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Design And Build Virtual Reality Technology To Create a 3D House Proprety simulation Based On Android

Dede Supriyadi[1*], Habib Nurfaizal[2]

[12]Information System, Universitas Pamulang, Pamulang, Indonesia, 15310
e-mail:[1] dosen00400@unpam.ac.id, [2]dosen02807@unpam.ac.id
*Corresponding author

Abstract

Virtual realty is a technology that can make users feel like they are in a virtual world (virtual). This technology can be used in various fields such as marketing for housing. Currently, the marketing process is still a lot that uses brochures and mock-up forms or miniature model houses with the aim of promoting where visitors or potential home buyers can find out examples of houses offered. In addition to the standard usage of brochures by marketers, making this mock-up takes a relatively long time and the results of the mock-up are not very detailed and not as similar to the original house. From the results of existing data and information, it is necessary to evaluate to change the way of promotion in accordance with current technological advances which aims to make it easier for marketing parties to convey the products sold to prospective buyers, so as to make potential buyers interested in buying the house offered. This study designs a simulation using visualization with designs and concepts that make potential buyers feel the sensation of being in a marketed house. For system design used is using UML, namely the use of use case diagrams, and flowchart diagrams. This Virtual Reality application is made using the C programming language and for implementation using Unity and several other supporting tools such as Google VR SDK, Android Studio and Blender for modular design. It is hoped that this solution will be useful to make it easier to carry out promotions so that it attracts the interest of potential home buyers.

Keywords: Virtual reality, Mock-up, Unity, Google VR SDK, Blender

Abstrak

Virtual reality merupakan sebuah teknologi yang dapat membuat penggunanya serasa berada di dunia maya (virtual). Teknologi ini dapat digunakan dalam berbagai bidang seperti pemasaran perumahan. Saat ini proses pemasarannya masih banyak yang menggunakan brosur dan bentuk maket atau model miniatur rumah dengan tujuan untuk melakukan promosi dimana pengunjung atau calon pembeli rumah dapat mengetahui contoh rumah yang ditawarkan. Selain penggunaan brosur yang umum dipakai oleh marketing, pembuatan maket ini membutuhkan waktu yang relatif lama dan hasil maketnya tidak terlalu detail dan tidak mirip dengan rumah aslinya. Dari hasil data dan informasi yang ada, maka perlu dilakukan evaluasi untuk mengubah cara promosi sesuai dengan kemajuan teknologi saat ini yang bertujuan untuk memudahkan pihak pemasaran dalam menyampaikan produk yang dijual kepada calon pembeli, sehingga dapat menjadikan calon pembeli tertarik membeli rumah yang ditawarkan. Penelitian ini merancang simulasi menggunakan visualisasi dengan desain dan konsep yang membuat calon pembeli merasakan sensasi berada di dalam rumah yang dipasarkan. Untuk perancangan sistem menggunakan UML, yaitu penggunaan diagram use case, dan flowchart diagram. Aplikasi Virtual Reality ini dibuat dengan menggunakan bahasa pemrograman C dan untuk implementasinya menggunakan Unity serta beberapa tools pendukung lainnya seperti Google VR SDK, Android Studio dan Blender untuk desain modular. Solusi ini diharapkan bermanfaat untuk memudahkan dalam melakukan promosi sehingga menarik minat calon pembeli rumah.

Kata Kunci: Virtual reality, Mock-up, Unity, Google VR SDK, Blender

1. Introduction

In this modern era, science and technology are developing rapidly, especially in the information, computers, and software fields. This requires everyone to be better prepared to face rivalry, one of which is marketing products. Numerous real estate development firms have thus far used brochures and miniatures to advertise their homes. Virtual reality (VR) is a technology to create immersive simulations that allow users to interact and feel like they are in an environment that exists in cyberspace (Hamurcu et al., 2020). So far, the most common use of VR technology has been in the consumer sector, namely in the form of applications and players that are easy to use (Jamil, 2018). In their research, Herman Thuan, Devi, and Jeremiah have conducted research on VR entitled "Virtual Reality Technology for Campus Information Media" (Saurik et al., 2019). In this research, VR technology was created to introduce the room in a campus building in Surabaya. Another form of implementation of VR technology is the manufacture of computer assembly simulations as a learning medium (Musril et al., 2020). These experiments have not made use of virtual reality with motion-activated animations that change based on the direction of view via triggers.

