

Beginning Arduino



Michael McRoberts

Apress

Contents at a Glance

About the Author	xix
About the Technical Reviewers	xxi
Acknowledgments	xxiii
Introduction	xxv
■ Chapter 1: Getting Started	1
■ Chapter 2: Light ‘Em Up	21
■ Chapter 3: LED Effects	49
■ Chapter 4: Simple Sounders and Sensors	79
■ Chapter 5: Driving a DC Motor	97
■ Chapter 6: Binary Counters and Shift Register I/O	111
■ Chapter 7: LED Displays.....	127
■ Chapter 8: Liquid Crystal Displays	165
■ Chapter 9: Servos	183
■ Chapter 10: Steppers and Robots	199
■ Chapter 11: Pressure Sensors	223
■ Chapter 12: Touch Screens	251
■ Chapter 13: Temperature Sensors	271
■ Chapter 14: Ultrasonic Rangefinders.....	285

■ CONTENTS AT A GLANCE

■ Chapter 15: Reading and Writing to an SD Card.....	305
■ Chapter 16: Making an RFID Reader.....	325
■ Chapter 17: Communicating over Ethernet	341
Index.....	391

Contents

About the Author	xix
About the Technical Reviewers	xxi
Acknowledgments	xxiii
Introduction	xxv
■ Chapter 1: Getting Started	1
How to Use This Book.....	1
What You Will Need.....	2
What Exactly Is an Arduino?.....	2
Setting Up Your Arduino.....	5
Upload Your First Sketch	13
The Arduino IDE	14
Summary.....	20
■ Chapter 2: Light ‘Em Up	21
Project 1 — LED Flasher	21
Parts Required.....	21
Connect It Up	22
Enter the Code	23
Project 1 — LED Flasher – Code Overview	23
Project 1 — LED Flasher – Hardware Overview.....	27
Project 2 – S.O.S. Morse Code Signaler.....	31
Enter the code	31
Project 2 – S.O.S. Morse Code Signaler – Code Overview.....	32

Project 3 – Traffic Lights	34
Parts Required	34
Connect It Up	34
Enter the Code	35
Project 4 – Interactive Traffic Lights.....	36
Parts Required	36
Connect It Up	37
Enter the Code	38
Project 4 – Interactive Traffic Lights - Code Overview.....	40
Project 4 – Interactive Traffic Lights - Hardware Overview	43
Logic States.....	43
Pull-Down Resistors	44
Pull-Up Resistors	45
The Arduino's Internal Pull-Up Resistors	47
Summary.....	47
■ Chapter 3: LED Effects	49
Project 5 – LED Chase Effect.....	49
Parts Required	49
Connect It Up	49
Enter the Code	50
Project 5 – LED Chase Effect – Code Overview	51
Project 6 – Interactive LED Chase Effect.....	52
Parts Required	52
Connect It Up	53
Enter the Code	53
Project 6 – Interactive LED Chase Effect – Code Overview	54
Project 6 – Interactive LED Chase Effect – Hardware Overview.....	55
Project 7 – Pulsating Lamp	56
Parts Required	56
Connect It Up	56

Enter the Code	57
Project 7 – Pulsating Lamp – Code Overview.....	57
Project 8 – RGB Mood Lamp.....	58
Parts Required.....	58
Connect It Up	59
Enter the Code	59
Project 8 – RGB Mood Lamp – Code Overview.....	60
Project 9 – LED Fire Effect	63
Parts Required.....	64
Connect It Up	64
Enter the Code	64
Project 9 – LED Fire Effect – Code Overview.....	65
Project 10 – Serial Controlled Mood Lamp.....	66
Enter the Code	66
Project 10 – Serial-Controlled Mood Lamp – Code Overview.....	68
Pointers in a Nutshell	71
Summary.....	77
■ Chapter 4: Simple Sounders and Sensors	79
Project 11 – Piezo Sounder Alarm.....	79
Parts Required.....	79
Connect It Up	80
Enter the Code	80
Project 11 – Piezo Sounder Alarm – Code Overview	81
Project 11 – Piezo Sounder Alarm – Hardware Overview.....	82
Project 12 – Piezo-Sounder Melody Player	83
Enter the Code	83
Project 12 – Piezo-Sounder Melody Player – Code Overview	85
Project 13 – Piezo Knock Sensor	88
Parts Required.....	88
Connect It Up	88

