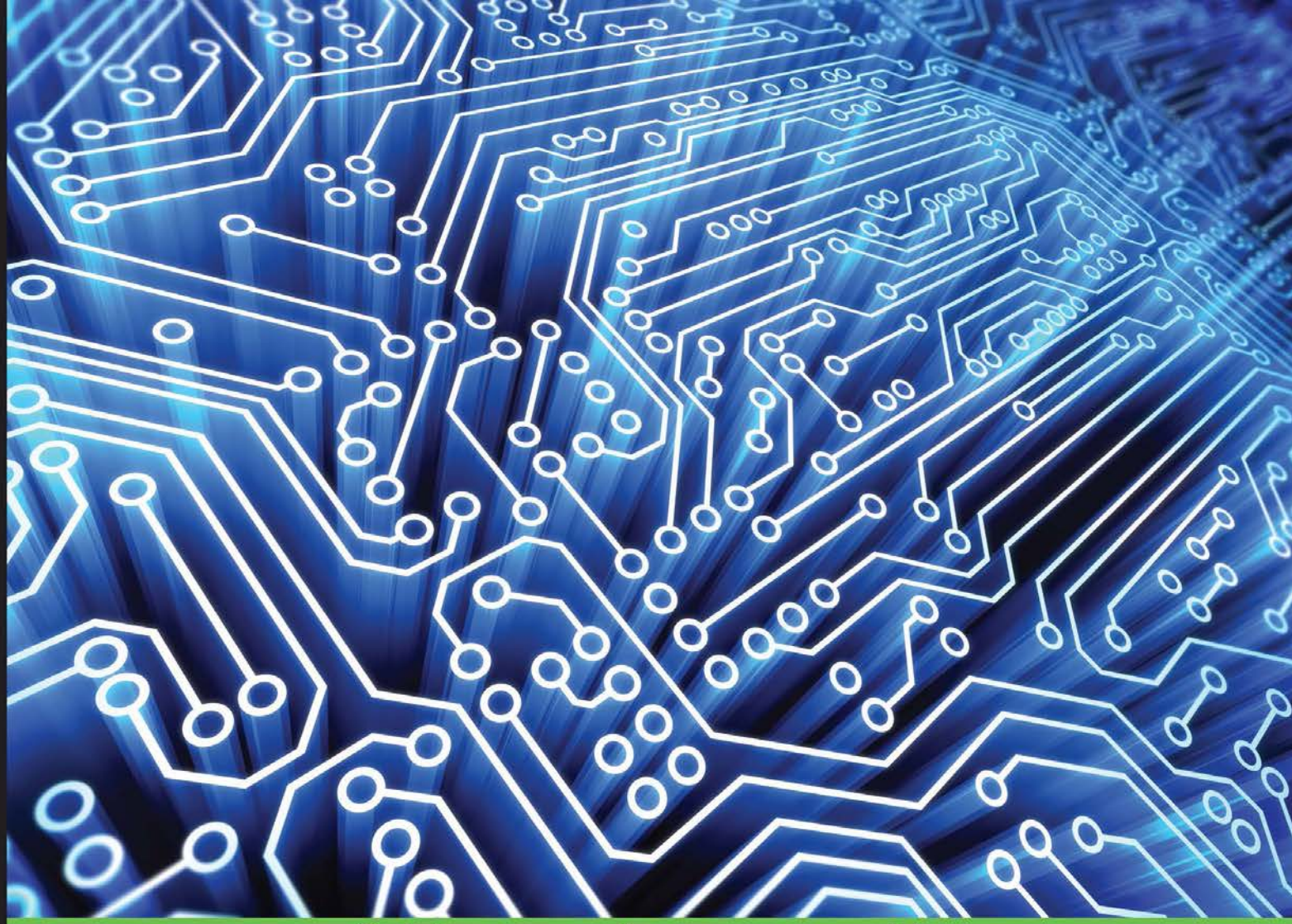

Quick answers to common problems

Intel Galileo Networking Cookbook

Over 45 recipes that will help you use the Intel Galileo board to build exciting network-connected projects

Marco Schwartz

[PACKT] PUBLISHING open source* community experience distilled

Intel Galileo Networking Cookbook

Over 45 recipes that will help you use the Intel Galileo board to build exciting network-connected projects

Marco Schwartz

[PACKT] PUBLISHING open source community experience distilled

BIRMINGHAM - MUMBAI

Intel Galileo Networking Cookbook

Copyright © 2015 Packt Publishing

All rights reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, without the prior written permission of the publisher, except in the case of brief quotations embedded in critical articles or reviews.

