The UBTECH Jimu Robots Builder’s Guide

How to Create and Make Them Come to Life

Mark Rollins
Contents

About the Author ........................................................................................................ vii

Chapter 1: Jimu Robots in STEM Education .................................................... 1

STEM Education ........................................................................................................ 1

Introduction to Jimu Robots and UBTECH ......................................................... 1

  What This Book Is ................................................................................................. 2

  What This Book Is Not ......................................................................................... 2

Similarities and Differences Between Jimu Robots and
LEG0 Technic/MINDSTORMS ............................................................................... 2

  The Differences Between Jimu Robots and LEGO ........................................ 3

  The Similarities Between Jimu Robots and LEGO ......................................... 3

Introduction to Jimu Robots: The Pieces ............................................................ 4

  Character Parts ................................................................................................... 4

Jimu Robot Kits and What Pieces to Find ........................................................... 20

  Builderbots Kit .................................................................................................. 20

  Buzzbot and Muttbot ......................................................................................... 23

  Inventor Kit ....................................................................................................... 25

  Karbot Kit .......................................................................................................... 29

  Tankbot ............................................................................................................... 32

Summary .................................................................................................................. 33
Chapter 2: Your First UBTECH Jimu Robots Construction .......... 35

Advice Before Building with Jimu Robots ........................................... 35
Organize Your Pieces ........................................................................... 35
Color Doesn’t Matter ........................................................................... 37
Build It Strong ...................................................................................... 37
Plan the Placement of Your Servos and Wires ................................. 37
Easy Access to MC Box Battery and its Ports ...................................... 38
Getting Started with Simple Instructions ............................................ 38

Building a Scorpion ............................................................................ 40

The Legs of the Scorpion ...................................................................... 40
The Tail ............................................................................................... 46
Left Claw ............................................................................................. 57
Right Claw .......................................................................................... 62
The Body of the Scorpion ..................................................................... 66

Putting It All Together ....................................................................... 74
Summary .............................................................................................. 76

Chapter 3: The Jimu Robots Software Application ......................... 77

A New Model for Jimu Robots .............................................................. 77
Actions ............................................................................................... 84
Scorpion Claw Movement—Drag and Drop ......................................... 85
Spin the Scorpion Claws—Drag and Drop ........................................... 86
Raise the Claws—PRP .......................................................................... 88
The Sting ............................................................................................. 90
Summary ............................................................................................. 90

Chapter 4: The Jimu Robots Vehicle and How to Make It Go ............. 91

Tank Treads Instructions ..................................................................... 91
Tank Treads—Making It Move ............................................................... 102
Four-Wheeled, Four-Wheel Drive Vehicle .............................................. 108
Setting Up for Servos with the Same Number ........................................ 120
Controls of the Four-Wheeled Vehicle .................................................. 125
Summary .................................................................................................. 125

Chapter 5: The Jimu Robots Walking Vehicle .............................. 127
Four-Legged Walker ............................................................................... 127
Getting the Walker to Walk ................................................................. 137
  Stepping Forward ............................................................................... 137
  Step Backward .................................................................................. 141
  Turning ............................................................................................. 141
Summary .................................................................................................. 144

Chapter 6: Advanced Programming Techniques ...................... 145
Accessing the Coding Screen ............................................................... 145
Programming Blocks ............................................................................ 148
  Start ................................................................................................. 149
  Moves ............................................................................................ 151
  Events ........................................................................................... 158
  Control ........................................................................................... 159
  Show .............................................................................................. 164
  Sensor ............................................................................................ 171
  Math ............................................................................................... 172
Summary .................................................................................................. 178

Chapter 7: UBTECH Forklift ................................................................. 179
The Forklift ........................................................................................... 179
Getting the Forklift to Work ................................................................. 200
Summary .................................................................................................. 204
Chapter 8: The Jimu Robots Robot Hand

Constructing the Robot Hand

Programming the Robot Hand

Summary

Index
About the Author

**Mark Rollins** has written six books for Apress, three of them about LEGO. Mark worked at Wal-Mart and Schweitzer Engineering Laboratories before deciding to devote himself to being a full-time writer. Since then, he has written for many tech and gadget blogs including coolest-gadgets.com, gadgetell.com, gamertell.com and many other journals that have since gone offline. In 2009, he started his own tech and gadget blog known as TheGeekChurch.com. In addition to his career in tech, Mark recently wrote a science fiction/fantasy known as *The Labyrinth House*, and he intends to write the next two books in the trilogy. He currently lives in Pullman, Washington with his wife and three children.
CHAPTER 1

Jimu Robots in STEM Education

We live in an age that was science fiction only decades ago. Clearly this technological and information age began with the necessity of a computer in every business and household. Now, computers that were once the size of houses have been miniaturized into a smartphone with easy-to-use apps that are accessible to almost every consumer. Surely this younger generation, being raised by this ever-advancing technology, needs to be prepared for even greater technological achievement.

Fortunately, there is a way to make the next generation advance to the next technological level with hands-on training with actual and applicable technology. This is where STEM education comes in.

STEM Education

STEM is one of those buzzwords that is making its way just about everywhere in higher and lower education. STEM is an acronym for Science, Technology, Engineering, and Mathematics, and it has become an umbrella term for any kind of educational curriculum that is very hands-on when it comes to science and technology. For example, a typical STEM program would have an emphasis on having students programming and building robots.

Introduction to Jimu Robots and UBTECH

UBTECH (pronounced You-Be-Tech) Robotics is a company born out of Shenzhen in China. In the company’s own words: “UBTECH Robotics is dedicated to bringing a robot into every home and integrating intelligent robots into your daily life, creating a more intelligent and human-friendly way of leisure life.”

