

Development of Interactive Simulation Game Cleaning the Trash Using Leap Motion Controller

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Abstract: Trash is one of the causes of environmental degradation in a wide range of regions including Indonesia. Anticipate for community not littering is by education about waste management at an early age is to use modern learning system and applicable to attract children. One way is to play educational games that are supported by technology to improve user interaction so that the material presented can be understood by way of interest. Leap motion controller is a computer hardware sensor device that supports the movement or gesture hands and fingers as an input function which can be equated with the mouse or keyboard. This interactive game is a game to sort organic and non-organic by taking control of beach environment with the main input from the game. Based on the results of tests and questionnaires to the beta tester, game simulation environment with the theme of waste sorting can be inferred that the user is very interested in the application of the control of leap motion controller on the game but the level of difficulty controlling the object is very high and the accuracy of the control of leap motion controller are still low.

Key words: Interactive games, leap motion controller, educational games, trash organic, non-organic

INTRODUCTION

The environmental destruction has been globalized. It affects climate change, the emergence of a disaster, the appearance of various diseases as well as the survival of humans, animals and plants along with their species. One of the causes of environmental degradation that is rubbish. Trash is currently a key issue in many countries, especially in the Indonesia. Waste is a part of our daily lives. The average daily big cities in Indonesia generate tens of tons of trash. To resolve this global problem needs to their attitudes and human behavior with environmental sensitivity. Human behavior can be shaped through education. According Nurjani (2009), environmental education is needed and should be given to children early so ingrained in children up to adulthood so that they understand and do not damage the environment. Children can gain an insight into the environment at home and at school in accordance with the existing curriculum.

Today, the technology was growing and has penetrated into the various fields in the form of digital media. Animation is one of the entertainment media that are preferred people to eliminate boredom or just to spend leisure time. According to Arsyad (2011), the animation has the potential to enhance the learning process becomes more effective because humans have basic properties more quickly learn everything visually.

Based on the background, the objectives of this research is developing interactive games related by to dispose, sorting and waste management with the leap motion controller. To support the delivery of game experience simulations using leap motion is used as a means of control. This tool has the potential to facilitate new ways of improving learning computers is to improve interaction. Games are packaged in the form of interactive multimedia, teach concern for the environment that make players play to remember to keep the environment in good condition.

Leap motion controller: Leap motion controller is a computer hardware sensor device that supports the movement of the hands and fingers as input which can be likened to function like a mouse but does not require direct contact with hands or touch (Yowanda *et al.*, 2014). Leap motion controller sometimes abbreviated to leap motion. However, the notion of leap motion controller can also mean the company that issued the leap motion leap motion controller. Thus, the tools that form this hand motion sensor hereinafter will be referred to leap motion controller.

Leap motion controller is an interesting tool. Due to its small size, it can easily be placed on the tabletop or laptop or keyboard (Nowicki *et al.*, 2014). In addition put on the table by overlooking table-mounted this tool can also be placed at the top of the head (Head-Mounted) facing forward and down with the help of specific tools

such as the oculus rift. Although, placed on different sides and facing different directions, leap motion controller in a state of permanent would produce hand position parallel to the body of the user at the user interface.

As a tool of sensors, leap motion controller has some tools in it to observe. The tools in the form of the IR camera and the three infrared monochromatic LED. With these tools, leap motion controller is able to observe the hand movements in the hemisphere-shaped range with a radius of 1 m. The distance of this range will make the region as a box adapted to the screen. Distance range itself can be formed into a class named interaction box in its application programming interface. Besides interaction box there are also other classes used in the application programming interface, especially in the manufacture of systems using leap motion controller.

MATERIALS AND METHODS

The concept of this game is the story of both brother who want to play on the beach but the beach is dirty with trash. Simulated player as older brother will clean up the trash and sorting organic and inorganic trash. Player have to sort out the trash and put it into the correct bins, if true will be added points, if one of the points will be reduced.

In designing a game with the theme of care about the environment, it is used 3D asset, besides adding the quality of experience in picking up trash, 3D assets can also stimulate player in organizing of understanding of the space. Assets of 3D is divided into two types: low poly and high poly. Low poly used in while the high poly game that has quality visual finer used at the beginning of the animation. Game asset production consists of making the characters and it environment. Character creation blueprint created in 2D hand drawing used as a reference in the picture process modeling as shown in Fig. 1. The blueprint is imported into the 3D modelling software and adjusted its position in accordance with the blueprint that easier to create character modeling as shown in Fig. 2. The method used in making the character models is constructive solid geometry.

After the characters created in 3D, the next process is the manufacture of rigging which is made of bone character and bone paste is made to the body of a character called skinning. In the process of rigging, bone-making required to make bone in a character corresponding body character. Rig must be made according to the joints that of the character as shown in Fig. 3.

