Journal of Management Research and Studies
https://jmrs.optima-science.com/index.php/jmrs

ISSN: 3024-8396
Vol. 3, No. 1, January - June (2025)

Management of Virtual Reality Application Usage: A Comparison of Usability and Immersiveness through Controller-Based and Hand Gesture Interaction Methods

Bianca Pingkan Nevista[1], Herman Tolle[2], Fitra A. Bachtiar [3]
[1,2,3]Master Program in Computer Science, Universitas Brawijaya, Indonesia

ARTICLE INFO

JEL Classification:
J24, M54, O15

Corresponding Author:
Bianca Pingkan Nevista

Received: *01-02-2025*
Revised: *10-02-2025*
Accepted: *19-02-2025*
Published: *28-02-2025*

Keywords:
Usability, Immersivity, Usability Testing, Igroup Presence Questionnaire

Abstract

Natural User Interface (NUI) is the latest development in the world of interaction between humans and computers that can be applied to immersive digital technology and realized in virtual reality. Virtual reality (VR) is usually accessed using VR headsets, so there are several companies that develop and improve VR headsets to facilitate interaction between humans and computers. This study was conducted to compare the usability and immersion of the two interaction methods on the Meta Quest 2 VR headset. The test was carried out at a Vocational High School (SMK) in Malang Regency majoring in Visual Communication Design (DKV) which had never used a VR headset before. There are two methods used, namely, Usability Testing to measure usability and the Igroup Presence Questionnaire (IPQ) method used to measure immersion. The applications used in this study are the Waltz of The Wizard Game, The Walking Dead: Saints & Sinners Game and Virtual Reality-Based Applications as Educational Media for Cultural Heritage Buildings in Malang City. The results of usability and immersion tests show that in the Waltz of The Wizard game, the hand gesture gets a high coefficient value of 0.136 and 0.096 on the controller. Meanwhile, in The Walking Dead: Saints & Sinners, the controller gets a high coefficient value of 0.398 and 0.171 in the hand gesture. And in the Cultural Heritage Application, the hand gesture gets a high coefficient value of 0.065 and 0.055 on the controller.

1. INTRODUCTION

Natural User Interface or often abbreviated as NUI is defined as a new approach or system in the world of interaction between humans and computers where the user operates a computer or technology using input from natural behavior or movements carried out by humans on a daily basis. The purpose of this NUI is to provide more intuitive interaction to help reduce the barrier between humans and computers (Brandon, 2020). In addition to this, NUI also has an innovative form of interaction because it can be done through natural movements of the human body such as touch

screens, recognition of body movements and sounds, and tracking using views (Guerino et al., 2020).

The technology that can be applied to use NUI is called immersive digital technology. Immersive digital technology or often also called immersive technology is technology that blurs or brings together the boundaries between the physical environment and the virtual environment, so that users feel a feeling that seems real and are able to interact in the virtual world. This technology is often manifested in the form of virtual reality (Nussipova et al., 2020).

Virtual reality or often abbreviated as VR is a three-dimensional (3D) virtual environment generated by a computer that can interact with the user, usually accessed using a headset used or mounted on the head, called a VR headset (Hamad & Jia, 2022). There are several companies that produce VR headsets such as Oculus VR, HTC Vive, and Sony Playstation VR. VR headsets have undergone many developments to make it easier to interact between humans and computers, one of which is by developing and improving the VR headset itself. One of the best VR headsets available for beginners and professionals alike is the Meta Quest 2 (Metanesia, 2022). This VR headset can be used with two inputs, namely a controller and a hand gesture so that the user feels that there are no boundaries between humans and computers in accordance with the NUI concept described above (VRStation, 2022). When using a controller, users need to learn and understand how to use the controller first, it can cause users to feel more rigid when using it and make users only focus on the controller. Meanwhile, in hand gestures, users can directly use hand gestures because this method uses hand gesture input, but when using hand gestures there is a possibility of inaccuracies when recognizing hand movements made by the user (Lorenzis et al., 2023).

