

Preface

Robots are used in the auto, medical, and manufacturing industries, and of course, in many science fiction films. Building and programming a robot is a combination of mechanics, electronics, and problem solving. What you're about to experience with the J-Bot will be relevant to realistic applications using robotic control, the only difference being the size and sophistication. The electronic control principles, example program listings, and circuits you will use are very similar (and sometimes identical) to industrial applications developed by engineers.

If you have used the J-Bot's cousin, the BOE-Bot, then you will already be familiar with many of the techniques presented in this book. The big difference will be the implementation, Java of course, and the approach taken in programming. The added power of Java allows a more flexible approach to be taken with advanced programming techniques like a multitasking system.

The word "robot" first appeared in a Czechoslovakian satirical play *Rossum's Universal Robots* by Karel Capek in 1920. Robots in this play tended to be human-like. From this point it onward, it seemed that many science fiction stories involved these robots revolting against human authority. This changed when General Motors installed the first robots in its manufacturing plant in 1961. These automated machines presented an entirely different image from the "human form" robots of science fiction.

This series of experiments will introduce you to basic robotic concepts using the Board of Education Robot (hereafter the "J-Bot"). The experiments will begin with construction of the J-Bot. After that, we'll program the J-Bot for basic maneuvers, and proceed to add sensors that will allow it to react to its surroundings. The goal of this text is to show students how easy it is to become interested in and excited about the fields of engineering, mechatronics, and software development as they design, construct and program an autonomous robot. The J-Bot provides students with a project area to build and customize their own mechanical,

electrical, and programming projects. The use of a J-Bot to introduce microcontroller circuits and interfacing is ideal since the outputs are almost entirely visible and easy to customize.

The Board of Education Rev B, which serves as the J-Bot's prototyping platform, was designed for use with all five Stamps in Class series of experiments, including J-Bot. The Board of Education, Rev B has four servo ports, and this makes it possible to use four servos without taking up any space on the breadboard prototyping area. Each port has a dedicated I/O line (P12, P13, P14, or P15 depending on the port), and each can be used for controlling a servo. Each servo port supply is tied to Vin, the unregulated 6 V supply from the battery pack, so use of a higher voltage supply is discouraged due to its tendency to overwork the servos. The Board of Education Rev B also has two large capacitors that stabilize the Javelin's power supply. They ensure that the Javelin operates continuously, even when the servos are performing direction changes, which could otherwise cause brownout conditions.

The Robotics curriculum is periodically revised and updated based on feedback from students and educators. If you would like to author an addition to this curriculum, or have ideas for improvements, please send them to stampsinclass@parallaxinc.com. We'll do our best to integrate your ideas and assist you with whatever technical support, sales support, or on-site training you need. If we accept your J-Bot project, we'll send you a free J-Bot.

Audience and Teacher's Guide

The Robotics curriculum was created for ages 15+ as a subsequent text to the "Javelin Stamp Users Manual". Like all Stamps in Class curriculum, this series of experiments teaches new techniques and circuits with minimal overlap between the other texts. The general topics introduced in this series are: basic J-Bot navigation under program control, navigation based on a variety of sensor inputs, navigation using feedback and various control techniques, and navigation using programmed artificial intelligence. Each topic is addressed in an introductory format designed to impart a conceptual understanding along with some hands-on experience. Those who intend to delve further into industrial technology, electronics or robotics are likely to benefit significantly from initial experiences with these topics.

Experts in their field independently author each set of Stamps in Class experiments, and they are provided leeway in terms of format. As a result, the depth and availability of teachers' guides varies. Please contact Parallax, Inc. if you have any questions. If you are interested in contributing material to the Stamps in Class series, please submit your proposal to stampsinclass@parallaxinc.com.

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Typographical Conventions

- ❑ Checklist instruction. The square box indicates a “how to” instruction. These instructions should be followed sequentially, like a checklist, through each activity in this text.

✓

TIP

Pay attention to and follow these instructions.
They will make the activities easier and save time.

FYI

This box contains useful information.



Caution: follow these instructions, or you may end up damaging your hardware.

