
BodyBeats: Whole-Body, Musical Interfaces for Children

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Abstract

We present the BodyBeats suite—three prototypes that explore the interaction between children and computer interfaces by using sound and music. Our prototypes attempt to engage children in physical interaction, play, mimicry, kinesthetic learning, pattern recognition, music making, and collaboration. We believe that electronic instruments for children that incorporate movement and physical play could support more active lifestyles and help challenge the growing childhood obesity trend. We plan to continue refining these ideas and testing them in order to expand the field of electronic instrument design.

Keywords

Tangible interfaces, music, instrument, physical activity, pattern recognition, learning, children, obesity, health, interaction design

ACM Classification Keywords

H.5.2 Information interfaces and presentation (e.g., HCI): Haptic I/O, Prototyping. I.3.6 Methodology and Techniques: Interaction techniques.

Introduction

Our goal is to design and build tangible, electronic interfaces for children that incorporate play and physical activity while helping children recognize, mimic, and create patterns. Our background is in

education and tangible interface design [5], our work here is an attempt to expand upon previous work on electronic musical interfaces by adding our perspective and addressing issues such as kinesthetic learning, physical activity, and play. Considering the rise in obesity among children [4] we feel it is important to demonstrate that the technology often blamed for childhood obesity [9] can be used to create compelling, whole-body, physical and social interfaces that encourage children's play and learning. To this end we have combined the insights gleaned from two lines of research: physical interfaces for children's play [1], [6] and musical interfaces for children [2]. Research in both areas has shown possible learning benefits for children; research in the former incorporates physical activity, research in the latter incorporates musical exploration.

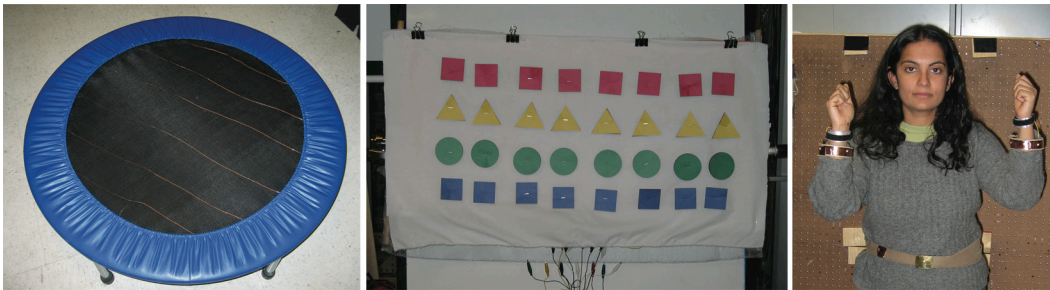


figure 1. The BodyBeats suite. From left to right: TrampleBeat, MixMatrix, and Ringalings.

In this paper we present our ongoing research to design and build tangible, electronic instruments for children. None of us are musicians; our work is an investigation of electronic instruments for young learners and musical novices such as ourselves. Our goals are to (1) build innovative, tangible, electronic instruments for children; (2) create interfaces that combine physical activity, sound, and play; and (3)

design compelling interactions that incorporate kinesthetic learning to complement the primarily visual and auditory computer interfaces used in education today.

BodyBeats

BodyBeats is a suite of three electronic instruments, first of which is the TrampleBeat, a small trampoline augmented with electronics to make it sound like a drum. The TrampleBeat is a body-scale instrument that requires aerobic activity to play. After building and testing the TrampleBeat, we built MixMatrix and Ringalings. MixMatrix is a wall-sized step sequencer (similar to software like Fruity Loops [3]) that is designed for multiple users. Users press and hold the push pads and listen to the rhythm generated as the play bar repeatedly sweeps past the pressed icons. Ringalings is a set of accessories (currently bracelets, in the future belts and anklets will be added) worn on the body that trigger user recorded sounds in response to customizable gestures.

The BodyBeats suite is an exploration of interaction with sound. To differentiate our instruments, we moved the locus of interaction from the body-scale TrampleBeat interface (beneath the users' feet) to the room-scale MixMatrix (on the wall). For Ringalings we switched the locus of interaction from the users' environment to their body; Ringalings provides a body-as-instrument, gestural interface.

