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Integrating Augmented Reality in Learning Type of Roses

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Abstract

Roses are commonly known for their ornamental looks and their usage in the perfumery industry. There are many types of roses available and some of them are rarely found, which limits the opportunity for people to recognize and learn about them. Thus, Learning About Types of Roses Using Augmented Reality is developed which focuses on learning about their species, types and color using mobile augmented reality technology. The project's main goal is to provide an alternative by providing engaging interactive learning to capture the attention of modern generations. The objectives of this project are to identify the scientific name, color, family, shape, and facts about the rose, to develop an augmented reality (AR) application using QR marker on Android platform, and to evaluate the effectiveness of the augmented reality mobile application. The methodology for this project is MADLC which is mobile applications development life cycle. It consists of five phases, which are to identify, design, develop, prototype, test and deploy. Overall, the system's design and execution were successful and performed as intended. The test results demonstrate that the project was successful in adhering to the project objectives. Perhaps, using the Augmented Reality technology would help people learn about roses effectively because they will be able to visualize the roses and learn their features easily.

Keywords: Roses, Mobile Application, Augmented Reality, MADLC, Android Platform.

Introduction

Roses come in over 300 varieties and tens of thousands of cultivars. Wild roses bloom only once a year and are pollinated spontaneously by insects. It has been widely used in the food industry as well as skin product industry for years. For example, rose syrup which is made from rose water and added with sugar. Besides, some people raw eat rose petals since they are edible, and it contains ingredients that make skin stay young and healthy. Exposure to flower education is important to encourage people to appreciate nature and be grateful to the creator and to be able to further expand the knowledge of existing flower species.

Some people are interested in knowing more about types of roses either for their own needs or for business purposes. Informative books about roses may be available in the market but they are conventional and less engaging. Besides, it is difficult to find the exact rose that they want to search from the search engine such as google without knowing its real scientific name. Without knowing its scientific name, people might get misinformation and lead them to a different type of rose. Based on Syahputra et al., (2021), it is necessary to be aware of the existence of rare plants to maintain and protect them so that they do not become extinct. By learning more about rare types of roses, we can indirectly learn how to preserve the ecosystem.

Nowadays, technology is seen to be growing rapidly in various aspects of life including education. In line with this development, information and communication technology has been utilized as a tool in assisting teaching and learning activities (Matimbwa & Anney, 2016; Balash et al., 2011). The use of applications for mobile devices has become a most debated issue in the education field. Flexibility, ease to use, easy to carry, user-friendliness, small, and various other capabilities make it valuable and necessity nowadays (Razali & Khalid, 2021).

This mobile education can be further enhanced with the use of Augmented reality (AR) technology. AR is a term that refers to the merging of real-world and computer-generated data (virtual reality), in which computer graphics items are blended into real time film. As a result, technology works through improving a person's existing experience of reality (Syahputra et al., 2021; Scholz and Smith, 2016). It is a very helpful application which will help everyone learn types of roses just by scanning the quick response code (QR code). Without the need for any specific high-end technology device people can already be exposed to augmented reality technology and at the same time they can enjoy using the application. Qamari & Ridwan (2017) state that AR technology has so far been utilised to create instructional materials in museums and in the medical profession, but it has also been used to successfully apply in the field of education.

Therefore, an Augmented Reality mobile application was developed, named MAWAR AR, for educational purposes which can help people in learning type of roses using customized card that have QR code. By using Augmented Reality, people can feel the existence of the image virtually and it can offer new and exciting ways to discover types of roses. Besides, this application also can help the roses industry in automize identification which is easier for people to know from which family or habitat that the roses came from. It is also very helpful and attractive since this application uses augmented reality technology rather than just reading a static page.

Related Works

Augmented reality (AR) is a group of technologies that allow computer- generated content to be mixed with live video in real time (Klopfer & Sheldon, 2010; Lara-Prieto et al., 2015; Arkan et al., 2023). Augmented Reality (AR) has been used in a variety of collaborative and cooperative human–robot industrial applications (Costa & Petry, 2022). Augmented is widely used in e-commerce, education, healthcare, and entertainment. Augmented reality can enhance customer experience, improve brand visibility, increase business performance, accessible training and improve safety, and enhance navigation.

AR technology has contributed a lot in the education field, and it has been applied to assist in the learning process. Using a gadget of some kind, AR builds upon what you already see in the actual world. The most widely used platforms for augmented reality now are mobile devices

and tablets. Using the device's camera, augmented reality apps superimpose digital material over the real world. It is because this application is easy to use for students. They do not need any specific hardware to use such as virtual reality and it is cheaper. With its greatest ability to help in learning process, AR technology has been utilized in learning plant by some researcher. Ibrahim et al (2022) has developed an ARPlant prototype which provides an interactive learning that displayed rainforest plant's information. Wilujeng et al (2019) make use of AR to develop multimedia learning materials to introduce plant morphology structure especially Wijaya Kusuma flower. Mohd (2020) also developed one mobile learning application, *Jom Kenali Bunga Malaysia* that offer children a new and exciting ways to discover Malaysian flowers. Syahputra et al (2021) designed learning media based on Augmented Reality in recognizing rare plants.

