PART 1

Introduction

CHAPTER 1

An Introduction to Robosapien

Figure 1-1. *Robosapien comes complete with remote controller, instruction manual, and a cup that it can pick up.*

What is it about Robosapien that makes it so interesting? If you are reading this book, this is probably a question that you have asked yourself at some point. Technically speaking, Robosapien is a biomorphic toy robot. In layman's terms (and according to WowWee Ltd., the company that produces Robosapien), it is a "fusion of technology and personality." Wait a second—I must admit, I paused as I was writing and referred to Robosapien as "it." Is it an it? Is it a he or a she? Or is it something else altogether? As we will see, Robosapien is in many ways an embodiment of its creator, Mark Tilden; however, the answer to a question like that is above all a personal preference. For the sake of consistency I'll refer to Robosapien throughout this book as an "it." I think that if you work your way through this book, you'll understand where I'm coming from, since one of Robosapien's most prominent features is that the robot is what you make of it. Now, with that potentially uncomfortable business out of the way, let's take a look at what I hope to accomplish.

Chances are, whatever it is that interests you about Robosapien will be covered in this book. We'll examine everything from the basics to more advanced topics. My hope is to give you not only an advanced user guide to Robosapien, but also some background information about the theories behind the machine, and to explore the ways to go beyond what comes in the box—using Robosapien as a platform for "hacks" or modifications. Finally, we'll sneak a peek at the new line of Robosapiens due out in 2005—including Robopet, Roboraptor, and the bipedal Robosapien V2.

That's a tall order, but I hope at the very least I can provide you with enough information to aid further, more detailed investigation on your own—to whet your curiosity, as they say. Or even better, to spark your creativity to come up with your own ways to use Robosapien. Curiosity and creativity. These are two words that define my relationship with this funny little robot.

In this chapter, I take a look at Robosapien. What exactly is it? What can it do? To close out Chapter 1, I'll discuss in more detail what I hope to accomplish with this book, and what you, the reader, will need to get the most out of *The Robosapien Companion*.

What Is Robosapien?

Strictly speaking, Robosapien is a battery-operated, remote-controlled robotic toy. Standing 14 inches at the shoulder, and weighing in at 4.8 pounds (including batteries), Robosapien takes up about the same amount of space as a small house cat.

Robosapien uses four D cell batteries, which go into compartments accessed at the bottom of its feet, and the 21-key remote control uses three AAA batteries.

There is a lot more to Robosapien than first meets the eye, particularly from a technical and design standpoint, and we'll examine some of these topics in more detail throughout the rest of the book. But first, we need to figure out exactly what Robosapien is. Is Robosapien a robot, or is it a toy?

Where Does the Term "Robot" Come From?

The term "robot" was first used by the Czechoslovakian playwright Karel Capek (1890–1938) in his 1920 play *R.U.R.* (Rossum's Universal Robots). The play is set on a remote island in the middle of an ocean, at a production facility for robots that are being sold for cheap labor all over the globe. The wife of the factory director uses her feminine charms to convince the lead production engineer, Dr. Gall, to imbue the robots with a soul. Gall complies, and the newly awakened robots quickly realize their mental and physical superiority to the human race and set about wiping out all of humanity. This is a common theme that would show up in subsequent robot fiction throughout the twentieth century.

The word itself is derived from the Czech noun "robota," meaning "drudgery," "servitude," or "labor"; a *robotnik* is the Czech word for "peasant."

In the December 24, 1933, issue of the Czech newspaper *Lidove Noviny*, Capek explains how the term was coined:

> *A reference by Professor Chudoba, to the Oxford Dictionary account of the word Robot's origin and its entry into the English language, reminds me of an old debt. The author of the play* R.U.R. *did not, in fact, invent that word; he merely ushered it into existence. It*

was like this: the idea for the play came to said author in a single, unguarded moment. And while it was still warm he rushed immediately to his brother Josef, the painter, who was standing before an easel and painting away at a canvas till it rustled. "Listen, Josef," the author began, "I think I have an idea for a play." "What kind," the painter mumbled (he really did mumble, because at the moment he was holding a brush in his mouth). The author told him as briefly as he could. "Then write it," the painter remarked, without taking the brush from his mouth or halting work on the canvas. The indifference was quite insulting. "But," the author said, "I don't know what to call these artificial workers. I could call them Labori, but that strikes me as a bit bookish." "Then call them Robots," the painter muttered, brush in mouth, and went on painting. And that's how it was. Thus was the word Robot born; let this acknowledge its true creator.[1]

Of course, Capek's Robots (he consistently capitalizes them in the play) are nothing like the fusion of metal, plastic, and circuitry that we think of as comprising a modern-day robot, though they may have appeared so in his productions. In describing the machines and mechanisms present at the robot production factory, Capek uses terms such as "kneading troughs" and "vats," and a "stamping mill" for forming Robot bodies.[2] From this we can gather that Capek's vision of what makes up a robot is based on biological elements. This makes sense, considering that from a practical standpoint, human actors would be given the task of playing the robot characters on the stage. What Capek's creations do share with our modern understanding of robots is the concept that they are somehow useful. This is a key distinction to make.

