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DESIGN AND DEVELOP AUGMENTED REALITY APPLICATION AS AN ANDROID-BASED INTERIOR DESIGN OFFER MEDIA

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Abstract

The use of augmented reality technology is increasing rapidly such as mobile android. This technology can be used as an interactive media offering, especially Interior Design offers. This study aims to determine the distance and angle and find out the differences in the application system in each application. Then this application will track and detect markers (markers) using the tracking system, after the marker is detected, a 3D object model appears above the marker as if the model were real. For this 3D model, the model must be made first using software. Applications are made using the markerless user defined target method and conducting tests on the utilization of this method using flat parameters, object shapes, distance, light and camera angles when tracking. The results of the test,

Keywords: Augmented Reality, Android, Markerless, Unity 3, Sketchup.

INTRODUCTION

Augmented Reality is an attempt to combine the real world with the virtual world. This technology is developing very rapidly making it possible to be applied in many fields, such as the world of entertainment, education, business, and so on. The development of AR technology is able to provide a visual display in the form of interesting 2D and 3D objects. This technology is very good to apply to making interior designs because it can present a realtime and better view and offers designers convenience and practicality in the design process [1]. By utilizing AR technology in the housing sector, of course, it will also attract buyers. They don't need to come to a housing fair or to the marketing office to see the house product they are going to buy, they just have to sit in front of their home computer and then interact with the 3D model of the house via the internet. Not only can buyers see the inside of the house in detail, but the environment around the house will also feel more alive with supporting animations such as passing cars, flying birds and so on. Thus this will be an attraction for potential buyers to see it.

Augmented Reality is a technology used to combine the real world with the virtual world. Augmented Reality refers to "visual augmentation", which is the addition of digital objects in visualization that can display visual objects in real form. Augmented Reality is used for interior design by providing virtual furniture, in addition to the real environment based on a PC system. Markers are placed on the floor or on walls to determine the scale and coordinate system of the room. Next, the user chooses which virtual furniture to place. On the Augmented Reality screen, 3D virtual furniture is integrated with the real environment and can be positioned next to real furniture. Because of that we need an implementation of Design to provide convenience to designers who use Augmented Reality. One solution that can meet the needs of the design implementation is the Augmented Reality Application as an Interior Design Offering Media. which is implemented on Android-based mobile devices, is an application that displays design results automatically.

Designing an Android-based Augmented Reality Media application for Interior Design, working on an application to view Interior 3D objects in the form of Augmented Reality, this application will display Interior Design 3D objects in real time. With this system, several 3D objects will appear on the Android cellphone screen.

METHODS

This research was conducted using the markerless user defined target method which focuses on objects in everyday life that can be used as markers, here researchers use colored paper with different contrasts. Tests were carried out in two places, namely indoors and outdoors, testing indoors using light and outdoors using sunlight. The intensity of light at each test site was measured using a Lux meter. These functions and tools can be seen in table I.

TABLE I
FUNCTIONS AND TESTING TOOLS

Tool's name	Function
Lux Meter	To measure the amount of light intensity at the test site

A. System planning

The following is a Block Diagram of the system design process used in the process of making the Augmented Reality application for Interior Design Offers, which can be seen in Figure 1 below.

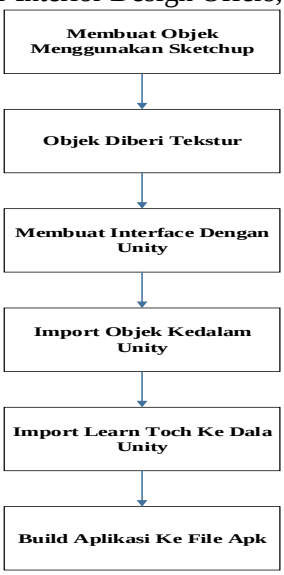

Figure 1 System Design

In the block diagram of the system design process for Augmented Reality Application Design Applications with Android-Based Interior Design Offering Media, the first step is to create 3D objects such as houses, stages, and tents using the Sketchup application. After the process of modeling the 3D objects is complete, the next process is giving a texture which functions as giving color to the object that has been modeled before so that a real impression will appear. Then do the interface creation.

B. Application Flow

The use of the Augmented Reality Media application for Interior Design Offers is seen in Figure 2 below.

