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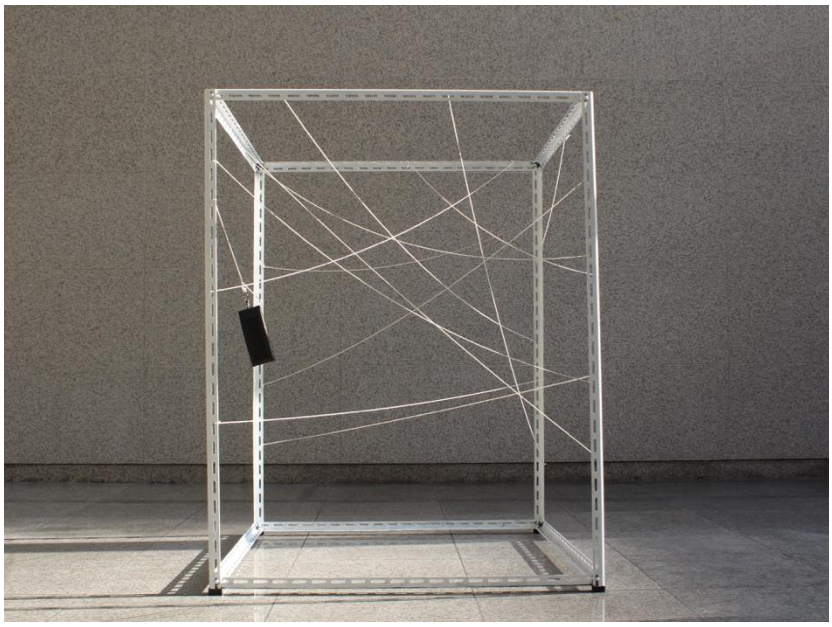
Designing Playful Metaphors in the Interactive Sound Installation

Focusing on 'Net Disruption'



Abstract
In the field of interactive media art, artists design how to make visitors voluntarily participate in their artwork. This paper discusses an idea of utilizing playful metaphors in an artwork in order for visitors to easily recognize the play and act according to the artist's intention. This paper presents an interactive sound installation 'Net Disruption' that adopted the metaphors of play including cat's cradle and musical instrument. The paper point outs the drawbacks discovered during the exhibition. It is related to the duality of the metaphors and technical issues. In the end, the study suggests a future plan that focuses on the main metaphor as cat's cradle reflecting the solution for the shortcomings.

Keywords: Affordance, Play Metaphor, Interactive Sound Installation

1 Introduction

Interactive media art requires visitor's participation. It is not yet complete until visitors participate and interact with the artwork. In order to attract visitors and lead them to participate, artists often design 'affordance' as the basic concept of interaction design. According to D. Norman, designers should care about whether users perceive that some action is possible when they encounter designed objects in everyday life [1]. Furthermore, affordance can be explained by the cultural and experiential viewpoint as well. William W. Gaver insisted that affordances are intrinsically about crucial properties that they need to be perceived as any form regarding human senses. He, then, illustrated the notion of affordances from the aspect of "culture, experience and learning". To be specific, the observer's culture, social setting, experience and intentions can influence the perception of affordances to be partially determined [2].

Therefore, affordance can primarily stimulate human senses visually, aurally, or physically. It gives a hint to a visitor what gestures to take based on human's common senses and knowledge. But most importantly, affordance can be also perceived by the person's cultural background and experience in the past. This study attempts to explain how the interactive art installation, *Net Disruption* expressed the notion of 'play' in

its form and interactions and how visitors can react to the new form of art through interactions recognizing the similar playful metaphor that the person had played in the past as young.

This study, first, explains how the installation *Net Disruption* reflects the metaphors of play as affordances such as a traditional game and musical instrument. Next, it explains how metaphors enable visitors to easily recognize what they are expected to do in order to participate in an interactive media art, in general. Then, it illustrates the technical aspects of realizing the metaphor of play in this installation. Finally, it discusses the shortcomings discovered during the exhibition and suggests improvements. In the end, the study presents the future development of this artwork, reflecting the overall improvements that can be made through the entire study.

