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Research on Content Control Technology using Hand Gestures to Improve the Usability of Holographic Realistic Content

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Abstract

Technologies that are considered to be a part of the fourth industrial revolution include holograms, augmented reality, and virtual reality. As technology advances, the industry's scale is growing quickly as well. While the development of technology for direct use is moving slowly, awareness of floating holograms—which are considered realistic content—is growing as the industry's scale and rate of technological advancement continue to accelerate. Specifically, holograms that have been incorporated into museums and exhibition spaces are static forms of content that viewers gaze at inertly. Additionally, their use in educational fields is very passive and has a low rate of utilization. Therefore, in order to improve usability from the viewpoint of viewers of realistic content, such as exhibition halls or museums, we introduce realistic content control technology in this study using a machine learning framework to recognize hands. It is anticipated that using the study's findings, manipulating realistic content independently will enhance comprehension of objects presented as realistic content and boost its applicability in the industrial and educational domains.

Keywords: *Artificial Intelligence, Bigdata, Hand Gesture, Machine Learning Framework, Realistic Content*.

1. Introduction

The MZ generation, which is at the forefront of contemporary cultural trends like games, YouTube, and Netflix, is changing in their approach to culture as a result of the prolonged COVID-19 and changes in daily living. It can also be argued that Korea's K-pop culture is having a significant influence on the global community. Specifically, in addition to Artificial Intelligence [1-4] and Bigdata [5- 8], the focus is on VR/AR and holograms, which are becoming important content-related technologies in the fourth industry [9]. The study of hologram technology has historically focused on replicating realistic content, but as more application technologies are developed, its potential as a tool for solving social issues is becoming more apparent. For instance, it can serve as a vital source of technology for application services like remote guidance and holographic therapy that don't require in-person interaction, as well as a technical way to use it as a human

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life partner. This procedure can serve as an illustration of an application service that creates holograms based on the demands of the moment, similar to technologies like metaverse that facilitate remote and non-face-to-face collaboration.

Present-day holographic technology is being presented as a means of recreating three-dimensional light and reflecting the characteristics of objects from their surface to create realistic stereoscopic images. Compared to 3D images displayed on current flat screens, stereoscopic images produced by holograms can maximize the sense of realism and have the benefit of being able to be viewed from a variety of angles, which can give them the advantage of being relatively wide [10]. Furthermore, content that stimulates the five senses of the viewer to create a realistic experience is categorized as realistic content [11]. However, there are numerous challenges in the real-world application of holographic technology for realistic content. When it comes to holographic technology, they can be broadly divided into three categories: analog, digital, and similar holograms. [12] Generally speaking, comparable holograms that are easily accessible around them not only fulfill their potential as realistic content in the future, but they can also be easily accessed. As a result, it’s important to examine the technology and applications of comparable holograms. Based on this, recommendations are made for how to advance technological advancement in the form of bettering the activation of realistic content that allows viewers to interact rather than only at the moment of content expression. This technology’s output can be categorized as a representative hologram example of the fourth industry, in which particular items in galleries and museums can be represented as holograms, allowing visitors to examine them in greater detail with their hands’ 360-degree rotation, enlargement, and reduction functions.

In this study, Session 2 covers the fundamentals of holography, while Session 3 presents the machine learning framework-based system configuration and justification for realistic content control. Session 4 wraps up with some examples of realistic content control.

2. Related works

2.1. How to understand holographic technology

With the use of holographic technology, which replicates images of real life in space, one can create 360-degree stereoscopic images of objects by recording and reproducing the distribution of light diffracted or reflected from real life [13]. It can be thought of as a reproduction technology comparable to analog and digital hologram technology [12]. Methods that display holographic effects by projecting images using a transflective screen are similar to and accessible from holograms. This approach is best suited for events like concerts or gatherings with particular items. The next way to express the real thing as a hologram using film is to use analog holograms in photos and exhibitions. By utilizing a device to obtain a holographic program, one can represent the digital holographic graph.

