# THE DEVELOPMENT OF AN AUGMENTED REALITY TECHNOLOGY APPLICATION USING ADDIE MODEL ON PACKAGING

**Nafisah Mat Nasir [1]**
**Noor Azly Mohammed Ali [2]**

[1] College of Creative Arts, University Teknologi Mara, 40450 Shah Alam, Malaysia.
Email: missnana_nasir@yahoo.com
[2] College of Creative Arts, University Teknologi Mara, 40450 Shah Alam, Malaysia.
Email: noora568@uitm.edu.my

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**Abstract:** *This research discusses Augmented Reality (AR) technology applications that we use to incorporate virtual information into the physical world. Due to the recent development of technology, augmented reality is commonly found to be one of the interactive experiences of a real-world environment refers to the objects being augmented. Augmented Reality (AR) has emerged as a new trend technology not only in gaming applications but also in product packaging. Indeed, augmented reality has numerous applications in the packaging industry nowadays. This technology can provide numerous benefits, including improving product packaging, increasing brand loyalty, attracting new customers, and differentiating product packaging from competitors. However, it is less focused on integrating the development of AR specific on the packaging due to the lack of academic studies in the field of AR packaging. Other than that, there is no standard design process for visual interfaces with augmented reality even though there are many success stories about the use of AR by brands that have been highlighted in technology reviews from other countries but are very reluctant in Malaysia. This study will discuss the role of augmented reality in packaging and determine the process of augmented reality development on the packaging. At the end of this research, we suggest a research framework to initiate the development of Augmented Reality technology applications using the ADDIE model on the packaging. A qualitative method has been used to collect data, where a survey through a closed-ended questionnaire instruments interviews with three experts especially in creative industry. Interview results, showed that the packaging product suitable to implement with AR technology as a prototype was food and beverages industry example Bee Honey product packaging. For future studies, it is expected that will assist researchers, creative industry practitioners, and packaging product marketers that will bring better improvement and implement augmented reality on the packaging by using this framework.*

**Keywords:** *ADDIE Model, Augmented Reality, Packaging*

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## Introduction

Augmented Reality (AR) is a concept in which we use technology to incorporate virtual information into the physical world we see. Augmented Reality (AR) has emerged as a new trend technology in not only gaming applications but also in product packaging. Indeed, augmented reality has numerous applications in the packaging industry. This technology can provide numerous benefits, including improving product packaging, increasing brand loyalty, attracting new customers, and differentiating product packaging from competitors. New design considerations arise as a result of these new target groups. All of these indicators point to the arrival of augmented reality, which is forcing marketers to plan for new packaging as a borderline demand for innovation. Furthermore, packaging has become an important part of many products' marketing, whether it's for end-users or supply-chain customers. This is becoming more significant as more products are introduced to the market. A big part of this is the use of packaging design to differentiate products. packaging has become a key aspect in maintaining the safe and effective distribution of food across the supply chain, according to the findings of his research. Packaging design also contribute to the creation of value for different performers in the food supply chain (Rundh, 2016).

## Background

With the recent advancement of augmented reality, it is now possible to explore augmented reality, particularly on the packaging. This research study aims to present various perspectives on product packaging, such as the process and advancement of AR on the packaging. The unique packaging element is critical for convincing consumers of the quality of goods and services and persuading them to select one product over another. Product packaging can also inspire marketers if the user experience is prioritized over visual components. As a result, digital content can still be beneficial in the context of sustainable packaging.

