User Experience in using VIVE Controller as a Controller in Anatomy Learning System in Virtual Reality Environment

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Abstract – Anatomy is not only can be learned by reading a text book, but also by using an interactive system, such as virtual reality. In this paper, an anatomy learning system using VIVE Controller has been developed. User agreement survey and user satisfaction surveys are required to determine the interactivity level of VIVE Controller in the system. The result of this research shows that users agree that using VIVE Controller in anatomy learning system in virtual reality environment is very interactive with an average score of 4.33. The result also shows that users are satisfied using VIVE Controller in this system.

1. Introduction
Anatomy is difficult to be learned by using a text book only [1]. A multimedia system can become another way to learn anatomy besides using a text book [2,3]. The Virtual reality system is one of multimedia systems that can be used to help to learn anatomy. Virtual reality is not only a tool for playing an interactive game [4]. Virtual reality can improve the immersive level of a learning system. By using virtual reality, the interactivity level to learn anatomy can be improved.

An anatomy learning system in virtual reality can be presented with a 3D human body [5]. The user is required to choose one of the anatomy objects models that are represented in 3D virtual reality environment and the system will show the chosen object name. In this paper, we narrowed down the anatomy objects only to show a human skeleton and naming the anatomy objects based on anatomy book [6].

Another feature that can improve the interactivity level of anatomy learning system is haptic feedback. Haptic feedback, such as vibration, can give a good impression to the user while using the anatomy learning system. This feature can be implemented by using VIVE Controller. VIVE Controller is a wireless controller from HTC VIVE that observed by a base station or lighthouse [7]. The base station observed the position of VIVE Controller and sent it to the computer [8]. This observation is based on the flash gap between the base station to the virtual reality headset and controller [9]. VIVE Controller also has haptic feedback such as vibration. VIVE Controller also a wireless controller that can move freely. These features can improve the motor and sensory nerve of the user. This improvement will also improve the quality of learning anatomy in a virtual reality system.

In order to get determine the suitability of using VIVE Controller in anatomy learning system for user, research of user experience is required. In this paper, a survey to determine the agreement level and satisfaction level of the user using anatomy learning with VIVE Controller is proposed. The method...
to survey the user experience in this research is explained in section 2. The result of the survey in this research is shown in section 3. In section 4 the conclusion of this paper is presented.

2. Material and methods

In this research, an anatomy learning system using VIVE Controller has been developed. This anatomy learning system is running in virtual reality environment. Users can explore the human skeleton in any way they like. VIVE Controller works as the virtual hands in this system. Although it is called virtual hands, in this system the virtual hand models are the same as the model of VIVE Controller in the real world (Figure 1). These virtual hands will move according to the real VIVE Controller in the real world in real time. If the virtual hands touch the virtual anatomy object, the user can press the trigger button on VIVE Controller to grab the anatomy object. This grabbed anatomy object name will be shown in the text area.

A wireless controller, especially in virtual reality system, can improve the user interactivity level of the system but the user needs to learn how to use it. Learning a new tool can be difficult for some people. This research is intended to find out whether using VIVE Controller is interactive, easy to learn, or not. In order to do that, a survey of 30 respondents was being held. These respondents are students in University of Sumatera Utara with an age range of 17 to 25 years old. These respondents also never tried a virtual reality system before.

![Survey](image)

**Figure 1.** Developed anatomy learning system in virtual reality is being tested by a user.

Before testing the system, respondents will be explained how to use the system. After testing the system in 5 minutes, respondents required to fill a form of survey. This survey consists of several statements about user agreement level and user satisfaction level. These statements will be scored by the user. These are the following statements that are used in the survey of interactivity level of VIVE Controller.

1. Using VIVE Controller for anatomy learning in virtual reality environment is very interactive.
2. I feel easy to learn using VIVE Controller.
3. The virtual hand moves according to my real hands’ movement.
4. The vibration when VIVE Controller grabs an object is very interactive.
5. The combination of VIVE Controller and virtual reality headset is very good.
6. VIVE Controller is suitable to be the controllers of anatomy learning system in virtual reality.
7. Pushing a button on VIVE Controller to grab an object is easy to learn.
8. I was successfully grabbing an object that I wanted using VIVE Controller.

These are the following statements that are used in the survey of the satisfaction level of VIVE Controller.

1. I am satisfied using VIVE Controller to learn anatomy.
2. I am satisfied with the combination of VIVE Controller and the virtual reality headset.
3. I am satisfied with the virtual hands motion produced by VIVE Controller.
4. I am satisfied with pushing a button to grab an anatomy object.
5. I am satisfied with the vibration on VIVE Controller when grabbing an anatomy object.
6. I am satisfied with the button used on VIVE Controller to grab an anatomy object.
7. I am satisfied with the virtual hand models shown as a VIVE Controller.
For those statements, users required to give a score to each statement. The scoring system for those statements is presented in Table 1.

Table 1. Scores in User Agreement Level Survey and User Satisfaction Survey.

| Level of Agreement | Level of Satisfaction | Score |
|--------------------|-----------------------|-------|
| Strongly Disagree  | Very Dissatisfied     | 1     |
| Disagree           | Dissatisfied          | 2     |
| Agree              | Satisfied             | 3     |
| Strongly Agree     | Very Satisfied        | 4     |

3. Results and Discussion
The results of this research are average scores from each statement. There are 8 statements for user agreement survey and 7 statements for user satisfaction survey. These statements are made to take a measure of the user agreement and user satisfaction for using VIVE Controller in anatomy learning system in virtual reality environment. Table 2 and figure 2 present the result of user agreement survey. Table 3 and figure 3 present the result of user satisfaction survey.

