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Original Research Article

Augmented reality as the medical electronic equipment inventory identifier

Frisa Y. Hermawan*, Wadianto, Ernia Susana, Fauzi Ramadani, Muhammad Fauzi

Department of Electromedical Engineering, Polytechnic of Health Jakarta II, Jakarta, Indonesia

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***Correspondence:**
Dr. Frisa Y. Hermawan,
E-mail: frisayugihermawan@gmail.com

ABSTRACT

Background: Inventory systems are very numerous and require a long time when rechecking. In doing a shortcut time for checking, it can be done the application of augmented reality.
Methods: This research can be applied to all types and brands of smartphones. The testing was carried out using three different types and brands of smartphones in three conditions: dark rooms, bright room and open spaces for three times for each smartphone. It examines the suitability of displaying asset objects such as Infusion Device Analyzer (IDA-1), Electrical Safety Analyzer (ISA) and Piranha radiology high voltage tester with target objects using existing inventory labels also Barbarian with the target a book cover with the distance 10, 15, 20, 25 and 30 cm.
Results: By using three different types and brands of smartphones: A, B and C, the incompatibility result percentage of the asset object with the target object is obtained. The average of incompatibility result of Smartphone A, B, and C for the ISA asset object is 83%. The average of incompatibility result of Smartphone A, B, and C for the IDA asset object is 71%, The average of incompatibility result of Smartphone A, B, and C for the Piranha asset object is 36%, For the whole result for Barbarian object asset is 100%.
Conclusions: Making augmented reality has been successfully carried out with 3D models but there is a discrepancy between the appearance of asset objects with the target object except for the book cover and barbarian.

Keywords: Augmented reality, Medical electronic equipment, Inventory, Identifier

INTRODUCTION

Inventory systems for tools and goods are things that must be present in every organizational system. The inventory system is very important in the governance system of tools and goods of an organization.[1–3] Inventory systems always use a certain identity to identify and identify the object of the tool. The tools and goods identified in an inventory system are numerous and require a long time when rechecking. Even though the recheck process can be done, the form of tools and inventory items cannot be seen in real time and requires time if you want to see the tools and goods directly. In doing a shortcut time for checking the inventory of tools and goods can be done the application of Augmented Reality that displays the "real" form of equipment and inventory items.

The development of digital technology has penetrated in various aspects. One form of the development of digital technology is the creation of augmented reality (AR).[4–7] AR technology is a technology that combines the description of virtual objects (3 dimensions) with a real environment. 3-dimensional (3D) objects that can be displayed in the form of animation or indeed real objects which is designed to be a 3D object. Real objects that are designed to be 3D objects require supporting software, in this case, you can use Blender. The 3D form that has been formed is arranged and combined with the real object as the target object. The merger was carried out in the vuforia and unity portal software.[10–12]

The application of AR is very broad.[13] In this study, the application of AR is focused on identifying inventory items. Goods inventory always uses certain identities in the form of labels. Items that have been labelled often need accurate archiving. In order to cut the search time in identifying an item, an application from AR can be applied. On the inventory label listed, it is necessary to first recognize the label.[14] An inventory label that has been identified as the target object, if a highlight is shown, a 3D object will appear on behalf of the label.

AR designed in this study can be applied to all types and brands of smartphones with special specifications located on the qualifications of Android. Types of Android are used, ranging from the type of Android 4.1 (Jelly bean) to the latest series of Android 7.1 (Nougat).[15–17] The type of smartphone camera that is used does not have a certain standard and only conditionally the target object gets a fairly bright beam of light.[18] The procedure for using this application is downloading a smartphone, followed by installation on a smartphone. The installed application is then run. Smartphones must be directed to the target object, in this case, is the label of Inventory of goods. With the correct direction on the target object, the 3D form of the asset object will appear.[2]

Implementation of AR in the system Inventory of electromedical equipment can make it easier for inventors to recheck their inventory. The inventor can see the form of inventory directly without having to go to the location of the item located. In addition, in general, AR systems have simplified aspects of human life in its application. This study examines the determination of Asset Objects using Infusion Device Analyzer (IDA-1), Electrical Safety Analyzer (ISA) from FLUKE and Piranha radiology high voltage tester with target objects using existing inventory labels.