2 The Concept of Play in 'Net Disruption'

Net Disruption is an interactive sound installation in which the form takes after the string figures of cat's cradle and presents the geometric figure made from the division of space inside. When it's played, interactions take after the gestures of playing a stringed musical instrument. This artwork can be specifically categorized as ludic interface, which is inherently "playful" interface according to HCI. It is related to the concept of humans as playful creatures, introduced in 'Homo Ludens' by Huizinga [3].

This artwork has a dual aspect of playfulness including the form and the gestures of interactions. The table below briefly explains how the metaphors of play are constructed in the form, contents, and experience of the installation (Figure 1). *Net Disruption* has two aspects of play, implying cat's cradle and a musical instrument. First, this artwork was inspired by the division of space and geometric patterns occurring during cat's cradle play. Therefore, the installation anchored the strings randomly inside the cube representing the geometric figures. Through the geometric string figures, the fundamental visual form of the artwork is constructed. The space inside is divided into different scales and disrupted when a smartphone on a string triggers sound through vibrations when it moves along with the string.

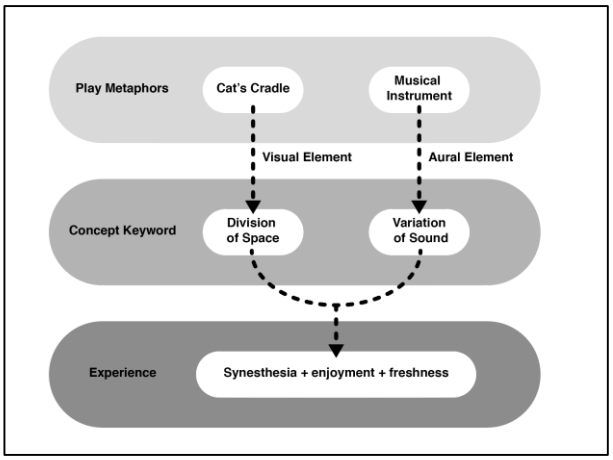


Figure 1 Conceptual Construction of 'Net Disruption'

Secondly, the installation leads to the playful interactions through gestures and sound, which play the most important role to compose substantive contents of this artwork. 12 strings are anchored in *Net Disruption*. This number implies the number of major scale of music. A visitor should take certain gestures in order to make sound as an outcome. This action occurs naturally as if "all play is a voluntary activity", mentioned by Huizinga [4]. These gestures have a metaphor of plunking the strings on a stringed instrument such as Korean traditional musical instrument, Gayageum.

The visual elements of the artwork extend to the auditory elements, so that audience can experience synesthesia while the two 'play' metaphors above converge. The experience for the synesthesia refers to the new experience, a slightly different from the experience of ordinary life with enjoyment and freshness.

3 The Roles of Play Metaphors in the Interactive Media Art

In *Net Disruption*, the roles of a play metaphor are demonstrated through interactions with visitors. Play metaphors have a significant role when it comes to interacting with *Net Disruption*. The diagram below shows the influences of playful metaphor on the interactive media art (Figure 2). A metaphor can influence the form, content, and experience of an interactive art, creating new experiences through digital media technology at the same time.

When the metaphor is reflected on the form, visitors can percept more intuitively what action they need to take according to the artist's intentions. When the metaphor is reflected on the contents, visitors can catch the message of the artwork more easily. Moreover, if a visitor has an experience of playing the metaphor that is reflected on the artwork, it will be much easier and more natural for the visitor to participate and play with it. However, the experience will be different from the visitor's expectations and experience in the past, because digital technology transforms a common experience into a whole new experience. In short, these three aspects mentioned above including the form, content and experience can be all referred

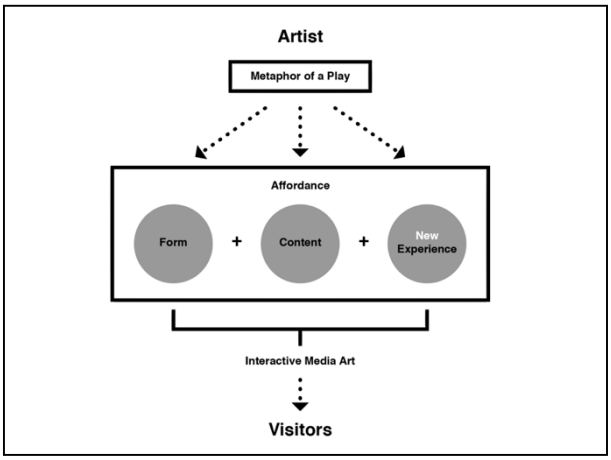


Figure 2 Illustration of the Influences of a Metaphor

to as affordance, which lead a visitor to take a certain action. Good affordance has a form of a 'metaphor' and there appears 'logic' between the interface and a desired event as well as 'clarity' during the process of interactions [5].

