Digital content that offers experience of listening to crystalized music

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Abstract

Presently, many people are listening to music through streaming services. Though listening to music in such a way is convenient, we feel it lacks the anticipation of encountering unknown music like we felt by looking at the album covers. In addition, listening to a vinyl record requires some errands; however, the effort yields a rich and immersive musical experience. In this paper, we design an alternative way to appreciate music that would provide a similar anticipation and immersive experience to encounter music. In the proposed experience, users perceive multiple 3D objects as crystallized music and select a song from them. When an object is submerged in water, bubbles are generated as part of the object dissolves, and music begins to flow. We developed an interactive system that realizes such an experience by creating objects, each with an IC tag inside, and preparing a water tank with a tag reader on the bottom to identify the object. Music objects are created from the sound source and molded by using 3D printer. We tested the interaction and confirmed that the system functions well as expected. We also ran a questionnaire to acquire users' feedback for designing a better experience. Our objective with this research is to design a novel way to appreciate music. The experience consists of listening to music and appreciating it also by sight, by materializing the tune as a 3D object. Digital technology has generally been used to achieve fast and convenient functions. In contrast, this work attempts to design a "slow" experience in which one is confronted with music more carefully.

Author keywords

Digital Content; Interaction with Music; Interaction Design; UX Design

Introduction

We have encountered musical compositions in many different ways. When listening to vinyl records, we have sometimes chosen a song based on a preference for its cover. Presently, people encounter new music through a streaming service by selecting a tune directly or following suggestions and playlists created by someone else. The latter seems to reduce the number of unexpected encounters with unknown music. We think there was the pleasure of collecting music before, by possessing the records and discs. However, such pleasure also seemed lost as people began to listen to music through streaming. Observing such situations, we devised an idea to conceptualize music as a tangible entity when we generally regard them as digital data now. We decided to design music as a crystalized object that produces sound when dipped in water and dissolving. We expect users to feel the music melting out of the object. We aim here to design an alternative experience of appreciating music and develop a system to realize it. We produce an object of music tune by analyzing the sound source and converting the music to a 3D shape as per a specific rule. The crystal's appearance helps in imagining music, as the shape represents the characteristic of music. In addition, we think one could feel like possessing music more directly than owning it as a digital file. We expect this system to offer a novel experience for encountering music, not only providing entertainment. This research can also be regarded as an attempt to design a new experience by giving different attributes from its original perception, allowing the viewer to appreciate the subject from a different perspective.

To realize the idea, we develop a system that identifies music tunes by objects. The system equips a water bowl into which a user throws the object. The object is molded by 3D printer, and an IC tag is installed inside it. The tag is read by a tag reader at the bottom of the bowl, which lets the system match the object with specific music. To make a representation of music melting out, we insert a material like dry ice into the object and let it produce bubbles when submerged in water. We examined the interaction with the developed system and multiple objects, each materializing different music, and confirmed that specific music is played by the corresponding object. To evaluate the experience provided by this study, we conducted a survey and administered a questionnaire to examine whether the system offered an engaging approach to music.

Experience with Crystalized Music

We considered what if we could crystalize a piece of music so one can take it by hand. Since the crystallized object is

music, we should be able to expect to listen to the tune by dissolving it. As it would be natural to expect a different shape from different music (Figure 1), you will have fun imagining the original music from its shape. To make it happen, we designed a mechanism for the interaction. We also prepared a method to transform a music tune into 3D geometry for creating crystalized music objects.

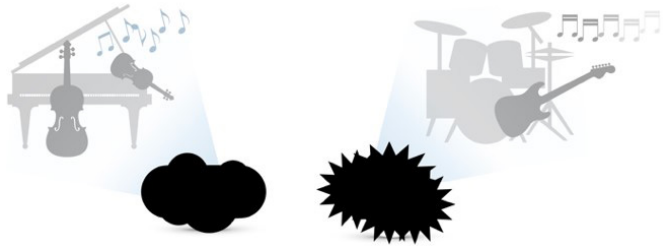

Figure 1. Concept of crystalized music.

