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A Study on Changes in Speech Characteristics Based on an Emotional Signal Processing in a Virtual Space

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Abstract

Users focused on film changes in order to obtain emotional effects in virtual space. These studies have recently been applied to various places such as games, medical care, and learning, and are trying to give more realistic effects. The purpose of this study is to create a more realistic virtual space by making voice and sound additionally. First of all, the image is processed by changing the light from dark to dark and giving the weight of sound or voice to the screen transition from dark to bright. Secondly, we proposed a method for continuously processing the sound signal at the speed of screen switching. Both methods are very useful because they are implemented to be sensitive to emotional changes. This study has the advantage that it can be applied to various existing contents because it can be used separately from video signal.

Keywords: Transition section, Virtual Image, Virtual space, Sound, Weighting, Realistic effects

1. INTRODUCTION

Until now, a variety of software has been developed and applied technology with various technologies is creating new smart devices. Most of the smart devices developed so far have been developed in two-dimensional or three-dimensional space in virtual space, and this has been applied with space limitations. The location movement in the virtual space is made by calculating the virtual space in the user's movement, especially if the movement is limited in the image. However, these features apply well to the characteristics of the virtual space, but the actual audio or sound research has not been made. Therefore, technical development of sound or audio is necessary, and development of more realistic virtual space can be made. This study studies various changes in these environments to overcome and improve acoustical constraints.

The method for realizing the effect of the virtual space was performed by increasing the image quality. Such research is important in image quality, but researches are conducted in various ways to avoid user's dizziness or cognitive problems. These studies have tried to overcome the problem of image quality or frame so far to maximize the effect in the image. Most studies believe that this is because the user focuses on realism only in order to pursue more realism, but this is due to the lack of acoustic consideration, which some researchers are working on. For this reason, the study of the user's reaction when the acoustic effect or influence in the virtual space is conducted. Considering the analytical aspect of the speech signal, it consists of pitch and formant. In particular, the individual pitch is different depending on the characteristics of the human vocal structure, so it can be said to be a characteristic of the speaker rather than an emotional component. In particular, in order to understand the emotional part, it is necessary to know the characteristics of various formants and variations. Since the characteristics of the emotional part of human being studied intensively since 2000 are the biggest change in the change section or the connection section of the sound, the change section has been intensively studied. Therefore, this study should be applied to the sound and voice as well as the visual effect by applying the emotional change of sound in virtual space.

2. CHARACTERISTICS OF EXISTING AND PROPOSED METHODS

The application of sound change in the existing virtual space is applied regardless of the change of image. In this case, the sound that could not be matched with the change of image gave a boring and fragmentary feeling. Due to the boredom and monotony of the user, the characteristics of the virtual space could not be maximized. It automatically adapts to changes in the image and uses the image as a reference so that the user does not feel monotony or boredom. Controlling and changing the sound pressure of the sound by extracting changes or features of the image away from the existing research methods can maximize the emotional part of the user using the virtual space to maximize the immersion. In Figure 1, the change in the input image signal is analyzed and the change in the image is analyzed. The value of the change is changed to the feature of sound using the feature of the

analyzed image. This change applies sound effects to the virtual space.

