Android-based Augmented Reality to Enhance Education System

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ABSTRACT

Recent times, Augmented Reality has become prominent technology in digital and virtual world due to rapid advancements in Internet and Information Technology, omnipresence of Wireless broad band connections and adaption to mobile technology and smart phones. Augmented Reality in short AR, a technology for augmenting digital information such as text, graphics, audio and animation, live video stream too. Using AR, virtual objects are generated into real world or real-time environment. Applications and ongoing research of Augmented Reality include various sectors like medical, military training, education, games and ecommerce. For example, in military, AR is used to display the augmented annotated information about hidden enemy units to the pilot. This paper tries to address how the Marker-based Augmented Reality with help of android application can enhance the current education system. In existing education system, for example, teaching primary school children, teacher uses blackboard teaching method or by showing 2D images in books to explain about any element in the real world. The above practice may or may not enhance the knowledge about the particular element by all the students in class. But by introducing augmented reality into education system, teacher can show 3D object to student instead of drawing 2D image on blackboard. The objects can be viewed from different angles – left, right, top, and bottom. And the object can be scaled even play animation on it with audio. The 3-D augmented model objects can easily understand by the students. This idea of learning enables them to quickly grasp more and more as compare to conventional teaching approach. In this paper, to enhance the education system, proposed an idea to use augmented reality with android platform. Here, for experimental purpose taken sample size of 35 tracker images to generate their 3D objects in our android augmented reality application. In this paper, described 10 samples with their augmented 3D objects.

General Terms
Marker-based Augmented Reality

Keywords
Augmented Reality, Android, 2D image, 3D object.

1. INTRODUCTION
Up recent, Augmented Reality has become prominent technology in digital and virtual world due to rapid advancements in Internet and Information Technology, omnipresence of Wireless broad band connections and adaption to mobile technology and smart phones [1].

Augmented Reality provides its users a completely different way to interact with the real world environment. Augmented Reality also known as Mixed Reality (virtual and augmented reality). It enhances digital information such as text, images, audio and video streams into physical world through screen of smart phones and personal computers too [2].

Augmented Reality is classified into two categories – marker based and marker less. In Marker based Augmented Reality, black and white 2-D images scanned by camera that connects with appropriate 3D object after pattern recognition. Whereas, In Marker-less Augmented Reality, images are captured and processed using internet and GPS and displayed on smart phones. The applications of marker based augmented reality includes domains such as medical science, education, gaming, fashion world, product information, military training etc. And still research is going on in different fields using augmented reality [3].

This paper tries to address how the marker based Augmented Reality with help of android application can enhance the current education system. In existing education system, for example, teaching primary school children, teacher uses blackboard teaching method or by showing 2D images or pictures from the books or through power point presentations to explain about any element or object in the real world. The aforementioned approaches may not connect the students with topic and students may find less interesting and finally lose their focus results in incomplete understanding of the topic.

But by introducing augmented reality into education system, teacher can show 3D object to student instead of drawing 2D image on blackboard. The objects can be viewed from different angles – left, right, top, and bottom. And the object can be scaled even play animation on it with audio.

The 3-D augmented model objects can easily understand by the students. This idea of learning enables them to quickly grasp more and more as compare to conventional teaching approach. In this paper, to enhance the education system, proposed an idea to use augmented reality with android platform.

2. BACKGROUND
Raviraj S. Patkar, S. Pratap Singh, Swati V. Birje, "Marker Based Augmented Reality Using Android OS" in their work described how the virtual objects are combined with real environment [3].

In 1990, Tom Caudell, at Beoing, introduced the term "augmented reality" to mark devices and upgrade diagrams for supervising factory workers. Mehdi Mekni Andr´e Lemieux, "Augmented Reality: Applications, Challenges and Future Trends" in research work specified different applications of augmented reality, limitations and challenges with respect to mobile devices [4].

Wendy E.Mackay, "Augmented Reality: Linking real and virtual worlds A new paradigm for interacting with computers" in paper illustrated three approaches to augment

real-world objects – that is user, physical object and environment surrounded with user and object [5].

R. Silva, J. C. Oliveira, G. A. Giraldi, "Introduction to Augmented Reality" in their work explained how the 3D objects masked clearly on the markers with help of libraries such as ARToolkit [6].

Brett E. Shelton, Nicholas R. Hedley, "Using Augmented Reality for Teaching Earth-Sun Relationships to Undergraduate Geography Students" in their research work described how ARToolkit is used to teach undergraduate geography students about earth-sun relationships [7].

3. ADVANTAGES OF AUGMENTED REALITY FOR EDUCATION SYSTEM

Following are the advantages of Augmented Reality for education system:

1. By integrating augmented reality into lectures, can expect that students will stay more focused and attentive on the topic.

2. Students can able to access models from their own devices via android application. And even teacher can create the 3-D Models of their own subjects. This will help the students to gain more knowledge and understanding of the concepts they are studying.

3. Student can able to access 3D model from their own mobile device this will be portable study material.

4. With a simple scan, students can access augmented models representing anything from a part of the wild life forest animals or the Fruit or the vegetable that can directly view 3D model of it from the android application.

For example, after scanning a marker image, linked with an appropriate 3D model, can view augmented 3D Model of tomato. Table 1 shows clear difference between black board image and 3D augmented object.

The augmented 3D objects look as identical as real objects in the real world.

