Implementation of Industrial 4.0 Library Based on Mobile using QR-Code

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Abstract. Libraries are an important element in the world of education so that libraries need to innovate by collaborating library services with technology. AR is the concept of combining virtual objects with real objects that are used to display interesting library service information so that it can improve library performance in providing information to people in need. The purpose of this study was to implement AR using QR-code to facilitate users in terms of college library collection services. In the development of multimedia research methodology, there are six stages, namely 1. concept 2. design 3. material collecting 4. assembly 5. testing 6. Distribution. These six stages can be carried out in an irregular manner, so that the stages of multimedia development can swap positions. But for this stage there is one stage that must be the first thing to do, namely the concept stage. The result obtained is the implementation of AR by using QR-code for library services such as library plans, bookshelves and book synopses in universities.

Keywords: Multimedia, Augmented Reality (AR), Library and QR-Code

1. Introduction

The library is a place that is useful for developing information and knowledge, as well as educational means to expedite the horizons of educators and students in teaching and learning activities that are well managed by an educational institution.[1][2][3]. The purpose and function of the inner library is to serve users, increase reading interest for readers, broaden insight and knowledge as well as a vehicle for education, research, preservation, information, and recreation to improve intelligence and empowerment[4]. The implementation of library services in improving the quality of services to users is needed in addition to the implementation of the SLiMs library automation system[5]. One example of improving services is by applying technology in the multimedia field of Augmented Reality (AR). AR is a development in the field of multimedia that combines virtual objects with real objects and then the objects are projected at the same time[6][7]. AR implementation in the library is used to make it easier for users to find collections in the library. The AR work system in this study uses a QR-code. QR-code is a two-dimensional image that can be used to store data[8]. QR Code is a type of two-dimensional image that displays data in the form of text. With QR Code users can access a web faster than having to do it manually[9]. Implementing AR using QR-code to make it easier for users in terms of college library collection services is the aim of this research. So that college libraries can implement digitization in the current millennial era.
2. Research Method

The development of this multimedia method is based on six stages, namely concept, design, material collecting, assembly, testing, and distribution[10]. In practice these six stages do not have to be sequential, they can swap positions. Even so, the concept must be the first stage to be worked on. Figure 1 is a picture of the stages of the MDLC method.

![Multimedia development diagram](image)

**Fig. 1. Multimedia development**

a) Concept

The design and implementation of the Augmented Reality Library Application using an Android-based QR-Code aims to improve efficiency and help college libraries in providing services to users using Augmented Reality technology to compare marker detection from QR-Code in the form of photo images that have been installed in the library. An overview of the use of this application, the user installs the library application first, after installing the smartphone then open the library application then click on one of the menus available in the application, after selecting the menu then just pointing the smartphone to the photo or image available in the college library then will automatically display menu selection data according to the choice of the user. The menu options in the library application are campus plans, library plans, various kinds of shelves in the college library and book synopses.

b) Design

There are four stages in the design, design and implementation of Augmented Reality library applications using an Android-based QR-Code, namely determining the target image in the form of a QR-Code that is created manually via the website http://goqr.me. In order to differentiate QR-Code from one another when creating it on the QR Code generator website, the QR-Code is differentiated by the number of text characters which will be automatically implemented in the form of different dots for each QR-Code depending on the character. Then after designing a marker or target image in the form of a QR-Code, the next step is to import photos that are merged with 3D objects in Unity. After that, implement it into the Augmented Reality project by creating an interface, application menu, and application when actively detecting in the scene. At this stage a marker in the form of a QR-Code is designed through the help of a QR-Code generator via the website http://goqr.me. On the website, there will be many choices of types of QR-Code content that will be created, such as text content, url, image, e-mail, geolocation, sms, and so on. In making this marker, text content is used to make it easier to implement characters in text into QR-Code form. The following is a picture of 3 steps to create a QR code using a QR-Code generator:
There are 4 library services taken, namely Campus Plan, Library Plan, Type of Shelf and Book Synopsis. The service becomes an asset in the Unity software to be used as a QR-Code code or marker. The application user flow chart design is illustrated in Figure 3 as follows:

**Fig. 3. Application User Flow Chart**

c) **Material Collecting**

At the material collecting stage, the researchers collected material in the form of two-dimensional images obtained from college library data.

d) **Assembly**

When building the application for the Design and Implementation of Augmented Reality, the Library application using an Android-based QR-Code, the hardware and software used are as follows:

| Hardware | Software |
|----------|----------|
| a. Notebook or Laptop with the following specifications: | a. OS X El- Capitan |
| 1. Processor 2.3 GHz Intel Core i5 | b. Pixelmator |
| 2. 8.00 GB RAM memory | c. Unity 3D |
### Hardware

- 3. 500 GB SATA hard drive
- 4. Graphics Intel HD Grapics 3000 512 MB
- 5. 14 inch LCD monitor
- b. 1 mouse
- c. 1 mobile device based on Android version 5.0.1

### Software

| No. | Function tested | Initial Conditions | Expected Final Conditions | Result |
|-----|-----------------|--------------------|--------------------------|--------|
| 1.  | Open the application | The user has not opened the application | The system displays the main page | successful |
| 2.  | Choose a menu | The user selects the menu on the main page | Displays the user options menu | successful |
| 3.  | Back button | The user returns to the main page | Return to the main page | successful |
| 4.  | Exit button | The user exits the application | Exit the library application | successful |

**e) Testing**

Testing the use of the Application Design and Implementation of the Augmented Reality Library application using an Android-based QR-Code, carried out through the black box software testing method, where each function of the application will be tested with the following test results:

**Table 2. System Testing**

| No. | Function tested | Initial Conditions | Expected Final Conditions | Result |
|-----|-----------------|--------------------|--------------------------|--------|
| 1.  | Open the application | The user has not opened the application | The system displays the main page | successful |
| 2.  | Choose a menu | The user selects the menu on the main page | Displays the user options menu | successful |
| 3.  | Back button | The user returns to the main page | Return to the main page | successful |
| 4.  | Exit button | The user exits the application | Exit the library application | successful |

**f) Distribution**

Distribution of this application is limited only to tax officers and certain parties, through devices such as USB, CD, or online.

### 3. Implementation

Application implementation is a stage where markers or markers, image objects and interface designs that have been designed at the design stage are compiled so as to produce an application based on Augmented Reality technology using QR-code.

**a) Display The Main Page Of The Application**

In the main menu view, this library application displays a menu of options such as the Campus plan, Library Plan, various shelves and book synopses as in Figure 4 below:

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**Fig. 4. Main Menu**
b) Display Campus Plan

If you choose the PNM floor plan menu, the library application will display the overall PNM 1 campus plan, as in Figure 5 below:

Fig. 5. Campus Plan Menu Display

To be able to display picture 5 above, after selecting the campus plan menu, we scan the new campus logo and it will display the campus plan as shown in Figure 5.

c) Library Plan Views

The library plan menu displays the library plan by selecting the library plan menu then scanning and pointing the cellphone camera at the library logo, image 6 will appear as below:

Fig. 6. Display of the Library Plan
d. Display Types of Shelves

After selecting a menu of various shelves, a shelf image will be displayed and explained in a voice making it easier for the user to choose the shelf that suits their book needs, as shown in Figure 7 below:

![Figure 7. Shown Various Types of Shelves](image)

e) Synopsis View

The synopsis menu displays a picture of the book and makes a sound explanation of the summary of the book as in Figure 8 below:

![Figure 8. Synopsis Menu Display](image)
4. Conclusion

After doing black-box testing, it can be concluded as follows:

a. Applications can run smoothly on smartphones with sufficient RAM capacity of 2 Giga.

b. The ideal distance for scanning QR-Code is the closest ± 10 cm and ± 45 cm for long distances.

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