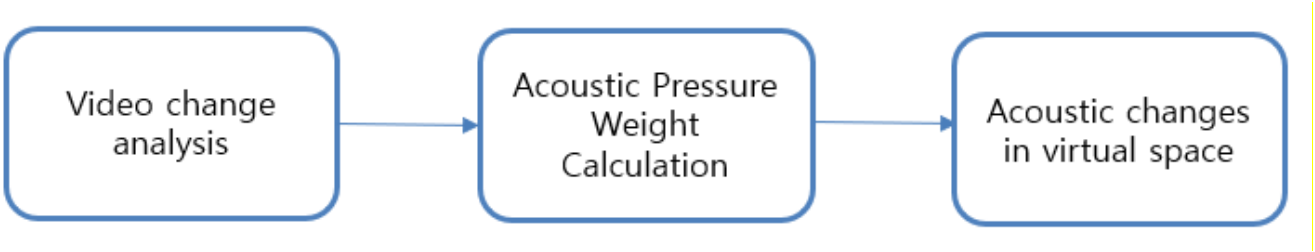


Figure 1. Sound Effects After Feature Extraction in Changing Images

3. PROPOSED METHOD

The most applicable to the visual change is the change of strength and weakness based on the sound pressure changing section, which can be applied primarily and examined the characteristics in the virtual space. When changing from the dark to the bright part of the virtual space, the light was transmitted using the bright sound. On the contrary, when the dark part appeared in the bright part, the strong sound was used to make the change. The characteristics of these changes were automatically applied using a visual change histogram. Since the firstly applicable method is automatically applied according to the change of the existing virtual space, the effect of the additional voice or sound is changed in the characteristics of the existing virtual space to give a realistic effect.

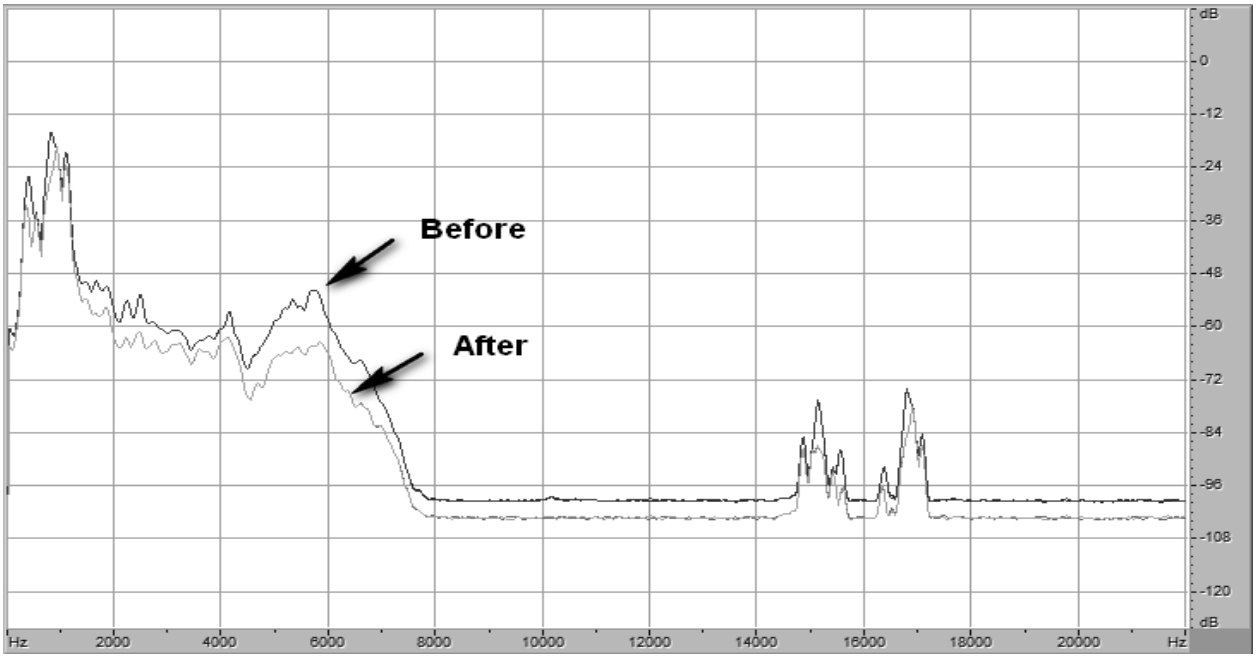


Figure 2 Dark in bright places, bright in dark places

Unlike the first method, the second method gives sound pressure strength when the image changes rapidly and when an object appears suddenly. This case is more effective than most common cases. The effect sound in the virtual space and the voice change of the dialogue were applied in various places.

