

Simulating Consequences of Smoking With Augmented Reality

B Remya Mohan

Amrita School of Engineering,
Amrita Vishwa Vidyapeetham,
Amritapuri, Kollam, Kerala, India.
remurenju@gmail.com

Kamal Bijlani

Amrita E-Learning Research Lab,
Amrita Vishwa Vidyapeetham,
Amritapuri, Kollam, Kerala, India.
kamal@amrita.edu

R Jayakrishnan

Amrita E-Learning Research Lab,
Amrita Vishwa Vidyapeetham,
Amritapuri, Kollam, Kerala, India.
jayakrishnanr88@gmail.com

Abstract— Visualization in an educational context provides the learner with visual means of information. Conceptualizing certain circumstances such as consequences of smoking can be done more effectively with the help of the technology, Augmented Reality (AR). It is a new methodology for effective learning. This paper proposes an approach on how AR based on Marker Technology simulates the harmful effects of smoking and its consequences using Unity 3D game engine. The study also illustrates the impact of AR technology on students for better learning.

Keywords— *Augmented Reality, Marker Technology.*

I. INTRODUCTION

AR applications can be built with the help of SDKs and various game engines. Among the various game engines, Unity 3D is the game engine used in the proposed system. It is a multiplatform, consisting of integrated IDE for game scripting and can also be used in 3D virtual worlds. To build an AR application in Unity 3D, external SDKs are essentially needed by the system. Certain Unity 3D like Catchoom, Metaio, ObviousEngine, PointCloud, Sphero, SSTT, Vuforia, Xloundia, NyARToolkit are also used. SDK used in the proposed system is Vuforia.

The two different ways in which AR applications can be built are based on marker and marker less technology. Markers can be defined as the target image which is stored in the Vuforia target database. Each marker has different size and also contains different patterns to differentiate it with other markers. When marker is detected by the AR camera; digital object is rendered on the screen which gives a realistic view of the object. It works with the help of software that identifies a particular pattern such as a barcode. Multiple markers can be used for an AR application. To identify different markers used in AR applications, different ids are used for each marker [15]. Figure 1 shows an example of a marker. Markerless AR uses sensors in the devices they are using to detect the real world environment. This allows users to place virtual object in that environment. In Markerless AR, any part of the environment can be used as a target and these targets can be tracked to place the virtual objects. Markerless technology allows users to extract information from environment that can be stored and used later.



Figure: 1 Marker [7]

Figure 2 shows an example of Markerless AR. By using Marker AR, all the features in the image can be clearly known, in case of Markerless AR, some random points in the image is taken and these are compared with the stored objects in database. This causes lot of time consumption when the database grows in size, so to avoid this markers are being used in the proposed system.



Figure: 2 Markerless AR [18]

Figure 3 illustrates a Marker based AR System. The system captures the image of the marker shown to the AR camera. As the captured image is identified with the target images in the database, the corresponding virtual object is

rendered [4]. The proposed system suggests the use of virtual buttons to make interactions more effective.



Figure: 3 Marker based AR System Setup [4]

Nowadays the consequences of smoking and its effects are shown with some animated videos and posters. But this may not give a real visual impact to the user how its effects or harm us. With the help of AR Technology this consequence can be illustrated with 3D effects and normal lungs, changes in lungs when smoke enters the lungs and diseases caused due to smoking along with the damage caused to the lungs are shown in the proposed system.

II. RELATED WORKS

AR is an upcoming technology; researches are more interested in using AR in education field to make learning easier. This helps in improving knowledge in the subject area of user's choice, which in turn creates a good educational experience for the user. Thus AR creates a learning environment which combines both educational and entertainment factors. Students are provided with a learning environment with the help of AR technology in their classroom, where it is found that students learn more in collaboration. AR technology increases the motivation level of students by creating a learning environment that enhances excitements among the students, which in turn increases their learning. The technology, AR helps students to learn at their own pace and experience a different learning environment with the help of information collected from the real world. It combines the real world and virtual world elements to provide a real world experience and concentrates on the objects in the real world with the help of digital information. Earlier days it was associated with expensive hardware's but nowadays it can be used in a much simpler way, with the help of a web camera, laptops etc. It finds a wide variety of applications in the field of Education [10], Medical Science [17] and Military [18] etc.

Importance of Augmented Reality in Education sector is explained in [2] and also using an interactive marker in Augmented Reality for teaching Computer Graphics. Students have interaction with the models and can view its details in 3D. The AR Technology helps students in learning at their own pace, which makes students. [3] Explains that AR Technology can be used in improving students cognitive test performance on a particular topic. AR tool can be used in

chemistry subject to make more interactive. [1] Gives more information about how AR technology can be used in the field of education. Students in medical field require more interactive experience which can be made possible with the help of AR Technology.

