PlaySoundGround: An Interactive Musical Playground

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Abstract

We describe a novel transformation of a playground - merry-go-round, teeter-totter (also referred to as a see-saw), swings, and climbing structure – from its traditional purpose to a collaborative and interactive musical performance system by equipping key structures with sensors that communicate with a computer. A set of Max/MSP patches translate the physical gestures of playground play into a variety of performer-selected musical mappings. In addition to the electro-acoustic interactivity, the climbing structure incorporates acoustic musical instruments.

Keywords: Real-time, Music, Playground, Interactive, Installation, Radical Collaboration, Play.

1. Overview

The PlaySoundGround is a functioning playground (scaled to adult size) that produces musical sound when participants play on and with the equipment. It is, as such, also a musical instrument that allows participants to explore musical interaction and the creation and control of musical gestures by learning the musical mappings of the play structures. As they learn the device's musical responses to their play, they can alter the quality of their play to produce desired musical effects.

The basic premise of the PlaySoundGround is that the "play" children perform in a playground and the "playing" of music share the property of creative interaction within structural, physical and technological constraints. Furthermore, both concepts of 'play' employ a set of unwritten implicit social rules. The PlaySoundGround makes these connections explicit by endowing recognizable, functional playground equipment with the power to generate musical sound, extending rehearsed, playful physical motions into the realm of artistic expression. In doing so, it also opens up new territories for instrument design and interactive audio art, acting as a musical instrument controlled by broad kinesthetic motion rather than fine motor movements.

Figure 1. Collaborators enjoying the merry-go-round and teeter-totter

2. Description

The PlaySoundGround consists of three pieces of furniture – a merry-go-round, a teeter totter and a pair of swings appending from a large climbing structure. The dimensions of the play structures were scaled such that the relation between the size of the play furniture and the adult

Figure 2. Playground installed at the Burning Man Art Festival.

users was approximately the same as the relation between the size of a children's playground and a child.

The PlaySoundGround was first installed at the Burning Man Arts Festival outside of Gerlach, Nevada. Burning Man is a one week art festival and cultural adventure where approximately 40,000 participants gather in a temporary city. The festival was founded by a loose gathering of artists and pranksters who envisioned a Temporary Autonomous Zone [1] free of the rules and commerce of contemporary society. With the exception of a small number of arts grants and limited safety regulations, there is no institutional control of the work that is shared at Burning Man.

With the help of a large number of volunteers, we designed and built the playground using the following methods and materials. The merry-go-round base is made out of a car wheel bearing. A web of square tubing and angle iron are welded to the matching wheel hub and a wooden platform is bolted to the top. Hall Effect sensors and rare earth magnets attached to the inside of the hub and bearing measure the direction and speed of rotation.

The teeter totter is constructed from a 16' salvaged aluminum truck ramp. In the center of the ramp, a 1.5" steel rod is mounted to a trapezoidal fulcrum using two pillow block bearings. A Nintendo Wii Remote attached to the side of the ramp near the fulcrum provides accelerometer data. The swing structure is schedule-40 pipe connected by specialized fittings designed for playground structures. Removable Kee Klamps are used to connect the swing structure to the wooden climbing structure. A potentiometer coupled to the top of each swing chain measures the placement, speed and direction of the swing seat. The climbing structure is a multi-tiered platform structure designed for climbing and playing. It supports, and is supported by, the swings. These choices of construction material made each piece of playground furniture portable and easy to disassemble.

Figure 3. Acoustic instrument designed by students.

The climbing structure contains a number of acoustic instruments designed by the students of Jonathan Berger's Technology and Art Class. The class was designed to engage the students in a radical collaboration where they worked together to determine how many instruments would be built, the relation of the instruments to one another, and the relation of the instruments to the 2008 Burning Man theme, the American Dream. They chose to use the instruments to tell a history of the American Dream through American material culture. The first level of the structure contained instruments made of wood and glass – scratched gourds burned with buffalo designs on one side and a set of bellows that blow air over the lips of large jugs on the other side. The second level contained percussion instruments built out of metal and housed in two concave sheet metal enclosures. The third level used plastic materials – rain sticks made out of pink flamingo lawn ornaments and PVC pipes pitched in complimentary blues scales struck on the top of the pipe with a flip-flop shoe.

Besides their interesting and event-appropriate visual aesthetics, these instruments granted the PlaySoundGround a variety of additional capabilities. They increased the number of users that could play at once; they added a relatively sedentary mode of activity to the higher-energy modes of activity already available; they allowed users to gather in more physically intimate and immediate groups (as opposed to the furniture, which was broadly spaced out for safety's sake); and they gave users an additional channel of musical engagement with the amplified audio produced by the furniture.

