Augmented Reality Application for Book Promotion

Aan Erlansari [1)] Paulus Insap Santosa [2)] Ridi Ferdiana [3)]
[1) 2) 3)] Electr. Eng. & Inf. Technol. Dept., Gadjah Mada Univ., Yogyakarta, Indonesia
email: erlansay@yahoo.com [1)] insap@ugm.ac.id [2)] ridi@ugm.ac.id [3)]

***Abstract*— With the proliferation of smartphone amongst the world population with ever increasing sets of advanced feature such as camera, high resolution and processor speed, Augmented reality (AR) has the opportunity to emerge from laboratories into product advertising. In this paper we discuss, implementation of AR to be use in book advertisement or book promotion to be viewed via mobile phone equipped with high resolution cameras. The prototyping of AR is using vuforia SDK library which allow the system to be deployed through eclipse or unity3D tools. The purpose of this research is to develop promotion media with AR technology application under android platform.**

Keywords-component; Augmented reality, mobile phone, vuforia, android

I. INTRODUCTION

In recent years the new type of mobile phones namely smartphones provide all necessary components to produce AR. Augmented reality relies heavily on image processing and ideally should take place in real time, because of those constraints it requires high amount of processing power. Until recent years it was impossible to achieve satisfying results on mobile devices, but nowadays the phones even have multiple processor cores which are up for the task. The possibilities for AR applications seem to be endless and it also seems to be reflected in an increasing number of applications available for mobile devices.

For the last few years, aside from traditional way or self-promotion book through conference or offline promotion, internet became most effective book promotion media. Internet has many new features that can be used for self-promotion. One of these is social media bookmarking. A key concept of this is tagging, which means assigning keywords to the bookmark. Each bookmark can have several keyword. This would work well for the sales page of a book. Social bookmarking attracts huge amount of traffics to tagged website, so it is an excellent way to get a buzz going about a new book.

Concept of book campaign or advertise using AR application to be used in this paper is to retrieve an information about book by tracking and recognizing a photo of a book cover with mobile devices. This is only one of numerous ways to introduce a book and be able to facilitate users to identify the book directly.

II. THEORY

A. Augmented Reality

Augmented Reality (AR) refers to a live view of physical real world environment whose elements are merged with augmented computer-generated images creating a mixed reality [1]. The augmentation is typically done in real time and in semantic context with environmental elements. By using the latest AR techniques and technologies, the information about the surrounding real world becomes interactive and digitally usable. This application aims at simplifying the user's life by bringing virtual information not only to his immediate surroundings, but also to any indirect view of the real-world environment, such as live-video stream. AR enhances the user's perception of and interaction with the real world.

Azuma's definition of an AR application guarantees that the dynamics of real world environments remain unchanged after virtual renderings have been added. However, in order to comprehensively fuse real and virtual information, both images have to be carefully combined rather than simply pasted together [2, 3]. To avoid limiting AR to specific technology Azuma also define as a system that combines real and virtual world, interactive in real-time and registered in 3D.

The broader definition of AR concluded [4] as follow:

a. AR combine the real world with computer graphics
b. Provides information with object in real-time
c. Track object in real-time
d. Provides recognition of images or objects
e. Provides real-time context or data

B. Vuforia

Vuforia[5] is an AR SDK for smartphones or other similar mobile device that allows executes AR applications into a real time video obtained from these devices. This software uses the capabilities of the computer vision technology to recognize and make the individually tracking of the objects captured by the video camera in real time. On the other hand, not all the objects will be detected, and only a few detected objects may be tracked due mainly to the mobile's CPU and GPU.

C. Image target and recognition

Image targets are an image that vuforia SDK can detect and track. Unlike traditional markers, image targets do not need special black and white regions or codes to be recognized. The Vuforia SDK uses sophisticated algorithms to detect and track the features that are naturally found in the image itself, and compare known image target to resources database [5].

Image recognition [4] is the process of identifying and detecting an object or a feature in a digital image or video. In machine learning, image or pattern recognition is the assignment of a label to a given input value. However,

pattern recognition is a more general problem that encompasses other types of output as well. Pattern recognition algorithms generally aim to provide a reasonable answer for all possible inputs and to do "fuzzy" matching of inputs.

Pattern recognition [4] is generally categorized according to the type of learning procedure used to generate the output value. Supervised learning assumes that a set of training data (the training set) has been provided, consisting of a set of instances that have been properly labeled by hand with the correct output. Unsupervised learning, on the other hand, assumes training data that has not been hand-labeled, and attempts to find inherent patterns in the data that can then be used to determine the correct output value for new data instances. A combination of the two that has recently been explored is semi-supervised learning, which uses a combination of labeled and unlabeled data (typically a small set of labeled data combined with a large amount of unlabeled data).