According to evaluations, holographic technology produces realistic content that can convey a variety of images without the need for special glasses. It also creates optical elements for reproduction and facilitates the acquisition, generation, and transmission of content [14]. As a result, there are numerous technical issues with the interference phenomenon, and since laser beams are widely used in technology today, many holographic technologies are comparable.

2.2. How to use holographic technology

Comparable holograms use high-definition images projected onto a two-dimensional transparent screen to convey a feeling of depth and realism. Additionally, because objects can be viewed in three dimensions without the need for 3D glasses, there is little chance of visual fatigue and the screen can be viewed for extended periods of time without the need for additional devices like VR/AR. Based on the image projection method, holograms with these benefits are classified as direct or indirect projection methods.

The direct projection technique involves projecting images directly onto a screen without the use of a reflector. It primarily employs a glass fiber net screen with a lattice-style net structure for projection. On the other hand, the indirect projection method, also known as floating, uses a reflector that is positioned at a 45° angle to the stage's floor to create the illusion of a three-dimensional hologram. This floating hologram is primarily placed in front of the stage. These all use actual objects and real-life imagery to convey their messages.

2.3. How to recognize hand gestures

Numerous studies on the hand have been done, and new algorithms are always being developed and published. A user's gesture must be recognized by an input sensor in order to develop gesture recognition technology. These sensors can be classified as contact or non-contact depending on whether they can make direct contact with and recognize the body. There are usually limitations on the user's movement and distance when using contactless technology because the user does not make direct contact with the sensor. Specifically, a hand-shaped recognition module should be included in the development of hand-based input technologies; RealSense and lip motion are good examples of this. Expensive equipment is needed for these technologies.

Hand gesture recognition and object control technologies are typically demonstrated in this study using cameras attached to computers and laptops, with a media pipe module being used to identify hand objects. These devices are necessary for hand gesture recognition [15]. The media pipe module is used to enable 3D object control according to hand shape and related contents are examined. Because it is a hand recognition module, it has the advantage of not requiring the construction of separate learning data on hand recognition.

3. Control technology for hand recognition

In this Session, hand recognition technology for realistic content control and the contents of controlling realistic content through it are described.

3.1. System configuration

The following Figure 1 shows the components necessary for function development in this study. The function that is offered to be used to express a 3D object expressed as realistic content is first and foremost under the control of the SketchFab platform. OpenCV libraries are utilized for real-time computer vision applications, and the Selenium and Chromium frameworks are utilized for object visualization. Furthermore used is mediaPipe, an open-source cross-platform framework capable of handling streaming and real-time media data, including video. An illustration of how an object can process and convey realistic content based on a hand gesture is shown in Figure 2.