There are numerous examples of businesses that recognized the value of digitization and outperformed those that were on the cutting edge of technology but did not adapt to new technologies. While this is a well-known issue, it deserves to be highlighted. Despite the fact that virtual reality (VR), augmented reality (AR), and three-dimensional (3D) technologies are not new to the industry, they are still underutilized in the commercial world (Konopelko, 2019). Furthermore, scholars claim that there is a lack of academic studies and academic literature in the field of AR packaging. This issue has received a lot of attention in the literature. Other researchers state that there has been little research into the presence of AR in Malaysia, and that there is no standard design process for visual interfaces with augmented reality (Lazim & Rahman, 2015), because AR is not as popular as VR only 44% of people are aware of its existence (Ng & Ramasamy, 2018). Ng & Ramasamy (2018); Wafa & Hashim (2016), again mentioned that Malaysia is lagging behind in the use of AR technology, particularly in gaming, tourism, retail, and other industries, due to Malaysian society's delayed adoption of the technology. Malaysia may face economic difficulties if its industries are unwilling to embrace the fourth industrial revolution, which includes augmented reality (AR) as one of its nine core pillars. AR adoption is impacted by a lack of comprehension of its capabilities stated by Ng & Ramasamy (2018), meanwhile according to Wafa & Hashim (2016), many success stories about the use of AR by brands have been highlighted in technology reviews and new sources in developed countries, but AR acceptance appears hesitant in Malaysia. Because of the growing market interest in augmented reality applications, the development of a future application is required. It is also critical to create such an extremely useful application because it is expected to have a significant impact on AR in the context and technology awareness of marketers,

packaging designers, and first-time users. Using augmented reality technology, this study aims to help packaging creative practitioners, designers and marketers understand the importance of packaging and consider its practicality.

The aim of this study is to achieve the purpose of additional research using the augmented reality technology platform on the packaging. The aim of this study are to identify the role of augmented reality in packaging, to determine the process of augmented reality development on the packaging and to propose packaging integrated with the new trend technology of augmented reality. The goal is to assist marketers in offering their product through effective new trend technology and appealing packaging that distinguishes it from competitors. Researchers should look into the process of developing augmented reality on packaging as part of this study.

**Augmented Reality**

Tom Caudell invented the term "Augmented Reality" in the early 1990s (Wafa & Hashim, 2016; Cassella, 2009; Caudell; Martinez et al., 2014). According to Arshad et al., (2017) AR is a direct or indirect live view of a physical, real environment. The elements are then supplemented by computer-generated sensory inputs. For example, GPS data, sound, graphics, or video (Bistaman et al., 2017). On the other hand, Zhao (2018), defined AR as a virtual environment with realistic vision, hearing, power, touch, and movement created by a computer. The user was immersed in the virtual world via sensing devices, allowing for direct, natural interaction between the user and the environment.     According to Javornik (2016), claimed that interactivity, virtuality (the presence of virtual reality elements), geolocation feature/location specificity, mobility (in terms of portability and wearability), and synchronization of virtual and physical/real worlds (augment) are the most important media characteristics of augmented reality. In a nutshell, AR technology adds computer-generated input to a real-world environment. After that, the real-world and augmented surroundings may interact and be managed digitally. The variety of uses for augmented reality technology grows as technology progresses, and it has the potential to affect our shopping, entertainment, work, and other activities.AR technology improves the user's impression of reality while also alerting the consumer about his or her surroundings. Meanwhile, virtual reality (VR) technology uses computer hardware and software to generate a virtual environment for the user as well as an immersive environment in which the user may interact with items comparable to those found in the real world (MarketsandMarkets, 2016).

**Role of Augmented Reality on Packaging**

According to Martin (2019), the importance of AR in packaging cannot be overstated. Today, most packaging is in a passive state, neither pleasant nor appealing, and it frequently ends up as waste. Given the effort and price involved, packaging could work much harder for marketers. The ability of AR is to re-imagine conceptual packaging. It blends real things with the technology as the audience engages with a smartphone on a daily basis. As a result, it offers a new and entirely digital communication channel filled with opportunities for marketers to engage with their target audience directly. AR not only improves user experience but also improves brand loyalty and consumer engagement.

GlobalData Consumer (2017), stated that AR packaging is a marketing technique that adds an interactive element to the packaging, thus creating a more positive user experience. The experience can lead to many different benefits, from increased brand loyalty to attracting consumers from competitors. It can be easily introduced to the brand's target audience, and when partnered with other events or services, it can help promote and attract connected

consumers. AR Packaging is also one of the few technologies that allow brands to offer consumers an exclusive experience with a potentially small investment. The majority of the costs revolve around the initial app development and graphic designs. It requires no additional materials, avoids major packaging or production redesigns, and can be integrated into any existing product. However, the quality of the application plays a major role in the pricing of AR apps (Michael & James, 2017).

