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A Study on the Platform that Provides Virtual Reality and Augmented Reality Content for Industrial Processes and Operations

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Abstract
A Virtual reality and augmented reality technology is rapidly growing due to the development of hardware and software technology. The perspective on the application of industrial technology using this virtual augmented reality is at an early stage.

System: This paper includes a study on the use of the process for the application of industrial virtual reality and augmented reality technology and the design of the technology according to the various operations required for the specific process. Administrator review and guidance is needed on the results of education and training in a virtual environment for industry's real work. Therefore, a platform that provides technical processes for training and detailed operation through virtual augmented reality technology is essential. Through virtual reality and augmented reality technology, we propose a process approach to processes in the entire industry, and it is expected that research results of proposals to provide services in real processes in many industrial applications will be possible in the future.

Keywords: *Virtual Reality, Augmented Reality, Industrial Application, Work Process, Virtual Training, Contents Platform.*

1. Introduction

The technology of virtual reality and augmented reality is rapidly growing through hardware and software development. However, the technologies of virtual reality and augmented reality are still in the early stages for industrial application. Starting from the development of entertainment, it is required and produced in many fields of education, culture, tourism, physical education, art, and medical care[1].

The world is already leading virtual and augmented reality technologies in Japan, China, Europe and the United States, as well as in Korea. Hardware vendors, virtual augmented reality authoring tools, and content developers are leading the technology of virtual and augmented reality in line with the 4th industrial revolution and the era of digital new media and 5G communications. It is a rapidly developing and growing trend. The Industrial Virtual Reality and Augmented Reality Forum was recently held, and it is expected that the software and hardware corresponding to the technology of industrial virtual reality and augmented reality will grow rapidly[2].

In the early days, virtual augmented reality techno

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logy was emphasized as a necessity as a content of entertainment elements, and gradually expanded to many fields related to education, culture, tourism, physical education, arts, and medical care. Recently, the necessity has emerged as a site-specific technology, not a research that can directly help the actual field work in the industrial aspect. Introduced the use of augmented reality technology in the production plant of BMW, a world-renowned automobile company, to lead the start of industrial applications, and many global companies began to participate and become interested. Currently, a virtual augmented reality association has been established in Korea, but in particular, research and development on industrial virtual reality and augmented reality devices and modules has not been conducted much.

Therefore, in this paper, we proposed to enable a lot of industrial applications by dealing with research on the operation of the controller according to various manipulations for industrial application and research on expression and application techniques on the result of the operation.

2. Methods

2.1 Related research

• Virtual reality technology

The virtual reality device uses a head mounted display (HMD) that is basically provided and provides a virtual space through a display in an enclosed space. A dedicated controller is used to select and control the functions applicable to the display. These controllers are provided with a basic library to enable interaction and events with specific 3D objects in the virtual reality through connection and control with the corresponding HMD.

Pimax 8K

Vive Pro

Oculus Quest

Mirage Solo

Odyssey

Company	Pimax	HTC	Facebook	Lenovo	Samsung
Model	Pimax 8K	Vive Pro	Oculus Quest	Mirage Solo	Odyssey
Platform	PC	PC	Standalone	Standalone	PC
Resolution	7680 x 2160	2880 x 1600	2880 x 1600	2560 x 1440	2880 x 1600
Freqeuncy	90Hz	90Hz	72Hz	75Hz	110Hz
Angle	200°	110°	110°	110°	110°
Weight	≒ 450g	≒ 555g	≒ 571g	≒ 645g	≒ 645g
Wire/Less	Wire	Wire/less	Wireless	Wireless	Wire
Release date	2018.10	2018.4	2018.5	2018.5	2017.10

Figure 1. Specification and Status of Virtual Reality Devices[3].

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The Contents are developed through scripts according to the events of the controller and the effects on 3D objects and the effects of 3D objects through Unreal, Unity, and EON reality, which are authoring tools for developing virtual reality and augmented reality. It is provided to end users through Steam VR and Oculus Store, which are distribution platforms that provide contents of these devices and virtual and augmented reality.

