double-check the connections. Ensure all cables and components are well connected and nothing is loose or pinched. Also, ensure no wires or other objects interfere with the fans or other components.
9. Close the computer case. Put the case cover back on tightly. Make sure all the screws are securely fastened so that the case does not come loose.

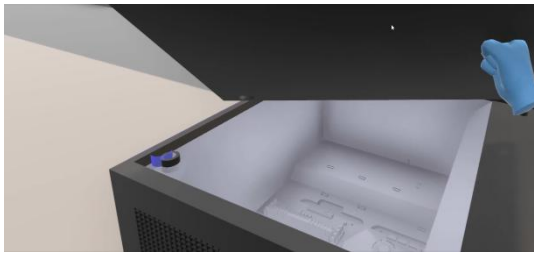

Image 7. 3D view of casing installation

10. Connect the monitor, keyboard, and mouse. Connect the monitor to the graphics card, the keyboard to the appropriate ports on the back of the computer, and the mouse to the appropriate ports on the front of the computer.
11. Turn on the computer. Connect the power cord to the power socket and press the power button. If all connections and components function properly, your computer should start booting and entering the operating system.

Image 8. 3D view of CPU connection to monitor and keyboard

12. At the end of the activity, a score (assessment) of the user's work will appear.

Image 9. App usage assessment results

CONCLUSION

Virtual reality (VR) assembly is a technological concept that provides users with extraordinary experiences, bridging the gap between the real and virtual

worlds. This is achieved through specially designed hardware to create virtual environments that resemble the actual reality or even create an entirely new reality. In essence, VR assemblies deliver experiences that transcend the limitations of time and space, transporting users into an entirely different world.

Assembling a computer is a process that involves several steps to connect hardware components physically. Commonly required components include the motherboard, processor, RAM, graphics card, hard drive or SSD, power supply, case, and cables. The results obtained from the development of VR for desktop computer assembly show that users can learn how to assemble a desktop computer without worrying about having to experience damage to the hardware, even a short circuit. In this VR, users can also see the value they get from their activities.

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