Ronald T. Azuma gives a detailed survey in the field of augmented reality. Here, in real time 3D virtual objects are integrated into 3D virtual environments [8]. This paper concentrates on some of the main areas in augmented reality and the work done in those areas. The areas taken into considerations are medical, manufacturing, visualization, path planning, entertainment and military applications. The paper also gives an overview of the characteristics of augmented reality systems and also difference between optical and video blending approaches. According to the author, augmented system has mainly three characteristics, they are [8]:

- Combines real and virtual
- Whether interactive in real time.
- Whether registered in three dimensions.

[9] Presents a detailed study of user evaluation techniques used in augmented reality research. The methodology used in this paper is characterized by iterative selection, filtering and classification process. Hannes Kaufmann presented the challenges in using collaborative augmented reality in the field of education [10]. According to the author, in a collaborative augmented reality multiple users access a shared space which is incorporated by virtual objects. This method helps users mainly for educational purposes and can use various natural means of communication (like speech, gestures etc) [10].

III. SOLUTION APPROACH

The study demonstrates side effects and diseases caused due to smoking using AR Technology. Unity 3D game engine is used for demonstration and uses some of the marker based toolkit for developing AR Application in Unity.

A. Unity 3D game engine

Unity 3D is a new technology that helps in making games easier. Unity consists of lots of packages and export options are also present for other platforms. Unity can be used as a multiplatform for developing 2D and 3D games [16]. Unity provides interactive experiences with the user. Unity is considered as one of the best development platform for creating games. Unity can be used between 21 platforms.

B. Vuforia

One of the SDK used with unity for developing AR Application is Vuforia. Vuforia is a software platform that enables the user to create augmented reality applications. The Vuforia uses technically more powerful computer vision based image recognition system and provides a wide variety of features which makes user to develop applications more effectively without any limitations [11]. Vuforia provides lots

of features, which includes identifying and tracking images, texts and markers.

1. Features of Vuforia

a. Target Images

Target Images are those images which Vuforia SDK can detect and track. Once the Image Target is detected, SDK will track the image whenever the image is in the field of camera. Vuforia Target Manager can be used to create Target Image using JPG or PNG images. Vuforia Target manager is a web based tool that can be used to create and manage target databases online. To work with Target Manager, Vuforia Developer Account is needed. A license key will be associated with all the databases created in the Target Manager. Once the license key is obtained, one can create database, add targets, download database and add it to Vuforia Project, update and manage databases and targets throughout the application. There are mainly two databases in Target manager: Device database and Cloud database. Device database are local databases that are stored on user's device [12]. Cloud databases are stored online and uses internet for queries [12].

b. Multi Targets

More than one Image Targets are used for creating Multi Targets and regular geometric shapes are used for their arrangement. Multi-Targets consist of multiple Image Targets in a geometric arrangement [13].

c. Frame Markers

Frame marker consists of a unique ID and this frame marker is encoded into binary pattern along the borders of the marker image [14]. Frame markers are used for applications that need to identify those images which are similar. With the help of frame markers, images are placed along the marker borders.

C. Proposed System

- There are mainly three modules in the proposed system. Modules include: Representation of Interactive 3D Respiratory system and its functionalities.
- Demonstration with Augmented Reality- Showing the consequences of smoking.
- Assessment – Quiz Module.

a) Representation of 3D interactive respiratory system and its functions

In this module, learner can view 3D respiratory system along with its functionalities. Learner can rotate the 3D model of respiratory system and can separate each part in the respiratory system and can join again. When learner mouse over to any part in the 3D model of respiratory system, a color change will occur to the corresponding part and also shows the detailed explanation of the specified part. In this way learner will get a detailed study of the human respiratory system and different organs in the respiratory system along with its functions. Figure 4 shows 3D model of respiratory system. This module demonstrates mainly two functions, parts labeling and parts separation of the respiratory system. Figure 5 shows the functionalities of each organ when mouse over. Figure 6 shows the parts separation of respiratory

system.