Isaac Asimov's "Robot Visions"

The science fiction writer Isaac Asimov (1920–1992) is perhaps most responsible for how we now think about robots in modern times. In his 1942 short story "Runaround," he coined the term robotics, meaning the field of science dedicated to building and studying robots. But much more important, "Runaround" is the first instance we see of Asimov's famed "Laws of Robotics":

- Law One: A robot may not injure a human being, or, through inaction allow a human being to come to harm.
- Law Two: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- Law Three: A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.[3]

1. Taken from Dominik Zunt's excellent webpage on Karel Capek found at `http://capek.misto.cz/english/robot.html`.
2. For more information on Karel Capek and the play *R.U.R.*, please visit Dennis G. Jerz's superb website on the topic at `http://jerz.setonhill.edu/resources/RUR/index.html`.
3. Isaac Asimov, *Robot Visions* (New York: Penguin Books USA Inc., 1991), p. 126.

These laws more than anything make a great backdrop for fiction based on robotic entities. Asimov was prolific, and wrote many short stories and novels set against the backdrop of these three laws, most of which involved some sort of conflict between these laws and revisited the "robots taking over the world" (or at least extinguishing humanity) themes we see even as early as the robot's creation in *R.U.R.*

Is Robosapien a Robot, or Is It a Toy?

Based on the writings of Capek and Asimov, I think that in order to be categorized as a robot, a machine must meet two requirements. First, it must be capable of following commands given to it by a human. And second, it must be capable of actually doing something useful.

Robosapien absolutely meets the first criterion. With its remote control, Robosapien is more than willing to execute commands sent to it from a human operator. Moreover, given its several programming modes and various sensors, it is extremely capable of following fairly complex commands. Whether it meets the second criterion is more a matter of interpretation. Capek and Asimov envisioned robots as being able to perform labor and tasks that humans usually do. The question "Can Robosapien do something useful?" is really best responded to by another question: "How do you define 'useful'?" Sure, Robosapien is capable of entertaining, and it can pick up small objects. It can also be programmed to act as a sentry and perform other tasks. But you have to ask yourself how useful these functions are. I think for all intents and purposes, right out of the box, Robosapien is not very useful and thus falls more under the category of toy than robot. However, apply some curiosity and creativity, and you will discover that Robosapien is actually designed to be easily "hacked" or modified, which can bridge the gap between toy and tool. Later on in this book, when we begin to explore "hacking" or modifying Robosapien, we'll see some ways to make it more "robot-like." But for now, let's just refer to it as a robotic toy. Throughout the rest of this book, you'll probably find that I refer to Robosapien as a robot more often than not. That is mainly for the sake of convenience, since I really view the stock, unmodified Robosapien as a toy first and foremost.

What Can Robosapien Do?

Yes, Robosapien can do a handstand (with a little help; see Figure 1-2). This is due in large part to its biomorphic design, which we'll discuss in greater detail in Chapter 2.

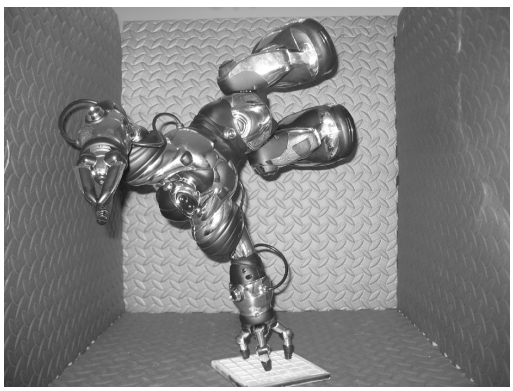

Figure 1-2. *It can take some patience, but you should be able to get your Robosapien to freely stand on one outstretched claw.*

For now, let's look at some of the key functions and capabilities of Robosapien.

