Analysis of Marker Based and Markerless Augmented Reality in Different Applications

[1] Shivavarshni K , [2] Dr. Senthil Vadivu M

[1] *Student, Department of Master of Computer Applications, Jyoti Nivas College, Bangalore, Karnataka, India*
[2]*Assistant Professor, Department of Master of Computer Applications, Jyoti Nivas College, Bangalore, Karnataka, India*

ABSTRACT

Augmented Reality is a breakthrough technology that could considerably ease execution of complex operations. It enables real-time interaction between the user, real objects and virtual objects. A marker based is one of the approach in augmented reality which uses a static image to project a 3D model. To create such applications open source tools are available. A few tools such as unity, vuforia, python (OpenCv) are used in this study to know the working of augmented reality. Markerless augmented reality is a different approach which doesn't use any target image but places 3D objects randomly on top of the physical world and it interacts with the user. This work is also extended to analyze whether the marker based reality or Markerless augmented reality stands best in applications like education, Gaming, Marketing and advertisement.

Key Words: Augmented Reality, Marker-based, Markerless AR, RANSAC algorithm, Feature Matching

I. INTRODUCTION

Augmented Reality (AR) is a breakthrough technology that could considerably ease execution of complex operations. It enables real-time interaction between the user, real objects and virtual objects. A marker based is one of the approach in augmented reality which uses a static image to project a 3D model. To create such applications open source tools are available. A few tools such as unity, vuforia, python (OpenCv) are used in this study to know the working of augmented reality. Generally, there are two types of AR – one is called marker-based AR, the other is called markerless AR. Currently, no official definitions of marker-based AR and markerless AR are available. But from their literal meaning it can be implied that marker-based AR has to use a marker as a trigger while markerless AR can be used without markers. For marker-based AR, marker can be either a 2D image with visual features that are easy to be extracted or natural objects directly in the real environment Instead of tracking features of a marker, markerless AR usually uses some types of localization technology, such as Global Positioning System (GPS), Radio Frequency Identification (RFID), and sensor technology to control the relative position relationship between virtual objects and the real world. This work is also extended to analyze whether the marker based reality stands best in all applications like education, Medicine, Military, Gaming, Marketing and construction. As a result how far the usage of marker based reality is effectively used in various applications is determined and an alternative approach is suggested.

II. LITERATURE REVIEW

In paper [1] provides a comprehensive study of AR including its history, architecture, applications, current challenges and future trends. This paper proposes a marker based augmented reality application using windows operating system which will help to combine virtual objects with the real environment facilitating various applications as mentioned in this paper.

In paper [2] an Augmented Reality (AR) system using quick Responsible (QR) code as the marker for Android Smartphone. QR code has many advantages to be a marker. It can encode relatively larger amount of marker information in an easy and standard way, also it has the capability of error correction. Basically the system detects the marker, decodes its information and overlays a 3D object on the marker. As QR code is widely used today, the idea of combining QR code and AR to develop an application in handheld smart device can extends too many fields.

In paper [3], Augmented Reality can amplify human perception and cognition in remarkable new ways. Currently, during a cardiac examination, it becomes extremely difficult for the patient to comprehend the results. As the results are non-intuitive, doctors have a tough time explaining them to patients. Therefore, the patients have to rely on doctor's judgment against his own. The system proposed in this paper intends to make use of Augmented Reality (AR) technology for evaluation and visualization of a beating heart to make this doctor-patient interaction more intuitive. The system proposed in this paper is an android application which uses device's camera to display the 3D heart model in the augmented view. The real-time pulse data is loaded via a pulse sensor connected with an MCU through the cloud. Hence, the results obtained have shown us that this system has proven to bring more intuitiveness in beating heart visualization and analysis.