• Hand motion controller

The Manus VR Glove from Manus company is a virtual reality controller for hand gesture recognition and interaction and is in the form of a glove. Gloves capable of processing haptic data track the movement of fingers and hands in real time.

The Manus VR Glove consists of a combination of several sensors, and the direction is measured by accelerometer, gyro and magnetometer sensors. Each finger for has two sensors designed by Manus VR, three sensors on the thumb, and two fingers for sensor detection. A vibration motor on the hand provides haptic feedback to the user, and the data is transmitted through a wireless RF transmitter with low latency (<5ms)[4].

Figure 2. Manus's VR Glove

The Manus VR Glove is primarily used for training, design, collaborative simulation, and the development of new rehabilitation technologies in virtual reality, as well as for hand data motion capture and robotic and mechanical arm control.

• Augmented reality technology

In the augmented reality market, ARKit of Apple company, which is a mobile augmented reality application creation platform, and ARCore of Google are attracting the attention of developers.

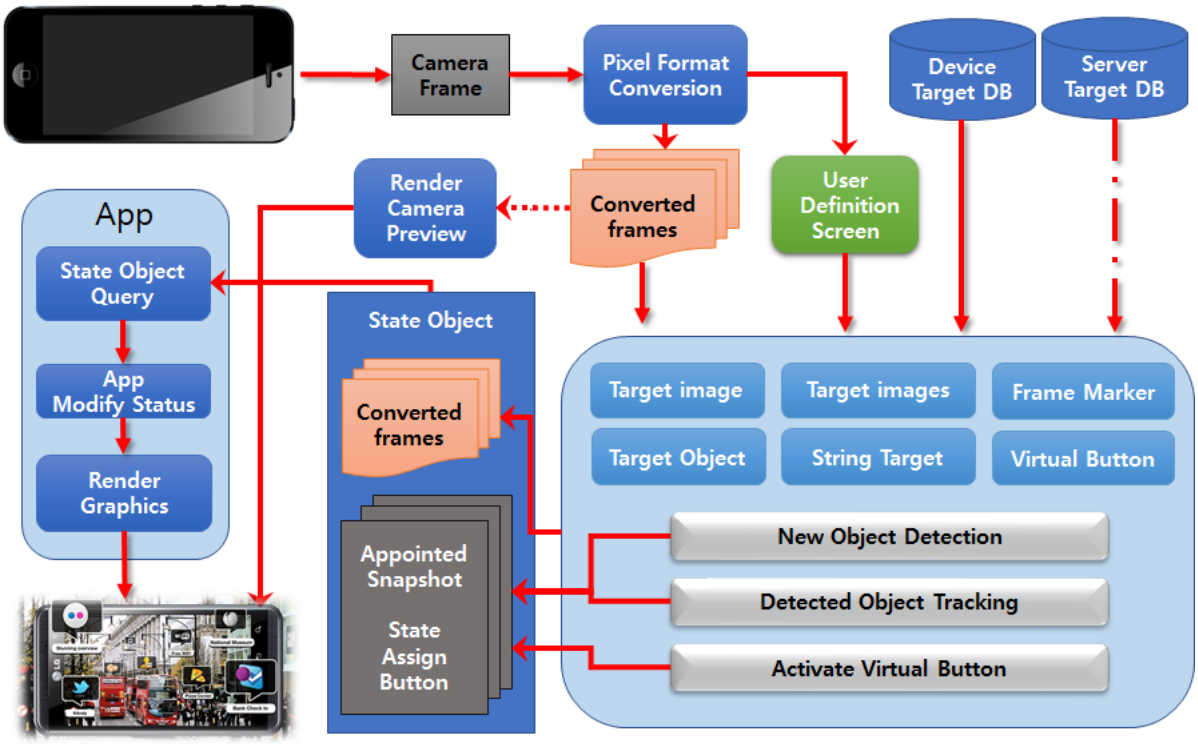

Figure 3. Diagram of Augmented Reality Technology[7].

