Augmented Reality for Respiratory System using Leap Motion Controller

U. Andayani[1], B. Siregar[1], Abdul Gani[1], M. F. Syahputra[1]
[1]*Department of Information Technology, Universitas Sumatera Utara, Jl. Alumni No.3, Medan, Indonesia*

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Abstract: Anatomy is a branch of biology. Science applied in the medical field is not easy to learn just by imaging or at least just using props to know the process directly. The anatomical system is the systemic of the body especially in the part of the lungs organ while breathing. Therefore, modern technology is used as one of the learning methods that can help research anatomy of the lung as a main organ in the respiratory system. In this study, the researchers use the anatomy of Three Dimension (3D) and multimedia animation system that helps with the Leap Motion Controller tool that supports the movement of fingers and hands as controlling the system. With this tool, objects with a 3D models on the respiratory system can be handled with gestures from the hands of both hands of the user. The process resulted in a merger of Augmented Reality systems and the Leap Motion Controller in which the system produced animated movements and virtual 3D object use marker which sized 21cmx29, 7cm where the results using best distance while camera detect the marker is 20cm-45cm, camera can detect the object use the slope distance between 35^0-145^0.

1 INTRODUCTION

Anatomy is the study of the structure of the human body (Paulsen, 2013). This knowledge is applied in the medical field,based on observations, a professor of trouble to explain to the students about the structure of the human body. This is because the science was likely learned by memorizing through textbooks but requires a relatively high visualization capabilities. The solution that has been done by the teacher is to encourage students into the laboratory to see the props and adapt to the atlas of the human anatomy, but the disadvantages are the props can only be used in the laboratory. In addition, students experience boredom with lecturers in teaching methods without using the props. Furthermore, with the support of an edition and visualization mode (Edgard, 2010).

Along with the rapid Information Technology (IT) almost all areas of life wanting everything his character interesting, so that may be one way to improve the ability to learn anatomy by using modern learning system. One of them is to learn anatomy using 3D technology (Nady, 2014). In addition, as a means of supporting tools 3D technology can also improve user interaction so that the anatomy is more observable in interesting ways.

Augmented reality technology is a 3D technology to combine computer-generated objects with real-world environment. Augmented reality enhance the user perception and interaction with the real world. Virtual objects indicates that the user information cannot be seen directly by eyesight. Information submitted by the virtual object to help the user do the work in the real world (Kato, 2000). Augmented reality is an innovation of computer vision that can provide the visualization and animation of an object model. It is expected that this technology will help the faculty in teaching and learning, so that the learning process becomes more interesting and no student interaction of the material.

To perform an interactive interaction, the system must be able to detect and capture the movement of the object (Giulio, 2014). In this study, the object to be detected and a search is conducted in the form of palms. Detection of palms is expected to connect the real world with the virtual world in a more realistic reality augmented system.

Leap motion as the controller can improve human interaction with computers to develop the application such as for accuracy (Frank, 2013). Leap Motion Controller is a tool designed to track the movements of the hand and fingers. At the moment the system is run, users can perform various activities with hand gestures. This hand movement was observed by

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sensors on the Leap Motion Controller as input to do various things that can trigger events in the program. In a 3D human anatomy, hand gestures will make the user as if they were interacting directly and in contact with the 3D model of the human anatomy.

The gesture is a static and dynamic movement that is used as a means of communication between man and machine as well as fellow human beings who use sign. By using hand gestures were observed Leap Motion Controller to do the control on the system. Certain gestures may trigger a process on the system. Position hands doing gestures can be supported for translational motion 3D Leap Motion Controller.

Anatomy harnessing modern technology has also been applied as in the Augmented Reality for Anatomy Study (Naoto, 2016), (Natapon, 2016), and (Yudhisthira, 2013). Leap Motion Controller is already widely used in a variety of systems, such as the system had been developed (Kasey, 2016), (Masaru, 2013), and (Farhan, 2015).

Based on the above background, the title of this research is "Augmented Reality Anatomy Respiratory System Using Leap Motion Controller For Media Medical Education".

2 CONCEPT DEVELOPMENT

The data used in this study were the marker captured in real time via the camera phone and using hand gestures detection leap motion controller. While capturing the hand movements required marker and mobile phone cameras, motion controller quality leap nice, lighting and distance marker making.

The methodology need to analyse the problems of the information obtained in the preceding stage in order to obtain a method to overcome the problem in this study. Then perform the system design according to the analysis of system problems. The following Figure 1 describes the general architecture of the system design of the study.

