

13 Fun Electronics Projects!

Electronics

FOR

KIDS

- Learn electronics the fun and easy way
- Control lights, sound, and timing
- Make 13 cool & useful projects



Cathleen Shamieh

Author of Electronics For Dummies, 3rd Edition

FOR
DUMMIES
A Wiley Brand

Electronics For Kids

FOR
DUMMIES
A Wiley Brand

by Cathleen Shamieh



GIFT OF THE ASIA FOUNDATION
NOT FOR RE-SALE

QUÀ TẶNG CỦA QUỸ CHÂU Á
KHÔNG ĐƯỢC BÁN LẠI

FOR
DUMMIES
A Wiley Brand

Electronics For Kids For Dummies®

Published by: **John Wiley & Sons, Inc.**, 111 River Street, Hoboken, NJ 07030-5774, www.wiley.com

Copyright © 2016 by John Wiley & Sons, Inc., Hoboken, New Jersey

Published simultaneously in Canada

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as permitted under Sections 107 or 108 of the 1976 United States Copyright Act, without the prior written permission of the Publisher. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

Trademarks: Wiley, For Dummies, the Dummies Man logo, Dummies.com, Making Everything Easier, and related trade dress are trademarks or registered trademarks of John Wiley & Sons, Inc. and may not be used without written permission. All other trademarks are the property of their respective owners. John Wiley & Sons, Inc. is not associated with any product or vendor mentioned in this book.

LIMIT OF LIABILITY/DISCLAIMER OF WARRANTY: THE PUBLISHER AND THE AUTHOR MAKE NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS WORK AND SPECIFICALLY DISCLAIM ALL WARRANTIES, INCLUDING WITHOUT LIMITATION WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE. NO WARRANTY MAY BE CREATED OR EXTENDED BY SALES OR PROMOTIONAL MATERIALS. THE ADVICE AND STRATEGIES CONTAINED HEREIN MAY NOT BE SUITABLE FOR EVERY SITUATION. THIS WORK IS SOLD WITH THE UNDERSTANDING THAT THE PUBLISHER IS NOT ENGAGED IN RENDERING LEGAL, ACCOUNTING, OR OTHER PROFESSIONAL SERVICES. IF PROFESSIONAL ASSISTANCE IS REQUIRED, THE SERVICES OF A COMPETENT PROFESSIONAL PERSON SHOULD BE SOUGHT. NEITHER THE PUBLISHER NOR THE AUTHOR SHALL BE LIABLE FOR DAMAGES ARISING HEREFROM. THE FACT THAT AN ORGANIZATION OR WEBSITE IS REFERRED TO IN THIS WORK AS A CITATION AND/OR A POTENTIAL SOURCE OF FURTHER INFORMATION DOES NOT MEAN THAT THE AUTHOR OR THE PUBLISHER ENDORSES THE INFORMATION THE ORGANIZATION OR WEBSITE MAY PROVIDE OR RECOMMENDATIONS IT MAY MAKE. FURTHER, READERS SHOULD BE AWARE THAT INTERNET WEBSITES LISTED IN THIS WORK MAY HAVE CHANGED OR DISAPPEARED BETWEEN WHEN THIS WORK WAS WRITTEN AND WHEN IT IS READ.

For general information on our other products and services, please contact our Customer Care Department within the U.S. at 877-762-2974, outside the U.S. at 317-572-3993, or fax 317-572-4002. For technical support, please visit www.wiley.com/techsupport.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Library of Congress Control Number: 2016931382

ISBN 978-1-119-21565-3 (pbk); ISBN 978-1-119-21572-1 (ebk); ISBN 978-1-119-21571-4

Manufactured in the United States of America

10 9 8 7 6 5 4 3 2 1

Contents at a Glance

Introduction	1
Part I: Discover Basic Circuits	7
Project 1: Go Shopping	9
Project 2: LED Flashlight	21
Project 3: Solderless Breadboard.....	41
Part II: Simple Projects That Control Light	65
Project 4: Two-Way Traffic Light	67
Project 5: Light Timer	79
Project 6: Stage Lights Dimmer	99
Project 7: Smart Nightlight.....	125
Part III: Do More with Less: Integrated Circuits	145
Project 8: Blinking LED	147
Project 9: Light-Sensing Alarm.....	169
Project 10: Light-Controlled Sound Effects	193
Project 11: One-Octave Keyboard	207
Part IV: Impress Your Friends: Advanced Projects	233
Project 12: Roulette (Guess-the-Number) Wheel	235
Project 13: Three-Way Traffic Light	271
Project 14: Radio and Amplifier	295
Index.....	329

Table of Contents

Introduction..... 1

About This Book.....	1
Foolish Assumptions.....	3
Icons Used in This Book.....	3
Beyond the Book.....	4
Where to Go from Here.....	4

Part I: Discover Basic Circuits..... 7

Project 1: Go Shopping..... 9

Plan Your Shopping Spree.....	10
Budget.....	11
Electronic Components and Accessories.....	11
Tools and Supplies.....	18

Project 2: LED Flashlight..... 21

Gather the Parts for the LED Flashlight.....	22
Energize Your Flashlight.....	23
Explore your battery.....	23
Voltage and current.....	23
Get to Know Your LED.....	24
Diodes and bicycle tires.....	24
Seeing light from LEDs.....	25
Examine your LED.....	26
Orienting an LED in a circuit.....	27
Protect Your LED with a Resistor.....	28
Understanding resistance.....	28
Resistor power ratings.....	29
Make the LED Flashlight.....	30
Build the flashlight circuit.....	30
LED flashlight switch.....	33
Make a case for your flashlight.....	34
LED Flashlight Circuit Diagram.....	37

