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VIRTUAL REALITY ANIMATION DESIGN OF DHARMAWANGSA UNIVERSITY BUILDING

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A B S T R A C T

This study aims to design and develop a virtual reality (VR)-based 3D animation of Dharmawangsa University's building to support campus introduction and promotion for prospective students. The application was developed to provide basic navigation and interaction features, including crosshair-based selection and menu access, allowing users to explore the campus environment virtually. System functionality was evaluated using black-box testing on four core components: application installation, application launch, main menu access, and crosshair interaction, with installation duration also recorded as a supporting metric. The results indicate that all tested functions operated successfully according to their intended design, confirming that the application is functionally stable at the basic operational level. However, this study is limited to functional verification and does not yet include quantitative performance measurements such as frame rate (FPS), loading time, or memory usage, nor does it include empirical user experience data such as questionnaires, System Usability Scale (SUS) scoring, or direct feedback from target participants (e.g., prospective students). Consequently, while the application is verified to run correctly, the notion of an "immersive and interactive experience" remains a design objective rather than an empirically validated outcome, as it is not yet supported by usability or performance data. Future research is recommended to incorporate performance benchmarking and structured user experience evaluation involving real participants to provide stronger empirical support for the application's effectiveness as an immersive and interactive virtual campus tour and promotional medium.

INTRODUCTION

As time progresses, the use of technology has also experienced significant growth. The rapid development of information technology has enabled the implementation of various more efficient methods in the production, distribution, and consumption of goods and services. In today's information age, geographical distance is no longer a determining factor in relationships between people or between business institutions, enabling the world to develop into a global village. Technology itself consists of both physical and non-physical forms. Examples of physical technology include smartphones, which are used for communication and various other activities, while non-physical technologies include Augmented Reality (AR) and Virtual Reality (VR) [1].

One technology that is experiencing rapid development and is beginning to be integrated into higher education is Virtual Reality (VR). This technology is capable of creating immersive and interactive three-dimensional environmental simulations, allowing users to experience real-life experiences within a virtual space [11]. In the educational context, VR technology is utilized not only as a learning medium but also as a promotional tool, new student orientation, and more engaging and informative visualization of the campus environment [6].

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Technological developments have also driven progress in the field of animation, from two-dimensional to three-dimensional (3D) animation. 3D animation can be created using various three-dimensional modeling software, which contributes to improving visual quality and simulation effects. In this study, researchers used Blender for the 3D animation modeling process and Adobe Premiere Pro to refine the animation results. Blender is a three-dimensional animation processing software that can run on various operating systems, including Windows, Macintosh, and Linux. Blender offers several advantages, such as interface flexibility, physics simulation, ease of use of UV mapping, and support for the development of digital animations and games [7].

Virtual Reality is a technology that allows users to interact with realistic, computer-simulated three-dimensional virtual environments. The primary goal of this technology is to provide a virtual experience that mimics real-life conditions, allowing users to experience the sensation of being present in the digital environment [11]. With the help of VR technology, real environments can be represented in interactive and informative virtual forms, providing a more immersive exploration experience.

Dharmawangsa University is a private university in North Sumatra, located at Jalan K.L. Yos Sudarso No. 224, Medan. Established in 1985, the university carries the motto "The Founding Father" of Dharmawangsa University. Currently, Dharmawangsa University has six faculties: the Faculty of Law, the Faculty of Social and Political Sciences, the Faculty of Fisheries, the Faculty of Islamic Studies, the Faculty of Economics, and the Faculty of Engineering and Computer Science.

The campus introduction media used by Dharmawangsa University Medan is still dominated by brochures, banners, and campus profile videos. This use of media is considered less innovative and unable to provide an interactive experience for prospective students. Therefore, a more modern and engaging campus introduction media is needed through the use of Virtual Reality technology. Using this technology, prospective students and the general public can virtually explore the campus environment through three-dimensional (3D) object visualizations. The application of VR is expected to provide a more engaging, interactive, and informative campus exploration experience for users [6], [11]. Based on this description, the author chose the title of his thesis "Designing a Virtual Reality Application for the Dharmawangsa University Building."

