3D Furniture Application Design Applying Augmented Reality (AR) Technology Based on Android

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Abstract. This study aims to create a media that can be connected to an Android device, so a media is designed easily for customers to see directly the shape of the furniture, the stages of system development using the Multimedia Development Life Cycle (MDLC) method, with 6 stages, namely concept, design material collecting, manufacture (assembly), testing, and distribution. Meanwhile, the modeling used is the Unified Modeling Language (UML), which consists of Use Case Diagrams, Activity Diagrams, Class Diagrams and Sequence Diagrams. The information system is designed based on Android which is made with Augmented Reality (AR) technology which is built using the Sketchup, Unity 3D, and Vuvoria SDK applications. In this study the authors have succeeded in designing and implementing in the form of a trial system a Guest Manager (Visitor Management System) that can Building and designing an Augmented Reality (AR) application requires detailed data collection at the time of observation so that the results of the running application look real and closely resemble the actual situation. Applications that are made and designed are very helpful and give a sophisticated and updated impression by following technological developments in modern times like today.

Keywords: Furniture · Multimedia Development Life Cycle (MDLC) · Android · Unified Modeling Language (UML) · Sketchup · Unity 3D · Vuvoria SDK

1 Introduction

Mobile communication technology has now developed very rapidly Along with these developments, there has been a change in people's point of view so that people are now utilizing mobile communication technology not only as a communication tool, but also as a tool to search for various information and news. Today's society considers mobile communication media as a necessity that is very practical in its use and has high mobility [1].

Furniture is necessary, useful, or preferred, such as goods or objects that can be moved around, used to furnish homes, offices, and so on. If we want to arrange furniture,

we have to move an item to where we want it, if the place doesn't feel right we have to move it again to another place until we find the place we want, this method will take a lot of time and effort if we do it continuously, especially if we going to buy a piece of furniture and it turns out that the furniture that was purchased doesn't match our house [2].

Jaya Furniture is a place where household furniture is made such as chairs, tables, etc. Usually there are types and sizes of this furniture. Currently, there are many types of promotion systems for selling furniture/furniture, both from catalogs and using other promotional media.

The process of making image movement in a 3 dimensional circle. The working principle is the same as 2-dimensional animation, only the objects that are built are 3-dimensional shapes, such as shapes, cones, cubes and others. 3D animation as a whole is done using the help of a computer. Through the movement menu in the computer program, the whole object can be shown in 3 dimensions [3, 4].

3D furniture is meant how we see the shape of a piece of furniture that looks real from any point of view, using an intermediary media, namely Android and designed to make it look more attractive and interactive when consumers want to order goods, here 3D itself is very suitable for us to implement using augmented reality.

Augmented Reality is a technology that combines virtual objects with real objects into a real environment in real-time. Augmented Reality (AR) is a combination of real and virtual objects in a real environment, running interactively in real time and there is integration between objects in three dimensions, namely virtual objects integrated in the real world [5, 6].

To create a media that can be connected to an Android device, a media is made to make it easier for customers to see directly the shape of the furniture, from that the authors try to use the stages of system development using the Multimedia Development Life Cycle (MDLC) method.

The design method used is the Multimedia Development Life Cycle (MDLC) method, which is a method for developing a multimedia system based on six stages, consisting of concept, design, material collecting, assembly, testing, and distribution [7–9].

As for the design modeling, it uses the Unified Modeling Language (UML) which is one of the standard languages that is widely used in the industrial world to define requirements, make analysis and design, and describe architecture in object-oriented programming [10–12].

Based on the problems found above, Jaya Furniture needs an application that supports and provides an overview and information about the types of furniture contained in the Jaya Furniture catalog. Therefore, the authors feel the need to create an android-based application in the form of augmented reality entitled "Design and Build 3D Furniture Applications applying Android-Based Augmented Reality (AR) technology.

2 Research Methods

The application design method that will be used by the authors in this study is to use the Multimedia Development Life Cycle model. The following is the process of making
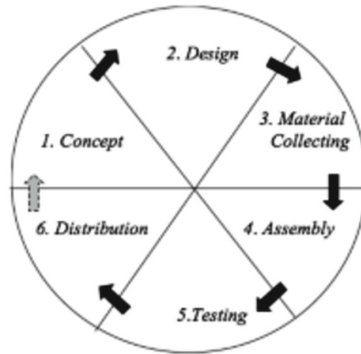
Fig. 1. Stages of the MDLC Method

an application using six stages, namely: concept, design, material collection, assembly, testing, and distribution [13–15] (Fig. 1).

