INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 13, Issue 7, (2023) E-ISSN: 2222-6990

The Utilization of Augmented Reality (AR) Applications as Packaging Design Enhancement

[1]Ma Nabila Husna Abdul Rani, [2]Mohd Khairulnizam Ramlie

[1]Kembara Khalifah Travel Sdn. Bhd., PSB, No.27-3, Jalan Cecawi, Jalan Cecawi 6/19a, Seksyen 6 Kota Damansara, 47810 Petaling Jaya, Selangor, MALAYSIA, [2]College Of Creative Arts, Universiti Teknologi MARA, Perak, Branch, Seri Iskandar Campus, Seri Iskandar, 32610 Perak, MALAYSIA

Email: nizamramlie@uitm.edu.my

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v13-i7/17332 DOI:10.6007/IJARBSS/v13-i7/17332

Published Date: *30* June 2023

Abstract

Food packaging functions as a hub because it is commonly recognized by consumers as the primary location from which they able to access the information that is printed on food packaging. Research done in the past suggests, that the information provided about foods is typically murky and difficult to understand. In the most recent trend of technological innovation, those who are in charge of marketing food are being pressured to consider more traditional methods of managing food information. Through the utilization of technology in the innovation of food packaging, it is possible to produce an interactive food package. Currently, Augmented Reality (AR) technology has been used as one of the features in packaging design. Therefore, it is necessary to conduct a comprehensive study on the incorporation of augmented reality into packaging design. This is to determine the factors that may provide the best user experience. Therefore, a systematic literature review was conducted to identify packaging design elements that must be considered and to identify the augmented reality (AR) technology utilized in packaging design.

Keyword: Food Packaging, Food Information, Augmented Reality, Multimedia Design, Packaging Design

Introduction

Food packaging is required to protect food products from environmental contaminants and other influences such as odors, shocks, dust, temperature, physical damage, light, microorganisms, and humidity, and it is essential for maintaining the food quality and safety, extending shelf-life and minimizing food losses and waste (Han et al., 2018). Furthermore, the goal of food packaging is to preserve food efficiently and effectively as possible while satisfying the demands of both industry and consumer demands, ensuring food safety, and minimizing the negative impact on the environment (Sharma et al., 2021).

Previous research indicates that, although food labels serve as the primary form of communication between a product and the consumer, they are increasingly regarded as insufficient, with studies revealing that the information on food packaging is frequently difficult to understand or consumers do not read it at all (Popovic & Van der Sijde, 2019). As a result of this situation, consumers are also confused by conflicting messages about what they should eat and how much they should consume (Van Der Horst et al., 2019). In addition, the design of food labels does not have an appealing appearance, which makes it challenging to attract the consumer's attention. According to the Institute of Public Health (IPH), National Health and Morbidity Survey (2017), a significant proportion of Malaysian adolescents (41.7%) do not read food labels because they find them uninteresting to read, and further research from this report revealed that 12.7% of Malaysian adolescents agree that the size of the print on food labels is too small to read. On the other hand, labels are a great way to connect with customers while enhancing packaging. A well-designed label usually appears in visually appealing and descriptive, attracting attention while conveying product-specific information. As a result, modern food packaging can provide a solution to make food safe, reliable, shelf-stable, and clean.

Recent advances in innovation and creativity have allowed packages to play a prominent role in marketing, protecting, and preserving foods (Drago et al., 2020). Many terms, such as interactive, active, smart, intelligent, and other user-friendly functions, have been used to describe innovative packaging technologies. These technologies are able to help packages maintain the safety and quality of the foods (Elkhattat & Medhat, 2022). In general, intelligent and interactive packaging is able to transform traditional passive packaging into internet-enabled device technology (IoT), which supports a wide range of interactions between the brand, the product, the retailers, and the consumers (Luo et al., 2022). However, a few issues with innovative packaging technologies need to be thoroughly investigated before the technologies are implemented in the food industry, such as the complexity of specific technologies, production costs, and consumer acceptance (Firouz et al., 2021).

The term "augmented reality" (AR) refers to a recently invented form of computer software and interaction technology. AR makes it possible for customers to experience offline and online services through their smart devices by providing highly personalized service, highly vivid experiences, and connected digital content such as advertising collaterals, the product itself, the product experience, and salesperson support towards the customer after experiencing the purchase experience (Chiu et al., 2021). This technology able to enhance the new user's existing environment by superimposing an image or animation over the user's view. Augmented reality (AR) reflects the augmentation of a virtual object over the real world. When it comes to marketing, augmented reality is an efficient tool that helps with brand interaction and innovative marketing, both of which allow a company to gain a competitive advantage (Ng & Ramasamy, 2018). Therefore, utilizing AR technology enabled consumers to use their smartphones to access special features of the product's packaging by communicating necessary details of the product, the instruction for use, and information regarding the product (Elkhattat & Medhat, 2022). Additionally, it can be an added value to the goods or the service because it enables the brand to associate its digital marketing content with it. Additionally, it assists the user in becoming more interested in the product, increasing the likelihood that they will purchase the service or product. Apart from this, technology provides a channel for improving story-telling about brand product attributes, provenance, how to use the product, and providing useful product information to the consumer in an easily

understandable communication format. Labels are indeed important for the purchase of food products because they can emphasize product quality and nutritional criteria (Jribi et al., 2021), and serve as the primary tool for conveying information about the products or the manufacturing process to the consumer.

