Electronics Projects FOR DUMMIES®

by Earl Boysen and Nancy Muir

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About the Authors

Earl Boysen is an engineer who after 20 years in the computer chip industry, decided to slow down and move to a quiet town in Washington state. Earl is the co-author of *Electronics For Dummies* and *Nanotechnology For Dummies.* He lives with his wife, Nancy, in a house he built himself and finds himself as busy as ever with teaching, writing, house building, and acting. Visit Earl at his Web site to get reviews and information about the latest components and techniques for building projects: `www.buildinggadgets.com`.

Nancy Muir is the author of over 50 books on topics ranging from desktop computer applications to distance learning and electronics. She has a certificate in distance learning design and has taught technical writing at the university level. Prior to her freelance writing career, she held management positions in the publishing and software industries. She lives with her husband Earl and their benevolent owners — their dog and cat. Nancy's company, The Publishing Studio, has its Web site at `www.pubstudio.com`.

Dedication

Nancy and Earl dedicate this book to their uncle, Ted Stier, with thanks for being such a great guy and giving Nancy away with such style and grace!

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Contents at a Glance

Table of Contents

Introduction

If you've caught the electronics bug, you're ready to try all kinds of projects that will help you develop your skills while creating weird and wonderful gadgets. That's what this book is about: providing projects that are fun and interesting as well as helping you find out about all kinds of electronic circuits and components.

Electronics Projects For Dummies is a great way to break into electronics or expand your electronics horizons. Here, we provide projects that allow you to dabble in using sound chips, motion detectors, light effects, and more. And all the projects are low voltage, so if you follow our safety advice, no electronics folks will be hurt in the process.

Why Buy This Book?

Electronics projects not only help you build useful and fun gadgets, but you pick up a lot of knowledge along the way about how various electronic parts work, how to read a circuit diagram, and how to use tools such as soldering irons and multimeters. So by using this book, you have fun and get some knowledge at the same time.

This book provides you with just what you need to get going in the fun world of electronics. It offers projects that you can build in a reasonable amount of time — and in most cases, for under $100 each (some well under!).

Foolish Assumptions

This book assumes that you have an interest in electronics and that you've probably explored the world of electricity and electronics a bit. You've probably scanned a few electronics circuit Web sites and maybe a magazine or two and have picked up some of the jargon. Other than that, you don't need anything but a minimal budget to buy parts and tools, a small space in your house or apartment that you can set aside for a workbench, and a little time.

If you feel like you want more information about terms and concepts in electronics to help you out, we recommend *Electronics For Dummies,* by Gordon McComb and Earl Boysen (Wiley).

You don't need to be an electrical engineer or have worked on electronic projects in the past. We provide some initial chapters that help you stock up on essential parts and tools, understand what each one does, set yourself up for safety, and master a few simple skills. Then you're all set to tackle any one of the projects in this book.

Safety, Safety, Safety!

We can't say this enough: Electronics, especially lower-voltage projects like the ones in this book, can be a painless pastime but only if you follow some basic safety procedures from the get-go.

Even low voltages can harm you, soldering irons can burn you, and small pieces of plastic or wire that you snip could fly into your face.

We recommend that everybody — even those with electronics experience — read the chapter on safety (Chapter 2). And because we can't cover every potential danger in a single chapter, be sure to read each manufacturer's warnings about how to use parts, power sources, and tools. Finally, use common sense when working on projects. If in doubt whether a safety precaution is necessary, just do it. *Better safe than sorry* is one of our mantras.

How This Book Is Organized

Electronics Projects For Dummies is organized into several parts, starting off with some general information about safety and stocking your electronics workshop. Then we offer several parts with different types of projects, and finally conclude with the Part of Tens chapters with additional resources you might want to explore. This book also has a spiffy full-color photo spread of some of the circuits and finished products of several of the projects.

Here's the rundown of how this book is organized.

Part 1: Project Prep

If you're new to electronics, read through this part first. Even if you're seasoned, humor us and read Chapter 2 about safety. Then use Chapters 3 and 4 to gather the parts and tools you'll need and also bone up on some essential electronics skills, such as soldering and reading schematics.

Part II: Sounding Off!

This part contains the first set of projects, all involving sound in some fashion. Here you work on projects to make lights dance to music, create a parabolic microphone to pick up sounds at a distance, make a wizard that talks when you push his buttons, and create your own AM radio.

Part III: Let There Be Light

Electricity can produce light (as Thomas Edison could have told you), so here we show you how to work with light in a variety of ways. These projects use light to amuse or even make gadgets run. In this part, you light up a pumpkin by using a motion detector, create a light display that will make your next party rock, and build a go-kart that you direct by using an infrared remote control device.

