

# A Study On Metaverse Spatial Acoustic Adaptation To Minimize Environmental Adaptation Using Spatial Sounds Around Accessors

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**Abstract** - *The metaverse space is one of the ways to utilize the virtual space. By making good use of the features of the virtual space, it became possible to apply various exchanges and information sharing between non-face-to-face users. Recently, these features have been used for non-face-to-face applications, but limited problems have arisen because of the use of networks. Therefore, this study introduced a method to solve these shortcomings and to minimize the time required for adaptability to participate in the virtual space at any time and to come back to the real space during participation to perform important tasks. This study provided a metaverse space considering the environment of the accessors by processing the acoustic elements. In order to adapt to these environmental changes, satisfaction was improved through weekly evaluations. This study can be applied in various ways to the utilization of metaverse space.*

**Keywords** - *Metaverse, virtual space, virtual sound effects, feedback, sound effects*

## I. INTRODUCTION

Communication using network networks is applied in various ways. Providing users' convenience by accessing various environmental places and sharing data are now taken for granted. Recently, the corona environment has been prolonged, and non-face-to-face conversations have increased. In the coming era, there is no restriction of time or space, and it is developing into the meeting and sharing data in mutually comfortable spaces. These days, the development of virtual space is developing in a way where a certain shared space is created, and individuals in the role of avatars participate to exchange education and information, away from the method used for education or guidance. These virtual spaces are called metaverse spaces. There are many advantages to developing and advancing these spaces in various ways, but there are also disadvantages. Therefore, this study was conducted to overcome the acoustic disadvantages of the metaverse space to speed up adaptation in virtual spaces and to minimize the problems that appear when returning to real spaces. The application of virtual space has generally limited development. First of all, the development was

very limited due to the picture quality, distant senses of space, and mechanical sound effects. These shortcomings, rather, have developed a lot as a way to overcome difficulties in the corona environment. In these fields, non-representative spaces were created so that business meetings could be held online, but new things were needed to guide, meet, and apply realism in common spaces.

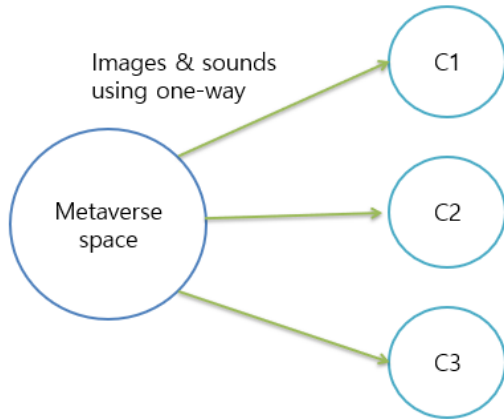
The method applied in this study has uniformity in the metaverse space with a certain composition, but the participants' environments are different. The second chapter describes the application of general metaverse spaces used in existing virtual spaces. The third chapter describes the method used in the metaverse space by applying the proposed method of minimizing adaptability to the environment. Finally, conclusions are drawn, and directions for future research are introduced.

## II. Virtual Spaces and Metaverse Spaces

In the corona environment, people have become very burdened with the meeting. Because of this characteristic, humans have accomplished most of their special purposes through encounters, so face-to-face was an important environment. However, during the corona period, we chose non-face-to-face rather than face-to-face, and these choices do not limit our lifestyle or environmental changes, but we have overcome them and made progress. In particular, these are the fields of research in the fields of virtual and complex spaces, which have been developing in recent years. The characteristics of virtual spaces have the advantage that users or administrators can create and change spaces in various ways. Although these advantages have been developed with diversity, the frames, picture quality, and sound that are so different from the real human environment eventually have many limitations in research. In the end, a lot of calculation was required to increase the picture quality and the number of frames, and it became an opportunity for the graphic field to develop a lot. However, there is a limit to the technology using the HMD because the picture quality problem is visible right in front of the eyes. In particular, using heavy equipment and maintaining or moving for a long time has emerged as an important issue. Since the frame parts are essential for realizing a sense of reality, it has emerged as a more important issue than image quality, and these days, a lot of



dizziness has come to be appealed to with a small number of frames. These characteristics have great limitations on the development in the field of using virtual spaces, and the use of virtual spaces has been limited due to these limitations.

