The Cultural Music Box

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ABSTRACT
This paper explores the interactive methods that can be applied to teach children about culture and the cultures they are a part of. Based on the author's interest in creating music songs and patterns using Arduino software, different iterations of a traditional music box were designed to invent a high-tech, cultural, and innovative music box experience. This music box builds on previous music box models as it is made to be customizable, including multiple songs and in some cases multiple cultures within one box. This higher fidelity music box eliminates the need to be wound up as it uses Arduino to program the songs within simple buttons. Understanding children's usage of toys for learning purposes, an iteration of the traditional music box designed for culture teaching can be a useful tool.

Keywords
Interactive music box; music; culture; culture toys; children's toys; learning toys

1. INTRODUCTION
Interactive toys have in the past proved to be effective teaching and learning tools for children. When these toys apply to the senses, a much more engaging experience is created. Children today are taught real-world concepts such as culture and diversity in various ways and through various forms of media. The question arises as to whether the teaching of real-world concepts can be simplified to a mere interaction with a toy—particularly one that invites the senses.

Interested in experimenting with musical teaching toys in particular, Danielle Canchola explored the idea of reinventing the traditional music box into an educational toy. Toys using sound or music on the current market will often play common children's songs or recite words or numbers children can learn. Few musical toys take into account concepts such as diversity and culture, which this product intends to wholly focus on.

Approaching the traditional music box from a more interactive and high-tech method, the Cultural Music Box combines Arduino piezo technology, buttons, LEDs and light sensing to make for a fun and innovative children's learning experience. The Cultural Music Box is imagined in several iterations; either being comprised of songs from several diverse cultures or just one or a few cultures the consumer is specifically part of.

2. BACKGROUND
While the inventor of the very first music box is unknown, music boxes have been created and perfected since the 18th century. They are believed to have been advanced particularly within the country of Switzerland, introducing the rotating cylinder plucking steel prongs to create a melody[1]. Originally designed to be placed on a table and entertain, music boxes have kept children and adults alike engaged for centuries. These boxes would be wound up and the melody could play until the cylinder had finished its cycle. The design for the Cultural Music Box is based heavily on the look of a traditional music box but evolves the need for winding or prongs into usage of buttons and buzzers. While traditional boxes were also meant to entertain, the Cultural Music Box intends to provide interaction and a full-on learning experience.

3. OVERVIEW
3.1 The Cultural Music Box
The Cultural Music Box in its current state is encased in a thick cardboard box. The design of the box can be customized according to the cultures associated with an individual box, similarly to the custom design of family crests. Within the box Arduino software is contained as well as a piezo buzzer, LEDs and a light sensor which assist in playing the music and creating a related display.

3.2 Piezo music
While past music boxes have made use of a rotating cylinder and wire prongs to create music, the Cultural Music Box makes use of a piezo buzzer to create programmable sounds and music notes. Piezo technology generates electricity with mechanical pressure[2]. Using Arduino's tone() method and a table of note variables written by Brett Hagman, the correct buzz tones for the applied songs are created[3]. An array of numbers associated with note durations is also included within the program to determine how long each note should play in a tune. These duration numbers are determined using a mathematical equation dividing them in relation to one full second. In turn, applying these functions to a full program loop produces full songs the box can play.

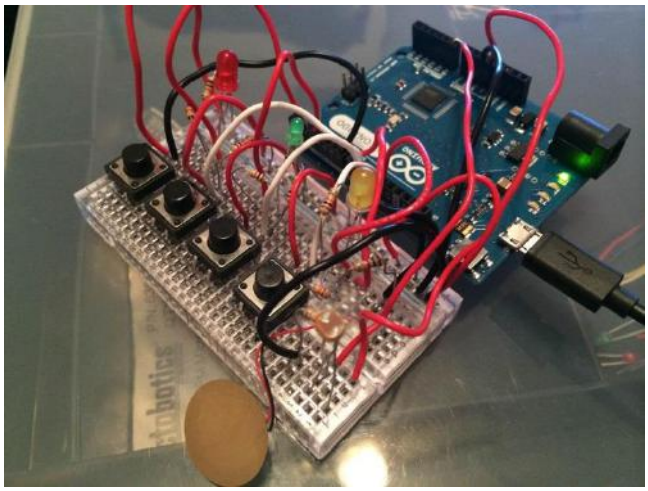

Figure 1. Overview of technologies used

3.3 Buttons and Interaction
As seen in Figure 1, the Cultural Music Box provides a set of buttons for which the user to press and switch between songs to listen to. Each button leads to the program loop for its respective song, in turn playing a variety of songs within one box. This

