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DEVELOPMENT OF HUMAN EXCRETION AUGMENTED REALITY SYSTEM USING MOTION LEAP

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ABSTRACT

Excretory system in humans is the subject matter level of high school biology class XI. This material discusses the constituent organ ekrsi system, the process of excretion of each organ and diseases - diseases of the organs of the human body. According to data obtained by the interview to one biology teacher at SMAN 1 Cicalengka Tina's mother Tatiana, the current curriculum that runs in SMAN 1 Cicalengka is the curriculum in 2013 where in the curriculum this 2013 wearing a learning model Project Based Learning where learning patterns to approach scientific (scientific approach), where the teacher is stressed to provide materials based iT and teachers as facilitators to be observed by students, while teaching and learning activities that are currently running, namely the teachers convey the material by using a slide presentation, while the availability of props (torso) were there has limited the number and function.

This application is a desktop-based application uses augmented reality technology Leap Motion, which created the application will display 3D objects on the organ system compiler ekresi and disorders - disorders in the organs ekresi system and there is also a video to clarify the existing material. To increase interaction Augmented Reality application is used a tool Leap motion. The use of gesture that is used in this application include Key gesture tap, grab, circle and swipe. Applications built using the tools Openspace3D as editor, 3dsMax 2010 to create a 3D object, Adobe Flash CS3 to create the application interface, and Movie Maker to make its video and audio. Application testing is done using blackbox, interviews and questionnaires.

The results of this study can be concluded that the application of multimedia presentations using augmented reality based learning tool for the Leap Motion ekresi system in humans are built sufficient assist teachers in presenting material ekresi system and can be the development of Augmented Reality technology, more interactive using the Leap Motion. Teachers also felt it was very interesting learning applications for use with augmented reality technology and Leap Motion technology which, according to them, including a new category of technology that they know.
Keywords: Human ekresi System, Leap Motion, Augmented Reality, Handtracking, gesture Leap Motion

1. Intoduction

Excretory system in humans is the subject matter level of high school biology class XI. This material discusses the constituent organ excretory system, the process of excretion of each organ and diseases - diseases of the organs of the human body. According to data obtained by the interview to one biology teacher at SMAN 1 Cicalengka Mrs. Tina Tatiana, the current curriculum that runs in SMAN 1 Cicalengka is the curriculum, 2013 curriculum 2013 wearing a learning model Project Based Learning where learning patterns to approach scientific (scientific approach) is learning that consists of the activities to observe, formulate questions, and try or collect data and draw conclusions, to support this need for media interactive learning to attract students to the material, but the availability of props (torso) that there has limited the number and function, as well as in this model also teachers emphasized to provide materials based iT but to provide teaching materials based iT teacher is sometimes difficult to provide teaching materials, teachers simply deliver the material using presentation slides alone so that the students are less active in teaching and learning activities , Augmented Reality (AR) is an innovative technology in improving the interaction between man and machine that specifically provides an interface for users. It is hoped the technology will help teachers in teaching and learning in class, so that the learning process becomes more interesting and there is interaction of students to the material.

Given the teachings of the new curriculum, SMAN 1 Cicalengka required to implement the technology in the school to assist and support the teaching and learning process in academic affairs. Leap Motion (Hand Motion tracking) is the term for recording hand movements into digital models used and an additional device that can be connected to a

computer and can then be used to replace the mouse and keyboard. The function of a tool called Leap Motion, can help users to control or replace the mouse and keyboard tasks on a computer just by the movement of hands and fingers. Leap Motion tracking tool in the palm of the hand in the augmented reality system. The case study is used to implement Augmented Reality system ekresi system in humans in real time Using the Tools Leap Motion as interksi users to be more interactive.

