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3D Spatial Interaction Method using Visual Dynamics and Meaning Production of Character

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Abstract

This study is to analyze the relationship between character and human semantic production through research on character visualization artworks and to develop a creative platform that visually expresses the formative and semantic dynamics of characters using the results will be. The 3D spatial interaction system using the character visualization proposed generates the transformation of the character in real time using the interaction with user and the deconstruction of the character structure. Transformations of characters including the intentions of the viewers provide a dynamic visual representation to the viewer and maximize the efficiency of meaning transfer by producing various related meanings. The method of dynamic deconstruction and reconstruction of the characters provided by this system creates special shapes that viewers cannot imagine until now and further extends the interpretation range of the meaning of the characters. Therefore, the proposed system not only induces an active viewing attitude from viewers, but also gives them an opportunity to enjoy watching the artwork and demonstrate creativity as a creator. This system induces new gestures of the viewer in real time through the transformation of characters in accordance with the viewer''s gesture, and has the feature of exchanging emotions with viewers.

Keywords: *3D spatial interaction, Visual dynamics, Meaning production, Character deconstruction, Character visualization*

1. Introduction

Character is are a measure of human culture and are one of the most important visual mediums as well as images. Character expressions are closely related to people's real life, and they have been expressing contents and conveying information in various and individualized forms according to the development of human culture. Nowadays, characters are recognized as visual, linguistic, and philosophical art genres, not merely as information transmission media. This is because characters can be visually transformed, interpreted in various ways, and shared by many people. With the development of media, characters are combined with

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images, and their meaning is extended to cultural texts in which analogue and digital coexist. Text is a term that cannot be defined in a word along with concepts such as letters, characters, sentences, stories, speeches, conversations, etc [1-2]. Therefore, discussions about visual literacy combined with 'literacy' ', which means 'reading and writing ability' and 'visual image', are actively underway [3].

In this study, all letters that can be read for convenience of description are called characters. This is a proposal on how to extend and visualize the viewer's visual literacy using characters. For this purpose, the research on the artworks that produce human meaning using characters and the relationship between the characters and the meaning production in the artworks are analyzed. The results of the analysis are used as a basis for developing a creative platform that visually shows the formative and semantic dynamics of the characters. The proposed 3D interaction system using character is a means of communication that extends the visual literacy of viewers by using deconstruction of character and interaction with viewer.

Most of our communication consists of visually perceived characters and unconscious body language rather than voice language. Human beings use characters and body as a medium of communication to connect the unconscious and the conscious world and discover their selves. On the other side of Descartes's metaphysics, Merleau Ponty believed that human beings were physical and sensual, and that vision was a fundamental advantage [4]. Merleau Ponty insisted that the mind was connected to the eyes (vision). And he thought that the language consisted of various gestures, and that the gesture was an act of expressing the meaning in the world human lives in through the body. Visualizing various characters of human intention using the body can be a way to connect the world of consciousness and unconsciousness. Artworks that interact using existing characters and the human body work within the input of characters or within the algorithm of limited representation. As a result, they do not reflect the active expression or interaction of visitors. This means that the artworks do not adequately reflect the immediacy of the emotional expression of the viewer, and thus the expression of dynamics is lacking. If there is a character visualization method that can express the visual literacy that a character has in a human gesture, it is possible to express the dynamics in three ways. One is to create the intrinsic meaning of a character and the various meanings that can be derived from it, the second is to express the human intention or emotion related to it, and finally the dynamic visualization is provided to give humans pleasure do.

The purpose of this study is to visualize a new reading method that can read modern cultural texts that have a fusion of language and vision by creating new dynamic relations between characters, human intentions, and human bodies. In the proposed system, a dynamic deconstruction method is used to create a distinctive and unique character shape according to the interaction with viewers [5]. Deconstruction is one of the characteristics of postmodernism seen in contemporary art. Deconstruction refers to the dismantling and reconstruction of all the relationships that are recognized, and the creation of new values and meanings. Therefore, the artworks to which deconstruction is applied do not have a clear meaning but have various features, meanings, and dynamics that enable complex and relative interpretations. If the concept of deconstruction is applied to the visualization of characters, the form and meaning of the characters will become more specific and diverse. This visual dynamics naturally leads to visualization of various human meanings.