Every effort has been made in the preparation of this book to ensure the accuracy of the information presented. However, the information contained in this book is sold without warranty, either express or implied. Neither the author nor Packt Publishing, and its dealers and distributors will be held liable for any damages caused or alleged to be caused directly or indirectly by this book.

Packt Publishing has endeavored to provide trademark information about all of the companies and products mentioned in this book by the appropriate use of capitals. However, Packt Publishing cannot guarantee the accuracy of this information.

First published: August 2015

Production reference: 1240815

Published by Packt Publishing Ltd.
Livery Place
35 Livery Street
Birmingham B3 2PB, UK.

ISBN 978-1-78528-119-8

www.packtpub.com

Credits

Author
Marco Schwartz

Reviewers
Tom Collins
Agus Kurniawan
Bharat Sesham
Alex Tereschenko

Commissioning Editor
Edward Bowkett

Acquisition Editor
Harsha Bharwani

Content Development Editor
Shweta Pant

Technical Editor
Narsimha Pai

Copy Editors
Dipti Mankame
Kevin McGowan

Project Coordinator
Sanjeet Rao

Proofreader
Safis Editing

Indexer
Hemangini Bari

Graphics
Sheetal Aute

Production Coordinator
Komal Ramchandani

Cover Work
Komal Ramchandani

About the Author

Marco Schwartz is an electrical engineer, entrepreneur, and blogger. He has a master's degree in electrical engineering and computer science from SUPELEC in France and a master's degree in micro engineering from the EPFL in Switzerland. He has more than 5 years of experience working in the domain of electrical engineering. His interests gravitate around electronics, home automation, the Arduino and the Raspberry Pi platforms, open source hardware projects, and 3D printing. He runs several websites related to Arduino, including the Open Home Automation website, which is dedicated to building home automation systems using open source hardware.

He has written another book on home automation and Arduino, named *Arduino Home Automation Projects*, *Packt Publishing*. He has also published a book on how to build Internet of Things projects with Arduino, which is called *Internet of Things with the Arduino Yun*, *Packt Publishing*.

About the Reviewers

Tom Collins is an entrepreneur, start-up enthusiast, and cofounder of AllThingsTalk. He received a first-class degree with honors and awards for his graduate exhibition on "The Convergence of Cloud Computing, Smart Devices and the Internet of Things". He has also developed SmartLiving.io project, assuming a jack-of-all-trades role spanning architecture, DevOps, full stack, and mobile development.

Tom's latest mission is to support innovation within start-ups and organizations through the IoT methodology, share toolkits, design patterns, and provide lessons to build IoT solutions.

Agus Kurniawan is an IT security and technology consultant, author, and lecturer. He has experience in various software development projects, producing material for training and workshops and producing technical writing for 14 years. He has been awarded the Microsoft Most Valuable Professional (MVP) award for 11 years in a row. He is involved in some research activities related to networking and security systems at the University of Indonesia. Currently, he's pursuing a PhD program in computer science in Germany. You can visit his blog at `http://blog.aguskurniawan.net` and his Twitter page at `@agusk2010`.

Bharat Sesham is enthusiastic and passionate about learning the latest technologies and applying them to solving real-life problems. He has participated in many reputed competitions; some of these are the Intel Embedded Challenge 2014, NASA Space Settlement Challenge 2013/2014, CANSAT 2015, Shell Idea 360 2015, which gave him a practical insight. He has a good knowledge of embedded systems, IoT, and OpenCV. Apart from this, he is also working for two start-ups based on OpenCV.

His blog site is `https://bharatsesham.wordpress.com`, and his Twitter page is `@bharat_sesham`.

I would like to thank Packt Publishing for providing this opportunity and I would also like to thank my parents for supporting and encouraging me throughout my journey.

Alex Tereschenko is an avid creator, who is sure that computers can do a lot of good for people when they are interfaced with real-world objects (as opposed to just crunching data in a dusty corner). That's what's driving him in his projects, and this is why embedded systems and the Internet of Things are topics he enjoys the most.

www.PacktPub.com

Support files, eBooks, discount offers, and more

For support files and downloads related to your book, please visit `www.PacktPub.com`.

Did you know that Packt offers eBook versions of every book published, with PDF and ePub files available? You can upgrade to the eBook version at `www.PacktPub.com` and as a print book customer, you are entitled to a discount on the eBook copy. Get in touch with us at `service@packtpub.com` for more details.