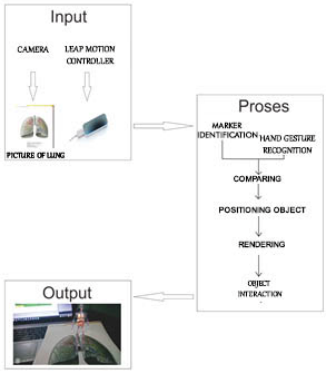

Figure 1: General Architecture

3 SYSTEM DESIGN

The research was done by dividing into three sections: input, process and output.

3.1 Input

Marker was placed in front of the camera to display 3d objects. Leap motion controller is placed under the hand to control 3D objects.

3.2 Process

3.2.1 Identify Marker

Marker consists of a piece of paper will be detected by a Mobile camera. The hand and finger movements above the Leap Motion Controller will be detected by the Leap Motion Controller tool. Furthermore, both of them will be reviewed and assigned a 3D orientation position as a virtual object above the marker.

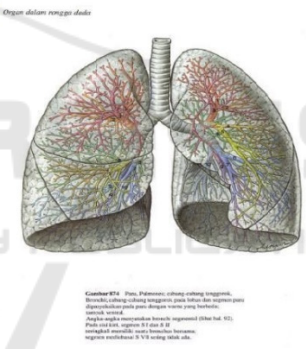

Figure 2: Marker

3.2.2 Database

Furthermore, the marker captured by the camera adjusts the marker image in the database, as well as the hand gesture, if the corresponding movement information will continue with the approximate scaling and placing 3D virtual objects above the marker.

3.2.3 Positioning Object

The position of the object is related to the X coordinate (moving the position to the right and left), Y (moving the position up and down), Z (moving the position forward and back) on the marker for the virtual position of 3D objects.

3.2.4 Rendering

In rendering, all data entered in the modelling process, animation, texturing, lighting with parameters will be translated in an output (the final view on the animation model).

3.2.5 Object Interaction

The 3D objects located above the marker will move according to the instructions of the hand movement.

3.3 Output

The resulting output is the movement of objects and animation updates, in accordance with hand gesture instructions.

3.4 Hand Gesture using the Leap Motion

Controlling or running applications using the Leap Motion Controller device. Leap motion controller will capture hand movements instructed by the user that are carried out, are:
1. Hand movements slide right and left to rotate objects.
2. Hand movements to grasp to stop rotating objects.
3. Hand movements slide down to display oxygen inhaling animation.
4. Hand movements slide up to display animation removing CO_2.
5. The hand movement points to display the displacement of the object's movement of the hand pointing with the index finger to display the anatomy of the lung section.

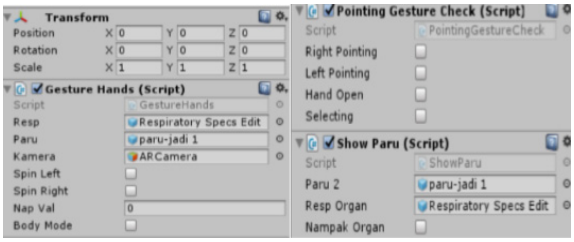

Figure 3: Leap Motion Controller Setting

4 RESULT AND DISCUSSION

The following an animation of the lung organs, such as while breathe oxygen and release CO_2.

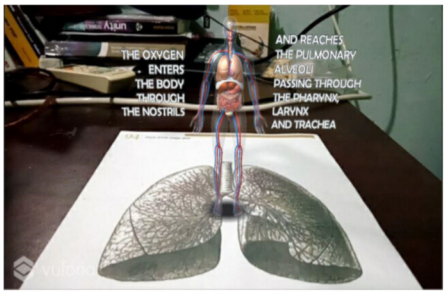

Figure 4: Animation of Breathing Oxygen

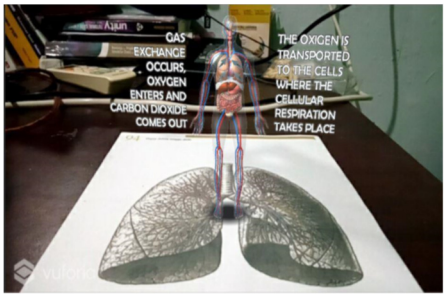

Figure 5: Releasing CO2

The purpose of testing system in order to know the achievement of the system to use the Leap Motion Controller as a tool for 3D human anatomyrecognition system. Test divided into 2 (two) parts.