1.1 *Augmented Reality*

Augmented reality (AR) or in Indonesian called augmented reality is a technology that combines the virtual object and the two-dimensional or three-dimensional into a real environment and then projecting the virtual objects in real time. Virtual objects function displays information that can not be accepted by humans directly. This makes augmented reality useful as a tool to help its perception of and interaction with the real world. Information displayed by virtual objects helps users carry out activities in the real world. By definition Ronald Azuma (1997), there are three principles of augmented reality. The first is augmented reality are merging real and virtual world, the second run interactively in real-time (realtime), and the third contained antarbenda integration in three dimensions, namely integrated virtual objects in the real world [3].In the current development of augmented reality is not only visually only, but it can be applied to all the senses, including hearing, touch, and smell. Besides being used in fields such as medical, military, industrial manufacturing, augmented reality has also been applied in devices that people use a lot, such as on mobile phones.

There are many definitions of augmented reality but the general assumption is that augmented reality allows perspective enriched by superimposing virtual objects in the real world in a way that invites the audience that the virtual object is part of the real environment. Therefore, augmented reality is a fusion between the real world and the virtual world, as illustrated by the famous diagram Reality-Virtuality Continuum.
Some definitions insist augmented reality virtual object is a type of 3D models, but most people accept the simple definition in which the virtual world is composed of 2D objects such as text, icons, and images. There is a lack of clarity in the definition of further wherein multimedia content (video or audio) and visual search capabilities is promoted as an augmented reality application.

In making the AR using a webcam as a device to capture the image. Before the image is converted into digital form, the digital image manipulation process can not be done. Digital image (f (x, y)) has two elements. The first element is a power source of light that surrounds our view of objects (illumination). The second element is the amount of light that is reflected if the object into our eyes or also called reflectance components. Both elements are written as a function i (x, y) and r (x, y) [2].

1.2 *Motion Tracking*

Motion Tracking is a term used to describe the movement recording and understanding these movements into digital models. Motion tracking is simulated as a photogrammetric analysis tools in Biomechanics research in the 1970s and 1980s, and extends into the realm of education, training, sports, and just to the realm of computer animation for television, cinema, and video games. The term Hand Motion Tracking is one term for one implementation techniques tracking and motion, where the tracking process is done on the object by human hands, Hand tracking can be implemented in many ways and fields, such as may be used to recognize sign language and can be used to be a technique the interaction between humans and computer-based vision and so forth. The human hand is a mechanical structure complex consisting of several segments of bone, ligame-ligaments that connect between segments of bone freely, the muscles that act as the motor motion, the tendons that act to connect muscles to bones, and skin, and nerves are fine which envelops the muscles and bones. The bones are connected on pesendian and does not change its size. The muscles produce propulsion and move the joints. Based on the type of motion and rotation possible, the joints in the human hand can be classified as flexion, twist, directive, or spherical. Examples of joint flexion type with 1 DOF is the knees and elbows, while examples of type joints twist with 1 DOF is a joint pronation of the forearm. Movement of the joint directive by 2 DOF produce flexion movement in the direction of more than 2. Joints spherical, as in the shoulder joint, has 3 DOF and can make a move and twist simultaneously Directive [4].

1.3 *Gesture Understanding*

Human interaction and communication with the machine through the use of gesture may be one way to increase comfort in the process of interaction between man and machine, especially when the interaction model is presented based on 3-dimensional space. Gesture understanding to model the movement of the hand can be grouped into two general definition, the first movement of gesture (hand) as the representation of the movement of a character in the game, the second is the gesture as a controller and users of the application / system. For example, when someone wants to start a system or application by using the mouse or keyborad, this process can be replaced in a gesture motion that

gives the same meaning, one example is the use of Tapgesture, swipe gesture, and so forth. so it depends on which definition is applied to a system. Model Interaction gesture can be divided into two groups, namely: a) The model of interaction gesture-based patterns shape gesture, where the system works by capturing an image and recognize the gesture of identification forms, one example on the gesture by hand pattern in which the detection of hand gestures with hand pattern captured by leap motion controller in accordance with the pattern of movement of the user's hands , Movement patterns gesture, a gesture which was captured by reading the signal generated from sensors that have been installed, one example is described in which the movement of gesture based user hand motions read based on the direction and movement patterns.