There are two types of AR, geographic location-based and computer vision-based (Zhao et al., 2018). Location-based augmented reality enables developers to associate geo-based markers with interactive and helpful digital material. This AR technology is applied in various business systems, such as Alipay launches the *ARreal Red Envelope* (Nian, 2017), *Baidu Map* that guide the user to their destination, and *Pokemon Go*, a popular game that search hidden treasures (Nian, 2017). Meanwhile, computer vision-based AR mapping the real world and virtual world by using computer vision (Zhao et al., 2018). This type of AR can be divided into two categories, Marker-Based AR and Marker-Less AR. Marker-Less augmented reality scans the area and requires no trigger photo but marker-based augmented reality experiences require a static image, or trigger photo, that may be scanned with a smartphone app. Example for marker-based technology is The Good Crisp Company spreads goodwill simply by scanning a QR code from the packaging with a smartphone and it will display holiday scenes in 2D from the packaging.

In this project, marker-based technology is used since it allows the user to experience the 2D flower around the marker and it is easy if used by children. Detailed instructions are not required for people who use it for the first time. This project uses marker-based technology instead of marker-less because if using marker-less technology people will find it difficult to utilize on a white background or other single-color surfaces.

Methodology

Mobile Application Development

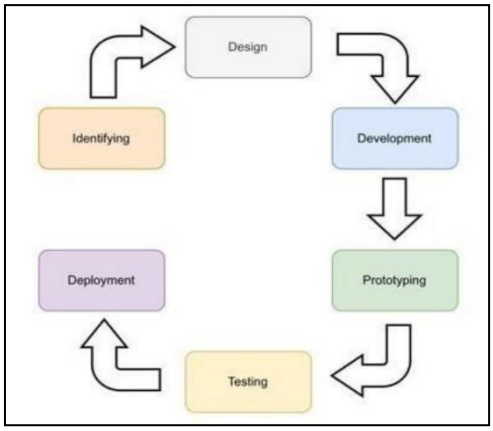


Figure 1. Mobile application development life cycle.

The design and development of the application follows Mobile Application Development Life Cycle as shown in Figure 1. It covers identifying or analysis, design, development, prototyping,

testing and deployment. The analysis phase focused on the learning objectives, project's scope, limitation, and relevance information related to the application. Next is the design phase that concentrated on designing the system architecture, user interface and storyboard of the application. The architecture of the system is a reaction to the conceptual and practical difficulties associated with characterising and creating complex systems. The software that is used in this activity is Draw.io.

A user interface (UI) is a platform of communication between humans and computers. A user interface (UI) aims to allow a user to effectively control a device with which the user interacts and receives feedback to communicate the completion of tasks effectively. To design the application of user interface, the software that is used is Adobe XD. The storyboard design is the last activity for this design phase. Storyboarding provides a rough outline of the project's appearance, including the placement of the subjects, the links, and a conceptual sense of where the photos will go, what the layout will look like, etc. Adobe XD is also used in this activity to design the storyboard.

The development stage involves the application's coding. The coding is done on two platforms interchangeably based on the developer's preference. The programming language used in the development phase is Java along with HTML and CSS. Initially, the application is coded on Visual Studio Code. The whole code is then pasted on unity, which is a cross-platform game engine. On Visual Studio Code, the former code is then altered and refined based on the errors found in the initial code. Next, the prototype of the application is sent to the client for any feedback after it has been tested by the developer. The testing stage is conducted to test the reliability of the application. There are two tests run for this application, functional test, and user acceptance test. The last phase is deployment where the application is uploaded to the android platform and made available for users to download.