The key factor to successful marketing is influenced by brand loyalty. AR improves customers' experience engagingly and in positive ways which helps build brand loyalty. All in all, marketers are up to 14 times more likely to sell to a satisfied existing customer than they are to sell to a new customer. 19 Crimes Wine is an example of AR technology product packaging. They incorporated AR features into their wine bottles to provide a more complete tale about the company. The term 19 Crimes alludes to British captives brought to Australia in the 18th century. Customers will be able to dive into the story when they scan the AR marker. One would expect that people would identify this wonderful narrative experience with the wine and continue to purchase it (David, 2018).

The crucial aspect for modern customers is dealing with the brand, the company, and the product itself. According to Konopelko (2019) and Charlesworth (2018), buyers are seeking items that have outstanding visualization, which is one of the most popular qualities of augmented reality among consumers since it makes the purchasing process easier and less opaque. Consumers are presently asking for an entirely new degree of product engagement. To conclude, AR is undeniably a digital marketing tool in advertising a product that offers an immersive experience to customers. Now the use of AR on the packaging has become well-known and useful. It is crucial to review the existing cases to observe if the packaging works in increasing customers' attractiveness. Several examples of AR packaging cases prepared by the Blippar company have been reviewed in this study. Blippar is one of the pioneers of AR technologies. Blippar (2022) stated that they have over 10 years of expertise and have delivered over 20 000 AR applications and campaigns. The situations detailed here are not the only ones that exist. Other additional firms are utilizing AR packaging technology in a variety of sectors. However, because there is no way to detail all of the existing situations, the author chose some of the most intriguing and effective. Table 1 shows six samples of AR packaging cases mostly developed by the Blippar company.

**Table 1: AR packaging cases, application and their characteristics.**

| No | Brand | Trigger | Context | Content | Marker | Appeal/ Evaluation |
|----|-------|---------|---------|---------|--------|--------------------|
| 1 | Nesquick | Jigsaw | Infotainment | Packaging | Packaging | 20% purchased another box |
| 2 | Kelloggs | Jigsaw | Infotainment | Infotainment | Packaging | 20% purchased another box |
| 3 | Cadbury | Advent-product | Promotion | Filters | Packaging | 1th bestselling advent calendar in the UK in 2017 |
| 4 | Boost | Drink/ Sport/ Game | Promotion | Game | Packaging | 3.5 interactions /user |

| 5 | Subway X Pepsi Max | Music | Promotion | Game /Music | Packaging | 70,000 customers |
| 6 | Magnum | Decision on Flavor | Hospitality | Decision /Game | Packaging | 48.5% engagement rate |

Source: Revised from Styliaras, 2021.

A set of classification criteria have been defined which are present in Blippar applications focus on food packaging existing cases. More specifically, the criteria represent the content of AR, functionality, implementation platforms, appeal, and evaluation. According to Styliaras (2021), many brand packaging products have used augmented reality to enhance their brand and packaging. Furthermore, it demonstrates that the marketer's brand packaging product has benefited from this. The use of augmented reality on the packaging is more than simply a marketing tool to persuade customers to choose one product over another in-store. However, it is more than that, as it delivers interactive material that customers can explore at home and share with their friends, which has a lot more post-purchase value and potential in terms of brand loyalty. Based on the findings of the preceding study, it is possible to infer that there are several roles for Augmented Reality on Packaging that may serve as a digital communication channel with numerous potential for marketers to initiate a direct conversation with their target audience.

**Methodology**
A qualitative research approach is used for this research to collect and analyze the data. This research conducted observations on existing cases regarding to AR on packaging. Instruments is referred as a measurement device that use by researcher. The instruments that use to conduct this research is by interview and survey. Researcher conduct survey for preliminary study. For inclusion as academic material, the research on AR packaging only includes the interview data of three respondents based on the following grounds: packaging and augmented reality developer. The findings of the interviews with these three respondents indicate that this study should be maintained, since all respondents are extremely supportive of the researchers' efforts to emphasize the usage of augmented reality in the packaging industry. Simultaneously, the same information supplied by respondents in this interview session demonstrates that the quantity of interview respondents was sufficient for this research. The sample used in interviews was chosen based on expertise fields of respondents in the study, including academician, creative industry practitioner and app & creative developer. This method was accomplished through the use of a computer to collect data in order to provide the highest quality and best information in develop AR on the packaging, which is the goal of this research. To simplify the implementation of the proposed method, the researcher introduced the ADDIE model into this research. It was implemented for its simplicity and as a guideline for the researcher in developing AR projects on the packaging.

