

DrumTop: Playing with Everyday Objects

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ABSTRACT

We introduce a prototype of a new tangible step sequencer that transforms everyday objects into percussive musical instruments. DrumTop adapts our everyday task-oriented hand gestures with everyday objects as the basis of musical interaction, resulting in an easily graspable musical interface for musical novices. The sound, tactile, and visual feedback comes directly from everyday objects as the players program drum patterns and rearrange the objects on the tabletop interface. DrumTop encourages the players to explore the musical potentiality of their surroundings and be musically creative through rhythmic interactions with everyday objects. The interface consists of transducers that trigger a *hit*, causing the objects themselves to produce sound when they are in close contact with the transducers. We discuss how we designed and implemented our current DrumTop prototype and describe how players interact with the interface. We then highlight the players' experience with DrumTop and our plans for future work in the fields of music education and performance.

Keywords

Tangible User Interfaces, Playful Experience, Percussion, Step Sequencer, Transducers, Everyday Objects

1. INTRODUCTION

The DrumTop project illustrates our effort to design and implement a new musical interface that takes advantage of everyday objects as a source of musical inspirations for musical novices. The goal in making DrumTop is to: create a simple physical interface that gives voice to everyday objects, afford self-expression and immediate engagement for novices, and encourage novices to explore the musical potentiality of their surroundings through musical interactions with everyday objects. Many new musical interfaces for musical novices focus on expressing music by means of electronic and digital sound productions [2]. By building a prototype, we seek to expand the possibilities of new musical interfaces for novices that produce sounds from real world objects themselves in intuitive fashion. The DrumTop interface provides novices with ways to explore rhythm patterns, sounds, and their combinations through task-oriented hand gestures with everyday objects. In addition to hearing the

rhythm patterns they created, players also visually and tangibly receive feedback through the objects.

Initial feedback from players suggests that DrumTop can be used to explore musical structures and the interactions among different objects, sounds, and patterns. Using everyday objects as a central ingredient of a musical interface design facilitates a fun and exciting experience, encouraging experimentation and collaboration among players. The feedback also suggests musical novices, especially children, would see DrumTop as an accessible and playful way to learn musical patterns, and that performers and artists will find it a rich tool for collaboration and playful interactive performance. We seek to further evaluate DrumTop as a tool for music exploration, teaching, and performance.



Figure 1: A player interacts with DrumTop using found objects. Almost any objects can be placed on the tabletop surface provided that the objects are not excessively large and can touch the transducers.

2. RELATED WORKS

Everyday objects are a fascinating source of musical activities and transforming everyday objects into percussive musical instruments is an old concept: music and new musical instruments often have their origin in objects around us such as household objects, natural objects, and crafting tools [17]. The concept of transforming household objects into musical materials was suggested by Erik Satie [6]. John Cage has frequently used found objects in his compositions such as *Water Walk* [4]. Many of us may have grown up playing and learning music through beating on buckets and kitchen utensils as composer Tod Machover did [15]. Within the NIME community, a countless number of projects that

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explore the use of everyday object in the musical context exist [7] [18] [19]. Perry Cook highlights that “everyday objects suggest amusing controllers” [5], and DrumTop makes full use of everyday objects to facilitate a creative musical experience for novices.

2.1 Automation

A number of related works explore transforming everyday objects into percussive instruments in an automated fashion. Duper/Looper, Beatbox, and Buonda focus on a modular tangible drum machine interface that can simply be attached to or placed on top of physical objects (Figure 2) [13, 10, 11]. Their interaction models are based on the relocation of *knockers*, actuators typically composed of solenoids or servo motors, which act in the manner of the user’s knocking hand gestures. The user simply places the knockers on top of objects or attaches them to the objects that they would like to generate a rhythm from. DrumTop resembles these projects in that the rhythmic patterns are automated and the sound production technique does not rely on digital signal processing but on the sounds of physical objects themselves.