The purpose of this study is to implement an Android-based AR system in medical electronic equipment, such as Infusion Device Analyzer (IDA-1), Electrical Safety Analyzer (ISA) from FLUKE and Piranha Radiology High Voltage Tester, with the special purpose: performing the design and manufacture of AR systems, making asset object user interface features and test the overall function in the AR system.

METHODS

This research is an AR applied research design system to identify the inventory of medical electronic equipment. The design used in this study with the steps described by the flow chart (Figure 1).

The explanation of the activities carried out is described in the following topics.

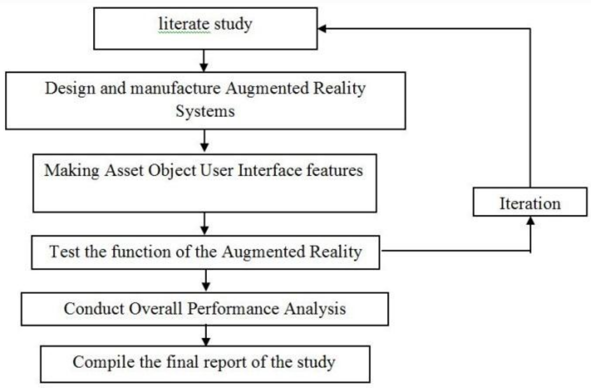

Figure 1: Research design flowchart.

Literate study

Implemented by searching and studying books and literature sources that have to do with this paper including other studies, similar, which have been applied to other fields. In this stage, there are also various understandings through the tutorial on making and designing AR, how to create object dimensions and the ability of the AR user interface from many sources.

Design and manufacture augmented reality systems

Determine image objects using a camera that is intended as the target object. In this case because the application needs of this research are in the inventory system, the target object used is the existing inventory label plus a book cover to differentiate the target object. Taking pictures of the target object is carried out in an open space under the sun so that it can get a bright intensity value. Creation of 3D objects from the target object. The 3-dimensional asset object is designed using Blender software by taking samples from various sides. The purpose of the use of IDA-1, ISA of FLUKE and Piranha radiology high voltage tester as asset objects is only as a representation of electromedical devices. "Barbarian" downloaded from online assets are used as reference assets. There are imperfections in IDA and Piranha in the form due to the duration of time for their short production.

The results obtained in the study up to this report are three electromedical devices: Infusion Device Analyzer (IDA-1), Electrical Safety Analyzer (ISA) from FLUKE and Piranha Radiology High Voltage Tester 3-Dimensional model. This 3-Dimensional model uses Blender software which stores files in the form of FBX (.fbx) and a "barbarian" asset that is used to compare outputs. Here is a 3-dimensional image of all of these devices.

The next stage after making the 3D model is the adjustment between each target object (inventory label) with the asset object. In the AR system, the four 3D models are known as asset objects, which can be raised from highlighting smartphone cameras to a target object. Setting the target object can be done through the program on the vuforia.com website on the website synchronization between target objects that will be used against Unity software is synchronized. The quality of the target object is determined by it. The more star values are given by the website (the most 5 stars, the worst 1 star). The target object that has been determined is a scanning process on the Vuforia Web Portal to obtain an augmentable grade, namely the grade of object quality in the target object to be exported in the form of unitypackage. This file can be configured in unity software.

The next stage is to download the file to be imported into unity software and integrate digitally to position the asset object within the scope of the target object's image. Integration is done through the vuforia portal configured in unity software. The configuration between the Vuforia Web Portal and unity software, produces a preview of the conditions that actually occur on real smartphones. There are obstacles at this stage, namely the difficulty of the researcher in making the form of Piranha as it really is. This is because the pattern is not symmetrical in shape. In Unity software, there is a process of integration between IDA, ISA, Piranha and Barbarian assets to each of the inventory labels. This condition can be seen from the following picture.

Making asset object user interface features

Asset objects and target objects that have been integrated, will be designed in terms of zooming and Yaw Axiz moving (rotate) which can see the top, bottom and other sides of the asset object. With this User Interface, the display of Asset Objects is interesting. Only by highlighting the inventory label, can the assets be seen through various sides. To be able to use this feature can be downloaded through "Lean Touch" at the Asset Store.