Bipedal Walking

The most obvious feature of Robosapien, once you get past its rather interesting-looking claws, is its ability to walk on two legs. WowWee describes Robosapien as "the first affordable humanoid robot." Its ability to walk on two legs is a bit of a breakthrough—this requires quite a bit of planning and synchronization between his various motors and body parts. Sure, there have been other bipedal robots, and as we'll see in Chapter 6 these have a long history, even going back as far as tin wind-up toys in the form of robots that shuffle around on two legs (see Figure 1-3).

Figure 1-3. *Here's an example of a bipedal wind-up toy robot.*

Additionally, more complex designs, such as The Original San Francisco Toymakers' "Ramon the Robot" (see Figure 1-4) are also capable of bipedal walking. But none of these products have been as proficient at walking as Robosapien.

Figure 1-4. *"Ramon the Robot" is manufactured by The Original San Francisco Toymakers.*

Is Robosapien's walking ability perfect? No. In fact, Robosapien's problem with consistently walking straight is one of the main criticisms about the toy. In Chapter 6 we look at the walking mechanism in greater detail, and I provide some tips and tricks to get your Robosapien walking to the best of its ability.

So What about Those Claws?

Robosapien has two types of hands, both with three fingers. Each hand has a touch-activated sensor, as well as an LED in the palm. The right hand (Figure 1-5), which has rounded fingers, is designed to pick up round or bulky objects such as cardboard tubes, balls, or action figures. The left hand (Figure 1-6), which features straight fingers and a rubbery gripping surface, is designed to grasp and hold smaller, thinner articles such as pencils, napkins, dollar bills, business cards, and paper.

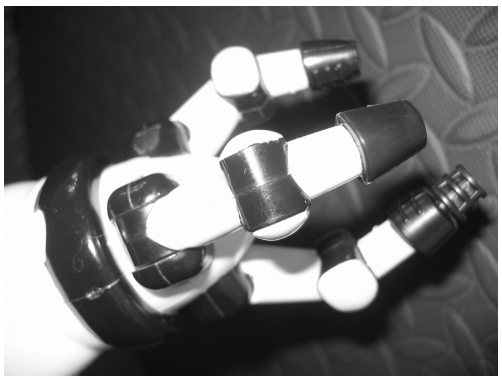

Figure 1-5. *This photograph shows Robosapien's right claw.*

Figure 1-6. *This photograph shows Robosapien's left claw.*

Sixty-Seven Unique Functions

Robosapien is controlled via infrared remote, and it can perform 67 unique functions, including four different ways of walking and two different ways of turning. Both arms can be moved up, down, in, and out. Robosapien bends sideways at the waist—not only does that help it reach objects on the ground, but its unique sideways swinging gait is part of what makes the robot such an accomplished bipedal walker. In addition to these basic commands, Robosapien comes preprogrammed to do some interesting combination moves in the form of kung fu, as well as several "attitude" moves that help to shape Robosapien's personality. Finally, Robosapien has two different demo modes, two diagnostic troubleshooting modes, and a musical dance program. The sidebar "Sixty-Seven Robosapien Functions," lists the functions as described by WowWee.

SIXTY-SEVEN ROBOSAPIEN FUNCTIONS

1. Right Arm Up
2. Right Arm Down
3. Right Arm In
4. Right Arm Out
5. Tilt Body Right
6. Left Arm Up
7. Left Arm Down
8. Left Arm In
9. Left Arm Out
10. Tilt Body Left
11. Turn Right
12. Walk Forward
13. Stop
14. Turn Left
15. Walk Backward
16. Right Sensor Program
17. Sonic Program
18. Left Sensor Program
19. Master Command Program
20. Program Play
21. (SELECT) Advance to GREEN Keys
22. Right-Hand Thump
23. Right-Hand Pickup
24. Lean Backward
25. Right Hand Throw
26. Sleep
27. Left-Hand Thump
28. Left-Hand Pickup
29. Lean Forward
30. Left-Hand Throw
31. Listen
32. Forward Step
33. Right Turn Step
34. Backward Step
35. Right Sensor Program Execute
36. Master Command Program Execute
37. Wake Up
38. Reset
39. Left Turn Step
40. (SELECT) Advance to ORANGE Keys
41. Left Sensor Program Execute
42. Sonic Sensor Program Execute
43. Right-Hand Sweep
44. High 5
45. Right-Hand Strike 1
46. Burp
47. Right-Hand Strike 2
48. Left-Hand Sweep
49. Talk Back
50. Left-Hand Strike 1
51. Whistle
52. Left-Hand Strike 2
53. Bulldozer
54. Right-Hand Strike 3
55. Oops!
56. Demo 1
57. All Demo
58. Power Off
59. Roar
60. Left-Hand Strike 3
61. (SELECT) Return to RED Command Functions
62. Demo 2
63. Dance Demo
64. <, < Combination “Right Walk Turn”
65. >, > Combination “Left Walk Turn”
66. Forward, Forward Combination “Slow Walk Forward”
67. Backward, Backward Combination “Slow Walk Backward”