Part IV: Good Vibrations

Some electronic gadgets do their thing when they sense vibrations. All the projects in this part depend on vibrations, including electrical, mechanical, or radio waves. Work through these projects to create a metal detector, a radio controlled vehicle that senses light and runs around a track, and a device that sits on your couch and raises a ruckus if your pet jumps on the cushion.

Part V: The Part of Tens

The chapters in this part provide the ever-popular *For Dummies* top-ten lists. Use the recommendations here to explore some interesting suppliers of electronic parts and tools; get information or swap ideas about general electronics topics online or in print; or look into resources for more specialized interests, such as audio effects and robotics.

Icons Used in This Book

We live in a visual world, so this book uses little icons to point out useful information of various types.

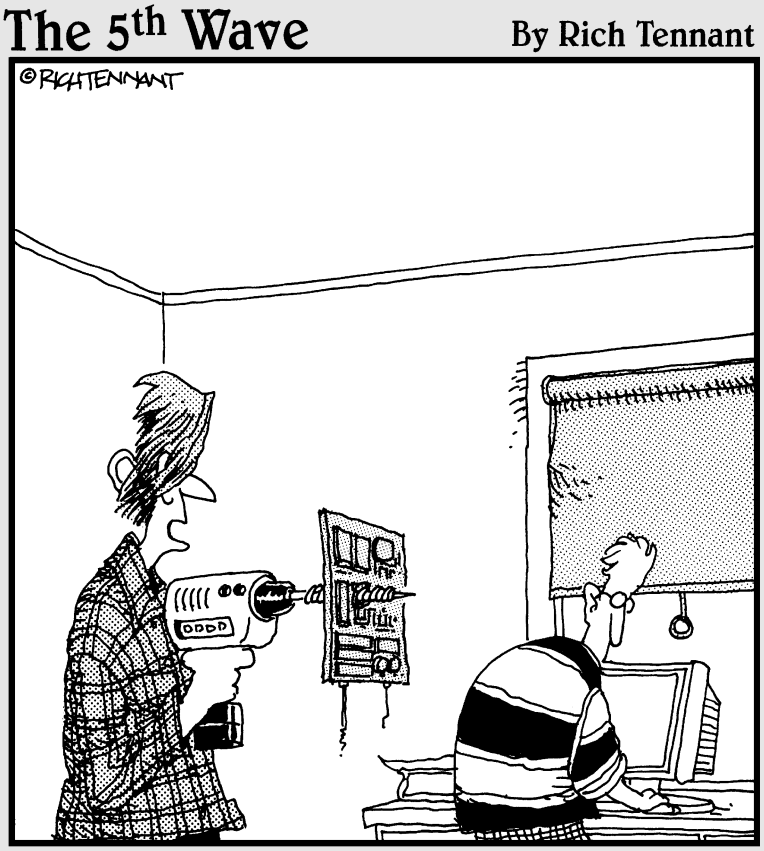
The Tip icon points you to information that is interesting and can save you time or headaches. These icons generally add a bit of spice to your electronic project education.

Oops. If you don't heed these little icons, you might regret it. Warnings alert you to potential danger or problems that you want to avoid.

Remember icons remind you of an important idea or fact that you should keep in mind as you explore electronics. They might even point you to another chapter for more in-depth information about a topic.

If you're gonna build an electronics project, you're gonna spend some money. To save you time and help you keep your costs down, we give you shopping tips wherever you see this icon.

Part I
Project Prep



"So I guess you forgot to tell me to strip out the components before drilling for blowholes."

In this part . . .

Before you can jump in and tackle projects, you might want to brush up on (or discover for the first time) the basics. Chapter 1 answers such urgent questions as "What is an electronics project, anyway?," and Chapter 2 provides our best advice about safety procedures that keep you intact while you play with gadgets. Chapter 3 runs down the parts and equipment you work with in a typical project, and Chapter 4 reviews some basic skills that you need to build all kinds of electronic toys.

Chapter 1

Exploring the World of Electronics Projects

In This Chapter

- Understanding exactly what an electronics project is
- Exploring the effects you can achieve
- Considering what's in it for you
- Determining what you need to invest to get started

You probably picked up this book because you love tinkering with gadgets, from that train set you got as a kid to the motion-activated dancing monsters on display in the store aisles at Halloween. Not only are you intrigued by them, but you wonder whether you can build something like them yourself. Now that you own this book, yes, you can!

In this chapter, we take a look at exactly what getting into building electronics projects involves, the kinds of great gadgets you can build yourself, what you'll get from spending your time with electronics, and what you need to commit to take the plunge.