The function test feature can be done when the AR application is installed on the smartphone because the two-finger motion function cannot be facilitated through the cursor. At this stage there are obstacles, namely the features of Lean Touch Assets. To get the features as desired, the researchers were only able to do trial and error because there was no specific description that showed how the features/capabilities would occur if executed.

Test the function of the augmented reality system

At this stage, the application that has been formed, will be stored on the computer (Unity program) in the format ".apk". The application will be installed and run on a smartphone. From the results of running on a smartphone, you will see the display quality and movement of the asset object. There is a “Build Setting” menu in Unity software to build applications in the .apk format.

After downloading and running on a smartphone, the results of testing the interface features (zooming out and sliding.) can be applied.

Iteration

Iterating is very important. Iterations are carried out if there is a difference between the final results and the theory when the results obtained are not in accordance with what was designed. After the application installation phase is complete, the next is testing the running or not the application on the smartphone. The application can run well on four types of smartphones that can be found in the public market in Indonesia, but there is a very serious problem, that is, there is no match between the target object and the asset object.

Except for Barbarian, the three other asset objects experience unstable conditions, which are not in accordance with the asset object with the target object on the smartphone screen when highlighting the camera. The use of book cover and barbarian is intended to ensure the program can display the real conditions of the application. In dealing with this problem, researchers have repeated the steps to make AR as a whole up to several times but the results remain the same. For this condition, researchers assume that the appearance of target objects is almost the same that makes misfunction. This condition is very possible to do further research to answer scientifically.

Compile the final report

In this study, data analysis was carried out by analyzing the performance of the overall results of the functional tests that have been carried out. The analysis is done to test the work function of the AR system based on light intensity (Lux Meter) and Distance highlighting the camera (ruler). At this stage the researcher takes measurements with three types of smartphones, with each target object three times in three different lighting conditions, namely in the dark room (lab classrooms without lights but sunlight still entering), bright room (same room but plus lighting) and under direct sunlight. Each of these conditions is tested three times for each smartphone. This study examines the suitability of displaying asset objects on a smartphone screen by highlighting the target object on the camera.[4,8,9,14,19,20] The test method also refers to distances of 10, 15, 20, 25 and 30 cm. Only by highlighting the inventory label, the assets can be viewed through a smartphone screen.

Research locations were at the Microcontroller Laboratory, in the Joint Laboratory Building, R.4.9 and in the Workshop Room of the Electromedical Engineering Department. The research process was carried out for 7 months (January to September) in 2018.

There is no ethical clearence for this research, because it has no any connection to human or animal aspects.

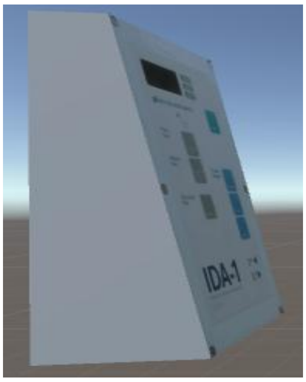

Figure 2: IDA-1 3D model.

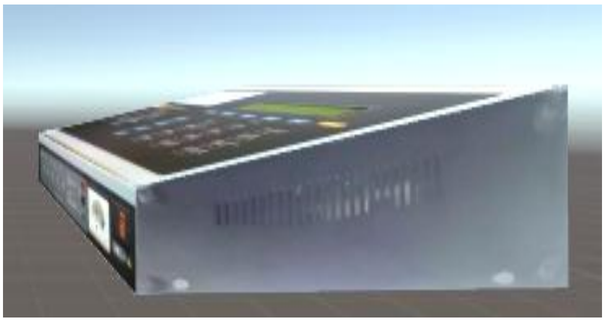

Figure 3: ISA 3D model.

Figure 4: Piranha 3D model.

Figure 5: Barbarian 3D model.

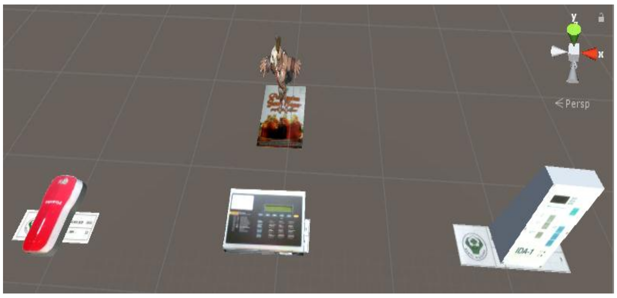

Figure 6: Integration between asset objects and target objects.