contributes wholly to the learning aspect of the Cultural Music Box. As opposed to a traditional music box which would often wind up and play one song, the Cultural Music Box is designed to play various cultural songs, teaching children common music and tunes of the culture/cultures their box is dedicated to.

Boxes are intended to be ordered highly customizable, either containing a set of four, six, or ten buttons. These buttons can lead to songs from just one culture or multiple cultures. The consumer is encouraged not only to choose a box tailored to their own cultures, but those containing songs of other cultures as well. This contributes to the diversity and learning aspects of the toy, therefore becoming more of a teaching and exploration tool to children as opposed to just a toy for entertainment.

3.4 Light Sensing

As in the case of traditional music boxes, songs are not intended to be played unless the box is opened. The Cultural Music Box makes use of light sensor technology to record whether light has reached a certain level. In pitch black light levels, the Cultural Music Box will not play songs. In lower light or full light, music will play as usual with the press of the buttons. This technology ensures that songs do not play while the lid of the box is shut.

Figure 2. LED display working within the box

3.5 LED display

Each Cultural Music Box will contain a set of LEDs, varying in number based on the colors associated with its respective cultures. These LEDs will flicker in tune with the songs as they play, displaying the colors of the culture a song comes from. For example, a Cultural Music Box prototype using songs of Mexican and Irish cultures will contain green, red, and orange LEDs. The green and red LEDs will flicker in tune with Mexican tunes, while the green and orange LEDs will flicker in tune with Irish tunes. This can be seen in Figure 2, where the green and orange LEDs are lit up during the playing of an Irish song. The association of flag colors connected with cultures allows children to make a further educational connection; gaining a further insight on the cultures they are learning about.

3.6 Design constraints

The Cultural Music Box was originally planned to include a servo motor through which a small figurine could spin, as in many traditional music boxes. This iteration of the music box had to be ruled out as it took up more memory and physical space than expected. The problem with a spinning figurine as well would be the inclusion of multiple cultures within one box. A single figurine representing multiple cultures may have caused design difficulties in the end.

A design constraint also presented itself with the inclusion of a light sensor. Because the light sensor allows songs to play only while the box is open and sensing light, this means children cannot play the music box in the dark, regardless of whether it is open or not. After consideration over the importance of this factor, it was decided to still include the light sensor to ensure music is only played while the box is open and to keep that extra bout of interactivity.

4. FUTURE WORK AND CONCLUSIONS

The Cultural Music Box, while existing through prototype, is still very much in an ideation stage. Taking into consideration the vast possibilities for customization of the box, there are several directions a learning toy such as this can go and aspects which can be improved on. The constraints of customization are a topic important to the software that must be addressed. While the Cultural Music Box is intended to be a very diverse learning toy for children, there must be a limit as to how many cultures or songs may be included as there is only so much Arduino program space available. Iterations of the Cultural Music Box using theoretical limits must be explored to prevent this issue in the future.

Future iterations of the Cultural Music Box's usage of the light sensor will also be considered. Because playing the music box in the dark may be an entertaining and engaging experience for children, perhaps a form of presentation mode or more exciting LED display may be included for darker settings or a "low-light mode."

The Cultural Music Box will continue to be iterated and developed into more interactive prototypes of its former self. With more interaction involved, children may grow further interest in diversity through playing with this toy.

5. REFERENCES

[1] Kochanny, Thaddeus. "Music Box History." *AMICA.* 2015. http://www.amica.org/Live/Instruments/Music_Boxes/Music_box_history.htm

[2] Jain, Arpit. "Insight – How Piezo Buzzer Works." *EngineersGarage*. 2012. http://www.engineersgarage.com/insight/how-piezo-buzzer-works

[3] "Arduino – ToneMelody." *Arduino*. 11 August 2015. https://www.arduino.cc/en/Tutorial/toneMelody