The following stages in MDLC are as follows:

1. Concept
   This stage the authors carry out a draft to determine goals, identify users and describe the application concepts needed at Jaya Furniture.
2. Design
   This stage is the manufacture of specifications regarding program architecture, style, appearance, and material requirements for making applications.
3. Material Collecting
   This stage is the stage of collecting the materials needed in the application process. These materials can be in the form of clip art images, photos, animations, videos, audio, and others which can be obtained free of charge or by ordering from other parties according to the design.
4. Assembly (Making)
   The manufacturing stage is the stage of working on an application that includes all multimedia objects or materials. The making of this application is based on design stages, such as storyboards, flowcharts, and/or navigation structures.
5. Testing
   Run the app to complete this stage when the build stage has been successfully completed. See if there is an error in the application or not. The first of these stages is sometimes referred to as the alpha test stage, and is when the designer or design environment itself performs the testing. Beta testing involving end users will be conducted after successful alpha testing.
6. Distribution
   At this stage the application will be stored in a storage medium. If the storage media is insufficient to accommodate the application, this stage can also be called the evaluation stage for the development of finished products to make them better.
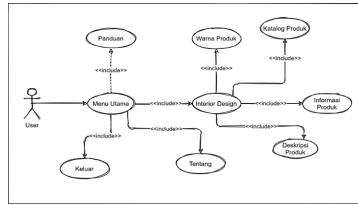
Fig. 2. Use Case Application Diagram

3 Result and Discussion

Designing and developing this application, the authors use the Multimedia Development Life Cycle (MDLC) method. This method is considered appropriate for the process of making this application because it is able to describe the description of the manufacturing process in a detailed and structured manner. MDLC has the following stages.

3.1 Concept

This stage, the objectives and users of the program are determined (audience identification), in this case, namely Jaya furniture and the consumers themselves. Conceptualizing and providing good multimedia nuances as a reflection of value and quality that influences the company's identity, it also provides effective and appropriate services and information to application users.

3.2 Design

This stage, specifications are made regarding program architecture, style, appearance, and material requirements for the program. The design will be made using application design, interface design from the application menu display.

1. Application Design
   This stage it is explained how an application can run and how application users run applications that will be made later. Described as follows:
a. Use Case Diagram
   Use Case Diagram provide information from actors or users that will later be used in the application, in this case the Use Case that the author will describe is how users can interact with the application (Fig. 2).

   The application user table will explain user activities when using the application (Table 1).

b. Activity Diagram
   Activity diagram describe the flow of activities in the application that is made, how each flow works and the decisions that will or may occur (Fig. 3).

Table 1. Application User

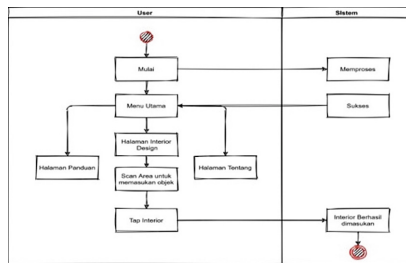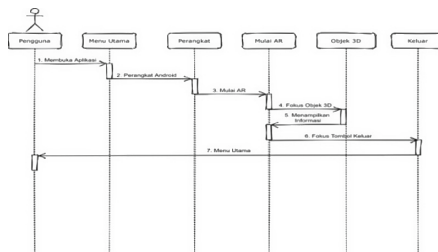| Application Users	User Activity
Customers/Consumers	Parties who use the application and run it as needed to be able to receive information and feel directly the effectiveness and uniqueness offered by the application made.

Fig. 3. Activity Application Diagram

Fig. 4. Sequence Application Diagram

c. Sequence Diagram

Sequence diagram are interactions between objects in and around users, views and so on in the form of information that is explained against time. Sequence diagrams consist of a vertical dimension (time) and a horizontal dimension (related objects) (Fig. 4).

1. Interface Design

Interface design is an initial design before making an application that is oriented to user needs so that it can be easily used or often called user friendly, which has been designed as follows:

a. First of all the author designed the interface design for the initial display before entering the application's main menu.
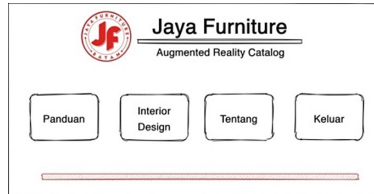
Fig. 5. Initial Display Interface Design

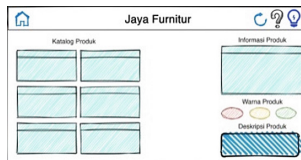**Fig. 6.** Main Menu Page Display Interface Design

Fig. 7. Interior Design Page Display Interface Design

b. This stage, the interface design is designed to display the main menu page, which is an application usage page that is tailored to your needs.

c. This page which is very important in using the application here we can interact directly which contains the types of product catalogs that we can apply and we want to show the appearance of AR Furniture (Figs. 5, 6 and 7).

