

Augmented Reality System for Engineering Graphics

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Abstract: Augmented Reality also known as AR is an upcoming technology in which the real-time environment is being totally imposing the information which is being generated by computer which includes graphics, text data, and even the audio contents on to the display device. The existing system is an android based mobile applications and the proposed system will be on the desktop based applications which will be further compatible with all the versions of any operating systems. The main motive of Augmented Reality (AR) is to augment the virtual world objects into the real world objects. It will consider every graphical view such as top, bottom, right, front, left, back side of that particular object. The object will be placed on to the 3D plane/cube which will help to map the actually virtual object completely and then it appears similarly as that of the coexisting within environment. The main advantage will be that it will be already compared to the Two Dimensional applications that would display in the Three Dimensional applications and also will allow any user to rotate it. It's mainly useful for the Engineering students. It will combine it with interactive 3D content with the purpose for understanding the graphics and also improving the visualization skills.

Keywords: Augmented Reality, Processing, Marker, Operating System, Engineering Graphics, Geometry Applications.

I. INTRODUCTION

Augmented Reality also known as AR is a direct or indirect view of any physical world environment whose parameters are being augmented such as text, graphical or audio contents, videos. Augmented Reality aims to duplicate the virtual world into the real world environment in any desktop. Virtual Reality also called as VR provides virtual space in which the user places them to exceed the physical reality bounds.

Now-a-days engineering graphics designs are playing a vital role in the engineering field in student's life. From the academic point of view modelling of 3D spatial abilities has become the key element. The spatial skills has been acknowledged as a major factor which is related to the higher level skills required for reasoning, critical thinking, success and the creativity in field of STEM (Science, Technology, Engineering, Mathematics).

In engineering education, developing 3D objects and spatial abilities is often listed as an important factor for designing the engineering graphics courses. These can be also developed indirectly by sketching or hand drawn practices or also by orthographical projections.

Some common type of Augmented Reality includes projection, location, recognition, and outline. They are detailed below as:

Projection: It is commonly used method of augmented reality, which is used to augment what we see. In this system the Webcam is used. Examples of augmented reality system include devices such as keyboards, virtual or projection which are used to project and flat area that uses interactive projections.

Recognition: It is another type of augmented reality that is commonly used for recognizing shapes or any real world

object. Any device which has proper software is used to recognize the object and provides the relevant data.

Location: It is used to constantly provide the relevant directional information. Example is a smart phone with the GPS to determine the location. This can be used to locate the nearby public stations.

Outline: It is type of augmented reality that merges the outline of any object, allowing user to pickup and also manipulate the objects that does not exists in reality.

This paper represents the use of Augmented Reality (AR) system as a tool to increase the delivery of engineering graphics materials. For our study printouts, 3D computer models and some visualization software were combined and emerged into one system to facilitate the process of learning.

II. AUGMENTED REALITY IN EDUCATION

Augmented Reality also known as AR can be treated similarly as the Virtual Reality. The Visualization technique which augments the real-time 3D graphics which are computer generated which includes the real videos, creating an enhanced representation of the reality.

As in the concept of virtual reality the whole world is generated artificially and the users are totally involved inside it. AR also allows users to immerse inside and also experience the whole modified version of planet. AR enhances the real world with the virtual world elements typically experiencing via computers screens, different head mounted displays and also projectors.

Flexibility feature of AR technology has also made it possible for the rapid growth of many new upcoming applications. It has also proven that it can be effectively

used tool for education purpose in many different fields which may include some as medical, geography, geometry, archaeology and architecture. AR has been also used to train the professionals for the use of new equipment and the implementation for new procedures as well as for teaching students anatomy.

Some desktop-based software are also used to interact with some pages or printed books which will be specially designed for delivering the contents of Augmented Reality easily. An example to view these 3D model uses is as shown below in Fig. 1.

Augmented reality technology provides an efficient and attractive way to enhance the concept of engineering graphics learning materials and also adapts education to increase more technologies for the modern students. Augmented Reality looks very similar to traditional books. However, when the Augmented Reality devices are used virtual contents are rendered in real world by creating the illusion that those models are coming out of the pages. This method provides a very familiar interface to interact with the contents easily.