The world is changing as a result of the marketing of constantly evolving innovative technologies. In addition to the primary service or product for which they are paying, consumers expect and demand a value-added experience. Food preferences are linked to a consumer's ability to comprehend nutritional information. Food labelling is a community-based method of providing consumers with information about the nutrient content of food as well as knowledge of basic nutritional principles. However, according to a previous study, consumers do not read food label information because they do not understand the terms and lack awareness regarding the importance of food labels (Ponnudurai et al., 2019), and due to the lack of consumer knowledge about mandatory food labeling, it able to impact public health-related issues (Moreira et al., 2021). These difficulties in finding information, such as mandatory allergen information on specific products, could pose an immediate danger and cause a reaction to the consumer.

The lack of knowledge that consumers have regarding labelling food products leads to additional occurrences of this problem. For example, food packaging labels contain various nutrition information, such as mandatory ingredient lists and voluntary manufacturer marketing. Thus, it makes interpreting nutrition information found on food packages more difficult because food packaging labels contain various nutrition information (Ahmed et al., 2020). In addition, some consumers were confused by the nutritional label and other information on food labels, such as the expiry date, manufactured date, and the ingredients contained in a product (Jefrydin et al., 2019). Consequently, consumers will spend more time reading the information labels printed on food packaging to select the type of food ingredient that they will consume.

Previous studies have indicated that the information provided on food labels is helpful. However, the way it is presented could decrease interest and understanding (Moreira et al., 2021) because the visual qualities of the packaging are a crucial sensory indicator of a product's success or failure on the market shelf (Sousa et al., 2020). In addition, food labels are a common way for consumers to gather information about their food. Thus, food labels, such as traffic light systems depicting the food's quality category, should be printed appealingly to encourage consumers to read food label information (Ponnudurai et al., 2019).

The significance of this study lies in the fact that it will assist consumers in better comprehending the information provided on food labels and in making more informed decisions by utilizing augmented reality technology. This is because the combination of interactivity and engagement with emotions has the potential to improve the consumer's ability to make better decisions regarding their food choices in the future. As a result, the utilization of augmented reality technology will contribute to the growing awareness and knowledge regarding food safety. Second, augmented reality has the potential to improve the customer experience while they are making food selections. Van Esch et al (2019) Augmented reality (AR) is an interactive technology that enables brands to enhance their vision digitally. As a result, consumers receive enjoyment and information at the same time because AR is able to simulate an experience by blending the real and virtual worlds through a digital setting such as a website or smartphone application, allowing the consumer to interact with the

physical item virtually. (Romano et al., 2020). These features have the ability to increase customer engagement and satisfaction with the service that is being provided.

There are a couple existing scopes of study for this research that should be considered. This research will be conducted within the framework of the food and beverages industry, and the results will be linked with the characteristics of this industry. Currently, there are already plenty of cases regarding AR in packaging in the Food and Beverages (F&B) industry which is potentially one of the interesting topics to study. Therefore, this research will focus on the label on the packaging and information as well as AR in packaging design. The focus will emphasize mostly on consumer engagement with the information on the packaging label through AR as a tool in conveying the information to the consumer. Therefore, the main objective of this study is:

i. To identify the current packaging design.
ii. To identify the current Augmented Reality (AR) in packaging design.

This is due to the question that arises as to whether the use of AR technology in packaging design can effectively convey information to consumers? To carry out the next study on packaging that uses augmented reality technology, it is necessary to conduct a systematic literature review on packaging and Augmented Reality specifically.

Packaging Insight

Packaging is necessary for physical products because it serves two purposes: it prevents the item from being damaged, and it presents the product and the brand in a way that is appealing to a target group of consumers. Food packaging is primarily used to store food products cost-effectively, protecting them from environmental influence or damage during transportation, and maintaining the food quality from the packaging to the time of the product's consumption (Jeevahan & Chandrasekaran, 2018). Despite claims that branding is more important than packaging (Ab Gani et al., 2023), packaging has its own significance. Furthermore, the packaging is the consumer's first point of eye contact with a brand, making it critically important to capture their attention and quickly convey messages that present and support the brand .

In most cases, the purpose of packaging is to act as a form of surface communication that educates customers about the product sold by a particular brand. Because it can communicate to customers the qualities and benefits of the product they will receive through text, images, and various other communication devices, the packaging is an important component of product branding. Packaging can communicate this information to customers in a variety of ways. In addition, packaging plays a part in the communication of brand characteristics, which helps position the brand in the mind of the consumer and ultimately differentiates the brand from the brand in question and its competitors. In addition, the packaging is used to hold a product, and plays an important role in attracting consumer interest in modern times by differentiating a product from its competitors and increasing its visibility through shape and design (Ozcan, 2020). As a result, various packages have been improved in terms of design, with different roles and functions based on the packaging of the products.

