Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th October 2025. Vol. 5. No. 1; e-ISSN: 2808-4519

Design of Augmented Reality Technology as an Educational Medium for Facial Skincare among Adolescents Based on Android

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Abstract

In the digital era, teenagers are more focused on the health of their facial skin, yet many experiment with different skincare products without comprehending their ingredients or how appropriate they are, which poses risks of side effects. Education on safe and suitable skincare is essential to reduce these risks. This research intends to create a facial skincare educational app utilizing Augmented Reality (AR) through the Marker-Based Tracking technique. The app was created with Unity and Vuforia to showcase interactive 3D models that present skin types and suitable skincare items. The phases employed in this research development utilized the MDLC approach: Concept, design, material gathering, production, testing, and distribution. The findings indicated that the application performed effectively on Android devices, 3D objects displayed properly in relation to markers, all buttons worked correctly, and 81.1% of participants perceived the application as beneficial. Consequently, this AR application serves as an interactive educational tool that improves comprehension of skincare in a visual, engaging, and easily accessible manner.

Keywords: *Augmented Reality, Marker-Based Tracking, MDLC, skincare, 3D Modelling*

1. Introduction

In the digital age, teenagers have grown more worried about their looks, especially skin health. The skincare trend, once favored by adults, is now embraced by teenagers. Nonetheless, the use of skincare products frequently occurs without adequate knowledge of the ingredients and possible side effects, which can result in skin issues. Consequently, awareness about the significance of appropriate skincare routines and choosing the right products is extremely essential[1]. Skincare education should generally be provided by experts, namely dermatologists. However, not all adolescents have the financial means to consult with dermatologists, thus creating the need for a platform or medium that can assist teenagers in addressing facial skin problems without requiring direct consultation. Augmented Reality (AR) is a technology that integrates virtual objects into a real three-dimensional environment and projects them in real time. AR is characterized by real-time interactivity and the ability to display 3D objects, making them appear more realistic. When applied to mobile devices, particularly smartphones, Augmented Reality can serve as an effective learning medium[2]. In Augmented Reality, two prevalent techniques are often utilized in its design: Marker-Based Tracking and Markerless Tracking. Marker-Based Tracking utilizes uniquely crafted markers (typically appearing as black-and-white barcodes) that act as gateways to the virtual realm in Augmented Reality [3]. In contrast, Markerless-Based Tracking eliminates the need for physical markers; it relies on natural features in the environment, like patterns or existing objects, to position virtual objects[4]. Therefore, this study employs Augmented Reality technology for facial skincare education through an Android-based application using the Marker-Based Tracking method, which displays 3D objects representing various skin types and their appropriate treatments.

2. Research Methods

Multimedia production typically involves six phases: idea generation, design, gathering materials, assembly, testing, and distribution. These phases do not have to be completed in order, as some may be swapped based on the project's requirements. Nevertheless, the concept phase must always be performed initially as the essential foundation of the development process[5].

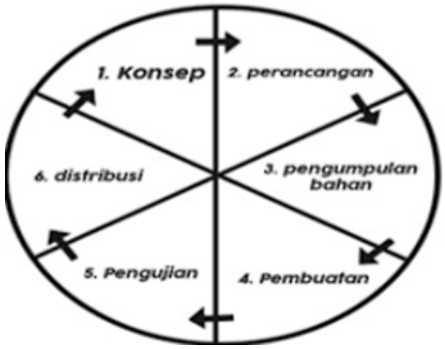


Fig. 1: Multimedia Development Multimedia Life Cycle

a. Concept
The concept stage involves establishing the goals and determining the intended users (audience identification). Furthermore, this phase identifies the kind of application (e.g., interactive, presentation) along with its intent (e.g., education, entertainment, etc.)
b. Design
The design phase involves establishing specifications concerning program architecture, style, interface, and material needs. At this phase, the design of the application and the storyboard are created
c. Material Collecting
This phase entails collecting the essential materials based on the project specifications. It can be executed simultaneously with the assembly phase. In certain situations, though, collecting and assembling materials occur one after the other instead of simultaneously
d. Assembly
In this phase, all multimedia materials and objects are produced, and the application development occurs according to the design phase
e. Testing
Executed post-assembly by operating the application program to detect possible errors. This phase is also known as the alpha testing stage, where testing is conducted by the developer or in the developer's setting
f. Distribution
This phase indicates that after the application has successfully completed testing, it moves to the distribution stage, where it is saved in the .apk format and can run on mobile devices or smartphones

3. Result and Discussion

The developed Augmented Reality (AR) application was successfully designed using Unity and Vuforia with Marker-Based Tracking. The implementation of 3D objects was achieved by importing models in *.fbx* or *.obj* format and linking them to Image Targets within the Unity hierarchy. When the application runs, the AR camera detects the marker and automatically projects the 3D object, which adapts to the marker's position, rotation, and scale. This allows users to interact directly with the 3D content in real-time, creating an engaging learning experience.

The application interface was designed to be simple and intuitive. The initial splash screen displays the Unity logo, the Universitas Harapan Medan logo (**Fig.2)**, and the application's icon, providing clear branding. The main menu contains navigation buttons directing users to the AR feature, information page, and an exit option**(Fig.3)**. Within the AR menu, users can choose among three skincare categories—facial wash, sunscreen, and moisturizer—each visualized as 3D objects with accompanying descriptions(**Fig.4**). An additional information page provides concise educational content about different skin types and suitable skincare products, supporting users in selecting the right treatment.

User testing was carried out through questionnaires involving 15 respondents. The evaluation focused on usability, interface design, clarity of information, and functionality. The majority of respondents provided positive feedback: 81.1% agreed that the application was helpful, 13.3% responded neutrally, and only 5.6% disagreed. Most participants highlighted that the AR visualization made the learning process more interesting and increased their understanding of skincare tailored to specific skin types.

