“ARRES” Augmented Reality for the human respiratory system

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Abstract. Technology is advancing at a brisk pace as many things that were not possible a few years ago are possible now. Augmented Reality is a synthetic, computer simulated reality or recreation of a real-time environment where a user can interact with the replicated real environments. Biology is only taught in conventional way through books so it makes the students only pay their attention to texts and pictures to catch their interest, the lesson will get more interesting and interactive if the students can look at the process directly in the form of 3D as it makes students memorize it at ease. Respiratory and blood circulation system are examples from Biology for second grade of Junior High School. By applying Augmented Reality, they can take a lesson interactively through digital object in a reality. The design of Augmented Reality in respiratory and blood circulation system for Junior High School students is made with Blender application. The making of AR application with android platform uses game engine unity. Based on the functional test conducted by the researchers, it can be concluded that by applying the application, the users can gain the information related to the human respiratory and blood circulation system can be conveyed interestingly and interactively to the students.

1. Introduction

In this era of globalization, the development of information and communication technology has plagued in public, as time goes by. Augmented Reality Develops very rapidly thus enabling the development of this application in various fields including education. Augmented Reality is an attempt to combine the real world and virtual world that is created through a computer so that the boundary between the two becomes very thin. The advantage of this Augmented Reality method is an attractive visual display because it can display 3D objects that seem to exist in a real environment. The Augmented Reality method also has the advantage of being interactive because it uses markers to display certain 3D objects that are directed to the camera. In addition, the application of the concepts that will be used is expected to increase students’ reasoning and imagination [1]. Based on the above, it is necessary to make the respiratory system and circulation of human blood based on Android as a learning medium. Android allows helping students to learn anytime and anywhere easily, but still refers to the textbook. In this case the author wants to implement Augmented Reality and use leaflets accompanied by markers to provide information on the respiratory system and circulation of human blood in 3D and writing. So, facilitate student understanding in studying biology subjects.
2. Literature

2.1. Respiratory and circulatory systems
Breathing is the process of inserting oxygen into the breathing apparatus and removing carbon dioxide and water vapor. There are 2 types of breathing in humans, namely inspiration and expiration. Human breathing mechanisms are chest breathing and abdominal breathing. Chest breathing is breathing that uses the ribs of the breastbone, the ribs are lifted so that the chest cavity enlarges. While abdominal breathing is breathing using a diaphragm. Human breathing apparatus is the nose, faring, trachea, bronchus and bronchioles, lungs, dan alveolus.

For biological scientists, breathing is the whole process of cells in an organism in receiving oxygen and releasing carbon dioxide. Therefore, according to McLaren & Rotundo, breathing can be divided into three forms, external respiration, internal respiration, and cellular respiration [2]. So, the respiratory process can take place, respiratory equipment is needed. These tools are sequentially started from the nose, faring, luring, trachea and lungs.

2.2. Android
Android was hailed as the first complete Mobile Platform, open source, and free (Complete Platform). Where designers can take a comprehensive approach when they are developing an Android platform. Android is a safe operating system and provides many tools in building software and allows for application development opportunities. Open Source Platform, android platform provided through a license open source. Development can freely develop applications. Free (Free Platform), where android is a platform or application that is free to develop. There are no licenses or royalty fees to be developed on the Android platform. There are no membership fees, and testing fees. There is no contract required. This android application can be distributed and traded in any form [3].

2.3. Augmented Reality
Augmented Reality has a simple work method based on image detection and is usually called a marker. For example, a camera that has been calibrated can detect markers that have been designed, then after detecting the marker, the camera will match the database that was created previously. And if the results match, then the information from the marker will be used to display 3D objects that have been designed in front of the user's screen, but if the marker does not match the database then the information from the marker will not be processed [4].

Augmented Reality (AR) is a technology that involves computer graphic images with the real world. Users can see the real world plus virtual objects and can interact with the real environment. In a more general context, AR is also called Mixed Reality which refers to a multi-axis spectrum that includes Virtual Reality (VR), Augmented Reality (AR), and other technology [5].

