

AUGMENTED REALITY APPLICATION FOR EDUCATION ON ANDROID OPERATING SYSTEM.

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ABSTRACT

Internet technology is faster and more important than the past. The mobile devices are popular and can be used to surf the Internet. Applications on mobile are very important things for our lives. It can be native run on the mobile devices. The application can access to mobile camera through its operating system library that can be run very stable compared with web application. In this paper, the augmented reality application for education on android operating system is proposed. This technology uses the camera of the mobile device to capture the marker on the document and show the result on the screen. There are user interface designing and augmented reality & contents mapping parts in this research. Our application is built and executed on Google Pixel 2 which is the standard smartphone for android provides by Google. User interface of this application is very easy to use and improve the user experience in this work. The results show that our application can be run on Google Pixel 2 and can be used to capture the markers and show augmented reality objects correctly. This can be implemented in the general education or other courses in Suan Sunandha Rajabhat university.

Keyword: Augmented Reality, General Education, Android, Application

INTRODUCTION

Nowadays, smartphones, tablets and mobile devices are very popular. The Internet technology is faster than the past and very efficient. The mobile devices can be connected with the Internet and used to run those features effectively. The users can surf the Internet for their information, entertainment or using social media.

There are 2 very popular operating systems that run on the smartphones, tablets and mobile devices. iOS and Android operating systems which developed by Apple and Google, respectively. Note that, iOS is supported only Apple devices. On the other hand, Android is the open source which support most of all devices except Apple devices [1]. The solutions to use the smartphone, tablets and mobile devices is developing an application [2]. The applications can be developed using the basic programming language like Swift [3] or Objective-C [4] language for iOS and Java or Kotlin for Android operating systems [5].

The Augmented Reality (AR) [6] is the advanced technology that user can be used to interact with virtual and real world in real time application. The concept of this technology is shown as follows: the marker is created using the image on that documents. Then, the developer maps the marker with the AR object or content which would like to show after scanning the marker. Finally, the developer can test using the device by scanning the marker and the AR object will be shown on the screen over the marker.

ARCore [7,8] is the augmented reality library for develop the application on the Android operating system. It consists of Motion tracking which allows the device to

understand and track the position, Environmental understanding which allows the device to detect the size and location of all type of surfaces, and light estimation which allows the phone to estimate the environment's current lighting conditions. This library supports and can be run on Android 7 (Nougat) and later.

In this paper, it is organized as follows: The related Augmented Reality technology works are proposed in section 2. Section 3 presents the research methodology of our Augmented Reality application. The experiments and results are shown in section 4. Finally, section 5 shows conclusion and future work.

RELATED WORKS

There are several works in Augmented Reality technology. Kaufmann [9] proposed collaborative augmented reality in education which designed for mathematics and geometry education called Construct3D in 2003. It is based on the mobile collaborative AR system "Studierstube" which is easy to learn, encourages experimentation with geometric constructions and improves spatial skills.

Liarokapis, F. et al. [10] proposed Web3D and augmented reality to support engineering education which is an educational application that allows users to interact with 3D Web content (Web3D) using virtual and augmented reality (AR). Four mechanical engineering themes (machines, vehicles, platonic solids and tools) are illustrated here to demonstrate the use of the system to support learning through Web3D.

Medicherla et al. [11] presented Visualization for Increased Understanding and Learning Using Augmented Reality which described a project in which an interactive solar system to help middle school students in the sciences understand spatial concepts using augmented reality. Preliminary feedback from students and educators indicates that this visual teaching method is effective.

Augmented Chemistry is presented by Singhal, S. et al. [12] in 2012. It provided an efficient way for designing and interacting with the molecules to understand the spatial relations between molecules. Their system is based on inexpensive webcams and open-source software.

Ma et al. [13] developed Personalized augmented reality for anatomy education which is the system behaves as a "magic mirror" which allows personalized in-situ visualization of anatomy on the user's body. The user can look inside their body using RGB-D sensor as a real-time tracking device to detect the user moving in front of a display.