2. Artworks using character visualization

In this section, character visualization artworks are divided into two categories: Symbolic expression and Interactive expression. Studies on how the works belonging to each category generate various meanings and express visual dynamics are going on. At this time, the characteristics of the works are analyzed on the basis

of disassembly and interaction. The artworks belonging to each category are analyzed on how to express various meanings and visual dynamics. The criterion for analyzing the characteristics of the artworks is the deconstruction of the characters and the interaction with the viewer.

2.1 Symbolic Expression of Character

Now, there are examples of artworks that increase the visual literacy of viewers using character visualization and induce viewers to produce new meaning.

Characters and images can vary in interpretation or visual literacy depending on the reader and viewer. This is because cultural differences between people make different interpretations. This is a continuous signification of characters and images. The semiotic term, signification, does not refer to the process of transmission of the character itself but to the structural relationship between the elements in which meaning is generated. This means that a viewer reading or viewing the characters produces a new visual symbol associated with the individual's visual experience. The same characters can have different meanings depending on its form, its environment, and the reader. Signification can vary from person to person and cause a variety of causes of visual literacy. If the interaction is added to the process of the new meaning production, viewers can create a visual literacy that generate various meanings according to the characteristics of characters and their intention. A variety of interactive elements such as time, space, sound, and viewer's motion create movements within a three dimensional space, which can materialize the message of characters and generate various visual literacies. Especially, if the subject of the artwork expresses the motion that responds to the gesture of the viewer rather than following the scenario of the artist, it attracts the attention of the viewer. Applying such non-linear interactions to artworks will enhance the meaning transfer effect and visual literacy of artists and viewers, and create more dynamic artworks. Therefore, the combination of the visualized characters and the interaction with the viewers is a result of visual reconstruction of characters using time and space, and is a necessary factor for the creation of new meaning production.

Ben Rubin's 'Listen Post' in Figure 1 is a result of the curiosity of an artist who wants to chat online [6]. First, the online conversations of people are collected, sorted, processed, and then some of the content is extracted. The extracted contents are displayed on 200 tiny screens hanging from the ceiling and converted into voice and heard by the audience. This artwork is a visualization and audioization of the various emotions of people in long stories in online chatting. This focuses on viewing and listening to the artwork without the viewer intervening directly in the artwork. In other words, this artwork excludes physical interaction and provides physical time and space for deriving various interpretations and meanings of texts using disassembly and combination of sentences instead. One drawback is that the generated meanings are transmitted unilaterally to the viewer in one direction. If there are various visual literacies produced by the viewer, there will be more vitality artwork.

In Figure 2, *TextAlive* is an interactive typographic video authoring tool that responds to audio signals [7]. After the characters included in music or video are extracted by natural language processing technology, they are synchronized and animated with sound information such as music or voice. The tool has a graphical user interface that provides users with visual effects in 2D space to better understand the content of music or video. This interactive typography authoring tool is aimed at English and provides character-based animation. This means that the interpretation of the meaning of the character varies, but the unique formality of the character is fixed. If we can deconstruct the formality of the character, the meaning of the character and the interpretation of the viewers will be more diverse.

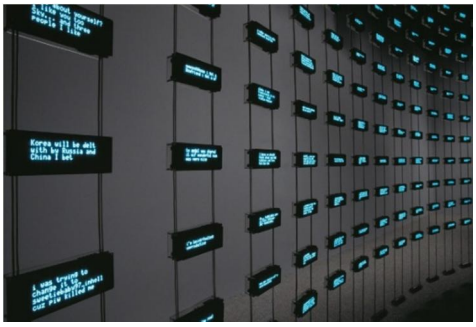

Figure 1. *Listening Post*, Mark Hansen and Ben Rubin, 2010 2015

Figure 2. *TextAlive*, http://textalive.jp,

Nota Bene Visual's work, *In Order to Control* in Figure 3 symbolizes the interactions between the wall and the viewer's self [8]. When texts are projected on the floor, and viewers enter the artwork to read them, texts flow through the body. When the viewer walks through the projector projecting from various angles, the outline of the body of the viewer is projected onto the wall. The viewer feels as if the characters projected on his/her body directly convey the meanings inherent in the characters. In this artwork, there is no active interaction with the viewer, but the viewer uses his/her body for the creation of literacy, so that he can produce more special and new meanings. It consisted of Kinect, two computers, and two projectors.