Based on the above explanation, this study was conducted to compare usability and immersion between two different interaction methods, namely controllers and hand gestures on the Meta Quest 2 virtual reality headset. What is meant by usability is the convenience of the user and the level of comfort felt by the user when using the virtual reality application with the interaction method. Meanwhile, immersion is to measure whether users feel as if they are in a virtual environment (Supriyatna, 2019). The test was carried out at one of the Vocational High Schools (SMK) in Malang Regency majoring in Visual Communication Design (DKV) which had never used a VR headset before. In addition, the test was carried out in the case study because in the Visual Communication Design department there are subjects related to game design, so it is hoped that with this test students will understand more about the design of the game so that the game is easy to use by users. The students were divided into 3 groups, namely the group that used controllers, hand gestures, and those who used both. The test was carried out by each group playing three VR applications, namely Waltz of The Wizard in the adventure genre, The Walking Dead: Saints & Sinners in the action genre, and the Malang City Cultural Heritage Application in the exploration genre, using a predetermined interaction method, then after that students will be asked to fill out a survey questionnaire.

The purpose of this test is to find out the comparison of usability and immersion when a group of users tries the VR application using a controller or hand gestures alone

or both. So that the results of this study can also determine the optimal form of control for the use of hand gestures as a manifestation of NUI. This study was also conducted to compare previous research with current research, in general the difference that can be seen is that this study compares usability and immersion in virtual reality applications with Controller and Hand Gesture interaction methods, making an important contribution to understanding the differences between the two methods. This allows for better development of VR applications by considering the influence of interaction methods on the user experience. The method used to collect usability data is the Usability Testing Method, while for immersion is the Igroup Presence Questionnaire (IPQ) Method.

2. LITERATURE REVIEW

Natural User Interface

Natural User Interface or abbreviated as NUI has emerged and developed as one of the main components that are often used by electronic consumers in several years. NUI is used for natural movement without the use of specific devices or tools such as mice, keyboards, and pens (Chae & Kim, 2022). NUI applies the principles of natural behavior that are often carried out by humans so as to facilitate interaction between humans and computers (Gîrbacia et al., 2020), usually manifested in the form of inputs such as eye movements, touches, sounds, gestures, or gestures that are expected to adapt to various user needs within their various needs (Ito et al., 2021) (Huang et al., 2021) (ICES, 2021).

Immersive Digital Technology

Immersive digital technology or often referred to as immersive technology is defined as any form of technology that allows the merger between the virtual world and the real world by giving users a sense of realism. The most prominent examples of this immersive technology are augmented reality (AR) and virtual reality (VR), these technologies can improve user experience, learning experience or training and planning (Dieck et al., 2022).

Virtual Reality

Virtual Reality or often abbreviated as VR is a branch of computer graphics which is defined as "the use of computer technology to create a virtual environment". Virtual reality is nothing but seeing a completely different reality than the real one that is present in front of you. Virtual reality may be artificial, such as an animated scene, or a real place that has been photographed and incorporated into a virtual reality application. Using virtual reality you can move and be able to see in all possible directions, i.e. up, down, side, and behind you. Users are immersed and can interact with the three-dimensional world. To interact with the three-dimensional virtual world, you must use a dedicated VR tool like Oculus Rift, a VR app like Google Cardboard (Terkhedkar, 2019).

Usabilitas

Usability comes from the word usable which can mean that it can be used properly. Usability itself can be interpreted as effectiveness, efficiency and satisfaction where users can achieve a certain set of tasks well and use them comfortably. In this study, usability is necessary because virtual reality applications and their interaction methods must be easy for users to use and not complicated to learn before being used by users.

Imersifitas

Immersiveness or immersion in virtual reality is defined as a computer that produces a three-dimensional virtual environment that intensively resembles the real world. This aims to provide an experience to users so that it is as if they are in a virtual environment that has been created (Maulana Aziz, 2020).

3. RESEARCH METHODS

The type of research used in this study is quantitative research, because this study aims to find out the comparison of usability and immersion in the controller and hand gesture of the Meta Quest 2 virtual reality headset. So it requires systematic research, there are certain samples, data collection and data analysis.

This research was conducted in one of the Vocational High Schools (SMK) in Malang Regency majoring in Visual Communication Design (DKV). The population in this study is students majoring in Visual Communication Design (DKV) at one of the Vocational High Schools (SMK) who have never used a VR headset before. The sample in this study is 30 students, which are divided into 3 (three) groups, namely the group that uses controllers, hand gestures, and uses both.

The independent variable in this study is the interaction method used, namely controller and hand gesture. The dependent variables in this study are usability (learnability, effieciency, memorability, error, and satisfaction) and immersion (presence, spatial presence, involvement, and experienced realism).

The test of research instruments is a testing process carried out to ensure that the tools used in the research are able to measure the variables contained in the research accurately, validly, and reliably. The test of this research instrument has 2 (two) stages, namely the validity test and the reliability test, both tests can be carried out directly using the SPSS application.