As seen from the artworks below (Figure 3), a physical object such as a bicycle or a spade gives a hint to a visitor what actions to take, working as a symbolic medium for the artwork. Visitors act based on their previous experiences and knowledge of a play. Utilizing a visitor's child memory and previous experience works as a starting point of interacting with the artwork.

Figure 3 Left: Jeffrey Shaw <The Legible City>,
Right: Everyware <Oasis>

Two examples below are interactive media art installed in the public space (Figure 4). The form itself is not in any degree different from the original shape of the rides we easily find in the playground. A visitor comes and plays with it thinking of the childhood memory and experience of playing the ride. Sound and light respectively work as a creative factor that makes difference to the common experience. Convergence of the visual element of light and the aural element of sound adds amusement and freshness to a usual experience.

Figure 4 Left: Eness <A Tilt of Light>,
Right: Daily tous les jours <Balancoires>

Next, two more examples (Figure 5) are interactive media art that encourage multiple visitors to interact and participate together with the installation. These artworks work as a musical instrument or a playful ride that generate either harmonious sound or ambient sound according to the movement of the participants. Specifically, in the picture on the left, visitors move around the chairs and sit on a random chair as if they play the game 'musical chairs' and listen to the different timbre of the sound each chair makes. In the picture on the right, visitors jump and climb around the bamboo structure, which is similar to the form of a jungle gym. These playful metaphors that are reflected through the form and content such as the game 'musical chairs' and a 'jungle gym' play an important role in an artwork, not only working as a cue for visitors to play their own music, but also to create melodies together with other participants [6].

Figure 5 Left: Bobby Petersen <Musical Chairs>,
Right: Meret Vollenweider <Sonic Motion>

In *Net Disruption*, playing cat's cradle is presented as a musical performance. The concept of cat's cradle is combined with the act of playing a stringed musical instrument. The installation works as a musical interface. When a visitor hangs a smartphone on a string and manipulates the string, the installation begins to work as a musical instrument. Through interactions, a visitor becomes a performer himself or herself creating sound. One or multiple visitors can participate at the same time and do the performance together.

4 The Technical Aspects of Realizing Playful Metaphors in 'Net Disruption'

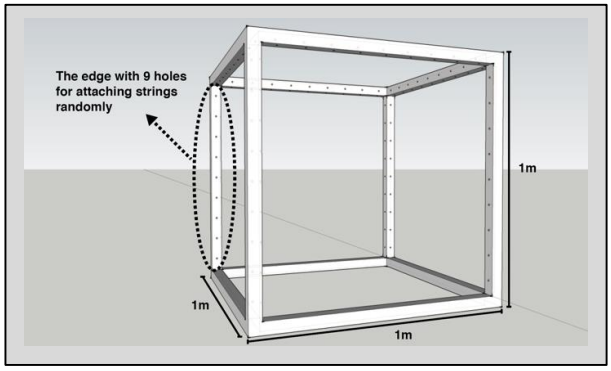


Figure 6 3D Sketch of the Structure of 'Net Disruption'

Net Disruption is a cube-shaped interactive sound installation with the dimension of 1m in width, 1m in length, and 1m in height as shown in the sketch above (Figure 6). Strings are randomly attached to the edges of the cube that create different scale of spaces inside. The string patterns are the metaphor of a net and the division of the space represents disruption of a net as audience interacts and transforms the shape of the spaces inside. This division of space can be experienced from the multi-sensory perspective, including the visual elements and the aural elements as well.

