

# Development of Food Pyramid Application Using Augmented Reality (AR) Technology

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## Abstract

This study aims to develop a food pyramid application by using Augmented Reality (AR) technology to be one of the effective branches of education for children to better understand the definition of the food pyramid and how to take balanced nutrition according to category level in the pyramid. The objective of the study was to develop a food pyramid application using Augmented Reality (AR) technology that is simple and easy to play by children, build an app. This is so because the description is through a picture in reality and can clearly be visualized to them. The methodology that has been used in this study is the ADDIE model which has five phases. The results of the analytical data obtained through the quantitative approach that has been used on 22 respondents consisting of children, parents and experts have shown positive feedback on the functionality and usefulness of this application. This has been evidenced through the results of the study which showed that the percentage of respondents strongly agreed that this developed application is suitable for use by children for learning purposes and the percentage is equivalent to 91.7 percent. The analytical data collected were displayed in the form of tables, bar graphs and pie charts. Ultimately, as a result of testing on the application, it has been shown that this application can work well for the purpose of learning about the food pyramid to children. But there are still some improvements that can be done in the future to make this application more perfect for everyone's use.

**Keywords:** augmented reality, food pyramid, balance nutrition.

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## INTRODUCTION

Malaysia is known as a country rich in various types of food. However, there are also a handful of parents who fail to discipline their children to adopt a nutritious eating style, especially children who

are still children. This will cause the symptoms of children's growth be unbalanced and most likely they will be obese, too thin or dwarf. According to Harits Asyraf, (2020) the increase in the prevalence of dementia among children under 5 years old from 17.7 percent in 2015 increased to 21.8 percent in 2019. Meanwhile, according to Jenny Imanina, (2020) Malaysia is one of the three countries with obese children (aged six months to 12 years) which is 11.5 percent.

Every parent in the world would like to see their children always be in good health especially when their child is still a child. When the age of children increases to the age of the school, this is a golden time for themselves and the age of children at this stage is called the golden age. The age of children at this time is very important because they will begin to learn and explore various things in their environment, and this also helps their own development. According to Masganti (2015), the golden age is a golden age for children in their growth phase and the golden age starts from the age of 0-8 years and will continue until they enter the school stage and adolescence. Therefore, children are considered an important group that needs to be taken care of by all parties including parents, teachers, and society.

The issue of children facing health problems occurs in Malaysia is because the disclosure on the introduction of a balanced diet according to the food pyramid mould recommended by the Ministry of Health Malaysia (MOH) is poorly explained to children. A balanced diet means that any food eaten by them must have every complete component in the level recommended by the MOH such as carbohydrates, proteins, vegetables, fruits, dairy products, vitamins, minerals, and fats. A clear description of this food pyramid is just as important as a description of language recognition to children. Through the description of the food pyramid information to children, at least it is able to educate children to be more sensitive to what they take in their daily diet. In addition, it can help them grow up healthy without any health problems.

However, according to Masganti (2015), at the age of 4-8 years, children have been able to focus on whatever they want to do, where this will involve their physical movements. He also commented that children are also able to recognize every letter, number, wordbreak and picture at this age, but they are still not skilled to stay focused. Thus, among the techniques that can be used for effective learning for children is to use technological equipment such as mobile phones, laptops, televisions, and various other technological equipment today. While according to Rahmadhani Minarta (2017), the use of flashcards, 3D images combined with Augmented Reality (AR) technology can produce more interactive learning.

## **LITERATURE REVIEW**

To the general knowledge, the first AR application that was developed was from Ivan Sutherland in the 1960s. According to Dunser (2008), AR allows its users to view and interact with virtual objects in a real environment. This technology has been used for the purpose of developing various types of educational applications where it is known as an augmented book. Based on the field of reading, AR

is proven to have provided many benefits to students through the Magic Book produced and developed by Billinghamurst, Kato & Poupyrev (2011). McKenzie & Darnell (2004), expect that AR books that interact in 3D visualization, can provide a more meaningful understanding of complex content because these existing objects can be manipulated, and the content can be actively explored and able to motivate students and increase focus while supporting their immersive learning.