As a result of designing these interfaces and conducting a survey of prior art we have addressed the issues relevant to our work by mapping a novel design space for musical instruments. Our design space maps musical instruments along two axes: physical activity

and musical expertise. Traditional musical instruments (e.g. pianos or guitars) are designed for precise interaction; players usually require a high level of expertise with their instrument before they are able to play them well while being very physically active. Newer, gesture-based, electronic musical instruments (e.g. the Yamaha Miburi [10] or Michel Waisvisz's The Hands [8]) are similar to traditional musical instruments in this respect, though different in the way that they create sound. We designed BodyBeats to be played with high physical activity at a novice level in order to fill the hole found in our design space analysis.

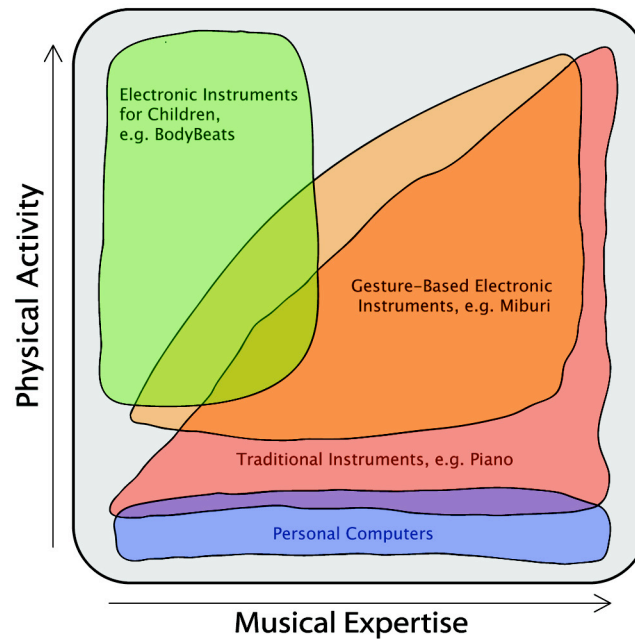


figure 2. Design space for musical instruments.

Implementation and Interaction

The BodyBeats suite uses the Scratch [7] programming environment to translate sensor data into synthesized instrument sounds and trigger prerecorded audio. Each prototype is connected to a PC running Scratch through a Scratch sensor board.

TrampleBeat produces different sounds depending on where the user contacts the trampoline surface. These sounds can correspond to different pitches for a single instrument, or multiple instrument sounds. Users play TrampleBeats by jumping on it and landing on different points along the trampoline surface.

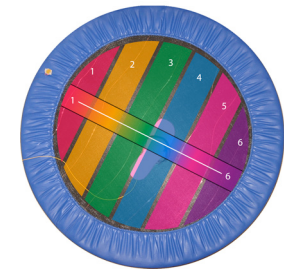


figure 3. TrampleBeat has a NiChrome wire for continuous sound and six copper wires for discreet sound.

The trampoline surface is 100cm in diameter, suspended by 36 steel springs. A Nickel Chromium (NiChrome) wire is used to sense where the user's feet contact the trampoline surface. Six copper wires lay across the NiChrome wire acting like frets on a guitar. The TrampleBeat is intended to support structured play, where the user follows a set pattern of cues; and less-structured play, where the user can explore variations in sound and jump independently of set patterns. Our goals for future versions of the TrampleBeat are to add more sensitive, low-profile sensing mechanisms as well as lights. The lights could illuminate sections of the trampoline surface, cuing the user to create set patterns of music, or leading the user in a "follow the leader" game mode.

