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Application of Augmented Reality in Android-Based Wallpaper Catalogs Using Marker-Based Tracking Method

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Abstract

The use of printed catalogs in wallpaper product promotion faces several challenges, including high printing costs, limited data update capabilities, and the impracticality of visualizing how wallpapers would appear when applied to walls. This study aims to design and develop an Android-based wallpaper catalog application using Augmented Reality (AR) technology with a marker-based tracking method. The application enables users to realistically visualize wallpaper appearances through 3D simulations displayed on a smartphone screen by scanning predefined markers. The development process utilizes Unity 3D and the Vuforia SDK as the primary platforms. The findings indicate that the application effectively assists consumers in selecting suitable wallpapers by providing a more interactive and efficient visualization experience. However, the application has certain limitations, such as a limited number of wallpaper options and the absence of online data update functionality. Further development is recommended to enhance its features and expand the catalog availability.

Keywords: *Augmented Reality, wallpaper catalog, marker-based tracking, Unity 3D, Android*

1. Introduction

Wallpaper is an integral part of wall finishing that features various decorative patterns and is available in a range of different materials. It is typically coated with a special layer to ensure the displayed pattern accurately matches the intended design. In its application as a surface covering for furniture, wallpaper is one of the widely sought-after products for interior space design, both in residential and office environments. Besides offering an alternative to conventional wall painting, wallpaper can be customized according to the desired pattern or image.[1]

Many wallpaper providers still rely on printed catalogs for the process of introducing the wallpaper collections they offer, resulting in numerous challenges. These include high printing costs, the vulnerability of physical books to damage from water or tearing, time-consuming reprinting processes whenever new wallpaper items are added or existing ones need to be replaced, and the difficulty of frequently updating the catalog. Furthermore, distributing printed catalogs to the wider public is inefficient and costly. Relying on printed catalogs also makes it difficult for users to visualize how the wallpaper will appear when applied to a wall.

To assist providers in addressing these issues, a catalog recognition application utilizing smartphone technology and augmented reality is required. This application can simplify the process of introducing wallpaper collections by enabling consumers to better understand the appearance of wallpaper when applied to their wall spaces, through the display of 3D representations of walls complete with the selected wallpaper.

A catalog is a term referring to a list or collection of information that is arranged systematically.[1] A smartphone is defined as a mobile phone that incorporates a PDA (Personal Digital Assistant) in its development. Over time, people have come to recognize the existence of smartphones through their integration with PDAs.

At its core, a smartphone is used for communication purposes such as making phone calls, while a PDA functions as a personal digital organizer system.[3] Augmented Reality (AR) is a technology that creates virtual 2D or 3D objects which are superimposed onto real-world environments. These virtual objects are projected in real time, increasingly aligning with the actual surroundings of the system. Virtual Reality differs from Augmented Reality in that it generates a completely simulated environment, whereas Augmented Reality enhances the real environment by overlaying digital elements onto it.[4]

Unity 3D is a software platform used for developing games and applications for desktop and mobile devices across multiple platforms. In the development of Augmented Reality (AR) applications using Unity 3D, the Vuforia SDK plugin is commonly employed. The use of Vuforia SDK facilitates and accelerates the development process, as the core functions and libraries are already built by Qualcomm, reducing the need for developers to create tracking and image recognition systems from scratch.[5] In the development of a wallpaper catalog recognition system on smartphones using augmented reality technology, Unity software is required to facilitate the implementation of augmented reality into Android-operated mobile devices. Therefore, the author intends to develop an application entitled

"APPLICATION OF AUGMENTED REALITY IN ANDROID-BASED WALLPAPER CATALOGS USING MARKER-BASED TRACKING METHOD".

In accordance with the explanations from the previous background, the problems being addressed are:

1. How to create a wallpaper catalog using augmented reality technology?
2. How can a smartphone display a virtual house interior using augmented reality technology?
3. How to create a wallpaper catalog using the marker-based tracking method?

The objectives of this study are:

1. To create a wallpaper catalog using augmented reality technology.
2. To enable smartphones to display a virtual representation of interior walls using augmented reality technology.
3. To develop a wallpaper catalog using the marker-based tracking method.

