The Application of Augmented Reality Technology on Promoting Tourism Industry in Malaysia

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Abstract. Augmented Reality technology brings people to experience a real-life environment in digital concepts. Augmented reality technology has been widely used in various fields, such as education, business, and gamification. As for tourism purposes, AR technology was injected to enhance physical tourism locations and tourist attractions. Some hotels integrate augmented reality technology to provide their customers with a clearer view of their rooms and facilities. In Malaysia, augmented reality application for tourism aspect is rarely can be found. The exposure of augmented reality technology in tourism marketing is also relatively new. In early 2020, due to the COVID-19 pandemic, most tourist attractions needed to close their operation and lose their income. As for wildlife parks like Snake and Reptile Farm and Zoo Negara, they also face difficulty feeding their animals due to the decreasing number of visitors. Some wildlife park request donors to support their feeding costs and management, for example, Zoo Negara. While visitors, especially children, miss the real-life experience of visiting the Zoo during the pandemic. Hence, augmented reality technology needs to be embedded in the Malaysian tourism sector, especially in the wildlife parks, to overcome the issues. For this paper, a mobile augmented reality application with an attractive scannable book has been developed for the Snake and Reptile Farm, Perlis. This augmented reality application was tested and received promising feedback from the user as well as the park management. The application was used to promote and collect funds when the user bought the scannable augmented reality book. The user also can watch their favourite animals in action when they scan the provided image marker in the book. In conclusion, augmenetde reality technology is very supportive and useful for advertising and raising funds for Malaysian tourist places. Comprehensive actions need to be taken to digitalize current tourist places as it may provide a larger opportunity to introduce Malaysia to the world.

Keywords: Augmented reality, tourism place, wildlife park.

INTRODUCTION

The impact of Covid-19 pandemic accelerates the rapid growth of technology in most sectors, including education, tourism, manufacturing, and health. The pandemic has led us to a new way of life or the 'new norm' environment that requires us to be more aware of health issues and get used to various technological software and devices to support our daily activities. The Movement Control Order (MCO) during the Covid-19 pandemic

negatively impacted the tourism sector and made some tourist attractions need to close their businesses (Ayittey et al., 2020). For the wildlife center, aquaria and zoo's in Malaysia, most of their funding typically depends on the visitor (Kamarulzaman, 2020; Wong, 2020), ample funds, and donations from people (Kamarulzaman, 2020). The MCO reduced the number of visitors and greatly impacted the operational cost. Cheema (2020) said, Malaysian zoo has been sustaining on emergency funds during the MCO. Kevin Lazarus, the chairperson of the Malaysian Association of Zoological Parks and Aquaria (Mazpa) reported Zoos and aquaria lost 98% of their funding during the MCO. Hence, the tourist industry should take a new step, move toward digitalization, and apply the latest technology, including augmented reality.

The introduction of the Pokemon GO mobile game in 2016 (Figure 1) made augmented reality a part of popular culture. It has become a phenomenon where we can see people hunting for their Pokemon in most places. In this game, the players can collect points by walking around in the real world to search, catch and collect virtual characters, called "pocket monsters", which are located at specific geographical locations (Nayyar, Mahapatra, Le, Suseendran, 2018). This game application also makes people realize that the augmented reality application can engage people worldwide in a single augmented platform and provides them with the best experience by transforming their physical environment into a new dimension. The augmented reality technology generates a virtual interface in 2D or 3D model (Elmqaddem, 2019) for a real-time indirect and direct view of a physical, real-world environment using computer-aided tools (Carmigniani & Furtht, 2011; Martin, Bohuslava, & Igor, 2018). Augmented reality is considered a component of mixed reality, which also includes augmented perspective that allows the actual objects are integrated into a virtual environment (Iatsyshyn et al., 2020). Augmented reality enhances the view of the real-time object and makes its characteristics and perception more visible to the user as they are integrated with the existing physical environments.

FIGURE 1. Pokemon GO Augmented Reality Game

Augmented reality not fully immerses the user in the virtual world like virtual reality, as the user can still perceive the environment around them when using the technology (Elmqaddem, 2019). With augmented reality, most of what the user sees is still the real world (Yung, Khoo-Lattimore, 2017). Boyles (2017) highlights the difference between virtual and augmented reality in terms of how the augmented reality application can modify a real-world picture with digital images or text only. In contrast, virtual reality needs to

build and design all elements in the virtual world. Most mobile-based augmented reality applications require users to hold their devices with their hands, as some of these applications might require the user to engage in outdoor activities. This augmented reality can enhance user experience (Cranmer, tom Deick & Fountoulaki, 2020) and encourage user interactivity with the surrounding (Boyles, 2017) when using the applications.

LITERATURE REVIEW

Augmented reality is a technology that receives positive momentum around the globe. The augmented reality application is widespread on the internet and downloadable by the user. The positive perspective of this technology increases the demand for augmented reality applications in most sectors, including tourism.

