



AUGMENTED REALITY A NEW ERA IN EDUCATION

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Abstract:

Augmented Reality is the technology using which we can integrate 3D virtual objects in our physical environment in real time. Augmented Reality helps us in bring the virtual world closer to our physical worlds and gives us the ability to interact with the surrounding. This paper will give you an idea that how Augmented Reality can transform Education Industry. In this paper we have used Augmented Reality to simplify the learning process and allow people to interact with 3D models with the help of gestures. This advancement in the technology is changing the way we interact with our surrounding, rather than watching videos or looking at a static diagram in your text book, Augmented Reality enables you to do more. So rather than putting someone in the animated world, the goal of augmented reality is to blend the virtual objects in the real world.

Keywords: *Augmented Reality; Virtual Reality; Education; Learning.*

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1. Introduction

1.1. Definition

Augmented Reality is a combination of two words, 'Augmented' and 'Reality'; where 'Augmented' means to make something greater in size or value by adding something to it and 'Reality' is our real environment around us. In a nutshell, Augmented Reality is a technology that superimposes machine generated graphics onto the user's vision of the real environment.

Augmented Reality gives composite view to the user with the additional information thus; AR supplements our environment rather than completely replacing it [1][2][3].

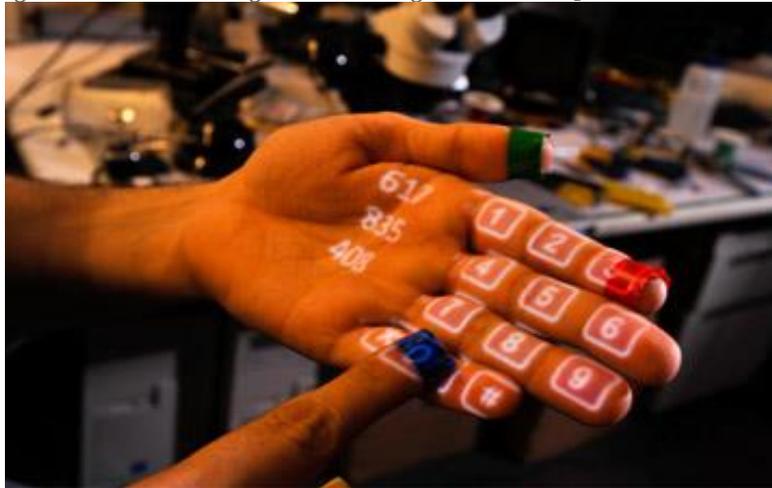


Figure 1: Real hand with a keypad augmented on it with the help of a projector (Courtesy of Pranav Mistry, Lynn Barry, and MIT Media Lab)

1.2. Motivation

A general question arises in mind “Why do we need Augmented Reality?”. It helps us to see information which we cannot infer with our senses and conveys information which helps us perform our daily tasks easily. AR has enormous applications; it can be used in various manners in the field of Medical, Military, Manufacturing, Entertainment, Education and many more [4] [5].

This paper specifically takes “Role of Augmented Reality in Education” in account. Though we will also see applications of AR in other fields as well, how AR works and its future scope.

2. Applications

2.1. Medical

Augmented Reality has a very vast scope in the field of medical and surgery. Medical students can perform surgery in a controlled environment with the help of AR. With improved visual perception, surgeons and doctors can see things which human eye can thus reduce the risk [6][7]. This technology reduces the human error to the maximum extent.

2.2. Military

‘Heads-up Display’ (HUD) and ‘Head Mounted Display’ (HMD) are the two examples of application of AR in Military. Heads-up display is basically a transparent screen placed in front of the pilot allowing him to see typical data like Air Speed, Altitude, Horizontal Line and more without even looking down at the instruments.



Figure 2: Typical Head Mounted Display of an aircraft showing data like Speed, Altitude, Horizontal line and more

Head Mounted Display is mostly used for training purpose. It creates a controlled situation for new recruits to practice in. Also being used in real situations, it displays information like enemy's position within the line of sight [8][9][10].