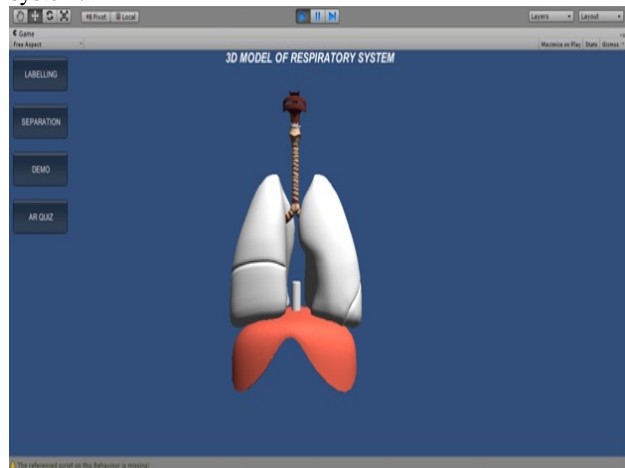


Figure: 4 Interactive 3D respiratory system

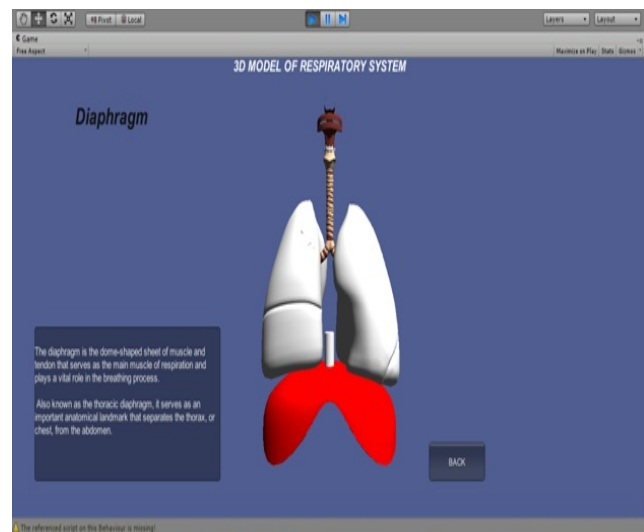


Figure: 5 Labeling different parts of respiratory system

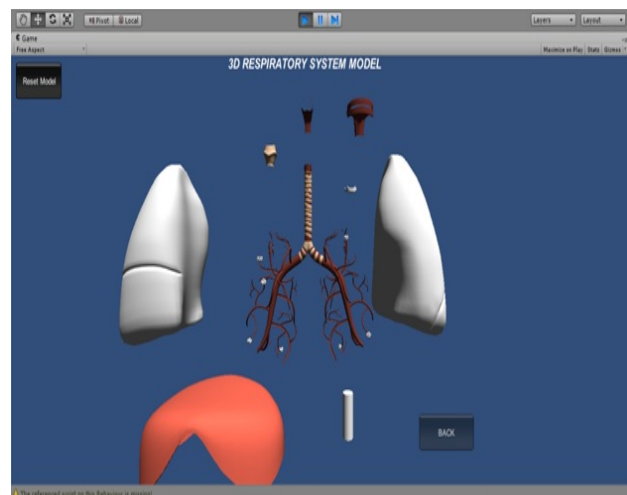


Figure: 6 Parts separation of respiratory system

b) *Demonstration with Augmented Reality- Showing consequences of smoking.*

AR marker is used here to demonstrate the consequences of smoking. AR Camera captures the target image in the AR marker, Respiratory System. The image is being tracked in the database (Vuforia) and checks in the database for the appropriate matching and displays the rendered object on top of the target image. When marker is captured by AR Camera, respiratory system which is hidden in the marker is rendered and also demonstrates the inhalation and exhalation of air into the lungs. The demonstration shows how harmful smoke enters the human body and how this smoke causes damage to different parts of the respiratory system. Figure 7 shows flow diagram.

