

# HAKONIWA: A SONIFICATION ART INSTALLATION CONSISTS OF SAND AND WOODBLOCKS

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## ABSTRACT

In this research we present an interactive tabletop installation "Hakoniwa". It consists of a wooden box, white sand and painted woodblocks. In this system, corresponding to the arrangement of woodblocks, a ceiling-mounted projector shows visual effects on the sand surface. At the same time, generative music is composed in a computer corresponding to the arrangement of woodblocks and modeling of the sand. This is an attempt of sonification of miniature garden. We studied Sandtray therapy, one of a famous form of art therapy, as a motif of the installation. We directed our attention to tactile sensation of sand and woodblocks, and tried to extend sandtray using computer vision processing and multi-media output. In this paper we describe details of the interactive system and discuss the possibility of supporting primitive play using such interactive systems.

## 1. INTRODUCTION

Today there are a huge number of video games. In those games visual effects and audio effects are extremely gorgeous, rich and flashy. On the other hand, primitive plays such as playing in the sand or building woodblocks are still attractive for a lot of people. They don't have dramatic effects, but their tactile sensation and interactions are ultimately intuitive. When they play with these primitive toys, children don't have to obey any rules. It is fairly different from video games. Even if young users may beat, throw and bite them, primitive toys allow it. If such a tough toys can be an interface of interactive games, it may provide unique experience.

So far we researched and developed some interactive devices, especially tangible interfaces. For example, before we proposed a tabletop interface inspired by a sandpit [1]. In this work we developed a digital sandpit that can change its solidity being controlled by a computer. Through this research we found a special possibility of sand as an interface. Then we directed our attention to sandtray, to build a computerized interface that provides primitive, attractive and flesh experience to users.

### 1.1. Sandtray Therapy

Sandtray therapy is one of a art psychotherapy. In this therapy clients arrange toys into the sandtray as they like. Basically the



Figure 1: Example of a work created in sandtray therapy

sandtray' size is 57 x 72 x 7 cm. There is sand in the sandtray and inside of the tray is painted in blue color. This means when a client dig a deep hole in the sandtray, blue color appears there and it is a metaphor of water. There is a shelf for toys aside of the sandtray. In the shelf there are over hundreds of toys, a therapist selected, for example miniatures of human, animals, plants, vehicles, and buildings. A client chooses toys he or she likes, and arranges them in the sandtray.

Most of clients finish the creation in thirty minutes. Through the creation, client's mental illness progresses toward recovery. Not only the creation, the feel of sand may be also important for recovery. Figure 1 shows an example of the miniature garden created in the therapy.

The origins of sandplay therapy stem from the psychoanalytic work of Margaret Lowenfeld[2]. Then Dora Kalff, Jungian therapist, developed sandplay therapy in Switzerland in the 1950s and '60s.

As an important aspect of the sandtray therapy, Tanji[3] point out that the garden created in the sandtray therapy express a state of mind of the client. The therapist can analyze the client's mental condition through the garden and it helps to decide next treatment for the client.

## 2. RELATED WORKS

### 2.1. Clay and Sand as interface

Ishii et al. presented a novel system for the real-time computational analysis of landscape models - called "Illuminating Clay" and "SandScape" [4]. Both Illuminating Clay and SandScape are based on the same principle, but the different point is material of 3-D modeling - clay and sand. In both system, the user can design 3-D model using the material, and a ceiling mounted 3-D laser scanner analyzes the model and the computer projector show graphic information to assist the modeling. This research is important precedence research that realized sensing system to analyze sand surface and projection output on the sand surface. This research showed a possibility of using materials such sand and clay for a user interface. Their tactile richness makes users pleasing to touch and easy to manipulate. Illuminating Clay and SandScape were interfaces mainly for designers and engineers, but such interfaces can make computer manipulation easier and more familiar for people who are not accustomed to using computers including children. On the other hand, we inspect the possibility of using such primitive materials as an interactive interface for play and therapy.

### 2.2. Interactive Sandtray

There are few papers that researched sandtray as an interface. Hancock et al. presented a virtual sandtray therapy system on multi-touch interactive tabletop [5]. In this research they worked with three sandtray therapists throughout the evolution of their prototype. Their work is important precedence research that studied sandtray therapy from the point of view of design and engineering. They developed virtual sandtray application based on the sandtray therapy's interactions. But the system was realized on a multi-touch tabletop display, so the tactile richness of sand and toys were missed. We consider that the tactile sensation of sand and toys are important constituents for sandtray therapy. We aim to design an interface, which have both the tactile richness and the virtual experience.

### 2.3. Tangible user interface

There are various previous works about tabletop tangible interface. Pompeu Fabra University Music Technology Group developed reactable [6]. This system captures objects on a table and generates electronic music. Sequence music is played corresponding to moving and turning objects. Compared to other musical interfaces to play live electronic music it is easier to understand for the audience how the player is controlling the music, because reactable has tangible object as a music controller. Being used by many professional artists for live performance, reactable proved to be tangible is important aspect for musical interfaces.