At `www.PacktPub.com`, you can also read a collection of free technical articles, sign up for a range of free newsletters and receive exclusive discounts and offers on Packt books and eBooks.

`https://www2.packtpub.com/books/subscription/packtlib`

Do you need instant solutions to your IT questions? PacktLib is Packt's online digital book library. Here, you can search, access, and read Packt's entire library of books.

Why Subscribe?

- Fully searchable across every book published by Packt
- Copy and paste, print, and bookmark content
- On demand and accessible via a web browser

Free Access for Packt account holders

If you have an account with Packt at `www.PacktPub.com`, you can use this to access PacktLib today and view 9 entirely free books. Simply use your login credentials for immediate access.

Table of Contents

Preface v

Chapter 1: Installing and Configuring Linux 1

- Introduction 1
- Configuring your Galileo for the first time 2
- Using a simple Linux image 4
- Using the IoT Linux image 6
- Accessing the Galileo board remotely 9
- Installing and updating modules 11
- Accessing Galileo via Wi-Fi 13
- Troubleshooting Linux installation issues 16

Chapter 2: Connecting External Sensors 19

- Introduction 19
- Using the Arduino IDE with the Galileo board 20
- Connecting an analog sensor 23
- Connecting a digital sensor 26
- Connecting an LCD screen 28
- Displaying the temperature on an LCD screen 31
- Troubleshooting the usual issues with sensors 35

Chapter 3: Controlling Hardware Devices 37

- Introduction 37
- Connecting a relay 38
- Connecting a DC motor 40
- Connecting an XBee module 43
- Controlling a servomotor from a rotating knob 46
- Using the SD card reader to log data 49
- Troubleshooting the usual issues 53

Chapter 4: Creating a Web Server 55
Introduction 55
Using the Intel XDK software 56
Running a simple Node.js server 58
Using Express on Galileo 60
Reading pins via a web server 62
Controlling pins via a web server 64
Creating an API to control Galileo 67
Troubleshooting web server issues 71

Chapter 5: Hosting Applications on the Galileo Board 73
Introduction 73
Creating a file-sharing server 74
Accessing weather data remotely 75
Tweeting from the Galileo board 77
Accessing web APIs via Temboo 80
Accessing more APIs via Temboo 85
Troubleshooting application issues 89

Chapter 6: Local Network Monitoring 91
Introduction 91
Accessing measured data remotely 92
Logging data in a local database 94
Displaying measurements stored in a database 98
Live data visualization 102
Troubleshooting the usual issues with sensors 105

Chapter 7: Cloud Data Monitoring 107
Introduction 107
Building and testing hardware for cloud monitoring 107
Sending data to a cloud device 110
Monitoring data remotely from a dashboard 113
Logging data in an online datasheet 116
Controlling your board from anywhere in the world 122
Troubleshooting cloud monitoring issues 126

Chapter 8: Building a Home Automation System 129
Introduction 129
Choosing the right components 130
Building a Wi-Fi Arduino sensor module 132
Connecting Arduino modules to the Galileo board 138
Building an interface for your home automation system 140

Connecting your home automation system to the Web **144**
Accessing your home automation system from anywhere **145**
Troubleshooting issues with your home automation system **147**
Index **149**

Preface

Intel Galileo is a great development kit for all your Do-It-Yourself electronics projects. The board has an in-built powerful Intel processor, but is usable with the well-known Arduino software. It is also compatible with most Arduino shields.

This makes it the ideal board for your projects, especially in the fields where you need to use cloud-based services, for example, to store data online. It is therefore a great board for Internet of Things (IoT) applications.

In this book, we are going to start setting up your board and building simple applications with the board, such as running a web server on the board. After this, we'll dive into more complex topics, such as IoT applications. Finally, we'll sum up everything we learned in the book by building a simple home automation system based on the Galileo board.

What this book covers

Chapter 1, *Installing and Configuring Linux*, explains how to set up your Galileo board and the development environment, so you can start building projects. We will install the Galileo IoT image and install the required software on your computer.

Chapter 2, *Connecting External Sensors*, will discuss connecting sensors to the board, such as a temperature sensor. We will see how to read data from sensors and use it in our projects.

Chapter 3, *Controlling Hardware Devices*, covers how to control devices from the Galileo board, such as a relay that can be used to control electrical appliances.

Chapter 4, *Creating a Web Server*, is dedicated to running a simple web server on the Galileo board. We will see that a server can also be used to control the inputs and outputs of the board.