Enter the Code	89
Project 13 – Piezo Knock Sensor – Code Overview.....	90
Project 14 – Light Sensor	91
Parts Required.....	91
Connect It Up	91
Enter the Code	92
Project 14 – Light Sensor – Hardware Overview.....	93
Summary.....	95
■ Chapter 5: Driving a DC Motor	97
Project 15 – Simple Motor Control	97
Parts Required.....	98
Connect It Up	98
Enter the Code	99
Project 15 – Simple Motor Control – Code Overview	100
Project 15 – Simple Motor Control – Hardware Overview	101
Transistors	101
Motors	102
Diodes.....	102
Project 16 – Using an L293D Motor Driver IC.....	103
Parts Required.....	103
Connect It Up	103
Enter the Code	104
Project 16 – Using an L293D Motor Driver IC – Code Overview	105
Project 16 – Using an L293D Motor Driver IC – Hardware Overview	106
Summary.....	108
■ Chapter 6: Binary Counters and Shift Register I/O	111
Project 17 – Shift Register 8-Bit Binary Counter.....	111
Parts Required.....	111
Connect It Up	111
Enter the Code	112

The Binary Number System.....	113
Project 17 – Shift Register 8-Bit Binary Counter - Hardware Overview	115
Project 17 – Shift Register 8-Bit Binary Counter – Code Overview	117
Bitwise Operators	119
Project 17 – Code Overview (continued)	120
Project 18 – Dual 8-Bit Binary Counters	122
Parts Required.....	122
Connect It Up	123
Enter the Code	124
Project 18 Code & Hardware Overview.....	125
Summary.....	126
■ Chapter 7: LED Displays.....	127
Project 19 – LED Dot Matrix Display – Basic Animation.....	127
Parts Required.....	127
Connect It Up	128
Enter the Code	130
Project 19 – LED Dot-Matrix – Basic Animation – Hardware Overview	131
Project 19 – LED Dot-Matrix – Basic Animation – Code Overview	134
Project 20 – LED Dot-Matrix Display – Scrolling Sprite.....	137
Enter the Code	137
Project 20 – LED Dot-Matrix – Scrolling Sprite – Code Overview.....	138
Project 21 – LED Dot-Matrix Display – Scrolling Message.....	141
Parts Required.....	141
Connect It Up	142
Enter the Code	143
Project 21 – LED Dot-Matrix – Scrolling Message – Hardware Overview	147
Project 21 – LED Dot-Matrix – Scrolling Message – Code Overview.....	151
Project 22 – LED Dot Matrix Display – Pong Game	158
Parts Required.....	158
Connect It Up	158

Upload the Code	159
Project 22 – LED Dot Matrix – Pong Game	160
Summary.....	163
■Chapter 8: Liquid Crystal Displays	165
Project 23 – Basic LCD Control	165
Parts Required	165
Connect It Up	166
Enter the Code	167
Project 23 – Basic LCD Control – Code Overview	170
Project 23 – Basic LCD Control – Hardware Overview	174
Project 24 – LCD Temperature Display	174
Parts Required	175
Connect It Up	175
Enter the Code	176
Project 24 – LCD Temperature Display	177
Summary.....	181
■Chapter 9: Servos	183
Project 25 – Servo Control	184
Parts Required	184
Connect It Up	185
Enter the Code	186
Project 25 – Servo Control – Code Overview	186
Project 25 – Servo Control – Hardware Overview	187
Project 26 – Dual Servo Control	188
Parts Required	188
Connect It Up	189
Enter the Code	189
Project 26 – Dual Servo Control – Code Overview	191

Project 27 – Joystick Servo Control	193
Parts Required.....	193
Connect It Up	193
Enter the Code	195
Project 27 – Joystick Servo Control – Code Overview.....	196
Summary.....	198
■ Chapter 10: Steppers and Robots.....	199
Project 28 – Basic Stepper Control	199
Parts Required.....	199
Connect It Up	200
Enter the Code	201
Project 28 – Basic Stepper Control – Code Overview.....	202
Project 28 – Basic Stepper Control – Hardware Overview	203
Project 29 – Using a Motor Shield.....	205
Parts Required.....	205
Connect It Up	206
Enter the Code	207
Project 29 – Using a Motor Shield – Code Overview	208
Project 29 – Using a Motor Shield – Hardware Overview.....	210
Project 30 – Line-Following Robot	211
Parts Required.....	211
Connect It Up	212
Enter the Code	215
Project 30 – Line-Following Robot – Code Overview	217
Summary.....	221
■ Chapter 11: Pressure Sensors.....	223
Project 31 – Digital Pressure Sensor.....	223
Parts Required.....	223
Connect It Up	224