Packaging Revolution

With the rapid development of internet technology, the use of a computer and network to process information has infiltrated various fields of human production and living, resulting in a significant change in people's production methods and lifestyles. In order to improve the sensory information packaging, the digitization trend has sparked a technological trend in today's fast-paced world, and the word digitization refers to the internal optimization of the process and the results in a cost reduction. The history of food packaging is linked to an understanding of the origins of packaging materials and the pioneering efforts in food packaging development. The highly sophisticated food packaging industry that serves modern society today is far from the simple packaging activities of the past.

Early Development of Packaging during Industrial Revolution

During the nomadic periods of human history, they ate whatever they could find and collect from their surroundings without worrying about protecting and storing their foods; however, as people began to live in communities, the need for a container to store foods became essential, as did the need for suitable methods of preserving the foods and also for packing the food products (Robertson, 2019). The Industrial Revolution developed new manufacturing processes and materials due to these needs and demands. Although many of them were not originally intended for food products, they have proven useful as packaging materials for food products. In addition, during the Industrial Revolution of the 1800s, due to significant technological advancements, the demand for packaging of higher quality increased. According to Risch (2009), a few types of food packaging have been invented and are associated with the following functions:

Metals can: It is manufactured for use in snuff, making it an excellent barrier that helps the product retain its moisture and protects its flavors by preventing the product from being exposed to elements found in the environment.

Figure 1. Collection of tin's in the year of 1800s
Source: White (2017)

Glass bottle: For the purpose of keeping food contained while it is being heated, glass bottles with corks that have been wired together serve as the closure. However, due to the fragility of the glass bottle, it was quickly replaced with metal cans. This was done because the metal

cans allowed the product to be heated and processed in a much more straightforward manner, thereby extending the product's shelf life and preventing it from spoiling.
***Paperboard*:** It was used to manufacture folding cartons during the early years of the 1800s.

Figure 2. Uneeda Biscuits packaging
Source: Twede (2019)

For example, Uneeda biscuits were packaged in a tray-style paper carton with a waxed paper liner inside, and the colorful brand-printed wrapper featured a child wearing an umbrella to emphasize the moisture barrier. This allowed the biscuits to be preserved for longer durations and transported conveniently in sanitary unit-size packaging. In addition, it is frequently cited as the beginning of consumer packaging due to its widespread distribution and the significant impact folding cartons had on the retail industry in that century. Later, corrugated boxes gained popularity as shipping containers because they could accommodate multiple smaller packages at once.

Plastics: They consist of cellulose nitrate, styrene, and vinyl chloride, but they were not utilized in packaging until the 20th century. After World War II, plastics originally designed for military purposes began to be used in food packaging. Cellulose plastics have revolutionized the industry and become the go-to option for flexible packaging solutions. As time goes on, the development of new plastics will make it possible to expand flexible packaging capabilities. As a result of this, the manufacturer is able to protect and extend their product effectively.

Current Packaging

The revolution from the past has brought a huge innovation in the packaging industry. However, due to the increasing demand for innovative and creative packaging to ensure food safety, quality, and traceability in recent years, this method has become insufficient, making the need for new technologies and integrated food packaging even more pressing (Siracusa, 2012). Therefore, the transformation continues as design innovation and technologies have expanded the packaging options available to manufacturers, who have to adapt to new methods and take advantage of new materials and solutions.

Smart Packaging

The term "smart packaging" refers to the packaging systems that contain embedded sensor technology and are used with various types of products, including foods, pharmaceuticals, and many others. There are various definitions of smart packaging in the literature. It can be defined as packaging that is not only produced by adding new technology to passive packaging

and material that does not only improve basic functions but also able to respond towards the external stimuli (Ozcan, 2020). Smart packaging has the ability to communicate with its environment in the supply chain or with the consumer.

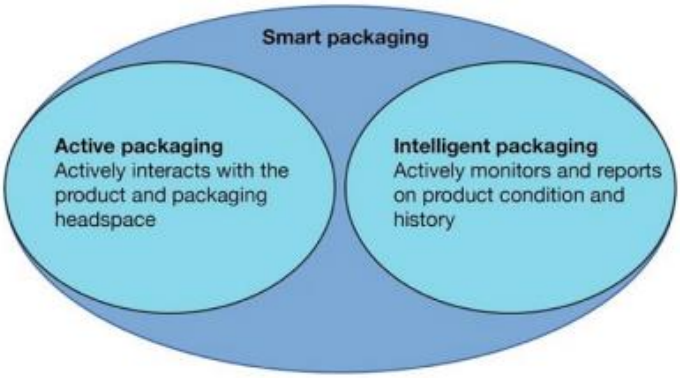

Figure 3. Types of Smart Packaging
Source: Ozcan (2020)