In paper [4], with Augmented Reality (AR) technology, where interactive three-dimensional (3D) content was developed and combined with traditional printed materials to enhance the visualization and understanding of technical information. In this study, they described a method to rapidly create custom marker-based AR content using 3D data from real objects and an authoring tool developed in-house. We present a twostep process, where 3D geometry is generated automatically by capturing and processing a series of photographs of a real object and subsequently converted to an AR element that can be linked to a unique marker and used with a marker-based AR system. This system provides an opportunity for instructors to quickly and effortlessly create their own AR content to support their innovative teaching practices.

In paper [5], with reports on the investigation of augmented reality system which is designed for identification and augmentation of 100 different square markers. Marker recognition efficiency was investigated by rotating markers along x and y axis directions in range from −90° to 90°. Virtual simulations of four environments were developed: a) an intense source of light, b) an intense source of light falling from the left side, c) the non-intensive light source falling from the left side, d) equally falling shadows. The graphics were created using the OpenGL graphics computer hardware interface; image processing was programmed in C++ language using OpenCV, while augmented reality was developed in Java programming language using ARToolKit. The obtained results demonstrate that augmented reality marker recognition algorithm is accurate and reliable in the case of changing lighting conditions and rotational angles – only 4 % markers were unidentified. Assessment of marker recognition efficiency let to propose marker classification strategy in order to use it for grouping various markers into distinct markers' groups possessing similar recognition properties.

III. PROBLEM SPECIFICATION

With the advanced technology nowadays, traditional way in advertising, education or any other applications becomes dull and boring whereas Augmented reality makes it more interesting to work with and more easier to understand than the traditional way. Marker and Markerless are few types of augmented reality which is analyzed in different applications such as education, Advertising and gaming.

IV. METHODOLOGY

In this project, various applications has been developed to understand which type of augmented reality suits the application using unity and vuforia.

ArUco markers - An ArUco marker is a synthetic square marker composed by a wide black border and an inner binary matrix which determines its identifier (id). The black border facilitates its fast detection in the image and the binary codification allows its identification and the application of error detection and correction techniques. The marker size determines the size of the internal matrix. For instance a marker size of 4x4 is composed by 16 bits.

RANSAC Algorithm – The RANdom SAmple Consensus (RANSAC) algorithm is a predictive modeling tool widely used in the image processing field for cleaning datasets from noise. The RANdom SAmple Consensus (RANSAC) algorithm is a predictive modeling tool widely used in the image processing field for cleaning datasets from noise.

First and foremost marker based augmented reality is studied using OpenCv and aruco markers. This project development involves three steps:

a. Detecting the marker
b. Analyzing the marker's position
c. Placing the marker on top of the marker