The string patterns that divide space inside the cube are consistently transformed while strings are sunk down with smartphones hung on the string. As an input device, smartphones were utilized in order to send the data from the movements on the string. The computer receives data from the smartphones and transforms the data into sound according to the mapping strategy. Therefore, a special case for smartphones was necessary to make a smartphone freely move along with the string. The case was created through the 3D printer. It protects a smartphone and enables a smartphone to move

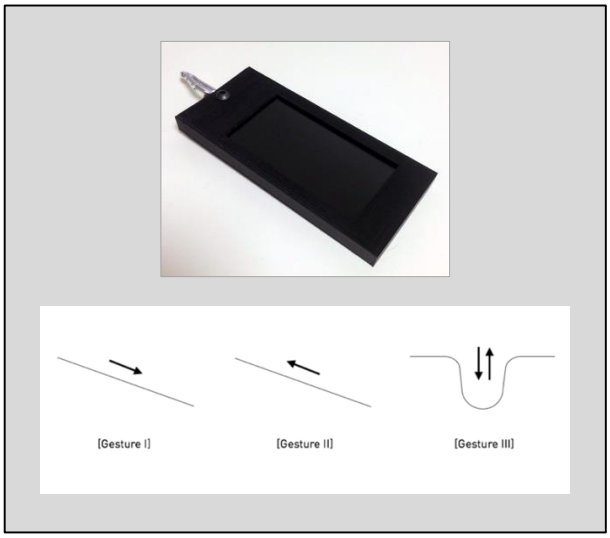


Figure 7 Top: Case for Smartphones,
Bottom: Three Gestures to Play with the Installation

smoothly on the string (Figure 7). There are mainly three gestures that the visitors can take in order to make sounds as the illustration on the bottom of the figure (Figure 7). Visitors can simply slide a smartphone along with the string, lift it or shake the string. When a smartphone is stuck at the middle of the string, the variations of sounds are made which lead to the variations of spaces as it visually and aurally disrupts the different scale of spaces inside. The pieces of the space divided by the strings are expanded or reduced by the gestures of audience.

Sound mapping was done through programs including OpenFrameworks, Xcode, Max/MSP and Logic Pro X. OpenFrameworks and Xcode were used to receive data from the sensors of a smartphone including the compass and the accelerometer. Xcode sends raw data from the sensors to the mapping in Max/MSP to transform the data into sound. Specifically, the data from the compass sensor is transformed into the pitch of sound. The range of the raw data from compass sensor is from 0 to 360 degree. The degree of data constantly goes up and down. Therefore, a compass sensor was considered to be appropriate for controlling the pitch of sound, which can make sound variations from low to high constantly. X, Y, Z values from the accelerometer sensor control loudness of sound. Logic Pro X software was used in order to transform pure sound

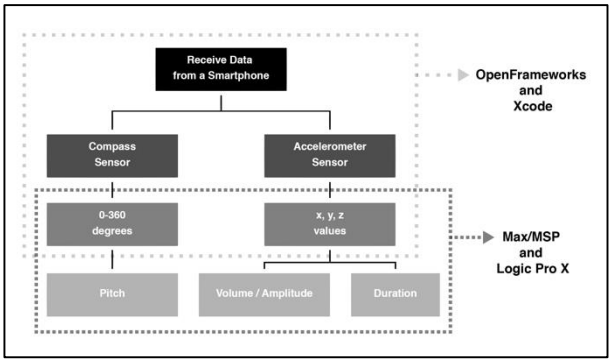


Figure 8 Structure of Sound Mapping Algorithm

wave into MIDI bell sound. The diagram above illustrates how the sound mapping algorithm works (Figure 8).

In addition, the accelerometer sensor was used to create an event to make variations of sound. Data coming from Z-axis value have much greater variations than that from X or Y-axis values when a visitor shakes or lift up the string. Therefore, Z value was used to create an event that generates sound with higher amplitude and duration instantaneously when visitors vigorously lift or shake the string. In this way, when there are big changes in data, it creates random sound and adds to the coincidences of the play. On the other hand, X and Y values were used to generate certain range of sound continuously. The sound mapping strategy for *Net Disruption* is shown as the source code from Max/MSP (Figure 9).