These systems are focused on improving packaging functions in order to meet the growing demand, increasing regulatory requirements, and growing interest in safety (Ozcan, 2020). Smart packaging has the ability to communicate with its environment within the supply chain or with the consumer. These systems are focused on improving packaging functions in order to meet the growing demand, increasing regulatory requirements, and growing interest in safety (Ozcan, 2020). In addition, these functions are used to extend the shelf life of the product, monitor its freshness, display information about the product's quality, and enhance the safety of both the product and the consumer (Schaefer & Cheung, 2018). However, the term “smart packaging” encompasses a wide range of new packaging concepts, the majority of which can be divided into two main categories: active packaging and intelligent packaging (Salgado et al., 2021).

Active Packaging

Active packaging is a system in which the product, the packaging, and the environment interact positively to achieve some characteristics, such as packaging that can change the condition of the packaging to extend shelf life or improve safety or sensory properties while maintaining the quality of packaged foods. One example of active packaging is packaging that can change the condition of the packaging to improve safety or sensory properties while maintaining the quality of packaged foods (Singh & Giri, 2018). Active packaging typically involves containers interacting with the foods they contain and the storage environment. These containers actively contribute to the preservation of the foods by removing unwanted substances from the containers themselves or by releasing active substances into the foods. Therefore, active packaging includes freshness enhancers, which participate in various packaging applications to enhance the preservative function of primary packaging systems.

i. Intelligent Packaging

The food packaging industry has recently seen the development of a new technology known as "intelligent packaging." The technology known as "intelligent packaging" refers to the practice of integrating communication tools into the infrastructure of food packaging systems

to track and respond to shifts in the system's internal or external environmental conditions. Since this technology is described as introducing the above tools, it is able to improve the quality of food products, their traceability, and their safety (Soltani Firouz et al., 2021). In terms of food quality and safety point of view, intelligent packaging is helpful to the industry and consumers in order to provide timely information regarding the status of the foods through a change within the packaged system. The research added in some intelligent packaging systems, the packaging are able to inform the consumer about the whole history of the food product such as the manufacturing process, expiry date, ingredient, and storage specification, and it is designed to inform the user of an event that may damage the packaging material or affect its protected life (Sohail et al., 2018). Therefore, these functions are able to share relevant information about the packaging systems and enhance food quality and safety.

ii. ***Interactive Packaging***

The creative concept of interactive packaging enables designers to create a direct advertising message targeted and integrated to suit the busy lifestyle of the consumer, a significant step forward in the advertising industry. In addition, interactive packaging provides customers with a selection of options in the form of a pleasurable and engaging interactive experience. Customers will be able to learn more about the product and the brand through this experience, whether it is with the packaging, the product contained within, or the advertising message. As a result, consumers' perceptions of the company that produced the product will improve (Youssef, 2019). Furthermore, interactive packaging enables two-way communication between the user and the packages through the use of recent advancements such as PE, AR, IoT, and NFC through networks which allowed the packaging to become interactive through digital service and improve the workforce efficiency and sorts of consumer experience, increasing security and monitoring surrounding environment (Lydekaityte et al., 2018). In addition, there is a scientific basis for the additional information provided by interactive packaging regarding food products. Therefore, it is a combination of frontline food service and intelligent and interactive packaging, which are applicable for future nutritional package production, and it verifies the highest possible degree of food safety while also meeting the demands of the population (Ibrahim et al., 2021). A package's digital functionality improves the product's ability to tell a story, allowing brands to interact with consumers in novel and revolutionary ways.

For the past two centuries, the pack has transformed from a product container into an essential component of product design. In addition, the military's requirements have accelerated or precipitated the development of some essential packaging. Marketing-led packaging innovation is defined as the adoption, recognition, and exploitation of a value-added novelty in economic and social spheres such as product, service, and market renewal and expansion, development of new manufacturing methods, and implementation of new management systems.

Roles of Food Packaging

Without packaging, it would be impossible to control food availability across geographic boundaries. Therefore, packaging is an essential component of any food product. In many cases, the packaging serves a practical function, such as storing or protecting the product. Thus, consumer protection of the product is becoming a significant role of the packaging in order to protect food products from outside effects and damages, maintain the food product,

and provide consumers with the ingredient and nutrition value of the foods, besides extending the shelf life of the food and improving its quality and safety. Today, every product has a short life but a long-lasting impact, so packaging serves several functions, including product protection, safety, and acting as a marketing and communication tool for the product.

Technically, protective packaging can be made of any material, not just cardboard, plastic, or metal (Alamri et al., 2020). In other words, packaging protects the product from shock, vibration, compression, and temperature while also preventing the product from becoming dirty or smudging customer hands due to contamination (Benjamin et al., 2019). It is useful for a variety of applications and forms of protective packaging, with the primary goal of ensuring the product arrives in pristine condition without being damaged (Alamri et al., 2020). According to the definition, protective packaging supplies are the materials used to protect and buffer a product from potential harm or destruction during shipping or warehousing.

