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Blind Reader: An Object Identification Mobile-based Application for the Blind using Augmented Reality Detection

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***Abstract*—Eyes are our window to this world, however not for everyone. Visual impairments can higly disrupt human's normal activities as simple as recognize all the things around them properly. Technological development of augmented reality is one of the fastest growing technology. Augmented reality, which combines the real world and the virtual world, allows interactivity between both including as an assistive tool such for those who are visually impaired. In this research, we propose a mobile application that identifies objects using smartphone camera by utilizing markerless detection. We used Unity 3D and Vuforia SDK as the place to make the dataset of the marker and running on the Android-based smartphone. The result of this research is an android application that can identify objects and produce a sound output of the product name.**

Keywords—assistive technology, assistive application, augmented reality, visually impaired, object recognition

I. INTRODUCTION

A. Background

Eyes are our window to this world, however not for those who had visual impairment by birth, disease, accident or due to old age. Our daily activities are high dependable on our sight, thus without clear visual daily activities are highly disrupted [1].

According to WHO, blindness is when our sight indicator is below the cut off point or 6/18, which means unable to see object between 0 to 6.1 meter ahead of us. In some country, those who unable to see less than 20^o wide is also considered legally blind [2]. According to a data in 205, there are an estimated 36 million blind people and around 217 million has severe sight problem [3]. Meanwhile, in Indonesia there are 3.6 million blindness cases, with around 70% caused by cataract. There are 120,000 cases added each year and around 43% unable to afford the treatment cost and, sadly, there are around 25% who didn't know there's a treatment available [4].

In their daily life these blind communities are really depended on other people in their daily activity. In a research on 5,329 blind people show that they need help in identifying an object (food, drink, drug and money), read information (digital display/analgo such as weight, temperature, nutrition facts, ingredients), as well as in describing object (color, whether the object is on or off, etc) [5].

Right now, technological development is growing rapidly, and one of the results of technological development is Augmented Reality (AR) which is one of the newest technology in multimedia [6]. AR is defined as a technology that can combine the real world and the virtual reality in a more interactive and interesting manner [7]. Unlike a virtual reality that replaces the real world entirely, but AR only adds to or complement reality. Right now, AR can be implemented in multiple media, for example, desktop application, website, and smartphone, and for this research will be implemented in an Android-based smartphone [8].

The problem in this research is that blind people can't recognize all objects – the objects around them properly because of their ability to obtain visual information is decreased and disrupted.

B. Related Studies

There are several previous studies that aimed to assist visually impaired people such as [9] and [10] which utilize printed code (QR and barcode) as well as [11] that did the similar thing but with Indonesian context and also there is [12] which utilize RFID scanner.

All these studies require the user to find the barcode or QR code. On this studies, the user simply needs to aim the front side of the object to the camera. While the implementation of AR with marker isn't something new, as seen on [13] and [14], however, the utilization of AR as visual impairing assistive has not yet being implemented.

II. RESEARCH METHODOLOGY

A. Suggested System Model

The research was based on prototype model paradigm [15] where we utilize quick plan, quick design, construction of prototype, deployment, and then feedbacks. The suggested system model can be seen in the application conceptual framework like in Fig. 1.

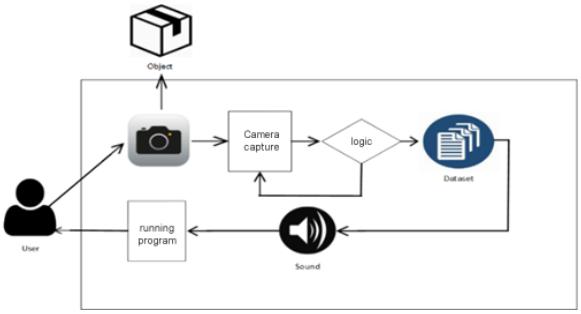

Fig. 1. Application Conceptual Framework.