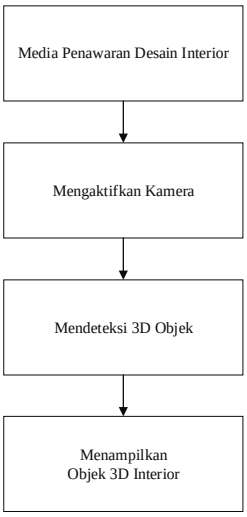

Figure 2 Application Flow

In the application flow, the first step is to run the Augmented Reality application. After the application is run, a camera will appear that will be used to detect targets. The next process is to direct the target to the currently active camera. Then the target will be captured by the camera from the smartphone and then the camera will display a 3D object if the target quality used is Medium or High Target. If the target used does not match, the system will re-detect the target.

C. System Functional

The functionality used to describe the functionality of the system to be created can be seen in Figure 3 below.

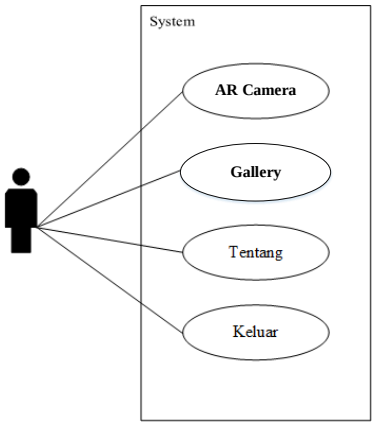

Figure 3 Use Case System Functional Diagram

a. Use Case Ar Camera explains the activities that users can do on the Ar Camera menu. When the user selects the Ar Camera menu, the user will enter the 3D Object type selection area.
b. Use Case Menu Galleries shows design drawings in the gallery. When the user selects the gallery menu, the user sees a collection of 3d Interior Design images.
c. Use Case Menu About explains about the activities that can be done by the user on the about menu. When the user selects about, the user will enter the about view which contains about the application
d. Use Case Exit menu describes the activities that can be done by the user on the exit menu. When the user chooses to exit, the user will exit the application.

D. Activity Diagrams

Activity diagrams describe the various flows in the designed system, how each functionality works, and how a functionality ends. Activity diagrams model the events that occur in use cases. The activity diagram of the application to be built is shown in Figure 4 below.

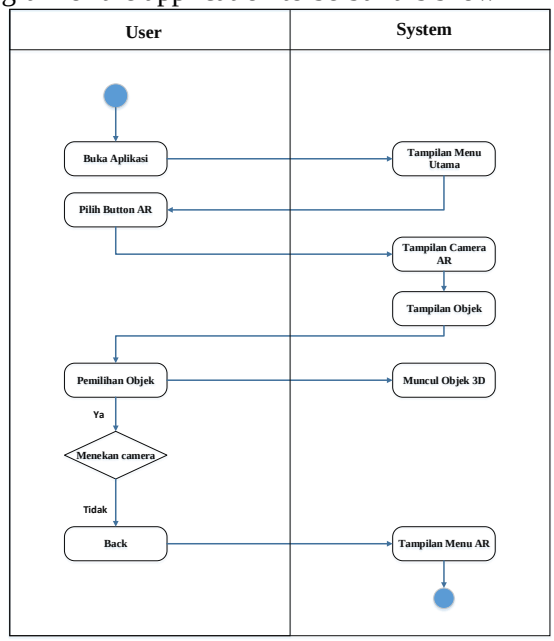

Figure 4 System Activity Diagram

From Figure 4 it can be seen that the activity flow which shows the process of running the media application system offers interior design in detail starting from the user opening the application to the touch of the hand on the specified 3D object display.

RESULTS AND DISCUSSION

A. Application Implementation

In the implementation, it will be discussed about the procedures and functions contained in the Augmented Reality application as an Android-based interior design offering media. Testing this application aims to determine the level of success and deficiencies of the system when displaying 3D media objects offering interior design media in the real world.

1) Main page view

Display of the Main Menu page which contains the main buttons to make it easier for users to go to other pages as shown in Figure 5 below.

Figure 5 Display Main Page

2) AR Menu page view

AR Menu page display where on this page the user can see 3D objects. The AR Menu page works when the camera is pointed at the target and then displays a 3D object. as shown in figure 6 below.

