Raspberry Pi IoT Projects

Prototyping Experiments for Makers



John C. Shovic, PhD

Contents

About the Author	XV
About the Technical Reviewer	xvii
Acknowledgments Introduction Chapters at a Glance	xix
	xxi
	xxiji
Chapter 1: Introduction to IOT	1
Choosing a Raspberry Pi Model	2
Choosing an IOT Device	3
Characterizing an IOT Project	3
Communications	
Processor Power	4
Local Storage	4
Power Consumption	5
Functionality	5
Cost	5
The Right Tools to Deal with Hardware	5
Writing Code in Python and the Arduino IDE	7
In This Book	R

CONTENTS

Chapter 2: Sensing Your IOT Environment	9
IOT Sensor Nets	10
IOT Characterization of This Project	10
How Does This Device Hook Up to the IOT?	11
What Is an ESP8266?	11
The LightSwarm Design	12
Building Your First IOT Swarm	16
Installing Arduino Support on the PC or Mac	16
Your First Sketch for the ESP8266	16
The Hardware	17
The Software	25
Self-Organizing Behavior	43
Monitoring and Debugging the System with the Raspberry Pi (the Smart Guy on the Block)	44
LightSwarm Logging Software Written in Python	44
The RasPiConnect Control Panel in Real Time	54
Results	58
What Else Can You Do with This Architecture?	61
Conclusion	61
■Chapter 3: Building a Solar Powered IOT Weather Station	63
IOT Characterization of This Project	65
How Does This Device Hook Up to the IOT?	65
Data Gathering	65
The Project - IOTWeatherPi	66
How This All Works	68
The Subsystems	68
The I2C Bus	71

Sizing Your Solar Power System	76
Power Up and Power Down	78
The Brownout Problem	80
Shutting Off the Pi	80
Starting the Pi	81
The Issue	81
Power Your Pi Up and Down with the USB Power Control	82
The USB Power Controller Board	83
One More Scenario	84
What Do You Need to Build This Project?	86
Connecting and Testing the Hardware	88
The Full Wiring List	90
The Software	95
Non-Normal Requirements for your Pi	95
The IOTWeatherPi Python Software	95
The RasPiConnect Control Panel	97
Improvements	98
Tweeting Your Weather Data	98
Getting Started	98
Registering a Twitter App	99
Texting Your Weather Data	102
Supplying Your Data to the World - CWOP	105
CWOP	105
CWOP Software Interface to IOTWeatherPi	105
CWOP Software	105
Example CWOP Packet	108
Results	108
Conclusion	110

CONTENTS

Chapter 4: Changing Your Environment with IOT and iBea	acons113
The IOTBeaconAir	113
IOT Characterization of This Project	114
How Does This Device Hook Up to the IOT?	115
Hardware List	115
iBeacons	116
Bluetooth iBeacon Scanner	118
Phillips Hue Lighting System	119
Phillips Hue Hub	120
BeaconAir Hardware, Software, and Configuration	121
BeaconAir Hardware Description	
BeaconAir Software Description	121
BeaconAir Configuration File	133
iBeacon Software	134
Trilateralization	134
The IOTBeaconAir Control Panel	135
Installing blueZ and phue on the Raspberry Pi	138
BlueZ	139
phue	141
RasPiConnectServer Startup	141
Startup Procedure	141
Making IOTBeaconAir Start on Bootup	142
How It Works in Practice	143
Things to Do	143
The Classic Distributed System Problems	144
Conclusion	1/15

Chapter 5: Connecting an IOT Device to a Cloud Server - IOTPulse	47
IOT Characterization of This Project	
The Internet Of Things on the Global Network 1	
Cloud Computing	
Application Builders	
Display and Report Generation	150
The IBM Bluemix Internet Of Things Solution	151
The IOTPulse Design1	152
Building the IOTPulse	
3D Printing Files for the IOT Case	157
Software Needed	160
The IOTPulse Code	160
Reviewing the Arduino IDE Serial Monitor Results	170
Joining IBM Bluemix and the IoT Foundation1	173
Sending your Data to Bluemix	175
Displaying Real-Time Data on the IBM Bluemix IOT Platform	179
Advanced Topics1	184
Historical Data	184
Node-RED Applications	185
Watson Applications	186
Conclusion1	186
■ Chapter 6: Using IOT for RFID and MQTT and the Raspberry Pi 1	87
IOT Characterization of This Project	187
What Is RFID Technology? 1	188
What Is MQTT? 1	
Hardware Used for IOTRFID	
Building an MQTT Server on a Raspberry Pi	

CONTENTS

The Software on the Raspberry Pi	192
Installing the MQTT "Mosquitto"	192
Configuring and Starting the Mosquitto Server	193
Starting the Mosquitto Server	194
Testing the Mosquitto Server	194
Building the IOTRFID	195
The Parts Needed	195
Installing Arduino Support on the PC or Mac	196
The Hardware	196
What Is This Sensor We Are Using?	196
3D Printed Case	197
The Full Wiring List	199
The Software for the IOTRFID Project	201
The Libraries	201
The Main Software	202
Testing the IOTRFID System	205
Setting Up the Mosquitto Debug Window	206
Set Up a Subscriber on the Raspberry Pi	207
Testing the Entire IOTRFID System	208
What to Do with the RFID Data on the Server	210
Conclusion	210
Chapter 7: Computer Security and the IOT	213
IOT: Top Five Things to Know About IOT Computer Secu	rity 214
Number 1: This is <i>important</i> . You can prove your application <i>is</i> can't prove your application <i>is secure</i>	s <i>insecure</i> , but you
Number 2: Security through Obscurity Is Not Security	214
Number 3: Always Connected? Always Vulnerable	214

n 215
y, 215
216
216
s 217
217
222
225
226
227
227
229
230
231