Meanwhile, for product safety, packaging plays a vital role in maintaining the content's safety for the consumer because the packaging should contain important information about the product for its safety. In addition, the primary safety feature of food packaging material in contact with food should be as inert as possible with as little interaction between food and packaging (Bou-Mitri et al., 2020). Furthermore, the interaction between food and packaging materials is considered an interchange between food, packaging, and the environment because it has the potential to affect food quality or packaging integrity (Alamri et al., 2018). As a result, protective packaging is able to keep the product safe during shipment between the manufacturing facility and the retailer until the product is placed on the shelf.

Packaging design constitutes marketing and communication from the product's first point of view with the consumer, and it acts as a silent salesman when it is at the point of sale (Bou-Mitri et al., 2020). Packaging design serves as a powerful marketing tool in the retail context by converting shoppers into buyers in the context of food and snack products; not only does packaging communicate the various sensory features to the shoppers at the point of purchase, but it also affects the consumer's post-purchase sensory experience (Togawa et al., 2019). Therefore, packaging is one of the modern tools of integrated marketing and promotion that can be found at the point of sale. Packaging remains the most crucial factor influencing consumers in the purchase decision process.

At this point, even though the goal of food packaging is to preserve food cost-effectively, the roles in packaging must meet the industry requirements to satisfy consumer needs while maintaining food safety. Therefore, packaging design plays a role in fulfilling consumer needs and ensuring food safety because packaging design connects the form, structure, materials, color, imagery, typography, and regulatory information with related design elements and serves as a marketing strategy.

Packaging Design

Packaging design is essential for enhancing marketing communications. Packaging design is the process of designing product packaging in order to safely contain, identify, and deliver a product. It is an added value because it significantly influences customers' expectations and can be created by professional packaging design based on a systematic approach to selecting visual elements such as graphics, typography, size, shape, and color that play a role in purchasing decisions. In contrast, informational elements such as product information are

related to the cognitive intention in the pre-purchase stage (Brozović et al., 2021). Consequently, when purchasing processes are made, attracting the consumer's attention and ability to distinguish from competitors in the shop or supermarket is intended to be the main task for packaging design.

Visual Element

In packaging, the first key for a product to attract the potential consumer is the visual element because, in product packaging, the visual elements enhance the appeal of the package to the consumer. Therefore, specific packaging elements send different information about the product to the consumer and are able to influence the consumer's purchasing choices and decisions (Zekiri & Hasani, 2015).

a. Graphics

Graphic design on the packaging is used to communicate the vision, encourage merchandising, and as a strategy to contribute to the cause of purchasing behavior. Previous research has found that graphic design, such as the image on the packaging, can help build the product's brand and create its own identity by allowing the consumer to differentiate a similar product manufactured by a competitor (Yeo et al., 2020). Usually, graphics include layout, color combinations, typography, and product photography, these aid in creating an image. In terms of images, it can be divided into two types: photos and illustrations, which are generally used on the packaging of food and fashion. Moreover, the use of photos can make the food look appetizing while photos of clothes look understandable and clear while the images are created using different kinds of techniques; hence, a variety of the images on the packaging could be interpreted in a wide range based on consumer point of view (Pensasitorn, 2015). Furthermore, based on previous literature reviews and relevant research, there were four types: photos, illustrations, photos with illustrations, and typography (Pensasitorn, 2015).

Figure 4. Sample of photo and illustration types of image
Source: Advant7 (2020)

An advantage of using images in a marketing context is that images capture buyers' attention better than texts; however, presenting information in an image seems more engaging and vivid than presenting the information through texts (Schifferstein et al., 2022). Therefore, these images on the packaging design are able to positively impact brand communication information and meaning, as well as set consumer expectations towards the product.

b. Typography

Typography plays a huge role in packaging design because it helps in balancing between textual and visual elements (Mukherjee, 2019). The typeface and font for product packaging are attracted significantly on product packaging. As a result, the typeface on the packaging should be associated with written information that is easier to process, and the meaning or specific information that consumers develop depends on how easy or difficult it is to read (Petit et al., 2018).

Figure 5. Example typography on the packaging of a sauce product
Source: Ateriet (2018)

Packaging contains a variety of information about the product, and it is hard to go minimal on the text, but textual information displayed on the packaging significantly affects the consumer's expectations of a product. Furthermore, the type of a information also seems important as well (Schifferstein et al., 2022).

c. ***Size and Shape***

The item's dimensions and the outline's appearance serve as the basis for determining the size and shape of the packaging. Customers are given information about a product based on its presentation, which includes its form or appearance (Vyas et al., 2015). A well-designed combination of packaging attributes with specific visual elements can elicit emotional reactions from consumers, and the most visible packaging attributes that the packaging appears to be at first glance are shape and material (Poslon et al., 2021). According to a previous study on the packaging, it was discovered that the size and shape of the packaging would influence the purchase intention of consumers, who prefer the design of packaging that is convenient (Yeo et al., 2020).