After the release of ARKit, the Apple company is expected to release its own smart glass in 2020, with a number of iOS-based augmented reality content in service on the App Store[6, 7]. The Microsoft's Hololens 2 is the latest release and is expected for all AR glass developers.

Augmented reality is a technology that adds a virtual image frame based on an image frame taken by the camera internally and can be described as a marker technique necessary for recognition of an image and an expression technique according to an event after recognition.

By incorporating such virtual reality and augmented reality technology, we propose a virtual augmented reality technology in support of the work required for industrial processes.

2.2. Proposed Research

When performing industrial work process mission, general components except story should be prepared and templated. It is proposed to create a component by maintaining objectivity as a kind of data container and to interact with the task mission in the system by mounting the actual data in the component for the assembly of procedural content in the future.

It proposes a module that can transmit / receive necessary network messages between clients in collaboration, and proposes a function to perform networking for work process mission.

• VR based proposal System

The path of the camera that was created and planned in virtual reality and augmented reality is set in Unity, an integrated development environment. After that, the environment is set by using the object to be placed at the camera angle and the 3D content resource. Then, through the library provided in the basic software development kit (SDK) [8], we propose the operation configuration of content suitable for interaction, output, and planning contents. We suggest the composition of the operation of the content that fits the planned content.

Figure 4. Example of Content Implementation using Virtual Reality Display

• AR based proposal System

Augmented reality display-based content should be loaded into a display device with a camera such as a smartphone or tablet PC, or an eyeglass display device such as MS Hololens[9]. The Displ ay device uses a marker method using the Vuforia engine, and AR Glass proposes space-based augmented reality content using devices such as MS Hololens.

Marker-type augmented reality content consists of

a marker that satisfies the conditions that the Vuforia engine can recognize by image processing, and an app with content to be executed when it is recognized. The content to be executed is developed by the Unity engine, a 3D authoring tool, and used to recognize markers using the Vuforia SDK.

Spatial-based augmented reality content can scan the space where it is currently located with MS Hololens to place virtual objects or suggest virtual interfaces[10]. The objects and interfaces to be used at this time are also designed to be produced by the virtual augmented reality authoring tool.

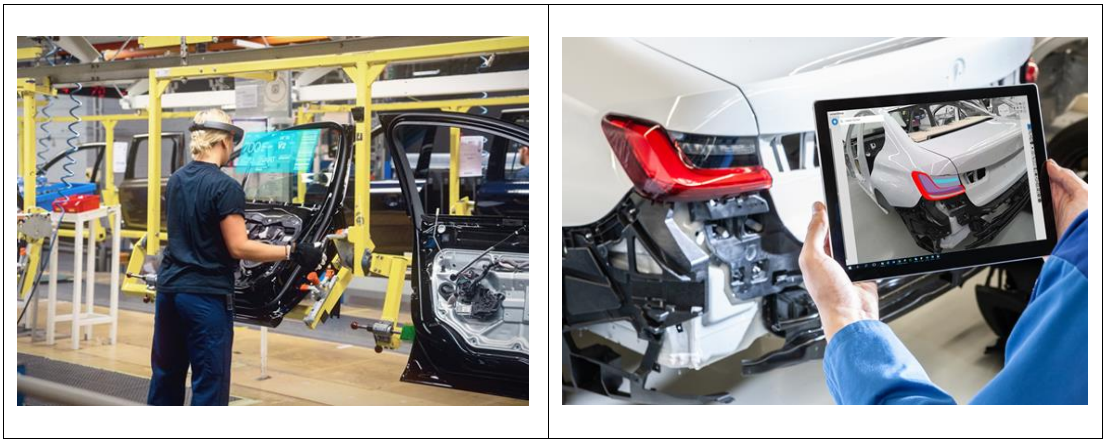

Figure 5. Example of Content Implementation using Augmented Reality Display

• Proposal System.

Industrial work processes vary in assembly, production, processing, processing, etc., and therefore training should be possible for each unit process. In addition, virtual reality and augmented reality technologies are used for each work process, and virtual reality equipment and controllers for each situation, augmented reality glasses and smart pads, and a monitor technology for managers are proposed to have the following configurations.