Figure 3. *In Order to Control*, Nota Bene Visual, 2015

2.2 Interactive expression of Character

Artists have been constantly contemplating ways to communicate with viewers through their artworks. One of the ways for viewers to produce various meanings for the characters that the artist shows is deconstruction. In particular, the field affected by deconstruction is character visualization. Recently, character visualization art works that extend the range of expression as an interactive medium have also used characters, images, sounds, time and the interaction with viewer as design elements. Now characters can be animated, connected with sound, music, motion, and also narrative. Deconstruction is being used to effectively animate characters. Character visualization using deconstruction can be more dynamic if the interaction with viewer is added. Interaction with viewer, which is an important element of interactive art, is mainly using NUI recently. The best NUI is to use human gestures without any tools. Most of the people's communication is made up of characters of visual perception and body languages which are the language of unconsciousness, not spoken language. Thus, a visualized artwork that combines characters with human

intent and human gestures can be a medium that connects the world of consciousness and unconsciousness. In other words, interactive character visualization artworks connected with human gestures can express various dynamics by having formability by character form and extensibility of human semantic expression. And the expression of dynamism is maximized through the deconstruction of character.

In Figure 4, Romy Achituv and Camille Utterback's *Text Rain* combines the deconstruction and reconstruction process of the English alphabet with the viewer's interaction [9]. The fact that hypothetical alphabets falling from the air respond to the action of a participant ensures that the relationship between image and text is not fixed but fluid. Viewers collaborate to interpret texts, communicate with each other, or interfere with each other. This artwork, which uses the body of the viewer as a mediator between virtual space and real space, provides pleasant confusion of space, creating the dynamics of the artwork and diverse interpretations of meanings. If the viewer has the authority to create the characters that are the components of the content, the characters in the artworks will have more specific meanings.

Camille Utterback's *Written Forms* in Figure 5 shows the digital realm of the characters created by the viewer's motion [10]. This artwork displays characters in three areas with different brightness (dark, medium and light). The areas are configured in real time by recognizing the gestures of the viewer. The darkest area among the three areas represents the human body of the viewer, and the middle brightness area represents the boundary space. The brightest area represents the outer space of the viewer. The viewer recognizes the characters of a specific area according to the brightness generated by his/her body, reads and interprets them, and produces his/her visual literacy.

Figure 4. *Text Rain*, Romy Achituv & Camille Utterback, 1999

Figure 5. *Written Forms*, Camille Utterback, 2000

J. Carroll's 'Screen' is an artwork that interacts with characters using the viewer's body in CAVE [11]. After the initial texts are displayed, one character flew to the viewer with the sound to be read. The viewer can use the globe or stick to play the character. The character thrown by the viewer again creates another new syllable by looking for spaces between words on the wall, and character that the viewer does not act will fall to the bottom. This artwork has the characteristic that the viewer can positively express emotions about specific characters using his gestures. Viewer also has the option of choosing the characters that make up the artwork. The viewer has a great immersion to make content composed solely of his intended characters. However, the viewer who encounters this artwork cannot afford to remind the meaning of characters or reminisce of other meanings if they are too immersed in active interaction. This is an example of how excessive interaction can interfere with the semantic functioning of characters.

In Figure 7, Daniel C. Howe's *Text.Curtain* is a reconstruction of poetry with the viewer's interaction [12]. This artwork is projected on the wall to allow multiple viewers to interact at the same time. When the viewer

approaches, 14 lines of text are displayed and the viewer tries to read the text while moving the characters or lines. This artwork used imaginary curtains and motion tracking technology made of characters to interactively engage the viewer. The viewer must move the curtains in order to read and interpret the new characters.