Rattanatrakun et al. [14] developed the packaging label scanner application on android operating system that can be used to scan the symbol of packaging label which their output of the application is shown as augmented reality technology.

Augmented Reality Technology Application for General Education on Android

This research aims to create the augmented reality technology application on android operating system. There are 2 parts in this research: user interface designing and augmented reality & contents mapping.

To design the user interface in this research, the developer should design the user interface in the application for the user experience and easy to use. It is divided into main menu, marker scanner, result screen.

Main menu is the first page when the application is launched by the user. This page is very important for the user experience. They will see this page firstly after the application is opened. The designer of our researcher aims to show the meaning of AR feature to the user on this page as shown in the top image of this page. We design the logo of CE or computer

engineering department of Suan Sunandha Rajabhat university which is the developer department. The main menu page is shown as Figure 1.

Figure 2 shows the marker scanner which is page which use to scan the marker to show the result of the marker as AR. This page is separated to 2 buttons: Camera is used to scan the marker and shows the AR object on the screen. Help button is the menu which shows how to use the application to scan the marker and shows the result as AR. To scan the marker, the camera button should be touched to launch the camera of device. The user can use this menu to scan document which contains the AR object. If image in the document is the marker, the AR object will show on the screen over that marker. Note that, the result of the AR object after scanning is shown as Figure 3.

Figure 1 Main menu



Figure 2 Marker Scanner

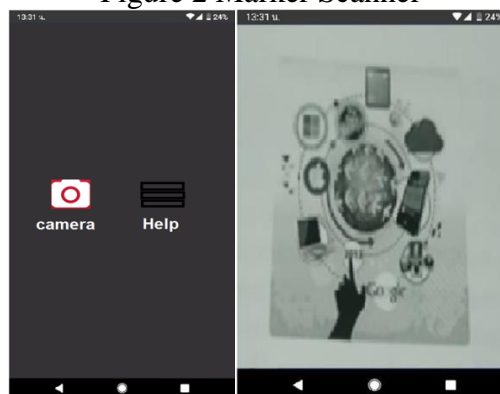


Figure 3 Result after scan the marker



To mapping the AR contents with the pictures in documents, the ARCore library is integrated and developed to this research. This library is developed by Google which can perform in our application perfectly. After the contents and pictures in the documents are

mapped together, the application is built and can be run on any devices. Secondly, developing the application to support the augmented reality technology. There is process of this application is shown as follows:

- 1) Scan the markers on documents using the camera of device.
- 2) Find and compare the markers with the data in database.
- 3) If there is no marker in the database similar with the document, the process is terminated.
- 4) Mapping the marker in database with the AR content.
- 5) Show the AR content in the area on the screen of device.

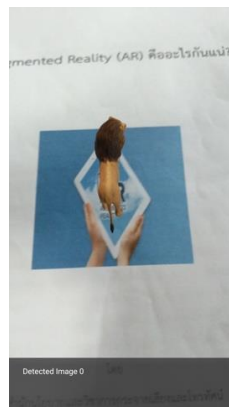
EXPERIMENTS & RESULTS

In this research, the application is developed and implemented for education. The augmented reality library called ARCore is integrated and developed to this application. The Google Pixel 2 is used to test in our experiment. Specification of this device is shown as Table 1

Table 1 Google Pixel 2 Specification

Display Type	AMOLED capacitive touchscreen, 16M colors
Display Size	5.0 inches
Resolution	1920 x 1080 pixels, 16:9 ratio
Operating System	Android 9.0
Chipset	Qualcomm MSM8998 Snapdragon 835
CPU	Octa-core (4x2.35 GHz Kryo & 1.9 GHz Kryo)
GPU	Adreno 540
Memory	64 GB (4GB RAM)
Main Camera	12.2 MP, f/1.8 27mm (wide), 1/2.55", 1.4micrometers, dual pixel PDAF, Laser AF, OIS
Front Camera	8 MP, f/2.4, 27mm (wide), 1/3.2", 1.4micrometers

Figure 4 3D Content as AR



In this research, the 11 markers are set and mapped with the contents. The 3D in Figure 4 and Video contents in Figure 5 is mapped to our database and the results of our application are correct.