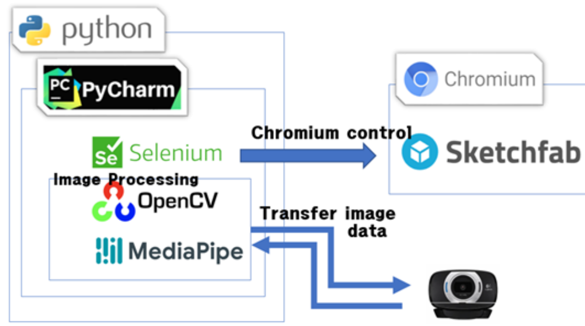

Figure 1. Configuration diagram of the entire system

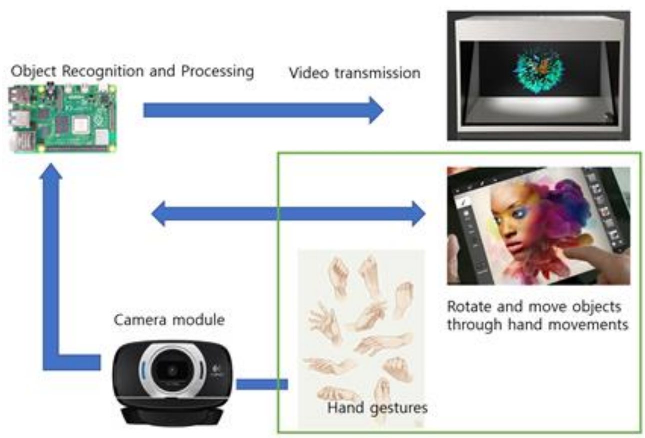

Figure 2. Example of content visualization processing based on hand gestures

3.2. Hand shape recognition and motion

In this study, the camera interacts with realistic content through the hand as a medium. In light of this, a media pipe hand tracking module is utilized to identify the shape of the hand and regulate the size, rotation, and up/down movement of realistic content in response to changes in hand position. The module tracks fingers and hands using 21 3D hand landmarks to identify hands using machine learning [16]. The media pipe hand landmarks in Figure 3 are identified by their 21-point structure [15]. A 3D-modeled ring is seen in Figure 4 as realistic content that can be moved in accordance with the user's hand. This content displays a shape that rotates frontally and backwards based on the hand.

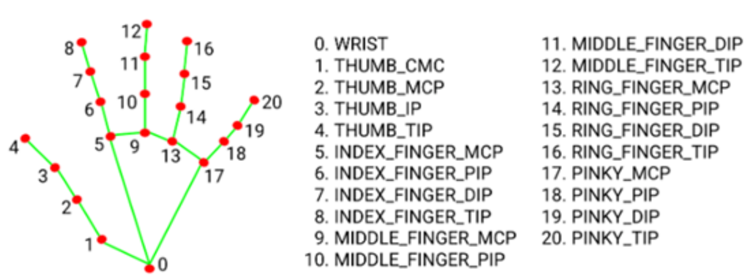

Figure 3. Hand landmarks

4. Experiment and its results

This study was conducted on an OS Raspberry 4B 8GB and OS Raspberry Pi Lite 64-bit, Debian Linux 11 (Bullseys) computer environment. A general universal camera C615 FHD/30fps/800 million pixels was used as the webcam. A display device size was employed, which was 13.3 inches. Python 3.9.x version was used as the development software. Furthermore, a ring model was employed, and this ring model came about as a consequence of the content product modeling that was done with MAYA. An example of a result screen snapshot generated by 3D is presented in Figure 4.

Figure 4. 3D object modeling snapshots of ring using realistic content

The response of the realistic content altered in accordance with the shape and motion of the hand is depicted in Figures 5 and 6. The procedure for identifying the hand using the hand landmark is depicted in Figure 6, wherein the 3D model is rotated in accordance with the movement of the realistic content from left to right. The middle snapshot in Figures 5 illustrates the form of an intermediate process, which appears as a circular ring when the hand position shifts from left to right. It also illustrates the process of revealing the backside again. Lastly, it displays the outcome of keeping the original shape.

Figure 5. Snapshots of content transformation according to hand position change (left to right)

Figure 6. Snapshots with hand position changes (rotation of left and right, zoom in and out)

5. Conclusions

Most realistic content research was only feasible when an expensive attachment or direct wear of an AR/VR device was made. It is therefore possible for us to control realistic content in this study without having to wear it directly on the body, and expensive equipment is not needed. The technology for controlling realistic content, which is expressed in holograms, was created using hands as a tool for AI-based communication in the future autonomous vehicles and fourth industries. It is feasible to conduct research on the creation of a portable device prototype and present a model in the future that will need accuracy and fast response times so that realistic content can communicate with people in a natural way.