After the data was successfully collected, the questionnaire was tested first using a test of research instruments, namely the validity and reliability test. After that, a test of research instruments was carried out, then a classical assumption analysis test was carried out, namely the normality test, the multicollinearity test and the heterokedasticity test. All of these tests were carried out using SPSS v25. Then the data that has been obtained is tested again using the Usability Testing method to test usability and the Igroup Presence Questionnaire (IPQ) for immersion. The next step is to test the data using multiple linear regression analysis, and the last is to test the hypothesis using the Paired T-Test.

4. RESULTS AND DISCUSSION

Comparative Analysis of Usability and Immersiivity in Controller and Hand Gesture

Based on the usability and immersion analysis that has been obtained in the previous chapter, the results are as follows:

Table 1. Results of Usability Assessment Criteria Using a Controller

No.	Variable	Average		
		Waltz of The Wizard	**The Walking Dead: Saints & Sinners**	**Aplikasi Cagar Budaya**
1	Learnability	4,45 (Excellent)	4,45 (Excellent)	4,03 (Good)
2	Efficiency	4,20 (Good)	4,25 (Excellent)	4,05 (Good)
3	Memorability	4,35 (Excellent)	4,30 (Excellent)	4,03 (Good)
4	Error	4,15 (Good)	4,20 (Good)	3,98 (Good)
5	Satisfaction	3,85 (Good)	4,25 (Excellent)	4,23 (Excellent)
TOTAL		**21**	**21,45**	**20,32**

Table 2. Results of Usability Assessment Criteria Using Hand Gestures

No.	Variable	Average		
		Waltz of The Wizard	**The Walking Dead: Saints & Sinners**	**Aplikasi Cagar Budaya**
1	Learnability	4,45 (Excellent)	3,95 (Good)	4,10 (Good)
2	Efficiency	4,05 (Good)	4,10 (Good)	4,05 (Good)
3	Memorability	4,15 (Good)	4,05 (Good)	4,50 (Excellent)
4	Error	4,40 (Excellent)	3,95 (Good)	4,25 (Excellent)
5	Satisfaction	4,10 (Good)	3,88 (Good)	4,15 (Good)
TOTAL		**21,15**	**19,93**	**21,05**

Based on the table that analyzes the usability above, it can be concluded that respondents prefer to use a controller in The Walking Dead: Saints & Sinners game, while in the Waltz of The Wizard game and the Malang City Cultural Heritage Application, respondents prefer to use hand gestures.

Table 3. Results of Immersivity Assessment Criteria Using a Controller

No.	Variable	Average		
		Waltz of The Wizard	**The Walking Dead: Saints & Sinners**	**Aplikasi Cagar Budaya**
1	Presence	4,10 (B)	4,25 (B)	4,05 (C)
2	Spatial Presence	4,80 (B)	5,40 (A)	4,82 (B)
3	Invovelment	4,60 (B)	4,70 (B)	4,49 (C)
4	Experienced Realism	4,60 (A)	4,55 (A)	4,35 (B)
TOTAL		18,1	18,9	17,71

Table 4. Results of Immersivity Assessment Criteria Using Hand Gestures

No.	Variable	Average		
		Waltz of The Wizard	**The Walking Dead: Saints & Sinners**	**Aplikasi Cagar Budaya**
1	Presence	4,35 (B)	4,20 (B)	4,35 (B)
2	Spatial Presence	4,80 (B)	4,82 (B)	5,00 (B)
3	Invovelment	4,65 (B)	4,59 (B)	4,65 (B)
4	Experienced Realism	4,60 (A)	4,19 (B)	4,45 (B)
TOTAL		18,4	17,8	18,45

Based on the table that analyzed the immersion above, it can be concluded that respondents experience a real or immersive virtual environment when using a controller in The Walking Dead Saints & Sinners game. Meanwhile, in The Waltz of The Wizard game and the Malang City Cultural Heritage Application, respondents felt a real virtual environment more when using hand gestures.