System Architecture

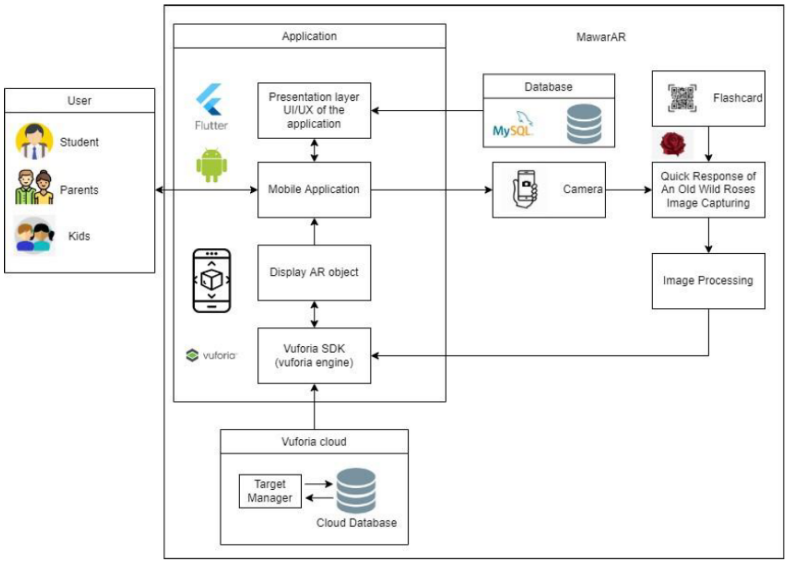


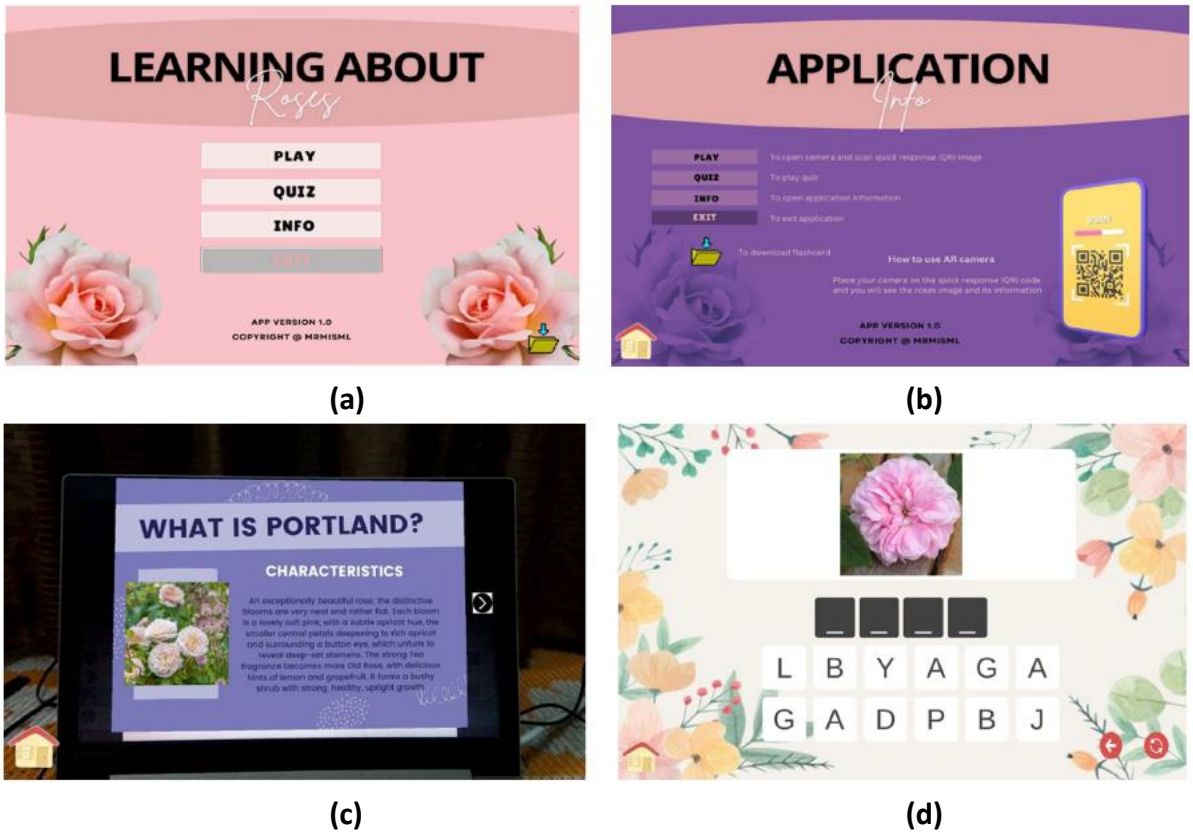
Figure 2. System Architecture

Figure 2 shows the system architecture of the project. Starting with the user, which may consist of the students, parents, and kids that use the mobile application. Flutter software handles the user interface (UI) and user experience (UX) of the application. Database, MySQL was used to store data about the application like image, question, audio, and many more. Firstly, the user uses the camera of the smartphone for image capturing. The source of image

capturing is from the quick response code, from flashcard. This process will proceed to image processing to detect the marker. This project is using Vuforia cloud to save the marker image which the quick response (QR) code. Prepared images will be uploaded to the Target Manager and accessed using Model Target Web API. In this process, an AR marker can also be detected to determine the position.