Tourism industry players recognized the potential application of augmented reality in tourism as early as 2000 (Jingen Liang & Elliot, 2020). Since then, many augmented reality applications have been introduced to the user. Nayyar et al. (2018) emphasise that augmented reality applications play an important role in tourism, especially in delivering real-time and reliable navigation at unfamiliar tourist locations. The researcher also highlights the impact of augmented reality on advertising the tourist attraction place via its attractive features, especially when the guests interact with their apps.

Space museum is an example of an augmented reality application developed by Huang et al. (2019) to represent the solar system in augmented mode (Figure 1). The application provides auditory information about the facts of the planet while the planet's size is visually presented. This research concludes that the augmented reality application provides better auditory information to the user than visual information. It also suggested that augmented reality applications best communicate important information in an auditory format.
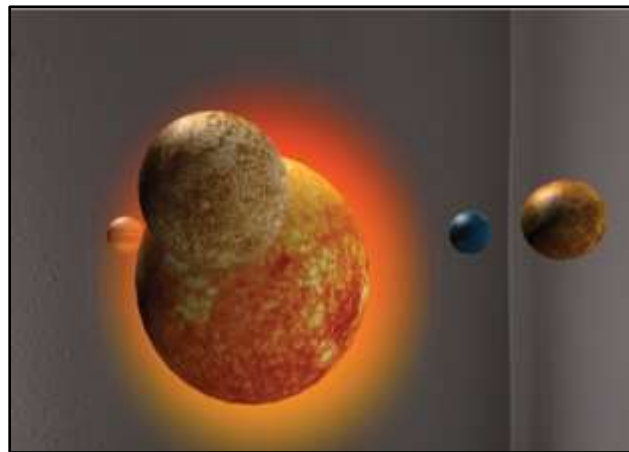

FIGURE 2. Example of Interface for Solar Museum Augmented Reality Application

Saragih and Suyoto (2020) also introduce an augmented reality application to promote tourism sites in Batam, Indonesia. The application provides a detailed description and the map location of the tourist attractions to the tourist. The application also provides a function where users can scan a marker object to allow them to interact with the visited tourist attraction environment. However, this application focuses on textual information instead of auditory information, contradicting a suggestion by Huang et al. (2017).

Monumen and historic tourist attractions like museums, the visitors' satisfaction is the most crucial element. Thus, embedding augmented technology could be a helpful tool in enhancing the value of the customer experience when they visit the museum (Serravalle et al., 2019). He, Wu, and Li (2018) researched the impact of information type and augmenting immersive scenes on visitors' evaluation of the augmented reality-facilitated museum experience and their subsequent purchase intentions. The research used Vincent van Gogh's painting titled Starry Night over the Rhone (Figure 3), along with an augmented reality display with various design element combinations. Their study reveals the important implications of technology adoption and experience design for tourism and hospitality practitioners. They also propose that museum practitioners may attempt to use augmented reality to bring portraits alive. This augmenting immersive scenes can effectively enhance visitors' perceived virtual presence and facilitate mental imagery processing.

FIGURE 3. Video Describing a Museum Experience Using Augmented Reality

Wildlife centers are one of the tourist attractions affected by the Covid-19 pandemic. The major impact is not only on their income but also on the survival of the animals. Wong (2019) reported, in April 2019, the horrific possibility of animals, from elephants to slow lorises, starving to death behind bars shocked Malaysians. An intensive strategic plan to prevent the issue from happening again in the future needs to be resolved. Promoting augmented reality technology in the wildlife center would benefit in multiple ways, especially for advertising proposes, leveraging the visiting experience, and making their tour more entertaining.

In Bandung, an augmented reality photo booth with animal-based was developed by Julio and Satiyadi (2019). The application applies leap motion technology to allow the visitor to interact with the augmented animals. The visitor can imprint their augmented reality experience in a printed photo. However, there are very few animals on the application; tiger, bear, eagle, and elephant, make the option too limited for the visitors. Figure 4 illustrates the camera menu view from the photo booth application. Cho, Kim, Oh, and Chung (2018) research, in conjunction, proposes an application to help visitors tour the zoo. This Anisearch application (Figure 5) integrates augmented reality technology to locate the animal's position using GPS and implements image recognization technology to verify the animal. Details information about the animal is viewable when the user clicks the info button. The digital animal information from the augmented reality application allows all visitors to read the animal information on their device, which is more effective

and convenient for the visitors than a single printed animal description board. This printed information board is usually placed in front of the animal cage but is difficult to view due to many visitors. The augmented reality application in this study shows the good side of augmented reality technology in delivering information to the user.

FIGURE 4. Augmented Reality Photo Booth Application from the Camera Menu View

FIGURE 5. Anisearch Animal Information Interface

Augmented reality application for Malaysian tourist places is hardly being found. This research purposely introduced an augmented reality application for one of the tourist attractions in Perlis, Malaysia, Snake and Reptile Farm.