The benefits of this study are:

1. Assisting users easily obtaining suitable wall designs that match their preferences.
2. Enabling the author to develop a wallpaper catalog application using the marker-based tracking method

2. Theoretical Foundation

Wallpaper is a part of wall finishing that features various decorative patterns and is available in different types of materials. It is typically coated with a special layer to ensure the displayed pattern accurately matches the intended design. In its application as furnishing material, wallpaper is one of the widely sought-after products used to fulfill interior space needs, both in residential and office environments. Besides offering an alternative to conventional wall painting, wallpaper can be customized according to the desired pattern or image.[1].

3D modeling is the process of creating a desired object in a three-dimensional form. This allows one to design or generate the object according to specific requirements, resulting in a more realistic and lifelike appearance. A 3D model may vary in quality, particularly in terms of the number of vertices it contains. Generally, the higher the number of vertices, the more detailed and realistic the resulting model asset. 3D models are designed to resemble real-world objects and are often created to appear as close to natural environments as possible due to their three-dimensional structure.[6].

A smartphone is a multimedia mobile device that integrates the functions of a personal computer into a handheld device, resulting in a sophisticated gadget. It enables various functions such as text messaging, digital photography, music playback, video, gaming, email access, digital television, search engines, personal information management, GPS navigation, internet telephony, and many others.[7]

Augmented Reality (AR) is a multimedia technology that enables users to visualize virtual elements as part of the real world, seamlessly integrated with the physical environment, allowing for interactive experiences.[9] Augmented Reality is a combination of virtual (digital) and real-world environments generated by a computer. Virtual objects may include text, animations, 3D models, or videos, which are overlaid onto the real environment, allowing users to perceive and interact with virtual elements within their physical surroundings.[10]

Marker-Based Tracking is an augmented reality method that identifies a marker and uses its position to overlay or display a virtual 3D object into the real environment. A marker is typically a square-shaped black frame with a white border and a distinct black pattern in the center, designed for easy recognition. The computer can detect the marker's position and orientation, then generate a virtual 3D space by setting the center of the marker as the origin point (0, 0, 0) in a three-dimensional coordinate system with X, Y, and Z axes. Marker-based tracking has been relatively well developed since the 1980s, and in the early 1990s, it began to be further developed for use in Augmented Reality technology.[11]

Unity 3D is game engine software used for processing graphics, audio, input, and other components, designed primarily for creating games, although its applications are not limited exclusively to gaming. For example, it can be utilized as a medium for educational materials or simulations, such as driving license test simulations. One of the main advantages of this game engine is its ability to develop both 3D and 2D-based applications, and it is relatively easy to use, making it widely adopted in various development fields.[12]

Android is a Linux-based operating system designed for mobile devices, encompassing the operating system, middleware, and applications. Android provides an open platform for developers to create their own applications.[14]

A catalog is a type of brochure containing detailed information about products, accompanied by images. Its size varies, ranging from a small leaflet to a book-like format, depending on the need. A catalog is a printed medium intended for dissemination and providing information. Physically, a catalog is a printed publication consisting of several pages bound together, resembling a book. Images or photographs included in the catalog serve to illustrate products or subjects such as goods, materials, locations, or events.

Marker-Based Tracking is an augmented reality method that utilizes Vuforia to detect and identify a marker as well as its orientation. In this method, the marker typically consists of a square-shaped black frame with a thick black border, a black pattern in the center, and a white background. The illustration of the virtual coordinate system for the marker in augmented reality is defined within Vuforia. Consequently, when the camera of a mobile device detects the marker, the system overlays the virtual object precisely at the predefined coordinates, creating an augmented reality experience that aligns seamlessly with the real-world environment.

3. Analysis

The analysis conducted by the author involves examining data obtained from websites and applications related to augmented reality technology, as well as information regarding various types of wallpaper, to implement these elements into an augmented reality-based wallpaper catalog application. This analysis is also carried out to improve the design and user interface, making it more user-friendly and effective when accessed via smartphone. The analysis includes:

1. Procedural analysis
2. System requirements analysis

In the development of the augmented reality-based wallpaper catalog application, system design is carried out using the marker-based tracking method, facilitated by Unity 3D and Vuforia software. The system design includes:

1. Database design
2. Interface design
3. Flash Display Form
4. Main Menu Display Forml

5. QR Code Scanning Form
6. Wallpaper Information Form
7. Wallpaper List Registration Form.

4. Analysis

4.1. Flash Form

The design result of the user interface for the flash form in the augmented reality-based wallpaper catalog application can be seen in Figure 4.1.