D. Feature based-tracking

Feature detection and tracking algorithms are widely used for different purposes in computer vision applications. They are applied in motion detection, image matching, tracking, image mosaicking, and panorama stitching, 3D modeling and object recognition [6].

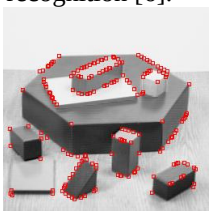


Figure 1. Feature based tracking

Features from registered image provide crucial information for recognition and matching purposes and measure different characteristics of an image such as geometry, spatial, algebraic etc. Feature detection and extraction is the initial and key step of many computer vision algorithms. There are many method of feature detection declared, e.g : SIFT, FAST, PSA, etc.

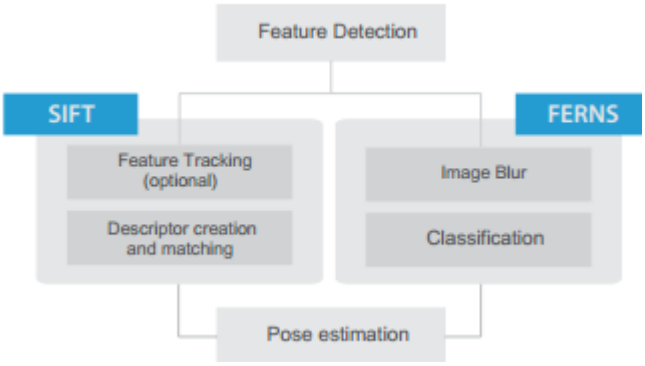


Figure 2. example of feature algorithm[7]

All of its aims to recognize an object feature for camera detection.

Vuforia as an AR library used a feature point based on corner/edge of each image to determine quality of trackable image for application as shown in table 1.

Table 1. feature comparison (4)

	Number f features	Star	High feature density	Uniform feature distribution	Local contrast
	0	0	✗	✗	✓
	4	0	✗	✓	✓
	24	0	✗	✓	✓

As can be seen in the table, maximum number of feature obtained with quad arrow shape with 24 features. With this test can show that the more corner have their image the more features detect to the target manager of vuforia sdk.

E. Transformation and rendering image

Tracking and detection process of images use transformation process which[6]:

$$x = TX \quad (1)$$

where X is a point in world coordinates, x is its projection in ideal image coordinates and T is the camera transformation matrix aka the extrinsic camera matrix or the pose matrix . Transformation T consists of translation vector t and 3 x 3 rotation matrix , R and can be expressed in matrix form,

$$x = [R \mid t]\, X \quad (2)$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} r1 r2 r3 tx \\ r4 r5 r6 ty \\ r7 r8 r9 tz \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix} \quad (3)$$

A rotation matrix has only three free parameters (α, β, γ) that define its nine elements. A translation vector has also three parameters, thus a pose matrix has six free parameters. A marker tracking system needs to solve this camera matrix for each frame when it detects a marker.

III. IMPLEMENTATION

A. Image Target and tracking

Image target database created form vuforia target management system (tms). Based on vuforia architecture target resource will be used for tracking image with AR camera. First, image target must be uploaded to vuforia tms, analyzed with feature detection algorithm, and qualified by image target rating.

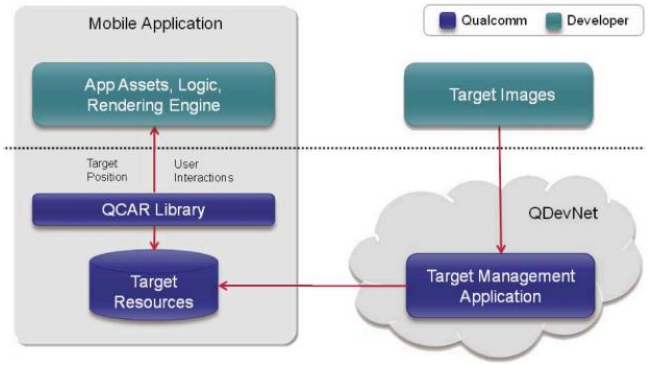


Figure 3. Target resources process[5]

The following image showed component and process to create target resources in vuforia sdk. All process sequentially build to get dataset result in xml and dat file.

```
?xml version="1.0" encoding="UTF-8"?>
<QCARConfig
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="qcar_config.xsd"
>
<Tracking>
  <ImageTarget size="247 173"name="target_name1"
/>
  <ImageTarget size="247 173" name="target_name2"
/>
</Tracking>
</QCARConfig>
```

Downloaded data set will be include in vuforia prefabs inside unity3D engine within QCAR.Behaviour class. Before rendering image or object of trackable image, image target from dataset will be scanned, compared and determined pose transformation of camera. The process show with the folowing figure.

Figure 4. Trackable image process

Objects or images will be rendered successful if dataset and dataset from resource target equal. Otherwise object and image will not show in trackable.