METHODOLOGY

The AR Virtual Snake Park was developed using Agile methodology. As shown in Figure 6, Agile Methodology consists of four main phases: Phase 1: Plan, Phase 2: Build, Phase 3: Launch and Phase 4: Feedback.
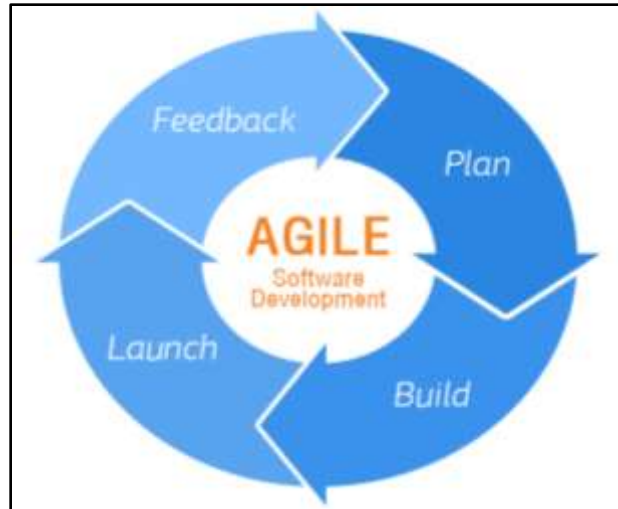
FIGURE 6. Agile Methodology

Agile methodology is selected to develop this augmented reality application since it is suitable for lightweight development and needs a faster software development process (Abrahamsson et al., 2017). Since this project needs to be completed within four months, this is the most suitable methodology. Based on these four phases, an explanation will be made in the following paragraph.

Phase 1: Plan

In the first phase, project objectives, problems, and project planning were formulated to set the milestones for the whole development process. This park was chosen because this tourist attraction is one of the famous wildlife sanctuaries in Perlis. Furthermore, the Snake and Reptile Farm is also affected due to the Covid-19 pandemic. In addition, the number of visitors to the Snake and Reptile Farm is not very promising especially when it is located in the small northern state of Malaysia, Perlis. There is also minimal promotion and limited advertising platforms to promote the park. As seen from the following website (https://itc.gov.my/listings/perlis-snake-park/) there is too little information about the park. Only several online pictures of the wildlife animals from the park are included on the website, which is too few to promote and introduce the park to people.

Once all the team members had agreed on the project objectives, the Snake and Reptile Farm manager was informed to get permission and set an interview to collect the required information for developing the augmented reality application. After the interview session was conducted with the park manager, the project requirements were successfully gathered. This information is used in the next phase, which is the Build phase. Several other discussions were held between the researcher and the owner of the Snake and Reptile Farm to clarify doubts and understand the process flow.

Phase 2: Build

Building the augmented reality application is divided into two main steps: Step 1: Designing and Step 2: Development. In Step 1: Designing, there are several interfaces and models that need to be carefully constructed. The design step is important since these interfaces and models are referred to in the second step, the Development step.

Several UML models were selected in order to describe the augmented reality application in detail. Models such as Data Flow Model, Flowchart, and Context Diagram were drawn first to highlight the important information on the data and the application flow. Figure 6 shows the Context Diagram of the augmented reality application.
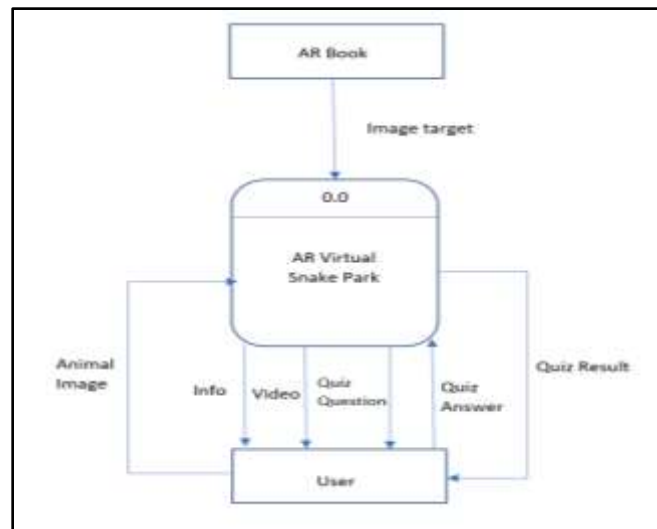

