Mobile Augmented Reality for Architecture

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Abstract—**Augmented reality is augmenting the real world with 3D computerised objects. Augmented reality maps the real world and augmented reality can provide the necessary functions and information in its application. Augmented Reality application development is simple, so it can serve as a promotional tool or the provision of information. In our project we use augmented reality application in architecture and real estate purposes. In the real estate, prospective buyers get the information more interactive with real look 3D objects of the land and they really don't have to visit the land. This study uses Vuforia software for development of the AR, Vuforia provides convenience to the Android and iOS mobile platform in the shooting in 3D objects.**

Index Terms—**Augmented Reality, Real Environment, Architecture, Vuforia**

I. INTRODUCTION

In this generation technology growth has been over the roof so far, this allows new possibilities for more innovations across all fields in providing the information in society. We are using augmented reality to improve marketing. Augmented reality as a real-world view that has been augmented with elements coupled with computer-generated imagery in real-time. Virtual reality is opposite to augmented reality, augmented realty don't need a headset to experience it. If the virtual reality allows interaction between the user by using the simulation of the environment generated by computer, then augmented reality combines virtual object and the real object and then project it in real-time . In this case augmented reality simply need a tool like a device with decent camera that can capture images of the surroundings in real time simultaneously producing 3D objects that is used as a promotional tool to improve marketing residence. So that prospective buyers get the information more interactive with real look 3D objects. This study use a software named Vuforia (QCAR) to build the augmented reality app lications. Vuforia provides convenience to the Android operating system in a shooting in 3D objects. Using AR user can view the building and sites by just pointing the camera at the brochure having the app open. So that prospective buyers do not need to come to the location of the house to see a model home that you want to view.

II. AUGMENTED REALITY

Augmented Reality (AR) is an interactive experience of a real-world environment between the objects that reside in the real world are augmented by computer generated 3D objects. Augmented reality is a combination of object generated by a computer with a real object displayed with the live video. The computer generates a real environment with information such as graphics, audio, or real object displayed on the screen.

The advantages of augmented reality technology are:
- Displaying information in real time.
- Combining the real world with the augmented object.
- Image tracking.
- Interaction with real time objects.

It is now possible to interact with the real environment in virtual by using the augmented reality technology. Information about the object and the environment is added to the augmented reality system which seems to make the augmented information is real. The most important in this technology is to create a good technique for interactions between with the augmented reality information and be benefitted by it.

Fig. 1. An example of application of AR in education

III. VUFORIA

Vuforia is software development kit (SDK) for augmented reality enabled mobile devices that allow in creation of augmented reality application. It uses computer vision technology to recognise and track images, such as boxes, in real time. The Vuforia SDK supports a variety of 2D and 3D target types including 'marker less' Image Targets,3D Multi-Target configurations, and a form of addressable Fiducial Marker, known as a VuMark. Vuforia software can be used in many platforms such as iOS, Android and Unity.

Vuforia uses computer vision technology to identify and track the target. The three-dimensional object with allowing the user to interact and adjust position of a virtual objects and with real world images that displayed through the smartphone screen in real-time. The virtual object will track the position of the image in real-time so that the view of the object and its environment can be in accordance with the user's view in the applications, which create virtual objects that appear similar to the real world.

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The image that have been uploaded will be evaluated first by the Vuforia web developer. Value target will be scored to define how well an image can be detected and tracked using Vuforia SDK. The assessment of the image is done in a rating of 0 to 5. The more the stars, the stronger the detection and tracking capabilities are obtained.

Vuforia can recognise image by analysing the sharp corners in the uploaded image. Vuforia image analyzer will display the results of the image in small yellow cross.

IV. MARKERLESS AUGMENTED REALITY

Marker less Augmented Reality is a method in Augmented Reality which does not require the marker to determine an object can be displayed in 3D. The use of this method is usually done by using the coordinates of the object detection when scanned by the device, for example, an object to be used as a trigger to display information about the object.