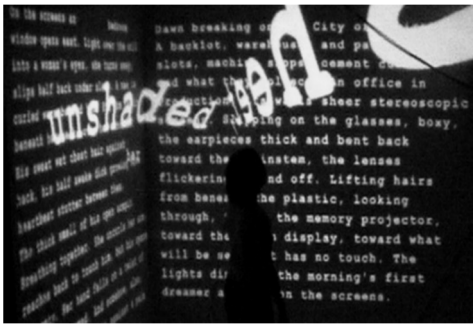

Figure 6. ***Screen*****, Joshua Carroll, 2003** **Figure 7.** ***Text.Curtain*****, Daniel C. Howe, 2012**

3. Relationship of visual dynamics and meaning production of character

Interactive art is not the same thing for all viewers, but has a special significance as it allows for completely different interpretations based on individual interactions. This means that the interaction of interactive art is related to the viewer's visual literacy. Also, the interaction with viewer has some influence on the expansion of the meaning of the characters. Interactive arts that interact using existing characters and the human body work within algorithm with limited input and representation of characters. Therefore, it does not reflect the active expression or interaction of the viewer. This means that the expression of dynamics is lacking because it does not reflect the immediacy of the expression of emotion of the viewer.

Table 1 shows the results of analyzing the artworks in the previous section by applying real-time interactivity, deconstruction, visual dynamics and new meaning production. This table shows that the morphological transformation of characters such as deconstruction and the interaction with the viewer help to stimulate visual dynamics. In the case of *Text Rain*, *Written Forms*, *Screen*, *Text.Curtain and TextAlive*, visual dynamics can be expressed by deconstructed characters or real-time interaction. Of course, if both methods are used, it is possible to express more maximized visual dynamics. *In order to control* has an interaction with the viewer. In this artwork, the shape of the characters is fixed and the viewer is provided with time for expanding the meaning of the characters by using the position information of the viewer. However, there is a limit in that the meaning production is done within the characters shown. This means that the viewer participates in the creation of the artwork, but does not go beyond the scope of the meaning that the artist induces. Therefore, for the new meaning production and the expression of visual dynamics, a character visualization artwork should be provided with a way of interaction with viewers, deconstruction of characters, and new meaning production.

Even if the expression of visual dynamics is good, the viewer cannot produce a new meaning of the character unless the viewer has time to think about the meaning of the character with a calculated scenario. Because the viewer focuses on reading characters. If the character was not chosen by the artist in advance, but the viewer chose it directly, it would be more meaningful. Therefore, this study proposes a method to provide various visual dynamics through the interaction and character deconstruction, and to allow viewers to produce various meanings by repeatedly exposing deformation patterns of characters containing intentions

of viewer.

Table 1. Characteristic analysis of Character visualization artworks

No	Title of artwork (year)	Interactivity	Deconstruction	New meanings Production	Visual Dynamics
①	Text Rain (1999)	○	○ (character unit)	×	○
②	Written Forms (2000)	○	×	×	○
③	Screen (2003)	○	○ (character unit)	×	○
④	Listening Post (2010)	×	×	○	×
⑤	Text.Curtain (2012)	○	×	×	○
⑥	TextAlive (2015)	○	○ (character unit)	×	○
⑦	In order to control (2015)	○	×	○	○

4. 3D Spatial Interaction method using deconstruction

Character visualization involving various forms and meanings differ in the interpretation of the character depending on who sees it. This means that the information conveyed through the character can vary depending on the viewer even with the same character. Distorted characters are implicit and ambiguous, so viewers produce new meanings through their vocabulary, grammar and background. Therefore, The visual change of the interactive character moving according to the intention of the viewer can make the character not only stay in the interpretation of the language symbol but also extend the meaning of the character.

In this study, we developed the 3d spatial interaction system that visualizes the dynamics of human meanings by character deconstruction. Figure 8 shows the general flow of the developed system. In this system, character deconstruction proceeds in order to more positively express the distortion of the character form. The range of characters that are deconstructed and transformed is much wider than the range of characters themselves. In particular, if pieces of deconstructed characters are reconstructed according to the gestures of the viewer, they will be able to show the shape of characters that are specific to the viewer. The various types of characters enable the viewer to produce new meanings associated with it, and the viewer can express various human meanings with their own intent using characters. The deconstructed characters are linked to the viewer's interaction, creating a tension relationship with the viewer and visualized in real time. By tying the form of the characters and the interaction of the viewer in the same time, the new meaning production of characters is maximized.