Project 3: Solderless Breadboard	41
Why Use a Solderless Breadboard?	42
Get Your Components Ready	42
Jumper wires	43
Use a battery clip	44
Explore Your Solderless Breadboard	44
Contact holes	45
Connections	46
Power rails	47
Binding posts	48
Breadboard an LED Circuit	49
Add a Power Switch	52
Understand how your switch works	52
Think about your switch connection	53
Connect your switch	55
Test your switch	55
Connect the Power Rails	56
Series and Parallel Circuits	57
Prepare your breadboard	58
Build the two-LED series circuit	58
Build the two-LED parallel circuit	59
Compare circuits	60
Visualize the flow of current	61

Part II: Simple Projects That Control Light..... 65

Project 4: Two-Way Traffic Light	67
Collect and Prepare Components	68
Create Neater Circuits	69
Construct the Two-Way Traffic Light Circuit	69
Two-Way Traffic Light Schematic	75
Don't Underestimate Your Switch	77
Project 5: Light Timer	79
What Is a Capacitor?	80
Check Out Your Capacitor	81
Gather Components and Tools	82
Build the Capacitor Circuit	83
Operate the Capacitor Circuit	87
Charge your capacitor	88
Store electrical energy	89
Discharge your capacitor	89

Change the Timing of the Light.....	90
Meet the RC time constant	90
Increase the capacitor discharge time.....	91
Decrease the capacitor discharge time	92
Control the Timing of Two LEDs	93
Add an LED to the charging circuit	94
Test the two-LED circuit	95
Why Use Capacitors?	97
Project 6: Stage Lights Dimmer	99
The Amazing Transistor	100
Transistors and faucets	100
Explore a transistor	101
Why Use a Transistor?	103
The problem with the RC time constant.....	103
The solution to the problem	104
Gather Components and Tools.....	105
Build the Basic Stage Lights Dimmer Circuit	106
Operate the Stage Lights Dimming Circuit	114
Explore the Schematic	115
Capacitor charging	115
Capacitor discharging	116
Transistor shutting off	117
Add More Lights	118
Operate the Eight-Light Dimming Circuit	121
Check Out the Schematic	122
Project 7: Smart Nightlight	125
Make Sense of Your Photoresistor	126
Check Out a PNP Transistor.....	127
Round Up Components and Tools	128
Build the Smart Nightlight Circuit	129
Test Your Nightlight Circuit	135
Make Adjustments	136
Explore the Schematic	138
Stage 1	139
Stage 2	140
Stage 3	142
Put it all together	143

Part III: Do More with Less: Integrated Circuits 145

Project 8: Blinking LED 147

What's an Integrated Circuit?.....	148
Check out some chips	148
Pay attention to the pinout!.....	149
Meet the 555 Timer.....	150
Round Up Components and Tools	151
The Optional Potentiometer	153
Examine a pot.....	153
Prepare your pot.....	155
Build the Blinking LED Circuit.....	157
Operate the Blinking LED Circuit.....	164
Change the timing.....	164
Use a potentiometer (optional)	165
Take a Look at the Schematic	166

Project 9: Light-Sensing Alarm 169

How a Speaker Works	170
Gather Components and Tools	171
Prepare Your Speaker	173
Build the Light-Sensing Alarm Circuit.....	175
Test Your Light-Sensing Alarm	184
Check Out the Schematic	185
How the tone is generated.....	186
How the 555 timer is switched on and off	189
How the transistor is switched on and off.....	191

Project 10: Light-Controlled Sound Effects 193

Collect the Parts You Need	194
Build the Light-Controlled Sound Effects Circuit	196
Create Some Sound Effects.....	203
Check Out the Schematic	204
How the sound effects are created.....	204
A range of frequencies	206

Project 11: One-Octave Keyboard 207

Probe a Pushbutton Switch.....	208
Collect the Parts You Need	209
Build Your Keyboard.....	211
Test and Tune Your Keyboard.....	222
Play Some Tunes!.....	224
Examine the Schematic.....	225

Part IV: Impress Your Friends: Advanced Projects 233

Project 12: Roulette (Guess-the-Number) Wheel 235

The 4017 Decade Counter IC	236
Protect your CMOS chip	236
Explore the 4017 decade counter	238
Use the 555 Timer as a Trigger	239
Gather the Parts You Need	241
Two-Part Project	244
Part 1: Light Chaser Circuit	244
Build the light chaser	245
Operate your light chaser	259
Troubleshooting the light chaser circuit	259
Part 2: The Roulette Wheel	261
Change the timing	261
Play the guess-the-number game	265
Add a potentiometer (optional)	265
Add sound effects	266
Schematics and Circuit Explanation	267
Light chaser	267
Roulette wheel	268
Reward yourself	270

Project 13: Three-Way Traffic Light 271

Meet the 1N4148 (or 1N914) Diode	272
Reuse and Save Time	273
Get Your Parts Ready	274
Build the Three-Way Traffic Light	276
Operate Your Traffic Light	289
Change the Timing	289
Alter the overall timing	289
Alter the relative timing	290
Understand Your Traffic Light Circuit	291
Explore the schematic	291
The importance of being a diode	293

Project 14: Radio and Amplifier 295

What Is Radio?	296
Plan Your Mission	297
Homemade Tuner	298
Make an inductor	299
Make a variable capacitor	302



Meet Your Radio Signal Detector	305
The LM386 Audio Amplifier	306
Gather Parts	306
Choose a Good Work Space	308
Build Your Amplifier.....	309
Connect the Radio	315
Operate Your Radio.....	319
Tap into a Headphone Set	320
Gather parts.....	320
Hack the headphones.....	320
Remove the radio inputs.....	323
Connect your audio inputs to your amplifier.....	324
Play your music player through your amplifier.....	325
Add a Selector Switch	325

Index.....	329
-------------------	------------