FIGURE 7. Context Diagram

There are two main entities for this application: the AR Snake Park Book, which produces the image target (marker) for the user to scan on the augmented reality application, and the user with several interaction functions with the system. Users can send the scanned animal marker to the application, can take the quiz on the application and also view the quiz results that had been taken. It can also be seen that this augmented reality application also generates animal info for the user. There are also videos on the wildlife animal living in the Perlis Snake Park that the users of the augmented reality application can view. As the functionality of the system has been clearly stated in the context diagram, the next step is to create the Data Flow Diagram (DFD).
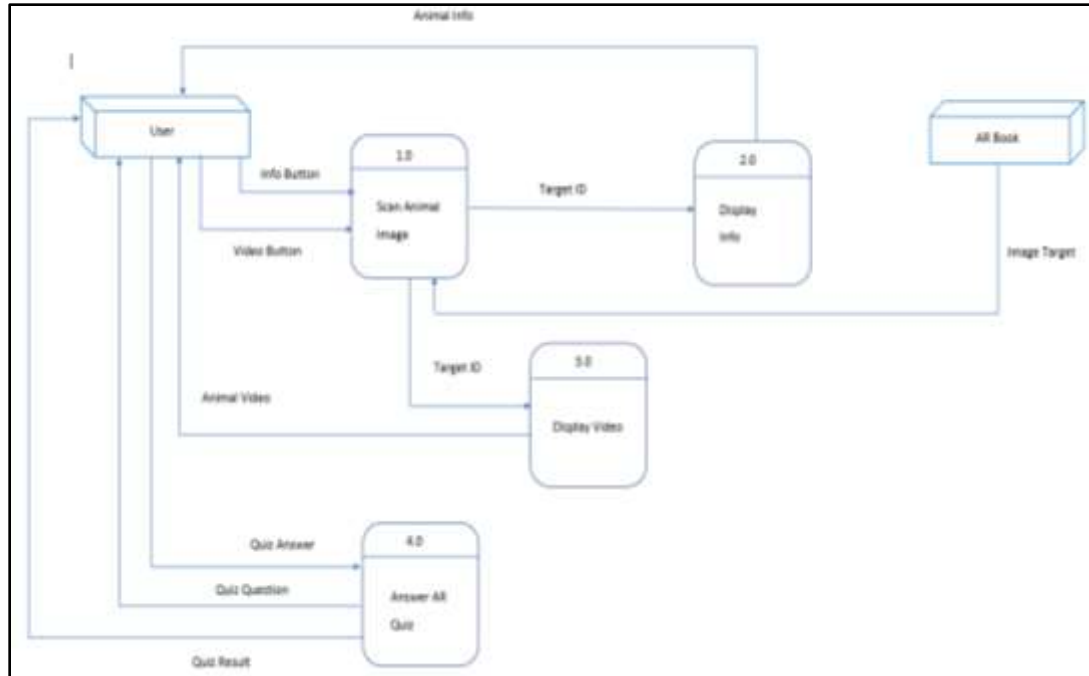
FIGURE 8. Data Flow Diagram of AR Virtual Snake Park

The DFD is a diagram that can illustrate the processes, data stores, and external entities in a business of other systems (Aleryani, 2016). In this diagram, a connecting data flow is included, which shows the flow of the data between the processes, data stores or external entities. It is useful to clearly represent the system's structure, which is why this model is included in this project. Figure 8 shows the DFD of the AR Virtual Snake Park application.

As seen from DFD in Figure 8 above, there are two entities for this DFD: the users and the AR Snake Park Book. This DFD is divided into four main processes, which are 1. Scan animal marker image, 2. Display information, 3. Display video, 4. Answer quiz.

In process 1, the user can scan the image marker on the AR Snake Park Book, which will then display information on the animal that had been scanned. Users are also given options to watch the scanned animal video taken from the Snake and Reptile Farm. The video will show how exactly the animal is; by doing so, the user can know the animal in detail. User understanding of animal information can be measured as there is also an interactive quiz that users can answer. This quiz will test the user's knowledge of whether they acquired any wildlife animal information when using the augmented reality application. In order to know the flow of the process involved in answering the quiz, Figure 9 below shows the flowchart of the quiz process.
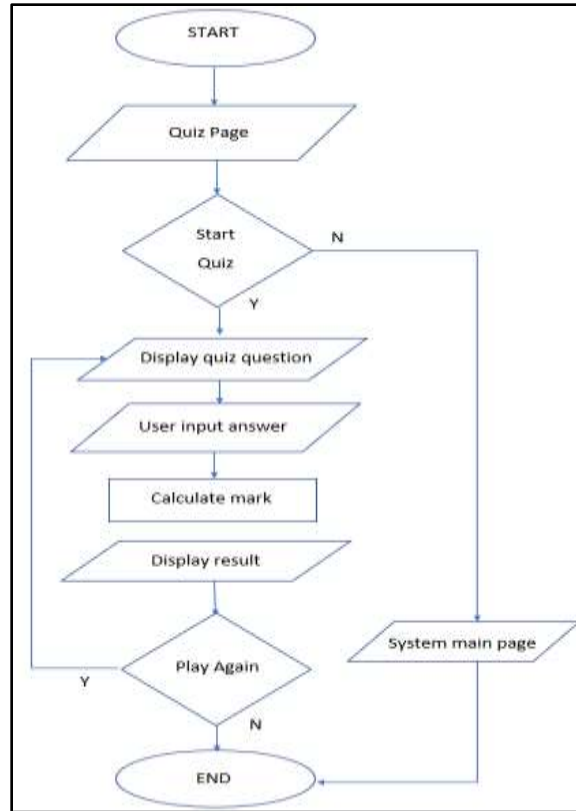
FIGURE 9. Flow Chart for the Quiz Process