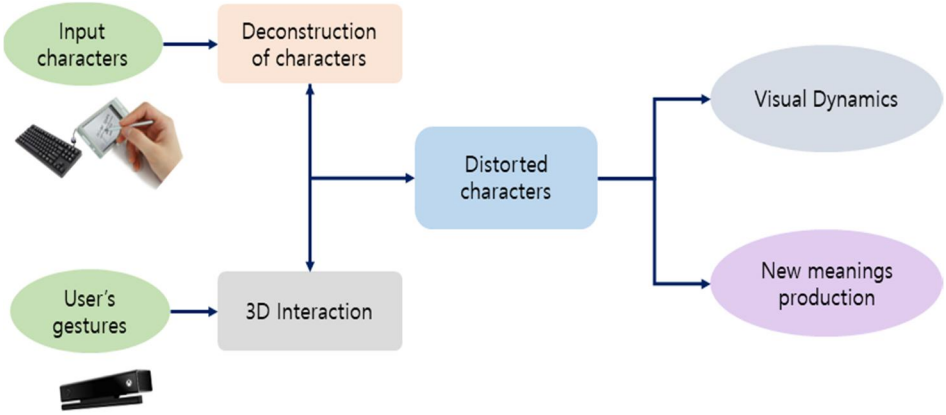

Figure 8. Overview of 3D spatial interaction system

Figure 9 depicts the relationship between the four distorted forms of Hangul '사랑해' and the emotions that the viewer can feel from the forms. In Figure 9, the X-axis indicates the degree of affirmation of the intention of the viewer related to the character, and the Y-axis indicates the degree of movement of the viewer. And the Z axis represents the distortion of the character. Even if the same character is written, it is necessary to distort the character to visualize the dynamics of the character because the viewer's interpretation differs according to the shape of the character. In this study, viewer's emotions were classified according to Russell's 28 emotional words [13]. The more distant the emotional words are represented in this figure, the more dynamic the meaning of the character becomes. The distorted character forms created by the intended interaction of viewer produce many new meanings (Annoyed, Excited, Happy, Satisfied, etc.) influenced by the cultural background and emotions of viewer. That is, the four distorted characters shown in this figure are the result of visualizing various changes of intention and emotion of viewer.

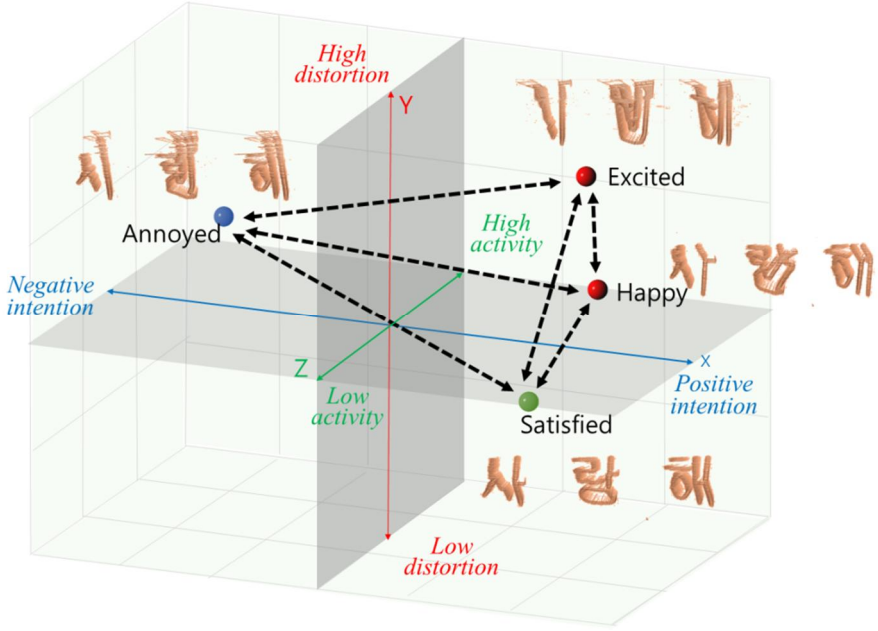

Figure 9. Distorted shapes and meanings production of '사랑해'