2.2 Tabletop Synthesizer/Sequencer

Several works make use of physical objects to synthesize digital sound and generate rhythmic patterns by analyzing them on the fly. We pay special attention to the core mechanics of the interaction model that these types of projects emphasize. These projects freely and quickly move around physical objects on a tabletop surface to progressively affect the sound outcome. Golan Levin’s Scrapple is a tabletop musical instrument with which users arrange a group of physical objects with different sizes and shapes on the table [14]. The instrument scans the table and synthesizes sounds in real-time. It does this by interpreting the objects on the table as spectrographic sound-events.

Reactable, a tabletop tangible musical interface, is capable of having multiple users locally or remotely collaborate to create electro-acoustic music [12]. Users move physical artifacts that have fiducial markers underneath them on the tabletop surface to construct and manipulate musical topologies. Other examples of tabletop tangible musical interface projects include Audiopad [20] and Jam-O-Drum [3]. The Bubblegum Sequencer is a step sequencer with a physical interface with which users create and perform percussive electronic music by arranging gumballs on a tabletop interface with gridded holes [8]. Sound samples are mapped to the color of the gumballs, and they are sequentially played at the appropriate time as users place gumballs on the holes of the interface. DrumTop is inspired by their tabletop interface design approach that makes the manipulation of music familiar and easy to understand for novices.

3. DESIGNING PLAYFUL EXPERIENCE

3.1 Task-oriented everyday gestures

Interacting with everyday objects is a daily routine for most of us. Simple noncommunicative task-oriented hand gestures such as reaching, grasping, placing, and pushing come natural to us without a conscious effort. DrumTop capitalizes on these gestures to engage players in musical activities. The players are capable of interacting with the interface if they are able to interact with everyday objects in a way they normally do in their daily life. As depicted in Figure 3, the basic gestures to play with DrumTop are adaptable from the gestures most of us already employ in our daily life including finding and grabbing objects, placing and pushing them on the DrumTop tabletop surface to program drum

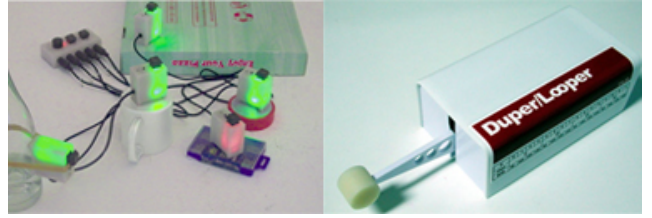


Figure 2: Beatbox (Left) and Duper/Looper (Right). Modular tangible drum machines that can be attached to or placed on top of found objects. Drum Patterns are programmable by rhythmically tapping on a button on the knocking device (Beatbox) or knocking on the object on which the device sits (Duper/Looper).

patterns, and rearranging the objects on the tabletop surface to make changes to sound patterns.

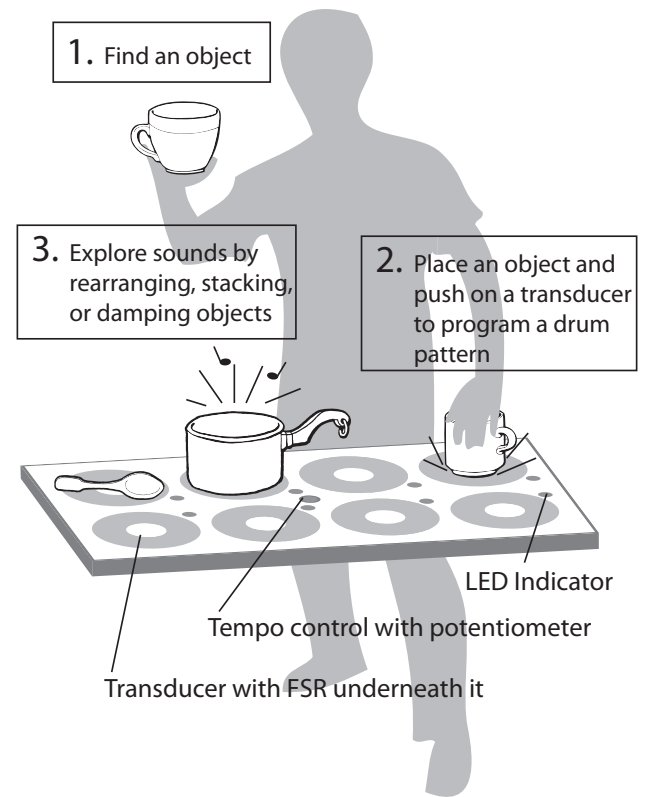


Figure 3: The *DrumTop* basic interaction model and building blocks.