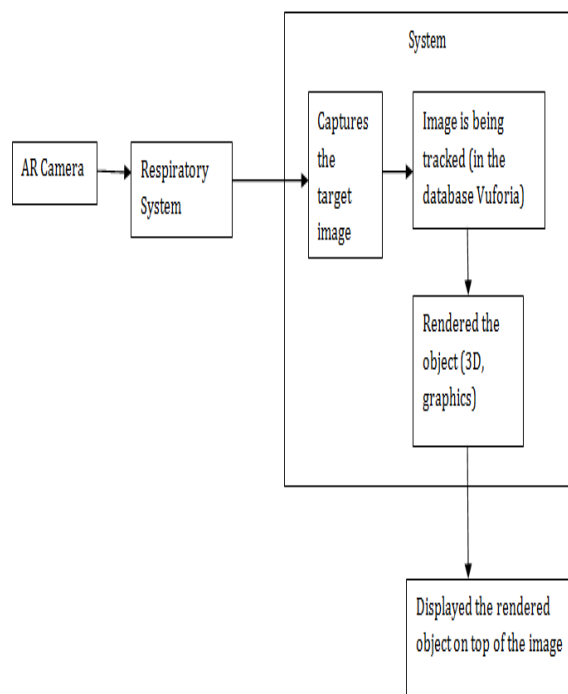


Figure 7: Flow Diagram

The study also demonstrates three different diseases that are caused due to smoking. The three different diseases demonstrated here are Emphysema, lung cancer and chronic bronchitis. Emphysema affects the air sacs in lungs, the alveoli and demonstrated by showing color change in the air sacs. Lung cancer causes abnormal growth in any part of lung. Chronic bronchitis causes difficulty in breathing by the sedimentation of mucus in bronchiole, making the bronchiole narrow and demonstrated by showing color change of the affected part. As smoke enters respiratory system, diseases are demonstrated along with their description.

c) *Assessment- Quiz module*

For assessment, quiz is conducted to analyze the understandability of the learner. Quiz is conducted with AR.

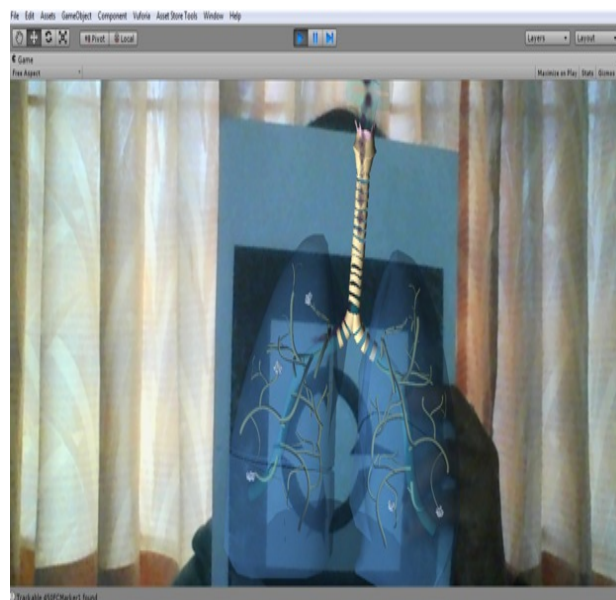


Figure: 8 shows smoke entering respiratory system

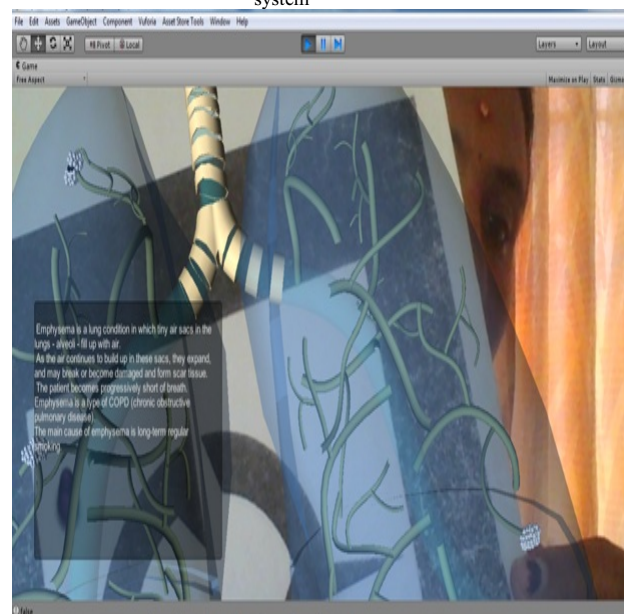


Figure: 9 Demonstrates disease emphysema..

In quiz module, quiz question appears and each question has four different options. These four options are having four different markers. Learner can choose any marker which they feel is correct and shown in front of AR camera. Message is displayed indicating whether the answer is correct or wrong. If the answer is correct score is incremented. Figure 10 shows the demonstration of assessment module using AR technology. Here question appears and user can select any of

the four options using any of the four marker. In figure 10 user selects a wrong answer and it is displayed as wrong.