Figure 10 is an abstract view of the created space of the viewer who has various meanings derived from '사랑해'. The movement of the characters is a powerful visual element that attracts the viewer's attention, and it is also a response to the viewer's gesture. The viewer feels speed, rhythm, and dynamics in the movement of characters. The movement of characters does not simply mean that characters travel around the screen, but it is a rational and reasonable move created by the viewer intentionally. The character that responds instantly to the intention of the viewer is the self-portrait of the viewer.

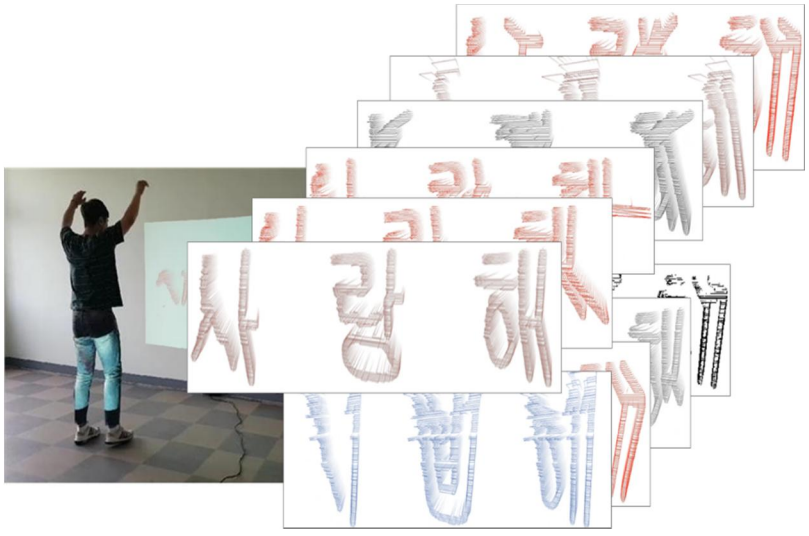

Figure 10. Viewer's creative space extended from '사랑해'

The viewer interprets its meaning differently according to the movement of the character. This is because the emotion of the viewer changes according to the movement direction of the strokes forming the character. Horizontal movement shows stability and lyricism. Vertical movement, on the other hand, is more dynamic and interesting than horizontal movement. Z-axis movement gives viewers 3D spatial feeling. The viewer moves freely in the direction of the three axes, making the shape of the character consistent with his movement and producing the related meaning. The greater the degree of movement, the more dynamic it is [14].

5. Conclusion

The 3D spatial interaction system using the character deconstruction proposed in this study has three contributions. First, the proposed system presents a new visual form of characters through interaction. After the process of dynamic deconstruction and reconstruction, the shape of imaged characters shows a destructive and shocking shape that deviates from the shape of traditional characters. This means that deconstruction of a character shape further extends the range of the character visualization. Second, it maximizes the efficiency of meaning transmission by mutual combination of the characters to be transmitted and audiovisual effect, and extends not only to the dictionary meaning implied by character but also to the meaning area. The proposed system derives new gestures of viewers and produces character meanings in real time through the transformation of characters in accordance with the viewer's gestures. This system has the characteristics of exchanging sensibility with viewers, conveying information in real time with esthetic and originality. Finally, this study contributes to the possibility that the possible applications of the developed system extend beyond various fields. This system can be applied to the media facade and various media

exhibitions as well as educational areas and specific spot customized ads combined with character and game elements such as corporate logos and product brands. In addition, this study has a different significance in diagnosing the development direction of modern character visualization art that constantly recreates visual messages and distorted meanings, and suggesting possibility of infinite expression of character and possibility of experimental reconfiguration. Therefore, the visualization of complex meaning production through various forms such as image, sound, and human motion will not only express the dynamics of human meaning, but also become a narrative method of important communication of contemporary art forming a field of social publicness.

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