Specifically, it proposes a dynamic plan that recognizes the surrounding space and reflects the user's position, movement and behavior in the space from static technology that showed information and 360-degree contents according to the eyes of the users who are sitting.

In the early stages of virtual reality, the direction of the head movement was tracked and 360-degree panorama image was displayed according to the direction in the fixed posture, but motion tracking technology and 3D scan technology were developed to allow free movement in the real space.

It has been developed into a mixed reality (MR) display, in which the boundary between virtual reality and augmented reality is broken down, and a mixed reality display combining the immersion of virtual reality and the communication characteristics of augmented reality can be used[11]. Existing devices can be used by one user, but it can be felt as if multiple users are in the same virtual space and proposed as a technology that can communicate with each other. Suggested to provide.

3. Results and Discussion

3.1 Mixed reality training Contents providing Platform

In order to train industrial processes with virtual reality, augmented reality, and 3D content using

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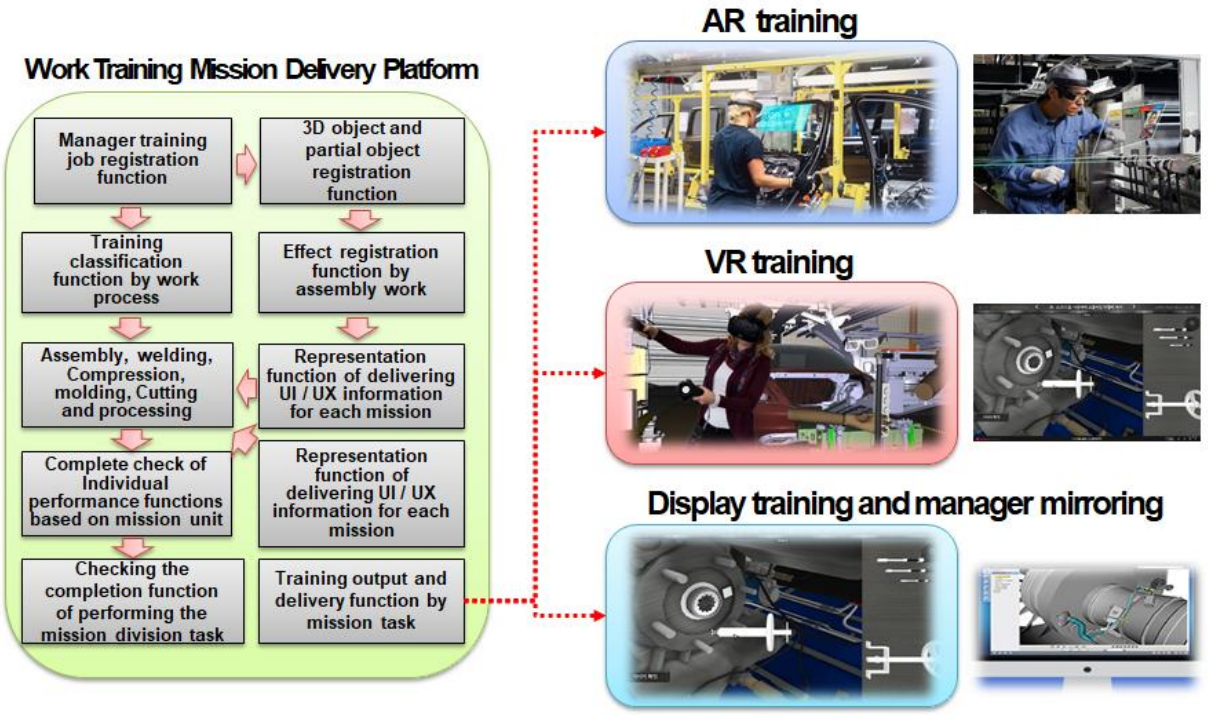

Figure 6. Functional Diagram of Work Process Provision Platform

mixed reality, It is important to apply controller and equipment through user's requirements as in related research, but to provide a platform for training as a service.

