PEEK–A–BOOK: PLAYING WITH AN INTERACTIVE BOOK

Amalia de Götzen

Sound and Music Computing group
Department of Information Engineering
University of Padova
degotzen@dei.unipd.it

Davide Rocchesso

VIPS group
Computer Science Department
University of Verona
davide.rocchesso@univr.it

ABSTRACT

This demonstration is about a prototype of a new digitally augmented book for children, using sensors to allow continuous user interaction and to generate (not just *play back*) sounds in real time. During the demonstration the user will experience the book, intuitively modifying and controlling the sound generation process.

1. INTRODUCTION

Current commercial interactive books for children are very often similar to conventional colored stories with the addition of some pre-recorded sounds which can be triggered by the reader. The limitations of these books are evident: the sounds available are limited in number and diversity and they are played using a discrete control (typically a button). This means that sounds are irritating rather than being a stimulus to interact with the toy-book or allowing for learning by interaction.

Pull-the-tab and lift-the-flap books play a central role in the education and entertainment of most children all over the world. Most of these books are inherently cross-cultural and highly relevant in diverse social contexts. For instance, Lucy Cousins, the acclaimed creator of Maisy (Pina in Italy), has currently more than twelve million books in print in many different languages. Through these books, small children learn to name objects and characters, they understand the relations between objects, and develop a sense of causality by direct manipulation [1] [2] and feedback. The importance of sound as a powerful medium has been largely recognized and there are books on the market that reproduce prerecorded sounds upon pushing certain buttons or touching certain areas. However, such triggered sounds are extremely unnatural, repetitive, and annoying. The key for a successful exploitation of sounds in books is to have models that respond continuously to continuous action, just in the same way as the children do when manipulating rattles or other physical sounding objects. In other words, books have to become an embodied interface [3] in all respects, including sound.

2. FUTURE PERSPECTIVES

In recent years, the European project "The Sounding Object"[1] was entirely devoted to the design, development, and evaluation of sound models based on a cartoon description of physical phenomena. In these models the salient features of sounding objects are represented by variables whose interpretation is straightforward because based on physical properties. As a result, the models can be easily embedded into artefacts and their variables coupled with sensors without the need of complex mapping strategies.

Pop-up and lift-the-flap books for children were indicated as ideal applications for sounding objects [4], as interaction with these books is direct, physical, and essentially continuous. Even though a few interactive plates were prototyped and demonstrated, in-depth exploitation of continuous interactive sounds in children books remains to be done.

Everyday sounds can be very useful because of the familiar control metaphor: no explanation nor learning is necessary [5]. Moreover, it is clear that the continuous audio feedback affects the quality of the interaction and that the user makes continuous use of the information provided by sounds to adopt a more precise behavior: the continuously varying sound of a car engine tells us when we have to shift gears. In this perspective sound is the key for paradigmatic shifts in consumer products. In the same way as spatial audio has become the characterizing ingredient for home theatres (as opposed to traditional TV-sets), continuous interactive sounds will become the skeleton of electronically-augmented children books of the future. The book-prototype is designed as a set of scenarios where narration develops through sonic narratives, and where exploration is stimulated through continuous interaction and auditory feedback. Through the development of the book, the class of models of sounding objects has been deeply used and verified[2]. The physical models of impacts and friction have been used to synthesize a variety of sounds: the steps of a walking character, the noise of a fly, the engine of a motor bike, the sound of an inflatable ball, etc.

3. SCENARIOS DESIGN

The integration and combination of the sound models available from the Sounding Object project in an engaging tale has been studied. The first step was to create demonstration examples of interaction using different kinds of sensors and algorithms. During this phase the most effective interactions (i.e. easier to learn and most natural) have been chosen, and several different scenarios were prepared with the goal of integrating them in a common story. The scenarios use embedded sensors, which are connected to the *Wiring* I/O board [3]. Data is sent to the main computer via USB from sensors and the sound part is synthesized using custom designed Pure Data (PD)[4] patches. These PD patches implement a set of physical models of everyday sounds such as friction, im-

[1] http://www.soundobject.org

[2] http://www.soundobject.org/articles.html

[3] http://wiring.org.co/

[4] http://www.pure-data.info

pacts, bubbles, etc. and the data coming from sensors is used to control the sound object model in real time. In the following subsections a scenario will be described.