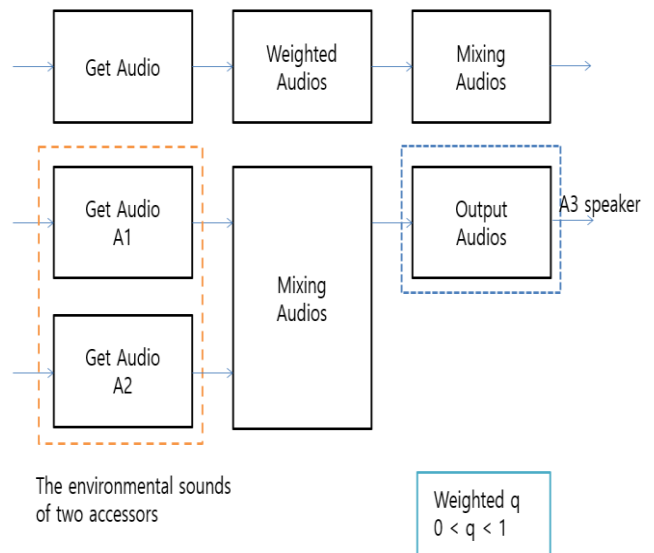


**Figure.1 Metaverse spatial communication using general one-way communication**

As the use of virtual space decreased due to these limitations, the research field began to utilize virtual space as non-face-to-face applications such as ZOOM and Webex, which are non-face-to-face applications using personal computers rather than using HMDs. This was the opportunity that made the development potential of the metaverse even more possible. Existing non-face-to-face programs played an important role in the corona environment, and through this, various ideas were shared, and tasks were performed. However, although non-face-to-face meetings and training conducted by specific groups were possible, it became impossible to perform tasks or tasks that had to be done in the same space. Due to this environmental necessity, the metaverse space developed, and these developments made possible things that could be used by sharing the space. In particular, it has become an important issue for Metaverse to start solving problems that limit the continuous use of virtual space. The development of picture quality shows the realistic side of the graphic field developed in the game industry, and the frame can also make the desired frame, so it has played the role of a bridge between virtual space and real space. As if the existing game space played a role as the subject of realism by allowing users in the real space to freely move the space. The metaverse that develops in this way is now being transformed into the use of game space, and research is ongoing. Because it is the existing computer and monitor that connects the use of these game spaces to the real space, the development of Metaverse is expected to develop just like the game industry. Here, most researchers are looking at this metaverse environment from the point of view of picture quality or frame, but this study needs to be developed in the acoustic part that has both the characteristics of both spaces. It will have a greater impact on the utilization of metaverse space.

**III. Improvement of applicability through acoustic consideration in metaverse space**

The utilization of metaverse space is the utilization of virtual space using video and audio. It is often applied as if the game space was now used as a virtual space. Here, the expression “game space” refers to a game that utilizes 3D, although general games are 2D. Of course, metaverses are created and used using 2D, but this is either too simple or because the space is too large to simplify the cross-section. In this case, images and audio are not too difficult, even if they are simple. However, since they take over the roles of complex and diverse real spaces, and cannot apply the environmental aspects of each of the users, a sense of heterogeneity may appear. The method used to eliminate this sense of heterogeneity is to use earphones to block acoustic sounds heard in the real space as if making a phone call. It is possible to give an immersive feeling by using this way, but when the user does not have a conversation, no notes are emitted as if there is silence. This characteristic can increase frustration because it appears as a feeling of suffocation or disconnection on the network.



$$Areal(n) = (Weighted1 * Audio1(n) + Weighted2 * Audio2(n))$$

**Figure 2. Method of mixing environmental sounds in case of accessor 3**

The use of face-to-face meetings using avatars in space using metaverse can be applied in a variety of ways in a common virtual space. Although research is still ongoing, acoustic considerations are not yet fully supported. In this study, since the environmental sounds heard by each user are appropriately used and processed, there is no disconnection of the network, and no disconnection of real space is necessary when earphones are used. The figure shows the environmental sounds used in different environments. In general, people have the characteristic of hearing well if they focus on the sound they want to hear, no matter how noisy the environment is. By using this feature to deliver the surrounding sounds to the accessors, it can be used to give time to adapt to the environment of

other accessors and to increase their adaptability. In the picture, the environmental sounds of the three accessors were mixed. These mixing sounds give you time to adapt to your own environmental sounds. One thing to note here is that you have to subtract your own environment sound from the environment sounds of the connected people. This is because the sound of one's environment is directly heard with the ear. It is a method of delivering the mixing sounds of the connected users only to the other party. In the picture, when three people connect to the metaverse space, the person watching the monitor mixes the ambient sounds of the other two users and outputs them through the speaker, so he can hear his own surroundings as direct sounds and mix the sounds of the guests without speaking. It can be heard through the speaker. If you are careful here, you cannot hear your surroundings when using earphones, so it takes time to adapt after the metaverse environment is over. This study is to apply ambient sounds that can be applied to the real environment in the metaverse environment without using earphones. In addition, each visitor hears his/her own environment sound, and only the environment sound of the rest of the visitors is weighted. There is an advantage in that the disconnection of the network or the silent section in which static flows disappears due to these environmental sounds. This study conducted a study to minimize the frustration and adaptability that appears when accessing the real space in the metaverse space.

