

University Logo Recognition Application Using Template Matching Method

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Abstract

A logo is a special symbol or symbol that represents a company or organization. A logo can be a name, symbol or other graphic element that is displayed visually [1]. All institutions have a logo, especially an educational institution, namely the University, but the university logo is rarely remembered by lecturers, students, or the public. To be able to remind and provide information about the university, the university logo scan application which will later be directed to the university link is considered by the author suitable to be made. This kind of research has been tested with high accuracy but does not use the University logo. This research will utilize Augmented Reality program design with slight modifications and apply the Template Matching method that will be made with the Unity Game Engine and Vuforia SDK. Template matching is a technique in digital image processing that functions to match each part of an image with the image that becomes the template (reference) [4]. This research was successful as evidenced by the smooth installation of APK and good program performance. In addition, this study obtained 84% accuracy in the detection of markers (logos) which were known by the distance and focus of the camera. This research also gets 100% accuracy in the direction to the intended university link.

Keywords: Logo, University, Template Matching, Vuforia SDK, Unity Game Engine

1. Introduction

A logo is a special symbol or symbol that represents a company or organization. A logo can be a name, symbol or other graphic element that is displayed visually [1]. The logo is also used by many institutions, especially educational institutions such as universities [6]. This is due to the number of universities that have emerged over time until a distinction between universities is needed, one of which is a logo. Every new school year universities do promotions through many things, from billboards, banners, and pamphlets that are distributed to get new students. On billboards, pamphlets, etc., there must be a logo as the identity of the university [7]. Often times the info in the promotional media is not complete, till there is less motivation for prospective students to enter the university. In addition, there are also many well-known universities that do not do enough promotion so as information about the university is less accessible to prospective new students. Because of this problem, this research was made with the result that prospective students, students, lecturers, and others could get information about the university by simply scanning the university logo through an Android-based application. So that the user will point the cellphone camera at a university logo and the application will point to the university link to get more information. To create an application like this, there are many methods that can be used, one of which is template matching. Template matching is a technique in digital image processing that functions to match each part of an image with the image that becomes the template (reference) [4]. This technique was chosen because this technique is usually used in object applications for allocating, object edge detection, to map routes for mobile robots and in image registration techniques. In addition, template matching is a technique commonly used in object

recognition because it uses the basic concept of computer vision, which is looking for key points (keypoints) or points that have special characteristics (feature points). Template matching has several methods of tracking points (points detectors), namely; Harris corners, fast features, scale-invariant SURF features, and SURF features.

Research on logo detection was conducted in 2014 at a university in France, by Alireza Alaei and Mathieu Delalandre. This study describes the detection of logos for image documents using a piece-wise painting algorithm (PPA) and several probability features along with the Decision Tree. The journal of the research explains the detection and recognition of logos. Logo detection is done using computer vision techniques, namely black and white. So as the logo is changed to only have black and white colors. Subsequently proceed with the introduction of the logo which is divided into 3, namely feature extension, reduction of search space and finally the application of the template matching method. This study uses the Tobacco 800 dataset in which there are 1290 images with 99,31% detected as the logo path and the accuracy rate is 97.90% of the total logo paths obtained [2].

This study will use the Template Matching method. This method is usually used in Augmented Reality. Augmented Reality is a real time display of information overlaid with virtual objects in a real world view [3]. The virtual object that is displayed in Augmented reality can be a 2-dimensional object or a 3-dimensional object. So that the application to be designed in this study will take the concept of Augmented Reality because it is judged by the author that Augmented Reality is a modern technology that is very suitable as a medium of learning and promotion. The concept of Augmented Reality in this study will undergo several modifications and will use a library commonly used in making Augmented Reality applications, namely Vuforia SDK and Unity Tools.

2. Research Methods

This research will combine the concept of Augmented Reality, where objects that are commonly displayed in the Augmented Reality application will be replaced with images that indicate that the logo scan has been successful. Then the application will direct the user to the University Website link according to the logo that has been scanned. The stages of making this application are collecting logo data that will be used in the application. Afterwards the application design will be made from the system created. And the last is system design [8].