2.4. Unity
Unity is an integrated tool for creating games, building architecture and simulation. Unity is not designed for the design or modelling process, because Unity is not a tool for designing. If you want to design, use another 3D editor like 3dsmax or Blender. Many things can be done with Unity, there are audio reverb zone features, particle effects, and sky box to add sky.

2.5. Vuforia
According to the official website of Vuforia (vuforia.com) Vuforia is Augmented Reality Software Development Kit (SDK) for mobile which allows the creation of Augmented Reality applications. Formerly better known as QCAR (Qualcomm Company Augmented Reality). This uses Computer Vision technology to recognize and planar images (Target Image) and simple 3D objects, such as boxes, in real-time. Image registration capabilities allow developers to adjust the position and virtual orientation of objects, such as 3D. models and other media, in relation to real-world images when this is seen through the camera of the mobile device virtual objects then track the position and orientation of the
image in real-time so that the user's perspective on the object corresponds to their perception of the Target Image, so it appears that virtual objects are part of the real world scene.

3. Analysis

3.1. System overview
The architecture of this application is a system that will involve users who use Android smartphone devices. Users use the respiratory system leaflets and human blood circulation as adjusted target or marker images. The marker is placed in front of the camera, then the camera will capture markers and display objects on the smartphone screen.

The following is a general description of the system shown in Figure 1.

![Figure 1. General description.](image)

3.2. Application specification
Specifications In the analysis phase regarding software requirements specifications needed in the application of Augmented Reality Human Respiratory for Middle School Students is:

- Windows 7
- Blender 2.77
- Adobe Photoshop CS 6
- Unity 5.6

3.3. Story board
Storyboard is used in the design stage in running applications. Can be explained in the following table 1.

| Figure | Information |
|--------|-------------|
| ![Image](image) | User uses Android smartphone device the AR application has been installed and leaflets respiratory system and circulation human blood as an image target or marker that has been adjusted Select the AR application that has been installed on the device Android smartphone. The application's main page contains the application name and the start button for the next menu |
Table 1. Cont.

A menu page that contains 4 buttons will appear: Start, application instructions, about the application and exit.

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4. Implementation

4.1. *Making alveolus organ objects*

Following is a display of alveolar organ modeling in the lungs. The first step is mesh with subdivision 1 for the alveolus model as shown in Figure 2.

![Figure 2. Model alveolar organs.](image)

Then make the alveolus form and prepare the alveolus channel as shown in Figure 3.

![Figure 3. Make alveolar ducts.](image)

4.2. *Making an Augmented Reality marker*

In making a technique for Augmented Reality, AR Camera will detect the marker, so that the arranged object can appear on the screen. Figure 4. is the image that is used to be a marker on this application.
Figure 4. Markers used in the application.

The marker image was created using Adobe Photoshop software. Can be seen in each marker representing each 3D object that has been made before. Actually, in Vuforia markers various shapes and colors can be recognized, but to make it easier to read by AR Camera a marker with two colors is chosen, namely black and white.

4.3. Implementation of 3D animation of nose Organs
The page display of 3D nose organs is shown in Figure 5. on the nose organ menu displays the process when oxygen passes through the nose.

Figure 5. Implementation of 3D animation of nose.

4.4. Implementation of 3D animations of pharynx and trachea
Organ Display of pharynx and trachea 3D organ page shown in Figure 6. on the menu the pharynx and trachea organs display the process when oxygen passes through the pharynx to the trachea.

Figure 6. Implementation of 3D animations of pharynx and trachea.
5. Conclusions
The conclusion of the test results is as follows.

- Myrespi application can model the organs of the Human Respiratory and Circulatory System in the form of 3-dimensional animations made with a blender application, so make it easier to understand biological subjects about the respiratory system and blood circulation for 8th grade students of junior high schools (SMP).

- This application can be an interesting learning medium for students. Based on the questionnaire, respondents gave responses that this application helped increase student learning interest.

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