1.4 *OpenSpace 3D*

Openspace3D is an editor or manager open source scene. Openspace3D can create applications games / 3D simulation easily without engaging directly with programming. Openspace3D act as a scene manager and editor in setting the scene. Users only need to enter the required resource such as 3D graphics in the form of an ogre mesh, material, texture and other multimedia including audio and video. To avoid difficult programming, OpenSpace3D provide a relational relationships between objects consisting of plugins that are complete enough to make a good 3D simulation applications, augmented reality or game and many more features that are provided by this Openspace3D applications [2].

This application is based OpenSpace3D Scol programming language, which is a programming language that comes from France and has recently developed. OpenSpace3D using OGRE 3D graphics engine that has quite a lot of the community but not in Indonesia. OpenSpace3D weakness is his output are not compatible, to run the application, are required to install SCOLVOY @ GER, which is a runtime of Scol [11]. There is a reason why you should install Scol, because actually Openspace3D devoted to the browser, so applications or simulations created can be displayed on a personal website, though the latest version of OpenSpace3D been providing facilities to create an executable file so that it becomes an app stand alone for Windows. Another plus of OpenSpace3D is compatibility with other multimedia files such as Youtube Video, Chat, Mp3, Wav, SWF and others. OpenSpace3D also supports input from the joypad controller, keyboard, mouse, joystick Nintendo Wii, and also voice controller [7].

1.5 *Leap Motion*

Leap Motion Controller is a computer hardware sensor device that supports the movement of the hand and fingers as input, which can be likened to function like a mouse, but does not require direct contact with hands or touch. Leap Motion Controller sometimes abbreviated to Leap Motion. However, the definition of Leap Motion can also mean the company that issued the Leap Motion Leap Motion Controller. Thus the form of a motion sensor device that is the next hand will be called Leap Motion Controller. Leap Motion Controller is an interesting tool. Due to their small size, these tools can be easily placed on the desktop or laptop or keyboard. In addition put on the table face-up (table-mounted), this tool can also be placed at the top of the head (headmounted) overlooking the front and bottom with the help of specific tools such as the Oculus Rift. Though placed in different side and and facing different directions, Leap Motion Controller will result in a permanent state of hand position parallel to the body of the user at the user interface.

1.5.1 *Features Leap Motion*

Initially, Leap Motion Controller can only observe the movement and the image of the hand as a whole, without regard to the parts of the hand in detail. After several development, Leap Motion Controller has finally been able to observe things more detail in the hand like a vertebra hand, left or right, the scale of the hand grip, and so forth. This development is called Skeletal Tracking also called V2. As for the features contained in Leap Motion Controller with Skeletal Tracking owned by Leap Motion (2015) are as follows: 1. Hand Model: hand model used after the development of V2 provides more complete information. The position of the hinge knuckles along turnover is more accessible and consistent. 2. Confidence Data: this feature detects when a hand is difficult to be observed by Leap Motion Controller. If one hand closer to the periphery of the screen or close to each other, the value of this feature will be dropped from one to zero. 3. Left or Right: observations mark the hand located on the screen whether the left or right. 4. Finger Type: observation supports the hand with five fingers composition that can be taken the value of the position and rotation of each. 5. Bone Positions: This feature returns the value of the position and rotation of each bone found on the palm and fingers do.

2. Research Content

Applications created a program to detect a marker while displaying a three-dimensional object . Objects created the organs associated with the human excretory system , so that users can interact directly with virtual objects in the real world are

presented with Leap Motion to control it as a medium of interaction.

2.1 Analysis Design Applications

The system will be built an augmented reality system using Leap Motion , how the design process from initial application initialization , take pictures , take the hand movements until the process of rendering 3D objects and control .