2.3. Gaming

Augmented Reality has been there for past 20 years but advancements in past couple of years is immense. Its applications spread across different domains. Gaming is a billion dollar industry today, and there are number of AR based games available on all the platforms; be it ios, Android or Windows. You walk around with your camera and you see virtual objects & characters augmented in your surroundings [11][12].



Figure 3: Augmented Reality based Android game (Courtesy of Qualcomm)

2.4. Advertisement

Augmented Reality can be implemented in Advertisement agency in number of ways. Boards are coming up, interactive mannequins, interactive displays to place in front of the store which interact with the user. Some top notch brands are using AR based trial rooms giving you a fast and effective way to try out new clothes quickly [11][12].

The interactive marketing strategies have become the need of the hour and with the use of Augmented Reality, the market can rise to a new competitive level that is both smarter and well versed with the growing generation, which is tech savvy.

3. How Augmented Reality Works

Technically, AR is achieved in 2 ways: Marker-based System and Marker-less System.

3.1. Marker-Based System

Marker based Augmented Reality Systems uses elements form physical world to lay down the computer generated graphics over them. For example, whenever a 2D printed card is placed in front of the web cam, the computer breaks down the image into binary stream, communicates with the database and renders 3D image right over it [14][15].



Figure 4: Marker-based AR System (Courtesy of University of Exeter)

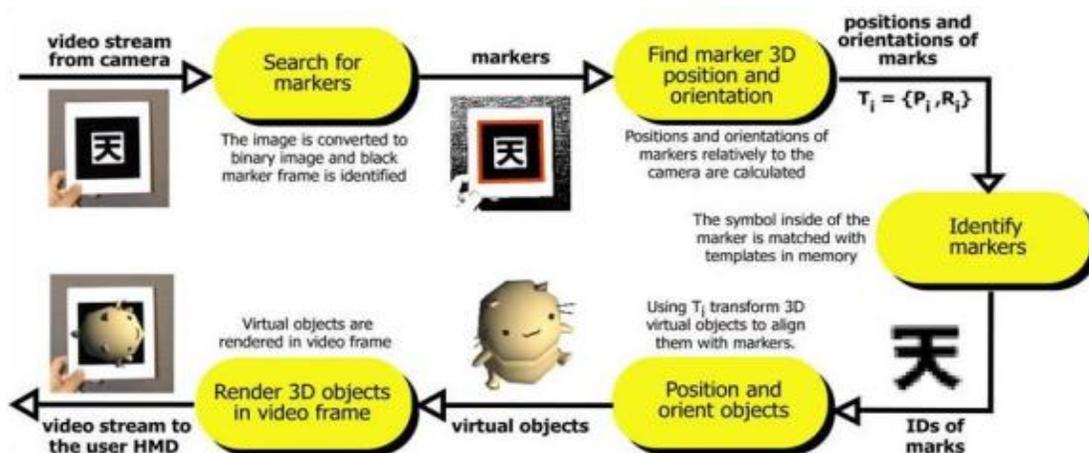


Figure 5: Flow Diagram of Marker-based AR System (Courtesy of SLARtoolkit)

3.2. Marker-Less System



Figure 6: Marker-less Augmented Reality System (Courtesy of University of Exeter)

Marker-less AR systems makes use of electronic sensors like GPS (Global Positioning system), Accelerometer, Gyroscope, compass, etc. to register the 3D Generated Graphics in the real worlds giving a hassle free user experience [16].

User's position is found with the help of the GPS, this data can be correlated with the database to know what the camera is looking at and then render the Computer Generated Graphics in the real world.

$$(x_2 - x_1)^2 + (y_2 - y_1)^2 < r^2$$

We make use of this formula to find the position of the user and identify where to display the virtual objects [13]. Here, x_1 , x_2 and y_1 , y_2 represents the position of the user and virtual object respectively. R is the range of the values. If the user is detected in the range of the object he/she will be notified and will be able to see the object.