B. Virtual object

Virtual object of this application could be 3D model or 2D model, and both can be used together within application. To build 3D object model we use 3D model builder such as blender, 3D max and Photoshop for 2D object(image). Both can be rendered to application from unity engine by importing file into resources application and use it as a texture or stand-alone object.

Figure 5. Virtual 3D object

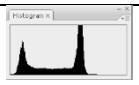
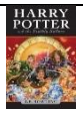
IV. EXPERIMENTAL RESULTS

This section will show the quality of application systems and it's limitation. Formed by several different test that will determine the robustness of the library.

A. Marker and tracking quality test

An augmentable rating defines how well an image can be detected and tracked using the Vuforia SDK. This rating is displayed in the Target Manager and returned for each uploaded target via the web API. The augmentable rating can range from 0 to 5 for any given image. The higher the augmentable rating of an image target, the stronger the detection and tracking ability it contains. A rating of zero indicates that a target is not tracked at all by the AR system, whereas a star rating of 5 indicates that an image is easily tracked by the AR system.

Table 2. Tracking quality test

Target Picture	**Rating**	★☆☆☆☆
	Histogram	
	Feature	
	Rating	★★★★☆
	Histogram	
	Feature	

As can be seen in the previous table, first picture had one star in quality test, which means the image has not enough features, poor feature distribution and poor local contrast. Otherwise, the second picture with 4 stars rating, had enough feature, good feature distribution and good local contrast.

B. Distance track

The purpose of this test is to determine the maximum detection distance in order to establish the distance of possible tracking image and the boundaries of the application, this test is using two type of smartphone device with camera integrated.

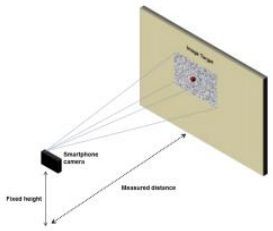


Figure 6. Maximum distance test

With different camera quality from each device, generate different point of distance.

Table 3. Distance test

Devices	Distance means (cm)
Samsung galaxy ACE	240
Andromax tablet	270

C. Video Content

The purpose of this test to determine the minimum requirement of device that able to play video content perfectly.

Table 4. Samsung Device specification

Operating System	Android OS, v2.3 (Gingerbread)
CPU	800 MHz ARM 6
GPU	Adreno 200
RAM	157 MB
Camera	5 MP, 2592x1944 pixels, autofocus, LED flash
Resolution	320 x 480 piksel
OpenGL ES	1.0

Table 5. Andromax Device spesification

Operating System	Android 4.0
CPU	1Ghz Processor
GPU	Cortex ARM A9
RAM	1024 MB RAM
Kamera	Dual Camera : Back 3 MP & Front 2 MP
Resolusi	1024 x 600
OpenGL ES	2.0

In order to get maximum quality of video content from the application, unity 3D engine only support for device that have a high processor speed ArmV7 and OpenGl v2.0. Meanwhile, Samsung S5830 built with ArmV6 processor and only support for OpenGl v1.0, that means, Samsung device have not enough capacity to play video content perfectly.

V. CONCLUSION

Last chapter present an answer of research question and test conclusion during the development of application.

A. Conclusion

1. This application gives an alternative solution to promote published book via smartphone android platform, developed with integration and implementation of vuforia sdk library and unity 3D.
2. This application provided information content of book, such as book feature, writer biography, internet link to online book store and video content of the book

B. Future work

With all application limitation, this application can be developed more interactive with an animation of book content, and using a cloud database to make application dynamically

VI. REFERENCE

[1] **Furht, B.** *Handbook of Augmented Reality.* s.l. : Springer, 2011

[2] **Azuma, Ronald, et al., et al.** Recent Advances in Augmented Reality. *IEEE Computer Graphics and Applications.* s.l. : IEEE , 2001.

[3] **Azuma, R.T** . *A Survey of Augmented Reality.* Teleoperators and Virtual Environtments, s.l. : MIT Presence, 1997, Vol. 6.

[4] **Maddern, L.** *Professional Augmented Reality Browser for Smartphone.* United Kingdom : Wiley Publisher, 2011.

[5] **Ibañez, Alexandro Simonetti and Figueras, Josep Paredes.** Vuforia v1.5 SDK: Analysis and evaluation of capabilities. *Master Thesis.* Catalunya : Universitat Politecnica De Catalunya, 2013.

[6] **Developer, Vuforian Qualcomm.** Resources. *Vuforia Developer.* [Online] 2011. [Cited: april 17, 2013.] https://developer.vuforia.com/resources/dev-guide/trackable-base-class..

[7] **Siltanen, Sanni.** *Theory and applications of marker-based augmented reality.* Finland : VTT, 2012.

[8] **Nikobonyadrad, Sam.** Augmented Reality for Product Packaging. *Bachelor thesis.* s.l. : Mittuniversitetet, 2012.

.