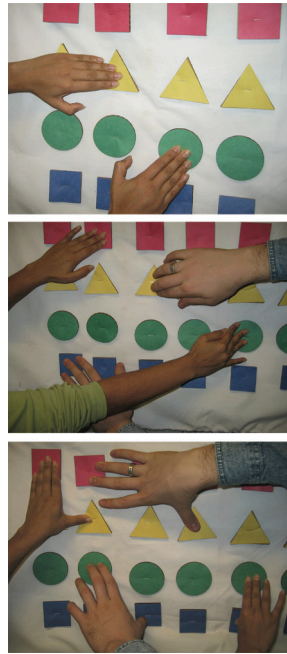


figure 4. MixMatrix with one user (top), two users (middle), and two users pressing multiple buttons (bottom).

long, though we envision future versions to be room sized, utilizing more buttons and rows for a more complexly layered sound. Future implementations of MixMatrix could include projected displays allowing users to manipulate the sound to a greater extent, as well as bringing the input and output from the system closer together.

MixMatrix is a wall-sized step-sequencer. Users play MixMatrix by pressing the colored buttons on its surface. Similar in design to sequencers found in the GUI environment, MixMatrix controls loops of sound with 32 7cm buttons arranged in 4 rows of 8. Each row corresponds to a different percussive sound. We designed MixMatrix to require the collaboration of multiple users—though it could be configured differently—our prototype plays sounds only while a button is depressed.

Therefore, to press more than 4 or 5 buttons at a time (assuming users don't employ their feet) multiple users must play together. Our implementation of MixMatrix measures 80cm

Where TrampleBeats and MixMatrix are instruments played by the body, Ringalings turns the body itself into an instrument. Users first link sounds to body positions and gestures. Then, when the gesture is recreated, the recorded sound associated with the gesture is triggered. The prototype is composed of two bracelets for each arm. One bracelet contains a reed switch that connects a circuit in the presence of magnetic fields. The other bracelet is lined with magnets. Currently users record sounds into an attached PC running Scratch and then trigger them by manipulating the bracelets. In the future we hope to enhance the Ringalings prototype so that record and playback functions are inside the bracelets. In order for the system to sense more complex gestures, additional accessories with more sophisticated sensors would be employed. Ringalings is designed to avoid the complex issue of mapping gestures to audio output. Users generate their own gestures and link them to customized sounds.



figure 5. Various body shapes that can be linked to sounds using Ringalings. The bottom picture shows the user mimicking a bird.

Educational Objectives

In this section, we explore the formal learning objectives of the BodyBeats suite. The BodyBeats instruments aim to help children recognize, mimic, and create patterns. Currently, most children learn about patterns through visual and auditory activities. BodyBeats provides the unique contribution of a kinesthetic activity that facilitates pattern exploration. Now, in addition to seeing and hearing the patterns, students can experience the patterns through their own body movements.

We hope that BodyBeats helps children explore patterns on two levels. The first step, or “close learning,” is the recognition, mimicry, and creation of patterns in sound. The instruments provide children with direct experience in manipulating beats and rhythms. As children jump on the trampoline, they begin to associate patterns of jumping with patterns of sound. With Ringalings, they associate moving their limbs with specific sound sequences. And with MixMatrix, they see and feel how holding their arms in various positions corresponds to repeated loops of sound.

The second step, or “transfer learning,” refers to the more ambitious goal of helping children hone their ability to recognize, mimic, and create patterns *beyond* sound. Identifying and manipulating patterns is a fundamental skill required for a wide variety of learning, including reading and math. In school settings, children typically examine patterns through visual symbols and auditory activities. For example, students will learn the sound that “at” makes, and through a combination of written and verbal exercises, will learn how to read “rat,” “sat,” “bat,” “cat,” and

“hat.” The task requires the students to recognize and manipulate similar sounds and symbols. While there is not a direct connection between the patterns that children make using the BodyBeats instruments and the patterns they use to learn to read, we hope that this new avenue of kinesthetic learning will provide a novel way to sharpen children’s fundamental ability to recognize, mimic, and create patterns.

Conclusion

We have presented BodyBeats, our ongoing project to explore electronic instrument design and address their possible impact on children’s activities and learning. Our attempt to create whole-body interactions for children, using technology and music has only started. It is our hope that through future work, publication, and feedback, we can refine our ideas and build devices that appeal to children and adults as well.

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