What Is an Electronics Project, Anyway?

Obviously, an *electronics* project involves electronics, meaning that you use electricity to make something happen. However, overlaps exist among electronics, mechanics, and even programmable devices such as robots. Here's what we mean when we say *electronics projects.*

Electronics, mechanics, robotics: Huh?

Do you dream of building elaborate Erector Set-types of mechanical structures — perhaps a model of the Golden Gate Bridge with pulleys and levers moving objects around? Is your goal to create a robot butler with a programmed brain that enables it to serve your every whim? Well, those aren't exactly what we categorize as electronics projects.

Certainly, electronics projects are often combined with mechanical structures that use motors, and a robot has electronic components driven by microcontrollers and computer programs. In this book, though, we focus on projects that use simple electronics components to form a circuit that directs voltage to produce effects such as motion, sound, or light. By keeping to this simple approach, you can pick up all the basic skills and discover all the common components and tools that you need to work on a wide variety of projects for years to come. For these projects, you don't have to become a mechanical or programming whiz.

An electronic circuit might run a motor, light an LED display, or set off sounds through a speaker. It uses various components to regulate the voltage, such as capacitors and resistors. A circuit can also use integrated circuits (ICs), which are teeny, tiny circuits that provide a portion of your circuit in a very compact way. This saves you time micromanaging pieces of the project because somebody else has already done that job for you, such as building a timer chip that sets off a light intermittently.

Programmable versus nonprogrammable

ICs are preprogrammed or programmable. And that brings us to our next distinction.

Although we do use ICs in many of our projects — for example, in the form of a sound chip that's preprogrammed with beeps and music — for the most part, we keep away from programmable electronics. In order to work with programmable electronics, you have to get your hands dirty with programming code and microcontrollers, and that's not what we're about here. Instead, we focus on building electronics gadgets that teach you about how electricity works and get your mind stirring with ideas about what you can do by using electronics, rather than computers.

Don't get us wrong: Microcontroller projects can be a lot of fun. After you get your hands dirty and pick up lots of basic skills doing the projects in this book, you might just go out and buy *Microcontroller Projects For Dummies* (if such a book existed).

Battery-powered versus 120 volts+

One other thing that we made a conscious decision about when writing this book was that we didn't want you tinkering with high-voltage projects. Electricity can be dangerous! Keeping to about 6 volts keeps you reasonably safe whereas working with something that uses 120 volts — like the juice that comes out of your wall socket — can kill you. While you're discovering the basics of electronics, our advice is that it's better to be safe than sorry.

When you get more comfortable and more knowledgeable about tools and skills and safety measures (which we put a lot of emphasis on, especially in Chapter 2), you might explore higher-voltage projects such as high-powered audio or ham radio projects. In this book, we show you how to work with low-voltage batteries and still have fun in the process.

Mixing and Matching Effects

The possibilities of what electronics projects can do are probably endless; on a basic level, the projects in this book use electricity to do a variety of things, from running a small cart around the room to setting off a sequence of lights or sounds.

Generally, most electronics projects consist of four types of elements:

- **Input:** This sets off the effect, such as a remote control device or a switch that you push. An event and a sensor, such as a motion or light detector, can also be used to activate an effect.
- **Power source:** We typically use batteries in these projects.
- **Circuit:** Components that control the voltage — such as transistors, capacitors, amplifiers, and resistors — are connected to each other and to the power source by wires and make up the circuit.
- **Output:** This is what is powered by the circuit to produce an effect, such as speaker emitting sound, LED lights going off, or a motor that sets attached wheels spinning.

What Can You Do with Electronics Projects?

You get to explore a number of variations in the projects in this book. And sure, this stuff sounds like it might be cool, but what's in it for you? Electronics projects offer three benefits (at least):

- Fun
- The thrill of making something work all by yourself
- A boatload of useful knowledge

Just for the fun of it

One obvious benefit of tinkering with gadgets is that it's just plain fun. If you're the type who's intrigued by how things work and what's under the hood, you probably already know this.

In fact, we have lost ourselves for hours figuring out circuits (this is the electronics equivalent of a jigsaw puzzle, which starts as a drawing, like the one shown in Figure 1-1), wiring the components, and refining the results. You can also, quite literally, amaze your friends with the things you build. And if you go in for electronic gizmos that you can race, scare people with, or use to entertain crowds at parties, you can share the fun with others.

Don't forget the social aspect: Electronics projects devotees comprise a friendly bunch of folks who like to help each other. You can get into discussion groups online or join a local electronics club and find both interesting ideas and friendships at the same time. Chapter 16 provides ten great Web sites about electronics where you'll find such online groups.