3. Sound Processing

Data from sensors embedded in the play structures is processed and interpreted in a Max/MSP patch. An Arduino prototyping platform is used to acquire data from the Hall effect sensors and potentiometers, while the Wii Remote communicates directly with Max/MSP via Bluetooth and is interpreted using Masayuki Akamatsu's aka.wiiremote object [2]. The Max/MSP patches run on a Mac Mini, which, at Burning Man, was housed in a small refrigerator to protect it from the dust and heat of a desert environment.

Sound processing of the sensor data is also performed in Max/MSP. Audio is sent to four speakers located around each piece of furniture. Generally, this audio is spatialized in relation to the movements of the users on the furniture (often applying a stereo image based on some arbitrary reference point). The speakers were constructed from salvaged car stereo speaker elements mounted in wooden box enclosures, steel trash cans, and 55-gallon plastic drums for the merry-go-round, teeter-totter, and swings respectively.

This audio is generated according to one of five selectable modes of musico-kinetic mapping. All of these mappings have sub-settings that alter a variety of parameters. The mappings are:

1. A simple additive synthesis system that produces complex, organ-like chords. The melodic sequences it produces are pseudo-random, based on one of several Markov chains that control transitions between pre-established pitches. The kinetic focus is on speed of

motion and frequency of event. The users' motions trigger the incident tones, thus controlling the melody's rhythm; their speed also alters the tones' timbres.

2. A granular synthesis system that manipulates samples from a wide variety of popular music into complex sound textures or altered versions of the original music. Depending on the setting, the general kinetic focus may be on particular position, speed of motion, or frequency of events; users' motions may control parameters ranging from grain pitch to volume to the density of sound textures.

3. A system that produces sounds based on four sorts of environmental noise : fire, water, electricity, and wind. The kinetic focus is on speed and position. Using a combination of spatialization, filtering techniques, and triggered samples, these sounds change in natural-sounding ways with the users' movements; water pours and then splashes at extrema, electricity zaps, and so on.

4. A simple sampler that, depending on its setting, uses the players' movements to trigger either notes in a variety of scales, percussive environmental noises, or looped mechanical sounds. The kinetic focus is on positioning and the sequentiality of movement.

5. A "scratcher" that uses the movement of the instrument like a virtual tape head or phonograph needle, rapidly advancing or reversing a recorded sample as users play.

4. Performance Practice

The vast majority of musical interfaces, both traditional and contemporary, are designed to be responsive to fine motor control. With few exceptions (large bells and drums, for example) musical gesture is generated and shaped by relatively subtle oral or tactile manipulation. Recently, a growing number of interfaces, particularly for motion-tracking of dancers [3]– have generated sound from relatively gross kinetic input. The vast majority of these instruments, from gloves to motion-capture arrays, are essentially sensor rigs for the human body rather than physical objects with meaningful presences in space [4]. They allow free movement and provide guidance to the user only through aural feedback.

By contrast, musically-enabled playground equipment provides users with a powerful set of readily-intelligible mechanical constraints on their movement. Swings, teeter-totters, and merry-go-rounds all work to restrict the range of human motion to a well-defined arc through space. An instrument that is tangible and provides tactile feedback has many advantages: increased capacity for precise control and virtuosity, the possibility of rational mappings between gestures and output, increased legibility of the relationships between gestures and musical outputs, and perhaps the satisfaction of interacting with a device. The PlaySoundGround provided all of these besides the development of precision and virtuosity, a quality that does not easily mesh with gross motor input: while extremely precise control of global coordination is certainly possible, it is difficult.

Moreover, because of the ubiquity of playgrounds in primary education, virtually all of our target audience came equipped with a carefully-rehearsed (if perhaps only half-remembered) lexicon of gestures for interacting with our equipment. In other words, they knew how to operate the instruments before they ever saw them. This, in conjunction with the participatory conventions associated with playgrounds, enabled our users to immediately enjoy engaging and pleasurable musico-kinetic experiences.

Our desire to facilitate their ability to rapidly gain facility with the PlaySoundGround strongly influenced our compositional choices. We preferred easy-to-understand mappings between musical events and meaningful motor events on the furniture. For instance, on the teeter-totter: a mapping between upwards motion and a rising scale, a mapping between height and the rate of audio grain generation, a completed “teeter” motion and the generation of a chord. However, the desire to make the mappings legible didn't mean that we made the audio output simplistic. Different settings varied the degree of control over the resultant musical output given to the performers, the composers, and randomness. As with many play forms [5], a pleasant degree of randomness added a great deal of spice to some of our compositions: among our most successful (as determined by informal user response) was our patch that generated chords triggered by completed motions (teeters, rotations, swings), with variable timbre based on motion velocity, with pseudo-random melodies based on preprogrammed Markov chains.