3.1. Steps

One of the first scenarios that has been implemented is the steps scenario that shows a rural landscape with a road full of snow. An embedded slider allows the user to move the main character along the road, and all movement data is sent to the computer, where the velocity of the character is calculated and a sound of footsteps is synthesized in real-time.

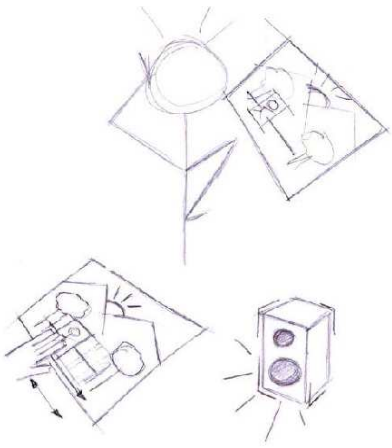

Figure 1: The user is looking at the scene, identifies the moving part and tries to move the character generating sound

When opening this page of the book, the user has to discover a number of things:

- What should I move to make something happen?(*mh, what should I do? mh, there is this little think coming out from the page, maybe I should move it!*)
- What is the character doing in this part of the story? how should I move this 'interaction' point? (*yes, Lucy seems to walk, so maybe I should move this little thing: also Lucy is moving whit it! it makes her walking through the road!*)
- Now that it is sounding, what kind of sound is it produced? what kind of information do I get from the sound? (*yes, and now that I moved her, I can also hear her steps! oh, hear the sound steps, oh yes there is the snow on the road!*)
- How many different sounds can I produce? (*look, the sound is always different!*)
- How is the sound changing according to my gesture? *hey, if I move faster Lucy, also her steps sounds faster!*)

It is quite clear that just by adding a new feedback (the audio one) and many different points of interaction, we solicit the imagination of the user and we engage him in a complex learning process which, by the way, can also be perceived as a funny game.

In this particular scenario the timing, distance, and force of the sound of each step is modified as a function of the control velocity of the impact model. Fig. 1 shows a preliminary sketch, while fig. 3 shows the final prototype with the embodied sensor.

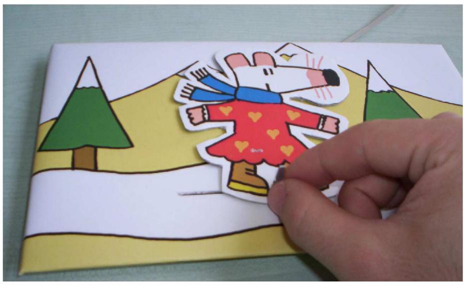

Figure 2: Interaction through slider: the footsteps scenario prototype

4. INTERACTIVE DEMONSTRATION

During the demonstration we will show a prototype of the interactive book: the public will be allowed to use the book, learning by doing the kind of interaction suggested by the tale to the child/user. The steps scenario is just one of the examples of interaction that are developed through the story. The book is made by 6 main scenes, each of them characterized by a different interaction point, a different sound feedback and a different control gesture. Table 1 summarizes the main characteristics of each scenario in terms of context, point of interaction, synthesis model used, everyday sound produced, sensor embedded in the page and gesture required to interact.