RESULTS

Tests are carried out by placing three types of smartphones with different brands and labeled smartphones A, B and C. The place of testing is carried out in three different conditions (places), namely in a dark room (room with sunlight through windows), a bright room (the same in the dark room but with maximum room light) and open space. The purpose of this test is to get the incompatibility percentage of the target object with the asset object that appears. Each test is carried out three times for each smartphone used.

For the first data group is the testing using smartphone A, B, C for ISA asset objects with ISA inventory target label object. The result table can be seen below (Table 1).

Table 1: The testing result for smartphone A, B and C to detect ISA (%).

	Dark room	Bright room	Open space
A	87	80	94
B	80	100	80
C	100	87	87

For the second data group is the testing using smartphone A, B, C for IDA asset objects with IDA inventory target label object. The result table can be seen below (Table 2).

Table 2: The testing result for smartphone A, B and C to detect IDA (%).

	Dark room	Bright room	Open space
A	67	60	74
B	80	87	80
C	80	67	47

For the third data group is the testing using smartphone A, B, C for Piranha asset objects with its inventory target label object. The result table can be seen below (Table 3).

For the fourth data group is the testing using smartphone A, B, C for Barbarian asset objects with the book cover target label object. The result table can be seen below (Table 4).

Table 3: The testing result for smartphone A, B and C to detect Piranha (%).

	Dark room	Bright room	Open space
A	54	47	60
B	27	27	47
C	20	20	26

Table 4: The testing result for smartphone A, B and C to detect Barbarian (%).

	Dark room	Bright room	Open space
A	100	100	100
B	100	100	100
C	100	100	100

DISCUSSION

From the testing table that uses smartphone A with the ISA object target, there is a mismatch between the target object with very high asset objects, 87% for a dark room, 80% for a bright room and 94% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room. When the smartphone A is used to detect the IDA object target, there is a mismatch between the target object with very high asset objects, 67% for a dark room, 60% for a bright room and 74% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room. For the testing table that uses smartphone A with the Piranha object target, there is a mismatch between the target object with very high asset objects, 54% for a dark room, 47% for a bright room and 60% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room.

The testing table that uses smartphone B with the ISA object target, there is a mismatch between the target object with very high asset objects, 80% for a dark room, 100% for a bright room and 80% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room. The testing table that uses smartphone B with the IDA object target, there is a mismatch between the target object with very high asset objects, 80% for a dark room, 87% for a bright room and 80% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room and for the testing table that uses smartphone B with the Piranha object target, there is a mismatch between the target object with very high asset objects, 27% for dark room, 27% for bright room and 47% for open space. An undetectable condition also occurs, ie when an asset object does not appear on a smartphone screen in any condition of the room.

From the testing table that uses smartphone C with the ISA object target, there is a mismatch between the target object with very high asset objects, 100% for a dark room, 87% for a bright room and 87% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room. It is also happened, for the testing table that uses smartphone C with the IDA object target, there is a mismatch between the target object with very high asset objects, 80% for a dark room, 67% for a bright room and 47% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room. For the testing table that uses smartphone C with the Piranha object target, there is a mismatch between the target object with very high asset objects, 20% for a dark room, 20% for a bright room and 26% for open space. An undetectable condition also occurs, i.e., when an asset object does not appear on a smartphone screen in any condition of the room

When testing smartphones A, B and C are performed on barbarian target objects, the results of the overall asset object display that are obtained are 100% accurate and clear. This perfect condition occurs in every lighting condition in the range of the overall varied range.

From the research and experiments that have been carried out it can be concluded that making Augmented Reality has been successfully carried out with 3-D models as asset objects for IDA, ISA, Piranha and "barbarian" and target objects that use inventory labels on each tool plus a book cover for target reference. The interface feature has been pinned and can be run properly, although it can only be done on a smartphone, because on the PC / Laptop screen (without touch screen) it is difficult to apply finger motion through the cursor. The overall test of the application has been successfully executed on the conditions on the smartphone, but there is a discrepancy between the appearance of asset objects (IDA, ISA, and Piranha) with the target object except for book cover and barbarian which look very good without any noise.