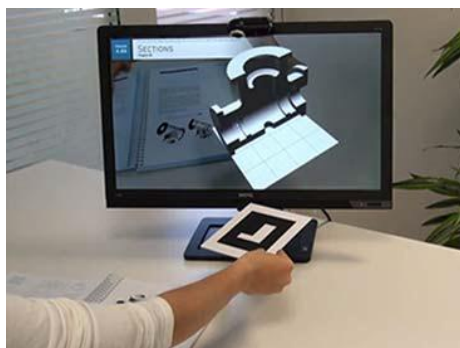


Fig. 1 Desktop-Based AR application

III. DESCRIPTION OF LEARNING TOOL

There are two types of Augmented Reality system which includes: Marker-based and Marker-less.

Marker-based uses cameras and some hints or clues. In marker-based images are detected by the camera and using the AR software is used to place the scene for virtual assets. Mostly black and white images are used, though colours can be used as long contrast between them which may or may not be properly recognized by camera.

Simple markers include one or more basic shapes such as black squares, rectangles against the white background so it can be properly read by a camera. Here a camera is used with the AR software to detect the AR markers. As the result the images can be viewed on display devices.

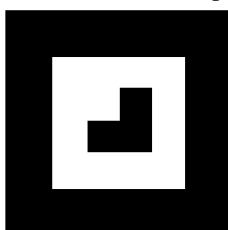


Fig. 2 Marker-based AR

In Marker-less AR, the images are gathered through the internet and can be displayed on any specific location also can be gathered using the GPS. It does not require any marker to display its contents. It is more interactive and attractive as compared to marker-based augmented reality.



Fig. 3 Marker-less AR

We present a Marker-based AR which is simple, less cost, and easy to learn. As our markers are black squares with some specific pattern that the AR Software will recognize using computer techniques. In addition to the printed pages we only require proper software installed and a web camera is required. The augmented world is experienced through the monitor. And usually this approach is called as "Desktop-Based Augmented Reality".

In order to start the AR content, the web camera must be pointed to any specific point of the printed page. These areas are the set of patterns which may be any square, simply called as markers (Fig. 4), which is then marker is automatically recognized by the AR software and renders the virtual content on screen in real time (Fig. 5). When the position of the printed marker on page is changed the virtual model is automatically adjusted.



Fig. 4 Example of AR markers

A proposed version is the desktop-based AR software which is implemented with the new markers. These help users still experience the same AR content without portable device by just using a desktop computer and the web camera. In addition, Windows 7 and all the upcoming latest versions of Windows will use this software.

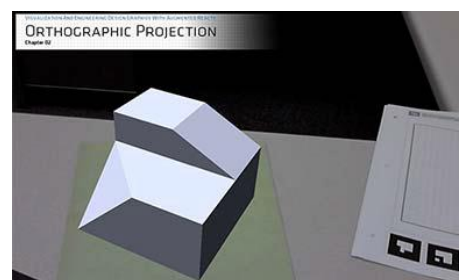


Fig. 5 AR model actually rendered by the original Version of our software

IV. RELATED WORK

“Jorge Dorribo Camba and Manuel Contero”, describes the development and integration of augmented reality contents with traditional Engineering graphics and presents the results for preliminary study for Engineering students. The method such as augmented reality was used which was developed on the mobile devices having the Android operating system. The features such as various predefined markers, spatial skills, augmented reality and the mobile devices were used to be developed on.

“Gustavo Salvador-Herranz”, describes about the comparative study between the Mobile devices and the Desktop devices for engineering education. The paper describes about the study of three different approaches used to deliver the contents in a 3D engineering Design Graphics tools by us AR such as Desktop AR, Mobile AR and an Interactive 3D viewer.

“Mr. Raviraj S. Patkar, Mr. S. Pratap Singh, Ms. Swati V. Birje”, describes about the Augmented Reality which is emerging technology in the real-time environment is enhanced by just imposing the computer generated information such as text, graphical content, audio and video contents as well as their objects on the displaying screen. The proposed application in this paper was mobile device which was android operating system based. This paper also gives the detailed difference between the two major types of augmented reality i.e. Marker based and Marker less.

