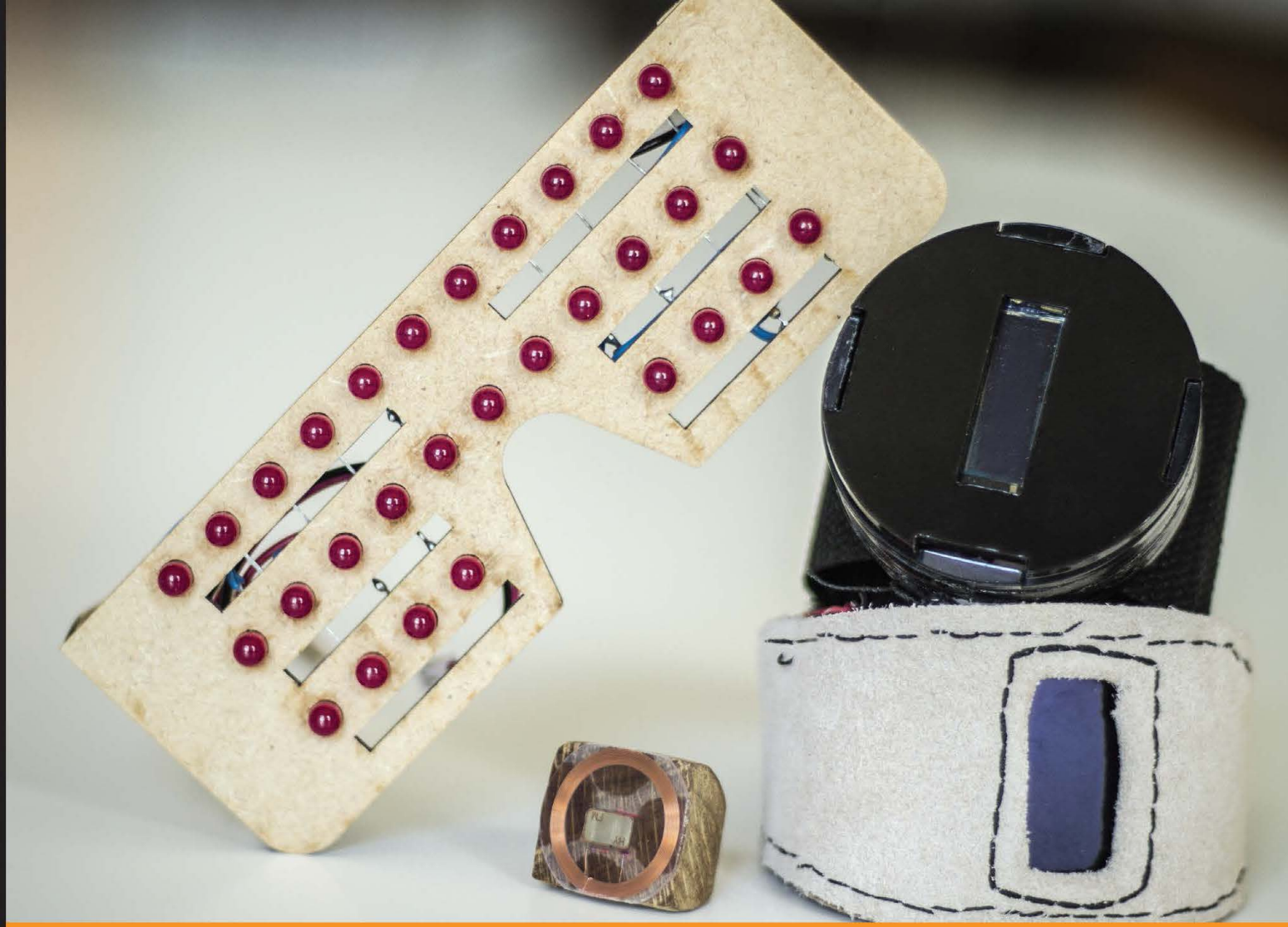

Community Experience Distilled

Arduino Wearable Projects

Design, code, and build exciting wearable projects using Arduino tools

Tony Olsson

[PACKT] PUBLISHING open source* community experience distilled

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Tony Olsson works as a lecturer at the University of Malmö, where he teaches multiple design fields with the core being physical prototyping and wearable computing. His research includes haptic interactions and telehaptic communication. Olsson has a background in philosophy and traditional arts, but later shifted his focus to interaction design and computer science. He is also involved in running the IOIO laboratory at Malmö University.