The technology of virtual reality (VR) has also helped boost business development across a range of industries. Among them is the building and architectural sector (Bashabsheh, 2019). The brochures and mock-ups as media for realty sales promotion are commonly used. In the process, making mock-ups is relatively long, lacks detail, does not resemble the original form, and is easily damaged.

Based on the explanation above, it is necessary to change the way of promotion by using virtual reality technology to attract customer interest; easy to operate, and the house design plan can be seen and felt immediately in the form of a simulation by potential buyers. In this research, the authors make an application with the title "Design and Build a 3D Home Property by using VR (Virtual Reality) Android Based Simulation" which was made with Blender as software for home property design, then the C# programming language to create trigger events on the Unity platform in making animations. The user will be able to feel as though they are inside the house being advertised thanks to this simulation's ability to move in response to the direction of their sight.

The application will be built into android (.apk) in this research. Android is an operating system developed for Linux-based mobile devices. This operating system was originally developed by Android Inc., which Google later took over in 2005. In 2007, to develop Android, the Open Handset Alliance (OHA) was formed, a consortium of several companies, including Texas Instruments, Broadcom Corporation, Google, HTC, Intel, LG, Marvel Technology Group, Motorola, Nvidia, Qualcomm, Samsung Electronics, Sprint Nextel, and T-Mobile which aim to develop open standards on mobile devices (Maiyana, 2018).

Among the tools supporting immersive VR approach there are the Cave Automatic Virtual Environments (CAVE), where the user is in a room where all the walls, as well as the floor, are projection screens (or flat displays). The user, who can wear 3D glasses, feels floating in the projected world where he can move around freely (Satria et al., 2023).

VR glasses or other sorts of Head Mounted Displays (HMD), often used with headphones, can easily produce the visceral feeling of actually being in the simulated world People will be able to see 3D images as a result, providing them with another visual experience (Kurniawati et al, 2020).

VR technology allows developers of a system to create a virtual environment in a possible way as a simulation. Realistic 360-degree views are possible using 3D processed images. (Martono & Putra, 2017). There are two words from VR, namely virtual and reality. Virtual, which means not real, and reality, which has the meaning of real. Virtual reality means real but not real. Virtual reality is a technology that allows users to feel they are in a virtual (virtual) world. Users can interact with a virtual environment simulated by a computer, thus making them feel as if they are physically and psychologically involved. This virtual reality technology will provide a visual experience for users on a screen. Still, some applications of this virtual reality include other sensory experiences, such as hearing through speakers or earphones.

The elements that lie in VR include:

1. Virtual World (Virtual World), content contained in a medium. This content can be a screenplay or a script.
2. Immersion is the user's sensation of being in an environment.
3. Interactivity, the virtual world can respond to user actions. Computers make this possible and can be done in real-time.
4. Sensory Feedback, information about the virtual

world, is displayed to the user's senses. It is audio, visual, and tactile.

Unity is an application that is used to create games. Unity is based on multi-Platform, an application that can publish many format files such as .exe, .apk, and others. Unity requires a license to be issued on certain platforms. However, Unity provides a free user version and can be published in standalone (.exe) and web forms. Unity can also create applications based on AR (Augmented Reality) and VR (Virtual Reality). Unity is a professional-quality game engine for creating targeted video games for multiple platforms (Hocking, 2015).

There are several features provided by Unity 3D, including :
1. Hierarchy tab, this tab serves to enter the object that will appear.
2. Inspector tab is used to edit object properties clicked on object components in the hierarchy tab. This tab is also used to edit and add object components, such as scripts.
3. The Project tab contains all the materials we will use for the project. This section is a place for components such as Folders, Animations, 6 Scripts, Images, Object3D, Assets, Materials, and many more.
4. Console tab is a place to display error messages in the project, but most often, error messages occur when creating scripts that are not recognized by the system or errors in making scripts.
5. Scene tab contains a room/place where you can put components such as Camera, Terrain, Object, and so on. You can place or work on the project as a whole on this tab with objects in the Assets tab.
6. Game tab, as a test game, can be run by clicking the Play button.