The next system architecture process is Tracker. The tracker is used in this process to calculate the relative position of the camera in real-time. The input image will be uploaded to the target that needs to be tracked during this phase. The mobile application can access target resources by accessing the target manager using web service or downloading from the target manager to be linked to the mobile application. Rendering is the next step in the system architecture to calculate the pose from tracking. The rendering process will then combine the original image and the virtual components by calculating the pose and rendering. Finally, the magnified 2-dimension image of the roses will display on the screen of the mobile device.

User Interface



(a) **(b)**

(c) **(d)**

Figure 3. Mawar AR application interface

Figure 3 shows the interface of MAWAR AR application. Figure 3(a) shows the front page of the application that displayed play, quiz, and info buttons. Meanwhile, Figure 3(b) shows the information page that guides user on how to use the application. Once the user clicks “play button”, this page will automatically access the camera and users can start scanning the QR code. The information of the roses will be displayed as shown in Figure 3(c). The best part of this application is the “quiz page” that was created to test user’s understanding towards type of roses presented in the application as shown in Figure 3(d).

Application Testing

The testing phase of this project is intended to test and ensure that the application's usability is acceptable to users and that the entire application functions properly. This phase is critical for determining whether the project's objectives have been met. There are two testing that took place, expert testing and user testing. Expert testing has been done by the florist and system developer and user testing has been done by the 50 android users ranging around 13 years old to 50 years old near Bayan Lepas, Pulau Pinang. Immediately after using the application, the participants were asked to evaluate the application using the System Usability Scale (Brooke, 1996). Survey questionnaires are incorporated in this test to learn what users thought of the application after they used it. There are 5-point Likert scale used which are 1 (Strongly disagree), 2 (Disagree), 3 (Neutral), 4 (Agree), 5 (Strongly agree) and 10 evaluation questions to be answered as shown in Table 1. Meanwhile, Table 2 shows the evaluation questions for user testing.

Table 1
Evaluation questions in the survey for subject matter expert testing.

1	This application is very easy to install.
2	I think this mobile application is easy to use.
3	I think this mobile application can assist people learn about old/extinct roses.
4	I found various functions in this application are well integrated.
5	This user interface is very user-friendly.
6	I think people will love to use this mobile application.
7	This application is very compatible with the operating system.
8	I think this mobile application can be used for other learning activities.
9	The application's features easy to handle.
10	I am satisfied with the overall performance.

Table 2
Evaluation questions in the survey for user testing.

1	Have you used any mobile application that use Augmented Reality before?
2	After using the app, do you think it can assist people in learning old/extinct roses?
3	Do you think this application fun and engaging?
4	Do you think this application is easy to install and use?
5	Do you agree AR technique can be adapted in the learning process?
6	Will you recommend this app to others?
7	Overall, do you satisfy with this application?

Result and Discussion

Table 3 presents the result from subject matter expert testing. This testing has been done to evaluate whether the application is functioning well as expected. Based on the results, it is clearly identified that the expert 60 % – 90 % strongly agreed with most of the questions. 90% strongly agreed to the application performance, it shows that the application is acceptable to be presented to the end user for further testing.

Table 3
Result from subject matter expert testing.

Question	Percentage (%)				
	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1	-	-	-	20	80
2	-	-	-	40	60
3	-	-	-	40	60
4	-	-	20	20	60
5	-	-	-	40	60
6	-	-	20	20	60
7	-	-	-	20	80
8	-	-	-	30	70
9	-	-	-	20	80
10	-	-	-	10	90

Once the developer received good result from expert testing, the application is introduced to the end user. Table 4 presents the result from user testing phase. Based on the result, most respondents provided positive feedback and are satisfied with the application. 90% of the respondents do agree AR technique can be adapted in the learning process.

Table 4
Result from user testing.

Question	Percentage (%)		
	Yes	Not Sure	No
1	50	10	40
2	90	10	-
3	100	-	-
4	100	-	-
5	90	10	-
6	80	20	-
7	100	-	-

Conclusion

The developed application uses marker-based Augmented Reality, which focuses on learning roses species, types, color, and more using Android mobile platform. The project's main goal is to provide alternative interfaces by utilizing engaging interactive learning to capture the attention of modern users. Overall, the system's design and execution were successful and performed as intended. The test results demonstrate that the project was successful in adhering to the project objective put out in this project. Besides, this application can help spread knowledge on roses species and improve knowledge about the ecosystem. There are some limitations encountered in this project such as, this application can only be downloaded by android user and the roses cannot be displayed in 3D mode since the operating system

does not meet the minimum requirements to do the 3D image. These limitations will be considered and encountered in the future work.

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