Figure 3. Sound pressure change in sudden change

The change of sound according to the screen change can appropriately express the change according to the change of emotion. Mostly dramatic changes can be used for surprises, joys, anger and screen transitions. If this is analyzed by acoustic analysis, it can be classified as above and below 1kHz as shown in Fig. 3. The energy below 1kHz is gradually increasing. Increasing the sound pressure frequency for low frequencies increases the pressure of sound in contact with the skin and rapidly changes the pressure delivered to the ear, expressing the ups and downs of emotion. A Low frequency sound pressure rise is because a lot of emotional elements are gathered here. The change in sound pressure in the expression of emotion occurs in various places, and the sound pressure gradually decreases above 1 kHz. This decrease is characterized by a intensive change in low frequency characteristics of emotional ups and downs. Changing from bright to dark or dark to bright, as shown in Figure 1, results in a large frequency sound pressure, but in Figure 3, the sound pressure is not large. For this reason, we should use the speed of time as the weighting factor for things that are applicable to negative changes.

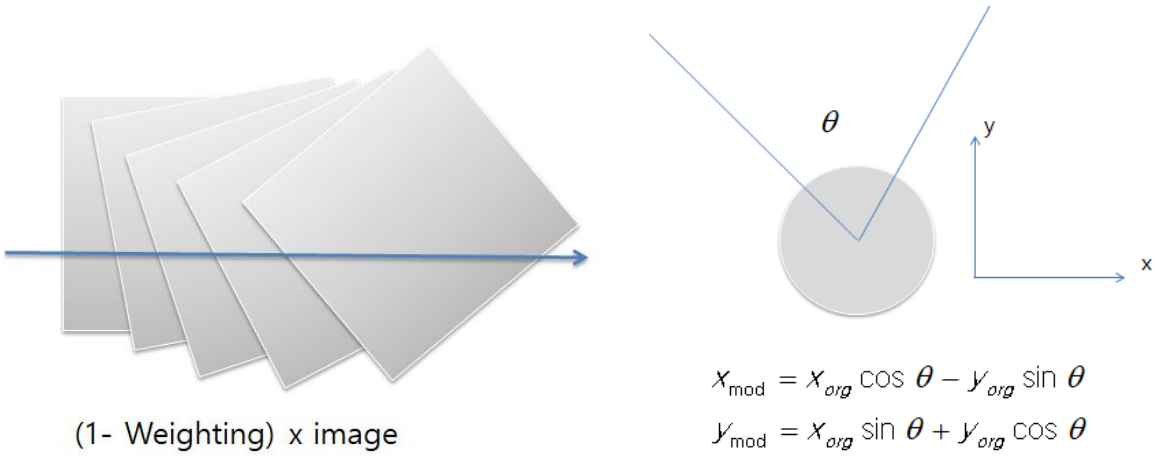
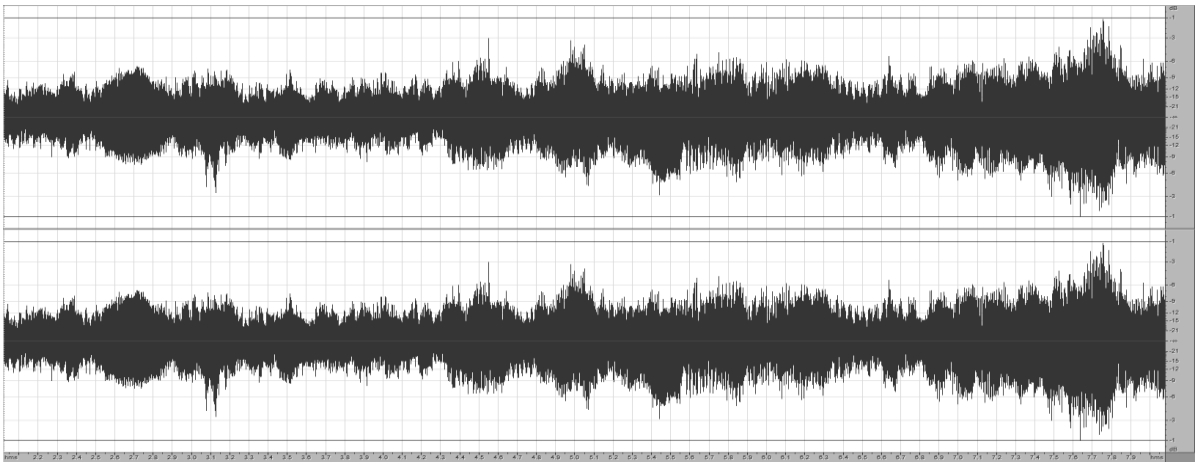
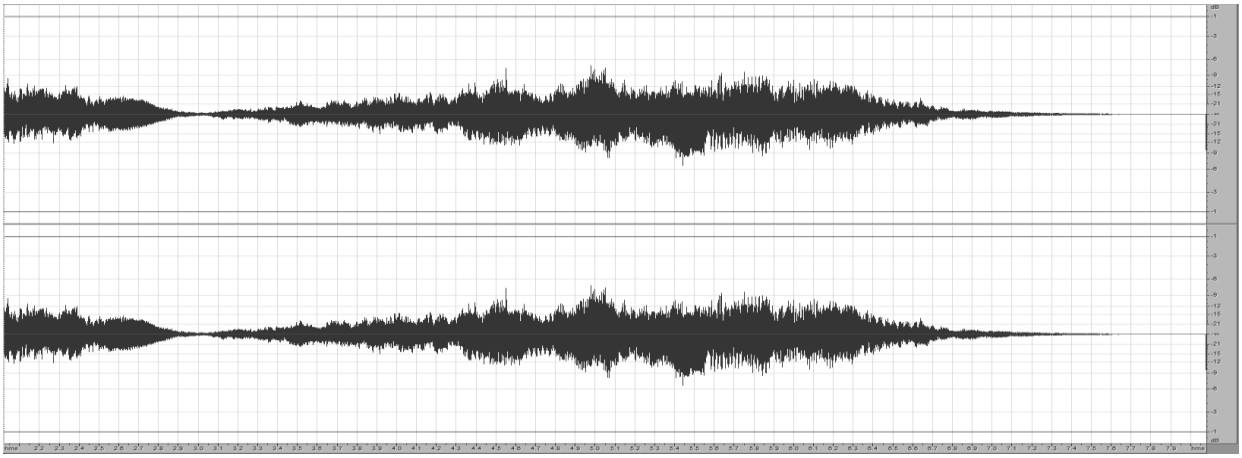