Fig. 2. Markerless augmented reality

Augmented reality is used widely and applied in daily life, industrial activities, even in the military, such as:

1) Medical: AR can be used in surgical or simulation for simulating the manufacture of vaccines and so forth.
2) Entertainment: Augmented reality is used in the world of entertainment, for example in the film or game industry. This technology is also applied to newspaper and magazine, where readers scan the marker to display the content.
3) Engineering: AR can be used to simulate the repair of heavy equipment or machinery.
4) Robotics: We can use visual imagery through augmented reality to control the robot.
5) Consumer products: AR technology can be used in e-commerce websites to simulate the products before purchasing them.
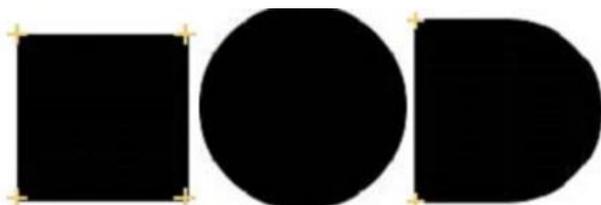
Fig. 3. Example of images of simple shapes that judged by Vuforia

By using Vuforia software we can create marker less AR contents. The marker less AR technology is used in this project to make the scanner of brochures hassle free and can add many content for different images. The image for the marker less scanning is carefully marked on the curves and edges of the image. The Fig 3. Shows the images that are judged by Vuforia based on its size and edges. In first image we see a square shape have four yellow mark on every corner, that shows the Vuforia detect the sharp corner of the shapes. But in the middle image, circle shape doesn't show the yellow mark because Vuforia cannot detect any sharp corner in the circle shape. Then in the third image, we can see only the sharp corner has the yellow mark. Since Vuforia uses rating technique to assess the image to obtain tracking capabilities. Some examples are,


Fig 4. Example of poor image target by Vuforia

The Fig. 4, is an image that is not good to be used as target for Vuforia. The yellow cross marks indicate a very little features. This is due to two factors, the lack of or poor distribution of features in the image and poor image contrast. Images are well used to being targeted by Vuforia is an image that has sharp corners that detail and the amount of features that much. A good image has more stars when mapped.
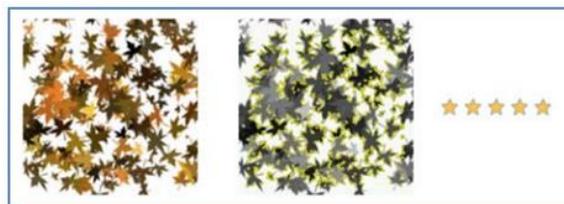
Fig. 5. Example of good image to be targeted by Vuforia

The Fig. 5, Vuforia can detect many sharp corner thus give the five star rating to the image

V. METHODOLOGY

The augmented reality technology can run on almost all devices. The device specification is given below:

- Device name : Samsung galaxy S8
- Camera : 12 megapixel
- RAM : 4 Gb
- Display : 5.8"(2960x1440 pixels)
- OS : Oreo
- Processor : Octa-core (2.3GHz Quad +
- 1.7GHz Quad), 64 bit, 10nm

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Once the planning process is complete, the testing process is starting. The augmented reality marker by visual code that has been determined before is tested. The process is been carried out using the Unity tools. Database applications are also made at this stage by using Vuforia SDK simultaneously the asset model is starting too. Using Autodesk 3Ds Max, the 3D residence object is created and by using Autodesk 3Ds Max, the colouring process, re-implantation texture on the roof, terrace, car parking floor and doors are painted, made to the model homes as it has been designed for residence marketing. These models will be used to be the 3D model displayed as augmented reality using the VUmark.

For the visual code marker (VUmark), we use the brochure of houses showing the landscape. For the visual code marker, we use the residence brochure that show the landscape of the houses. The picture below is a snippet from a page brochure marketing office residence which is used in the application.

Fig. 6. Example brochure

On the brochure, there are four types of homes. The drawings of these houses will be used as a target via the augmented reality on the Vuforia website. By uploading the pictures, API Qualcomm detect whether the images are eligible to become a target for augmented reality applications. Compatibility of the image becomes the target will be assessed with a star. More and more of its star, the better the image to be used as target shooting.