Interactive Reflex System

All of the commands listed in the sidebar can be arranged together via Robosapien's "interactive reflex system" (or programming modes), and the robot can be set up to react to both touch and sound through its four individual programming modes. Robosapien's four program modes include a "master program," a "sonic program," and left and right programming modes that react to the sensors in its claws and feet (see Figure 1-7).

Figure 1-7. *Touch-sensitive sensors on the front of Robosapien's feet allow it to react when it bumps into things.*

All told, Robosapien is capable of remembering 84 total steps—as long as you don't turn it off. Robosapien's memory is wiped each time you shut off its power. Robosapien communicates through a series of grunts that WowWee has dubbed "international caveman speech." These grunts are not particularly helpful, but they add a lot to Robosapien's unique "personality."

What Does This Book Hope to Accomplish?

I hope with this book to provide you with the means to get the most out of your Robosapien. On its own, this book will give you some background information on the theories and the mechanics behind Robosapien, some simple projects you can do on your own to make Robosapien even better, detailed programming information, and a good hard look at Robosapien's capabilities.

Beyond this, I hope to change your perception of Robosapien, and challenge you to think of it as less of a toy and more of a platform. This is, in my opinion, the secret of a long-lasting relationship with your Robosapien. I feel that, as a toy, Robosapien can get boring pretty fast. Once you have run it through the various routines a few times and mastered the remote control, you may find yourself asking, "Well, what else is there?"

By looking at where Robosapien comes from and what it can do out of the box, and by giving you some ideas about where you can go using Robosapien as a platform for hacks and modifications, I hope to provide you with many more hours of discovering exactly what else there is when it comes to the Robosapien.

What Will I Need to Get Through This Book?

I had originally titled this section "Materials Checklist and Safety Precautions," but that is a bit ambitious. This book endeavors to give you the best experience with your Robosapien out of the box, with no modifications or tools needed. From time to time I'll suggest some easy modifications that you can do to improve your Robosapien's performance, and the last few chapters will concentrate on beginning modifications that will require you to open up the robot and void your warranty. But my goal is to make this book as accessible as possible to everyone, including those of us who are not electronics experts.

A Robosapien Robot

Figure 1-8. *You want me to do WHAT with this screwdriver?!*

The number one item you'll need to work your way through this book is, of course, a Robosapien robot. The author in me hopes that I can make this book so captivating that you could read through it and find it interesting even if you don't own a Robosapien. But the realist in me knows that an accomplishment such as that is probably beyond my (or anyone else's) reach. Although you won't need a Robosapien to work through the chapters on the development of Robosapien and the theories of biomorphic robotics that control it, having one handy will help you understand some of the concepts presented a little bit better. And while no one except the people at WowWee have the version 2 Robosapien (at least at the time of publication), which is called "V2," having a version 1 Robosapien and understanding its abilities can only help you understand the significant upgrades planned for V2.

Your Own Curiosity

Beyond a Robosapien, you'll also need a sense of adventure as well as a sense of curiosity about not only *what* Robosapien can do but *why* it can do it. There is a lot more to Robosapien than just its motors, circuitry, and plastic shell.

Outfitting Your Work Area

Robosapien is designed to go almost anywhere, and for the most part you'll be able to enjoy this book anywhere that Robosapien is capable of going—and even some places where it can't go. However, if you choose to enjoy a chapter or two of this book while relaxing on a raft in your pool, I suggest that you leave Robosapien on dry land!

If you plan on exploring the interior of Robosapien, and doing some of the simple hacking projects I outline throughout the book, a decent work area is essential (see Figure 1-9). It should be well lit and relatively clutter free, and provide you with a comfortable place to sit while working on Robosapien. It should be quiet and out of the way; the last thing you want is to take a break from working on Robosapien only to wake up and discover that your sibling/parent/spouse/cat/dog has accidentally (or otherwise!) disturbed your progress. You should have an area large enough to not only hold Robosapien and your tools, but that also allows you to lay out parts and components as you remove them (should you choose to do so). Finally, I prefer an area where distractions are limited. I use an old desk out in my garage.