Besides his work at the university, he also works as a freelance artist/designer and author. Prior to this publication, Olsson published two books based on wearable computing and prototyping with Arduino and Arduino-based platforms.

I would like to thank all the people and students of the IOIO laboratory and the K3 institution, both current and past. The work we do together has always been inspiring. Thanks to my sister and mother for all their support. A special thanks to David Cuartielles and Andreas Göransson. Without our endeavors together, this book probably would have never been written. I would also like to thank Hemal and Pooja at Packt; it has been a true pleasure working with them on this book. I'd also like to thank the rest of the Arduino team, Massimo Banzi, David Mellis, and Tom Igoe, for their impressive work with Arduino; and the Arduino community, which remains the best in the world. Last but not least, I would like to thank Jennie, I can only hope to repay all the support and understanding she has given me during the process of writing this book.

About the Reviewers

Tomi Dufva is an MA in fine arts and a doctoral researcher at Aalto ARTS University. He is a cofounder of Art and Craft School Robotti and lives and works in Turku as a visual artist, art teacher, and researcher. Tomi researches creative coding at Aalto University, in the school of Arts, Design, and Architecture. Tomi specializes in code literacy, maker culture, pedagogical use of code, and integrating painting and drawing with electronics and code. Tomi has taught in schools from kindergartens to universities. You can see Tomi's research on his blog (`www.thispagehassomeissues.com`).

Kristina Durivage is a software developer by day and hardware hacker by night. She is well-known for her TweetSkirt—an item of clothing that displays tweets. She lives in Minneapolis, Minnesota, and can be found on Twitter at `@gelicia`.

Jimmy Hedman is a professional HPC (High Performance Computing) geek who works with large systems where size is measured by the number of racks and thousands of cores. In his spare time, he goes in the opposite direction and focuses on smaller things, such as Beaglebone Blacks and Arduinos.

He is currently employed by South Pole AB, the biggest server manufacturer in Sweden, where he is a Linux consultant with HPC as his main focus.

He has previously reviewed *Arduino Robotics Projects* for Packt Publishing.

I would like to thank my understanding wife, who lets me go on with my hobbies like I do. I also would like to thank Packt Publishing for letting me have this much fun with interesting stuff to read and review.

Kallirroi Pouliadou is an interaction designer with a strong visual design and architecture background, and experience in industrial design, animation, and storytelling. She explores technology as an amateur maker.

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Preface

Almost 10 years have passed since I picked up my first Arduino board. At the time, I was an interaction design student at Malmö University. At the front of the classroom that day, there was a bearded Spaniard talking, rather claiming, that he could teach us all about electronics and how to do programming for microprocessors, all in 1 week. Of course, since I knew nothing about electronics and never thought I would learn anything about it, I did not believe him.

The Spaniard had a completely new approach to teaching, which I had never encountered before. He wanted to teach us, not by books and lectures, but by doing things. One of my classmates pointed out that most of us did not know anything about electronics, so how are we supposed to do anything with it? The Spaniard replied that it does not matter, you can do things without knowing what you are doing, and by doing them, you will learn.

After 15 minutes, we all had connected a small lamp to our Arduino boards, and we had managed to program the lamp so that it would turn itself on and off. What baffled me was not only what we had achieved in such little time, but also that parts of what was going on actually made sense. We were learning by doing.

The bearded Spaniard was actually David Cuartielles, who together with Massimo Banzi, just 1 year before, invented the Arduino board. Soon after they invented it, Tome Igoe and David Mellis joined the team, and as they say, the rest is history. But I still remember that day, as if it was yesterday, when I looked down at my blinking light and something sparked inside me. I wanted to learn and do more. Then David gave me the second valuable lesson, that the best way to learn more is to share your knowledge with others, and he put me in a position where I was able to do so. Again I was skeptical, since I had no knowledge to speak of, but again the lesson followed, even if you only know a little, it is enough to help those that know nothing yet.