Tabel 5. Nilai Koefisien Usabilitas pada Metode Interaksi Controller dan Hand Gesture

Interaction Methods	**Coefficient Value**		
	Waltz of The Wizard	**The Walking Dead: Saints & Sinners**	**Aplikasi Cagar Budaya**
Controller	0.096	0.398	0.064
Hand Gesture	0.136	0.171	0.110

Tabel 6. Nilai Koefisien Imersifitas pada Metode Interaksi Controller dan Hand Gesture

Interaction Methods	**Coefficient Value**		
	Waltz of The Wizard	**The Walking Dead: Saints & Sinners**	**Aplikasi Cagar Budaya**
Controller	0.102	0.177	0.055
Hand Gesture	0.321	0.134	0.065

Based on the table above, it can be concluded that respondents feel usability and immersion in the controller when using an action genre application, in this study the game The Walking Dead: Saints & Sinners was used, because the coefficient value obtained when the respondent used the application was higher when using the controller than when using hand gestures. Meanwhile, in hand gestures, respondents feel more usability and immersion when using adventure genre applications, for example in the Waltz of The Wizard game and browsing on the Cultural Heritage Application.

The following is documentation when respondents used the controller-based interaction method on the three applications used in the study.

Figure 1. Documentation for the Use of Controller-Based Interaction Media

Based on the results obtained in the study, the usability and immersion in the use of controllers were higher when respondents played applications in the action genre, in this study the game used was The Walking Dead: Saints & Sinners. This is because when using the controller, the respondent feels that the controller has a fast response when detecting and translating the input or commands made by the respondent. In addition, controllers are also more familiar to respondents because respondents are used to holding the device when playing a game.

The following are action genre games used in the study and obtained higher usability and immersion when respondents used a controller compared to hand gestures.

Gambar 2. Game The Walking Dead: Saints & Sinners

The following is documentation when respondents used the hand gesture-based interaction method in the three applications used in the study.

Figure 3. Documentation for the Use of Hand Gesture-Based Interaction Media

Based on the results obtained in the study, the usability and immersion in the use of hand gestures were higher when respondents played adventure genre applications,

which were used in the study were Waltz of The Wizard and exploration genre applications, for example the Cultural Heritage Application. This is because when using hand gestures and respondents played adventure and exploration genre applications, respondents felt that hand gestures provided more natural experiences and interactions because they felt free to move like in the real world. And when using hand gestures, respondents do not need special instructions because interactions using hand gestures are easier to understand.

The following are adventure and exploration genre games used in the study and obtained higher usability and immersion when respondents used hand gestures compared to controllers.

Gambar 4. Game Waltz of The Wizard

Figure 5. Cultural Heritage Application

The results of hypothesis testing using the t-test based on the image above on each application, namely the Waltz of The Wizard game, The Walking Dead: Saints & Sinners, and the Cultural Heritage Application, received a significance value of 0 (zero). This means that the significance value obtained in the study is less than 0.05. And concluded that H0 was rejected and H1 was accepted, that is, there was a difference in usability and immersion when respondents used controller-based interaction methods and hand gestures. However, it also depends on the type or genre of application used when using a certain interaction method.

Based on the research, it can also be concluded that the controller-based interaction method has higher usability and immersion when compared to the hand gesture-based interaction method when the respondent uses an action genre application (for example The Walking Dead: Saints & Sinners), due to the accuracy and speed when detecting and translating the movement, position, and actions of the respondent when in the virtual

environment. In addition, the controller has a level of ease that allows respondents to complete tasks quickly. Meanwhile, when respondents used the hand gesture-based interaction method, they obtained high usability and immersion values when compared to controllers when using adventure genre applications (for example, Waltz of The Wizard) and exploration (for example, Cultural Heritage Applications). This is because respondents feel more involved in the virtual environment because when using hand gestures, respondents can interact more naturally or naturally and are free from physical limitations that exist when using the controller.

5. CONCLUSION

The interaction method on the Meta Quest 2 headset, both using a controller and hand gestures, does affect usability and immersion when using virtual reality applications. Usability and immersion in the use of controllers is higher in action applications, such as The Walking Dead: Saints & Sinners due to its faster response to detecting and translating user input, as well as being familiar to the user. Meanwhile, in hand gestures, usability and immersion are high when using adventure genre applications, for example Waltz of The Wizard and exploration, for example the Cultural Heritage Application because it provides a more natural interaction experience so that users feel free to move and interact in a virtual environment. Thus, the interaction method and the type of application used have a direct impact on usability and immersion when using virtual reality headsets.

The optimal form of control for the use of hand gestures on the Meta Quest 2 Virtual Reality headset depends on the type of app used. In adventure (Waltz of The Wizard) and exploration (Cultural Heritage Apps) genre applications, natural hand gestures such as waving, pointing, or grasping, tend to be more optimal because they allow for interactions that are easy to understand and use naturally by users without the need for special instructions. Meanwhile, in the action genre application (The Walking Dead: Saints & Sinners), hand gestures are less optimal because the application requires a faster response when detecting and translating input from the user, and there are complex movements or combinations of buttons that make it difficult to do with hand gestures. So the use of Natural User Interface (NUI) which is realized with virtual reality using a hand gesture-based interaction method needs to be adjusted to the type or genre of application used.