Figure 6. Example of food packaging in various size and shape
Source: Ateriet (2018)

While size affects both the visibility of the package as a whole and the information displayed on it, shapes are an essential component of visual encouragement in marketing strategies and are essential features of packages (Chitturi et al., 2019).

d. Colour

Colors are used as a tool for both visual differentiation and brand recognition. It typically plays a role in every stage of a consumer's interaction with a variety of products, including from the initial search for a product in the supermarket aisle or online through its use to the discarding of any ways after use. Packaging colors can be developed to have an intuitive meaning for a specific product category, and the color of the packaging is related to the product's content (Garaus et al., 2019).

Figure 7 Example of same product packaging with different colour
Source: Jean David Design (2020)

Color is a visual representation of a brand, an essential component of product packaging. Color has the ability to elicit thoughts, feelings, and emotions about a product, and it has a direct impact on a consumer's purchasing decision. Based on Figure 2.7, the color representation on the packaging conveys different meanings for each product. For example, the red color is able to increase appetite, while orange is a combination of red and yellow, creating cheerfulness, energy, and enthusiasm. Several studies mention that orange color is

associate with affordable products. However, orange is the nominal favourite color among adults, but children are most drawn to it as well (Roberge, 2017). Meanwhile, purple is often associated with royalty, luxury, spirituality, and bravery, its shades are often used to denote berry flavours in food products, and brown is often identified with the earth and nature and can be recognized as natural, organic, and healthy. Thus, the color of the packaging seems to create an image of the color as well as the taste of the product inside the packaging.

Information Element

Aside from the visual element, the informational element includes product information and information about the technology used on the packaging (Tahir et al., 2018). In general, the information element provides consumers with information to help them make an informed decision about a product. As a consequence, well-designed packaging integrates appealing visual elements that are supported by informative information elements.

a. Product Information

Product information is known as printed information regarding the product. It has become a medium of information between the manufacturer and consumer as it is designed to attract consumers and motivate them to buy a product. The consumer needs accurate and detailed information regarding a food product's characteristics, properties, and attributes to make an informed choice and decision regarding their purchase. The informative function of packaging serves the purpose of providing the consumer with this sort of information so that they can make an informed choice and decision (Ankiel et al., 2020). Usually, product information such as nutritional information and food labels are progressive and significant in influencing purchase intention because purchasers, such as consumers, rely on the details or against purchasing material provided on the truthful package (Todd et al., 2022). For instance, the packaging design and informational element should be determined by considering the requirements, such as the needs and wants of the consumer and the cost of implication they have on the brand.

i. Food Labeling

Labeling provides potential in various sectors, such as economics, sociology, pharmacy, psychology, education, and others. However, in the context of food labeling, it is frequently applied to the packaging of the product, particularly food products, because it communicates the contents, product specifications, contact details, health and safety warnings, usage guidelines, and other product information. According to the World Health Organization (WHO) 2022, this information is necessary, especially for food products, because it is commonly believed that food labelling serves as “the principal means of communication between the maker and seller on the one hand and the customer or consumer on the other.”

Today, according to the current scenario, healthy food consumption is another definition of a healthy lifestyle, and several studies have highlighted the increasing demand for healthy food, particularly among young people (Savelli et al., 2019). Hence, a simplified nutrition labelling has been identified as a necessary strategy for supporting consumers in making decisions that are better for their health about the foods that they eat, and it has been proposed as a policy measure in the non-communicable diseases (NCDs) action plan for 2013-2020, which was adopted by the 66th World Health Organization (WHO) assembly in 2013 (Sulong et al., 2019). The term “nutrition labeling” refers to any written, printed, or graphic information used to inform consumers about the nutritional content of food products. This

information can be found on food packaging. Therefore, certain aspects of nutritional labels may influence consumers' motivation, attention, and ability to comprehend the nutritional information presented on food packaging. These aspects include label location, color scheme, size, and format, the visual clutter on food packaging (Cheah et al., 2015).

Additionally, labelling is used as a marketing tool, particularly in the food industry sector, because it impacts the general principle of nutritional labeling. The label should not describe a product or present information in any way that is false, misleading, or deceptive, or create a false impression about the product's character. Moreover, food labels contain information that can support consumers in building a well-balanced diet and avoiding risks that may be connected with consuming foods containing allergy ingredients. Therefore, by ensuring clear labelling, it will help consumers make proper food choices and be less crucial (Halagarda et al., 2018).

a. ***Food Claims***

Price, taste, brand, apparent quality, product familiarity, and habits remain the main reasons for food choices, but over 20 years of previous research indicate that nutritional labelling is able to drive a healthy food selection and encourage product reformulation (Shangguan et al., 2018). The composition of claims such as nutrition and health is often found in the commercial complement of food packaging (Koo et al., 2018). Among the claims that can be used on food and dietary supplements, there are three categories of claims that are defined by the Center for Food Safety and Applied Nutrition, 2022 regulation: health claims, nutrient content claims, and structure or function claims.

b. Health Claim

According to U.S Food & Drug Administration (FDA) 2018, health claims are often described as a relationship between food substances, for example, a food component or dietary ingredient and supplement, as it can reduce the risk of gaining diseases or health-related conditions.