V. PROBLEM STATEMENT

Now-a-days the concept of AR applications is in its earlier stage and its growing faster and faster. This includes various applications like Gaming, Medical science, Fashion world, Product Information. The proposed system mainly aims to provide the environment which will help users to augment 2D as well as 3D objects artificially in the real time by using AR markers.

Proposed system also allows user to take decisions where to locate the object in real world. Once the object has been successfully located in the scene, it will produce accurate with respect to the perspective in the actual original scene, which is the main challenging task in the case of virtual 3D objects. The proposed system is further going to solve the problem of tracking as well as virtual interaction of objects. The advantage is that, the students will get more familiar with the graphical objects and it will be easy for them to understand and also will be available at very low cost.

VI. PROPOSED SYSTEM ARCHITECTURE

The proposed system work is a marker-based system and its architecture contains the main three units as is illustrated in Fig. 6: Infrastructure Tracker Unit, Processing Unit, and Visual Unit.

The Infrastructure Tracker Unit works for collecting the data from real world, and sends it to the Processing Unit, which then mixed the virtual content into the real content

and sends the result to the Video-Out Module of the Visual Unit. Video-In module of Visual Unit is used to acquire data which is required for the Infrastructure Tracker Unit.

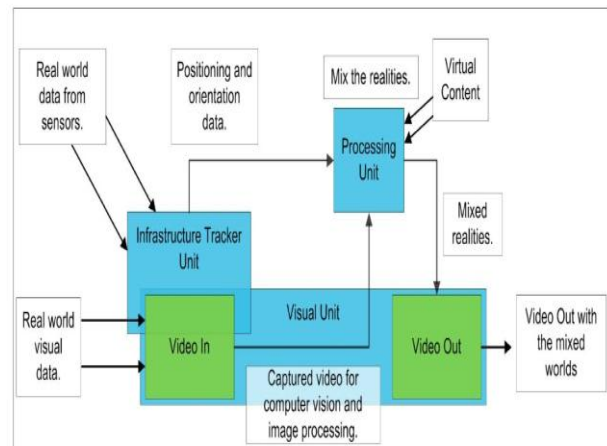


Fig. 6 Architecture Block Diagram

The Visual Unit is further classified depending on the visualization technology as:

1. Video see-through: It uses Head-Mounted Display (HMD) that does the video mixing and displays the merged images on a closed view HMD.
2. Optical see-through: It also uses HMD optical combiners to merge the images with an open view HMD.

HMDs are currently dominant display technology in the AR field. However there are some aspects in which they lack such as high prices, small size and connectivity features. Also problem with the HMD was the interaction with the real time environment.

Alternative approach to develop AR system involves the use of monitors and tablets. Monitors are used as an option for the indirect view, since the user does not directly enter into the mixed environment.

VII. PROJECT CONSTRAINTS

There are still some of the challenges which are to be yet overcome by Augmented Reality. AR systems are also expected in the real-world so it becomes possible for the users to move freely with the scene and also see rendered augmented images properly.

The application will be built for desktop, mobile phones, which usually will have very low cost also for handheld devices it will have small screen dimensions and the resolutions.

It also creates a problem for the Operating System as augmentation utilizes high processing power. Also the developers of this application system should have a thorough knowledge of Windows and Android Operating Systems (Applications which are developed in and also developed for). Also developers should also be familiar with the Augmented Reality Toolkit.

VIII. APPLICATION AREAS



MEDICAL SCIENCE



GAMING



PRODUCT INFORMATION

IX. CONCLUSION

This paper proposes a new marker based augmented reality application for Windows Operating System which will help to combine virtual objects with the real time contents. The main advantage is use of low cost devices as compared to costly HMD devices. Our study has shown that the use of Augmented Reality has the potential to become an effective tool to deliver engineering graphics objects. AR technology provides an attractive and new way to complement and enhance traditional teaching and learning materials.

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