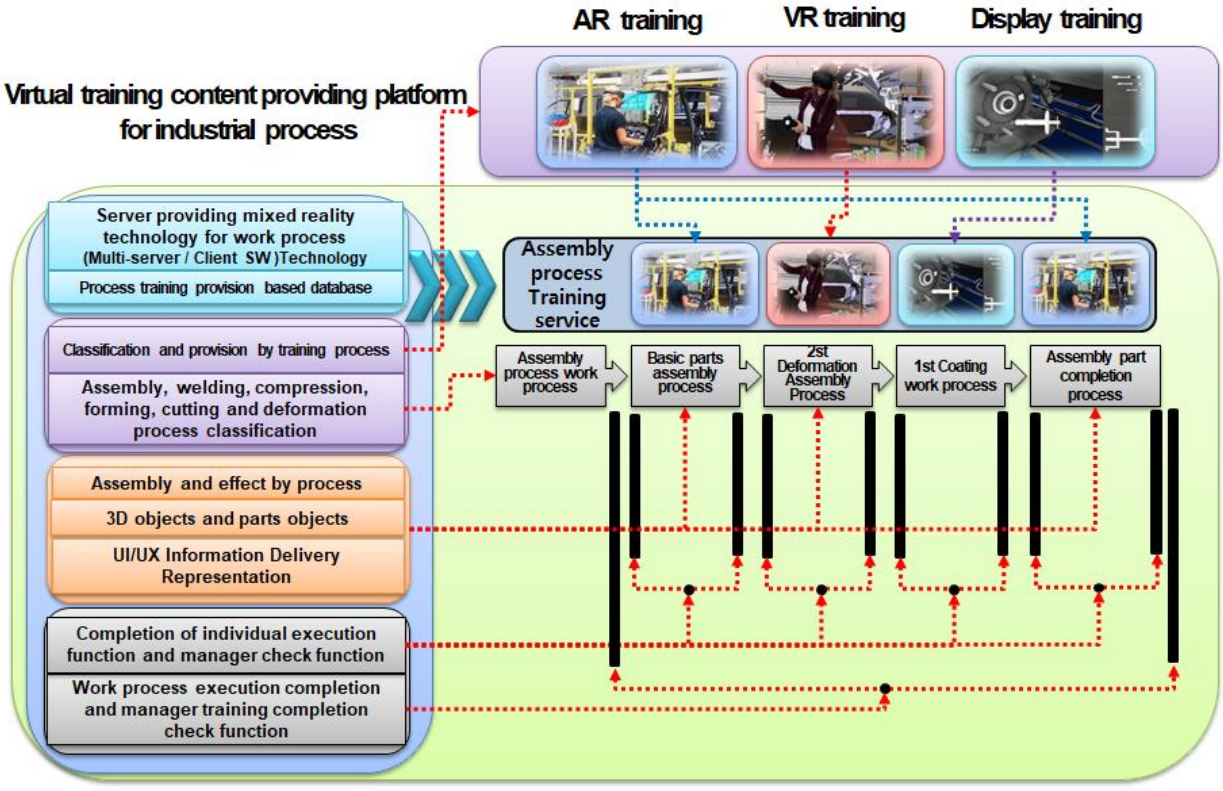

Figure 7. Detailed functional diagram of a single service on an industrial mixed reality training delivery platform

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The function of the manager's role in evaluating the training of the work and checking and taking action based on the results of the training should be provided in accordance with the process in which the various categories of work in one process are performed sequentially and the final finished product is made. This is necessary.

In order to start training through the control of the trainees of the single models of all processes, it is necessary to design the DB of information on specific effects, expressions, and results according to events, rather than designing through the sequential flow of content.