UBTECH developed Jimu Robots as something of a toy, but it is easily something that adults can use. In fact, building even the most basic Jimu Robots constructions can be seriously challenging to both children and adults.

Using the Jimu Robots pieces that fit together, as well as Servos that can literally power a creation, the user can create many machines or robots that can be programmed to do all sorts of actions. It is possible for the user to sync their creations with a smartphone or tablet, in order to take control of them with a common mobile device.
What This Book Is

This is a book that is about how to build with Jimu Robots. Within these pages are several creations that you can build, and also instructions on how to program them to do all kinds of commands at the touch of a button. The user can use this information to learn more about programming and coding as well.

The best part about the creations within this book is that they are very basic, and I mean that in two ways. First, they are very simple to build, and the instructions are mostly pictures with written directions for the details. Second, many of the creations can be applied to other creations that the user/reader can create on his or her own. For example, Chapter 4 details how to make a four-wheeled creation, which can easily be applied to making bigger or smaller four-wheeled creations without literally having to “reinvent the wheel.”

In the end, I hope that the reader gains a better understanding of how to build and program their Jimu Robots creations, which will advance their technological intellect. I would love it if you, the reader, is later inspired to create the next automobile, microwave, smartphone, or whatever technology that we can’t live without in the future.

What This Book Is Not

If you flip through this book, you will notice a lot of illustrations. Yes, this is a book that shows you how to build your own interesting creations, but honestly, you are required to take the next step.

In other words, don’t limit yourself to the instruction manual like Will Ferrell’s human character in The Lego Movie. Yes, I will show you how to build things like wheeled vehicles and walking robots, but you will get much more of an experience from this book if you use the methods to develop your own creations.

With Jimu, you can bring your imagination to life! However, I am going to deliver a warning that in addition to the building, which is already very hard, there is an element of programming that can sometimes be a lot harder. If you have ever programmed anything before, then you know that there is more to programming than just creating a program that can run. After all, you might end up creating a program that does not do exactly what you programmed it to do, because you unintentionally programmed it to do something else. In other words, garbage in, garbage out.

Most of the problems that you will have with your creations can be solved by building and rebuilding, but I won’t lie when I tell you that it can be a difficult and time-consuming process.

Similarities and Differences Between Jimu Robots and LEGO Technic/MINDSTORMS

Even though this section of this chapter could be edited out of my final draft, I felt that this topic is worth bringing up. On the surface, Jimu Robots may look like certain pieces of LEGO with their Technic or MINDSTORMS editions.
If you are not familiar with the LEGO Technic or the MINDSTORMS collections, they are specialized parts that reject the traditional blocks and slate pieces with their studs (the circular bumpy parts with the LEGO logo) for beams, connectors, axles, and other parts that I will define later.

I bring this up because I have written three books devoted to LEGO Technic and MINDSTORMS EV3. And if you are interested in those for STEM education, here are the titles.

*Practical Lego Technics* (Apress, 2013)
*LEGO Technic Robotics* (Apress, 2013)
*Beginning LEGO MINDSTORMS EV3* (Apress, 2014)

Please understand that just because I have written three books on LEGO and just this one book on Jimu Robots, I am not saying that any construction kit is “better” than the other. I found that both of these construction kits are similar and different, and I can honestly say that I enjoyed working with them equally.

The Differences Between Jimu Robots and LEGO

The first thing I am going to say is something that I want to make clear: LEGO AND JIMU ROBOTS ARE NOT COMPATIBLE!!!

Yes, there are beams, connectors, and axles that are very like LEGO, but I tried them out, and I can’t make the pieces fit together. The LEGO pieces are slightly bigger than the Jimu Robots pieces, and this difference is obvious when they are put side by side.

I also have no intention of trying a workaround to get them to work. It’s like using metric tools for British standard units, so pick one or the other. Another one of the biggest differences is how some of the pieces fit together. The Jimu Robot kits have some pieces that can “slide” (for lack of a better word) together, which are not found in LEGO at all. Jimu Robots calls these pieces connectors, and they also snap together and come apart with the ease of the other kinds of pieces.

The Similarities Between Jimu Robots and LEGO

As I have said before, Jimu Robots and LEGO have pieces that look the same. They have straight beams that always have an odd-number of holes, to insert fasteners (tiny pieces that can join beams together). Overall, most of the pieces of Jimu Robots, with the exception of the sliding pieces (connectors) have the same look and function as LEGO pieces.

Jimu Robots has a Main Control that is like the EV3 control box, but unlike the EV3 control box, the Main Control (MC) Box has no buttons for control and must be controlled via smartphone or a tablet, thanks to the iOS and Android apps.

The Jimu Robots also have motors that come in the form of Servos, which can be programmed to spin or rotate from 118 degrees to –118 degrees, as well as be controlled to specific speeds. The motors for Jimu Robots are smaller than the ones for LEGO MINDSTORMS, and they also have a distinct way that they need to be oriented, which I will explain in later chapters. These motors require a wired connection to the MC Box to function, and a switch is required to be connected for the MC Box to work.
Introduction to Jimu Robots: The Pieces

Jimu Robots always come in a complete set, which has boxes classified by several terms, including character parts, connectors, fasteners, Servos, and more.

Character Parts

“Character Parts” is a pretty vague term, but it describes a lot of interesting pieces that apparently have a lot of character, hence the name. It includes some parts that I will classify as beams, wings, flats, axles, rubber pieces, not to mention some gears/wheels.

Beams

These are essentially girder-like pieces, with holes made for fasteners, which I will describe later in this chapter. There are a lot of great uses for these, and the basic beams come either straight or at certain angles. Most of the Jimu Robots include some kind of variation of the following, as seen in Figure 1-1.