As a tangible musical interface played on a table, we developed PocoPoco [7]. In this device built-in 16 cylindrical units visualize music by moving dynamically. At the same time, each unit can detect height and rotation of itself. Then a user can use moving or turning these units as musical effectors. This device also proved tangible objects are suited for visualize music.

YAMAHA Corporation developed The Music Table [8]. In this system multiple players can collaborate on playing music by hitting pads on the tabletop device. On the other hand, Iwai et al. developed Musical Chess [9]. In this system, two persons sitting down face-to-face play a game like chess, and music is generated corresponding to the situation of the game. These researches proved that tabletop device is suited for musical communication.

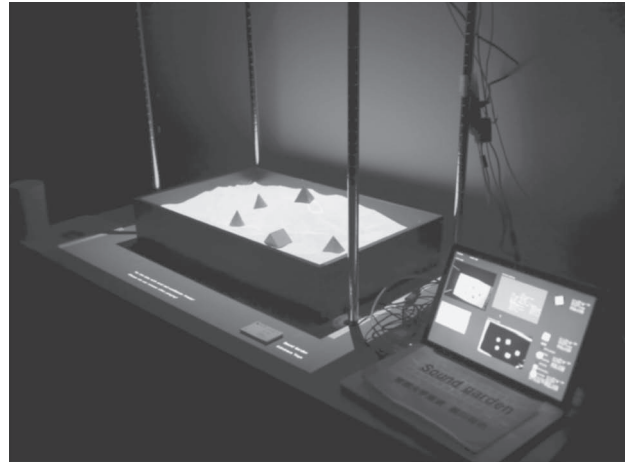


Figure 2: outlook of the installation

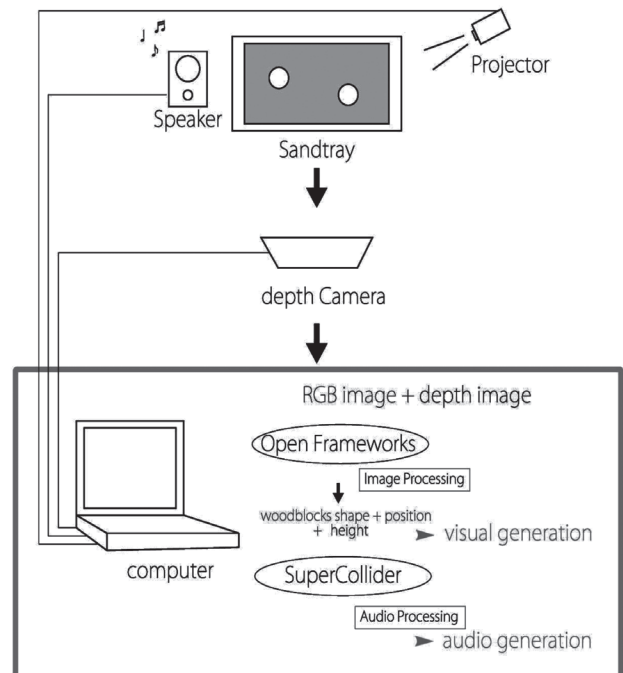


Figure 3: configuration of the system

### 3. METHODOLOGIES

We developed an interactive sandtray installation called “Hakoniwa”. In this art installation, light effects and music is generated corresponding to the arrangement of the sand and woodblocks. Figure 2 shows the outlook of the installation. The depth camera is used to capture depth image and color image, and the data is used for shape detection and color detection. Corresponding to the arrangement of sand and woodblocks, visual effects and music are generated dynamically. In this chapter we describe the hardware system, the software system, and interactions.

#### 3.1. Hardware system

This system consists of a sandtray, white sand, wood blocks, a ceiling-mounted projector, two speakers, a depth camera and a laptop computer. Figure 3 shows the configuration of the system. We prepared 80 x 50 x 20 cm ‘s sand tray. White sand is natural heat-treated sand erased impurities. We painted those simple woodblocks in sprays to several colors. To get image and depth information, we used a depth camera (Microsoft Kinect). The camera is mounted to the ceiling together with the projector. The data is sent to the laptop computer, and then it generates visual effects and sound according to the situation of the arrangement of the garden, and then sends them to the projector and speakers. In this system, users can play with sand and woodblocks freely. Both sand and woodblocks are natural stuff with no marks and no built-in mechanism, so users can play with them without any special care. We think this feature is important for the systems that children may use.