METHOD

This research uses a research and development (R&D) engineering or systems design approach focused on developing a Virtual Reality (VR)-based animation application. This approach was applied to design and build a VR application as an interactive visualization medium for the Dharmawangsa University Building environment. Data collection techniques were conducted through observation and documentation. Observations were conducted through direct observation of the Dharmawangsa University Building environment to obtain a realistic picture of the physical condition of the building and its surrounding area. Documentation was conducted by taking pictures or photographs, which served as references in the three-dimensional (3D) object modeling process.

This research utilized a combination of software and hardware tools. The software used included Blender and SketchUp for 3D object modeling, the Unity game engine for application development and build integration, and the Android SDK for compiling the application into an Android-executable package. The hardware used for the development process consisted of a laptop with an AMD Ryzen processor, an NVIDIA RTX 3050 GPU, and 8GB of RAM, which supported the 3D modeling, texturing, and rendering workflow. For functional testing, the application was installed and run on an Android smartphone; a Shinecon VR Box was used as the head-mounted viewing device to present the application in stereoscopic VR mode, enabling visual assessment of the rendered environment through the headset. However, the black-box testing conducted in this study was limited to functional verification on the Android smartphone screen—covering installation, application launch, main menu access, and crosshair interaction—and did not include a formal, separately documented testing procedure performed specifically through the VR headset.

The research design used a Unified Modeling Language (UML)-based system development model, using Use Case Diagrams and Activity Diagrams to illustrate the system workflow. The 3D animation development process involved several stages: modeling, texturing, lighting, and rendering, which were then integrated into an Android-based VR

application. The sampling technique in this study used purposive sampling, selecting specific objects deemed relevant to the research objectives, such as the campus environment and Android devices that support VR applications.

The variables measured in this study included application performance, Android device compatibility, and user experience in navigation and interaction within the virtual environment. Application performance was measured based on aspects of speed, system stability, and rendering quality. Data collection was conducted through field observations, visual documentation, and direct application testing on several Android devices. Data analysis was conducted using descriptive qualitative methods, supported by functional system testing. The application evaluation used the Black Box Testing method to assess the suitability of system functions based on the output produced without directly reviewing the program code.

RESULTS AND DISCUSSION

Multimedia system implementation is understood as a process to determine whether the multimedia system is capable of operating properly and whether users can use the application independently [12].

System Specifications

The minimum hardware and software specifications used are as follows:

1. Software Specifications

The software specifications used by the researcher to develop the animation are as follows:

1. Operating System: Windows 11 64-bit
2. Tools used: Blender 3.6 and Unity 3D 4.40

2. Hardware Specifications

The hardware specifications used by the researcher to develop the animation are as follows:

1. The laptop used has an AMD Ryzen 4000 Series processor
2. The required RAM capacity is 8 GB.
3. A mouse to facilitate object selection, resizing, coloring, and placement.
4. Devices used to watch "Virtual Reality" animations
5. Smartphone

System Development Steps

From the requirements analysis stage to the ready-to-use program, the author outlines all the steps involved in creating an animation in this section.