From Figure 9 above, for the user to answer the quiz, the first step is to click on the 'Quiz' button, and then the quiz page will display to the user. Once the 'Start' button is clicked, the Quiz will start and the questions will be displayed. The user needs to click on the correct answers and answer all of the questions before the application shows the result (mark) on the screen. If the user is not satisfied with the mark, the user has the option to retake the quiz. If the user needs to go back to the main page, the user will need to click on the main page or home button. The questions in the quiz are randomly selected, and users will not get the same question sequences each time they answer the quiz.
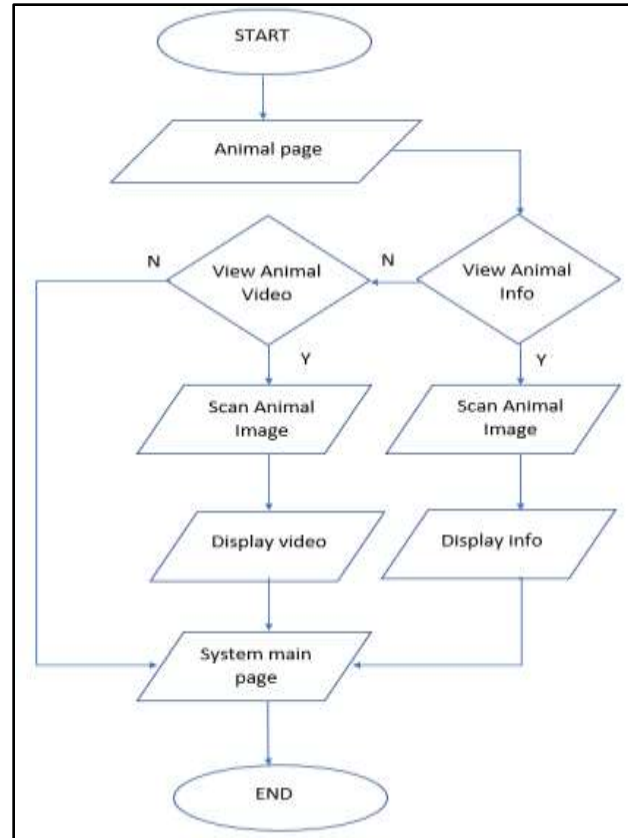
FIGURE 10. Flow Chart for the Application Process

Figure 10 shows the flow for the user to scan the image, view animal information and watch the animal video in the augmented reality application. As illustrated in the diagram, the flow for the user to scan the image to display the information about the wildlife animal is rather easy. Users need to go to the animal where the button 'Info' and 'Video' located and then click on one of the buttons. A camera view interface appears on the screen to allow the user to scan the animal image from the AR Snake Park Book. If the image marker is correct, the animal's information or video will be displayed in the application according to the user's selection. Users can read the text information and watch the video to get to know the animal in detail. All these models and diagrams are then converted to a storyboard which will graphically design the interface of the AR application. The interface storyboard for the augmented reality application was prepared to clarify the flow and process involved in the application. Once the storyboard is constructed, the next step is developing the AR Snake Park application.

The AR Snake Park was developed using Vuforia and Unity software and later converted to .apk format. The application was tested using White Box and White Box method. Unit test plan and integration test plan document were prepared to assist the testing process. User feedback was recorded for the refinement process.

Phase 3: Launch

The AR Virtual Snake Park application was demonstrated to the Snake and Reptile Farm staff. As a user, the staffs need to download and install the AR Virtual Snake Park application using the apk file to scan the image and view the information about the wildlife animals in the application. Once the application is installed, the user can scan the image marker provided in the AR Snake Park Book to read the animal description and watch their video.

Phase 4: Feedback

In the feedback face, the user implements and tests this application. The manager and a few staff from Perlis Snake and Reptile Farm were selected to evaluate the augmented reality application. Users are given time to explore the augmented reality application and scan every animal marker. The Launch phase is important since this not only provides time for the user to use the augmented reality application but also to verify project's requirements and to test whether there are any bugs or errors in the augmented reality application. Users' feedback is documented and evaluated to measure their satisfaction level when using the augmented reality application. Next, all the feedback and comment will be discussed with the team members before the refinement process is made on the application.