Figure 5 Video Content as AR Object



CONCLUSION & FUTURE WORK

In this paper, the augmented reality application for education on android operating system is proposed. There are 2 parts in this research: user interface designing and augmented reality & contents mapping. In application design part, it is divided into main menu, marker scanner, result screen. The markers are mapped with the AR objects which consists of 3D and Video contents in augmented reality & contents mapping part. The results show that the AR objects can be shown perfectly by scanning all of markers in the experiments. This work can be improved by developing the application on the iOS devices using swift integrated with ARKit[15,16].

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REFERENCES

- [1] Sheikh, A. A., Ganai, P. T., Malik, N. A., & Dar, K. A. (2013). Smartphone: Android Vs IOS. The SIJ Transactions on Computer Science Engineering & its Applications (CSEA), 1(4), 141-148.
- [2] Charland, A., & Leroux, B. (2011). Mobile application development: web vs. native. Communications of the ACM, 54(5), 49-53.
- [3] Nahavandipoor, V. (2014). IOS 8 Swift Programming Cookbook: Solutions & Examples for IOS Apps. " O'Reilly Media, Inc.".
- [4] Neuburg, M. (2013). iOS 7 Programming Fundamentals: Objective-c, xcode, and cocoa basics. " O'Reilly Media, Inc.".
- [5] Goadrich, M. H., & Rogers, M. P. (2011, March). Smart smartphone development: iOS versus Android. In Proceedings of the 42nd ACM technical symposium on Computer science education (pp. 607-612). ACM.
- [6] Azuma, R. (2004, August). Overview of augmented reality. In ACM SIGGRAPH 2004 Course Notes (p. 26). ACM.
- [7] Lanham, M. (2018). Learn ARCore-Fundamentals of Google ARCore: Learn to build augmented reality apps for Android, Unity, and the web with Google ARCore 1.0. Packt Publishing Ltd.

- [8] Linowes, J., & Babilinski, K. (2017). *Augmented Reality for Developers: Build practical augmented reality applications with Unity, ARCore, ARKit, and Vuforia*. Packt Publishing Ltd.
- [9] Kaufmann, H. (2003). Collaborative augmented reality in education. Institute of Software Technology and Interactive Systems, Vienna University of Technology.
- [10] Liarokapis, F., Mourkoussis, N., White, M., Darcy, J., Sifniotis, M., Petridis, P., ... & Lister, P. F. (2004). Web3D and augmented reality to support engineering education. *World transactions on engineering and technology education*, 3(1), 11-14.
- [11] Medicherla, P. S., Chang, G., & Morreale, P. (2010, March). Visualization for increased understanding and learning using augmented reality. In *Proceedings of the international conference on Multimedia information retrieval* (pp. 441-444). ACM.
- [12] Singhal, S., Bagga, S., Goyal, P., & Saxena, V. (2012). Augmented chemistry: Interactive education system. *International Journal of Computer Applications*, 49(15).
- [13] Ma, M., Fallavollita, P., Seelbach, I., Von Der Heide, A. M., Euler, E., Waschke, J., & Navab, N. (2016). Personalized augmented reality for anatomy education. *Clinical Anatomy*, 29(4), 446-453.
- [14] Rattanatanurak, A. (2019). PACKAGING LABEL SCANNER APPLICATION ON ANDROID. *Actual Economy: local solutions for global challenges*, 32-35.
- [15] Buerli, M., & Misslinger, S. (2017, June). Introducing ARKit-augmented reality for iOS. In *Apple Worldwide \Developers Conference (WWDC 2017)* (pp. 1-187).
- [16] Shekar, S., & Haney, S. (2018). *Swift Game Development: Learn iOS 12 game development using SpriteKit, SceneKit and ARKit 2.0*. Packt Publishing Ltd.