#### IV. Conclusion

This study suggested a direction for the study on the activation of virtual and complex spaces. Recently, the use of virtual space is being applied to non-face-to-face space utilization in various ways. This study considered the acoustic aspect, not the image quality effect of the virtual space. Although there are many advantages that appear in the characteristics of the environmental sound of the virtual space, there is an aspect that the ability to adapt to the environment is poor due to the earphones used to increase the congestion and concentration of the network. Therefore, in order to compensate for these shortcomings, an emphasis was placed on improving the user's adaptability and resolving the frustration of the network by using the ambient sound of the accessors. The characteristic of this study is to provide a familiar connection environment by applying the characteristics of a general virtual space as if using a game space. It was used to enhance adaptability by providing the meeting or meeting in the common space of the metaverse space by optimizing it for the individual environment of the visitor as much as possible. In the method used so far, weights are applied, but by designing which part and how to apply it depends on the user's options, various applications can be made. This study suggested a direction for the study on the activation of virtual and complex spaces. Recently, the use of virtual space is being applied to non-face-to-face space utilization in various ways. This study considered the acoustic aspect, not the image quality effect of the virtual space. Although there are many advantages that appear in the characteristics of the environmental sound of the

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#### REFERENCES

- [1] Seong-Geon Bae, A study on the specificity of metamaterials using polygonal changes in the acoustic environment, *IJETT*, 69(12) (2021) 203-206.
- [2] Seong-Geon Bae, A study on the analysis of sound signals according to adaptive sound image change in various virtual spaces, *IJETT*, 69(12) (2021)144-146.
- [3] Seong-Geon Bae, A Study on the Acoustic Variation to Environment Changes in Virtual and Complex Reality *IJETT*, 13(4) (2020) 648-651.
- [4] Seong-Geon Bae and Myung-Jin Bae, A Study on Recovery in Voice Analysis through Vocal Changes before and After Speech Using Speech Signal Processing, *IJAER*, 12 (2017) 5299-5303.
- [5] S.G. Bae, M.S. Kim, and M.J. Bae, On Enhancement Signal Using Non-uniform Sampling in Clipped Signals for LTE Smart Phones, *IEEE ICCE-berlin*, (2013)125-126. ICCE-Berlin 2013.
- [6] Seong-Geon Bae and Myung-Jin Bae, A Study on Recovery in Voice Analysis through Vocal Changes before and After Speech Using Speech Signal Processing, *IJAER*, 12 (2017) 5299-5303.
- [7] S.G. Bae, M.S. Kim, and M.J. Bae, On Enhancement Signal Using Non-uniform Sampling in Clipped Signals for LTE Smart Phones, *IEEE ICCE-berlin*, (2013) 125-126, ICCE-Berlin 2013.
- [8] M. J. Bae and S. H. Lee, *Digital Voice Signal Analysis*, Books Publishing Dong Young, 3(6) 1998.
- [9] Seong-Geon Bae, A Study on the Acoustic Variation to Environment Changes in Virtual and Complex Reality, *IJETT*, 13(4) (2020) 64-651.
- [10] Seong-Geon Bae, Won-hee Lee, and Myung-Jin Bae, A Judgment of Intoxication using Hybrid Analysis with Pitch Contour Compare in Speech Signal Processing, *IJAER*, 12 (2017) 2342-2346.
- [11] Seong-Geon Bae and Myung-Jin Bae, A Study on Recovery in Voice Analysis through Vocal Changes before and After Speech Using Speech Signal Processing, *IJAER*, 12(2017) 5299-5303.
- [12] Won-Hee Lee, Myung-Sook Kim, and Myung-Jin Bae, Using valid-frame deviation to the judgment of intoxication. *Information, An International Interdisciplinary Journal*, 18 (2015) 4131-4136.
- [13] Seong-Geon Bae, Myung-Sook Kim, and Myung-Jin Bae, Using High-Frequency Accentuation in Speech Signals as a New Parameter in Intoxication Judgment. *Information, An International Interdisciplinary Journal*, 17 (2014) 6531-6536.
- [14] Seong-Geon Bae, Myung-Jin Bae, A New Speech Coding using Harmonics Emphasis Filter, *ISAAC 2013, AACL*, 1 (2013)43-44.
- [15] Geum-Ran Baek, Myung-Jin Bae, Study on the Judgment of Intoxication State using Speech Analysis., 352(2012) 277-282. Springer-Verlag. 2012.