2. Method

Virtual reality is a computer-based technology that combines an input and output device so that users can interact with the virtual environment as if they were in the real world (Chandel & Chauhan, 2014). In Virtual Reality, a concept that is frequently mentioned is "immersion" (Howard et al., 2014). VR and the reality, it creating virtual objects that can interact with the actual environment (Alcañiz et al., 2019).

Figure 1. Google VR simulation

A. Application VR design.

Creating a VR (Virtual Reality) software application for house property can be seen in flowchart Figure 1.
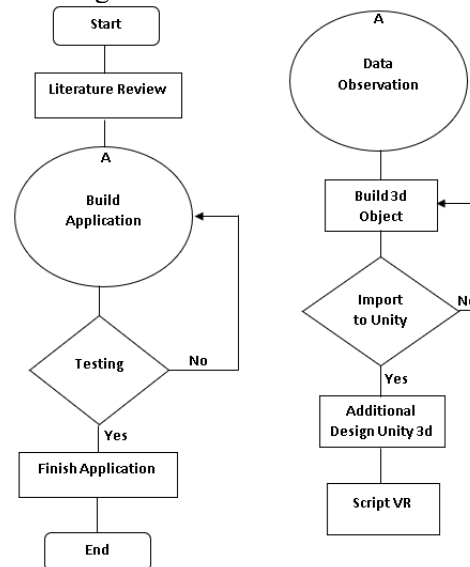

Figure 2. Flow Chart Creating an application

A document flowchart, which is mostly used as a communication tool and for documentation, is a chart that logically illustrates the flow in a program or system procedure. A system flowchart is a visual representation of the system's overall work flow that also explains the order in which the system's procedures are carried out (Muafi et al., 2020). Flowcharts can be used to present manual activities, processing activities or both. Flowchart is a series of symbols used to construct (Budiman et al., 2021). The concept of the current system that will be easy to create for marketing in selling the property usually uses printed media and mock-ups as a promotional medium for selling the property at the exhibition can be seen in Figure 3.
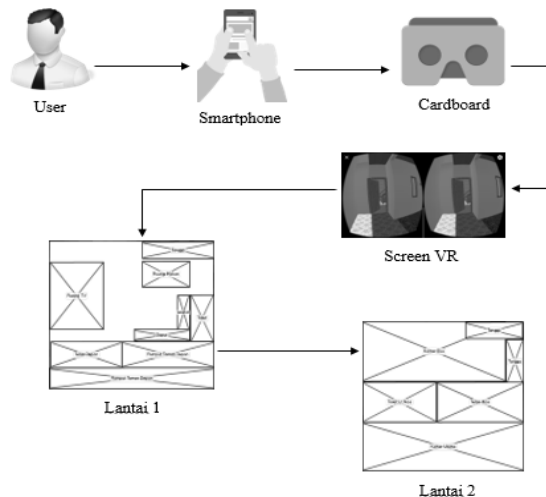
Figure 3. Schema simulation of VR property

From Figure 3, it can be seen that a smartphone is used to display a virtual reality simulation of a house's property. Cardboard is a medium/tool to provide a 3D sensation for users or consumers. With this concept, customers can see the detail of the house/property that will be marketed using virtual reality.
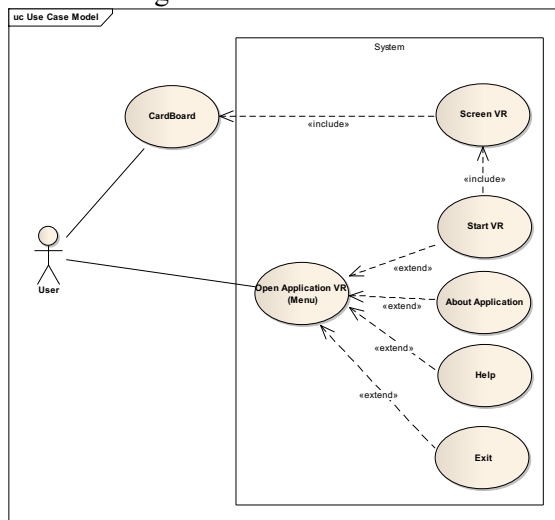
B. Use Case Diagram

Figure 4. Use case Diagram Home VR 3D

UML facilitates system development by providing a description of the design, construction, and documentation of each software system components (Abdillah & Rahman, 2020). A use case diagram is a type of diagram used in UML that shows the interaction between users and actors in the system that is going to be developed (Anardani et al., 2023). In the system analysis, to identify, clarify, and organize system requirements can used use case diagrams (Aleryani, 2016).