a. Opening Blender 3D

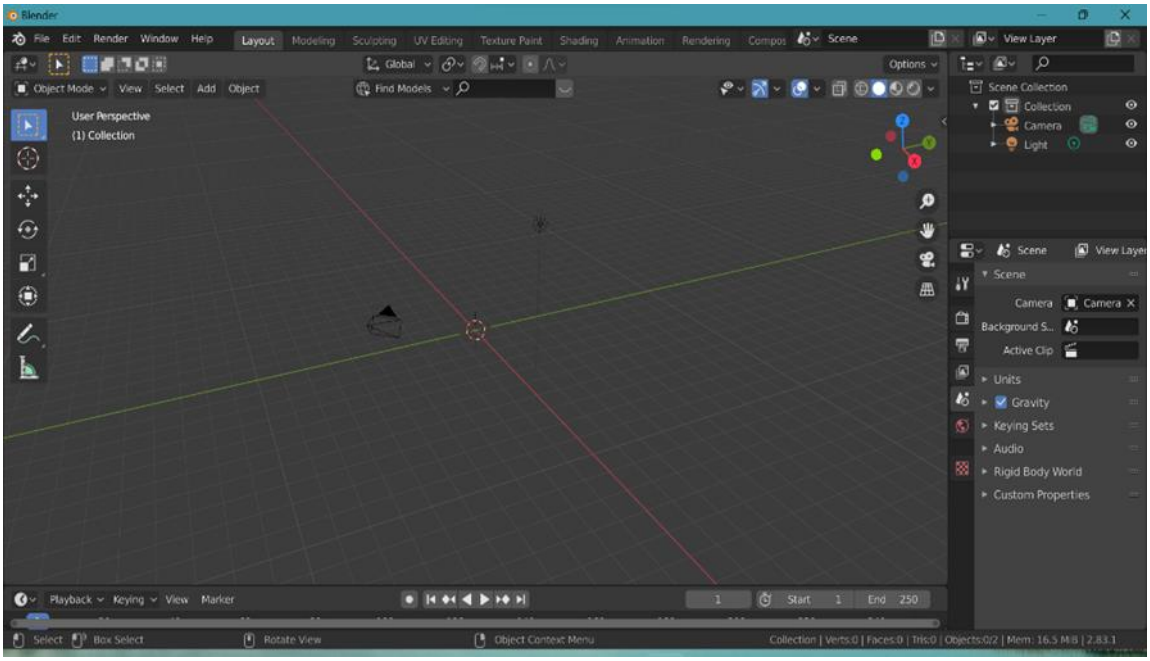

Figure 1. Blender Initial Screen

Open the Blender software installed on your computer. A screen like this will appear.

b. Sketching

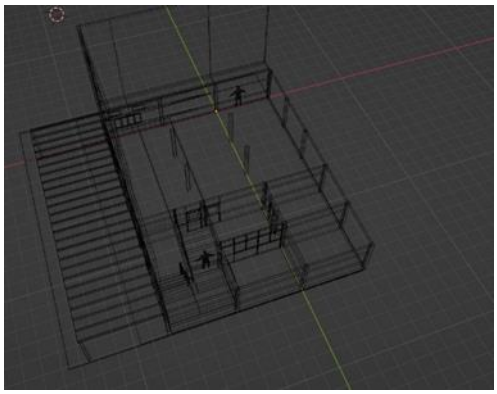

Figure 2. Make a sketch of the building

The first step in this process is to sketch the building's shape. Simply having an idea of the model's size and shape is enough to create the front and side views.