![Figure 1-1. The beam pieces from Jimu Robots](image)
1. The P16 is a $4 \times 6$ beam that is bent at an angle.
2. The P17 is a $3 \times 7$ piece at the same angle.
3. The P18 has two angles, but is essentially a 90-degree turn with 7 holes on one leg and 3 on the other.
4. The P19 is another angle piece at the same angle but is $4 \times 4$ with a shared hole on the corner.
5. The P20 is a straight beam with 15 holes.
6. The P21 has 13 holes.
7. The P22 has 11 holes.
8. The P23 has 9 holes.
9. The P24 has 7 holes.
10. The P25 has 5 holes.
11. The P26 has 3 holes.

Those are just the straight and oddly-angled pieces of beams, but there are some that come in even greater variety, as seen in Figure 1-2.

**Figure 1-2. Other variations of beams**

1. The P37 is a $3 \times 3$ beam in a T shape.
2. The P38 is a $4 \times 2$ beam at a right angle.
3. The P67 is a $3 \times 3$ square.
4. This is a $3 \times 5$ part that has a curve joining it. In the corners are holes with a “plus” shape, which I will describe when we get to the section about axles.
Wings

These pieces I call wings because they are often flat in their construction with a shape that looks like it could work as a wing. There are samples of this in Figure 1-3.

1. The P01 is an interesting wing piece with $5 \times 1$ on one formation, 3 holes on the side, and one on top. This one would be made for the left side as it has an “L” marking on the inside.

2. The P02 is another wing that is a mirror image of the P01, and would look good on the right side of a plane. Like the P01, there is a marking for right with an “R.”

3. The P03 is a smaller version of the P01 but with a $1 \times 3$ in the corner, 3 holes on the side, and one hole on top. It has a marking of an “L” on it.

4. The P04 is the mirror image of the P03, and it has the “R” on it.

5. The P05 is a thinner wing piece that looks like it is a small 747 wing. It has the $1 \times 3$ on the corner, 3 holes on the side, and one on top, not to mention the “L” marking.

6. By now, you have noticed a pattern and seen that the P06 is a mirror image of the P05, but with an “R” on it.

7. The P07 is a flat and rectangular piece with $1 \times 5$ holes on each corner, 5 holes on the back, and two on each side on top. It is about 15 holes wide, and doesn’t have the “L” or “R” designation.

8. The P08 is another flat and rectangular piece with $1 \times 3$ holes on each corner, 3 holes on the back, and two on each side on top. It is about 9 holes wide and also gets rid of the “L” and “R” designation.
Flat

Jimu Robots have a subgroup of character parts I call flat, because they are, for the most part, flat. Some of them are made to hold fasteners, and some made for the sliders. Here are some samples of them in Figure 1-4.

1. The P09 is a rectangular flat piece that can slide into place. It is very handy for holding a wire in place for a Servo.
2. The P12 is an interesting diagonal shape of a piece that has two holes in the corner, and has an “L” engraved on it.
3. The P13 is made to be a mirror image of the P13, with the “R” engraving.
4. The P14 is a long, flat piece with small vent-like lines in the center and three holes on the bottom.
5. The P15 has a similar shape of the P14, and it has three holes on the left and right sides.
6. The P78 is a flat strip with two fasteners, and can be used to hold a wire in place.

Figure 1-4. Variations of flat pieces
Axles

The axles are essentially pieces that are plus shaped on the side, but they are perfect for locking something into place. Here’s a sample of a few in Figure 1-5.

1. The P103 is an axle that is about 15 holes long, meaning it is about as long as the P20 beam.
2. The P106 is about 9 holes long, as long as the P23 beam.
3. The P107 is about eight holes long.
4. The P110 is about 5 holes long, as long as the P25 beam.
5. The P99 is also about 5 holes long, but it has a “stopper” on the end that will keep it from sliding forward any more in one direction.
6. The P98 is about 3 holes long, and it also has a “stopper.”

Figure 1-5. Samples of axles
Cross Blocks

These particular pieces are unique because they have holes on one side and then others at 90 degrees. They are useful for all kinds of constructions, as one can always use a good turn in a construction. Figure 1-6 has some good examples of them.

1. The P34 is essentially a beam that is four holes long, but two of them on one side are 90 degrees from each other.
2. The P35 is a $3 \times 4$ beam but the holes are on the other sides 90 degrees with $2 \times 3$ formation.
3. The P36 is a 3 hole beam with a hole on the top at ninety degrees.
4. The P68 is essentially a $3 \times 3$ piece like the P67, but this has one center hole on top, then a hole in each corner.
5. The P46 has an axle hole, and then a through hole at 90 degrees.
6. The P89 is a piece with a through hole in the middle, and then two axle holes at an angle.
7. The P97 has a spot to pass through an axle, and an axle hole 90 degrees from that.

Figure 1-6. Various cross blocks of parts
8. The P69 has two through holes with a half of one on the other side, creating a terrific effect when linked together.

9. The P70 is a $5 \times 7$ rectangular piece with 3 holes on one side, and then four holes on the ninety degrees.

10. This is another version of the P70 that appears in some Jimu Robots kits, with the only difference being the two beams in the center.

11. This is a $5 \times 11$ piece with five through holes on two sides, and seven centered on the other. There are through holes on the top and bottom.

**Rubber Pieces**

The rubber pieces are parts that add character to your robot. They are often used as hands and feet, but can also be used to absorb shock and create traction. Here are some variations of them in Figure 1-7.