Fig. 1: Flash Form

4.2. Main Menu Display Form

The design result of the user interface for the main menu display form in the augmented reality-based wallpaper catalog application can be seen in Figure 4.2.

Fig. 2: Main Menu Display Form

4.3. QR Code Scanning Form

The design result of the user interface for the QR Code scanning form in the augmented reality-based wallpaper catalog application can be seen in Figure 4.3.

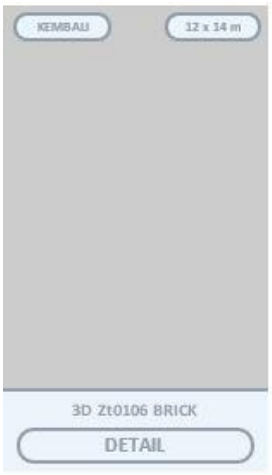

Fig. 3: QR Code Scanning Form

4.4. Wallpaper Information Form

The design result of the user interface for the wallpaper information form in the augmented reality-based wallpaper catalog application can be seen in Figure 4.4.

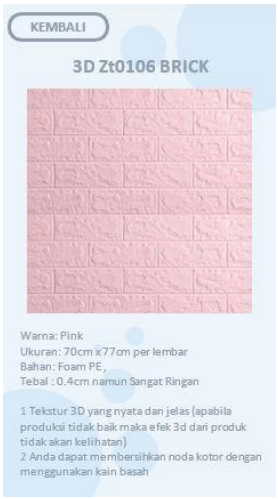

Fig. 4: Wallpaper Information Form

4.5. List Registration Form

The design result of the user interface for the wallpaper list registration form in the augmented reality-based wallpaper catalog application can be seen in Figure 4.5.

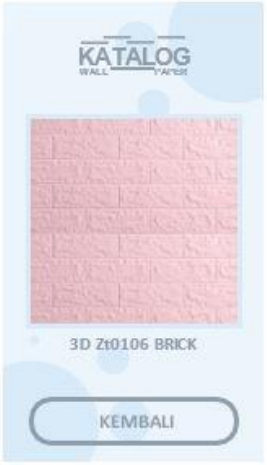

Fig. 5: List Registration Form

4.6. Discussion

The discussion presented by the author involves an analysis of the advantages and limitations found in the augmented reality-based wallpaper catalog application developed using the marker-based tracking method. Several advantages identified by the author in the design of this application include:

1. The augmented reality-based wallpaper catalog application facilitates customers in visualizing the appearance of wallpaper when applied to a wall.
2. The augmented reality-based wallpaper catalog application facilitates customers in selecting the desired wallpaper, requiring only a smartphone as the device.

There are several limitations that the author identified in the development of the augmented reality-based wallpaper catalog application, namely:

1. The augmented reality-based wallpaper catalog application cannot access data updates in real time or from online sources.
2. The augmented reality-based wallpaper catalog application only contains a limited number of wallpapers available for use.

5. Conclusion and Recommendations

5.1. Conclusions

There are several conclusions that can be drawn from the research conducted by the author in the development of the augmented reality-based wallpaper catalog, namely:

1. The augmented reality-based wallpaper catalog application assists buyers in visualizing the appearance of wallpaper once applied to a wall, as if real, due to the presence of simulated wall objects with various dimensions available within the application.
2. The development of an augmented reality-based wallpaper catalog using the marker-based tracking method facilitates users in finding the desired wallpaper by simply scanning a provided QR code, which then displays the selected wallpaper onto the available virtual wall object.

5.2. Recommendations

There are suggestions that can be derived from the research conducted by the author on the development of the augmented reality-based wallpaper catalog, namely:

1. The augmented reality-based wallpaper catalog application should be further developed into an online system so that users can add new wallpaper catalogs at any time.
2. The wallpaper catalog application requires an expansion of the wallpaper database to include more designs, allowing users to add several wallpaper options according to their preferences.

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