REFERENCE

Brandon, A. (2020). Implementation of a Natural User Interface to Command a Drone. 1139–1144.

Chae, M. K. T. H. S., & Kim, M. (2022). Real-time Multi-device Control System Implementation for Natural User Interactive Platform. 0170(1), 19–29.

Dieck, M. C. T., Han, D. D., & Dieck, M. C. T. (2022). The role of immersive technology in Customer Experience Management The role of immersive technology in Customer Experience Management. Journal of Marketing Theory and Practice, 30(1), 108–119. https://doi.org/10.1080/10696679.2021.1891939.

Gîrbacia, F., Postelnicu, C., & Voinea, G. D. (2020). Towards Using Natural User Interfaces for Robotic Arm Manipulation. Advances in Intelligent Systems and Computing, 980, 188–193. https://doi.org/10.1007/978-3-030-19648-6_22

Guerino, G. C., Malveira, N., & Valentim, C. (2020). Usability and user experience evaluation of natural user interfaces : a systematic mapping study. 14, 451–467. https://doi.org/10.1049/iet-sen.2020.0051

Hamad, A., & Jia, B. (2022). How Virtual Reality Technology Has Changed Our Lives: An Overview of the Current and Potential Applications and Limitations. International Journal of Environmental Research and Public Health, 19(18). https://doi.org/10.3390/ijerph191811278

Huang, Y. J., Liu, K. Y., Lee, S. S., & Yeh, I. C. (2021). Evaluation of a Hybrid of Hand Gesture and Controller Inputs in Virtual Reality. International Journal of Human-Computer Interaction, 37(2), 169–180. https://doi.org/10.1080/10447318.2020.1809248

ICES. (2021). No 主観的健康感を中心とした在宅高齢者における 健康関連指標に関する共分散構造分析Title. March, 1–19.

Ito, K., Kogami, H., Kang, S. I., Yoshizaki, R., Sakurai, Y., Nakano, K., Yoshioka, D., Wu, J., Fujisaki-Sueda-Sakai, M., Sugarawa, I., Miura, T., Yabu, K. I., & Ifukube, T. (2021). Configuring interface for IoT: Natural user interface study on senior adults in Japan. LifeTech 2021 - 2021 IEEE 3rd Global Conference on Life Sciences and Technologies, LifeTech, 200–203. https://doi.org/10.1109/LifeTech52111.2021.9391943

Lorenzis, F. De, Nadalin, M., Migliorini, M., Scarrone, F., & Lamberti, F. (2023). A Study on Affordable Manipulation in Virtual Reality Simulations : Hand-Tracking versus Controller-Based Interaction. 2023 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), 103–107. https://doi.org/10.1109/VRW58643.2023.00027

Metanesia. (2022). Apakah Meta Quest 2 Layak untuk Dibeli? Simak Spesifikasinya di Sini! Apakah Meta Quest 2 Layak untuk Dibeli? Simak Spesifikasinya di Sini!

Mulyana, A., Mukmin, M. N., & Hambani, S. (2023). Efektivitas Media Pembelajaran Berbasis Teknologi Play on DemandPada Mata Kuliah Akuntansi Dasar. Jurnal Ekonomi, Manajemen Dan Akuntansi, 1(1), 353–366. http://jurnal.kolibi.org/index.php/

Nussipova, G., Nordin, F., & Sörhammar, D. (2020). Value formation with immersive technologies : an activity perspective. 3(June 2019), 483–494. https://doi.org/10.1108/JBIM-12-2018-0407

Supriyatna, A. (2019). Penerapan Usability Testing Untuk Pengukuran Tingkat Kebergunaan Web Media of Knowledge. Teknois : Jurnal Ilmiah Teknologi Informasi Dan Sains, 8(1), 1–16. https://doi.org/10.36350/jbs.v8i1.17

Terkhedkar, T. (2019). "Introduction To Virtual Reality." https://medium.com/@tanmayct/introduction-to-virtual-reality-c9c01b6fb69f

VRStation. (2022). Peningkatan besar Datang ke Quest 2 Pelacakan tangan dengan Upgrade '2.0.' https://vrstation.id/2022/04/20/peningkatan-besar-datang-ke-quest-2-pelacakan-tangan-dengan-upgrade-2-0/