These findings demonstrate that AR can effectively serve as an educational tool for teenagers by combining interactive 3D visualization with practical skincare knowledge. The positive reception from respondents suggests that the application not only provides accessible skincare education but also enhances user engagement through immersive interaction. This supports the potential of AR as a medium for health education, particularly in contexts where professional consultation is limited.

Based on the analysis of six questionnaire items completed by 15 respondents, the overall percentage of responses was as follows: 81.1% agreed, 13.3% were neutral, and 5.6% disagreed. These percentages were obtained by calculating the average of each question using the following formula:

$$Overall\ Percentage = \frac{\sum Percentage\ of\ Each\ Question}{Total\ Number\ of\ Questions} \quad (1)$$

For example, in the "agree" category, the total percentage from the six questions was calculated as 86.7 + 86.7 + 73.3 + 80 + 80 + 80 = 486.7. This value was then divided by the total number of questions, namely 6, resulting in 486.7/6 = 81.1%. A similar calculation was applied to the "neutral" and "disagree" categories, which produced overall percentages of 13.3% and 5.6%, respectively. Overall, the questionnaire results indicate that 81.1% of respondents answered "agree," 13.3% answered "neutral," and 5.6% answered "disagree." These findings suggest that the majority of respondents provided positive feedback to the questions posed. This result shows that most respondents tended to give positive assessments by choosing "agree" for each question, while a smaller proportion selected "neutral" or "disagree."

Fig.2: Display Splash Screen

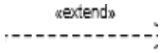
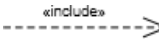
Fig.3: AR Menu

Fig.4: Information

3.1. Usecase Diagram

A Use Case Diagram is a specific type of UML diagram designed to represent the interactions occurring between users and a system in a particular context. The Use Case Diagram visually illustrates the system's features, aiding in comprehension and dialogue between software developers and clients or end users[6].

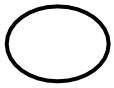
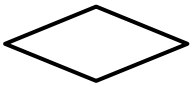
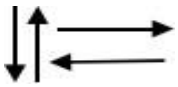
Table 1: Use Case Diagram Symbol

Name	Symbol	Description
Actor		An actor refers to a person, process, or another system that interacts with the information system being developed but exists outside of it. Although the symbol for an actor is typically represented by a human figure, it is usually denoted using a noun at the beginning of the actor's name phrase.
Use Case		The functionalities provided by the system, represented as units that exchange messages between one another or with actors, are typically expressed using a verb at the beginning of the use case name phrase.
Assosiation		Communication occurs between an actor and the use case in which the actor participates, or when a use case interacts with an actor.
Extend		An additional use case relationship refers to a link to a primary use case, where the added use case can operate independently even without the primary use case, and it typically shares the same prefix as the related use case.
Generalitation		A generalization–specialization relationship between two use cases occurs when one function represents a more general function than the other.
Include		An additional use case relationship refers to a connection with a primary use case, where the added use case requires the primary use case to execute its functionality or serves as a prerequisite for the execution of the primary use case.

3.2. Activity Diagram

An Activity Diagram represents the idea of data/control flow, organized actions, and well-structured processes in a system[7].

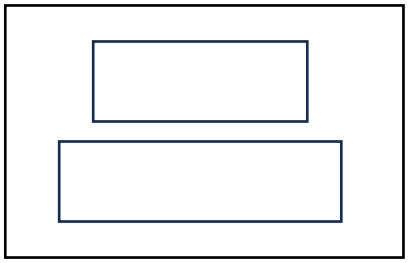
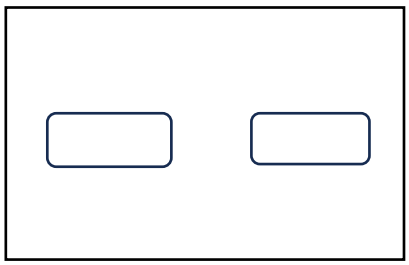
Table 2: Activity Diagram Symbol

No	Image	Name	Description
1.		*Activity*	Interaction of each interface class
2.		Process	Processing performed within the system
3.		*Initial Node*	The initiation or creation of an object
5.		*Dicisio*	A condition that produces several possible outcomes
6.		*Line Connector*	Connecting on symbol with another symbol

3.3. Storyboard

The storyboard aims to offer a visual depiction of the narrative, user engagements, and functionalities to be incorporated into the application. The storyboard depicts how users engage with virtual objects within the AR space and witness visual representations of gravity on various planets. Every scene is organized to provide a captivating and informative learning experience. A storyboard is also considered a visual script designed to map out a project, displaying each scene, often called a frame.

Table 3: Storyboard

No	Scene	Description
1		The first scene displays an initial page, which is connected to Scene 2 as well as to the option for exiting the application.
2		This scene displays buttons in the form of a board, where selecting one of the buttons will navigate to the next scene.

4. Conclusion

Based on the design and testing that have been conducted, it can be concluded that the Marker-Based Tracking Augmented Reality (AR) application was successfully designed and developed using Unity and Vuforia. The development process involved creating 3D objects, integrating markers, and embedding interactive content that is automatically displayed when the marker is recognized by the device's camera.The implementation of AR technology in this application has proven effective in enhancing users' understanding, particularly among adolescents, regarding facial skincare. Through interactive visualizations and the delivery of information using images and 3D objects, users can more easily comprehend different skin types and the appropriate skincare products. Thus, the educational process becomes more engaging, effective, and enjoyable, while also demonstrating the potential of AR as an innovative learning medium in the field of health.

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