Enter the Code	225
Project 31 – Digital Pressure Sensor – Code Overview	227
I2C Bus	228
Project 32 – Digital Barograph	236
Parts Required	236
Connect It Up	237
Enter the Code	239
Project 32 – Digital Barograph – Code Overview	243
Summary.....	249
Subjects and Concepts Covered in Chapter 11.....	249
■Chapter 12: Touch Screens	251
Project 33 – Basic Touch Screen.....	251
Parts Required	251
Connect It Up	252
Enter the Code	253
Project 33 – Basic Touch Screen – Hardware Overview.....	254
Project 33 – Basic Touch Screen – Code Overview	256
Project 34 – Touch Screen Keypad.....	258
Parts Required	258
Connect It Up	259
Enter the Code	260
Project 34 –Touch Screen Keypad – Code Overview.....	262
Project 35 – Touch Screen Light Controller	264
Parts Required	264
Connect It Up	265
Enter the Code	266
Project 35 – Touch Screen Controller – Code Overview	268
Summary.....	270

■ Chapter 13: Temperature Sensors	271
Project 36 – Serial Temperature Sensor.....	271
Parts Required.....	271
Connect It Up	272
Enter the Code	273
Project 36 – Serial Temperature Sensor – Code Overview	274
Project 37 – One-Wire Digital Temperature Sensor.....	275
Parts Required.....	275
Connect It Up	276
Enter the Code	277
Project 37 – 1-Wire Digital Temperature Sensor – Code Overview	281
Summary.....	284
■ Chapter 14: Ultrasonic Rangefinders.....	285
Project 38 – Simple Ultrasonic Rangefinder	285
Parts Required.....	285
Connect It Up	285
Enter the Code	286
Project 38 – Simple Ultrasonic Rangefinder – Code Overview	287
Project 38 – Simple Ultrasonic Rangefinder – Hardware Overview	288
Project 39 – Ultrasonic Distance Display	289
Parts Required.....	289
Connect It Up	290
Enter the Code	292
Project 39 – Ultrasonic Distance Display – Code Overview	293
Project 40 – Ultrasonic Alarm.....	296
Parts Required.....	296
Connect It Up	297
Enter the Code	297
Project 40 – Ultrasonic Alarm – Code Overview	299

Project 41 – Ultrasonic Theremin	302
Enter the Code	302
Project 41 – Ultrasonic Theremin – Code Overview	303
Summary	304
■ Chapter 15: Reading and Writing to an SD Card.....	305
Project 42 – Simple SD Card/Read Write	305
Parts Required	305
Connect It Up	306
Enter the Code	307
Project 42 – Simple SD Card Read/Write – Code Overview.....	309
Project 43 – Temperature SD Datalogger	312
Parts Required	313
Connect It Up	313
Enter the Code	315
Project 43 – Temperature SD Datalogger – Code Overview	317
Project 43 – Temperature SD Datalogger – Hardware Overview	322
Summary	323
■ Chapter 16: Making an RFID Reader.....	325
Project 44 – Simple RFID Reader	325
Parts Required	325
Connect It Up	326
Enter the Code	327
Project 44 – Simple RFID Reader – CODE Overview.....	327
Project 44 – Simple RFID Reader – Hardware Overview	328
Project 45—Access Control System	329
Parts Required	329
Connect It Up	330
Enter the Code	331
Project 45 – Access Control System – Code Overview	334
Summary	339

Chapter 17: Communicating over Ethernet	341
Project 46 – Ethernet Shield	341
Parts Required	341
Connect It Up	341
Enter the Code	342
Things You Need to Know about Networking	345
Project 46 – Ethernet Shield – Code Overview	346
Project 47 — Internet Weather Display.....	350
Enter the Code	353
Project 47 – Internet Weather Display – Code Overview	357
Project 48 — Email Alert System.....	360
Enter the Code	360
Project 48 – Email Alert System — Code Overview	364
Project 49 — Twitterbot.....	369
Enter the Code	369
Project 49 – Twitterbot – Code Overview	372
Project 50 – RSS Weather Reader	377
Enter the Code	377
Project 50 – RSS Weather Reader – Code Overview	381
Summary	389
Index.....	391