Table 2. User Agreement Survey Result.

| No. | Statements                                                                 | Average Score |
|-----|-----------------------------------------------------------------------------|---------------|
| 1   | Using VIVE Controller for anatomy learning in virtual reality environment is very interactive. | 4.33          |
| 2   | I feel easy to learn using VIVE Controller.                                  | 4.53          |
| 3   | The virtual hand moves according to my real hands’ movement.                 | 4.27          |
| 4   | The vibration when VIVE Controller grabs an object is very interactive.      | 3.57          |
| 5   | The combination of VIVE Controller and virtual reality headset is very good. | 4.23          |
| 6   | VIVE Controller is suitable to be the controllers of anatomy learning system in virtual reality. | 4.13          |
| 7   | Pushing a button on VIVE Controller to grab an object is easy to learn.      | 4.33          |
| 8   | I was successfully grabbing an object that I wanted using VIVE Controller.   | 4.70          |

Figure 2. User Agreement Survey Result.
Table 3. User Satisfaction Survey Result.

| No. | Statements                                                                 | Average Score |
|-----|-----------------------------------------------------------------------------|---------------|
| 1   | I am satisfied using VIVE Controller to learn anatomy.                      | 4.17          |
| 2   | I am satisfied with the combination of VIVE Controller and the virtual reality headset. | 4.27          |
| 3   | I am satisfied with the virtual hands motion produced by VIVE Controller.   | 4.20          |
| 4   | I am satisfied with pushing a button to grab an anatomy object.             | 4.53          |
| 5   | I am satisfied with the vibration on VIVE Controller when grabbing an anatomy object. | 3.70          |
| 6   | I am satisfied with the button used on VIVE Controller to grab an anatomy object. | 4.10          |
| 7   | I am satisfied with the virtual hand models shown as a VIVE Controller.     | 4.03          |

Figure 3. User Agreement Survey Result.

As shown in both survey results, almost all of the statements reach a score of 4 which means the users agree with the statement or satisfied. In the user agreement survey, only statement 4 is the one that did not reach a score of 4. In the user satisfaction survey only statement 5 did not reach a score of 4.

4. Conclusion
In this research, an anatomy learning system using VIVE Controller has been developed. This research purpose is to determine how suitable is VIVE Controller used in anatomy learning system in virtual reality environment. By following the result in section 3, we can conclude that VIVE Controller is suitable to be used in anatomy learning system in virtual reality.

The user agreement survey presents that users agree that VIVE Controller is very interactive in anatomy learning system. Also, the average score of ease to learn using VIVE Controller reached a score of 4. Although the trigger in VIVE Controller is pressing a button, users agree that triggers can be used in anatomy learning system. The only thing users did not fully agree is the vibration as haptic feedback in VIVE Controller can improve the interactivity level. The highest score in user agreement survey is users can grab the anatomy object that they wanted, which reached a score of 4.70.

Users mostly satisfied with VIVE Controller in anatomy learning system in virtual reality environment. The average score in user satisfaction survey presents that users are satisfied with the movement of the virtual hands produced by VIVE Controller. The only thing that users did not satisfied
is the vibration on VIVE Controller. Button to trigger the grabbing hand and VIVE Controller hand models are still satisfying the user.

From both surveys, vibration as haptic feedback on VIVE Controller did not reach a score of 4. This means not all users agree and satisfied with the vibration on VIVE Controller. In the future, a new controller that can get better use of vibration is required to improve the interactivity level. This new controller also has to keep the good points of VIVE Controller.

References
[1] Notebaert, A. 2009. Student Perceptions about Learning Anatomy. University of Iowa. http://ir.uiowa.edu/etd/312 (accessed on June 17th, 2015).
[2] Sugand K, Abrahams P, Khurana A. 2010. The anatomy of anatomy: a review for its modernization. Anat Sci Educ. 2010 Mar-Apr; 3(2):83-93.
[3] Hoyek, N., Collet, C., Guillot A. 2011. Experimental Research Validation for the Use of 3D in Teaching Human Anatomy. Université Lyon 1.
[4] Garbaciauskas, Simonas, Moesgaard, Tomas G., Nielsen, Mads H., 2016, Interaction Methods for Virtual Reality Installations in Museum Environments, Master Thesis at Aalborg University Copenhagen.
[5] Nainggolan F L , Siregar B and Fahmi F 2016 Anatomy learning system on human skeleton using Leap Motion Controller In Computer and Information Sciences (ICCOINS), 2016 3rd International Conference on (pp 465-470) IEEE
[6] Sobotta. 2001. Sobotta Atlas of Human Anatomy. 13th Edition. Urban & Fischer: Munich.
[7] Niehorster, Diederick C., Li, Li, Lappe, Markus, 2017, The Accuracy and Precision of Position and Orientation Tracking in the HTC Vive Virtual Reality System for Scientific Research.
[8] Kreylos, Oliver, 2016, Lighthouse tracking examined, http://doc-ok.org/?p=1478 (accesssed on 17 October 2019).
[9] Borrego, Adrian, Lattore, Jorge, Raya, Mariano L. A., Llorens, Roberto, 2018, Comparison of Oculus Rift and HTC Vive: Feasibility for Virtual Reality-Based Exploration, Navigation, Exergaming, and Rehabilitation.