Table 1. Black board Image and Augmented Object

4. PROPOSED SYSTEM

In this paper, to enhance the education system, proposed an idea to use augmented reality with android platform. The traditional and conventional teaching style on blackboard to describe about the particular element in depth such as vegetables, fruits, animals etc., may not imparted completely to the students. But by using Augmented Reality Android application for education system, teacher can smartly explain about the abovementioned elements in 3-D model to students.

The objects can be viewed from different angles – left, right,

top, and bottom. And the object can be scaled even play animation on it with audio. The 3-D augmented model objects can easily understand by the students. This idea of learning, enable them to grasp more and more as compare to blackboard teaching.

In this system, live feed camera image (i.e., 2D image on paper) is captured by the camera, called Tracker image. The next step is the Pattern Recognition phase, here the tracker image is processed with the help of Image processing model to identify Patten behind 2D image and connect that recognized Patten with appropriate 3D object shown Figure 1.

Fig 1: A block diagram to generate 3-D Model

In the below Figure 2, given an experimented result of one sample 2-D image tomato, transformed into a 3-D object model.and Same procedure applied to rest of the 34 samples to generate 3-D object models, some of them specified below in Experimental Results.
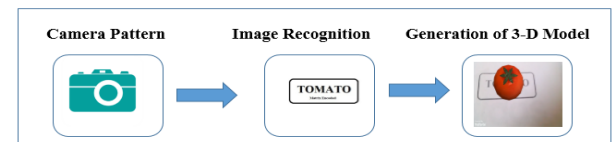

Fig 2: Generation of TOMATO 3-D Model

5. DEVELOPMENT PROCESS OF AUGMENTED REALITY ANDROID APPLICATION

The Android application development process for Augmented Reality consists of following 4 steps mentioned in Figure. 3.

1. *3-D Model Creation* – For creating interactive 3D Model with visual effects, art, animation, simulation, texture and raster graphics many open sources as well as commercial tools are available such as – Max 3D, Autodesk Maya , Blender and many more.   In this experiment, used Blender as it is open source [8].

2. *Creating Tracker Image* – To create tracker image free and Commercial AR (Augmented Reality) Tools are available. Some of them are Metaio SDK, Vuforia SDK and Wikitude. Here, experimental purpose to create tracker image used Vuforia SDK (Software Development Kit). Vuforia creates its own patterns after uploading tracker image on their website. Vuforia generates .unity package that easily imported in Unity software [9].

3. *Embed in Unity* - The tool allow to embed 3-D model and Tracker image to into Unity package. Unity allow us to modify objects scaling and with X-axis, Y-axis and Z-axis. Unity also allows us to code in C# or Java Script that makes application more interactive and in customized form [10].

4. *Generation of .APK* - With the help of Java (SDK) and Android Studio, enable to generate android file that executed in android mobile [11].
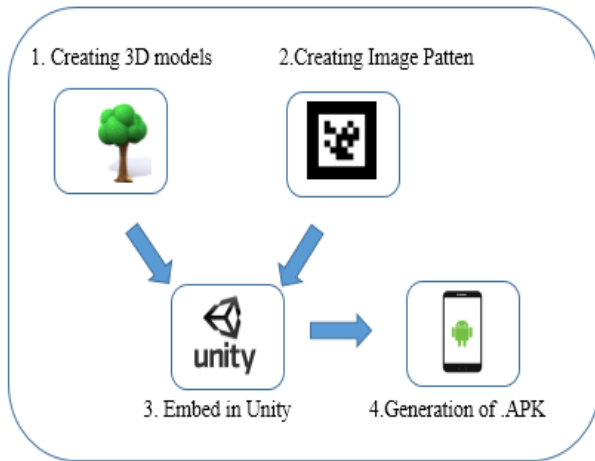
Fig. 3. Android Augmented Reality Application Development Process

Here, in this experiment, taken sample size of 50 2D images to test the accuracy of Android Augmented Reality application. The following Table 2 consists of 10 samples with their marker based image as well as produced augment 3D objects.

Table 2. Marker Image and Augmented Object

SR No.	Marker Image	Augmented Output Image
1	BANANA Matrix Encoded	
2	CUCUMBER Matrix Encoded	
3	POTATO Matrix Encoded	
4	LEMON Matrix Encoded	
5	WATERMELON Matrix Encoded	
6	TOMATO Matrix Encoded	
7	ZEBRA Matrix Encoded	
8	BEAR Matrix Encoded	
9	ELEPHANT Matrix Encoded	
10	LION Matrix Encoded	

While conducting experiment, observed that the length of the tracker image and camera resolution also matters for generating 3D object.

6. CONCLUSION

This research paper primary objective is to enhance the current education system by introducing concept of augmented reality through smart phones.

With this technology, students and teachers both will get benefited. Moreover, teacher can create their subject topics augmented 3D Models and smartly explain to their students. Even, students can better understand the topics explained with the help augmented Reality 3D Models.

Furthermore, the important advantage of augmented reality android application is that even with the basic android enabled device with good camera can allow running the application. This application also facilitates the multiple targets recognition.

This paper suggests to use augmented reality android application by teachers of rural and urban schools in their day to day teaching for students.

In future, augmented reality can be combined with Artificial Intelligence to develop more automated smarter applications that can be witnessed in next coming years.

7. REFERENCES

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