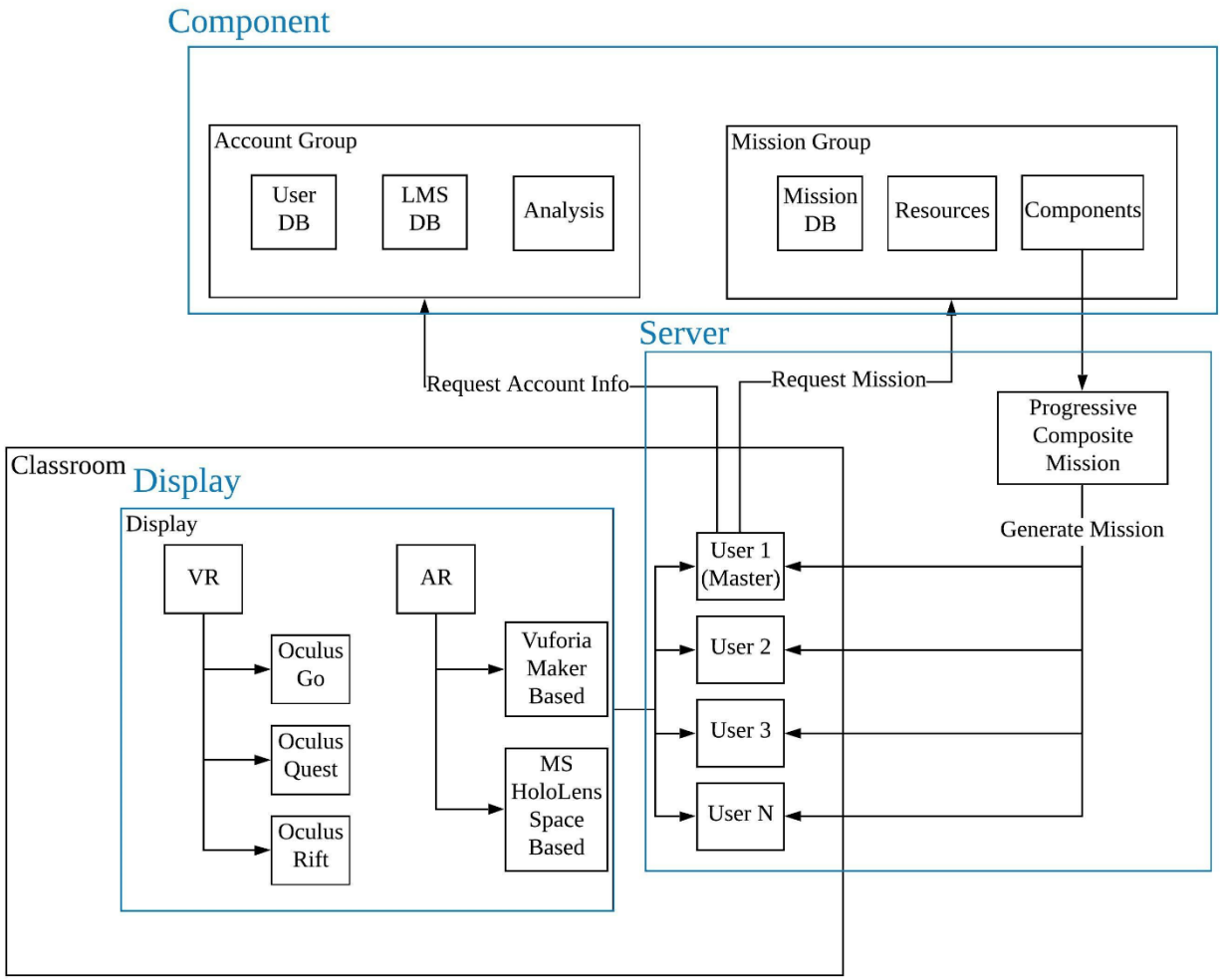

Figure 8. Diagram of Component Server System for Mission Control

This enables the training of the trainer through the monitoring of the training of the manager's work trainer and the result information, and the information necessary for the transition and transfer to the next work process can be processed according to the flow[12].

3.2 Mission Control Component Server System

The mixed reality content provided in this way should be designed and trained according to the technical classification of the mixed reality required for the process.

Through the server function of the platform, several people can simultaneously train their work, and information is required for each step of the training.