![Rubberized pieces from UBTECH](image)

*Figure 1-7. Rubberized pieces from UBTECH*

1. The P27 is a claw that has two holes on the end and another hole 90 degrees of them in the center.

2. The P28 is a claw that has two holes on the end.

3. P78 is a $5 \times 5$ rubberized plate, which is good for projects that make contact with the floor.

**The Eyes**

This set of eyes came with the character parts in the Tankbot set (see sets later in this chapter). They serve as a decoration piece that connects via fastener holes on the back. This piece adds a lot of character to your robot. Decoration pieces vary per set. Figure 1-8 displays the eyes that come in the Tankbot set.
Gears and Wheels

Here are some gears and wheels that are made to spin. I’ll talk about them in greater detail when we get to the vehicles chapter, but here is a sample of them in Figure 1-9.

Figure 1-8. Character part eyes from Tankbot set

Figure 1-9. Samples of gears and wheels in Jimu Robots
1. The P86 is made to interlock with another gear, and it can also be used for the tank treads.
2. The P87 connects together to form a tank tread, and is made to work with the P86.
3. P82 is essentially a rim for a tire.
4. P84 is a rubber tire that mounts on the P82.
5. The P85 is a steering wheel.
6. The P91 is a handy piece that is a perfect piece for a wheel.
7. The P116 is a thing that you can mount on a vehicle that allows for very efficient turning.

Fasteners
The holes in the beams and other parts are made for beams and more, such as these fasteners, which come in many different colors. Here are some samples in Figure 1-10.

1. The P47 is a connector that can go through three beams. It has a ring through 1/3 of it that blocks it from going in any further.
2. The P48 is a connector peg that can latch two beams together.
3. The P49 is half a connector peg that can fit through half a beam.
4. The P50 is half a connector peg that can also fit through half a beam, but it is different because the other half of it is slightly bigger to hold a P51.

5. The P51 is a circular hole that can fit on a P50.

6. The P53 has a piece with both an axle and a connector peg.

7. The P54 has a ball on one end and it is usually only used on the MC Box, which I will talk about later.

Disassembly Tool

This piece can be found in the same container as character parts; however, its function serves you beyond that. There is only one of these included in each set, but trust me, it is worth it to have it.

Not only is the thing able to push through fastener pegs to knock them out with the pointed end, but you can also use the other end to grab troublesome fasteners. All you need to do is put the other end on a fastener, grip with your fingers, and give a good pull. See a sample of how in Figure 1-11.

Figure 1-11. The Disassembly Tool and how to use it
Connectors

Connectors are the “joints” of your robot, as many of them come in handy when it comes to installing the Servos of your creation. Unlike the character parts, they slide and snap into each other, but some are compatible with the fasteners. Figure 1-12 has some samples of them, and you can see that there are both male and female versions of the sliders.

1. The C1 is a piece that is often used as a joint on a leg or arm and made to connect well to a Servo. It has an “L” listed on it, which I will assume means that something is on the left side.
2. The C2 is a mirror image of the C1, and it has an “R” on it.
3. Like the C1 and C2, the C3 is a good place for a Servo. Unlike the C1 and C2, this doesn’t have any kind of “L” or “R” on it because there is no mirror image piece.
4. The C4 is a great sliding piece, as it has a female sliding end and then has the male portion immediately 90 degrees from it.
5. C5 is essentially a double-ended male slider.
6. The C6 has a female slider on one side and a male slider on the other.
7. The C7 is a large piece that has the female sliders ready on one side, and ready to hold two Servos.
8. The C8 is essentially a 5 × 5 area with a male slider on top.
9. The C9 is a very flat piece that looks like a foot with a large flat area on it, and has a spot for two male sliders together.
10. The C10 is a very flat piece and fits very well in the C9.

Figure 1-12. Some samples of connectors for the Jimu Robots
There are other types of connectors as well, and you may notice that some of them have holes that can hold fasteners, which can then join with beams. There is a sample in Figure 1-13.

![Figure 1-13. Several different types of connectors](image)

1. The C11 is a female slider with a $3 \times 3$ piece on the other side.
2. The C12 is an asymmetrical piece that is flat with a female slider on one end and then flipped and male on the other.
3. The C13 is three squares with a female slider in the middle on one side, then two males on the opposite side at each end.
4. The C14 serves the same functions as C13, but the male sliders have more space in between them so the female slider is accessible from either side.
5. The C15 has a female connector on each side.
6. The C16 is a circular shaped piece made to work well with wheels.
7. The C19 is like a C15 but with an additional male slider 90 degrees from the female sliders.
8. The C20 is like a C15 but with male sliders on each side.
Main Control Box

The Main Control Box is a box with sliders and holes on all sides, and holds the battery and controller for the kit. You can see what it looks like in Figure 1-14.

![Main Control Box](image)

**Figure 1-14. The Main Control Box**

You will note that the number of through holes on each side, as well as the ports. The ports labeled 1–3 and 4–5 on each side are made for the wires for the Servo motors and the Sensor, which have three pins. As for Port 6, it has four pins and is currently idle, but could be used for other types of Sensors in the future.

Port 7 is made for the Switch, and it has only two pins. Port 8 is currently idle and should not be used, with the Switch wire (W4), as the size of the hole is different.

As for charging the battery, your MC should come with a charging cord that connects on the side and plugs into the wall. Switching out the battery is pretty simple, as shown in Figure 1-15. Simply detach the fasteners in the two through holes, and you will be good.

![Battery Installation](image)

**Figure 1-15. How to install the battery in the Main Control Box**
Robotic Servo Motors

These particular black boxes are the Servo motors for the Jimu Robots Kit. The wires connect to the MC Box, and these tiny motors allow you to take control of what you have created. You can see what they look like in Figure 1-16.

![Image of Servo motors](image)

Figure 1-16. A sample of one of the Servo motors

If you look at one closely, you will see that they each have an individual number. So if you have a set with three Servos, like the Karbot KIT, it will be labelled ID-01, ID-02, and ID-03. It is possible to use up to 32 Servos with the Main Control Box. It is also possible to change the ID on the ServoID, but that will be discussed in later chapters.