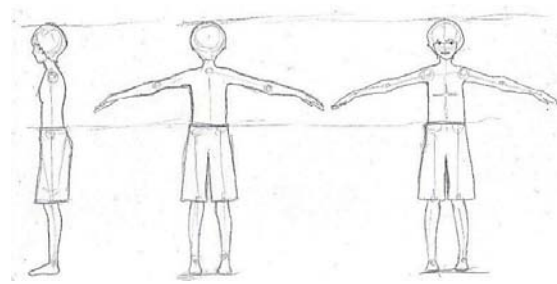


Fig. 1: Sketch of the game character

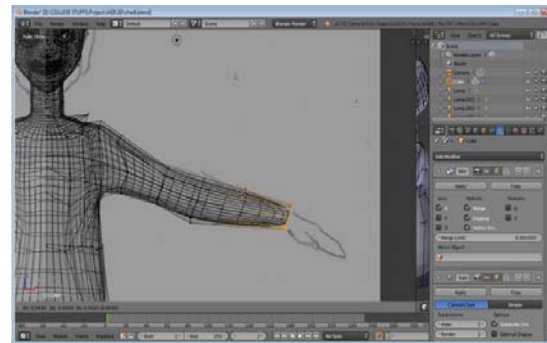


Fig. 2: 3D character modelling



Fig. 3: Character rigging process

After the rigging process is finished, the next stage is to move every part of the body or determine the desired poses refers key pose according to storyboards that have been made. One important body movement is walking motion (walk cycle) as shown in Fig. 4. After the

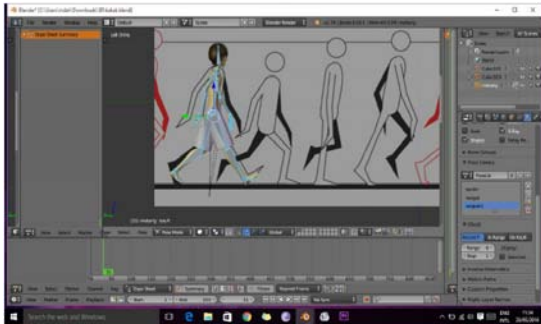


Fig. 4: The process of walk cycle

animation process is done correctly, the final stage is the process of rendering. After the rendering process is completed, the stage of making asset games and animated characters the game had been completed, the next stage is to make a game interactivity by using Leap Motion Controller (LMC) as the controlling hand movement game characters who have made. Leap motion controller is a sensor hardware a computer that supports the movement of the hands and fingers as input and can be like to function a mouse but does not require direct contact with hands or touch. At the time the game is run, the user can perform the activity that was taking the trash out of the air where the object detected gesture LMC user's hands on the game. Gesture is read by LMC sensor that uses two IR cameras monochromatic and three infrared LED. This instrument observed surface shaped like a hemisphere on top of it with a distance range of approximately 1 m.

As shown in Fig. 5, the LMC is connected to the computer with a USB cable. LMC to connect with the windows operating system, it is necessary to install the leap motion sdk for the windows platform. After that users need to perform initial calibration at LMC with the user's hands. If you have to install LMC SDK, users can open the game application executable form (.exe) and follow the instructions of the game. Flow overall game can be seen from the flowchart (Fig. 6).

In the realization of this simulation game used the game engine unity 5. To connect the control input of the Leap Motion into the game engine, required asset module for unity provided by leap motion is unity core assets in the form of unity package. On the game development of this application which is used is unity core assets V.4.1.1. Such assets need to be imported into unity manner custom package import into unity. Unity within the core assets there are some script modules are available in c# that can be used as a module to provide input commands from leap motion controller (Fig. 7). The function takes the object using a script magnetic pinch on the unity asset core. Game object waste must be given a script for the collision.



Fig. 5: Leap motion flow device

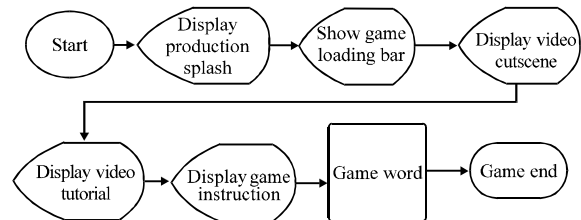


Fig. 6: Flowchart of the game

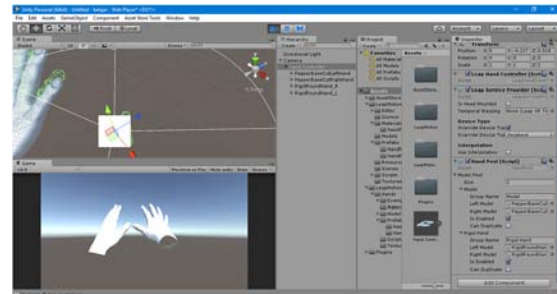


Fig. 7: Result of hand gesture implementation

The script used in to leave a collision between the object and the trash is hand rigid body and collider. Box collider function to create an object becomes solid so as to have a component that can receive the collision (collision with other objects). Rigid body function to create an object has the body in this case as a human that has a weight that has the force gravitation.