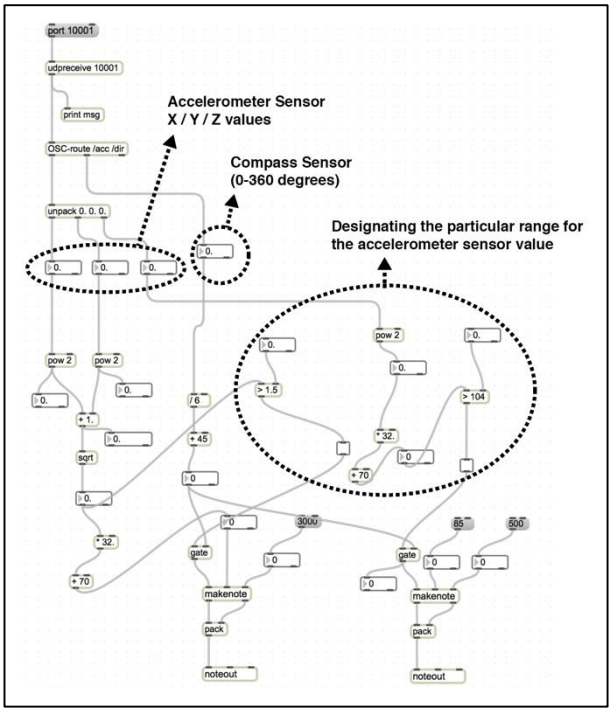


Figure 9 Source Code of Sound Mapping

5 Exhibition and Evaluation

Net Disruption was selected to have a showcase during the FutureEverything Festival held in Manchester City Hall, UK in February 2015. During the conference, *Net Disruption* was introduced as 'Interactive Art Performance' for the installation shows its interface as a musical instrument. Through performance, visitors learned how to interact with the installation and played with it after the presentation. Pictures above describe how visitors interacted with the installation and participated in the performance (Figure 10).

Visitors shook a string with one hand, while pressing it with the other hand as if playing an instrument. Usually, two people participated at the same time and played together. The way of playing with the installation varied depending on each person. In the meanwhile, there were some feedbacks from the visitors related to the sound of the artwork. Some visitors recommended

Figure 10 'Net Disruption', Showcase in City Hall, Manchester

for the artwork to be a more delicate musical instrument that can control volume and pitch more freely as if a traditional musical instrument produces sound with controllers.

There were some shortcomings discovered during the exhibition as in the following. One of the prominent weaknesses was that there was a collision between the two different metaphors of 'play', which were cat's cradle and playing a musical instrument. Due to the duality of 'play' metaphors that are reflected on the installation, metaphors of the play overlapped and didn't work properly as clear affordances. The form of the installation reflected the concept of space division from cat's cradle play. The interaction reflected the metaphor of playing an instrument. There should have been one single integrated metaphor that has a main metaphor and sub metaphors that support the main metaphor. Thus, there could have been a clearer distinction between the main and sub metaphors, which indicate certain actions visitors mainly have to do in order to participate.

Another shortcoming related to the technological issues was that the installation didn't work properly as a musical instrument. Since the installation was presented as a musical performance before audience, visitors might have expected an elaborate musical instrument that enables them to control pitch and volume of sound more freely and easily. For instance, 12 strings that are attached to the artwork could have been analyzed by the different degrees and applied more delicate sound mapping that allow visitors to play the installation as a traditional musical instrument.

6 Moving Forward

In order for this artwork to properly provide affordances to visitors, it needs to have more delicate work as a musical instrument or as a cat's cradle play. It has to have a clear identification of which play to reflect as interactions. Therefore, the future plan of this work will be reflecting the motions of cat's cradle for the interactions as well. Furthermore, detailed sound mapping should be applied to the installation in order for visitors to freely and easily control the elements of sound.