Here’s what is interesting about these Servos, you will need to connect them with wires to the MC Box. You will notice that the wires have three prongs to connect them, and it is possible to take control of quite a few.

However, you may be doing a project where you need more than five Servos, which is more than you can plug into the ports of the MC. In that case, it is highly recommended that you simply wire them together in tandem, and this aids in AB and CD port labels. In other words, you link a Servo to the MC Box by plugging it in to a port, and then the AB. Then link the Servo from CD to AB on another Servo.

The Servos have a square on them that is the part that spins, also known as the rudder. You can spin it with your own hand when it is unpowered, and you will hear a whirring sound from within.

You will also notice that these spinning squares have a triangle, circle, star, and square. The purpose of that is a visual cue so you will know what position you start from. The triangle position indicates zero, so you will need to calibrate accordingly, which will be explained in later chapters.
Sensor, Switch, Bluetooth Speaker, and LED Light

There is a Sensor (S01), made for some specific actions. I won’t go into detail about it until later chapters, but I wanted to let you know that it exists and it has two 3-pin ports on the back. The Switch (P80) is made to turn on the MCBox, which will turn on the Servos. In fact, if you want to do anything with the Sensors, this must be hooked up to your model in some way.

The Bluetooth Speaker is made for an extra speaker for the sounds your Jimu Robots creations can make, but I will discuss that in more detail in Chapter 6. The LED Light is made to display some very great colors, and it can be programmed by the user. We will also go into more detail about it in Chapter 6.

The Switch can turn the MC Box.

Figure 1-17. The Sensor, switch, Bluetooth Speaker, and LED Light
Wires

The wires are necessary to power the Sensor, the Switch, Servos, and other things as well. Each of them are of different lengths, and the W4 has two prongs on its connector to fit on ports 7 and 8.

You can see samples of them in Figure 1-18, and they are of varying lengths.

1. The W1 is a three-prong wire that is the longest length at about 6 inches (15 cm). It has a blue stripe on it with its black color.
2. The W2 is also a three-prong wire, but shorter at 4 ½ inches (11 cm), and it has a white stripe.
3. The W3 is the shortest of wires at 3 inches (8 cm), and also has a white stripe.
4. The W4 wire is meant for Port 7 and the Switch only, and is about the same length as W1 at 6 inches (15 cm).

Figure 1-18. Samples of the wires
Jimu Robot Kits and What Pieces to Find

For those that are looking to expand your Jimu Robot pieces, there are many kits available for purchase on https://jimurobots.com/find-a-store/. If you have all four of the kits below, then you should not have any trouble building any of the models in this book. These are the kits that I took my parts from.

**Builderbots Kit**

This is a kit made for some terrific projects like the scooper robot and the claw robot as seen in Figure 1-19.

*Figure 1-19. The Jimu Robots Builderbots Kit*
These are the parts that it comes with.

<table>
<thead>
<tr>
<th>Piece Name</th>
<th>Amount in Kit</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>2</td>
<td>Gray</td>
</tr>
<tr>
<td>C4</td>
<td>6</td>
<td>Gray</td>
</tr>
<tr>
<td>C5</td>
<td>7</td>
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Buzzbot and Muttbot

This is a terrific kit that can make two different models: the Buzzbot, a two-legged, two-armed robot, and a Muttbot, a four-legged dog as seen in Figure 1-20.

![The Buzzbot and Muttbot Jimu Robots Kit](image)

**Figure 1-20.** *The Buzzbot and Muttbot Jimu Robots Kit*

Here are the pieces that it comes with.

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(continued)
### Inventor Kit

This is a kit that is capable of a lot of creations, about six in the basic instructions, as seen in Figure 1-21.

![The Jimu Robot Inventor Kit](image)

*Figure 1-21. The Jimu Robot Inventor Kit*
Here are the pieces that this comes with.

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Karbot Kit

This is where the wheels come in! There are instructions for about three basic vehicles with separate forms of controls, as seen in Figure 1-22.

![The Jimu Robots Karbot Kit](image)

**Figure 1-22. The Jimu Robots Karbot Kit**

Here are the pieces that it comes with.

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Tankbot

This is where you can get some great robots with tank tread and able to grab, as seen in Figure 1-23.

![Tankbot Robot](image)

**Figure 1-23. The Jimu Robots Tankbot Kit**

Here are the pieces that you will get with this kit.

<table>
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### Summary

STEM education is a very practical way to put hands-on learning of programming and creating technology in the hands of adults and children, so it is good for the user to become familiar with the pieces that he or she will be using.

Jimu Robots have pieces that are similar to LEGO, but they are very different in many ways. Character parts, fasteners, and connectors all fit together to form many creations, and it helps to have the Servos, Main Control Box, Switch, and wires that really bring them to life.

I highly recommend that you attempt to get ahold of as many Jimu Robots kits as possible, and figure out how the pieces work together and what they are capable of. You might be surprised at what you can build, and there is a creation that you can begin in the next chapter.

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CHAPTER 2

Your First UBTECH Jimu Robots Construction

So, now that you have got yourself familiar with the pieces of Jimu Robots in Chapter 1, it is time to see how they fit together. In other words, it is time to take the plastic off your Jimu Robots kits and start constructing!

Advice Before Building with Jimu Robots

I highly recommend taking out all the pieces and start randomly putting them together to see what you can construct. However, you did buy this book to help you out, so I will start by sharing with you what I know. Here is some advice that you will need if you want to be a creative builder with whatever Jimu Robots kits that you have.