c. Adding mesh and texture to the sketch

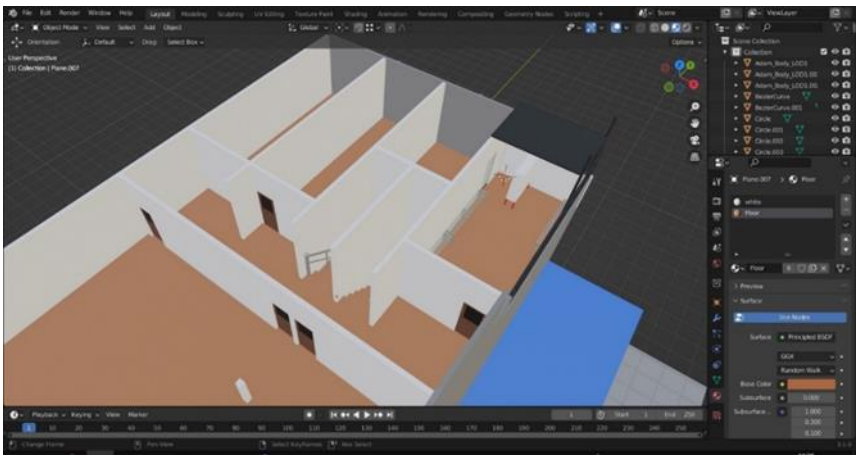

Figure 3. Added Texture and Mesh

In the Introduction to Texturing in 3D Asset Creation section, incorporating texture or color into an object's surface is a crucial step in creating 3D assets, where texture plays a role in achieving high levels of realism and detail. In the context of 3D asset development, texturing techniques play a crucial role in enhancing the visual quality and user experience in games. Blender is one of the most advanced software tools available for enhancing 3D graphics and includes a wide range of features to assist with texturing.

d. Adding a Roof

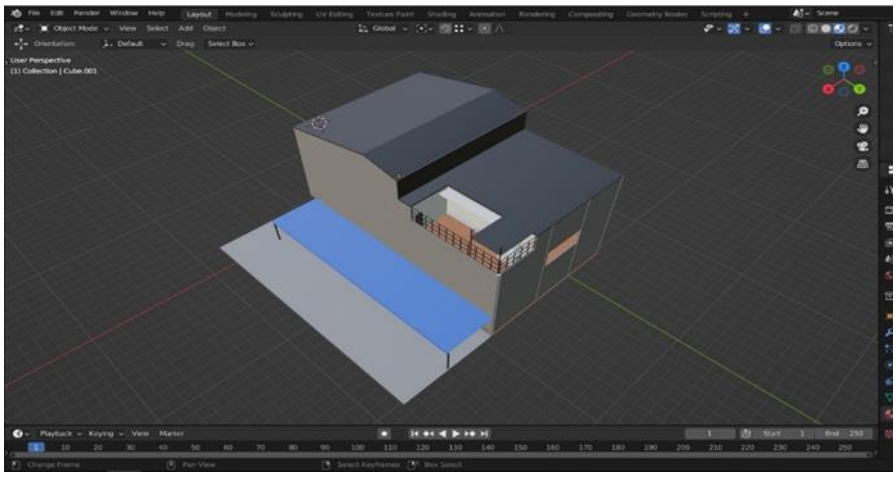

Figure 4. Adding a Roof

In this section, researchers created a roof to cover the building to achieve the best and most perfect 3D rendering. They also added several properties, such as doors, windows, and stairs.

e. Adding 3D text with the university name

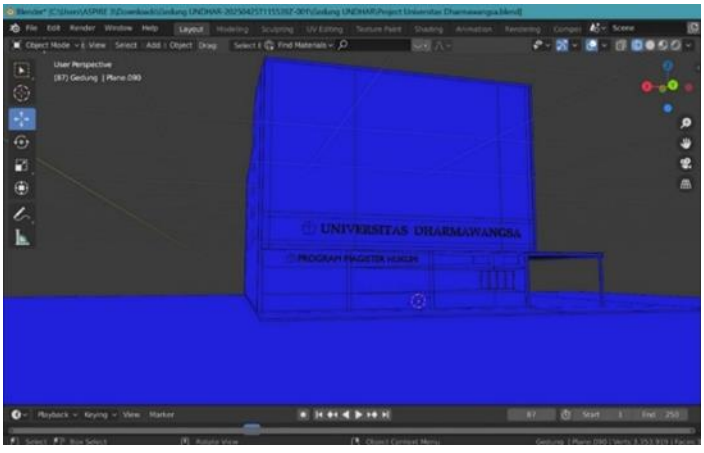

Figure 5. Added Building Text

In this section, the researcher created the university name and logo, which were useful for making the building more visually appealing.
a) Add a font by selecting Add > Text
b) Next, to change the text, press TAB on the keyboard
c) Select Font Settings
d) Add thickness/extrude
e) Then press R and X to rotate the font
f) Select Font Settings to change the font type
g) Then select the desired font type
h) After selecting the desired font type, press OK
i) Next, color the text.