1. The user opens the Virtual Reality 3D property home application on the android phone.
2. Then, the user meets the main menu display.
3. Select the "VR Start" menu to run the home's 3D Virtual reality property.
4. Users use cardboard to see the details of the house in the form of 3D simulation and sound.
5. The user selects the "About Application" menu to find out information about the application.
6. The user selects the "Help" menu to obtain information on how to use the application.
7. The user selects the "Exit" menu to close the virtual reality application.
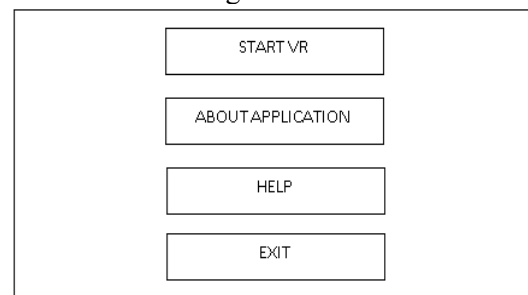
C. Main menu UI design

Figure 5. Main menu

Figure 5. The main menu interface has several buttons, including Start VR, About Application, Help, and Exit.
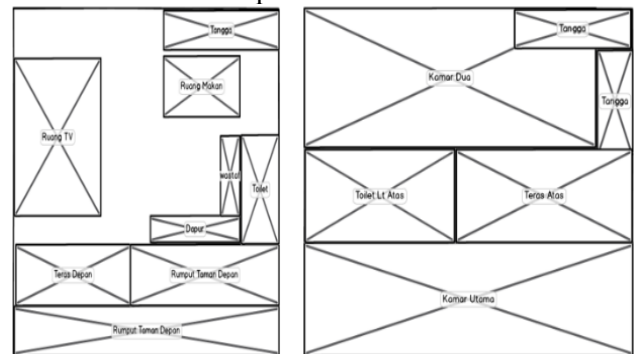
D. 1st and 2nd-floor plans

Figure 6. 1st-floor and 2nd-floor plans

Three-dimensional or 3D animation is described as an image with volume in the computer (Victor et al., 2016). Although not in real 3D form, but a 3D form on a 2D screen (TV, cinema, computer, projector, and similar media). 2D animation is flat, while 3D animation has volume. 3D animation can also be defined as animation that can be viewed from various points of view. In this research, the author uses Blender software to create 3D designs. Blender is an OSS (Open-Source

Software), or it can be called software that can be used on various OS (Operating Systems) and is free. Blender supports all 3D workflows, such as modeling, rigging, animation, simulation, rendering, compositing and motion tracking, video editing, and game creation (Zebua et al., 2020). In 3D projects, this application is suitable for individuals and studios (Suratinoyo et al., 2013).

Figure 6. is a plan for the 1st and 2nd floors. On the 1st floor, there is a front yard in the form of a terrace and grass. Then inside the house are several rooms such as the TV Room, Kitchen, Sink, Toilet, Dining Room and Stairs. The 2nd-floor plan has a terrace and several rooms, including the Master Room, Toilet, and second bedroom. Using Blender software, this two-dimensional image will be continued into a three-dimensional format.

3. Result and Discussion

Interface implementation is one of the services the operating system provides as a means of interaction between the user and the operating system. The interface is the component of the operating system that comes into direct contact with the user. There are two types of interfaces: Command Line Interface (CLI) and Graphical User Interface (GUI). The following is the implementation of each interface made in this study.