Organize Your Pieces

One of the first things that you will discover when you open up a Jimu Robots Construction Set is how the pieces are organized. For example, in Figure 2-1, you can see all of the pastel color boxes of the Builderbots Kit.
1. Fasteners (Purple)
2. Main Control Box (Blue)
3. Recharging Power Adapter (Yellow)
4. Robotic Servo Motors (Green)
5. Character Parts (Red)
6. Connectors (Orange)

Note how only those parts are in those boxes, and there is a plastic bag in each of them to insure that some of the smaller pieces don’t slip through the cracks. It is a good idea to keep them organized this way.

If you want to combine two sets together, it is recommended that you purchase something that will keep the different parts in order so you won’t have to be rustling through a lot of parts just to find “the one you need.”

So if you have multiple Jimu Robots sets, I would recommend a tacklebox. You should be able to find one in retail outlets like Wal-Mart in the Sporting Goods section, and they contain special compartments that you can use to organize specific pieces.

Figure 2-1. The way Jimu Robot kits are organized
Color Doesn’t Matter

Man, I really hope that one day all of us will learn this, at least when it comes to skin color. However, this isn’t going to be a warning against racism, but this is about the color of your Jimu Robots parts.

If you look in the Jimu Robot kits that I mentioned in Chapter 1, you will notice that most of them have a really consistent color scheme. The Inventor Kit is blue and white, the Tankbot Kit is orange and black, the KarBot Kit is green and yellow, and the Builderbots Kit has many different colors.

You will notice with my creations that I did not go out of my way to make a good color arrangement happen. I tried to make my creations as symmetrical as possible, but if I had to use white, green, blue, orange, gray, yellow, or any color of beam to make something work, that is what I used.

Does this make my creations ugly? Maybe. I was more interested in creating machines that worked rather than something that looked good. When I first did my books about LEGO, the illustrations were in black and white, and I had some complaints from users saying that they didn’t know what color of parts to use. If any one of these complainers is reading this book, I would like to give you an answer of “who cares.”

There are many who want to build a creation with a consistent color scheme. I applaud that if you can make that happen. I did my best with what I had, and as I have said before, you are encouraged to take what I have made and improvise.

Build It Strong

One of the things that make construction kits like Jimu Robots so educational is that much of the projects relate to architecture and engineering. These sciences allow us to construct the best buildings and vehicles that will stand the test of time as well as daily usage.

You will notice that a lot of the Jimu Robots creations in this book are fortified several times, even if they don’t need to be. For example, you might notice that I might use three fasteners to connect beams together, even though you could get the same result from two fasteners. Believe me, there are times where I wanted to use more than two fasteners, and had to change the design so I could fit something together and make the entire construction stronger.

My point is that if you have a construction that has a place that is not secure, you will want to alter your construction so it is as secure as possible. In some cases, you really want it doubly secured, so take the time to really lock something into place.

Plan the Placement of Your Servos and Wires

As mentioned before, what can really bring your creation to life is the application of the Servos, which are designed to rotate sections of your creation, or even turn a wheel.

The issue is that the Servos need the wires in order to make them work. This means that these Servos can’t be located too far away from the Main Control (MC) Box. The longest wire is only 6 inches (15 cm) long, and you may discover that getting a specific Servo to work could cause a lot of problems.
The same advice goes for the Switch, which is going to need to be placed in such a way that the wire can access it. The only type of wire it takes is a W4, and it is a pretty long one, but again, it is not too long.

You will also discover as you build that some wires might have too much slack, and this slack could easily get tangled. Like a journeyman electrician, you should find a way to guide the wires to where they need to go, making certain they are connected at their proper points. I recommend using flats like the P09 and the P78 in order to make certain that the wires are firmly in place where they need to be, and you will see examples of that on instructions throughout this book.

Easy Access to MC Box Battery and its Ports

The best part of creating a Jimu Robots creation is giving it power and seeing what it can do. The worst part is that the power is just a battery, and that only lasts so long. You may discover that your creation will need some power, but if some pieces on your creation block the port, then you are out of luck. You might have to do a major deconstruction of your project just to change the battery.

There are some times where this is unavoidable, but if you plan this from the start, you can make it so you can either change the battery out or make certain that you have access to the AC cord port. You will always want to keep at least one of those areas clear.

Getting Started with Simple Instructions

Honestly, this is a chapter that you can skip if you just want to get to Jimu Robot construction. In fact, all you need to do is download the Jimu Robots application on iTunes or on Google Play.

From there, you can open the application and you will see this screen in Figure 2-2.

*Figure 2-2. The opening screen for the Jimu Robots application*
Every Jimu Robot kit comes ready for constructing, and the Story button will allow for a great hands-on introduction that I will let you discover for yourself. The Community button will allow access into the Jimu Robots community, where you can share and rate creators’ individual models.

Before I get to the bottom center Model button, I want to address the three buttons in the top right corner. The Clipboard gives daily tasks for members, and you can join the Jimu Robots community there. The Question Mark will give a hands-on tutorial of the Component, Build, Connect, Actions, and even Programming. The Settings button (the Gear wheel) offers some options that you can define as a user.

If you open the application and click on the Model button, you will find all kinds of great robots, animals, vehicles, and whatever to build, as in Figure 2-3. You can even filter it depending on whatever set that you have.

*Figure 2-3. Where you can find the instructions for your Jimu Robots set*

You can click on the model from this page, where you can download the instructions and even the programs necessary to make it come to life. I’m going to talk about how to make something of your own, and I’ll discuss how to make it come to life in Chapter 3.
Building a Scorpion

One of the greatest features of a construction toy is that there are essentially no limits to what you can construct, assuming that you have enough pieces. For me, I wanted to demonstrate what UBTECH and Jimu Robots can do, and decided to go with a scorpion. I’m not certain why, because honestly, scorpions really creep me out.