We expect a user would have the experience shown in Figure 2. First, the experience begins with viewing multiple music objects. Each object represents a different music. As the shapes represent certain musical features, they are generally different in their looks; some are spiky, whereas others are smooth. Therefore, the user can imagine the tune from the object's shape. A user would choose one to listen, not knowing what music it is. Once chosen, one can throw the object into the water to dissolve it. The user will see the bubbles forming as the object dissolves, and the music starts to play with a lighting effect appearing simultaneously. When it is resolved entirely, the sound will cease.

We aim with this research to propose a different perspective of being involved with music. First, we want to provide a sensation of feeling music crystalized as an object. This expression realizes the transformation of music, a temporary phenomenon, into something static and tangible that one can appreciate before listening to the sound. In addition, users can feel the music by watching and touching the object. That would allow users to select a tune to listen to in a different approach than generally practiced. We expect this interaction would lead to emphasizing the music's transient nature because users will observe the event also by sight.

To establish an immersive experience with our approach, we wish to have the shapes somewhat reflect the music's characteristics. However, we do not want to create an object referring to a personal impression that would differ for each individual. Therefore, we need a method that automatically transforms the music into the sculpture design according to a particular rule or algorithm. We started by employing a simple transformation rule that converts the sound wave pattern to a 3D object. By finding an appropriate transformation rule, people could envisage music by browsing the objects' shapes. One could find similar music by sight but not through recommendations provided by a streaming service. That would be another different experience this approach would provide. Seeking an ideal algorithm is a topic for future work.

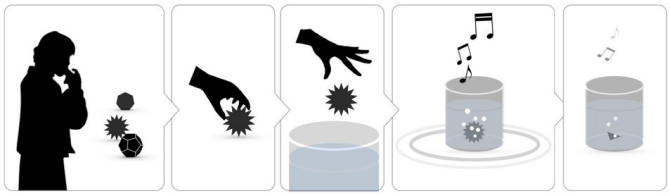

Figure 2. Entire process of the experience.

Related Research and Works

Various ways of interacting with music have been proposed. Some make the experience an installation that facilitates a specific space to appreciate listening to and interacting with the music. The Intelligent Street is an installation work that designs a space for interactively listening to music, where people can affect the music by sending text commands via smartphone (Lörstad, 2004). Sound Forest is another installation work, a room with numerous illuminating interactive strings (Frid, 2019). Multiple people can play with a string simultaneously to emit a sound and share the experience. Mayer et al. (2014) have developed a system in which two users collaborate to create music and visual effects by interacting with two-sized semi-sphere domes. While these works and ours share the objective of attempting to design a novel experience of interacting with music, theirs also aim to provide interaction among the individuals entertaining the experience.

From an interaction design perspective, our approach can be considered a variation of designing a tangible user interface (TUI). A first of that kind happens to take a theme related to music (Ishii, 2004). Our work shares the concept of providing an alternative experience relating to music. However, with Ishii's Music Bottle, music is still the same sound phenomenon, though the interaction with music differs from regular listening practices. Our approach is different in making music a tangible entity to interact with. reacTable (Kaltenbrunner, 2006) is a synthesizer system employing a tangible user interface (TUI) to create sound. The user synthesizes a sound by putting circular and cubic objects on a circular table. The visual effects of the objects appear on the table when they are placed on the table. When positioning multiple objects in a neighborhood, their effects link in creating a sound. There is still other research on designing specific tangible interfaces. "The Table is The Score" (Levin, 2006) proposes to use spectrogram shapes formed by a rubber or felt and place them on the table to play sound. In adopting TUI, many approaches seem to treat objects as interfaces. In the case of Ishii's Music Bottle, the interaction is designed by fitting music into the metaphor of a bottle, as a thing to keep something in it. We believe that the interactions with a TUI must be designed so that the object is well integrated with the context of the content, rather than simply being used as an interface. We conducted this study considering this concept.

In realizing this work, we have sculpted the music as a three-dimensional object. Similarly, several attempts have been made to transform music into a visual representation. Narratives 2.0 (Dittrich, 2008) is an example of music visualization. It uses the frequency of a music channel to determine the turns of lines and colors in creating a visual representation. Another visualization work created for a poster (Bremer, 2020) utilizes the music's data and includes information on how the tune has been listened to at a streaming service. In addition, var-

ious methods have been proposed for converting music into visual representation (Lima, 2021, Khulusi, 2020). Macrogroove (Chable, 2019) attempts to interactively convert sound into 3D shapes. A common approach among these studies and ours is that the shapes and colors are automatically generated from the music data according to a specific rule rather than through individual tastes. The resulting expression may not conform to human senses; however, it may lead to discoveries about a tune, providing a different perspective on appreciating music.