RESULT

The AR Virtual Snake application page is shown in Figure 11. The main menu page (a), has three main options: the 'Animals', 'Quiz' and 'Manual'. The 'Animals' button is where users can choose whether they want to view snakes (b) or other wildlife animals in the park. If the user chooses snakes, figure (c) shows some of the snakes that are available in the park, and if the user clicks on 'Other' button then the other animal that is not under the snakes category will be displayed in (d). The 'Quiz' button is where the user can click to answer the quiz to measure their understanding related to the animal listed and displayed in 'Animals' button (a). 'Manual' button, on the other hand, is used for the user to refer to the application manual, which explains the steps to use the augmented reality application (view information and watch the video.
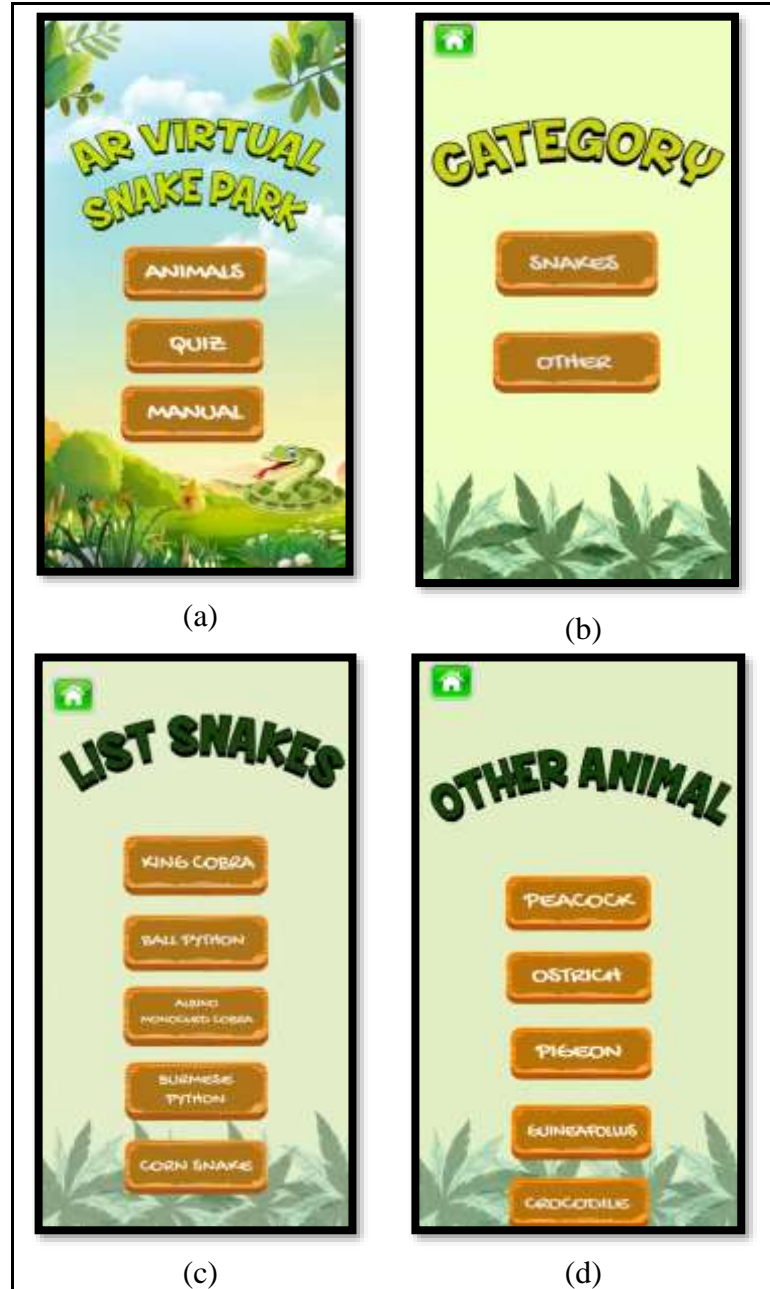
FIGURE 11. AR Virtual Snake Park Interfaces

The animal image used for image markers is available in the AR Snake Park Book. There are two types of images in the AR Snake Park Book, marker image and non-marker image. The marker image in the book can be identified by the label 'For More Info, Please Scan Here'. Figure 12 shows an example of a non-marker image (a) and a marker image (b). The user can only scan the book's images marked with the above label to view the animal information or video.
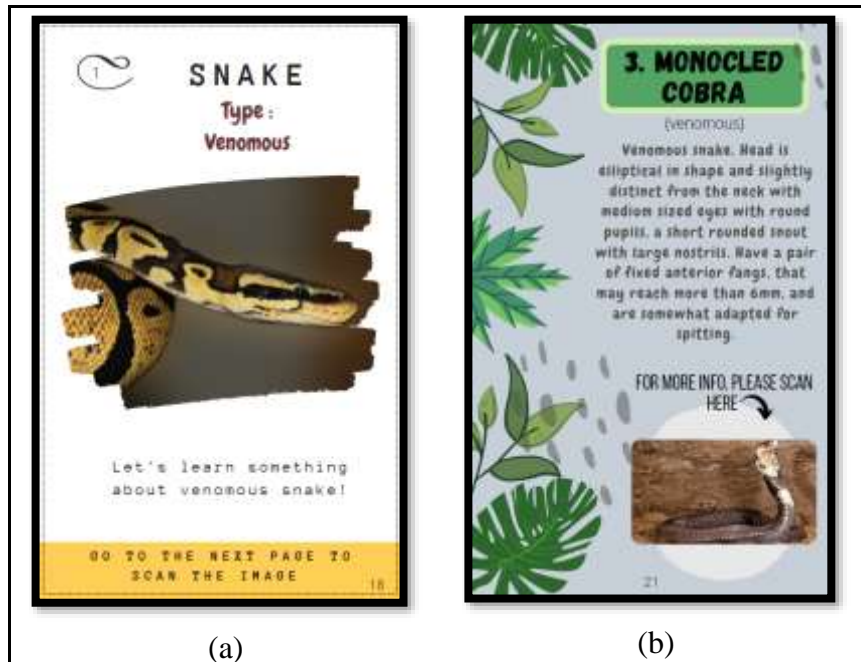
FIGURE 12. Two Types of Images in AR Snake Park Book