Soon after, I found out about a field called wearable computing. The idea was to design and apply a technology to the human body in different ways, and it all sounded as wonderfully crazy as the idea that you could learn electronics and programming without any prior knowledge of how to do so. With inspiration from Arduino and its team members, I leaped headfirst into the field. In this new field, I found new inspiration in the works of Steve Mann and Leah Buechley. Mann, now a professor at the University of Toronto, developed his own wearable computer in the 80s and had mostly done so on his own. Buechley, also a professor at MIT, had taken the Arduino board and developed a new prototyping platform, which is specialized for a wearable context. Both seemed to have done this against all the odds. Again, I was inspired, and started to develop my own wearable devices, teaching others how to do the same. Eventually, I collected enough know-how on things that I started to write them down. When I started to share my writing, I found out how truly amazing the Arduino community is a world-wide group of people that share a love for making things with electronics.

It's safe to say that if it had not been for all these people, I probably would never have written any of my books, so I would like to extend my thanks to all. I would also like to thank you for picking up this book. You might be a novice or an expert, but I do hope it will not matter. This book is based on the idea that anyone can learn anything by the simple principle of actually "doing." If you are already an expert, then you know there is always something to learn from "doing" things in a new way.

So, I hope you will gain some new knowledge and inspiration from the projects we created in this book, and I wish you all the best in your creating endeavors.

Do check out "Soldering with David Cuartielles" on my YouTube channel at `https://www.youtube.com/watch?v=Mg01HFjsn6k`.

What this book covers

Chapter 1, *First Look and Blinking Lights*, covers the basic steps of installing the development environment and how to get started with coding. We also take a look at how to create our first circuit and control an LED.

Chapter 2, *Working with Sensors*, teaches about interfacing with sensors and extracting data from them. The chapter also introduces digital and analog sensors ranging from simple to complex sensors.

Chapter 3, *Bike Gloves*, introduces the reader to the first project of the book, where the goal is to create a pair of bike gloves. In this chapter, we introduce the use of LEDs and how to control them, as well as how to use sensors for some simple gesture recognition.

Chapter 4, *LED Glasses*, teaches you to create a pair of programmable LED glasses. These glasses will be covered by LEDs in the front, which will be programmable to display different patterns and shapes. The reader will also be introduced to the construction of a pair of sunglasses.

Chapter 5, *Where in the World Am I?*, focuses on the making of a wrist-worn GPS tracking device. The information will be displayed on a small LCD screen. This chapter also includes instructions and tips on how to create a casing containing the components so that the device can be worn on the wrist.

Chapter 6, *Hands-on with NFC*, deals with NFC technology and servomotors and how they can be combined into a smart door lock. This chapter also includes how to design around NFC tags and make wearable jewelry that will work as a key for the lock.

Chapter 7, *Hands-on BLE*, deals with low-powered Bluetooth technology and how it can be implemented into wearable projects. This chapter introduces the Blend Micro board and how it can be used to create projects that connect to your mobile phone.

Chapter 8, *On the Wi-fly*, introduces you to the Wi-Fi Particle Core board and its web IDE. This chapter also talks about how to connect to online services.

Chapter 9, *Time to Get Smart*, focuses on the creation of a smart watch, which connects to the Internet and uses online services to create custom notifications to be displayed on a small OLED screen.

The online chapter (*Chapter 10*), *Interactive Name Tag*, expands upon *Chapter 7*, *Hands-on BLE*, which deals with small screens, and shows you how to interact with them over Bluetooth in order to make an interactive name tag. This chapter is available at `https://www.packtpub.com/sites/default/files/downloads/ArduinoWearableProjects_OnlineChapter.pdf`.

What you need for this book

Download and install the preconfigured Arduino IDE from Adafruit: `https://learn.adafruit.com/getting-started-with-flora/download-software`.

The Particle Build Web IDE, sign up for a free account on: `https://build.particle.io/login`.

Free account on IFTTT: `https://ifttt.com/`.