Image 3 Flow diagram

Information:

1. *Initialization*
   This stage meruapakan where the hardware will detect the availability of devices needed (Leap Motion) and camera .
2. *Leap Motion took a hand gesture*
   At this stage , leap motion will detect movements through the tracking area .
3. *Tracking Hand*
   After the leap motion capture movements that pass through its tracking area , then the next stage of the leap motion will mentracking or recognize the right hand and left hand for defining gesture given / diperintahan by the user .
4. *The camera takes pictures*
   At this stage , the camera will capture the image directly from the real world .
5. *Tracking marker*
   This stage of the marke tracking system used then matched with a marker that is in the database .
6. *View and control the 3D object*
   Once the marker is detected will dimuculkan 3D objects and can be controlled by hand using Leap Motion

2.2 Analysis Marker

Marker is a very important part . Design marker should not be done haphazardly , there are rules that must be met in designing a marker .
Marker supplied in OpenSpace3D 1.1.0 software amounted to 1024 in total starting from marker to marker number numbers 0 to 1023, from markers that have been used in the design of applications that Marker id with the numbers 0, 1 , 2 , 3 , and 5 , marker- the marker can be saved as an image file with the extension .bmp or .jpg file, it is stored is to open (double -click) one by one PlugIT AR marker , and press the Save button located next to the image marker after it put all the image files in one folder to facilitate search those files .

2.3 *Multi Marker*

Multi marker is a marker -based tracking technique that uses two or more markers to manipulate an object . This is one way interaction to manipulate virtual objects that seemed to be in the real world .
In the multi- marker system will be implemented techniques to reduce the amount of position error that occurs by means of 3D objects relate with many markers . This can be done by specifying a reference point of some markers that are detected . This technique can reduce the error value system position if the majority of marker is not detected or the process of tracking its unstable .
At this stage , will look for a model with a multi-marker parameter settings such as :

a. *number marker*
b. *The size marker*
c. *The distance between marker*

The implementation of multi marker has two types: static and dynamic . Static markers used for tracking objects dynamic cameras and other markers used to manipulate objects .

2.4 Analysis Functional Requirement

Analysis of functional requirements is modeled using UML (Unified Modeling Language) . Where the stages of the design is done in building applications based learning multimedia presentation augmented reality for the circulatory system include a Use Case Diagram , Class Diagram , Sequence Diagram and Activity Diagram.
a. Use Case Diagram
Use Case Diagram is a model for the behavior (behavior) information system that will be created . Use case describes an interaction between one or more actors with the information system will be made [10] .
Here is the design of the processes contained in the application -based learning multimedia presentation augmented reality for the human excretory system to make use of Leap Motion , which is illustrated with Use Case Diagram that can be seen below :

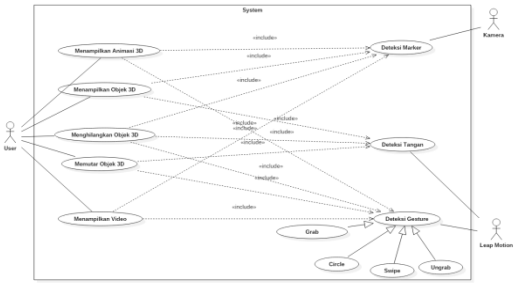


Image 4 ***Use Case Diagram***

a. Activity Diagram

Activity diagram or Activity diagram illustrates the workflow (workflow) or activity of a system or business process [8] . Depictions activity diagram resemblance to the flowchart diagram . Activity diagrams model the events that occur in the Use Case and used for modeling the dynamic aspects of the system.

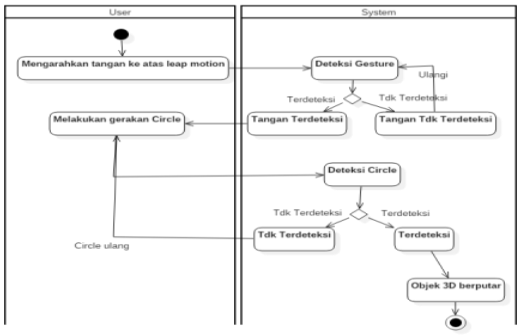


Image 5 ***Activity Diagram*** **AR** ***application***

b. Class Diagram

The class diagram or class diagram illustrates the structure of the system in terms of defining the classes are made to establish a system [10]. Here is the design of the system structure contained in the application AR excretory system in humans are depicted with Class Diagram that can be seen on the next page .

