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Programming Sound with Pure Data

Make Your Apps Come Alive with Dynamic Audio

The Pragmatic Bookshelf

Dallas, Texas • Raleigh, North Carolina

The Pragmatic Programmers

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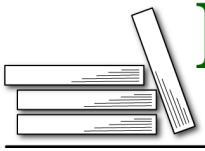

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Preface

I love sound. That may seem a little strange; a lot of people would say they love music, but I love sound—*including* music. I group them together, and I find that the line between them is blurry. There are interesting rhythmic and even melodic and harmonic elements in everyday sounds, if you listen for them. On the other hand, elements of music when taken out of context can lose their musicality and sound like natural events.

I hear little things all the time, which can be either good or bad. If something's rattling in the car it drives me *crazy* and I have to stop the car and make the noise stop. That makes *my wife* crazy, but I can't help myself. That's why it's so important to me to have sound done well in digital experiences, where I spend most of my time. When I say "digital experiences" I mean anything happening on a computer: web pages, web applications, native applications, mobile apps, kiosk apps, art installations, and, of course, games in any form.

Sound, and now I mean sound effects as distinct from music, is tricky to get right in digital experiences. Sound is very rarely a necessity. Even in games, where it's expected as a part of the experience, it's rare that the user *needs* sound to play. There are usually controls somewhere to turn sound off, but you'll never find a control to turn off the screen or mouse or touch interaction.

On the other hand, playing a game without sound takes away an important dimension of the experience. It's flat, boring, unconvincing. If there's not a little *ding* when you collect a coin, it's not satisfying. If you're running through the forest and you don't hear forest sounds, it's the opposite of immersive—it feels like merely looking at someone running through the forest on a little screen instead of *being there*.

Not only games can benefit from sound in this way, though. A few apps I've used struck the right tone, if you'll pardon the pun, with some tasteful and, above all, *meaningful* sounds as part of the experience.

This book is not able to teach you good taste, sadly. But, if you decide this book is for you, you will learn how to gain understanding and control over

the sound you decide fits the digital experiences you create. You'll learn how to design and create the sound you want to hear.

Who Is This Book For?

I make a few assumptions about you, the reader. First of all, I assume you're as interested in the audible experience as I am. You may be a programmer or designer. You're probably interested in what you can learn about the technical details of getting sounds into a web or native app, but it's OK if you're just interested in learning about some technical approaches to designing sound.

I assume you've dabbled with sound design in the past. It was most likely by digging around in a sample library for the right premade sound and maybe editing that sound a bit to get what you wanted out of it. Maybe you're intrigued by the idea of doing some professional sound design in the game or movie industry, or maybe not, but for now you want to know how to gain more control over your ability to enhance digital experiences both native and on the Web.

You may also be a musician. As I mentioned, this book isn't about music in digital experiences; it's geared toward sound effects. However, all of the skills you'll learn here are easily applicable to musical experiences and musical apps, and at the very least they'll give you a better understanding of how to think about sound in music.

In short, I assume you have little to no experience with anything but dabbling with sound, but you're interested and want to learn more. I would be extremely happy if this book helps out those independent or small-shop developers and designers who have to wear many hats during the day and don't have the budget for a dedicated sound team.

What This Book Covers

This is a practical book for people interested in digital sound design for the Web and native apps. We'll focus on using one software application, Pure Data. We'll go through the steps of creating two sets of practical examples: sound-effect scenes that can be controlled dynamically or output to a file.

The first set will illustrate a few different sound-synthesis methods, and the second will show how to work with existing sounds, like you might get from a professional sound-effect library.

After getting used to using Pure Data and creating these examples, we'll look briefly at how to get the sounds we've made out of Pure Data and into a usable format, and then quickly discuss some sound-production topics.

We'll then take a brief interlude to discuss the user experience (UX) of sound on the Web and in native applications.

Finally, we'll consider two premade projects, a web project and a native application. We'll design sound effects for both of these, taking into account what the best UX for each is and what you've learned of sound design, and consider the possibilities of dynamic sound in the native applications.

We'll wrap up by considering what you've learned so far and a few possible directions you could take next in your journey to becoming a sound designer.

What This Book Doesn't Cover

Sound design is a deep and rich field. It grew up with the movie industry and is an essential part of the game industry. There are also many different approaches to designing sound within those areas. This book is an introduction to sound design for digital experiences on the Web and in native applications, which could include games.

We've chosen a pragmatic approach to introducing this subject; one that focuses on building practical examples using synthesis with a procedural sound application, which is only one of many possible ways to design sound. Here are some other important topics that aren't in scope for this book, but you may want to dig into next:

- This book does not cover capturing or recording sounds for analysis or sound production. Audio engineering, field recording, and Foley studio work are all good things to have under your belt as a sound designer, but we won't discuss them in any depth here.
- Analysis of recorded sound is also beyond the scope of this book. To reproduce a convincing effect it's very useful to know what's going on in a real-world example instead of guessing. We'll only have space to do a very rudimentary, intuitive analysis of some sounds as we build our examples, but as an area for later study, sound analysis would be very beneficial.
- There is a lot of math behind describing and reproducing sound. Algebra. Trigonometry for describing oscillators and geometric waves. Calculus for, among other things, Fourier analysis. That math is good to know, but beyond the scope of this book.

- A deep understanding of the science of sound is extremely helpful to the sound designer. In the field of physics, material physics, fluid dynamics, acoustics, and many others will help you understand from first principles how sound is made and how to reproduce it. Understanding the math used to express the physics in these areas will be helpful too. All of our practical examples will be intuitively designed, and we won't take the time to dig into the science of why the sound works the way it does. A great next step would be to start to understand the underlying causes of sound.
- Psychoacoustics, or the study of how humans process and perceive sound, is important to understand as a sound designer. There are some surprising things to learn from the field that can help you become a better and more efficient sound designer, but we won't have time to dig into those here.

Where Will You Be When You Finish This Book?

When you've read this book you'll have had the experience of creating a set of sound effects using Pure Data, ready for inclusion in a dynamic sound application or for creating a static sound file. You'll have a practical understanding of sound-synthesis techniques and a general understanding of how different fundamental components of sound can be used to produce sounds anywhere, from those we hear every day to those we'd hear only in a futuristic science-fiction world.

You'll be ready to take the next steps to understanding and growing as a sound designer, whether that be practicing what you learn here, building sounds for games and apps you'll be making, or digging in deeper to the math, physics, and other fundamentals of sound design.

Online Resources

On The Pragmatic Bookshelf's page for this book there are some important resources.[1] There are code downloads containing all the Pure Data patches you'll see in this book, as well as the source for the web, Android, and iOS projects. You'll also find feedback tools such as a community forum and an errata-submission form where you can recommend changes for future releases of the book.

1. http://pragprog.com/book/thsound/programming-sound-with-pure-data