Fig. 1 explains about the process and how the application works where the user will open the application and will scan objects using a camera, which will be scanned per-camera frame, and then the object data will be checked with the dataset inside the application which has markers and sound of 40 defined objects. The application also has logic or conditional program, when an object that is read has a registered marker in the application, the logic or program will do rendering and will give output in the form of sound to the user, but if not, the program will keep doing the process until a marker is detected.

B. *Application Design*

We use Unified Modeling Language (UML), which is a standard model that being used for software development. UML aimed to present standardization that is object oriented [16].

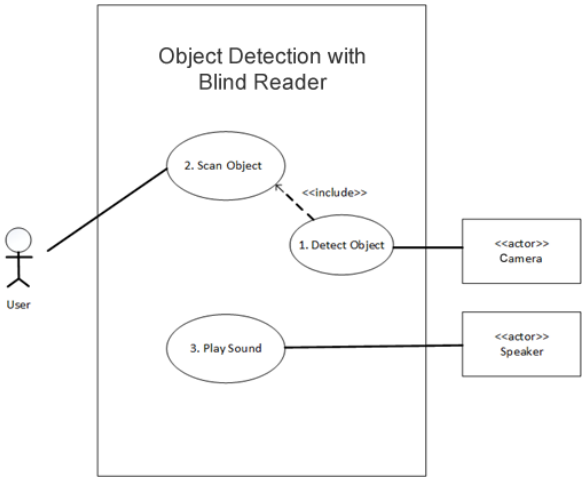

Fig. 2. Use Case Diagram.

1) *Use Case Diagram*

The architecture of the application in this research is made using a use case diagram as shown on Fig. 2.

2) *Class Diagram*

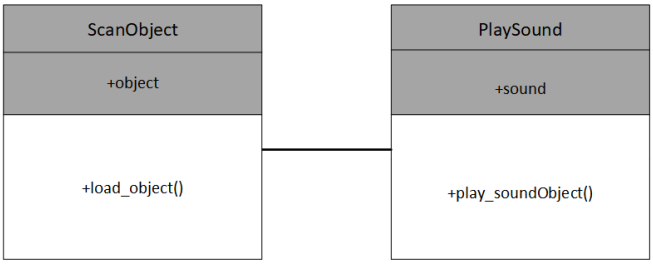

Fig. 3. Class Diagram.

The class diagram explains the description of each *class* in this research. The class diagram can be seen in Fig. 3.

C. *Dataset Marker Design*

In this step, the making of the dataset marker is done using the Vuforia SDK by doing a couple of steps:

1) *Picture Taking*

The picture that is taken is the front view of the object, as can be seen in Fig. 4.

Fig. 4. Sample of an object image that has been scanned.

2) *Creating License Key*

Before making the dataset marker, it is necessary to make the license key so the dataset that is made can be used in Unity 3D. License key production can be seen in Fig. 5.

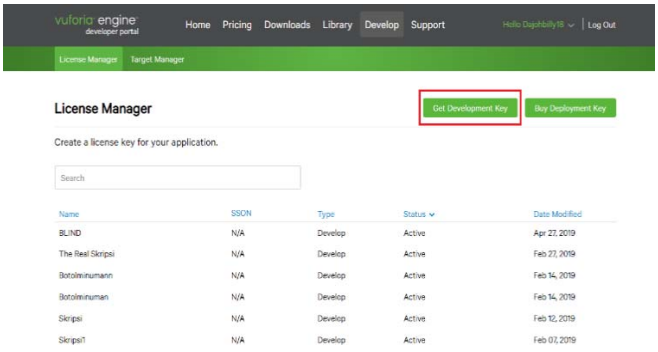

Fig. 5. Making License Key.

3) *Creating Dataset*

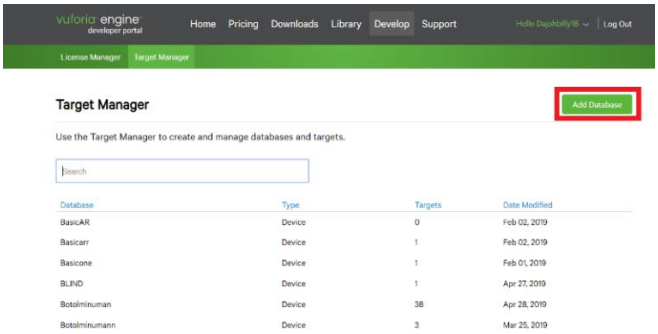

Fig. 6. Creating Dataset.