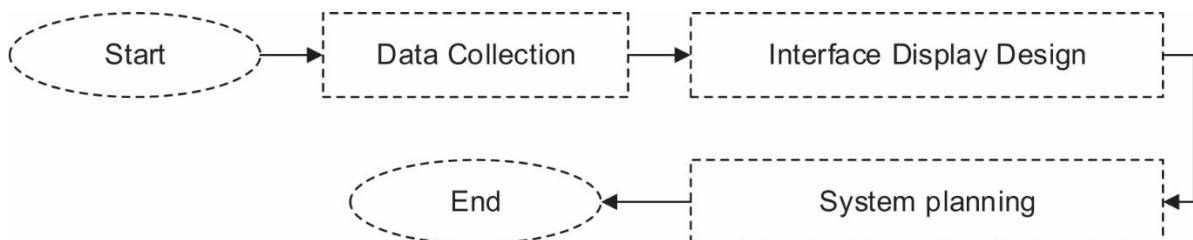


Figure 1. Research Methodology Flow

2.1. Data collection

The data that will be used in this study are data in the form of university logos in Indonesia. In this research, the author will use 3 university logos obtained via the internet, namely Udayana University, University of Indonesia, and Gadjah Mada University. These logos consist of various types such as those with text, only logos, or modified logos that are usually printed on alma mater coats, university hats, and t-shirts bearing the university logo. Users can also provide university logo suggestions which can be done by selecting the logo request menu and will be immediately directed to send the logo via email.



Figure 2. University Logo Data

2.2. Designing Application Interface Views

Before doing system design, first design the application interface. The application interface is the display that will be shown in the application in the form of a menu display and an icon or image in the application. This application interface is made using CorelDraw 2019 tools. Because the application is mobile based, the author uses a canvas with a ratio of 16: 9 (portrait) with a resolution of 720p, namely 1280 pixels x 720 pixels. The following is an example of the application interface of this study.



Figure 3. Application Interface Display

2.3. System planning

System design is done by taking the concept of Augmented Reality. In designing the Augmented Reality program, several engines are needed [5].

- Vuforia SDK is one of the engines developed to support the creation of Augmented Reality applications that have the ability to perform image recognition in developing image recognition.
- Unity Game Engine is an IDE (Integrated Development Environment) application which is commonly used to create 3-dimensional video games. Unity Game Engine is not only a game engine, but also an editor.
- Android Software Development Kit (SDK) is a kit used by application makers to develop Android-based applications in which there are several tools such as debuggers, software libraries, and emulators.
- Android Native Development Kit (NDK) is an engine that is used to control native activity and access physical device components, such as sensors and touch input on Android by simply running C and C++ language programs.

- e. *Target Manager* is an image or object that is used as a reference or a place to place the desired object. In this study, the University Logo will be used as the Target Manager.

