

Overlaying Virtual Object into Real World by Using Augmented Reality

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Abstract - Augmented Reality (AR) is a technology which combine virtual and real environment. AR is based on coupling between the virtual and the real object that is based on their geometrical relationship. This makes it possible to combine the virtual content with the right placement and 3D perspective with respect to the real. There are many fields in which AR is used such as education, military, commerce, business etc. In this system, we are going to develop augmented reality for education system. To develop this system, we are using ARToolKit, an open source non-commercial library that enables development of Augmented Reality applications. ARToolKit uses predetermined printed patterns to track computer graphics. But this system allow us to create new patterns to augment graphics on it. This system not only implements 3D models as animation input but also supplies a user interface that allows even non technical users to take a benefit from augmented reality. The AR system is developed as dialog-based Microsoft Foundation Class(MFC) application using C# language. This user interface accepts models and various parameters from the user by means of which the user can tailor the augmented environment according to his or her aim of usage. With these inputs, 3D objects are tracked on real world to manipulate animation based on real patterns and virtual objects.

Key Words: Augmented Reality, Markers, Pattern AR Toolkit, 3D Model

1.INTRODUCTION

Currently most of the system use virtual reality technique or many hardware to see virtual object. The Virtual Reality (VR) based applications applies computer simulated environments that can simulate physical presence in real world, as well as in imaginary worlds. The hardware needed for VR experience is still cost prohibitive. Training with a virtual environment does not have the same probable causes as training and working in the real world. This means that even if someone does well with virtual environment, that person might not do well in the real world. VR systems are capable of letting student to walk around the surfaces and see how the variables interrelate. To overcome this problem augmented reality based

application propose. As large energy is required for wireless communication network which leads to emit high power radio waves with very high battery consumption Causes various human health problems. In digital communication for every transmission of data we requires almost 4000 joules of energy for one bit of binary ,so if we transmit 8 bit of data then $4000 * 8$ will require almost 32000 j of energy every time, so our motivation is to find solution using which we can reduce these no of ones.

In this paper we introduce Overlaying Virtual Object Into Real World by Using Augmented Reality it uses Marker Based technology for displaying Augmented view by using web camera. This system uses Augmented reality (AR) is a live, direct or indirect view of a physical, real environment whose elements are augmented by input such as sound, video, graphics. This is augmented reality based desktop system which allows the user to decide, where to place the object in real world. Once the object has been placed in the scene, it will be displayed accurate according to the perspective in the original scene. This system also supplies a graphical user interface that allows even non-technical users to take advantage from augmented reality.

1.1 Related Work

Myron Krueger [1] coined the term virtual reality in 1970. Virtual Reality is a computerized combination of natural or imaginary reality. The user of VR is fully or partially merge with the environment. VE is the term used to describe the scene created by any computer program in which the user plays an interactive role within the computer generated three dimensional world. The hardware needed for VR experience is still cost prohibitive. VR is becoming much more common place but programmers are still confused with how to interact with virtual environments. Training with a VR environment does not have the same probable causes as training and working in the real world.

H. Kaufmann [2] discussed an application that utilizes augmented reality as the tools for kids to learn how to read and also help children in learning vocabulary. Rekimoto developed a 2D matrix markers that allows camera tracking

with six degree of freedom. This system is based on OpenCv to make elementary students learning efficient using protractor. But this application only shows the standard geometric object. This system cannot be used for displaying user defined objects.

Lus Almeida [3] proposed archeoguide system in 2002. Archeoguide is augmented reality based cultural heritage on-site guide, to bridge the gap between recreation, education and scientific research. The system was electronic guide to outdoor archaeological sites, help users navigate and make the most of their visit and enable archaeological data on any given site. Archeoguide displays this information on a digital map of the archaeological site with the most important monuments positions. But there is small error in visualization of the resulting reconstruction models because the actual viewing angle may slightly different from that assumed for the augmentation of the natural user's view. User need to wear AR glasses and helmet to use this archeoguide as electronic guide. Some users said that they felt uncomfortable wearing them while walking.

Hannes Kaufmann [4] discussed tool Construct3D in 2003. Construct3D is a three dimensional geometry construction tools specifically designed for mathematics and geometry education. It is based on the mobile augmented reality system Studierstube. This system was developed for the improvement of spatial abilities and maximization of transfer of learning. Construct3D is easy to learn, encourages experimentation with geometric constructions and improve spatial skills. This system uses augmented reality to allow multiple users to share a virtual space. Construct3D offers functions for the construction of primitives such as points, lines, planes, cubes, spheres, cylinders and cones. They had use HMDs capable of overlaying computer-generated images onto the real world, there by achieving a combination of virtual and real world, allowing natural communication among users. Construct3D is not always used by students on a regular basis in mathematics and geometry education. The student need to wear HMD's to use construct3D for elementary learning which is not always feasible for students.

Mau-Tsuen Yang and Wan-Che Liao [5] proposed system VECAR in 2014. This system incorporate the latest AR and CV algorithms into a Virtual English Classroom, called VECAR, to promote immersive and interactive language learning. By using a pair of mobile computing glasses, users can interact with virtual contents in a three-dimensional space by using intuitive free-hand gestures. VECAR uses markerless AR by using the detection, tracking and 3D pose estimation of the free-hand of users. First, the captured images are transformed from RGB to HSV color space to perform skin color segmentation. A distance transform algorithm is applied to extract the largest component in the skin regions. It is tedious task for each learner to wears a pair of mobile computing glasses with a head-mounted display and camera. The VECAR system is complex as it required to detect, track and estimate 3D pose from free hands of users which is difficult task.