Making dataset as a place to contain the marker. The making process can be seen in Fig. 6.

4) *Creating Marker*

This research uses single image target. As can be seen in Fig. 7.

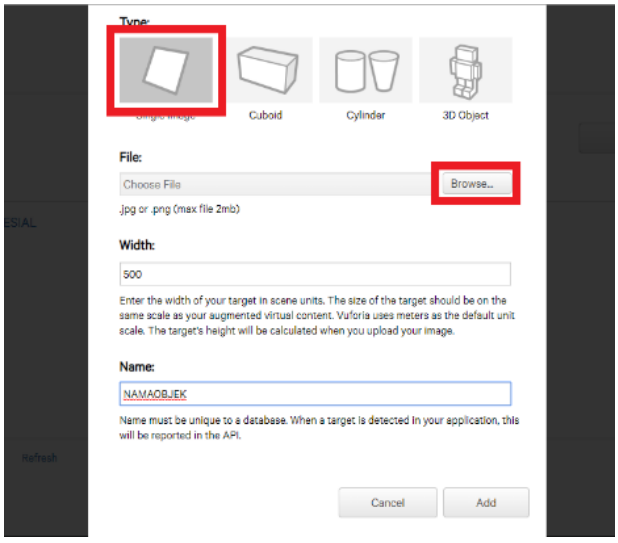

Fig. 7. Creating Marker of a Single Image.

D. *Sample Objects*

In this research, the objects used in total are 40 objects consisting of instant noodles, wafer, and jelly powder.

III. Result and Discussion

This step discusses how to use the application and the testing step.

A. *Testings*

The research does testing to find out if the application is working properly or not, based on the application's capability to detect an object that has a marker in the application dataset and also the time the application needs to detect objects. The testing will be done to five sample objects below. The testing result can be seen in Table I.

TABLE I. Testing Result

No.	Object Name	Scan Object	Audio Output of the Object?	Time required (secs)
1	Mie Sedaap Chicken Garlic	Success	Success	3
2	SuperMie Extra Soto Beef	Success	Success	2
3	Tango Strawberry Waffers	Success	Success	4
4	Nutrijell jelly powder chocolate flavour	Success	Success	4
5	Mie Sedaap Chicken Curry	Success	Success	3

B. *How To Use The Application*

For visually impaired people to use this application, they can access it with the help of the service provided by Google, which is Google Assistant. By saying "Ok Google" until we hear a notification sound from google assistant and call the application name which is “blind reader," which google assistant will give a sound notification when the application is opened. The display of google assistant can be seen in Fig. 8.

Fig. 8. Google Assistant view.

After the application is opened, user can immediately point the camera to the desired object and if the marker of the object that is scanned is in the application dataset, the application will give output in the form of sound which contains information about that object. Application display when scanning the object and giving information in the form of sound can be seen in Fig. 9, it also shows the ideal distance for the object could be detected.

Fig. 9. Clear display of the app and the ideal distance for object.

IV. Conclusion

The blind reader is an object identifier mobile application for blind people using markerless detection made using the Unity 3D with Vuforia dataset. This application has the capability to identify the object and give information in the form of sound.

This application can be used by blind people who can’t distinguish objects with the same shape but have different functions, attributes (such as color or labels) or contents (flavor, types) for example while picking package food in the store or at home. This application can identify and give information of 40 objects that has a dataset in the application.

V. Limitation and Future Studies

The limitation of the first construction of this software with this augmented reality method is the limit of the object it can detect. In the future, it is recommended to allow the

user to be able to add objects themselves. Adding object also is a huge challenge, we found that cylinderical isn't detected easily thus need to be add as a limitation for this moment. We also suggest to develop this app on other mobile platform such as iOS and Windows Mobile.