A. Object Implementation of Blender

The first step is to create a 3D house object property using the blender software. This software is used to create 3D (three-dimensional) house designs. The blender software that the author uses here is v.2.78 version.
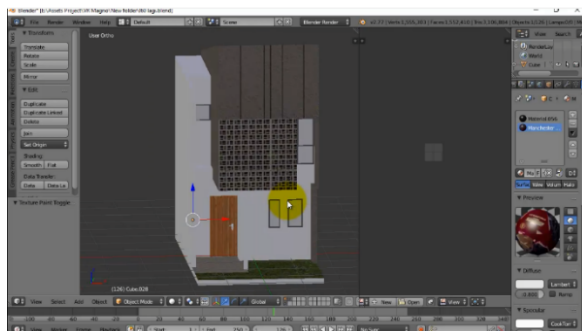

Figure 7. Object Property in Blender

Figure 7 above is a 3D house object property created using the blender software. This object property will be imported into the Unity software and create a 3D simulation.

B. Object implementation import to Unity

Unity is an application to create games. Unity is based on Multi-Platform, an application that can publish many file formats such as exe, apk, and others.
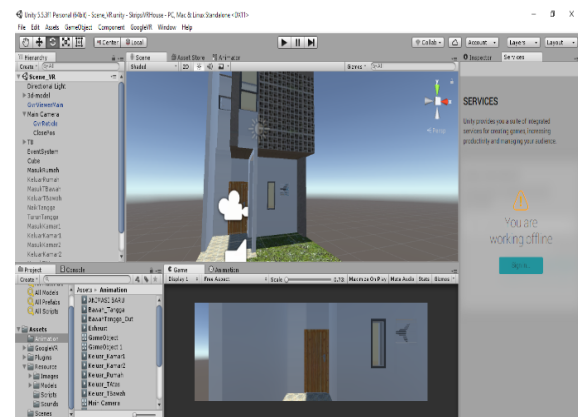

Figure 8. Object property in Unity

The display in Figure 8 above is a view of the project object property imported into Unity. From the previous project, in Blender, import by first selecting the object on the Blender as a whole, then click the file, select the export, then select FBX (.fbx), give the project name and save it in the specified directory.

After finishing exporting from the blender software, then open the unity software. In this software, importing can only be done by using drag and drop. Before that, we created a new project, then input the textures into the unity project directory in Blender. After that, in Unity, select Resource, Models, then select the directory texture that has been input. After that, drag and drop the exported FBX (.fbx) file.

C. Implementation of Home Page (Main Menu)

Virtual Reality Property Page 3D Home is the center of all pages. This view contains the main menus that can access and become a liaison between the user and the system. The following is the display of the main menu page in Figure 9.

Figure 9. Main Menu Page

Figure 9 is the interface of the main menu. The following is the implementation of the structure on the main menu in Table 1.

Table 1. Description Main Menu

No	Menus and Descriptions	
	Menu	Description
1	Start VR	This menu aims to display the 3D property simulation VR mode.
2	About Application	This menu provides information about virtual reality property applications.
3	Help	This menu provides information about the guide to application use.
4	Exit	This menu is used to close the application.

D. Black Box Testing

Black Box testing focuses on the functional requirements of the software. This information system test uses test data from a 3D House Simulation with Android-based Virtual Reality technology.

Table 2. Button Main Menu Testing

No	Table Column Head		
	Menu	expected results	Result
1	Start VR	Enter the virtual reality simulation	(√) Succeed ( ) Fail
2	About Application	Showing the About Application menu	(√) Succeed ( ) Fail
3	Help	Showing the contents of the guide menu	(√) Succeed ( ) Fail
4	Exit	Exit / Close the application	(√) Succeed ( ) Fail

Start VR, About Application, Help, and Exit are the four menu buttons, based on the testing in Table 2. When you click these menus in accordance with the intended command, they function properly.

Table 3. 3D Virtual Reality Animation Testing

No	Table Column Head		
	Trigger	expected results	Result
1	Front Door	The door opens, and entering the house	(√) Succeed ( ) Fail
2	Downstair Toilet	Animation moving towards the toilet downstairs	(√) Succeed ( ) Fail
3	Stairs	Animation moving towards the stairs going up to the 2nd floor	(√) Succeed ( ) Fail
4	2nd floor Master Room	Animation moving into the master bedroom on the 2nd floor	(√) Succeed ( ) Fail
5	2nd-floor Bedroom	Animation moving into the bedroom on the 2nd floor	(√) Succeed ( ) Fail
6	2nd-floor Toilet	Animation is moving into the toilet on the 2nd floor	(√) Succeed ( ) Fail

From the animation test results in Table 3. VR animation can move according to the trigger that has been determined in the program. The trigger is directed at the front door, downstairs toilet, stairs, master room, second room, and upper toilet. The animation movement runs according to the command without any errors or the direction of movement that is not following the trigger. The black box testing findings are displayed in figure 10 below.