Implementation

System for Playing Sound

The system equips a water bowl where users can drop the object. To realize the experience explained in the previous section, we need to implement the following functions for building the system.

1. Identification of objects
2. Detection of an object submerged in water
3. Control of playing sound
4. Illuminating effect (optional)

First, the system should be able to identify the object chosen for playing music. Several approaches can be used to identify the object. In this study, we inserted an IC tag into the objects. We employed this method because the system can simultaneously detect an object's immersion in the water by placing a tag reader at the bottom of the water bowl.

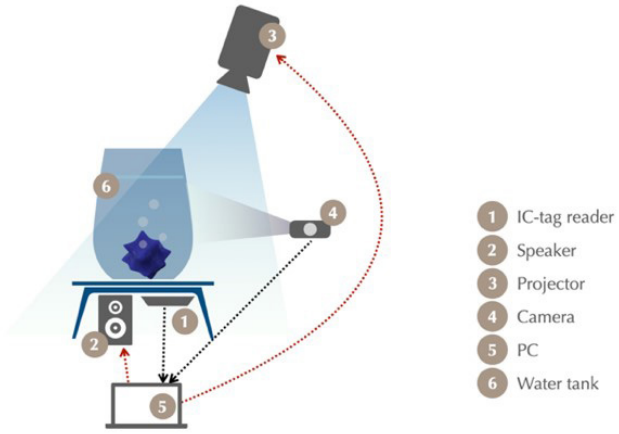

Figure 3. System overview

When the system detects an object submerged in water and identifies the corresponding music tunes, the system starts playing the sound via a speaker at the bottom of the system. Simultaneously, the system projects a visual effect onto the surrounding plane as a supplemental representation of sound. An extra function is required to stop the music by observing the melting progress. However, we have not implemented it yet. It is a topic for future work. Figure 3 illustrates an overview of the system.

Crafting of Music Objects

We need the followings for preparing the music object.

1. Conversion of sound data to a 3D shape
2. A mechanism to identify an object
3. A mechanism to make the object look soluble in water

We do not want to manually design a 3D shape of each music by relying on individual sensitivity and preference. It would be ideal to have an automatic translating rule to create the objects of many different musical tunes. We are currently adopting a method that transforms the sound volume and pitch changes into a 3D object. The objects are then fabricated using a 3D printer (Figure 4). We make a hole in the object for placing an IC tag, as shown in Figure 5. We also place a soluble material in that space. This mechanism generates bubbles, creating the appearance that the object is dissolving in water. The object itself remains unaltered even after the bubbles subside with the current setup, though. We also attempt to prepare molds and create objects out of meltable materials. However, placing an IC tag inside an object created this way is awkward because the tag remains after it melts. Therefore, we need to design another system for object identification, which we have not implemented yet.

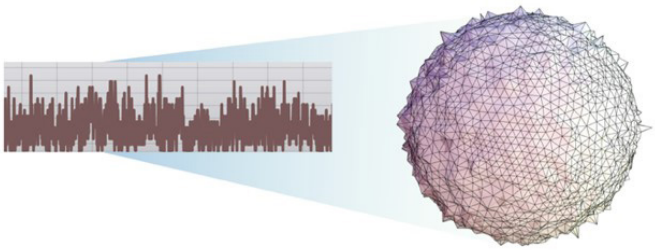

Figure 4. Conversion of music data to a 3D shape.