Here is one of the types of housing taken from a marketing brochure on residence. Objects are displayed in 3D.

Fig. 7. One of the building plan from the brochure

There are 2 techniques that should do to get the 3D AR object from the marker.

Edge Detection: Edge detection technique is one of the techniques that affect the camera to catch the object become augmented reality. These some several test that already done, this test based on smartphone camera to determine what optimal edge should be detected to define the 3D object.

TABLE I
TESTING THE EDGE

Perspective Of The x-axis	Result
90° degrees	3D Object show perfectly
45° degress	3D Object show perfectly
30° degress	3D Object show perfectly
10° degrees	3D Object not show.

Detection:
Edge detection is often affected by the distance to get good AR objects. There are several testing done based on specific distance between the object and the camera.

TABLE II
TESTING OF DISTANCES

Light Intensity (Dark, light dimmer, Bright)	Result
Dim light, without flash.	3D object are not detected.
Bright, without flash.	3D object can be detected.
Dark, with the lights flash.	3D object can be detected.
Dim light, with flash.	3D object can be detected.

Light detection:
Edge detection is also affected by the light intensity during the process to detecting 3D object. In order to get a better result of the detected object needs to be in a particular distance of the light source. Below are the light intensity testing in bright light condition, dim light condition, and dark condition using flash light and not using flash light.

TABLE III
TESTING LIGHT DETECTION

Distances in centimeters	Time detection	Result
50 cm	0	3D object not show
40 cm	2	3D object appear with a long time, and rendering object are not perfect.
30 cm	2	3D object appear with a long time, but the result is quite perfect rendering object.
20 cm	1	3D object quickly appeared with a little time, and the result is perfect rendering.
10 cm	1	3D object appear with a fast time, and the result is perfect rendering object.

If the image detecting technology hasn't encountered any problem in the detecting the source from the brochure, it displays the augmented 3D object perfectly without any

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problem. The displayed 3D object can be viewed from any perspective with respect to viewing angle of the viewer and the 3D object stays in its place.

VI. System Architecture
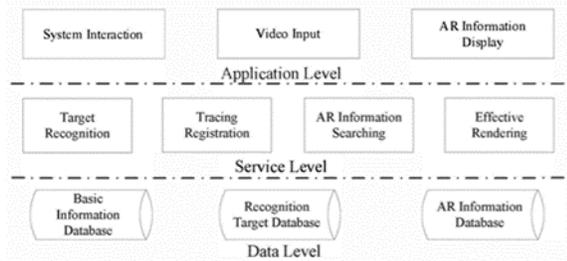
Fig. 8. System architecture

A. Data Level

It provides basic data support for the whole system, with the man contents including basic information library, recognition target library and augmented information library. The basic information library stores the basic formation needed and generated by the operation of the Recognition target library stores the target feature model data needed by the AR application; AR information library stores AR content data, including texts, images and models.

B. Service Level

The service level is mainly responsible for the calculation based on the needs of the application level and the application for data level, thus realizing the intercommunication between application level and data level. The middle level contains core technological services of the augmented reality, including the target recognition, augmented information search and highly-efficient rendering.

C. Application Level

Targeted at the user, the application level is responsible for providing the input of basic video flow data for the service level and checking the system interaction requirements of users. When the service level recognizes the target and famishes the

calculation of the data concerning the tracking register matrix, the application level will demonstrate the augmented information on the user interface.

VII. Conclusion

In this study, have been developed Augmented Reality applications that used to facilitate the residence marketing. Where this research applied Markerless Augmented Reality, using QCAR Vuforia software applied to the mobile platform (Android). An image with a good feature will have a minimum probability of error when Vuforia generate the target image into a 3D object. To get a good 3D Object, edge detection and light detection have become the main factor in image processing. The results of this research is to facilitate the marketing department of housing in the provision of facilities and specification information about the object home and present the products of brochures resulting visualisation of 3D objects using augmented reality technology is applied to the mobile platform Android.

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