(1) View Teras Rumah

(2) View Ruang Tamu

(3) View Dapur and Wastafel

(4) View Ruang Makan and Tangga

(5) View dalam Toilet bawah

(6) View Kamar Utama Lantai 2

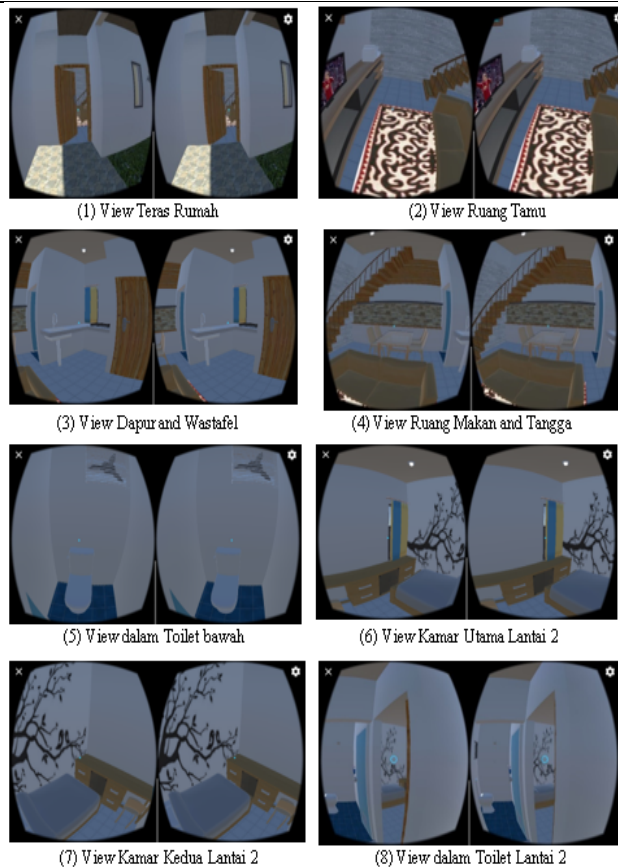(7) View Kamar Kedua Lantai 2

(8) View dalam Toilet Lantai 2

Figure 10. Main Menu Page

In Figure 10, we can see the implementation of 3D virtual reality objects from various corners of the house, including the terrace view, living room, kitchen, dining room, 1st-floor toilet, 2nd-floor master room, 2nd-floor bedroom and 2nd-floor toilet. Each room corner has a trigger to direct the user to move to the desired room. Figure 10 illustrates how the animation advances in the direction of the trigger based on the black box test findings, allowing you to see multiple views of the house from different angles.

4. Conclusion

Based on implementation and testing in previous chapters. It can be concluded from this 3D simulation using Virtual Reality Property technology, buyers will get detailed information on the sample house to be purchased in a 3D simulation of the house. To provide detailed visualizations that make buyers feel like they are in the house to be purchased by using an Android-based application with 3D Simulation Virtual Reality. This is demonstrated by the outcomes of the home view and the animation, which moves in response to the user-directed trigger. With the rapid development of technology and business competition, the use of Virtual Reality technology is worth trying to be applied as a digital promotional medium to attract buyers.

There are several suggestions for future research; this Android-based 3D home property VR (Virtual Reality) simulation is still far from perfect. Further development is needed regarding the animation system's work and the benefits of creating a good system. The following are some suggestions that researchers can submit based on our research experience. This system only provides detailed information on houses in 3 dimensions with movements like the buyer is in the house. In the future, it is hoped that animation can use four dimensions so that information and visualization can look more real. Then the design of this VR system is only based on Android, and the author hopes that in the future, it will be developed in other mobile applications, such as iOS, so that it can be used by more users and is user-friendly.

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