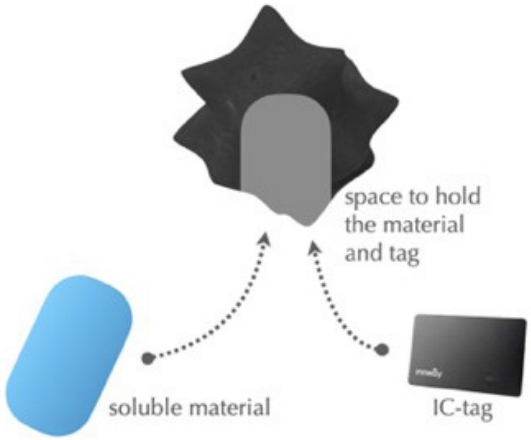

Figure 5. Structure of the music object

Evaluation and Discussion

To verify that the system functions properly, we threw the objects into the water to examine if it correctly identified them. We threw three different objects into the tank in random order 20 times, with 16 times success. The failures were not due to misrecognition but because the function to recognize them was not activated properly. We interviewed 11 persons on their experience with the system. 10 answered that it was an entertaining and impressive experience, and eight answered that they felt music was melted out from the object. The results suggested that the intention of the experience was conveyed to the participants, though we consider further improvements are necessary to provide the experience more realistic.

This work offers the users largely two different experiences. One is choosing an object by imagining the music by its shape, as shown on the left image of Figure 6. The other is to feel the music as if it is melting from a solid object (Figure 6, right, Figure 7). To make the first experience more affluent, we believe the object's shape should reflect the music's characteristics more. It would be possible to extract various other attributes that give the music its characteristics, such as the length of notes and the frequency of specific scale changes on the score. In this study, we only considered shapes to represent a piece of music; however, attributes like color, tactility, and weight could also be regarded as representational elements. Reflecting these in the model is an issue for future research.

We have added some small interaction designs to reinforce the feeling of listening to crystallized music. After the system detects an object is submerged, an interval is inserted before the music begins, making the sound start at a low volume and increase in volume over time to match the amount of bubbles. Another design is applied to the music's sound. If the sound is clearly audible, users cannot feel the music is playing underwater. Therefore, in addition to placing the speaker at the bottom of the water tank, we have digitally converted the music so that it sounds like it is playing underwater. These small designs are not necessary to achieve functionality. However, when creating an experience, we believe it essential to mind these small details. Currently, the object remains after the bubble and music ceased because it is plastic. However, we want the object to disappear to express the one-time nature of crystallized music. We consider this would alter the experience further.

Conclusion

To design a new experience of appreciating music, we devised the concept of listening to music by melting a crystalized object. The innovation of this study is designing music

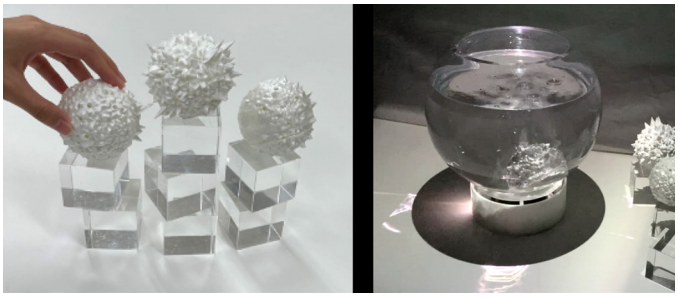

Figure 6. Choosing a music (left), music and light are coming out from object (right)

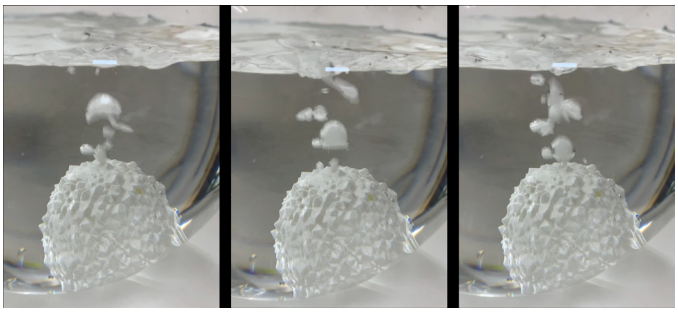

Figure 7. Bubbles coming out of the object

itself as a tangible entity. Further modifications are required to make the user's experience of listening to the crystallized music melted out more natural. Having reviewed the result of the user experiment's feedback, we became aware of the need to reconsider the design method for the object's appearance. However, we believe we succeeded in demonstrating this idea's feasibility. In the future, we would like to revisit the molding of objects and formulate conversion rules that will produce many variations in object design. We did not design this system for listening to music in daily use. The experience would be one that users would encounter in exhibitions. The experience must also be evaluated from such a viewpoint in future work.

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