

SMaCK: A Sound Modelling and Control Kit for Children

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Abstract: This paper describes the concept of a Sound Modelling and Control Kit (SMaCK) geared for children aged 9-13. The kit consists of hardware and software components that aim to enable children to build their own, personal digital musical controllers that can be used to control their previously modelled sound. The environment aims for extending the EduWear kit (an educational low-cost construction kit for wearable and tangible interfaces) as currently tested and improved by the research group Digital Media in Education¹ (dimeb) at the University of Bremen.

1 Introduction

EduWear is a toolkit that “consists of programming software, smart textiles, sensors, actuators and micro-controllers that enable learners to actually make ‘smart fashion’ artefacts” [Re08]. The research group dimeb regularly arranges *TechKreativ* workshops² where children are seen as inventors and creators of innovative ideas concerning smart textiles. During these workshops with children on design of wearable and tangible interfaces the need to create a flexible framework for music interaction was found. Children showed significant interest in embedding sound capabilities in their applications. Similarly Buechley, who does research in the field of smart textiles for children as well, presents five artefacts out of which three contain some sort of sound output capability [BE08]. However, the only simple and accessible form of sound output with the basic configuration of the EduWear kit is a piezo speaker directly connected to the utilised hardware platform, the LilyPad Arduino³. During the workshops the Arduino is programmed with *Amici*, a block based, programming environment designed by the dimeb research group to enable children to programme the Arduino platform⁴.

¹ www.dimeb.de

² www.techkreativ.de

³ www.arduino.cc

⁴ *Amici* is available from <http://dimeb.de/eduwear>

It supports the generation of frequencies of certain duration with a sound block, taking the digital pin number, the note (one octave scale of C major available) and the duration in microseconds as inputs. As this was found to be very limiting and not doing justice to the advances in computer based sound synthesis, it was decided to extend the kit to provide access to more advanced synthesis methods.

2 Prior Work

In the past some attempts have been made to provide flexible, reconfigurable, and easy access to control parameters of modern synthesis methods. For instance Jensenius et al. suggest using game controllers and self-made sensors as the basis for affordable music controllers driving their *MultiControl* software [JKW05]. Merrill et al. provide *Audiopint*⁵, an instant-on hardware platform relying on Pure Data (Pd) as a synthesis environment [MVB07]. Yet these developments do not address the special needs of “children as inventors” [RS05]. As the EduWear kit proved to be successful in workshops with children, it was decided to rely on its components and the *Amici* software.

3 SMaCK

To extend the existing kit and advance a step further into the realm of do-it-yourself (DIY) music controller kits for children, a prototypical software was developed that allows connecting sensory data from self made controllers to a “personal” sound, modelled in a simple graphical synthesis environment. Following Seymour Papert’s Constructionism [PH91] a GUI was created that allows modelling a sound with respect to its frequency components and their individual temporal behaviour.

To map the incoming sensor data, a mapping unit was conceptualised that enables the graphical connection of micro-controller pins to the sound properties PITCH, AMPLITUDE, and DURATION. Furthermore it is possible to link digital pins to the actions TRIGGER and RELEASE. The GUI and a prototypical controller are presented below in Figure 1.

The GUI concept of the modelling environment was based on the popular time-varying spectrum plot. It visualises the sound properties pitch, amplitude, and amplitude variation over time for each partial in a single plot. For reasons of simplicity the temporal envelope of the partials was decided to be a simple attack, decay, sustain, and release (ADSR) curve. In SMaCK a partial is represented by a line, which can be moved up or down. Moving it up relates directly to increasing the frequency of that partial, moving it down decreases the frequency. Amplitude is represented by a sphere, where the size of the sphere (“closeness”) relates to volume. The amplitude can be altered by directly manipulating the size of the sphere. The occurrence in time can be adjusted by dragging the sphere left (earlier in time) or right (later in time).

⁵ <http://audiopint.org/>

SMaCK was entirely implemented in the scripting language Tcl/Tk due to the possibility of fast prototyping, easy GUI creation/modification, as well as portability. The sound synthesis unit for this project is SuperCollider. SMaCK communicates with this unit via Open Sound Control (OSC) and the network protocol User Datagram Protocol (UDP). Data coming from the LilyPad Arduino is received through a COM port connection (either Wireless/Bluetooth or through a USB cable). The separation of the GUI instance and the sound synthesis unit provides a powerful and flexible set-up that should allow for modular extension of the soft-ware and its sound capabilities.

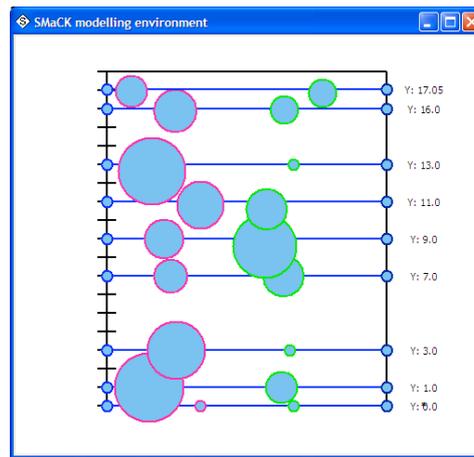


Figure 1: SMaCK's modelling interface shows partials with volume settings.

4 SMaCK's Appropriateness for Children

For estimating the potential of the new approach we tried out the SMaCK software with a prototypical music controller that was created in the labs for test purposes with two children aged 12 and 10 in our lab. This first test was considered as a first step of a systematic evaluation process that is to be carried out in the near future. Some first observations gave the following results: The tangibility of the controller captured the attention of the children, while the rather abstract interface proved to have an inhibition threshold that could be overcome by transforming the modelling environment into a tangible interface.

5 Discussion

Although many different kinds of new interfaces for musical expression have been presented over the last couple of years the authors of this paper argue that the movement lags a paradigm shift from "users" over "participants" to designers. While early synthesiser options for customizable sounds were rarely used, the challenge for the interface is to conceptualise a "development stage".

The strength and potential of digital media lies in their programmability. To make this potential accessible is the new challenge. New interfaces for educational environments should open the programmability of digital media for learners.

The first step towards a flexible framework for children has been made and will be extended to cover further synthesis methods and control mechanisms. Certainly, the range of controllers possible to be implemented with SMaCK are limited to the selection of sensors available in the EduWear kit, as well as the choice of the synthesis method (additive) and parameters available for active mapping (VOLUME, PITCH, DURATION, RELEASE, TRIGGER), and inactive mapping (partial frequencies with individual, linear ADSR envelopes). This is to be extended in a next version of SMaCK.

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