To develop AR on packaging involves Instructional Design also known as instructional technology. According to Aldoobie (2015), instructional design is a systematic process that uses art, science, learning, and instructional theory to help create and build effective, attractive, and efficient instructional content in a supportive setting. The ADDIE model, which is widely used in the instructional design profession, is a guide to creating an effective design. This methodology enables instructional designers, content producers, and even academics to create successful instructional tools and materials.

The ADDIE model is a framework for instructional design that is extensively utilized by application designers and developers. It is used in the development and training processes by instructional designers (KloudLearn, 2020). Using this previous supporting research, the researcher strongly believes that this is the best known practical method for developing AR on packaging. The ADDIE model technique is used to create the AR application, which is divided into five stages in this study: analysis, design, development, implementation, and assessment. Figure 1 showed an illustration of framework how each phase involves numerous tasks and delivers. According to Serhat (2018) and Steven (2020), the ADDIE Model is an iterative instructional design method in which the outcome of any step might bring the instructional designer back to any previous phase. These levels occasionally overlap and may be interconnected, but they provide a dynamic, adaptable framework for developing effective and clear instruction.
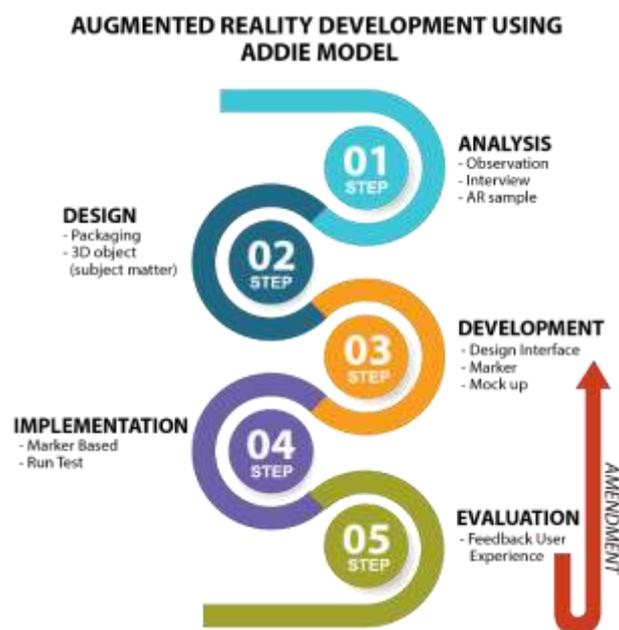


**Figure 1: Framework of development of AR using ADDIE Model**

**Design Process and development of Augmented Reality using ADDIE Model**

Because of the hierarchical nature of the phases, the procedure had to be completed in a sequential manner, with one portion completed before the next began. In this research, the researcher developed an AR prototype on the packaging primarily based totally on the ADDIE model. At the end of this project, a usability test is executed to decide how far the application has progressed. The model offers the researcher a streamlined, targeted method that gives remarks for continuous improvement. Five phases in the ADDIE model are defined as below and refer Figure 2 for detail in pictograph.

**Analysis**

In this phase the process of analysis begins. During this phase, the developer makes a list of all the issues that have arisen. The developer can notice the issue through observation and other methods. To obtain information that will enhance the project's success, the issue description, purpose, and current apps on any of the common platforms are compared. In this study, there

are a few applications and software researchers used. To create and develop AR on packaging researcher used software Adobe Illustration, Adobe Photoshop, Unity 3D, Vuforia, and APK Android application. The researcher makes the list and framework to develop prototype AR on packaging as a guideline. The list of software was also recommended by experts during interviews. This phase also includes sketching the technical drawing, design element packaging, and also 3D object trigger for Marker Based. Last but not least, this phase researcher designing a storyboard as an instructional that will help the researcher see more clearly of the project development.