f. Results

Figure 6. Results Before Rendering

The rendering process is the process of producing 2D pixel images from predefined textures, lighting, and materials for a scene and 3D assets. In this process, highly complex software simulates the behavior of light as it occurs in the real world, based on the principles of physics. Calculations about light transport play a crucial role in determining the visibility, reflection, refraction, and scattering of light rays as they interact with various surfaces. By combining all the built-in visual elements and their settings within the view, the rendering process uses objective physics-based simulations to produce photorealistic images that mimic real-life camera behavior.

g. Importing Blender Files into Unity 3D

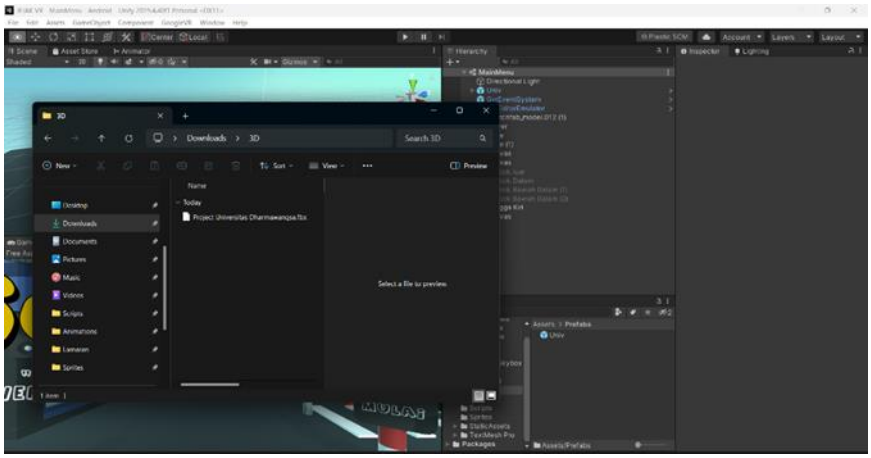

Figure 7. Import Blender

To import a model into the Assets folder, drag and drop the Blender file into the Assets panel at the bottom center. Alternatively, move and save the Blender file to the Unity project's Assets folder. Another option is to go to "Assets > Import New Asset" and select the file.