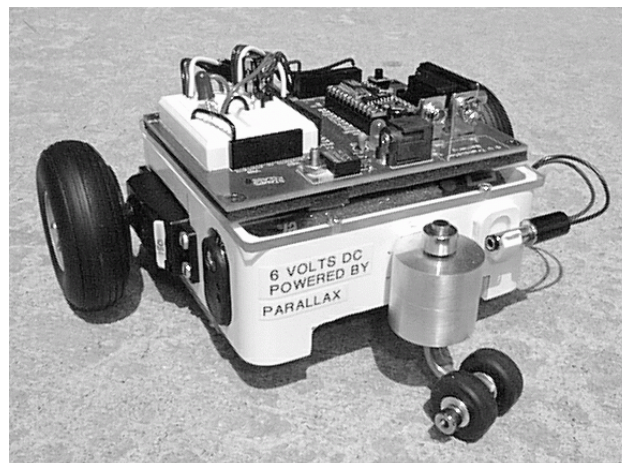
```
// Java Program Listings.
```

```
// Java excerpt from a program listing. This kind of excerpt  
// always follows a paragraph of text explaining what it does  
// and how it works.
```

JAVA code in a paragraph of text takes the form of: **method** (*argument1*, *argument2*, etc.) Note that the method is not italicized, but its arguments are.

J-Bot Contributors

Chuck Schoeffler, Ph.D.,
authored portions of the v1.2
text in conjunction with
Parallax, Inc. At that time,



Dr Schoeffler was a professor at University of Idaho's Industrial Technology Education department. He designed the original Board of Education Robot (Boe-Bot) shown here along with many similar robot derivatives with many unique functions. After several revisions, Chuck's design was adopted as the basis of the Parallax Boe-Bot, the precursor to thhe J-Bot that is used in this Text. Russ Miller of Parallax designed the Boe-Bot based on this prototype.

A special thanks to the Parallax, Inc. staff. Each and every member of the Parallax team has in some way contributed to making the Stamps in Class program a success.

If you have suggestions, think you found a mistake, or would like to contribute an activity or chapter to forthcoming J-Bot v1.1 text, contact us at stampsinclass@parallaxinc.com. Subscribe and stay tuned to the Stamps in Class e-group for the latest in free hardware offers for J-Bot contributions. See the Internet Javelin Stamp Discussion Lists section just before the Table of Contents for information on how to subscribe.



Read this
First - Before
You Start

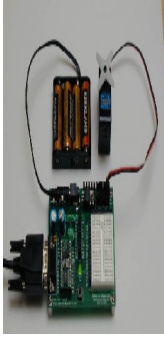
This J-Bot update contains three important messages:

1. Check your Servo Labels
2. Use the Right Power Supply
3. New J-Bot Web Sites

Check Your Servo Labels

Starting in June, 2002, Parallax will ship all J-Bot kits with pre-modified servos. This book is written exclusively for use with J-Bots that have pre-modified servos. Pre-modified servos are labeled "PM".

If you have questions about whether your servos are pre-modified or standard, check the label on the front of each servo against those shown in the Servo Identification Table below.

<div>Parallax Servo</div> 	<div>Servo Identification Table</div> <div>Check the labeling on the servos in your J-Bot kit.</div>	<div>Examples of the labeling for pre-modified (PM) and standard (STD) servos</div>
	<div>Use J-Bot v1.0 (this text)</div> <div>Use this student workbook only if the letters PM are shaded on the label on the front of your servos.</div>	<div> PARALLAX STD PM BB HS HT www.parallaxinc.com </div>
	<div>Use J-Bot v1.4</div> <div>If the letters PM are not shaded or do not appear on your servo's labeling, use the Robotics v.1.4 Student Workbook available for free download from the www.stampsinclass.com - > Robotics page.</div>	<div> PARALLAX STD BB HS www.parallaxinc.com </div>

Use the Right Power Supply

The J-Bot is designed for use with the battery pack that comes with the J-Bot kits. When selecting batteries for the J-Bot:



- Use only AA 1.5 V batteries with this battery pack.
- Do not use 1.2 V rechargeable AA batteries.



Do not use a 9 V battery or AC adaptor; it could damage your J-Bot's servo motors.

If you want to use a wall mount AC adaptor and save batteries for autonomous navigation, make sure your AC adaptor has these output specifications (preferred values are bold):

Output:

- Voltage rating should be 6 V DC or 7.5 V DC
 - Current rating from 600 mA to 1000mA (1 A)
 - 2.1 mm center positive barrel plug
- Make sure the AC adaptor's label has the center positive symbol

J-Bot Forums

Visit <http://forums.parallax.com/>. Look at the [Stamps In Class](#), [Javelin Stamp](#), and [Robotics](#) for listings on the J-Bot. These forums contain:

- Examples using the J-Bot
- More J-Bot activities for students after they have completed the J-Bot Student Workbook
- J-Bot application kits
- J-Bot application modules

Students and instructors are encouraged to submit projects to stampsinclass@parallaxinc.com for posting to this resource site. Hobbyists and hardware developers are also encouraged to submit proposals, proofs of concept, or completed and documented J-Bot application kits/add-on modules.

Another J-Bot online resource is [JavelinCode](#).