Figure 1-9. *The author's robot laboratory is in his garage.*

This space is out of the way, there is plenty of power, and it is close to all of my tools. I cover my work area with a sheet of glass. Most glass shops can cut you a piece to order, and they even round the edges so you don't cut yourself. Glass is not only impervious to hot items like soldering irons and hot-glue guns, but it provides an excellent place to keep diagrams, lists, schematics, and other sheets of paper in full view yet out of the way and protected. Additionally, working on Robosapien involves a lot of small screws and components. When these fall and hit a glass surface they make a noticeable noise, meaning that you won't accidentally drop a part and not hear it fall.

It is important that you have adequate electricity in your work area, both for lighting and for any power tools you may need. One tip someone gave me a long time ago is to run all your tools into one power strip that has a central on/off switch (see Figure 1-10).

Figure 1-10. *A good power strip is not only convenient but also a good safety precaution.*

This way, if something goes awry and you smell smoke, you can turn everything off quickly and easily and *then* figure out what you have shorted. Speaking of smoke, make sure your work area has decent ventilation. Electrical smoke does not smell good, and some people find that it irritates their throat and lungs. Also, flux used in soldering gives off smoke when it is heated and this can be irritating to some people as well.

You'll need some simple tools (see Figure 1-11).

Figure 1-11. *You don't need a lot of tools to work on Robosapien, but you can never have too many.*

All that is needed to take most of Robosapien apart is a simple Phillips head screwdriver. You should already have one of these, since you also need one to insert Robosapien's batteries in his feet and remote control. Small precision-style flat-head screwdrivers can help you get into places that are glued together, and "Exacto" knives, generically referred to as hobby knives, can help you in a lot of ways too. A good drill, as well as a high-speed rotary tool like a Dremel, can also come in handy. A hot-glue gun can also be useful, as is a variety of tape and glues. A set of wire cutters and a wire-stripping tool can come in handy as well. I also like to use a modeler's tool referred to as a side cutter or a sprue cutter. This tool is designed to cut plastic model components off of the "sprue," or the frame that they come on when you buy the kit. I also use a "miner's style" headlamp, which you can find in most camping supply sections. Since it is worn just above your eyes, it directs the light down directly onto what it is you are working on, and helps you illuminate things, particularly in small, cramped spaces like the interior of Robosapien.

As we'll see in Chapter 13, where I present a pictorial guide to taking the Robosapien apart, everything is very clearly labeled on the inside, and most of the wiring is connected via connectors. Still, when working on anything electronic, a decent-quality soldering iron as well as an inexpensive digital multimeter will save you a lot of time. More on these items later.

Finally, no workspace is complete without a pad of paper and a pen, or better yet, a hacker's journal. Keeping a list of what parts you remove, and the order in which you remove them, can come in handy if you forget where something goes or how to put a piece back

together. It is also a great place to keep a running tab of ideas for future projects, things that might only come to you while you have Robosapien partially disassembled.

I don't recommend that you rush out and buy all these tools before you start working on your Robosapien. Start slowly, and just take its shell off a few times to familiarize yourself with the interior of Robosapien before you move on to further disassembly. Gather these tools as you find that you need them, and not only will you not break the bank, but you'll be ready to use them.

Safety Precautions

The most important thing you'll need to protect is your eyes, since they will be open (or at least I hope they will be open) throughout your work. I recommend a good set of goggles that you can keep in your work area. These take a little getting used to, but I think you'll find that putting them on becomes like second nature. I recommend getting a comfortable set. They might cost a bit more, but they'll also be higher quality and more comfortable. You have only one set of eyes, so it is important that you protect them at all costs.

Although nothing we'll work on is capable of starting a fire, it is still a good idea to keep some sort of fire protection near your workspace. For small battery-powered items like Robosapien, a fire extinguisher is probably overkill—a decent container of water is usually all you need. (It also comes in handy if you get thirsty!) If you plan on regularly using really hot tools, such as soldering irons and hot-glue guns, you may want to invest in a small fire extinguisher.

Summary

The Robosapien robot is by all accounts something that is greater than the sum of its parts: a remarkable toy that combines high tech with low tech, complexity with simplicity, and humanistic traits with robotics. It is amazing to learn all that went into creating this robot. Let's start our journey by looking at Robosapien's creator, Mark Tilden, and some of his ideas that have revolutionized not only the toy industry but theories of robotics as well.