Past research has shown that teachers are positive about the potential advantages of AR for teaching subjects such as earth, sun and moon and they believe that in certain circumstances or situations, AR can make certain things based on daily life more effectively understood by children. (Kerawalla et al, 2006). This means that AR technology is a technology that can indeed help bring location-based experiences and learning to children with added effectiveness from the existing real-world rather than creating a new world for them. Through the combination of these technologies as well as the locations that children see for themselves, AR has the potential and ability to bring their learning out of the classroom into the space in which they live.

In addition, according to the Educate Learning Initiative (2005), encouraging accessible formal learning can be proven effective, especially for the purpose of engaging where learning can be expanded to a space that can help them form relationships with the content and location that provides context for such learning. Through the writing of Billinghamurst (2002), he asserted that AR offers unique educational benefits such as (i) AR can create seamless interactions between virtual and real communication environments that result in the added value of user interaction, (ii) Creating seamless interactions between physical and virtual objects in the AR environment with the provision of new teaching and learning strategies even if children with experience in computers are limited (so-called tangible interface metaphor), (iii) Creating an immersive environment with the probability of AR means text will no longer be a static object but allow it to help create new interactions with students.

After reviewing the articles on the use of AR in the rehabilitation of disabled persons, we found that the enhanced reality has proved to be useful in various disciplines related to persons with disabilities or those with special needs

According to Rahmadhani Minarta (2017), the use of augmented reality for learning purposes, such as reading materials can attract children to learn by visualizing fruits and animals with the help of augmented reality technology. In addition, a review about articles on the use of AR in the rehabilitation of disabled persons, found that the enhanced AR has proved to be useful in various disciplines related to persons with disabilities or those with special needs (Alshafeey et.al, 2019). Therefore, with the help of AR technology, he hopes to help to some extent to attract interest in learning and reading among children. At the end of his writing, it was stated that the development of an introductory book on fruits and animals had been successfully implemented. Therefore, throughout the study of food pyramid application development using Augmented Reality technology was implemented, the researcher has used several reference sources from the scholarly writing of

Ramadhani Minarta (2017). It aims to get additional ideas and info to develop an application that uses Augmented Reality technology in the world of education and the era of globalization today for children. Through ideas and additional info from previous references, the application that will be developed must be a good application and able to contribute knowledge and be able to attract children to learn with fun.

In addition, among the previous studies that use AR technology in the teaching and learning process is from the study of the Use of Augmented Reality (AR) to Improve English Word Reading Skills of Preschool Children, writing from Sharmili Nair Vargavan (2021). According to him, this study aims to look at the use of AR technology in improving the English word reading skills of preschool children. The advantage implemented in this application is that the model developed in AR will move while producing video, audio of English words for each picture displayed in the created product. Each picture scanned by the user will produce sound with the help of the use of Blipp AR



**Figure 1:** English Preschool AR

software. This can also attract children to read because the use of audio is indeed a thing that will attract children. Using AR, the pictures and videos displayed will be visible on a real surface just like a real object. Figure 1 shows an example of the use of a material or product that has been invented by Sharmili Nair Vargavan (2021).

Next, Syafriani et. al. (2014), has used Augmented Reality technology as a guide or interactive learning module for students in schools who use android smartphones in schools for the purpose of solar system teaching delivery. In this development, he uses markers as object markers to display virtual objects. Each marker produced will be done in a booking sheet that has a front page, content and back page display. Then a picture in a marker that has a 3D object will be printed and when the AR camera is pointed at the marker then a 3D object that looks like a real object on the solar system will appear in the Figure 2.



Figure 2. 3D Solar System Planets

Nurhazarifah et al. (2017) had developed a mobile AR application for early Arabic language education: Arabic. Based on the data of a study conducted by Nurhazarifah et al. (2017), this application can be used by respondents easily according to the available categories such as ease of use of the content of respondents, ease of use of the application, user satisfaction. Every feedback collected in this study showed a positive impact from the students. This application is not only focused on students, but it can also be used by parents, teachers who teach children within 7 years for educational purposes. This application contains features that are so practical where it has a combination of elements such as animation, 3D object models, video, graphics and audio. Apart from the purpose of developing this application to be used as a learning module, it can also be used as a training module for students.