REFERENCES

[1] R. R. Lubis, E. R. Megawati, and L. D. Lubis, "Identifikasi kelainan mata dan koreksi tajam penglihatan presbiopia," *ABDIMAS TALENTA*, vol. 1, no. 1, pp. 13–19, 2017.

[2] World Health Organization, "Change the definition of blindness," Disponível no endereço eletrônico http://www. who. int/blindness/ChangetheDefinitionofBlindness. pdf, 2008.

[3] World Health Organization, "Blindness and visual impairment," World Health Organization. [Online]. Available: http://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment. [Accessed: 04-Sep-2018].

[4] Fred Hollows Charity, "International Eye Health | Charity | Fred Hollows | Indonesia." [Online]. Available: https://www.hollows.org/au/what-we-do/where-we-work/south-east-asia/indonesia. [Accessed: 04-Sep-2018].

[5] E. Brady, M. R. Morris, Y. Zhong, S. White, and J. P. Bigham, "Visual Challenges in the Everyday Lives of Blind People," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, New York, NY, USA, 2013, pp. 2117–2126.

[6] A. R. Yudiantika, E. S. Pasinggi, I. P. Sari, and B. S. Hantono, "Implementasi Augmented Reality Di Museum: Studi Awal Perancangan Aplikasi Edukasi Untuk Pengunjung Museum," Yogyakarta: Konferensi Nasional Teknologi Informasi dan Komunikasi (KNASTIK), Fakultas Teknologi Informasi, Universitas Kristen Duta Wacana, 2013.

[7] A. K. Wahyudi, Y. J. Kairupan, and Y. C. Masengi, "Alat Peraga Jantung Manusia Berbasis Augmented Reality dengan Menggunakan Teknik 3D Object Tracking," *CogITo Smart Journal*, vol. 4, no. 1, pp. 46–59, 2018.

[8] K. Khallis, "Implementasi Augmented Reality (AR) Sebagai Media Pengenalan Alat Musik Khas Sumatera Barat Berbasis Android," 2018.

[9] H. S. Al-Khalifa, "Utilizing QR code and mobile phones for blinds and visually impaired people," presented at the International Conference on Computers for Handicapped Persons, 2008, pp. 1065–1069.

[10] E. Tekin, D. Vásquez, and J. M. Coughlan, "S-K Smartphone Barcode Reader for the Blind," *Annual International Technology and Persons with Disabilities Conference*, vol. 28, pp. 230–239, 2013.

[11] F. Wahyutama, F. Samopa, and H. Suryotrisongko, "Penggunaan Teknologi Augmented Reality Berbasis Barcode sebagai Sarana Penyampaian Informasi Spesifikasi dan Harga Barang yang Interaktif Berbasis Android, Studi Kasus pada Toko Elektronik ABC Surabaya," *Jurnal Teknik ITS*, vol. 2, no. 3, pp. A481–A486, 2013.

[12] S. Kesh, "Shopping by blinde people: detection of iteractions in ambient assisted living environments using RFID," *International Journal of Wireless Communication and Networking Technologies (WARSE)*, vol. 6, no. 2, pp. 7–11, 2017.

[13] H. Vitono, H. Nasution, and H. Anra, "Implementasi Markerless Augmented Reality Sebagai Media Informasi Koleksi Museum Berbasis Android (Studi Kasus: Museum Kalimantan Barat)," *Jurnal Sistem dan Teknologi Informasi (JustIN)*, vol. 4, no. 2, pp. 239–245, 2016.

[14] J. Waworundeng and A. Wahyudi, "Real-time recognition and information extractin on C++ syntax with Augmented Reality," in Proc. *IEEE Third Int. Conf. on Informatics and Computing (ICIC)*, Palembang, Indonesia, 2018, pp. 1-6. doi: 10.1109/IAC.2018.8780473.

[15] R.S. Pressman, "Software Engineering: a practitioner's approach," Palgrave Macmillan, 2005.

[16] R. Miles and K. Hamilton,"Learning UML 2.0," O'Reilly Media, Inc., 2006.