Figure 6 AR Menu page view

3) Object page view

Scane Target page display where 3D objects appear after the camera is pointed at the target. As shown in Figure 7 below

Figure 7 Display of Target Scane Page

4) Display of 3D Object Results for Augmented Reality Applications

1. 3D Object View

   3D objects are modeled using the SketchUp application. This page will appear after the button / button on the page is pressed. On the 3D object page view, there are 4 buttons, namely AR Camera, Gallery, About, and Exit. The display of 3D Interior objects can be seen as follows.
2. Display of Lean Touch Usage

   Lean Touch is one of the input libraries in Unity which functions to read the touch of the user's finger on the device screen. In this study the authors used 3 functions of lean touch, namely lean menu, lean information, lean zoom out / lean zoom in, lean interior and lean rotation using the touch of the user's finger. The display can be seen in the following image.
3. Type 1 House 3D Object View

   The appearance of the house with type 1 is brown in color, where the user chooses brown, the walls of the house will be cream in color. The appearance of a house with type 1 can be seen in Figure 8 below.

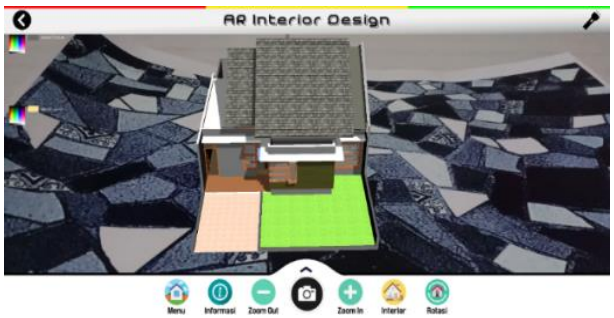

Figure 8 Preliminary Appearance of Type 1 House Exterior Objects

In figure 8 is a detailed view of the room type 1, where the user chooses to open the roof of the house, and we can find out the contents of the house, and along with the price.

4. Type 2 House 3D Object View

The appearance of the house with type 2 is yellow, where the user chooses yellow, the walls of the house will be yellow.

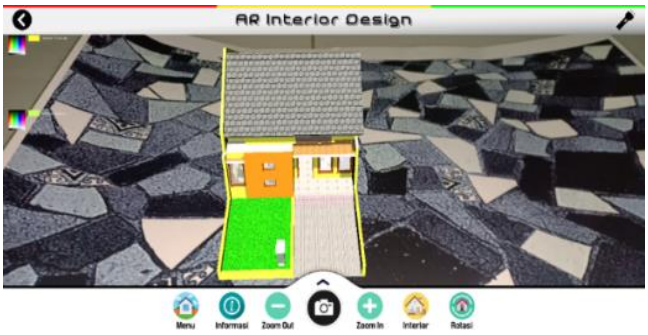

Figure 9 External View of Type 2 House Objects

In figure 9 is a detailed view of the room type 1 house, where the user chooses to open the roof of the house, then the house will clearly see the rooms in the house.

5. Type 3 House 3D Object View

The appearance of the house with type 3 is yellow, where the user chooses yellow, the walls of the house will be purple.

Figure 10 External View of Type 3 House Objects

In figure 10 is a detailed view of the room type 3 house, where the user chooses to open the roof of the house, then the house will clearly see the rooms in the house.

6. 3D Object Display of Maonen Stage Tent

The tent display in detail, in which the user chooses a tent design for a festival event, is yellow, in which the user chooses yellow, as shown in Figure 11 below.

Figure 11 View of the Maonen Stage Tent Object

7. Gudang Garam 3D Stage Event Object Display

The Stage view in detail, where the user selects the tent design for the event, is red. like figure 12 below.

Figure 12 Display of Gudang Garam Stage Event Objects

B. **System testing**

1. Testing the Markerless User Defined Target Method

This test uses black and white contrast on a flat surface which is used as a marker/target. Tests were carried out in two places, namely indoors and on the terrace of the house. Indoor testing using a light source and testing on the terrace of the house using a sunlight source. The parameters used in this test are divided into two, namely the main parameters and supporting parameters. The main parameter is the color contrast of the flat surface. Supporting parameters are tilt angle, light intensity and camera distance. The tools used in this testing process can be seen in the table

TABLE II
DISTANCE TESTING OF CAMERA USING SUNLIGHT

Distance	**Contrast Value**		
	100 %	**50 %**	**-70 %**
10cm	Not detected	Not detected	Not detected
20cm	detected	detected	Not detected
30cm	detected	detected	detected
40cm	detected	detected	detected
50cm	detected	detected	detected
60cm	detected	detected	detected
80cm	detected	detected	detected
90cm	detected	detected	detected
100cm	detected	detected	detected
120cm	detected	detected	detected
140cm	detected	detected	detected

This test was carried out on a flat surface of paper which has different contrast values using sunlight with a light intensity of 70 lux, and a distance of 10 cm to 140 cm. Based on table 4.2 and figure 4.19 above, all surfaces used can display 3D objects. Black and white contrast with values of 100%, 50% and -70% at a distance of 10 cm cannot display 3-dimensional objects because the camera is too close to the paper and cannot detect the paper.