Figure 4. Frequency Sound Pressure Consideration in Screen Switching

Figure 4 shows sound pressure considerations applied to dramatic scenes or screen transitions. The principle of the conversion is to apply the sound pressure of the basic frequency and then process the emotional weighting in consideration of the effect on the emotional transmission in the virtual space. The positional change of sound pressure was corrected by applying the angle according to the visual change to the screen change. We can predict the screen transition through **Xmod** and **Ymod** and apply weighting by adjusting this value.



a) Original sound signal



b) Sound effect with proposed method

Figure 5. Sound effect applied to screen change in virtual space

Five MOS tests were performed to verify the proposed method. First, we heard the original sound and sound and measured the feeling of immersion using HMD. Second, the immersive feeling was evaluated by applying the sound effect only in the place where the simple brightness change was severe. Finally, the evaluation was carried out by applying the sound effect where the screen transition takes place. The first proposed method gained 3 points which was more effective than the original sound, and the second method gave 4.2 points. It can be appreciated that the user's immersion increases with the stereoscopic effect or method of the sound effect.

Table 1. Sound psycho-modal test for dadeumi sound

	A	B	C	D	E	average
Orignal sound	2	2	3	2	3	2.4
Proposed method 1	2	3	4	3	3	3
Proposed method 2	3	4	4	4	3	4.2

5. CONCLUSION

Consideration of acoustic pressure in virtual space is very important. In particular, since the time and magnitude of sound pressure to be reached vary according to the user's

location, this study applied this feature to screen switching to maximize the sensory effect that the user feels. First, the magnitude change of sound pressure according to the frequency change was analyzed, and the weighting factor was analyzed in consideration of the screen switching time. The change in sound pressure analyzed in this way was applied as a value. The effect that depends on the response speed of the user was very good in expressing the specificity of virtual space. The characteristics of the frequency were analyzed in consideration of the transition from the dark to the bright or the bright to the dark. The change in sound pressure of the frequency was large at the time of switching. If the screen transition time is too fast, a change in sound pressure that is too large has an effect of being insensitive to the response. This study applies temporal considerations to this study using weighting factors. In the future, this study can provide more effective effects on user's immersion if we consider the characteristics in various virtual spaces.

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