## METHODOLOGY

This section will provide a description of the research methodology which consists of the selection of methods, study samples, study instruments, study design and methods to analyze the data that have been used during the implementation of this study. According to Ang (2016), the selection of appropriate methodology is an important aspect before conducting research development. This is because it serves as a guideline that should be referred to from time to time to ensure that research can be implemented or carried out in a systematic and planned manner. The main purpose of this study is to develop a food pyramid application using Augmented Reality (AR) technology so that it can be one of the effective branches of education for children to better understand the definition of food pyramid because of the description through reality and clearly visualized to them.

Therefore, this section will involve the development stage of the application. Since the researcher has chosen the ADDIE model as shown in Figure 3, then there will be five phases that will be discussed in this chapter. The first phase is the analysis phase (Analysis), the second is the design phase, the third is the development phase, the fourth is the implementation phase and the last is the evaluation phase (Evaluation).



**Figure 3:** ADDIE Model

## **DESIGN AND DEVELOPMENT**

Design is an important phase to determine the overall product to be developed so that the product or application can help users and achieve the objectives of the study. In fact, this phase is useful for researchers and product developers to plan the production of effective learning applications about the food pyramid with the help of AR technology and explains in detail and structured the use of each element to be used such as audio, video, text, graphics and animation. For application development, the use of multimedia elements is important that should be considered by every developer. This is because the use of complete multimedia elements can attract the interest and focus of children or users of the application to use it. There is several software that has been used for the purpose of product development or application of this food pyramid. Among them are:

### ***Unity 3D***

Unity 3D is an application used for the purpose of game development or is often understood as a game engine. Usually, unity is a game engine to design 3D models, but it can also be used to design games that use 2D models. Unity 3D is known as a cross-platform toy machine where it will help build and integrate 3D objects in an AR environment with an Integrated Development Environment (IDE). This will indirectly allow developers to write command code in programming languages that are very popular today, namely C ++, JavaScript or Python. The use of Unity 3D software is very important and useful during the implementation of AR technology that will integrate with 3D models in the design phase.

### ***Vuforia SDK***

Vuforia is an augmented reality software development kit (SDK) for mobile devices that creates

augmented reality application development. It uses computer vision technology to recognize and detect planar images and 3D objects in real-time. Vuforia SDK is a platform that is usually used by developers for the purpose of editing the marker as an image or target image before it is implemented into other software such as Unity. It is also used for the purpose of building Augmented Reality, Android, iOS and UWP applications for mobile devices and AR glasses where it will create an AR experience that will interact realistically with objects and environments. Vuforia Engine can be accessed through Unity Package Manager by adding a repository of Vuforia packages using specific scripts. Vuforia Engine is the most widely used platform for AR expansion purposes through support for smartphones, tablets, and AR glasses.

### ***Android SDK***

Android Software Development Kit (SDK) is a set of development tools used for the purpose of application development for the Android platform. This SDK will provide a selection of tools needed to develop Android applications as well as ensure every process runs smoothly without any errors. It is also a software development tool and library needed for the purpose of developing Android applications. Whenever Google updates or launches a new version of Android, the appropriate SDK will also be launched where it must be uploaded by the developer. Android SDK Platform-Tools is a component for the Android SDK. This includes tools that interact with Android platforms such as ADB, fastboot, and systrace. This tool is very necessary for Android application development, and it is needed if the developer wants to unlock the bootloader of the device and use it with a new system image. The software is used to process and develop the interface and implement 3D animated objects in Unity. Figure 4a and 4b shown the interface that has been developed in this software has several buttons or navigation icons as well as links to open the AR camera for the purpose of marker detection (scan marker). Subsequently, the 3D animations created will then be integrated or incorporated into the Unity software for the purpose of perfecting food pyramid applications using AR cameras.