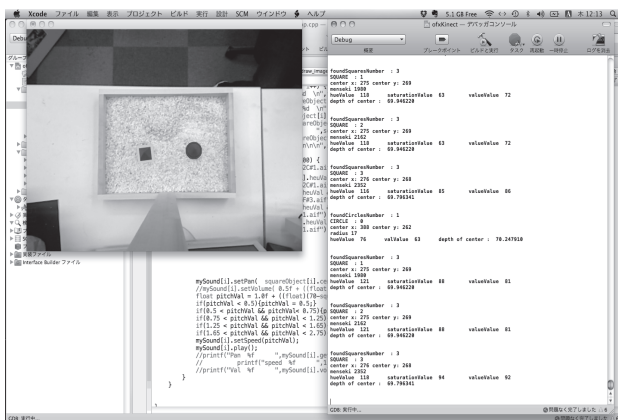


Figure 4: screen shot of the application

#### 3.2. Software system

This application is written in C++ language. We used openFrameworks [12] as an application development environment. This application processes full color image and depth image and detect dynamic sand modeling and the type of arranged woodblocks. We used openCV library [13] for the computer vision processing. At first, full color image from the depth camera is converted the binary format image. Then shape matching and object recognition is processed. This process

detects shape of the woodblocks and locates woodblock’s 2-D coordinates in the sandtray. After finding the woodblocks, this application detects each block’s color from the full color image. On the other hand, the depth image is used to acquire woodblock’s height and modeling of the sand. Figure 4 shows a screen shot of the application. The information of woodblocks is displayed in the console.

To generate graphics for projection, we used basic libraries in openFrameworks. To generate sound, we used SuperCollider [14]. Host application communicates to another application written in SuperCollider, using Open Sound Control (OSC) [15].

#### 3.3. Visual effects

Figure 5 shows an example of visual effects projected on the sandtray. In this case, light ripples are spreading over the sand surface around each conical woodblock. Light color changes corresponding to the color of the arranged woodblock, and the animation type changes corresponding to the shape of the woodblock. When a ripple hits to other objects, sound is played. Then visual effects work as visualization of music, and they are helpful when users make some musical phrase intentionally.

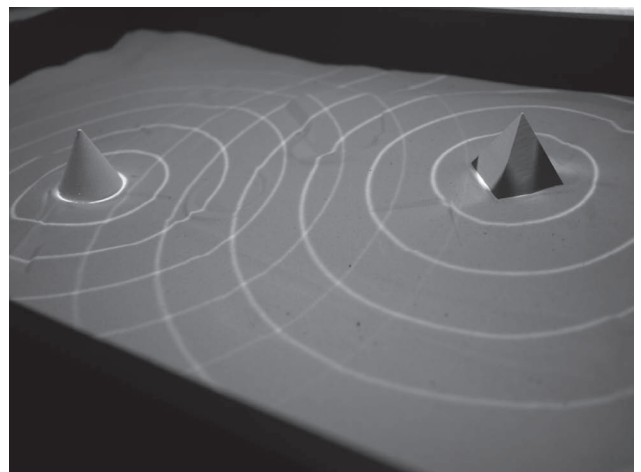


Figure 5: example of visual effects

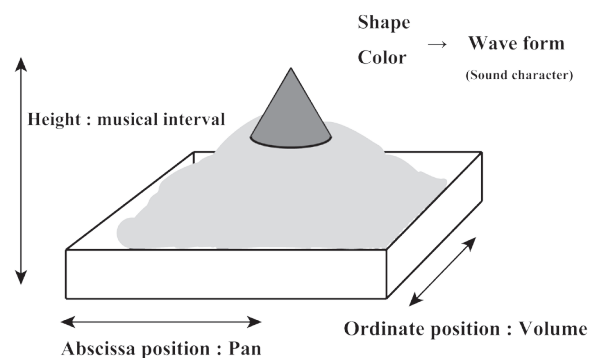


Figure 6: Mapping between a woodblock to sound

### 3.4. Sound generation

Music is generated in a computer according to the data of shape detection and color detection. Woodblock's shape and color is being mapped to waveform and musical phrase, the ordinate is mapped to sound volume, the abscissa is mapped to sound pan, and the height is mapped to the musical interval (Figure 6). Specifically, cylindrical woodblocks are mapped to soft edge wavy sounds like sine wave, and pyramid woodblocks are mapped to sharp edge wavy sounds like square wave. All sounds are generated by the application written in SuperCollider.

By moving woodblocks to a proper spot, a user can compose intentional sequences. At the same time users can change melodies by modeling sand, because the height of each woodblock decides each music interval.

## 4. CONCLUSIONS AND FUTURE WORK

In this paper we described a sonification art installation work consists of sand and woodblocks called "Hakoniwa". In this system, simple playing with sand and woodblocks generates sound and visual effects. Through the exhibitions, we confirmed the high potential of sand and woodblocks as an interface.

A significant aspect of sandtray therapy is that the insight of a user is expressed in the arrangement of the sandtray. Therapists can understand of the clients' mental condition by observing the sandtray. For the future work, we intend to develop a system to analyze the creation of the sandtray, infer the user's state of mind, and then reflect the user's mental condition to the generative visual effects and music. To realize it, we are going to accumulate use's playing data and the state of mind, then build a statistical analysis system. Then this system might generate the music and visual effects suitable for each user. It might be kind of a biofeedback system. Then this interactive system can be used practically.

## 5. REFERENCES

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