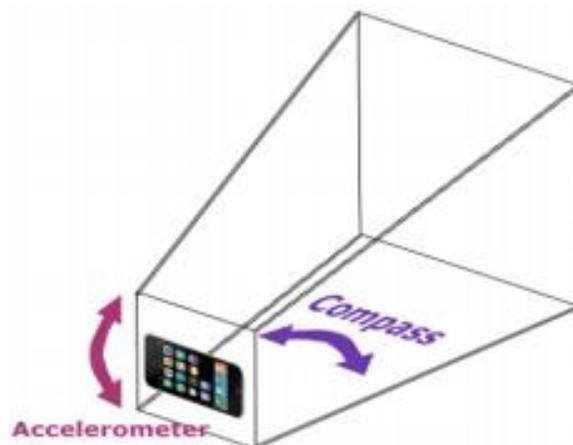


Figure 7: Frustum Controlled by Electronic Sensors

For improved user experience the compass of the device checks for the rotation of the object and streamline the movement of the virtual object whenever the camera is moved. Accelerometer controls frustum's altitude as depicted by the figure 7.

4. Augmented Reality in Education

In recent years it has been observed that number of techniques have evolved to increase the involvement of student in classroom teaching by incorporation technology like animation, virtual environment, videos, presentations, simulation can improve the visualisation of concepts [17], still the number of students specially science students are reducing [18] because of lack of visualisation of concepts which may leads to misconception. Virtual reality can play a big role in developing concepts and to make students to visualise the actual working of concept or model.

4.1. Technology for Visualisation of Concepts

Scientific concepts are of two types theoretical and descriptive. Descriptive concepts can be seen directly from naked eyes like animals while theoretical concepts cannot be seen from naked eyes like atoms, molecules, genes. By using visualisation technologies we can model the things which are too small or too large and fast or slow [19]. H.K.Wu and his friends designed an animation to explain the molecular bounding in Chemistry [20]. B.J.Stith in 2004 used an animation for explaining enzyme-substrata binding [21].

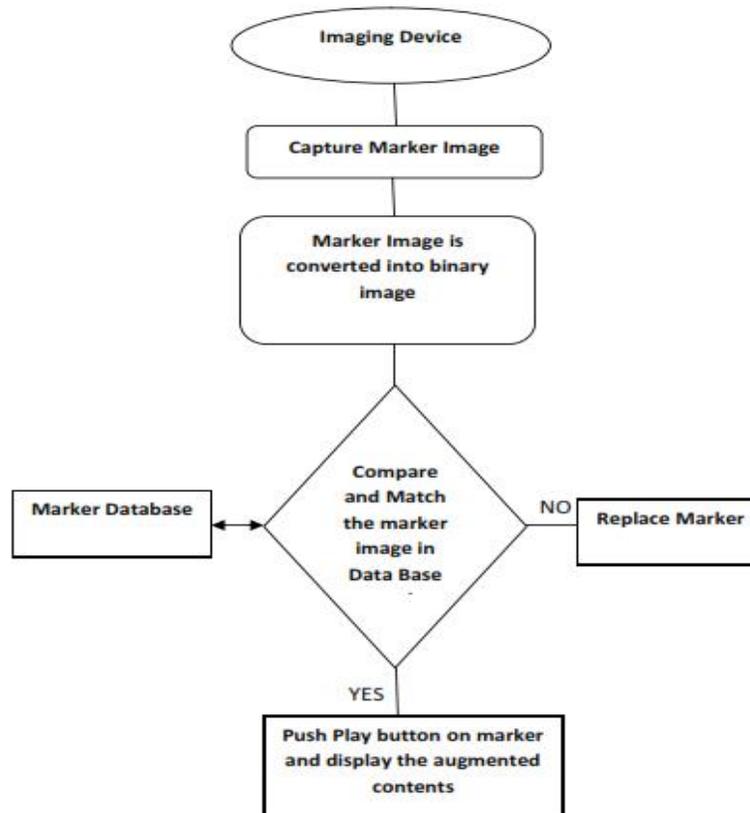
Now a days the most prominent technology in the field of animation for visualisation is AR According to Horizon report from 2004 to 2010, AR is a technology which is bringing computer world to human world.[22] AR is a new way to visualise or understand the things at micro or macro level which cannot be explained by using wooden or fibre models[23] for example; molecular structures, machine internal parts and assembly, biological sequencing. AR will help students to understand the subject by different angle, which cannot be understood otherwise.