Boards

Here's a list of the boards you'll work on:

- Adafruit Trinket—Mini Microcontroller—5V Logic
- Adafruit Pro Trinket—5V 16 MHz
- FLORA—Wearable electronic platform: Arduino-compatible
- Spark Core with Chip Antenna Rev 1.0
- Redbear Blend Micro BLE board

Components and tools

Here's a list of all the components and tools you need:

- Soldering iron
- GA1A12S202 Log-scale Analog Light Sensor
- Long Flex/Bend sensor
- LDRs
- Adafruit TSL2561 Digital Luminosity/Lux/Light Sensor Breakout
- Breadboarding wire bundle
- Flora Wearable Ultimate GPS Module
- Monochrome 128 x 32 I2C OLED graphic display
- Adafruit LED Sequins
- 3.56 MHz RFID/NFC tags
- Adafruit PN532 NFC/RFID Controller Shield for Arduino + Extras
- Lithium Ion Polymer Battery—3.7V 1200 mAh
- SHARP Memory Display Breakout—1.3" 96 x 96 Silver Monochrome
- Small Alligator Clip Test Lead
- Lithium Ion Polymer Battery—3.7V 500mAh
- Monochrome 1.3" 128x64 OLED graphic display
- Adafruit Micro Lipo w/MicroUSB Jack—USB LiIon/LiPoly charger (V1)
- Full-sized breadboard
- OLED Breakout Board—16-bit Color 0.96" w/microSD holder
- Half-sized breadboard
- USB cable—6" A/MiniB

- FLORA 9-DOF Accelerometer/Gyroscope/Magnetometer—LSM9DS0 (V1.0)
- Lithium Ion Polymer Battery—3.7V 150mAh
- Hook-up Wire Spool Set—22AWG Solid Core—6 x 25 ft
- Flush diagonal cutters
- Helping Third Hand Magnifier W/Magnifying Glass Tool

Who this book is for

For readers familiar with the Arduino prototyping platform with some prior experienced with ordinary hardware tools.

Conventions

In this book, you will find a number of text styles that distinguish between different kinds of information. Here are some examples of these styles and an explanation of their meaning.

Code words in text, database table names, folder names, filenames, file extensions, pathnames, dummy URLs, user input, and Twitter handles are shown as follows: "We can include other contexts through the use of the `include` directive."

A block of code is set as follows:

```
//Variable to store the pin
int ldrSensor = 10;

void setup(){
//Start the serial communication
  Serial.begin(9600);
}

void loop(){
//Save the data from the sensor into storeData
  int storeData=analogRead(ldrSensor);
//Re-map storeData to a new range of values
  int mapValue=map(storeData,130,430,0,2000);
//Print the re-mapped value
  Serial.println(mapValue);
//Give the computer some time to print
  delay(200)
}
```

New terms and **important words** are shown in bold. Words that you see on the screen, for example, in menus or dialog boxes, appear in the text like this: "Clicking the **Next** button moves you to the next screen."

Warnings or important notes appear in a box like this.

Tips and tricks appear like this.

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Errata

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If you have a problem with any aspect of this book, you can contact us at `questions@packtpub.com`, and we will do our best to address the problem.

1
First Look and Blinking Lights

The basis for this book is the Arduino platform, which refers to three different things: software, hardware, and the Arduino philosophy. The hardware is the Arduino board, and there are multiple versions available for different needs. In this book, we will be focusing on Arduino boards that were made with wearables in mind. The software used to program the boards is also known as the **Arduino IDE**. **IDE** stands for **Integrated Development Environment**, which are programs used to write programs in programming code. The programs written for the board are known as **sketches**, because the idea aids how to write programs and works similar to a sketchpad. If you have an IDE, you can quickly try it out in code. This is also a part of the Arduino philosophy. Arduino is based on the open source philosophy, which also reflects on how we learn about Arduino. Arduino has a large community, and there are tons of projects to learn from.

First, we have the Arduino hardware, which we will use to build all the examples in this book along with different additional electronic components. When the Arduino projects started back in 2005, there was only one piece of headwear to speak of, which was the serial Arduino board. Since then, there have been several iterations of this board, and it has inspired new designs of the Arduino hardware to fit different needs. If you are familiar with Arduino for a while, you probably started out with the standard Arduino board. Today, there are different Arduino boards that fit different needs, and there are countless clones available for specific purposes. In this book, we will be using different specialized Arduino boards such as the FLORA board and Spark core board.

The Arduino software that is Arduino IDE is what we will use to program our projects. The IDE is the software used to write programs for the hardware. Once a program is compiled in the IDE, it will upload it to the Arduino board, and the processor on the board will do whatever your program says. Arduino programs are also known as sketches. The name sketches is borrowed from another open source project and software called **Processing**. Processing was developed as a tool for digital artists, where the idea was to use Processing as a digital sketchpad.