Adrian Shatte [6] proposed framework for mobile AR in 2014. They had implemented a robust framework and conduct a case study of sorting activities with two distinct groups: individual and group pair settings. The proposed framework of mobile AR for sorting consists of three main parts: input marker, mobile based AR and algorithm, and the output. Hand-held AR is used for learning multitasking: mobile based information processing and learning. However, multitasking is an obstacle in learning since human context switching is expensive and multitasking causes more human errors due to insufficient attention.

Ahmed Amer [7] proposed system in 2014 to make use of two displays. They developed a low-cost platform that opens such application development to a much broader world, requiring the most minimal of hardware and computing infrastructure. The first is the display within the headset itself and used by the wearer as a means of observing the video feed (in this case, the view from the camera of the smart phone mounted on the headset itself). The second is the display in the smart phone, which is arguably unnecessary (although useful in a minor way for demonstration purposes, as it allows a second party, facing the wearer, to see the view being observed by the wearer). The limitations of this is that it requires a fair amount of initial manual adjustment and does not result in the best quality virtual or augmented reality experience. For example we did not perform precise transforms on the split images to compensate for distortion due to the slightly off-center lens focal points.

Rafael Radkowski and James Oliver [8] proposed a novel method in 2014 for enhancing the natural visual perception afforded by augmented reality (AR) workstations. The approach incorporates a method for tracking perspective viewing using a monitor-based AR workstation that acts as a window to the physical workspace in front of it.

Jingang Wang, Xiao Xiao, Hong Hua [9] presented a 3D augmented reality micro integral imaging display system in 2014 by combining conventional integral imaging and an augmented reality technique.

Jorge Camba [10] presented paper which describes the results of a comparative pilot study of three different approaches to deliver 3D content in an Engineering Design Graphics textbook using Augmented Reality: Desktop based Augmented Reality, Mobile based Augmented Reality and an interactive 3D viewer. They had presented a marker-based Augmented Reality system that is simple, low-cost and easy to learn. Our markers are specific white pattern with black squares that the AR software can recognize using computer vision techniques. An additional marker is used as a user interface to visualize and manipulate the virtual content.

1.2 Existing Augmented Reality System

There are many augmented reality system which is based on marker technique. The one AR based application that utilizes augmented reality as the tools for kids to learn how to read and also help children in learning vocabulary. This system is

based on OpenCv to make elementary students learning efficient using protractor. But this application only shows the standard geometric object. This system cannot be used for displaying user defined objects. There was another AR based system VECAR(Virtual English Classroom). VECAR uses markerless AR by using the detection, tracking and 3Dpose estimation of the free-hand of users. By using a pair of mobile computing glasses, users can interact with virtual contents in a three-dimensional space by using intuitive free-hand gestures. The VECAR system is complex as it required to detect, track and estimate 3D pose from free hands of users which is difficult task.

2. SYSTEM FLOW

In this system, marker patterns and 3D models are used as data for displaying augmented view on screen. There are different phases in system where marker patterns and 3D models are required for processing. i.e. marker and 3D model are data object.

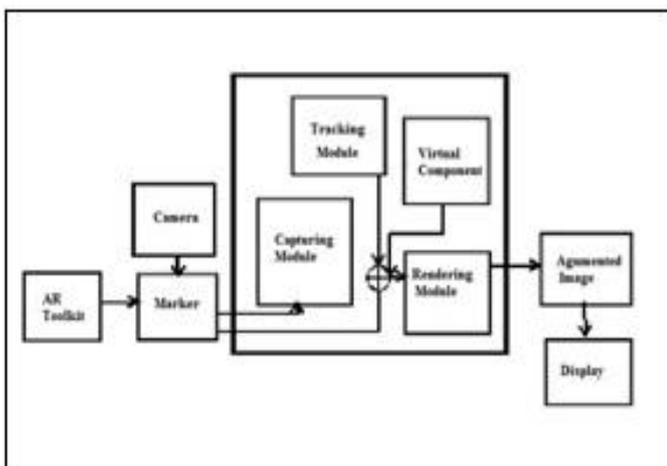


Fig -1: SYSTEM FLOW

Module description:

In Image Capturing phase, marker image is captured by camera. Marker patterns are basic shapes made up of black squares against white background. These marker pattern is stored as file with .patt extension and loaded from path which is displayed on screen when user click on load pattern tab.

In Marker tracking phase, tracker module determine positions of 3D model which is to be displayed on real world marker. This 3D model is file with .3ds extension which is loaded from path which is given by user.

In Rendering phase, rendering module combines original marker image and 3D model. And displays augmented world on computer screen when user click on Start Augmented World tab.

Algorithm:

Marker detection steps are required to detect marker coordinates. Then marker tracking module is used to track marker coordinates and calculate 3D pose. Rendering module is used to map 3D model onto marker coordinates.

1. Detect marker by camera.
2. Calculate physical marker coordinates using capturing module.
3. Track marker coordinate and calculate pose. That is 3D location and orientation of 3D model.
4. Map marker coordinate with 3D model coordinates.
5. Render 3D object on actual marker coordinates.
6. Display augmented view on screen.

3. CONCLUSIONS

This application propose a marker based augmented reality application using desktop system which will help to combine virtual objects with the real environment facilitating various applications such as engineering graphics. The prototype system will make learning efficient and provide benefited information related to business products.

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