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REFERENCES

1. Dzenzelyuk N. Adaptive inventory management system of an industrial enterprise in the unsteady

market environment. SHS Web Conf. 2017;35:01148.
2. Setiyani L. Desain Sistem Manajemen Inventory Produk Farmasi Menggunakan Pendekatan Prototipe (Study Case : Pt. Zalfa Mandiri). 2018;11(3):225-34.
3. Gao C, Wang Y, Xu L, Liao Y. Dynamic Pricing and Production Control of an Inventory System with Remanufacturing. Math Probl Eng. 2015;2015:1-8.
4. Dastageeri H, Storz M, Koukofikis A, Knauth S, Coors V. Approach and evaluation of a mobile video-based and locationbased augmented reality platform for information brokerage. Int Arch Photogramm Remote Sens Spat Inf Sci - ISPRS Arch. 2016;42(4W1):151-7.
5. Endres C, Butz A, MacWilliams A. A Survey of Software Infrastructures and Frameworks for Ubiquitous Computing. Mob Inf Syst. 2005;1(1):41-80.
6. Kamelia L. Perkembangan Teknologi Augmented Reality Sebagai Media Pembelajaran Interaktif Pada Mata. 2015;IX(1):238-53.
7. Prabowo AZ, Satoto KI, Martono KT. Perancangan dan Implementasi Augmented Reality sebagai Media Promosi Penjualan Perumahan. J Teknol dan Sist Komput. 2016;3(1):161-70.
8. Winata IC, Prasida TAS. Design of Batik Plumpungan Salatiga Book Using Augmented Reality Technology Based Android. 2017;15(1):36-45.
9. Tsui KM, Dalphond JM, Brooks DJ, et al. Accessible Human-Robot Interaction for Telepresence Robots: A Case Study. Paladyn, J Behav Robot. 2015;6(1):1-29.
10. Blender.org. Blender projects in 2018 to look forward to- blender.org. Available at: https://www.blender.org/press/blender-projects-in-2018-to-look-forward-to/. Published 2018. Accessed January 23, 2018.
11. Vuforia Developer Library. Object Recognition. Available at: https://library.vuforia.com/content/vuforia-library/en/articles/Training/Object-Recognition.html. Published 2018. Accessed January 23, 2018.
12. Unity3D. Unity-Products. Available at: https://unity3d.com/unity. Published 2018. Accessed January 23, 2018.
13. Rämö J, Välimäki V. Digital Augmented Reality Audio Headset. J Electr Comput Eng. 2012;2012(October):1-13.
14. Prathivi R. Feature Recognition Berbasis Corner Detection Dengan Metode Fast, Surf Dan Flann Tree Untuk Identifikasi Logo Pada Augmented Reality Mobile System. J Transform. 2018;11(2):51.
15. Webtol.com. Pengertian, Sejarah Serta Perkembangan Android – webtol.com. Available at: http://www.webtol.com/teknologi/pengertian-sejarah-serta-perkembangan-android/. Published 2017. Accessed January 24, 2018.
16. KOMPAS. Evolusi OS Android, dari Versi 1.0 hingga 7.0 Nougat Halaman 1 - Kompas.com. Available at: http://tekno.kompas.com/read/2016/10/17/19480037/evolusi.os.android.dari.versi.1.0.hingga.7.0.nougat. Published 2017. Accessed January 24, 2018.
17. Priyo. Pengertian Augmented Reality - Sistem Knowledge Management TIK. SOLMET Kementerian Pendidikan dan Kebudayaan. Available at: http://solmet.kemdikbud.go.id/?p=2895. Accessed June 13, 2019.
18. Aguston RL, Andika H, Trianto EM. Pemanfaatan Augmented Reality Pada Permainan Othello. Teknika. 2017;5(1):1-9.
19. López-Mir F, Naranjo V, Fuertes JJ, Alcañiz M, Bueno J, Pareja E. Design and Validation of an Augmented Reality System for Laparoscopic Surgery in a Real Environment. Biomed Res Int. 2013;2013:1-12.
20. Kustijono R, Hakim SR, Kustijono R, Hakim SR. Pengaruh intensitas cahaya dan jarak pada sistem augmented reality objek animasi. 2014;4(2):8-14.

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