Figure 8 Example of Health claims
Source: Kantors Creative (2019)

Dietary guidance statements used on food labels must be truthful and non-misleading. Consumers prefer the nutrient's functions and benefits to be in clear, direct, short, and simple language and avoid scientific terminology (Klopčič et al., 2020). It is their primary source of

information, and the majority of consumers have quick and easy access to the information they require, such as nutrition labels; however, the majority of consumers do not make use of nutrition labels because they either do not have enough time or are unable to interpret the information included on them (Oostenbach et al., 2019). In addition, familiarity also influences how consumers respond to these claims, such as risk-reduction claims, which are more common in contexts where the benefits are typically linked to diseases and their risk factors (Lähteenmäki et al., 2013).

c. ***Nutrition Claim***

According to the Ministry of Health Malaysia (MOH), there are three types of claims permitted in Malaysia: nutrient content claims, comparative nutrient claims and nutrient function claims. For example, nutrition content claims (such as "low in fat") or, more simply, nutrition claims describe the relative or absolute level of a nutrient in a food product (Oostenbach et al., 2019). They can be contrasted with health claims (such as "calcium helps build strong bones") that describe the properties of a food product or food component concerning health or disease (Oostenbach et al., 2019).

Figure 9. Example of nutrition claim
Source: Find This Best (2020)

Nutritional claims can be described as nutrients or energy that a product contains or provides, contains or provides in increased proportions, contains or provides in reduced proportions, or does not contain.

d. Structure or Functions Claims

Traditionally, structure or function claims have appeared on the labels of conventional foods, dietary supplements, and pharmaceuticals. Structure or function claims describe the role of a nutrient or dietary ingredient in affecting the standard structure or functions of the human body, such as "calcium builds strong bones," and they may characterize how a nutrient or dietary ingredient acts in order to maintain such structures or functions for example, "fiber maintains bowel regularity" or "antioxidants maintain cell integrity".

As a result, despite the visual elements in the packaging, the packaging is frequently overlooked as a consumer product component. Packaging, in the most basic sense, provides vital information about the product, and a wide range of design options provides a brand with practical ways to engage consumers at the point of sale. However, as packaging has evolved and new technologies and materials have emerged to meet the changing manufacturing needs among consumers and retailers, these functions are now considered standard. The key to emerging technological and material innovations during this extended period became clear

that these developments were strongly linked to previous packaging revolutions and consumer behaviors prevalent at the time.

Product development has been going on for thousands of years. Its primary utility is based on its ability to keep a product safe and dry from the outside environment. Initially, the changes were gradual; however, as society advanced, the subsequent changes accelerated (Bolanča et al., 2020). As a result, technology has been adapted in today's packaging to meet the trend and needs. Incorporating AR technologies into packaging is a significant trend that able to serve as a marketing tool and provide a service to the consumer. This is because AR is a highly visual, interactive method of presenting relevant digital information in the context of a physical environment by connecting the consumer or user to the services offered.

Insight of Augmented Reality (AR)

The most vital medium for information acquisition, information display, has been rapidly evolving since the third industrial revolution began at the beginning of this millennium (Zhan et al., 2020). AR is a technology that combines virtual and physical information. AR is a digitally enhanced version of the physical world achieved through digital visual elements, sound, or other sensory stimuli delivered through technology. This is due to the capability of augmented reality (AR) technology to superimpose 3D or 2D graphics on top of a real-world view, implying that information can be continuously updated through the design of new objects (Todorović et al., 2019).

Multimedia, 3D-modeling, real-time tracking and registration, intelligent interaction, sensing, and the application of computer-generated virtual information, such as text, images, 3D models, music, and video, to the real world are some of the features of technology offered by AR applications (Chen et al., 2019). Unlike Virtual Reality (VR), which creates an artificial environment, Augmented Reality (AR) uses the existing environment and overlays new information on top of it; consequently, AR requires fewer computational resources than VR because it only needs to render the overlaid objects rather than every pixel on the screen (Djurdjevic et al., 2018).