Chapter 5, *Hosting Applications on the Galileo Board*, covers how to host useful applications on the board, such as a simple file-sharing server.

Chapter 6, *Local Network Monitoring*, is dedicated to creating applications to monitor the activity of the Galileo board via the local network connection, for example, you will be able to monitor measurements done by the board in real time.

Chapter 7, *Cloud Data Monitoring*, is all about connecting your board to cloud services in order to build Internet of Things applications, such as remotely logging data on a cloud platform.

Chapter 8, *Building a Home Automation System*, sums up all that was done in the book with an application: building a home automation system based on Arduino, using the Galileo board as the "hub" of the system.

What you need for this book

For this entire book, you will need an Intel Galileo board. In the first chapter of the book, you will learn how to install all the required software to configure your board.

You will also need a computer running Windows, Mac OS X, or Linux, as this will be needed to configure your Galileo board.

Who this book is for

This book is intended for those who want to build exciting projects using the Intel Galileo board. It is for people who are already experienced in using more classic Arduino boards and want to extend their knowledge to the Intel Galileo board.

It is also for people who want to learn about electronics and programming, and Intel Galileo is the perfect platform for this.

Sections

In this book, you will find several headings that appear frequently (Getting ready, How to do it, How it works, There's more, and See also).

To give clear instructions on how to complete a recipe, we use these sections as follows:

Getting ready

This section tells you what to expect in the recipe, and describes how to set up any software or any preliminary settings required for the recipe.

How to do it...

This section contains the steps required to follow the recipe.

How it works...

This section usually consists of a detailed explanation of what happened in the previous section.

There's more...

This section consists of additional information about the recipe in order to make the reader more knowledgeable about the recipe.

See also

This section provides helpful links to other useful information for the recipe.

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: "Every time you see a line starting with `root@galileo`, this means we will be using the terminal."

A block of code is set as follows:

```
// Sensor pin
int sensorPin = 0;

void setup()
{

  // Start Serial connection
  Serial.begin(9600);
}
```

When we wish to draw your attention to a particular part of a code block, the relevant lines or items are set in bold:

```
// Sensor pin
int sensorPin = 0;

void setup()
{

  // Start Serial connection
  Serial.begin(9600);
}
```

Any command-line input or output is written as follows:

```
opkg install package_name
```

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: "To solve this problem, simply push the **Reboot** button on the board."

Warnings or important notes appear in a box like this.

Tips and tricks appear like this.

Reader feedback

Feedback from our readers is always welcome. Let us know what you think about this book—what you liked or disliked. Reader feedback is important for us as it helps us develop titles that you will really get the most out of.

To send us general feedback, simply e-mail `feedback@packtpub.com`, and mention the book's title in the subject of your message.

If there is a topic that you have expertise in and you are interested in either writing or contributing to a book, see our author guide at `www.packtpub.com/authors`.

Customer support

Now that you are the proud owner of a Packt book, we have a number of things to help you to get the most from your purchase.

Downloading the example code

You can download the example code files from your account at `http://www.packtpub.com` for all the Packt Publishing books you have purchased. If you purchased this book elsewhere, you can visit `http://www.packtpub.com/support` and register to have the files e-mailed directly to you.

Downloading the color images of this book

We also provide you with a PDF file that has color images of the screenshots/diagrams used in this book. The color images will help you better understand the changes in the output. You can download this file from `http://www.packtpub.com/sites/default/files/downloads/1198OS_ColorImages.pdf`.

Errata

Although we have taken every care to ensure the accuracy of our content, mistakes do happen. If you find a mistake in one of our books—maybe a mistake in the text or the code—we would be grateful if you could report this to us. By doing so, you can save other readers from frustration and help us improve subsequent versions of this book. If you find any errata, please report them by visiting `http://www.packtpub.com/submit-errata`, selecting your book, clicking on the **Errata Submission Form** link, and entering the details of your errata. Once your errata are verified, your submission will be accepted and the errata will be uploaded to our website or added to any list of existing errata under the Errata section of that title.

To view the previously submitted errata, go to `https://www.packtpub.com/books/content/support` and enter the name of the book in the search field. The required information will appear under the **Errata** section.

Piracy

Piracy of copyrighted material on the Internet is an ongoing problem across all media. At Packt, we take the protection of our copyright and licenses very seriously. If you come across any illegal copies of our works in any form on the Internet, please provide us with the location address or website name immediately so that we can pursue a remedy.