Actually, the reason why is because I felt that I could build something that could do a lot of physical actions. I mean, scorpions can both pinch and sting, and I can use the Servo motors to mimic that.

Of course, you have to build a body to go with it, and yes, it can get very complicated. In fact, the scorpion that I will be constructing will not be able to walk or maneuver, but stays in one place. I am going to talk about how to make claws and stinger move via programming in Chapter 3, so be patient. While I am on the subject of patience, let me say that it took several tries before I settled on this particular model.

Yes, you can build this, just like you can create something else. One of the reasons why I wrote this book wasn’t to give you instructions for something and you can build it. There are a lot of instructions in this book, but honestly, you need to figure out creations of your own. I’ve said before: don’t be like Will Ferrell’s character in The Lego Movie and just purchase kits to build and just keep on the shelf. You are not Lord Business! Learn to create and innovate, as there is greater reward there.

If you are concerned about having all the pieces required to complete the scorpion, you should be able to find all that you need in the Inventor Kit, and I was able to create the scorpion using nothing but pieces from the Inventor kit alone. However, you might be able to literally piece them together using other kits as well.

The Legs of the Scorpion

Since scorpions are arachnids, they have eight legs. I decided to do four, which is going to be enough to keep the body of it off the ground and well-supported.

We’ll start with the back legs, which are, for the most part, pretty simple, and it will illustrate how the pieces that I introduced in Chapter 1 work together.
The Scorpion’s Back Legs

Go ahead and get out a C8 connector, and put in four P48 fasteners as shown in Figure 2-4.

![Figure 2-4. Step 1 of the scorpion's back legs](image)

You will note that I had to use photographs to depict these construction steps, which means that I can only show a step from a certain angle. It goes without saying that I will be using both pictures and descriptions to give instruction, but it should be obvious if you are doing this yourself.
For example, go ahead and flip over what you have created and put in a rubber P79 on the top. It is possible to see what it looks like in Figure 2-5, and believe me, the rubbery P79 will click into place.

![Figure 2-5. Step 2 of the scorpion’s back legs](image)

Add the C15 and slide it in so the back part of it lines up with a hole on the C6 as seen in Figure 2-6. If you have used these connectors before, then you know you have to literally hear a click to make certain that it is locked.

![Figure 2-6. Step 3 of the scorpion’s back legs](image)
Add a C5 in the same sliding manner that is seen in Figure 2-7.

**Figure 2-7.** Step 4 of the scorpion’s back legs

You will then need to take a C4 and orient it as seen in Figure 2-8.

**Figure 2-8.** Step 5 of the scorpion’s back legs
This next step involves putting two parts on at once, one on top of the other. Start with the C15 on the C4 from Step 5, and then slide the C5 on top of that as seen in Figure 2-9.

![Step 6 of the scorpion’s back legs](image)

**Figure 2-9.** Step 6 of the scorpion’s back legs

The last step involves putting on a C15 and C4 as shown in Figure 2-10.

![Step 7 of the scorpion’s back legs](image)

**Figure 2-10.** Step 7 of the scorpion’s back legs

Now that you have the back leg, put it aside. It is time to build another one, so **repeat the Back Legs Steps 1–7**. Once you have done that, it is time to move on and build the front legs, which I have simplified to only two steps.
The Scorpion’s Front Legs

Now that you have created the back legs, the front legs will be even easier. The front legs are exactly like the back legs Steps 1–2, as seen in Figure 2-11.

**Figure 2-11.** Step 1 of the scorpion’s front legs

The next step is to add the two C15 connectors and the C5 (see Figure 2-12).

**Figure 2-12.** Step 2 of the scorpion’s front legs
Once again, this is another part where it is time to repeat what you did before. In this case, repeat the Steps 1–2 of the front leg to make another front leg.

The Tail

This is the first motorized piece with the tail, but it will not be the last. Start with the Servo known as ID-09 and slide on a C8 with the nine P48 connectors on it, as shown in Figure 2-13.

![Figure 2-13. Step 1 of the scorpion's tail](image1)

Go ahead and get a C7, and put three of the P49s on each side as shown in Figure 2-14. Put on the other four P49s, and follow the pattern of two on each side. Before you insert Servo ID-09, be certain to spin the square part so the triangle side is pointing down (toward the top of the C7 roof), then click it into place.

![Figure 2-14. Step 2 of the scorpion's tail](image2)
Go ahead and slide the ID-10 on the C7 as shown in Figure 2-15, and make certain the ID-10 is also orientated with the triangle pointed down (toward the top of the C7 roof). Plug one end of the W2 wire to the CD port on the ID-09 and the other end to the AB port on the ID-10 Servo.

You will need to snap on a P14 and P15 on each side of the C7, as shown in Figure 2-16. Take the P09 Flat pieces and slide them into place on the ID-09 and ID-10 Servos, and slide on a C6 connector as shown.
Slide on a C5 connector atop the C6 from Step 4, and then Slide on the ID-11 as shown in Figure 2-17. Attach a W3 wire to the CD port for ID-10 and the other end to the CD port for the ID-11.

**Figure 2-17. Step 5 of the scorpion’s tail**

Slide on a C3 connector with the ID-11 square triangle pointing down. Slide on the C15 and C5 connectors, as shown in Figure 2-18.

**Figure 2-18. Step 6 of the scorpion’s tail**
Go ahead and put that section of the tail aside, as it is time to deal with the next section from scratch. Start with a C11, then add on the P53 and the two P48 fasteners as shown in Figure 2-19.

**Figure 2-19.** Step 7 of the scorpion’s tail

Attach the T-Shaped P37 using the three P47 fasteners (see Figure 2-20).