5. Implementation of Marker Based Augmented Reality in Education

The paper has covered the major portion including the applications and implementation. It further shows how AR can be used in education i.e. our work.

5.1. Algorithm Used

- 1) Authenticate User
- 2) Get all data available on marker.
- 3) For every y period of seconds, check if user is at a close distance from a webcam.
- 4) If marker is read properly then pop the 3D view of image from server/Database and display on screen
- 5) Play the image and convert into moving image you may rotate it in different direction.
- 6) You can pause the video as you want by pressing pause button'
- 7) You can dismantle the image into different parts by placing appropriate marker in front of webcam.
- 8) Dismantle image can be again use as primary image and same can be repeated as above.



6. Result

We made a number of paper cards (Markers) for different elements (say, a 4 stroke engine, c-60 Fullerene, an earth, etc.) each card has a unique pattern printed over it so that it can be uniquely identified. The Marker also has play and pause buttons over it as shown in fig 8. For the sake of simplicity we will consider the example of a 4-stroke engine in description.

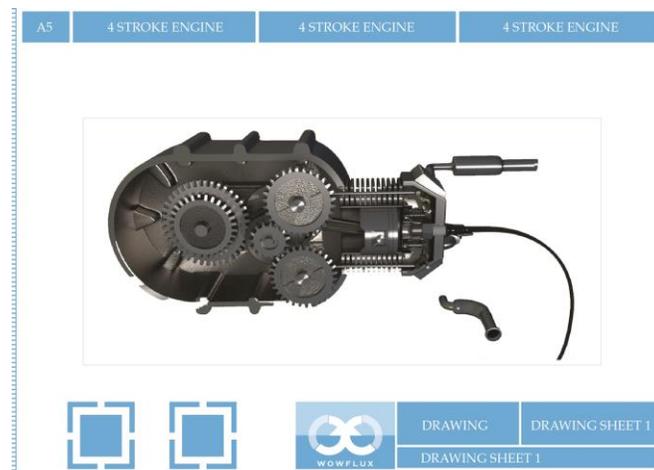


Figure 8: A Marker for 4 stroke engine with play and pause button on bottom left

When you place the marker in front of the web cam, the marker gets converted into binary image and goes into the database; the respective 3D model from the database is then displayed on top of the marker. When you place your finger on top of the play button, the animation starts to play and whenever you want to stop the animation you tap the pause button. The web cam keeps track of your finger and whenever it over laps the play/pause button on the market, it triggers the effect.

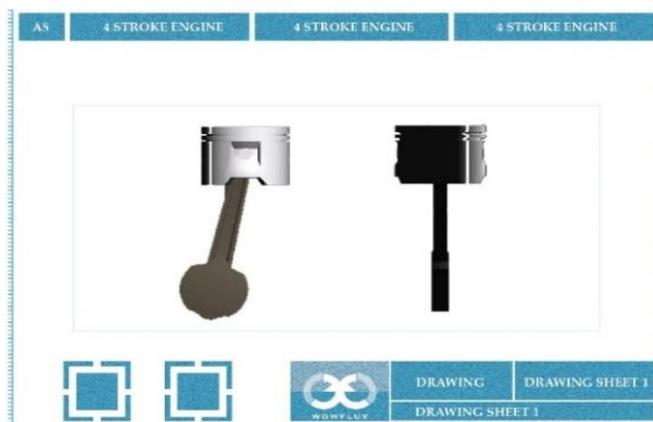


Figure 9: A Dismantle Marker

Apart from these features we also have dismantle feature in our Marker-based AR Education System, for example, if you want to see the position and movement of the piston all alone, you bring a separate piston marker into the scene (in front of the web cam) and the piston is highlighted separately in blue colour. If you want to see the movement of piston separately you tap the dismantle button and the piston comes out of the engine and moves separately.