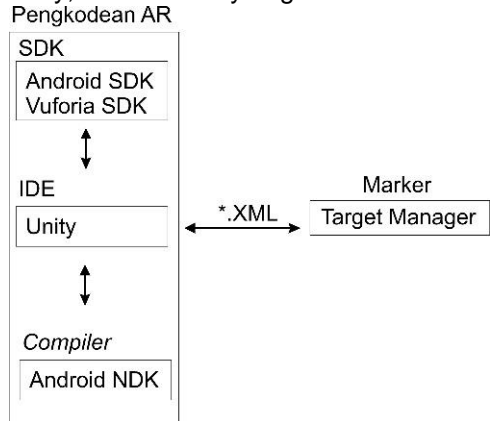


Figure 4. Integration Between Augmented Reality Engines

The picture above shows the integration between *Augmented Reality* Engines which includes the AR coding process, and marker design. In the coding process *Augmented Reality* includes the use of the SDK (Android SDK and Vuforia SDK), the Unity Game Engine IDE, and the Android NDK Compiler [5]. The designed marker is to determine the pattern first for the Template Matching pattern process. Template matching is a technique in digital image processing that functions to match each part of an image with the image that becomes the template (reference) [4]. This technique performs tracking on the characteristic points of an image using the angles contained in the image can be a solution to finding patterns from an image. The detection corners are mapped to facilitate the design of the image pattern. These corners are interesting because they have two-dimensional characteristics that can accurately limit any sub-pixel accuracy (as a cross between two sides / edges). In this application, template matching uses Harris corners point tracking. This is done by determining the angle notation that is on the image / object. The notation of the corners of the image is determined by averaging the value of the intensity of the direct change in small windows around the suspected point of interest. In its application, this method applies correlation calculations. Correlation is a technique for finding a relationship between two variables. Correlation is needed in order to count the number of lines and objects in an image. Here is the formula for calculating the correlation value between 2 matrices.

$$r = \frac{\sum_{k=1}^n (x_{ik} - \bar{x}_i) \cdot (x_{jk} - \bar{x}_j)}{\sqrt{[\sum_{k=1}^n (x_{ik} - \bar{x}_i)^2 \cdot \sum_{k=1}^n (x_{jk} - \bar{x}_j)^2]}} \dots \dots \dots (1)$$

$$\bar{x}_i = \frac{1}{n} \sum_{k=1}^n x_{ik} \dots \dots \dots (2)$$

$$\bar{x}_j = \frac{1}{n} \sum_{k=1}^n x_{jk} \dots \dots \dots (3)$$

Information

- r = the correlation value between the two treesh matrix (the value Among -1 and +1).
- x_{ik} = score pixel to -k in the matrix i.
- x_{jk} = score pixel to -k in the matrix j.
- \bar{x}_i = average score pixel matrix i.
- \bar{x}_j = average score pixel matrix j.
- n = the number of pixels in a matrix

Furthermore, the pattern from the marker is afterwards stored in the database *Augmented Reality* in (exported) * .xml format which the Android SDK can call up. After that it is carried out by combining all the engines in the Unity application and placing a marker (target image) under the object to be displayed. In this application the object displayed is a successful scanned image. After that, do the modification by directing to the university link. When the scanned image is successfully displayed.

3. Result and Discussion

3.1. System Design

The system design is a general description of the system that has been created. This general description is in the form of Stages or how the system works. The stage starts by displaying the menu. Then the University Logo will be scanned with a phone camera. After that, after being scanned, the Template Matching process will be carried out, which is the process of matching the image taken by the camera with the existing database, if it is suitable, the system will display a successful scan image otherwise it will return to the menu. Subsequently the system will direct to the university website link for clearer information, as shown in the flowchart in Figure 5.

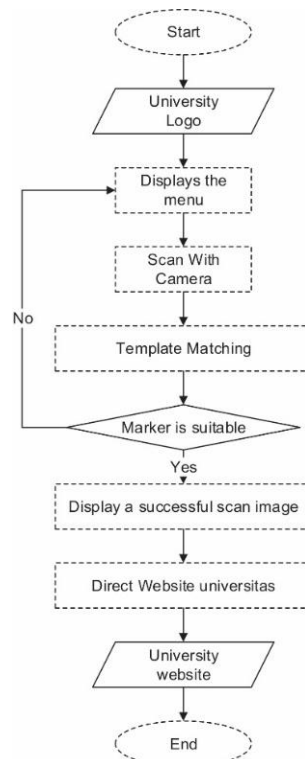


Figure 5. System flowchart

3.2. Implementation

The following are the results of implementing the application that has been made. The application will be greeted with a menu page consisting of 3 buttons, namely the scan button, exit button, and the request logo button. The scan button will lead to the Augmented Reality view which only has 1 button, namely the return button to the menu. If this display is directed to the university logo and is successful, it will be directed to the university website link. The exit button will be directly directed to the home of each device. The Request logo button will be directed to the guide page

for a logo request which contains 1 button, namely the button to send an email that has been directed to the developer email.