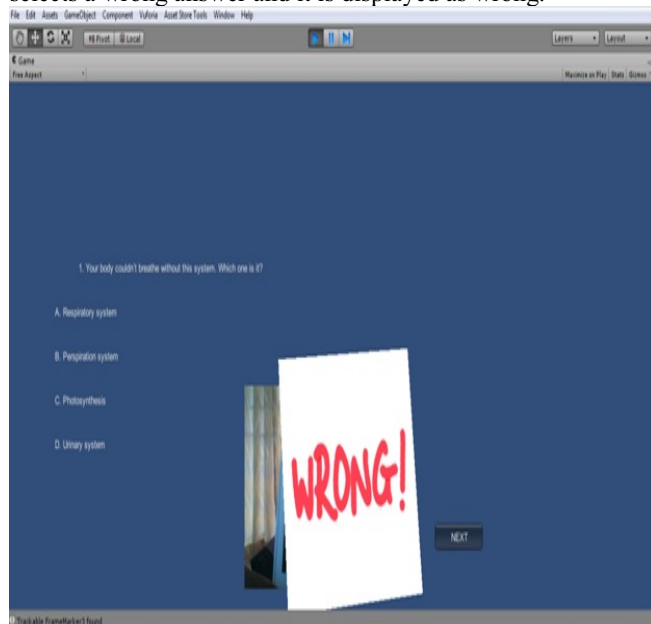


Figure: 10 AR quiz selecting a wrong answer.

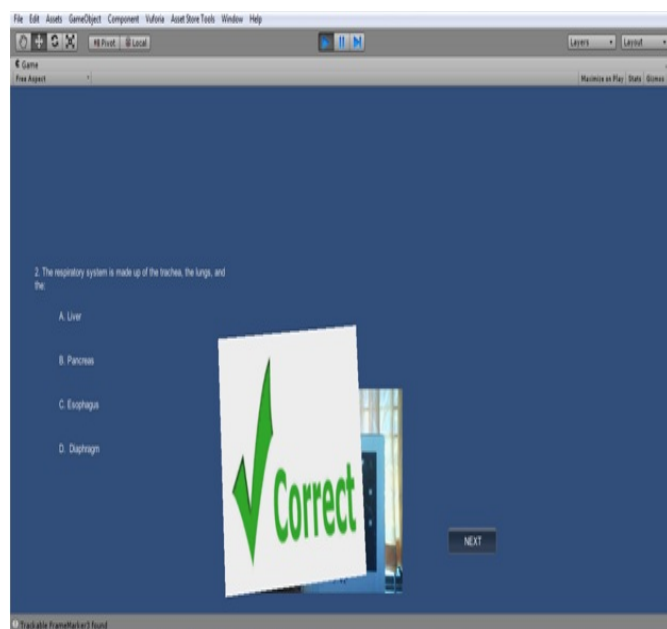


Figure: 11 AR quiz selecting a correct answer.

Figure 11 shows the demonstration of assessment module using AR technology. Here question appears and user can select any of the four options using any of the four marker. In figure 11 user selects a correct answer and it is displayed as correct.

IV. RESULT AND ANALYSIS

To understand the respiratory system and effects of smoking in human body using augmented reality, we performed assessment on two bases: pre- assessment and post

assessment. In case of pre-assessment a group of students were shown a normal video and the feedback of students were taken. In case of post- assessment, the same group of students were shown the proposed system illustrating the harmful effects of smoking and the feedback of students were taken. The feedback from students are presented in the form of a graph shown in figure 12. It is clearly evident from the graph that students strongly agree with augmented reality technology than a normal video.

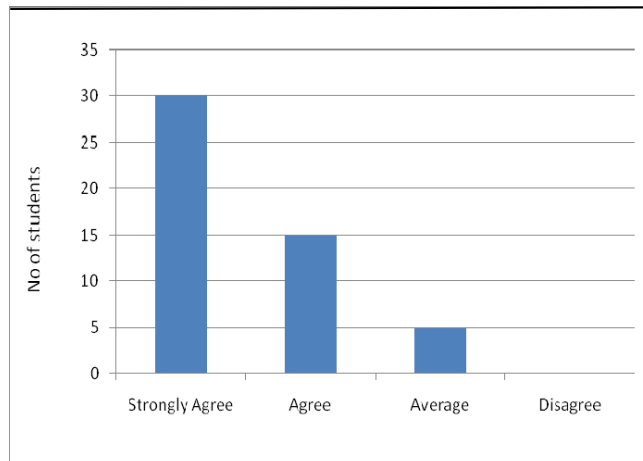


Figure12: Evaluation

V. CONCLUSION

The paper presents the use of AR Technology in the field of education. Students and people get more visual impact of the concepts they are studying. AR Technology also helps students to learn at their own pace. The study demonstrates the awareness among students regarding smoking and the diseases caused by it and this is made possible through augmented reality technology. Students will get more attracted towards the 3D visualization of objects than a normal video. So, augmented reality technology helps students to get a 3D visualization of the object rendered. The study also shows that students had an impact of the system using AR technology.

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