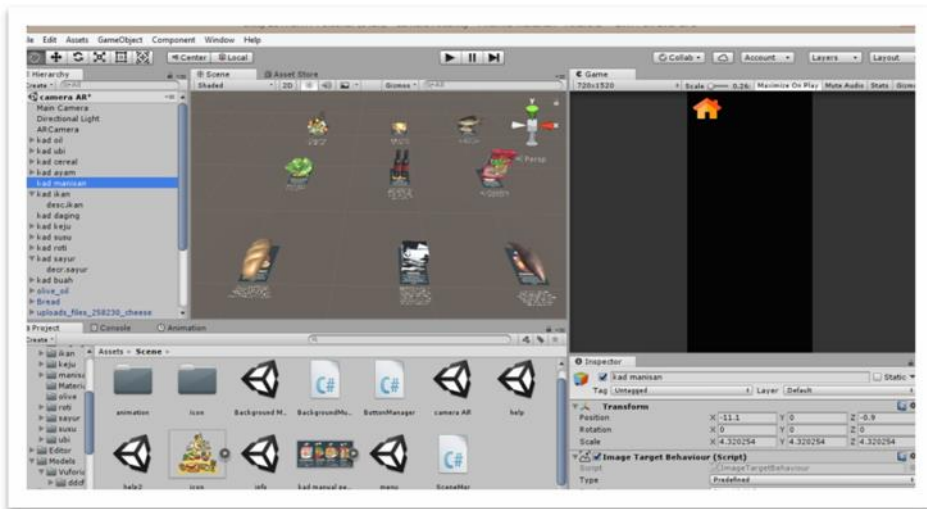


Figure 4a: The process of designing the interface and buttons as well as application icons



Figure 4b: The implementation process of object animation and 3D writing

## ANALYSIS AND RESULT

Each study found based on the feedback received from the respondents through the questionnaire questions will be described in this section. The researcher has prepared two different forms of questions according to the category of respondents in the form. This is thus aimed at obtaining feedback on the functionality and usefulness of food pyramid applications that use Augmented Reality technology from the perceptions of children, parents and experts. All the findings of the study are presented in the form of Table 1.



**Table 1: The Finding of the study**

No	Questions	Scala				
		1	2	3	4	5
1	Is the user interface of this application user-friendly?	0	0	0	0	12 (100%)
2	Is the design of the icon and navigation buttons in the app appropriate and working well?	0	0	0	2 (16.7%)	10 (83.3%)
3	Is the design of this app responsive to your usage?	0	0	1 (8.3%)	11 (91.7%)	0
4	Does the use of AR cameras in the app work well?	0	0	0	0	12 (100%)
5.	Is this application suitable for use by children for learning purposes?	0	0	0	1 (8.3%)	11 (91.7%)
6.	Does this whole app work well?	0	0	0	8 (66.7%)	4 (33.3%)

Based on Table 1, referring to the research question (1), total 12 (100%) have chosen a scale of 5 which is they strongly agree that this food pyramid application has user-friendly interface. This aspect is very important in an application to make it easy for users to operate it, especially for users who are new to using an application for the first time. While research question (2) shows that most respondents strongly agree that the design of the icon and navigation buttons in the application is suitable for use, and it works well. The number of respondents who strongly agreed were 10 people and the percentage was 83.3 percent. Lastly, only 2 respondents who chose scale 4 (16.7%) which is agreed that this application has an icon and navigation button design that is suitable, and it works well.

Whilst for research question (3), the finding shows a total of 11 respondents chose the scale agreed that this application is responsive to their use when testing the food pyramid application using AR camera. Only one respondent chose scale 3 which represents a moderate choice. Based on the percentage rate, for respondents who chose scale 4 is 91.7 per cent and respondents who chose scale 3 is 8.3 per cent. As for the research question (4), the finding shows that all 12 respondents which is 100 per cent, strongly agree that the AR camera in this application works well. The function of the AR camera in this application is very important because it is the main aspect focused on the study which is to provide a teaching concept that provides a 3D image like a real object.

Next, the research question (5) respondents who chose the scale strongly agreed on the level of functionality of food pyramid applications that use AR technology for learning purposes is a total of 11 people and the percentage rate reached 91.7 per cent. However, there is one respondent who has chosen the answer choice on scale 4 and pushed the percentage rate of scale 4 to 8.3 per cent. The last research question showed that respondents consisting of experts and parents who chose scale 4 had the highest percentage of 66.7 per cent where a total of 8 people agreed that the entire food pyramid app that uses this AR technology works well. The other 4 respondents have chosen the answer on a scale of 5 for the given question and the percentage rate for scale 5 is 33.3 per cent.

## CONCLUSION

Based on each analysis obtained by the researcher for the study of food pyramid application development using AR technology has shown positive feedback from respondents and proved that this research successfully achieved all the objectives of the research. However, this research also still has some improvements that need to be done according to the opinions of respondents who have been involved in the survey of questionnaires distributed online. Through this questionnaire, the researcher can see more clearly the number of respondents who gave feedback on the products that have been developed.

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