**Design**

The second step of the ADDIE process is designed. The purpose of this level is to construct the framework of the application. It might be as basic as a storyboard with a few sketches, or as extensive as a thorough plan with explanations and schematics. The layout of a development AR, in whatever form it takes, typically consists of descriptions of the main content material, it will cover and goals it seeks to achieve, as well as short descriptions of segment contents and a general idea of how the navigation and user interface will look. During the conceptualization phase, the emphasis is on the content of AR, which may include audio, video, picture, 3D object, animation, and so on. Aside from that, the packaging design step is also included. All goals, performance measurement techniques, assessments, content analyses, planning, and resources are defined. The idea for the AR Packaging project is implemented in an early design for the application in this phase. It is checked whether the application can be developed for all mobile platforms. The data collected during the analysis step is then examined and compiled. By creating a storyboard, the researcher can create the interface of the project. The storyboard helps to better understand the project flow.

**Development**

All of the designed elements are created and used as guidelines for the machining process during this phase. During the design phase, multimedia components must be used. This design was created using a software development process that included a variety of applications for an image, animation, and authoring. A pipeline for augmented reality production is mentioned when developing Augmented Reality. To create an augmented reality product or asset, a user, hardware, and software combination is fine-tuned to work in a precise sequential order. Pre-production, production, and post-production are the three primary processes in the production channel or pipeline.

**Implementation**

The testing phase is another name for the implementation phase. Researcher will review all applications once they have been completed. The researcher tests are used to identify errors or unintentional errors that occur during the process. If an error occurs during the test, it will be fixed. The test is repeated until all errors in the application have been corrected and the application is running properly.

**Evaluation**

The final stage is the evaluation stage. It is the process of gathering feedback from respondents on the content, user interface, audio, visuals, videos, photos, and animations. Purpose is to guarantee that apps suit the demands of users. Once all process testing, surveys, interviews, and so on have been approved by the supervisor, the project is handed over to the end-user.

**Figure 2. Development of AR on packaging using ADDIE Model**

**Findings & Discussion**

According to interview results, respondents mentioned that the packaging product suitable to implement with AR technology as a prototype was food and beverages industry example Bee Honey product packaging. All respondents agree that the AR implemented on packaging functions well and the content is very adorable with BEE 3D animation as a trigger object. Meanwhile the User Experience also functions well and AR very easy to use because have instructions on the packaging and on the apps also. The prototype of AR packaging has proven its interactivity as a product. This statement supported by one of the interview results from the respondent. It also allows for two-way communication between the user and the product package itself. Overall, packaging integrated with AR is good as a marketing tool because it can attract users to buying that product. However, there are also a few feedbacks from respondents regarding this prototype that need to make an improvement on future research project development. After evaluation process, these AR packaging still need to do improvement regarding packaging prototype that should to create more shape and form rather than square. Packaging design also need to become odd rather than common design, so that can represent as the beauty of creative thinking and design. Meanwhile, in context of AR User Experience: AR content needs to improve with Interactive Content like edutainment or infotainment which deliver message or value to user.

To conclude, because of the growing market interest in augmented reality applications, the development of a future application is required. Using augmented reality technology, this study aims to help packaging designers and marketers understand the importance of AR on packaging and consider its practicality especially in the food and beverages industry. This approach will have a significant impact on the food and beverage industry for the future. The use of augmented reality on the packaging is more than simply a marketing tool to persuade people to choose one product over another in-store with an immersive experience. Based on the findings from the conducted study, it is possible to infer that there are several roles for Augmented Reality on packaging that may serve as a digital communication channel with numerous potential for marketers to initiate a direct conversation with their target audience. AR not only improves user experience but also improves brand loyalty and consumer engagement.

In this study, researcher provides a QR Code to make the reader view the prototype of Augmented Reality on the Honey packaging. The reader can watch the video by scanning the QR Code.

**Figure 3: QR Code for AR Technology on Honey Packaging Prototype**

The most important is awareness among marketers, packaging designers and related industry especially food and beverages should consider regarding new trend technology of AR. This research has a significant impact on AR packaging development especially to researchers, creative industry practitioners, and packaging product marketers in improving and implementing augmented reality on packaging. Finally, future AR developers interested in developing an augmented reality system may find this study useful.

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