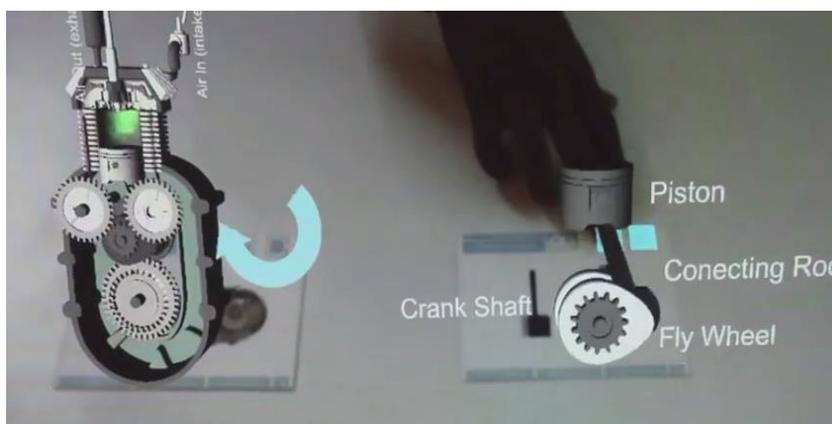


Figure 10: Four Stroke Engine and its piston displayed on their respective cards

So with this technology learning becomes hassle free and seamless. You see everything in motion; you see whatever you want to see and all of it with gestures and interaction.

The second application that was done by us included Marker Based AR for instruction manuals. There are times when you want to follow a certain procedure, for example: you want to perform a Chemistry Experiment or want to make a Lego Car. For this, we made a similar system which works on the same lines of the Marker-based technology. We parse through an instruction manual and made a 3D animation for that, now when you place that instruction manual in front of the web cam, it will guide you through all the instructions with the help of 3D animations as shown in figure 9.

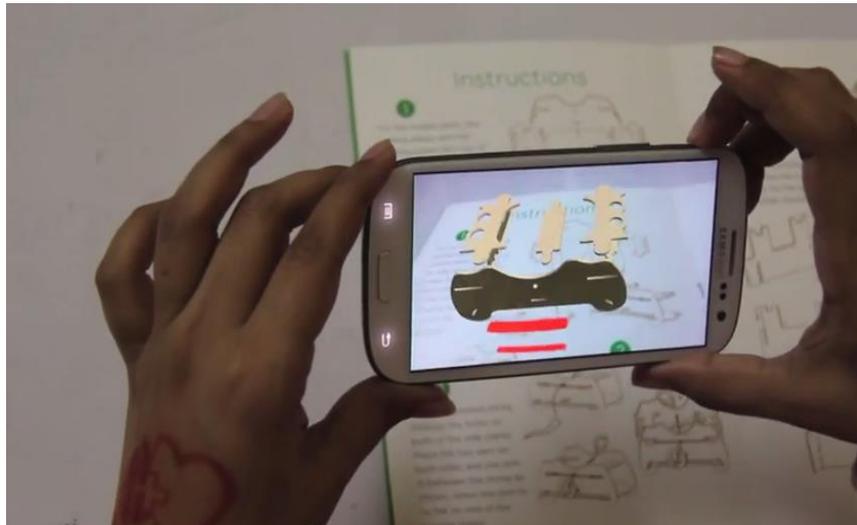


Figure 11: 3D animation plays when you point the camera over the instruction manual

7. Conclusion

Since the day, the idea popped out in the minds of researchers and thinkers; AR has seen times like discovery of HMDs all the way to The Sixth Sense Technology. The field of Augmented Reality makes use of the virtual world and superimposes it to the real world we live in. The applications include the medical field, education, marketing, and many other.

The most prospect being the education and medical, as it not only opens the new and improved ways of implementation but also foresees a future that has a huge contribution in the context of human beings.

The work and application conducted and mentioned in this paper reflects the sole purpose of improving the way the education sector is working. With the classes getting smarter day by day and the tech getting easier and easier, we need more implementation of such in what the students are learning. Augmented Reality simplifies this by making the facts, figures, diagrams, working and all other related study material easier. The markers/cards generated are the new notes that the students need to carry; a total replacement of what it was a decade back. AR and its usage in the education as per the paper and its guidelines imparts a practical approach to the theory and also focuses on the creative and intellectual learning of the students. As the work in this field continues, more technology and AR based education aids will be available to the faculty, students and institutes thus making the next generation a way smarter than what we see of ourselves.

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