3.2 Feedback

In DrumTop, everyday objects are the primary feedback source of sound, tactile, and visual experience: the players hear the sound directly coming out from the objects; they touch the objects to feel the sound and change the acoustic properties of the objects; and they see the objects buzzing caused by a hit from the transducers. The coupling of the sound generation system and the physical interface with which the players interact, often missing in digital musical instruments [16], offers immediate feedback to the players of DrumTop, leading to a creative, intuitive, and playful interactive musical experience.

3.3 Rapid sound exploration

In the design of DrumTop, special attention has been paid to the physical object’s manipulability to ensure that the players can quickly rearrange objects on the tabletop surface and program rhythmic patterns. While DrumTop is designed to be a step sequencer, its interface design borrows that of traditional electronic percussion pads with an intent to make hands-on manipulation of the physical object and sound associated with that object intuitive. DrumTop is capable of giving voice to everyday objects, and we have tried various materials ranging from paperclip boxes, metal disks, mobile phones, and plastic toy balls. With the combination of appropriate objects, the players can also create simple melodic patterns that may not necessarily follow the traditional western musical scale. Therefore, the potential for creating a new sound combination is in the hands of the players; the creative expressions of the players are stimulated from what they find around them and how they decide to play and combine everyday objects.

4. IMPLEMENTATION

DrumTop was designed to be relatively low-cost, simple, and robust. The tabletop interface consists of a 2x4 array of circular pads. Within each pad, a transducer, an audio exciter from HiWave Technologies [9], equipped with a force sensitive resistor underneath it is placed flat, facing up, at the center. The eight pads represents a measure in musical structure. Each pad represents one eighth note in a measure of music. An Arduino board [1], a platform of DrumTop hardware and software implementation, steps and loops through each pad in a sequence creating an eight beats per measure structure. As the loop continues, LEDs next to each pad indicate which pad is currently being activated.

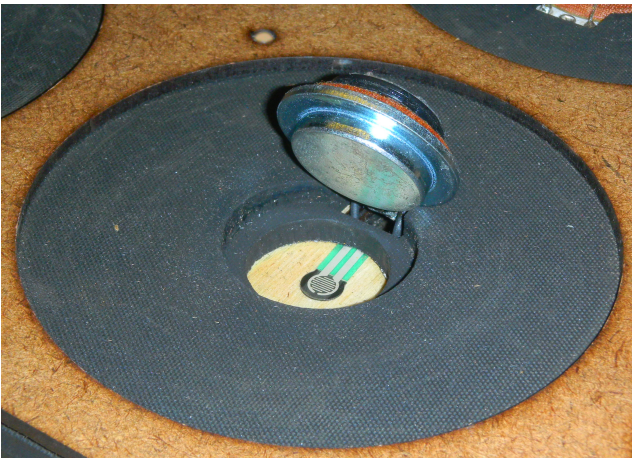


Figure 4: A force sensitive resistor under a transducer for detecting pushing input from the players. An LED indicator at the top of a pad signals players that the pad is currently activated.

4.1 Programming drum patterns

As the players place physical objects on the circular pads and press on the transducers, force sensitive resistors underneath the transducers signals the Arduino board that a push from the players has been communicated. A preprogrammed drum pattern immediately loads from the board memory, producing a unique hit pattern each time the transducers are pressed. The transducers are operated with digital output pins from the Arduino board to produce a short impulse. When the impulse is transmitted to the physical objects, they produce sounds with their unique acoustic

properties.

4.2 Tempo

At the center of the tabletop surface, a potentiometer is placed to control the tempo of the step sequencer. The players change tempo at will by twisting the potentiometer knob, and the visual feedback of an LED sequence helps anchor players in their beat making and provides a consistent indication of the current tempo.

