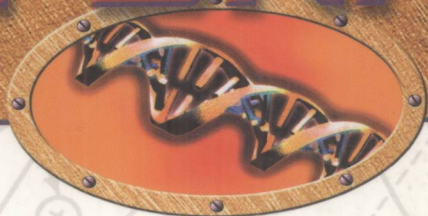
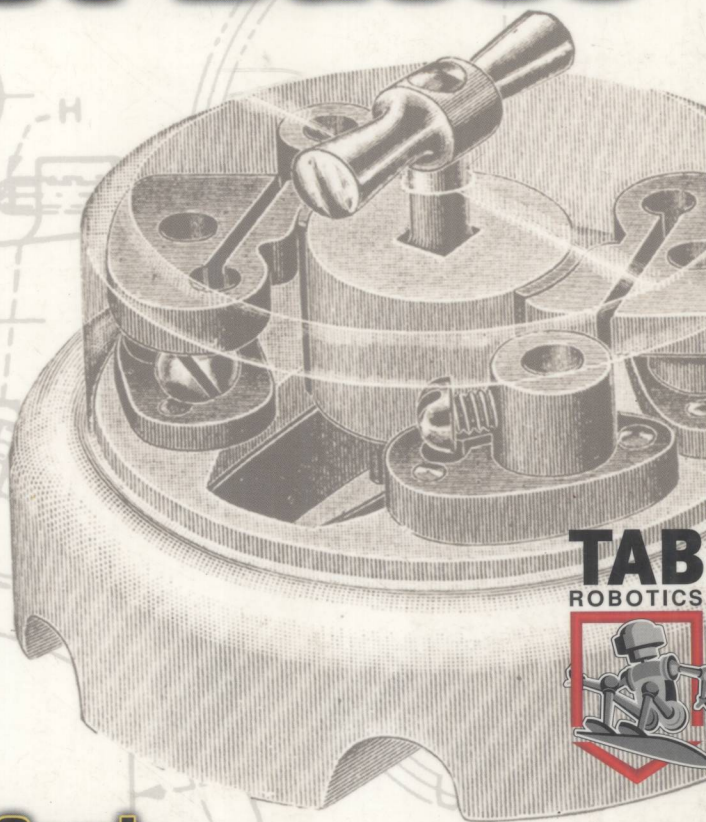


ROBOT DNA SERIES



Constructing Robot Bases



TAB
ROBOTICS



Gordon McComb

M129

Constructing Robot Bases

Gordon McComb



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For Jeffrey Lane McComb,
1942–2002

Big brothers never ask for the job, but mine
was perfect at it.

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INTRODUCTION

A few short years ago, the typical amateur-built robot had difficulty navigating through a room. It probably cost over \$1,000 to build, and it required significant engineering and construction knowledge to assemble.

Today, the landscape of robotics is vastly different.

Thanks to the collective efforts of builders in all corners of the globe, today's robots are smarter, less expensive, and easier to construct. Information is traveling faster and farther, too. New ideas spread quickly via the Internet, and a growing library of how-to magazines and books chronicle the construction and application of robots of all types.

Until now, most books on robotics could be classified into two groups. On the low end of the spectrum were the beginner's books, well suited for the roboticist in his or her formative years, but lacking the meat and potatoes for going further. On the high end were college texts containing lots of theory, but little practical building assistance.

Missing were good books in the middle . . . books for the reader who may have built a robot or two and is now looking to delve deeper.

That's how the Robot DNA series of robot construction and programming books was born. Each book concentrates on a specific segment of the robot building craft. Current books in the DNA series cover the core concepts:

- *Constructing Robot Bases* (ISBN: 0071408525) The book you're reading now is on constructing the bodies of robots using plastic, metal, and wood. It provides practical guidance on the materials and tools to use, weight distribution, fastening systems, adhesives, shop techniques, and more.
- *Building Robot Drive Trains* (ISBN: 0071408509) Motorizing with wheels, treads, and more. In this book, you'll learn how to use motors, wheels, gears, pulleys, and other mechanics to move your robots across the room.
- *Programming Robot Controllers* (ISBN: 0071408517) Giving your robot a brain is the subject of this book. Inside, you'll learn how to program robots with microcontrollers, principally the PICMicro from Micro Chip.

More books are planned in the Robot DNA series for the near future. All books are published by McGraw-Hill/Tab Electronics and written by experts.

Exploring Amateur Robotics

The field of robotics is actually fairly old, but much of the exciting technologies used in robotics are brand new. What's more, parts for making robots are far less expensive than they used to be, thanks to an increase in willing buyers. With more buyers, prices have come down.

Robotics is a huge endeavor. The Robot DNA series concentrates on a particular subfield of robotics, appropriately named *amateur robotics*. Amateur robotics is to robotics what amateur radio is to wireless communications. Both involve the same science, technologies, and even construction procedures. But like amateur radio, amateur robotics is far more contained and affordable.

So in this series, we turn the focus away from industrial and commercial robots—the kinds that build cars or travel to other planets—and toward automata that are within the physical and financial reach of the average individual.

Amateur robotics is for anyone interested in exploring the integration of electronics, mechanics, and computers for noncommercial use. This includes hobbyists, teachers, students, backyard experimenters, and others. The DNA series is well suited to the robot enthusiast working out of his or her garage shop, using ordinary tools and materials. The books are also handy for those studying robotics in school. The various titles in the series cover all the major subsections of a robot: mechanism, electronics, and programming.

Further, these books concentrate on mobile amateur robotics—robots that are meant to move, as opposed to those that bolt to a table or floor. This distinction is a matter of scope: Discussing stationary robots would greatly increase the material the books would have to discuss. In order to provide a reasonable depth of coverage in each book, we decided to limit ourselves to those robots that rolled, walked, slithered, or otherwise moved across the floor.