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4. Conclusion

In this paper, we propose a process-oriented module that can be industrially applied in the technology of virtual augmented reality and several basic technologies for applying in stages. In addition, the proposed study suggested the research contents for the training of the virtual augmented reality training or the process-oriented training that can occur industrially at the process site. In this way, the virtual augmented reality technology in the supporting dimension of the work required for industrial process is now proposed and developed as a more realistic and practical technology that can be utilized in the field. By providing it, it can be used as a basic method and suggestion that must be provided in the future development of industrial virtual augmented reality application.

In addition to preventing errors in the manufacturing process, you can find the most efficient process for producing the desired product, evaluate the feasibility and feasibility of the process, and become familiar with new tasks before entering into difficult and complex manufacturing processes. It is possible to simulate business in a virtual environment so that a variety of complex processes can be identified at a glance, and the manager can examine the entire process and identify which functions can improve productivity and reduce employee stress.

The research on the proposed method is proposed to be applied based on the entire industry, and it is expected to be applied for the purpose of recognition, processing and recognition of various user movements and motions in the virtual augmented reality tool. Technology will be needed in a variety of areas as well as in virtual augmented reality technology and applications.

In addition, as a method for enhancing the realism in the haptic experience, the hybrid model function mixed with the base technology per cognition and motion and the additional research are required.

Based on these studies, it is expected to be used in many industrial applications by dealing with researches on the operation of controllers according to various manipulations for industrial applications and researches on expressions and application techniques on the results of the operations.

Acknowledgment

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References

[1] ONG , S. K.; YUAN, M. L.; NEE, A. Y. C. Augmented reality applications in manufacturing: a survey. International journal of production research, 2008, 46.10: 2707-2742.

[2] BOTTANI, Eleonora; VIGNALI, Giuseppe. Augmented reality technology in the manufacturing industry: A review of the last decade. IISE Transactions, 2019, 51.3: 284-310.

[3] J ang, Y. C., Lim, J. S., Kim, J, H. Virtual reality· Augmented Reality(VR/AR) Industrial Trends. The Journal of The Korean Institute of Communication Sciences, 2018, 36(1), 35-41. (http://www.dbpia.co.kr/Journal/articleDetail?nodeId=NODE07614729)

[4] Yoon, Y., Moon, D., & Chin, S. Fine Tactile Representation of Materials for Virtual Reality. Journal of Sensors, 2020.

[5] ERIVANTCEV, Viktor Vladimirovich, et al. Devices for controlling computers based on motions and positions of hands. U.S. Patent No 10,509,469, 2019.

[6] NOWACKI, Paweł; WODA, Marek. Capabilities of ARCore and ARKit Platforms for AR/VR Applications. In: International Conference on Dependability and Complex Systems. Springer, Cham, 2019. p. 358-370.

[7] GATTULLO, Michele, et al. Exploiting Augmented Reality to Enhance Piping and Instrumentation Diagrams for Information Retrieval Tasks in Industry 4.0 Maintenance. In:

March - April 2020
ISSN: 0193-4120 Page No. 4470 - 4478

International Conference on Virtual Reality and Augmented Reality. Springer, Cham, 2019. p. 170-180.

[8] BERMEJO, Carlos; HUI, Pan. A survey on haptic technologies for mobile augmented reality. arXiv preprint arXiv:1709.00698, 2017.

[9] NAYYAR, Anand, et al. Virtual Reality (VR) & Augmented Reality (AR) technologies for tourism and hospitality industry. International Journal of Engineering & Technology, 2018, 7.2.21: 156-160.

[10] CALVO, Isidro, et al. Towards a methodology to build virtual reality manufacturing systems based on free open software technologies. International Journal on Interactive Design and Manufacturing (IJIDeM), 2017, 11.3: 569-580.

[11] SCHMIRLER, Paul D., et al. Virtual reality and augmented reality for industrial automation. U.S. Patent Application No 15/718,856, 2018.

[12] ANDALUZ, Víctor H., et al. Virtual reality applied to industrial processes. In: International Conference on Augmented Reality, Virtual Reality and Computer Graphics. Springer, Cham, 2017. p. 59-74.