h. Import assets into Unity 3D

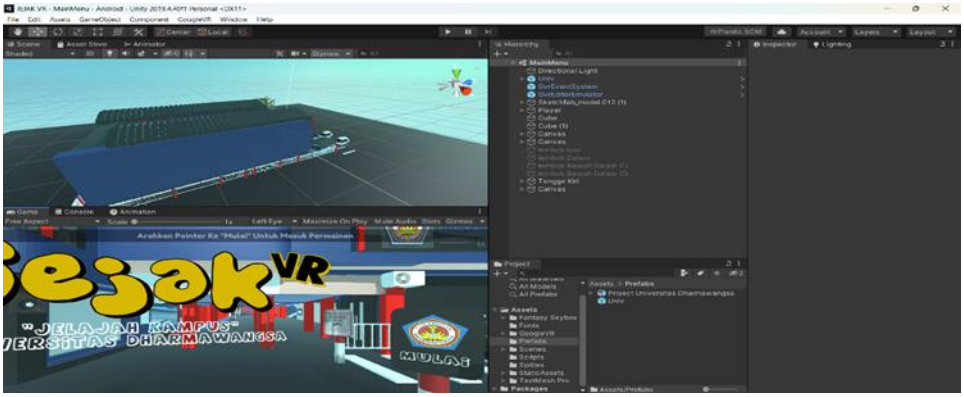

Figure 8. Import Assets

i. Drag & Drop Unity Package Files

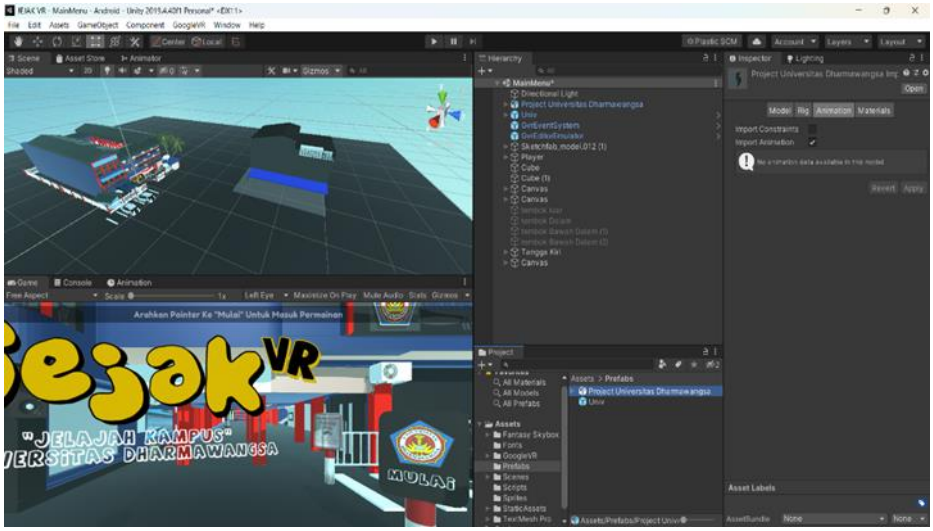

Figure 9. Drag & Drop 3D models

After a successful drag and drop, you'll see a file arrangement like the one shown below: the 3D model and a folder named Materials. Then, drag and drop the 3D model from the project window to the scene window. The result will be a shape without texture, so it's white.

j. Constraining Colliders

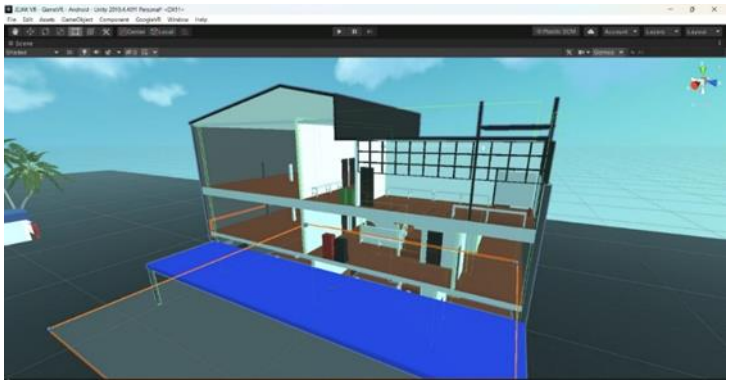

Figure 10. Constraining Collider

In this section, colliders can be used to create areas that certain objects, such as walls or barriers, cannot enter, so that when using them, they cannot leave that area.

k. Determining the Android SDK

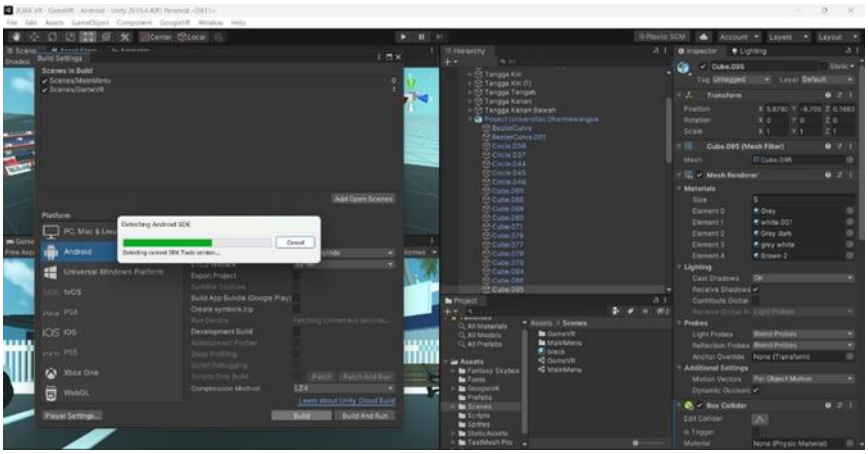

Figure 11. Determining the Android SDK

In this section, determine the target and minimum requirements for the Android device version used to run the application.