Functions for give score on trash right and wrong in this function, if game object trash bins collide with similar, then the score will be awarded 2 points. The following snippet of his script.

Script functions for scoring:

```

// init variable
setting-var = GetComponent<global-setting>();
score-ui = setting-var .score-ui;
point correct = setting-var .pointCorrect;
minuswrong = setting-var .minuswrong;
score-ui .text = "" + total-score;
}
a
//update is called once per frame
void update ()
  
```

```

{
}

public int get current score ()
{
return total-score;
}

public void updatescore(gameobject gameobject, string tipesampah)
{
    tipesampah tipesam =
gameobJect.gameobJect.get component<tipesampah>();

    if (tipesam != null)
    {
        if(tipesam. Tipe == tipesampah)
        {
            Total-score+= point correct;
            Score-ui.text = ""+total-score;
        }
        else
        {
            total-score-= minuswrong;
            Score-ui.text = ""+total-score;
            Destroy (gameobJect);
        }
    }
}

```

RESULTS AND DISCUSSION

Tests are performed with the black-box testing, according to Pressman (Rogers, 2015). Black-box testing focuses on functional requirements. This test aimed to test the feasibility of an application based on the features and specifications stipulated in the design. The features and functionality in these applications must be tested first before being tested for beta testers.

Control test leap motion controller this test is done to check whether the control takes the object at leap motion controller on the interaction of this game is quite good (Table 1).

After testing the technical on leaf motion controller, further beta testing involving 30 person beta testers are picked at random. Beta testers are asked to play a game of one-time and after the play testers were asked to fill out questionnaires. The results of the questionnaire used for the analysis results with a success rate of players control the input and interaction. In this test there are five questions posed to beta testers as indicators of assessment is as follows.

Question to beta tester:

- Q1: How interesting do you think about the use of leap motion controller as input control game?
- Q2: How difficult was it you control the game by using leap motion controller?
- Q3: How effective accuracy rate feedback control input leap motion controller on this game?

Table 1: Experimental results of pinch detector

Number of experiments	Game object	Status
1	Apple	Pass
	Bottle	Failed
	Hen	Pass
	Paper	Failed
2	Apple	Failed
	Bottle	Pass
	Hen	Pass
	Paper	Failed
3	Apple	Pass
	Bottle	Failed
	Hen	Pass
	Paper	Pass

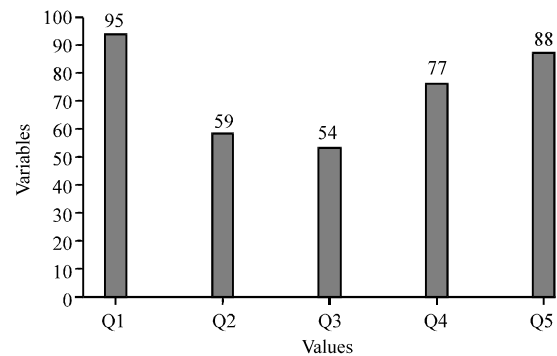


Fig. 8: Percentage of beta testing

- Q4: How high the interactions that occur between games with you (if you feel a very deep interaction with the game)?
- Q5: How helpful is the development of the game controls leap motion controller with the community?

The calculation of results of the questionnaire are calculated by Likert scale is a scale used to measure perception, attitude or opinion about a person or group events or social phenomena, based on the operational definition a predetermined. Figure 8 percentage calculations aim in order to determine the level of interest in the rating obtained from each question questionnaire which can be found by using the following Eq. 1:

$$Q_n(\%) = \frac{Q_n}{\text{Index scale}} \times 100 \quad (1)$$

The average scale score for Questions No. 1 (Q1) is 4.7:

$$\begin{aligned}
 Q_1(\%) &= \frac{Q_n}{5} \times 100 \\
 &= \frac{4.77}{5} \times 100 \\
 &= 95\%
 \end{aligned}$$

Having obtained the results of all the questionnaires to beta tester then these values are represented in the following chart (Fig. 8).

CONCLUSION

Based on the results of tests and questionnaires to the beta tester, game simulation environment with the theme of waste sorting can be inferred that the user is very interested in the application of the control of leap motion controller on the game but the level of difficulty controlling the object is very high and the accuracy of the control of leap motion controller are still low.

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