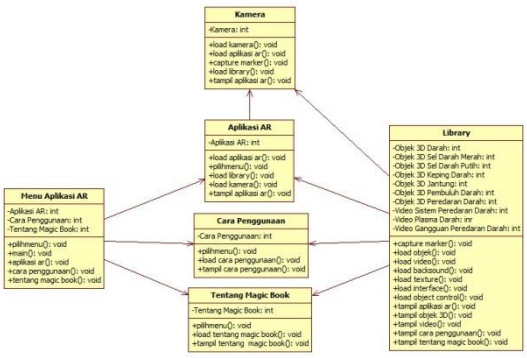


Image 6 ***Class Diagram*** **AR application excretory system**

c. Sequence Diagram

Sequence diagrams or sequence diagrams describe the behavior of objects in use case by describing the life time of the object and the message that is sent and received between objects [8] .

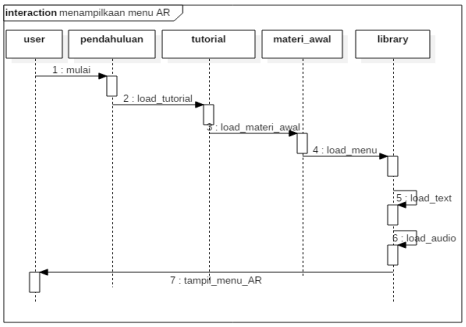


Image 7 ***Sequence diagram*** **AR** ***application***

2.5 Designing Interfaces

The designs are made in the form of a desktop - based application that is easy to use by the user , as well as the application of information generated can be understood by users . Interface design aims to provide an overview of the application. Three-dimensional object is an object to be displayed on a marker that can be viewed by the user with the help of a webcam and can dikonrol ole Leap Motion.

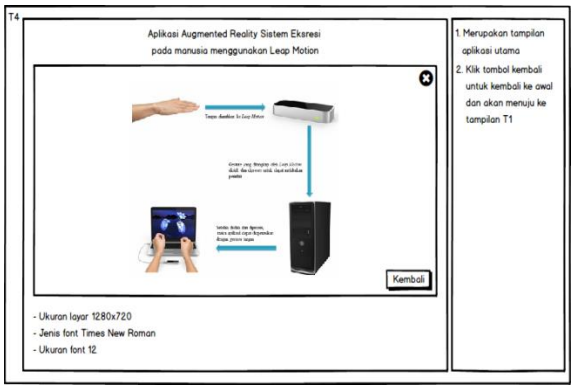


Image 8 Interface Application AR Circulatory System

2.6 Implementasi Antarmuka

At this stage, the application interface design results into applications built using software that has been described in section software implementation, listed in the figure below and to the interface can then be viewed on :

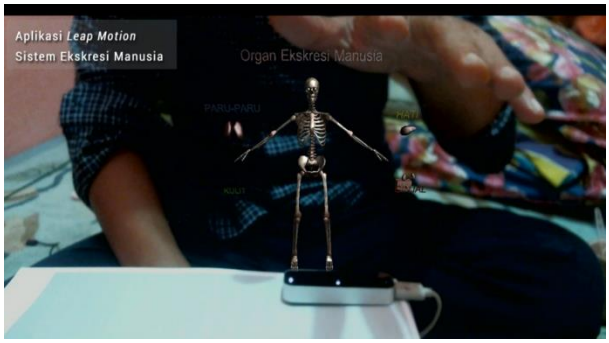


Image 9 Tampilan Antarmuka Menu Utama

3. *Closing*

Based on the results of research , analysis , system design and implementation as well as testing , we concluded that : 1. In accordance with the results of interviews and questionnaire of Augmented Reality Application materials ekresi system in humans , this application can petrify teachers in teaching and learning. 2. In this application of Augmented Reality technology can be implemented on learning materials ekresi system in humans . 3. In this application and Augmented Reality technology Leap Motion technology coupled to and implemented on human ekresi system materials.

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