l. Build Assets into APKs

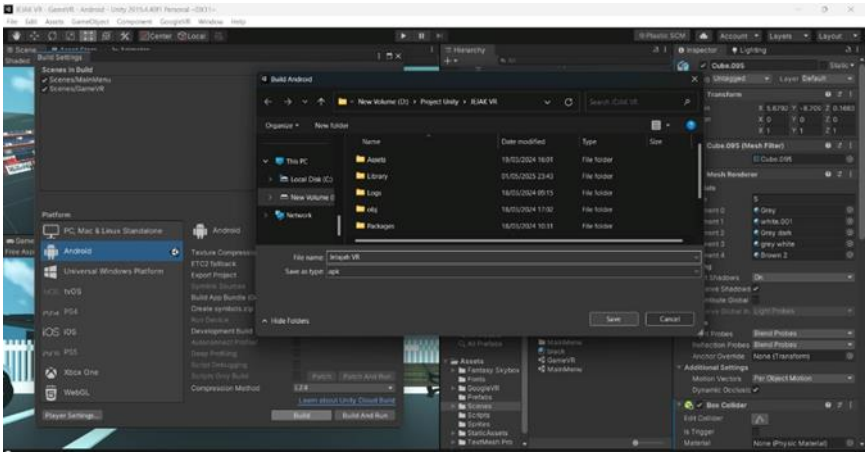

Figure 12. Build Assets Into APKs

The final step in this process involves compiling all assets, scripts, and project configurations into a single APK package ready for VR.

Testing

System testing in multimedia applications aims not only to find errors or defects, but also to ensure that all system functions operate according to specifications and user needs. This testing is crucial to ensure the final multimedia application meets the planned requirements, in terms of function, appearance, and performance.

The testing phase typically includes evaluating system performance, such as application response speed, file storage capacity, and user usability. Testing is conducted comprehensively, including using black box testing, where all features are tested based on expected input and output without reviewing the underlying code structure. The results of this testing provide important information regarding the application's reliability, its level of conformance to its original purpose, and its freedom from significant bugs or errors.

For example, recent research indicates that the testing process for multimedia applications ensures the application runs smoothly, all menus and features are accessible, and no errors are encountered during use. Therefore, multimedia system testing plays a crucial role in ensuring the quality and suitability of the application to user needs and development objectives.

Black Box Testing

The first step a user must take to use this system is to ensure that no login is required and that anyone can access it simply by downloading the application. Black box testing is conducted to determine whether the system's menus operate as designed.

Table 1. Black Box Testing

No	Name	Test Results	Description
1.	Install	Installs the application on a smartphone with an Android system.	Successful
2.	Open the application	Runs the application.	Successful
3.	Main menu	Displays the initial screen on the application.	Successful
4.	*Crosshair*	The dot in the center is used to start the application.	Successful

Testing Devices

Android-based devices were tested with different specifications to ensure the animation ran smoothly. The four devices used by researchers to test this animation are shown below:

Table 2. Testing Devices

No	Nama Perangkat	Spesifikasi
1.	Samsung A9 (2018)	1. Has a 6.3-inch, 60Hz Super AMOLED display. 2. Android 9.0 (Pie) system. 3. Qualcomm Snapdragon 660. 4. Octa-core (4x2.2 GHz Kryo 260 Gold & 4x1.8 GHz Kryo 260 Silver). 5. 128 GB storage, 6 GB RAM.
2.	Samsung A50	1. Has a 6.4-inch, 6.4-inch, 100.5 cm2 (~84.9% screen-to-body ratio) screen. 2. Android 9.0 (Pie) system. 3. Exynos 9610 chipset (10 nm) 4. Octa-core (4x2.3 GHz Cortex-A73 & 4x1.7 GHz Cortex-A53) 5. 64 GB memory, 4 GB RAM
3.	Xiaomi Redmi Note 13 5G	1. Has a 6.67 inches, 107.4 cm2 screen (~88.9% screen-to-body ratio) 2. Android 13 system 3. Mediatek Dimensity 6080 (6 nm) 4. Octa-core (2x2.4 GHz Cortex-A76 & 6x2.0 GHz Cortex-A55) 5. 256 GB memory, 8GB RAM.
4.	Vivo V40 5G	1. Has a 6.78 inches, 111.0 cm2 screen (~90.1% screen-to-body ratio) 2. Android 14 system 3. Qualcomm SM7550-AB Snapdragon 7 Gen 3 (4 nm) 4. Octa-core (1x2.63 GHz Cortex-A715 & 3x2.4 GHz Cortex-A715 & 4x1.8 GHz Cortex-A510) 5. 256 GB memory, 8GB RAM.

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The table below shows the application testing results using the Black Box method on four different devices:

1. Application Input Test Results

a. Installation Process

Table 3. Test Results

Device Name	Duration
Samsung A9 (2018)	16 Seconds
Samsung A50	25 Seconds
Xiaomi Redmi Note 13 5G	11 Seconds
Vivo V40 5G	12 Seconds

Test Results During Use

Table 4. Navigation Functions

Device Name	Conclusion
Samsung A9 (2018)	Installed very well, and the app ran smoothly.
Samsung A50	Installed well, but the app ran a bit difficult and caused the phone to overheat.
Xiaomi Redmi Note 13 5G	Installed very well, and the app ran smoothly on this smartphone.
Vivo V40 5G	Installed very well, and the app ran smoothly on this smartphone.

CONCLUSION

Based on the discussion presented, this study successfully developed a Virtual Reality-based 3D animation displaying the exterior visualization of the Dharmawangsa University Building, covering the main building, parking area, and surrounding open spaces. Black-Box Testing confirmed that all four core system functions — installation, application launch, main menu display, and crosshair-based interaction — operated successfully, indicating that the application is functionally reliable at the basic operational level (Table 1).

Testing across four Android devices with varying specifications showed that installation completed within 11–25 seconds, with the two higher-specification devices, the Xiaomi Redmi Note 13 5G and Vivo V40 5G, installing fastest at 11 and 12 seconds respectively, compared to 16 seconds on the Samsung A9 (2018) and 25 seconds on the Samsung A50 (Table 3). In terms of runtime performance, the application ran smoothly on three of the four tested devices — the Samsung A9 (2018), Xiaomi Redmi Note 13 5G, and Vivo V40 5G — while the Samsung A50, the device with the lowest RAM capacity (4GB) among those tested, experienced running difficulties and device overheating (Table 4). This indicates that application performance and stability are influenced by device hardware specifications, particularly RAM capacity, rather than being uniformly consistent across all mid-range Android devices.

Overall, these results demonstrate that the developed VR application is technically functional and generally compatible with mid-to-higher-spec Android devices, and provides users the flexibility to control the camera while exploring the 3D environment. However, as functional and installation testing does not directly measure user-perceived immersion or interactivity, this study's evidence for user experience should be interpreted at the level of successful navigation and interaction functions verified through Black-Box Testing, rather than as a validated measure of an "immersive experience." Further research incorporating performance metrics (e.g., frame rate and memory usage) and structured user

feedback (e.g., usability questionnaires or SUS scoring) involving prospective students as target users is recommended to more robustly substantiate the application's effectiveness as an interactive and immersive campus promotion medium.

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