Figure 13 shows the animal information once the user scans the image marker. The animal information describes the habitat, size, weight, origin, diet, and fun facts. For example, if the user scans the Saltwater Crocodile image marker. In that case, as can be seen, the details description and the scientific name of the Saltwater Crocodile, which is Crocodylus Porosus, appear on the user's mobile device screen.

FIGURE 13. Animal Information from the AR Virtual Snake Farm Application

Not only textual information, the user also have the functionality to view the video of the selected animal, as in Figure 14 below.

FIGURE 13. Animal Video from the AR Virtual Snake Farm Application

In the video, users can see the physical elements of the wildlife animal. The colour of the animal, how it walks, how it sound, and the habitat of the animal in the Snake and Reptile Farm. To measure the user's understanding of the provided wildlife animal information, the user can also answer the quiz questions in the application.
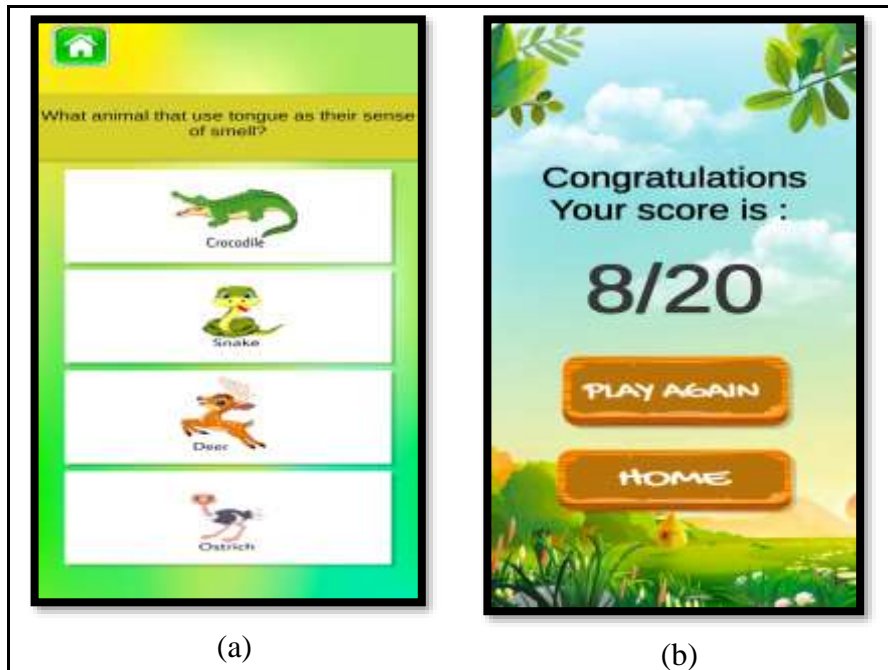

(a)   (b)

FIGURE 14. Example of Quiz Question

Although the quiz questions are limited, this quiz module is very helpful for children and other users to test their knowledge. After the user finishes answering all given questions, the result will appear on the screen, as illustrated in Figure 14 (b). This experience creates excitement for the user to learn more about the wildlife animal. It also indirectly motivates users to physically visit the Snake and Reptile Farm to see their favourite animals.

CONCLUSION

The augmented application gives several advantages to the Snake and Reptile Farm, including the Perlis tourism sector. The entire processes are online; hence, the visitor only needs to scan the AR Snake Park Book image marker using their smartphone to read information and see how the snake and other animals look in the Snake and Reptile Farm. It will be so efficient that the user is also able to view Perlis Snake & Reptile Farm map and history in the AR Snake Park Book. The augmented reality application will help Perlis Snake Park to support its operational cost by selling the AR Snake Park Book. The AR Snake Park Book and the augmented application also can be used as an advertising platform to promote this tourist attraction place to people. The user can also learn how augmented reality works in real life. It will give a new experience and exposure to people who are not very familiar with augmented reality technology. Educational perspective, the application can use as a part of teaching material to introduce children to wildlife animals. Besides, they also can test their knowledge by answering the quiz questions provided in the application. Suggestion for future enhancement, the application can be improved in the aspect of object markers and 3D models. The augmented reality application in the future should be able to support 2D images (AR Snake Park Book) and 3D objects (real animals). Currently, the application only prepares animal descriptions, quiz and videos. The application's new version should be prepared with 3D animals and supported by auditory information, as suggested by Huang et al. (2019), to enhance user understanding.