5. PRELIMINARY FEEDBACK

5.1 The interface and player’s feedback

Based on our preliminary demonstration, people tend to take DrumTop as a surprise and quickly understand the basic concept of the system. By the time players construct a basic rhythm pattern, they are usually smiling and seem to enjoy the whole creative experience. DrumTop seems to stimulate players’ curiosity with everyday objects and their sound as the most common action players take with DrumTop was to look in their pockets or around them to explore the sound of different objects on DrumTop. One player even took out a wallet from his pocket to place all his cards and money on DrumTop to experiment with sounds by stacking and rearranging them. DrumTop also appears to stir collaboration among players as players discussed about, shared, and agreed upon objects that would go on top of the interface as they enjoy themselves with DrumTop. These are exactly the type of exploratory interactions what we hoped to bring out from the players with DrumTop.

5.2 Musical control and variations

The mechanism for programming drum patterns was obscure to most players; most people expected to hear a sound when they placed an object on one of pads not thinking that they had to press on the pads to cause a sound. We often needed to demonstrate how to program drum patterns before the trial. After having used the system for a few minutes, most players could predict that rhythm patterns on each pad would change according to their push inputs on the transducers but they did not necessarily have the understanding of how the patterns changed every time transducers were pressed. After the initial learning curve, people were able to control the interface at will and they reported that the interface of DrumTop was easy to understand and learn. While most players enjoyed the experience with DrumTop, some felt that DrumTop interface should be much bigger in size to accommodate bigger objects such as buckets, guitars, and chairs. Others commented that the sequence of the transducer activation should not loop in a left-to-right order but rather in a circular form. Some players also suggested that they want more musical control than what the current DrumTop prototype offers, such as to replace the drum pattern programming interface with a computer graphics based interface, to increase the number of pads on the interface, or to add a sequencer bank to progressively record and play back user defined rhythm patterns.

6. FUTURE WORK

Our future plan is to conduct a formal study to evaluate DrumTop as a tool to teach and perform music. The feedback from players suggests that children and musical novices would see DrumTop as an accessible and playful way to learn musical patterns, and that DrumTop can be used as a tool for music performers and artists for collaboration and interactive performance. Tina Blaine and Sidney Fels suggest that the opportunities for social interaction and collabora-

oration among participants through collaborative musical instruments can create an engaging musical experience for novices [2]. We believe that encouraging players to collaborate can further enhance the creative musical experience.

With respect to the design of the interface, one approach towards enhanced collaborative experience is to physically separate the pads on the tabletop surface while maintaining the link between the pads through a wireless communication system (Figure 5), making the system modular and portable. Modularizing the system would allow players to be more flexible in how they play DrumTop. For example, the players reconfigure the position of pads to any arrangements that they desired. The design would keep the complexity of the interface simple but would add more variety to the type of musical interactions that novices could create.

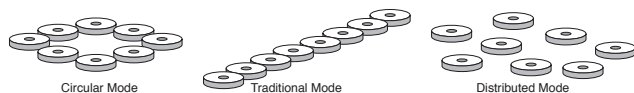


Figure 5: Conceptual ideas of the future implementation of DrumTop. The players can reconfigure the pads in any position, making collaboration with others easier than current design.

7. CONCLUSION

We presented a tangible step sequencer that transforms everyday objects into percussive musical instruments. Our intention was to create a simple physical interface that gives voice to everyday objects, afford self-expression and immediate engagement for novices, and encourage novices to rediscover their surroundings through musical interactions with everyday objects. DrumTop adapts everyday task-oriented gestures with everyday objects as the basis of musical interaction, allowing novices to freely explore sounds and combinations of sounds with everyday objects. As players explore the musical potentiality of everyday objects, DrumTop provide sound, tactile, and visual feedback through those objects.

Priliminary feedback from players indicate that DrumTop can be used to explore musical structures and the interactions among different objects, sounds, and patterns. DrumTop can be an accessible and playful tool for children and musical novices to learn music, and that it can be a rich tool for collaboration and music performance. We will continue to evaluate DrumTop as a tool to explore teaching and performing music.

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