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References

[1] M. A. Boden, “Artifi Artificial Intelligence ial intelligence,” Elsevier, 2023.
[2] Y. Mintz, and R. Brodie, “Introduction to artificial intelligence in medicine,” Minimally Invasive Therapy & Allied Technologies, vol. 28, no. 2, pp. 73-81, 2019. DOI: https://doi.org/10.1080/13645706.2019.1575882
[3] S.H. Kim, J.K. Choi, J.S. Kim, A.R. Jang, J.H. Lee, K.J. Cha, and S.W. Lee, “Animal Infectious Diseases Prevention through Bigdata and Deep Learning,” Journal of Intelligence and Information Systems, vol. 24. no. 4. pp. 137-154, 2018. DOI: https://doi.org/10.13088/jiis.2018.24.4.137
[4] C. H. Lee, K. Park, and S. Lee, “Development of IoT Healthcare Platform Model for the Elderly using Bigdata and Artificial Intelligence,” International Journal of Membrane Science and Technology, vol. 10, no. 1, pp. 108-113, 2023. https://doi.org/10.15379/ijmst.v10i1.1435
[5] D. Fasel, and A, Meier, Bigdata, Springer Vieweg, 2014
[6] S. Lee and J. Kim, “Data Design Strategy for Data Governance Applied to Customer Relationship Management,” International Journal of Advanced Culture Technology, vol. 11, no. 3, pp. 338-345, 2023. DOI: https://doi.org/10.17703/IJACT.2023.11.3.338
[7] S.H. Kim, S. Chang, and S.W. Lee, “Consumer Trend Platform Development for Combination Analysis of Structured and Unstructured Bigdata,” Journal of Digital Convergence, vol. 15. no. 6. pp. 133-143, 2017. DOI: https://doi.org/10.14400/JDC.2017.15.6.133
[8] S. Sagiroglu, and D. Sinanc, “Bigdata: A review,” The 2013 international conference on collaboration technologies and systems (CTS), IEEE, pp. 42-47. 2013, May. DOI: http://doi.org/10.1109/CTS.2013.6567202
[9] Y.J. Park, and B.C. Choi, “The destination of realistic media video: digital holograms,” KISTEP, pp.1-27, 2019.
[10] S.J. Jung, and T.H. Lee, “A Study on the Present Condition and Prospect of Architectural Cultural Heritage Content Applied to 3D Digital Technology,” Journal of the Korea Academia-Industrial cooperation Society, vol. 22.no. 2. pp. 188-198. 2021. DOI: https://doi.org/10.5762/KAIS.2021.22.2.188
[11] H. K. Joe, “A study on the use of immersive media contents design based on extended reality(XR) technology in digital transformation era,” Journal of the Korean Society Design Culture, vol.26, no.4, pp. 497-507, 2020. DOI: http://dx.doi.org/10.18208/ksdc.2020.26.4.497
[12] W.J. Lee, E.J. Shin, H.S. Yoon, and H.M. Choi, “Realistic Contents and Interaction Based Realistic Contents Service,” KIPS Trans. Softw. and Data Eng. vol. 10, no. 10. pp. 429-438. 2021. DOI: https://doi.org/10.3745/KTSDE.2021.10.10.429
[13] S.H. Oh. “A Study on convergence video system trough Floating Hologram,” Journal of Digital Convergence, vol. 18. no. 10. pp. 397-402. 2020. DOI: 10.14400/JDC.2020.18.10.397
[14] J. H. Ryu, E. S. Cho, and J. I. Lee. “Display of 3D digital Contents sing Pseudo-Hologram and Interaction Technology, Socciety of Design Convergence,” vol. 17. no. 6. pp. 19-36. 2018. DOI: 10.31678/SDC.73.2
[15] F. Zhang, V. Bazarevsky, A. Vakunov, A. Tkachenka, G. Sung, C. Chang, & M. Grundmann, “MediaPipe hands: On-device real-time handtracking,” arXiv.2006.10214v1, Jun. 2020. DOI: https://doi.org/10.48550/arXiv.2006.10214
[16] Y.J. Lee, and T.Y. Kim, “Development of an Efficient Home Training System through Deep Learning-based Pose Recognition and Correction,” vol. 17. no. 6. pp. 89-99, 2021. DOI: http://10.23019/kingpc.17.6.202112.008