4.1 Introduction Test of Leap Motion Controller

The introduction test of Leap Motion Controller is to know how accurate leap motion detect user gestures. Testing is done by connecting the leap motion with laptop with a USB cable. After the Leap Motion will connect automatically leap motion lamp life and will detect hand movements. Tests carried out ten times. In in order to determine accurately degree system in this study.

Table 1: Leap Motion Controller Scenario Test

No.	ScenarioTest	Test	Correct	False	Test Result
1	Introduction of Fingers	10	8	2	Detected and unstable
2	The introduction of the right hand handheld	10	10	0	Detected and stable
3	The introduction of the left hand handheld	10	10	0	Detected and stable

4	The introduction of horizontal and vertical movement of the hands of the right hand	10	10	0	Detected and stable
5	The introduction of horizontal and vertical movement of the hand left hand	10	10	0	Detected and stable
6	The introduction of the right hand pointed object	10	7	3	Detected and unstable
7	The introduction of the left hand pointed object	10	8	2	Detected and unstable

From the experiments can be concluded that the introduction of the hand and finger movements are detected and everything is run well. Besides testing to detect hand movements Leap Motion Controller to light intensity.

Table 2: Leap Motion Controller detect to light intensity

No.	Light Intensity(Lux)	No. of Test	Correct	False	Test Result
1	0	10	0	0	Not detected
2	43.50	10	3	7	Detected and unstable
3	83.68	10	6	4	Detected and unstable
4	138 005	10	9	1	Detected and unstable
5	141 828	10	10	0	Detected and stable
6	146.74	10	10	0	Detected and stable
7	153 294	10	10	0	Detected and stable

4.2 Augmented Reality Marker Testing

Marker testing was conducted to determine the level detect marker image. Testing is done by connecting the camera with a USB cable next mobile camera will automatically detect the marker image and display the object. Marker used already registered on the website next Vuforia markers be inserted into the database of Unity software. The markersize used for this application is 21cm x 29.7cm (A4 paper size). Meanwhile marker testing divided into 2 (two) parts.

4.2.1 Distance Detection

Tests conducted to determine the distance detector to detect the level of the marker image with a certain distance. Testing is done how far the camera to detect the marker.

Table 3: Distance Marker Detection Test

No.	Distance (centimetres)	No. of Test	Correct	False	Test Result
1	15	10	10	0	Detected and Stable
2	20	10	10	0	Detected and Stable
3	25	10	10	0	Detected and Stable
4	30	10	10	0	Detected and Stable
5	35	10	10	0	Detected and Stable
6	45	10	10	0	Detected and Stable
7	50	10	8	2	Unstable
8	55	10	0	10	Not detected

From the experimental detection distance, there comes a time marker cannot know in because the picture is less clear marker captured by the camera so that the camera can detect and stable when the distance between 20cm - 45cm.

4.2.2 Slope Distance Detection

Tests conducted to determine the distance detector detects the level of the marker image with a certain distance. Testing is done how much tilt the camera to detect the marker.

Table 4: Tilt Marker Detection Test

No.	Slope Distance (^{0})	No. of Test	Correct	False	Test Result
1	0	10	0	10	Not detected
2	25	10	7	3	Detected and Unstable
3	35	10	10	0	Detected and Stable
4	75	10	10	0	Detected and Stable
5	110	10	10	0	Detected and Stable
6	135	10	10	0	Detected and Stable
7	145	10	10	0	Detected and Stable
8	155	10	6	4	Detected and unstable
9	180	10	0	10	Not detected

From the experimental point of the camera to the marker, there is a time marker cannot know because the picture is less clear marker captured by the camera so that the camera can detect and stable when the distance between 35^0 - 145^0.

5 CONCLUSIONS

1. Leap Motion Controller when detect hand movements in these applications run properly and perform the movement of 3D animation.
2. The results of the calculation of the average value of 2,916 where the user agrees that the 3D human anatomy using Leap Motion Controller is a highly interactive system.
3. Leap Motion Controller can be used as tools for the manufacture of human anatomy recognition system, especially the lungs - lungs with the help of 3D augmented reality marker measuring 21 cm x 29.7 cm where the results are best when the camera detect the distance marker is 20 cm -45 cm, the camera also can be tilted in marker detection where the best angle results between 35^0 - 145^0.

For further research, it is expected the research that can improve the revision of the Leap Motion Controller tool. So when in use, the display can be more in line with the movement of the user's movement. Conformity users with hand gestures displayed by the 3D system can help the ease learn gestures found on the system. In addition, the detailed matters of anatomy can also be developed based on the organs function. So the visualization of human anatomy using Leap Motion Controller can be more detailed.

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