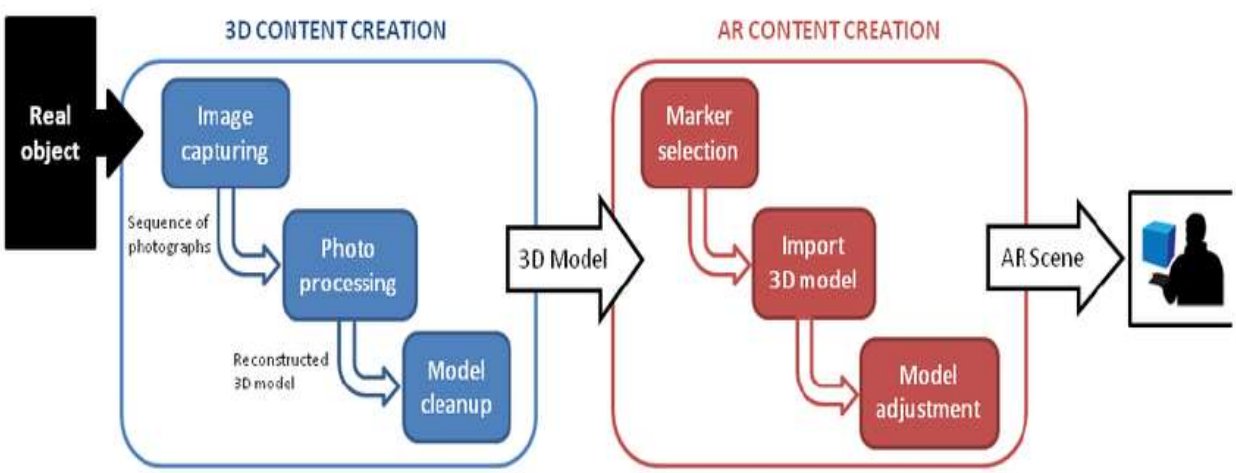

Figure 1: Methodology Flowchart

V. EXPERIMENTS AND RESULTS

Environmental setup

A marker is first developed using ArUco marker library using python and jupyter notebook. The marker which is generated using ArUco is used as a target image on which the 3D object is placed. 3D objects I have used here is from a free source low-poly 3D models. Keypoints are found using cv2.ORB which is used to find the descriptors. The keypoints are saved to match with the target image to identify whether the target image which is scanned is same as the image mentioned as the path.Once the image scanned it tries to match the features and if all the features matches the object is placed on the target using RANSAC algorithm.

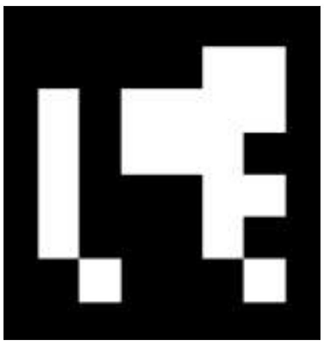

Figure 2: Target image

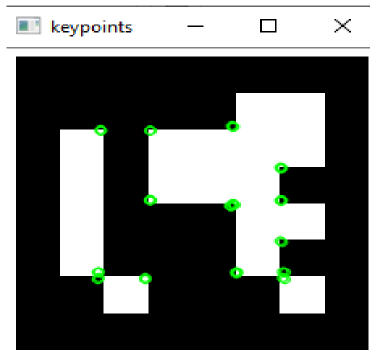

Figure 3: Target image with keypoints

Figure 4: low-poly 3D model (pirate-ship-fat)

Experimental Results:

In this research 3 different projects are developed to analyze whether marker or markerless augmented reality is better in different applications. The applications chosen here are gaming, advertising and education. These projects are developed using unity3D and vuforia. For developing such projects minimum of 2GB and windows 64 bit is required.

These analysis are done by comparing the output and the feasibility of each type of augmented reality in applications.

AR advertising is a mobile ad unit which uses the smartphone camera to superimpose 3D assets, such as game characters and scenarios from the advertised game, onto the user's real world surroundings. According to advertising application it needs some target image to express the value of the product so here a project is created using marker to compare which type of augmented reality is best for this application.

Using augmented reality in the classroom can turn an ordinary class into an engaging experience. According to education using AR, it needs some target image to show the content to make students understand. A project is created which uses a marker and also voice recognition is included which is more interesting for the students to learn the concept.

Augmented reality gaming (AR gaming) is the integration of game visual and audio content with the user's environment in real time. According to gaming, it doesn't need any target image since gaming is not about one 3D object but interacts with many objects. A project is created which is markerless augmented reality in which the application doesn’t searches for a target image but the 3D objects are placed on the environment once the application starts.

Figure 5: Output for gaming application using markerless augmented reality

Figure 6: output for education application with voice recognition

Figure 7: Output for Advertising application using marker based

VI. CONCLUSION

In the proposed problem statement 3 different projects has been developed using Unity 3D and Vuforia and also with the help of OpenCv and also managed to analyze how the features are matched with the source and destination images. OpenCv also helped me to analyze how RANSAC algorithm is used to map objects and that explains the working of marker based augmented reality. The 3 different projects portrays the importance of each application. The applications that are considered here are Gaming, Advertising and Education. Since only two types of augmented reality has been considered and concluded which one of these would suite the type of application. With the help of unity and vuforia marker based augmented reality is developed and thus suits both advertising and education but not gaming. Gaming is a very interactive platform which is better with markerless augmented reality.

VII. REFERENCES

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