In today's world, the widespread use of mobile devices has made it possible for smartphones and tablets to represent all of the sensors and processing units required for an AR application to be developed and deployed. In addition, as a result of technological advancements that affect mobile devices, these devices are now able to produce new and challenging products, which are generally referred to as wearable, and industries are moving forward with the development of new categories of AR devices (De Pace et al., 2018). As a result, Augmented Reality (AR) technologies are expanding rapidly, and the widespread usage of AR technologies has an evident impact on society.

i. Mobile Augmented Reality (MAR)

Mobile Augmented Reality (MAR) has emerged as a mainstream technology associated with the popularity of smartphones and tablets, and it is currently a hot topic among researchers across fields (Dirin & Laine, 2018). In the past, mobile augmented reality (MAR) required specially built hardware installations in order to function, whereas traditional AR could only be accessed through the use of high-end computers. In fact, MAR are particularly useful whenever people need informational support for a task while remaining focused, as they allow people to interact with computer-supported information in such a way that they able to maintain their concentration (Todorović et al., 2019). Therefore, when capturing such

content using a digital camera (Bonetti et al., 2018) on devices such as tablets or smartphones or any handheld devices, wearables, projectors, or fixed interactive screens, AR draws consumers' and users' attention by giving them the possibility to interact with virtual objects. As a result, the product simulation and richness of the media create an experiential value for consumers thus, it improved their subsequent image of the brand and increased their purchase intention (Penco et al., 2020).

ii. Type Of Augmented reality

The real world is combined with a computer-generated or virtual world in creating augmented reality. It is accomplished by superimposing computer-generated images on top of real-world scenes. Marker-based AR and marker-less AR are examples of image-based augmented reality that can be utilized (Abdinejad et al., 2021). The bases each display a unique set of characteristics and functions in their respective applications.

a. ***Marker Based AR***

Marker-based augmented reality employs makers to activate the augmented experience, and these makers frequently feature recognizable patterns, such as QR codes or other distinctive designs, which serve as an anchor for the technology.

Figure 10. Example of marker based AR on product packaging
Source: Were Studio (2020)

Marker-based AR is used to target images to position the object in a given space, and these markers determine where the application will be placed in the 3D digital content within the user's field of view. The systems need to know where the user is and the position in which the user wants to focus (Boonbrahm et al., 2020). It has been proven to be sufficiently robust and accurate in all AR software kits that support maker-based tracking methods (Liu & Tanaka, 2021). An AR marker based on scanning is characterized by the fact that it initiates an augmented reality experience whenever an object, text, video, or animation appears on the device, and it typically requires software in the form of an application that enables users to scan markers from their device using the camera.

b. Marker-less Based AR

Location-based augmented reality (AR) works by reading data from a camera, GPS, digital compass, and accelerometer while predicting where the user is focusing as a trigger to pair dynamic location with points of interest in order to provide relevant data or information; thus, it is enabled by the availability of smartphone features that provide location detection and AR functions by associating an enhancement with a particular location.

Figure 11. Example of marker less AR on packaging
Source: The Box Maker (2019)

Marker-less AR has many advantages over marker-based AR because the virtual object does not need to be anchored to any image or shape in the real world to be visualized, eliminating the need for the user to print a distinct shape, image, or barcode in order to view the AR (Abdinejad et al., 2021). Instead, information and virtual objects are mapped to a specific location or touch point. Then, it will be displayed when the users' device data matches the location. Unlike marker-based AR, this type of augmented reality is made possible by the location detection capabilities of our smartphones, which recognize things that were not provided to the application in advance (Aggarwal et al., 2019).

AR is regarded as an object illusion. Because it provides information about the physical world, the user or consumer could obtain information more clearly, and it is more interesting for the consumer to engage with technology rather than traditional vision by manipulating the consumer in its way. Furthermore, AR is a beneficial application in the packaging industry due to its role. AR on the packaging is one of the technologies that allow brands to provide new experiences to consumers.

Conclusion

In today's digital era, AR has particular untapped potential in the packaging industry, as brands can use it to improve the knowledge and loyalty of their product, enhance the user experience, increase consumer purchase intention, and entice new consumers. AR offers consumers the opportunity to select or manipulate the content they view or, more specifically, interact with, which enhances engagement and results in a more compelling customer experience (UX). In addition, AR boosts the UX by exposing the users to more product information than products with no augmentation, and it leads to a higher UX at the time of the purchase, leading to a lower level of anxiety and making the decision easier.

To sum up, the food and beverage (F&B) industries have discovered new growth opportunities within existing packaging. These opportunities include smart, interactive, active, and intelligent packaging. Since the beginning of packaging, which dates back thousands of years, there has always been an evolution in requirements due to shifting consumer preferences and preferences in general. The use of AR in packaging is not only a marketing tool but also an interactive tool for customers to learn more about the food product they purchase to satisfy the demand. According to the information presented in this chapter, it is possible to incorporate augmented reality (AR) into packaging and use it as a digital communication tool between customers. For further study, the effect of user experience (UX) acceptance on the use of augmented reality in packaging design can be investigated.

Acknowledgement
The researchers thank the Seri Iskandar campus of Universiti Teknologi MARA Perak Branch for supporting this study. The researcher also thanks Dr. Mohd Khairulnizam Ramlie, who served as both the corresponding author for this work and my main-supervisor during my Master's degree studies, for his assistance and contributions.

Corresponding Author
Mohd Khairulnizam Ramlie, PhD
College of Creative Arts, Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, Seri Iskandar, 32610 Perak, MALAYSIA
Email: nizamramlie@uitm.edu.my

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