The future plan of *Net Disruption* is illustrated in the sketch (Figure 11). *Net Disruption* anchored strings in the cube, which clearly worked as the visual element. Besides, the smartphone swinging through the movement of the strings stood out as the visual object. However, hands and thread are the visual objects while generating geometric patterns and interaction between players in the real cat's cradle play. Thus, the cube frame and the smartphone can be the serious impediments to form refined interface which leads visitors' interaction of the play metaphor concerning on the cat's cradle in this artwork. Therefore, in this future plan, small-sized accelerometer sensors, compass sensors, and speakers will be directly utilized, hanging on strings, not as the components of a smartphone. In addition, visitors will control strings more freely with their hands out of a solid frame. Instead of a fixed cube-frame, a pivot will exist in the middle linking 12 strings. Each string has a hole on the edge in order for visitors to put their fingers inside and then move the string. It will give a few options for visitors. A visitor will be able to play alone with the new instrument because holding different strings by using one finger. Also, multiple visitors can play together with the instrument since they can hold each string. It will allow visitors to act as playing cat's cradle not only by oneself, but also with others. This way of playing with the artwork by visitors will make more diverse visual patterns as well as various sounds in the artwork.

Furthermore, in order to make this artwork more elaborate musical instrument, sound with a continuous scale has to occur

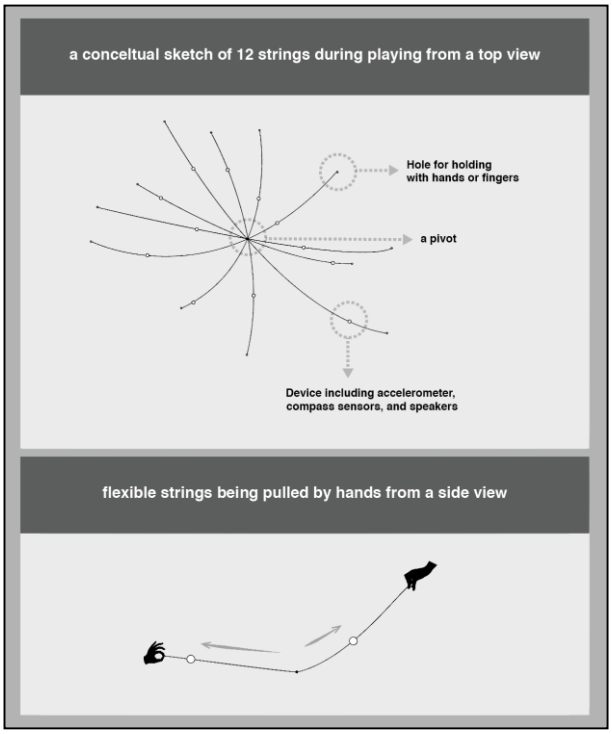


Figure 11 Future plan of 'Net Disruption'

while pitch and volume change if there is movement at any time. Therefore, in the developed version of *Net Disruption*, 12 strings will be mapped to each musical note in major scale. Also, the strings will be replaced by the more flexible material, for example an elastic band so that the movement of strings with each particular scale will have much more unconstrained changes. According as moving the flexible string up and down, left and right or transforming the string to be shorter or longer, the accelerometer and compass sensor will detect the large or small variation of the string. The change of the value from the accelerometer data will be mapped on the variation of the volume. Moreover, the change of the degree from the compass sensor will be mapped on the alteration of the octave for each note. Consequently, the more various sounds will be created.

7 Conclusion

This study investigated 'Play metaphor' which gives an opportunity to visitors to experience newness and familiarity simultaneously, evoking the previous memory from childhood or past experience with amusement. Interactive sound installation *Net Disruption,* proposed in the paper, tried to imply the metaphor of playing an instrument with the concept of division of space, disrupting the net visually and aurally. It first started as cat's cradle, which almost everyone played as a child, especially girls. The concept influenced on the formation of the installation. For interacting with the artwork, another playful metaphor, which is playing a stringed musical instrument, was adopted. Therefore, there were some collisions between the form of the installation and the approach to play with the installation.

In order to solve the problem, a single integrated metaphor and the structure of the main and sub metaphors were adopted in the future plan. Cat's cradle works as a main metaphor and sub metaphor is a stringed musical instrument. It can control pitch and volume of sound freely like playing a traditional musical instrument.

Therefore, the future plan for this artwork emphasizes the motions of playing cat's cradle with multiple people for interactions. Furthermore, sound mapping will be developed in order to allow visitors to freely and easily control the elements of sound including pitch and volume by just playing with the strings. Eventually, the installation will more strongly and intuitively give hints to visitors what they are expected to do through the form and interactions of the artwork that reflect cat's cradle as one single integrated metaphor.

Acknowledgment

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