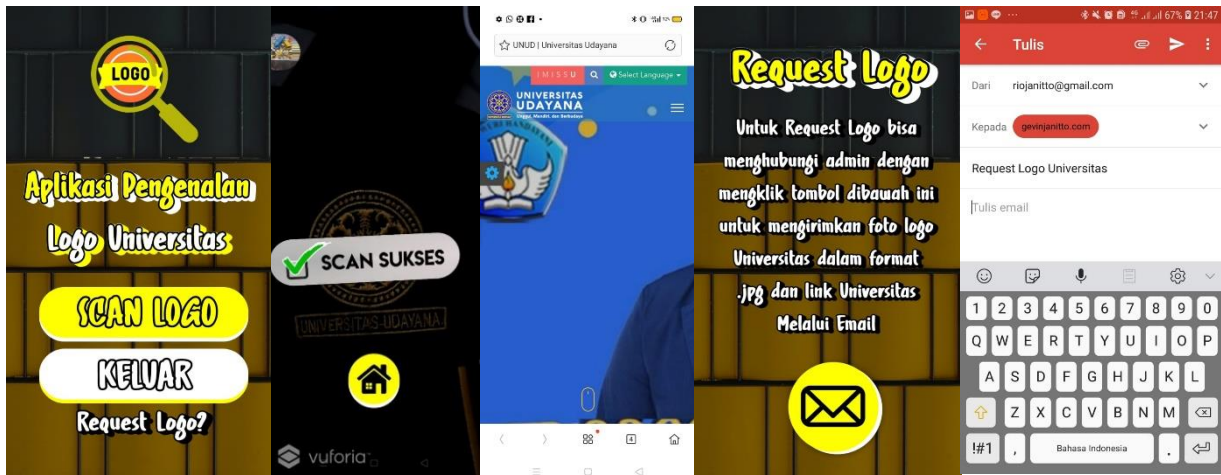


Figure 6. Implementation

3.3. Testing System

Testing this application is done using blackbox testing. Blackbox testing is a software testing method that only focuses on application output, whether the application is functioning properly or not. This test is done by trying to run the application on several different devices both in terms of smooth scan and the displayed link. The test devices used include the Samsung Galaxy J7 Prime, Samsung Galaxy S8, Samsung Galaxy M21, Realme C3 and Xiaomi Redmi Note 7. From the test process obtained the following data.

Table 1. System Testing

No.	Testing	Result	Information
1	Install APK	The installation process went smoothly	It works
2	Running Applications	The application runs smoothly	It works
3	Marker Detection	The marker is detected properly so that the scan image is successful, if the light and focus of the camera match an accuracy of 84%	It works
4	Direct link	The system redirects to the University's website link that is 100% correct and accurate	It works

Table 2. Test result

No.	Testing	Successful Detection	Detection Failed	Percentage
1	Samsung Galaxy J7 Prime	3	2	60%
2	Xiaomi Redmi Note 7	4	1	80%
3	Samsung Galaxy S8	5	0	100%

4	Realme C3	4	1	80%
5	Samsung Galaxy M21	5	0	100%
Total				84%

4. Conclusion

The application made in this study was built so that the public could recognize the logos of various universities. This application uses the template matching method because this technique is usually used in object application for allocating, object edge detection, for mapping routes for mobile robots and for image registration techniques. This application was made with Unity Game Engine and Vuforia SDK. While this application can detect 3 university logos, Udayana University, University of Indonesia, and Gadjah Mada University. However, users can propose logos for other universities by taking advantage of the logo request feature which will then be directed to send the university logo and link to the developer email. Testing of this application is carried out using blackbox testing, so that the results are as follows:

1. The detection of markers is going quite well, but the detection is very much influenced by the distance and focus of the camera, the closer the camera and the focus, the sharper the marker, the faster the marker will be detected with 84% accuracy.
2. The system design is done quite well so that when the APK installation process runs smoothly and the application runs well when it is run.
3. The directions to the university link are well established and 100% accurate to the link of the intended university.

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