3.3 Material Collection

This stage, materials are collected according to the needs that are being worked on. Materials that facilitate the process of making applications so that they run according to plan.

1. 3D Materials
   The material requirements used during the modeling process in the application were made using a 3D application, namely Sketchup and taken from several types of the Jaya Furniture catalogue edition 1 of 2019 in the table below.
2. Unity 3D Materials
   In Material Unity 3D the author has prepared materials that will become additional logos and designs that function to make it easier for users to run applications.

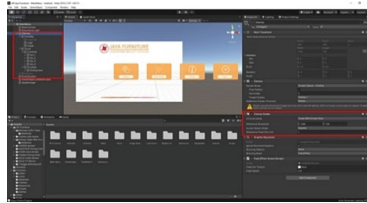**Fig. 8.** Imported All UI Image Like Button, Logo

Fig. 9. Imported All UI Image Like Button, Logo

3.4 Assembly

The assembly stage is the stage of making all multimedia objects or materials to be used as a predetermined application. Making an application is based on the design stage, such as design, flowchart, and how to work on the application.

1. Import All UI, Images Like Button, Logo
   This stage is needed because here the materials for building AR applications such as buttons, logos, navigation, etc.
2. Main Menu Creator
   The main menu creation stages use the Canvas UI (user interface), Image UI (user interface), Button UI (user interface). There are several menus that can be used, such as the guide menu, interior design menu, about menu, and exit menu.
3. AR Menu Creation
   The stages of making the AR menu display use Canvas UI (user interface), Image UI (user interface), Button UI (user interface), Text UI (user interface). In this menu are the contents of all the results of making the AR Furniture Jaya Furniture application.
4. Immported All 3D Furniture
   Imported all 3D Furniture in Unity 3D along with their textures on the Interior design menu (Figs. 8, 9, 10 and 11).

3.5 Testing

This testing phase is carried out as a reference for whether the application is feasible to use by running the application and seeing whether there are errors or not. The first stage at this stage is also known as the alpha testing stage (alpha test) where the test is carried out by the manufacturer or the manufacturer's own environment. After passing alpha testing, beta testing involving end use will be carried out (Table 2).
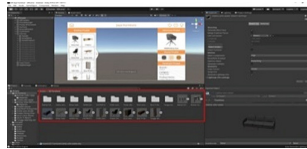
Fig. 10. AR Menu Creation

Fig. 11. Import All 3D Furniture

Table 2. Alpha Test Testing

No.	Open Application	Action
1	*Loading Screen*	Succeed
2	Displays Main Page	Succeed
3	Pressing Buttons (Home, Back, etc.)	Succeed
4	Displays the Guide Page	Succeed
5	Execute interior design data	Succeed
6	Displays the About Page	Succeed
7	Importing Furniture Items	Succeed
8	Close Application	Succeed
9	Rotate and Draw furniture Items	Succeed
10	View Product Information Items	Succeed

3.6 Distribution

This is the stage where the application will be stored in a storage medium and distributed to users, in this case Jaya Furniture to be used properly. This stage can also be called the evaluation stage for the development of finished applications so that they become better. Here's what the application looks like after running it on Android:

1. Main Menu Display
   The results of the Main Menu display after the application has been successfully installed and run on Android.
2. Main Menu Display
   The results of the Interior Design Menu display after the application has been successfully installed and run on Android.

Fig. 12. Main Menu Display

Fig. 13. Interior Design Menu Display

Fig. 14. Interior Design Menu Display

Fig. 15. Product Information Detail Display

3. Product Information Detail Display
   The results of the Detailed Product Information display after the application has
   been successfully installed and run on Android (Figs. 12, 13, 14 and 15).

4 Conclusion

From all the aspects that have been explained and arrived at the results of research on
"3D Furniture Application Design Applying Android-Based Augmented Reality (AR)
Technology", the authors draw the following conclusions: In this study the authors have
succeeded in designing and implementing in the form of a trial system a Guest Manager
(Visitor Management System) that can

1. Building and designing an Augmented Reality (AR) application requires detailed data collection at the time of observation so that the results of the running application look real and closely resemble the actual situation. And how important it is to add texture and supporting materials to add a real impression to the application, so that users feel a more real sensation.
2. Applications that are made and designed are very helpful and give a sophisticated and updated impression by following technological developments in modern times like today.

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