TABLE III
ANGLE TESTING 0 O SD 60 O USING SUNLIGHT

Corner	Contrast Value		
	100 %	**50 %**	**-70 %**
0o	detected	detected	detected
5o	detected	detected	detected
10 o'clock	detected	detected	detected
15o	detected	detected	detected
20 o'clock	detected	detected	detected
25o	detected	detected	detected
30 o'clock	detected	detected	detected
35o	detected	detected	detected
40o	detected	detected	detected
45o	detected	detected	detected
50o	detected	detected	Not detected
55o	detected	Not detected	Not detected
60o	Not detected	Not detected	Not detected

This test is carried out on a flat surface of paper that has different contrast values using sunlight with a light intensity of 70 lux, and a distance of 50 cm. This can be done by shifting the AR Camera to the right or left from the Z axis to detect objects that have been displayed only up to a maximum of 45° from the AR Camera's initial position. If the AR Camera is shifted above 75°, the object will not be detected again, so the object will disappear. Based on the results of testing the distance and angle of inclination of the marker towards the camera that has been carried out, the maximum and minimum values of the distance and maximum and minimum inclination angles that are still detected by the camera can be obtained from the results of previous tests.

TABLE IV
DISTANCE TESTING USING THE CAMERA LAMP LIGHT

Distance	Contrast Value		
	100 %	**50 %**	**-70 %**
10cm	detected	Not detected	Not detected
20cm	detected	Not detected	Not detected
40cm	detected	detected	Not detected
60cm	detected	detected	detected
80cm	detected	detected	detected
100cm	Not detected	Not detected	Not detected

120cm	Not detected	Not detected	Not detected
140cm	Not detected	Not detected	Not detected

TABLEV
ANGLE TESTING 0 O SD 60 O USING SUNLIGHT

Corner	Contrast Value		
	100 %	**50 %**	**-70 %**
0o	detected	detected	detected
5o	detected	detected	detected
10 o'clock	detected	detected	detected
15o	detected	detected	detected
20 o'clock	detected	detected	detected
25o	detected	detected	detected
30 o'clock	detected	detected	detected
35o	detected	detected	detected
40o	detected	detected	detected
45o	detected	detected	detected
50o	detected	detected	Not detected
55o	detected	Not detected	Not detected
60o	Not detected	Not detected	Not detected

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This test was carried out on a flat surface of paper which has different contrast values using a lamp with a light intensity of 87 lux, and a distance of 10 cm to 140 cm. Based on table 4.4 and figure 4.21 above, the entire surface used can display 3D objects. Black and white contrast with a value of 100% at a distance of 100 cm, 120 cm and 140 cm cannot display 3D objects and black and white contrast with a value of 50% at a distance of 10 cm - 20 cm, and the distance is too far 100 cm, 120 cm and 140 cm, because the distance is too far with the camera unable to detect the paper. Black and white contrast with a value of -70% at a distance of 10 cm, 20 cm, 40 cm, cannot be detected because using light, and distances of 100 cm, 120 cm and 140 cm, cannot display 3D objects because the camera cannot detect the paper.

CLOSING

Conclusion

The conclusions that can be drawn based on the research conducted are as follows:

1. The distance can be detected through the area of the marker captured by the camera. With a certain distance until a certain marker area is detected, it will bring up a virtual building exterior or interior, making a single marker function as if it were a multi marker. Even though the marker is tilted, there is no significant change to the distance or area detected by the system. Based on the marker detection test for the closest distance is 40 cm, and the farthest distance reaches 120 cm, as well as adjusting the height of the marker with the user.
2. Based on the target detection test the minimum tilt angle of the detected target is 00, the maximum tilt angle of the detected target is 600. And the best results camera tilt angle is 450.

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