Skills You Need

In this book, and others in the Robot DNA series, we make modest assumptions about your knowledge and skills. That said, we do leapfrog over the very basics, and assume you've already been exposed to those. If you're just starting out in robotics, you might want to put this book aside for a while, and start with an introductory guide. My book, *Robot Builder's Bonanza* (ISBN: 0071362967, McGraw-Hill), a perennial bestseller, is the ideal guide for introducing you to the world of robotics.

To get the most out of this and other Robot DNA series books, you'll need the following skills:

- Only a cursory understanding of schematics is required, since most robot circuits use a minimum of electronic parts. Schematic diagrams are presented for most circuits, rather than wire-to-wire drawings.
- Basic shop skills are needed for the proper operation of hand and power tools. This book does not step you through operating your Black & Decker drill, as your drill comes with a perfectly good instruction manual.
- No special attention is given to the operation of tools for electronic construction and testing. You are assumed to already know how to use them. If any tool is new to you, be sure to refer to its manual.

Tools You Need

Robotics covers many disciplines, each requiring a basketful of tools, or so it seems. Each book in the Robot DNA series requires its own basic tools. Here are the fundamental tools you need for each major discipline.

Tools for Materials Construction

When you're tired of building robots from cereal boxes, you must turn to standard construction materials: wood, plastic, and metal. These require a base set of tools if you desire a good-looking end result. These tools include the following:

- Motorized drill, with standard drill bits. If you're only interested in building robots from wood, you can make do with a hand-operated drill.
- Hacksaw. Different blades can be used to cut material.
- Screwdrivers, pliers, and wrenches, for fasteners and other hardware.

This book covers materials construction and the required tools to some degree. See Chapter 2, "Robot Tool Crib," for a more complete rundown of required and optional tools for robot construction.

Tools for Electronics Construction

No ghastly expensive tools are required for the electronics construction projects in any Robot DNA book, so you're likely to already own the ones you need:

- Soldering iron, and assorted tools, such as solder, desoldering pump, solder wick, and so on
- Volt-ohm meter, digital or analog
- Basic wiring tools: wire clippers and wire nippers

Other electronics tools are purely optional, and their use will speed you along your way to robotic nirvana. These tools include an oscilloscope, a digital waveform analyzer, a logic probe, a logic pulser, a frequency counter, and a bench-top power supply.

Tools for Programming

The Robot DNA series concentrates on robots that use microcontroller brains. Therefore, most of the required tools revolve around microcontrollers and their development systems:

- Microcontroller programmer, suitable for the chips you are using. Many programmers are designed to be used with a particular brand of microcontroller, such as the PICMicro or Atmel AVR. Other programmers are generic and can work with many programmers.
- Personal computer, with development software. Microcontrollers are programmed from a host computer, requiring a compatible PC (Windows, DOS, Linux, or Macintosh, depending on the programmer being used), software, and interface cable.

A Word (or Two) About Safety

All in all, robotics is a safe and sane hobby. Still, there's plenty of chances for you to be electrocuted, poisoned, or dismembered. So exercise care, and observe all reasonable safety precautions. We'd like you to be around to read the next books in the series!

Good safety starts with your workshop. It should be clean and uncluttered, with adequate lighting around all task areas, especially those where tools are used to cut or drill. If you work in a garage or basement, make sure the floor is dry. A wet floor can cause injury if you fall, or electrocution when using ac-operated tools.

Avoid messy and cramped work tables, where tools such as hot soldering irons can get lost or be tipped over. You'll enjoy the job of building robots much more if you avoid the added frustration of an untidy workbench.

Good ventilation keeps you awake and alert, and quite possibly, alive. A number of chemicals and other adhesives used in the construction of robots give off noxious fumes. These fumes can be both toxic and flammable. I recommend keeping a fan blowing to ensure a good exchange of air. This is particularly important when soldering. Don't breathe solder smoke.

Cutting and drilling tools are *very dangerous* if dull. Replace or sharpen as needed. Dull tools require more work, more friction, and more heat to do their job. Your grip may slip when using a dull blade or drill bit, and you could be seriously injured.

Additional tools safety tips are provided in later chapters.

Finally, wear adequate eye and ear protection. Don't even think about whacking away at some metal or plastic part without wearing safety glasses. Robot building isn't nearly half the fun with only one eye. And, if you're handling dangerous chemicals, wear gloves (as needed) and a long-sleeved shirt or lab coat to protect against skin burns.

ACKNOWLEDGMENTS

The Robot DNA series was inspired by Scott Grillo, publisher of the McGraw-Hill Professional book division. I am eternally grateful for Scott's keen vision into the world of amateur robotics, and for the opportunity to play with neat toys in the guise of writing books. Or maybe it's the other way around . . . Thanks also to Judy Bass, acquisitions editor at McGraw-Hill.

Myke Predko, book author and fellow robot enthusiast, codeveloped this book series with me. Myke likes to leave no stone unturned, yet he still manages a prolific output that a gang of writers would be hard-pressed to match.

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Once again, my robots, and this book, would not have been even remotely possible without the continued support of my family: my wife Jennifer, my daughter Mercedes, my son Max, and my grandson Lane. I love you all.

ABOUT THE AUTHOR

Gordon McComb needs no introduction to robotics hobbyists. Mr. McComb has written more than 50 books and 1,000 magazine articles and newspaper columns, many of them on science and technology. His writings have appeared in *Popular Science*, *Omni*, *PC Magazine*, and dozens of other recognized publications. For 15 years, Mr. McComb wrote a weekly nationally syndicated newspaper column on computers and was the founder of the Robotics Workshop in *Popular Electronics* magazine. He is the author of the blockbuster *Robot Builder Bonanza*, the best-selling book on amateur robotics.

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