REFERENCES

1. Abrahamsson, P., Salo, O., Ronkainen, J., & Warsta, J. (2017). Agile software development methods: Review and analysis. *arXiv preprint arXiv:1709.08439*.
2. Aleryani, A. Y. (2016). Comparative study between data flow diagram and use case diagram. *International Journal of Scientific and Research Publications*, *6*(3), 124-126.
3. Ayittey, F. K., Ayittey, M. K., Chiwero, N. B., Kamasah, J. S., & Dzuvor, C. (2020). Economic impacts of Wuhan 2019-nCoV on China and the world. In the *Journal of medical virology*, *92*(5), 473.
4. Boyles, B. (2017). Virtual reality and augmented reality in education. *Center For Teaching Excellence, United States Military Academy, West Point, Ny*.
5. Carmigniani, J., & Furht, B. (2011). Augmented reality: an overview. In the *Handbook of augmented reality*, 3-46. DOI 10.1007/978-1-4614-0064-6_1.
6. Cheema S. (2020, March 20). Malaysia's 57-year-old zoo can only sustain itself for 3 more months because of coronavirus. Mashable SE Asia. https://sea.mashable.com/culture/9811/malaysias-57-year-old-zoo-can-only-sustain-itself-for-3-more-months-because-of-coronavirus

7. Cho, Y. J., Kim, J. H., Oh, J. H., & Chung, I. Y. (2018). Development of zoo tourism application anisearch using augmented reality technology. In the *Journal of Digital Contents Society*, *19*(10), 1833-1841.

8. Cranmer, E. E., tom Dieck, M. C., & Fountoulaki, P. (2020). Exploring the value of augmented reality for tourism. In the *Tourism Management Perspectives*, *35*, 100672.

9. Elmqaddem, N. (2019). Augmented reality and virtual reality in education. Myth or reality?. In the *International journal of emerging technologies in learning*, *14*(3).

10. He, Z., Wu, L., & Li, X. R. (2018). When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions. In the *Tourism Management (2018)*, *68*, 127-139.

11. Huang, K. T., Ball, C., Francis, J., Ratan, R., Boumis, J., & Fordham, J. (2019). Augmented versus virtual reality in education: an exploratory study examining science knowledge retention when using augmented reality/virtual reality mobile applications. In the *Cyberpsychology, Behavior, and Social Networking*, *22*(2), 105-110.

12. Iatsyshyn, A. V., Kovach, V. O., Lyubchak, V. O., Zuban, Y. O., Piven, A. G., Sokolyuk, O. M., Iatsyshyn A. V., Popov O. O., Artemchuk V. O. & Shyshkina, M. P. (2020). Application of augmented reality technologies for education projects preparation.

13. Jingen Liang, L., & Elliot, S. (2021). A systematic review of augmented reality tourism research: What is now and what is next?. In the *Tourism and Hospitality Research*, *21*(1), 15-30.

14. Julio, A., & Setiyadi, A (2019). Application Of Zoo AR Photo Service With Animals Based On Augmented Reality And Leap Motion Technology.

15. Kamarulzaman F. (2020, December 12). Another way of saving the zoo. The Sun Daily. https://www.thesundaily.my/opinion/another-way-of-saving-the-zoo-XB5407752

16. Nayyar, A., Mahapatra, B., Le, D., & Suseendran, G. (2018). Virtual Reality (VR) & Augmented Reality (AR) technologies for tourism and hospitality industry. In the *International journal of engineering & technology*, *7*(2.21), 156-160.

17. Saragih, R. E. (2020, July). Development of Interactive Mobile Application with Augmented Reality for Tourism Sites in Batam. In *2020 Fourth World Conference on Smart Trends in Systems, Security and Sustainability (WorldS4)* (pp. 512-517). IEEE.

18. Serravalle, F., Ferraris, A., Vrontis, D., Thrassou, A., & Christofi, M. (2019). Augmented reality in the tourism industry: A multi-stakeholder analysis of museums. In the *Tourism Management Perspectives*, *32*, 100549.

19. Wong S. L. (2020, June 19). Should we save zoos during Covid-19 crisis? Malaysia kini. https://www.malaysiakini.com/news/530855

20. Yung, R., & Khoo-Lattimore, C. (2019). New realities: a systematic literature review on virtual reality and augmented reality in tourism research. In the *Current issues in tourism*, *22*(17), 2056-2081.