Scene	Sound model	Sound feedback	Sensor	Gesture
the steps	impact	steps	slider	linear
the fly	friction	buzz	magnet	erratic
inflating a ball	friction	air	fsr	pushing
the motor bike	impact	engine	potentiom.	rotatory
swimming	impact	bubbles	fsr	linear
drinking	impact	pouring	fsr	pulling

Table 1: Scenarios characteristics: sound model used, everyday sound feedback produced, embedded sensors and gesture required

Each scenario is characterized by a specific pd patch: while using always the same physical model according to the needed everyday sound different parameters are controlled in real time or set by default to a given value (according to size and/or material, force with which the user interacts, etc.). Each patch is automatically muted after some time (3 sec) if the user is not interacting with the sensor. Fig.3 shows a typical pd environment, in particular the main parts of the steps scenario patch are pointed out. At the moment all the sound synthesis is done by a computer which is connected to the wiring board by a USB cable; the next step of this work will involved a programmed DSP in order to create an object which is completely independent from a computer.

4.1. Equipment

The book consists of embedded sensors, a *Wiring* [5] I/O board to which all sensors are connected, and the physical book-object. A laptop communicates with the *Wiring* board via USB. The Wiring

[5] http://wiring.org.co/

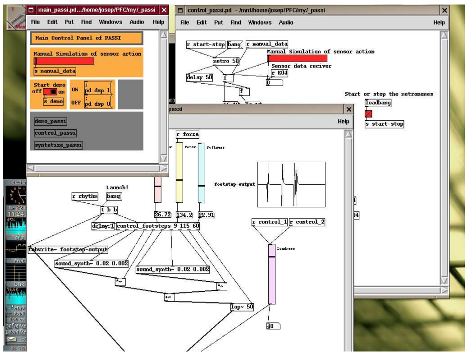

Figure 3: Snapshot of the pd patch of the steps scenario

board has been used in this case just to keep the sensors values which control the physical parameters of the sound synthesis engine. A more interesting way to use the board is with actuators: we can imagine scenarios where we have more than just one point of interaction, and where actuators are used to create changes in the physical world (light, movement, temperature, etc.) according to the scenario that is explored by the user, making possible to create all kinds of interactive artifacts.

4.2. Space

For the demonstration we need a couple of loudspeakers and a small table where we will place our laptop and book prototype.

5. CONCLUSIONS

The demonstration will show a new use of sounds in interactive book for children using sound models based on a cartoon description of physical phenomena.

The final outcome of this work is a lift-the-flap scenario for a book for children, augmented by sounds that respond continuously and consistently to control gestures. The sample scenarios shown in the demonstration will show the effectiveness of sound as an engaging form of feedback, and the feasibility of real–time physics–based models of everyday sounds in embedded systems.

As a concluding remark, we highlight the fact that all the scenarios that will be presented in the demonstration have been implemented by using two sound models only (impact and friction) even though the sounds are remarkably different from each other.

Authorship

The conception and realization of an early prototype of a sound-augmented book were carried on by the second author as part of the Sounding Object project[6]. Later on, students Damiano Battaglia (Univ. of Verona) and Josep Villadomat Arro (Univ. Pompeu Fabra, Barcelona, visiting Verona in 2004) realized the sketches that are described in this paper as part of graduation projects, under the guidance of the authors. At the moment, the first author is pursuing her PhD on fundamental issues in sound-mediated interaction, such as causality and Fitts' Law, and she is looking at children books as a possible application scenario.

[6] http://www.soundobject.org

6. REFERENCES

[1] E.L. Hutchins and Hollan J.D. et al., *Direct manipulation interfaces. User-Centred System Design.*, pp. 87–124, Lawrence Erlbaum Associates, NJ, USA, 1986.

[2] B. Schneiderman, *Leonardo's laptop: human needs and the new computing technologies*, MIT press, Cambridge, 2002.

[3] Paul Dourish, "Where the actions is: the foundations of embodied interaction," *MIT PRESS*, 2001.

[4] Davide Rocchesso, Roberto Bresin, and Michael Fernström, "Sounding objects," *IEEE Multimedia*, vol. 10, no. 2, pp. 42–52, April 2003.

[5] Brewster S., *Non-speech auditory output*, Lawrence Erlbaum, 2002.