5. User Experience

The PlaySoundGround also works as a novel and surprising environment. It does so through one primary mechanism with several elements: the making-unfamiliar of previously familiar objects through repurposing or augmentation.

First, much of the PlaySoundGround is constructed from junk and scrap. It turns half-recognizable elements like loading ramps and truck bearings into entirely new objects. In this respect, it sits in a long tradition of instruments and installations that rely on a junk-construction aesthetic -- most immediately, Harry Partch's work, previous NIME work [6] and the environs of Black Rock City itself. [7]

This repurposed-and-recycled construction methodology provided a foundation for a higher-level defamiliarizing aspect of the PlaySoundGround: its augmentation of familiar objects with new capacities. It does not contain mysterious new objects constructed from junk, like Partch's plantlike fantasias; it contains friendly, recognizable structures. Moreover, the fashion in which it augments the capacities of these objects, unlike many

methods of musical instrument augmentation, [8] does not rely on the addition of new control surfaces. Instead, it adds new functionality to the existing control surfaces of its furniture. These new functions serve as a set of new and hidden ways of being used that, while perhaps easy and natural, are not part of the furniture's conventional uses and are not telegraphed by some added surface or marking.

There is a relationship between this stealthy enhancement of usable objects and the notion of ubiquitous computing [9]. The PlaySoundGround's technological augmentations, however, do not add entirely new methods of using its furniture: for instance, one may not blow on the teeter-totter to check one's email. Instead, it enhances the existing lexicon of functional gestures towards their existing purpose. It couples musical play to the motions of physical play to enhance the fun of play. It gives auditory feedback that might influence the qualities of these gestures, but does not alter their fundamental form.

The ease of use, inviting nature, and safely transgressive qualities of the PlaySoundGround formed a coherent performance modality, which proved infectious, spreading to users' interactions with the acoustic instruments included in the structure. These also had hidden capabilities, but of a slightly different type -- one does *not* normally use fire bellows to create music, for instance. However, the hidden, playful augmentations in the furniture led users to see every object in the space as a proper instrument for musical play -- even, to our chagrin, those that weren't, like our speakers, which became drums one too many times for their liking.

6. Performance Ethic

This interface relies on a relational ethic of radical audience participation -- audience participation so radical that there is no particular boundary between performers and audience members. The PlaySoundGround should be considered a performance space as much as a device for musical performance – both an installation and an instrument. As such, its capacity to serve as a fully-functional playground even apart from its musical functionality made this ethic immediately and intuitively perceptible to our users. Playgrounds are not spaces for a large number of people to watch a single performer or small group of performers demonstrate their virtuosity; they are spaces for lots of people to play in all at once. Their fundamental conventions as performance spaces demand user participation.

We worked to manifest this ethic through the construction process and the presentation venue as well as the final product. The installation was constructed by a large team of volunteers, who brought a wide array of skills and interests to bear on the labor and were invited to participate in every aspect of the work. And Burning Man was a natural choice for the presentation of a piece of this nature: one of the central elements of the event is an ethic of radical participation and collaboration, ensuring an audience ready to participate in the spirit of the installation.

7. Conclusion

The design process was influenced by historcical and psychological studies of play as well as by studies in game design. We were inspired by philosophical discourse on play as a phenomenon, and a few brief instances of this influence are worth citing. Johan Huizinga's classic description of play as a generalized cultural process that manifests itself in a wide variety of contexts influenced our feeling that musical play and kinetic play were similar and could be made simultaneous. This was enhanced by Richard Schechner's description of play as a mode of performance, much like theater, dance, and music, which, along with the contributions of game design scholars like Katie Salen, led us to conceive the PlaySoundGround not simply as an instrument, but as a performance space designed to help its user-performers actively create certain kinds of experiences. Finally, Brian Sutton-Smith's understanding of play as an ambiguous phenomenon that resists being closely defined by rhetorics or forced to conform to a particular purpose lent force to our decision to make our playground's goal entertaining aesthetic experience rather than teaching or developmental growth.

The integration of musical performance and recreational play in a ubiquitous and familiar performance interface such as a playground provided a novel musical environment that enables collaborative and social interaction to create music.

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