**Figure 2-20.** Step 8 of the scorpion’s tail
It is time to again start another part of the tail. Start by centering the P47 fasteners on the P36 Cross Blocks, as shown in Figure 2-21. (Don’t worry about the space between the individual sections).

**Figure 2-21.** Step 9 of the scorpion’s tail

Snap on the two P08s, and secure them with P47 fasteners. Don’t forget the two P48 Fastners as shown in Figure 2-22.

**Figure 2-22.** Step 10 of the scorpion’s tail
Note that there are no new parts in this step, but you will need to combine tail Steps 7–8 with Steps 9–10, as shown in Figure 2-23.

**Figure 2-23.** Step 11 of the scorpion’s tail

Turn over what you created in Step 12 and then add on the P35 and P48 parts, as shown in Figure 2-24.

**Figure 2-24.** Step 12 of the scorpion’s tail
Snap on the P20 beams on the P48 fasteners from the last step, and then attach more P48 fasteners as shown in Figure 2-25.

![Figure 2-25. Step 13 of the scorpion’s tail]

Snap on a P67 as shown in Figure 2-26. Note the placement of the P24 beam, as well as the P48 fasteners.

![Figure 2-26. Step 14 of the scorpion’s tail]
Add on the P05 and P06 as shown in Figure 2-27. Add on the P78 and the P48 fasteners as well.

Figure 2-27. Step 15 of the scorpion’s tail

It is time to start from scratch once again with a third section of the tail. Start with a P71 and center two P47s as shown in Figure 2-28.

Figure 2-28. Step 16 of the scorpion’s tail
Go ahead and add on a P71 on each side, and then add on two P48 and P53 fasteners on each side as shown in Figure 2-29.

Figure 2-29. Step 17 of the scorpion’s tail

Snap on a P22 on each side and add two P48 connectors to each, as shown in Figure 2-30.

Figure 2-30. Step 18 of the scorpion’s tail
Snap on the rubbery P27 pieces as shown in Figure 2-31. Put on the P21 beams along with the P48 fasteners.

**Figure 2-31.** Step 19 of the scorpion’s tail

Go ahead and put on the P34 Cross Blocks and the rubbery P28s. Also snap on the P03 and the P04 as shown in Figure 2-32.

**Figure 2-32.** Step 20 of the scorpion’s tail
Time to connect all the parts of the tail together. Slide the C11 from Step 7 to C5 from Step 6, and connect the P34 from Step 20 to the P48 from Step 15 as shown on Figure 2-33. What you will get is a pretty big creation, but put it aside for now.

We’ll see how to attach the tail later, but for now, let’s move on to the claws.
Left Claw

We’re going to make one claw, and then another like it, with some small changes. Start with the ID-05 with a C5, and then add on the C1; be certain that the Servo spinner has its triangle pointed down. (See Figure 2-34).

![Figure 2-34. Step 1 of the scorpion’s left claw](image)

Add on the C4 and C15 connectors, as well as the P49 fasteners as seen in Figure 2-35.

![Figure 2-35. Step 2 of the scorpion’s left claw](image)
Attach P13, C4, and C5, as shown in Figure 2-36. Plug one end of the W3 wire into the AB port on ID-05.

![Figure 2-36. Step 3 of the scorpion’s left claw](image)

Add on a C2 connector and a P09 as shown in Figure 2-37.

![Figure 2-37. Step 4 of the scorpion’s left claw](image)
Attach Servo ID-06 to the C2 connector of the last step with the triangle pointed down on the C2, and connect ID-05 (AB port) and ID-06 (CD port) together with a W2 wire as shown in Figure 2-38.

**Figure 2-38.** Step 5 of the scorpion’s left claw

Attach the W2 wire to the AB port as shown in Figure 2-39. Use the C13 connectors as shown.

**Figure 2-39.** Step 6 of the scorpion’s left claw
Plug in the W2 from Step 6 to the AB port, and then plug in another W2 into the CD port. Put ID-07 on the C13 connectors, as shown in Figure 2-40.

**Figure 2-40. Step 7 of the scorpion’s left claw**

Slide the ID-08 on the ID-07 and put P49 connectors on that, as seen in Figure 2-41.

**Figure 2-41. Step 8 of the scorpion’s left claw**
Get out a P18 and attach the two P34 Cross Blocks on the P47 fasteners on each side, like in Figure 2-42.

![Figure 2-42. Step 9 of the scorpion’s left claw](image)

Attach all P49 fasteners on the C2 as shown in Figure 2-43.

![Figure 2-43. Step 10 of the scorpion’s left claw](image)
Put on the P17 connectors as in Figure 2-44. This time, the circle on the spinning square of the ID-08 Servo is pointed down on the C2.

Figure 2-44. Step 11 of the scorpion’s left claw

And now it is time for the right claw, which is very similar in design.

Right Claw

Start with the ID-04 and attach a C2 with the square of the ID-04 spinning square pointing down, and don’t forget the C5 connector (see Figure 2-45).

Figure 2-45. Step 1 of the scorpion’s right claw
Attach the C4 and C15 and the P49 fasteners as seen in Figure 2-46. Slide on the P09 on the bottom of the ID-04.

**Figure 2-46.** Step 2 of the scorpion’s right claw

Attach a C5, then C1 and P12, as shown in Figure 2-47.

**Figure 2-47.** Step 3 of the scorpion’s right claw
Connect W2 with CD of ID-03, and this time, put the circle of the ID-03 spinning square facing up (see Figure 2-48).

**Figure 2-48. Step 4 of the scorpion’s right claw**

Insert the W2 into the ID-03 and connect it to the C13 connectors (see Figure 2-49).

**Figure 2-49. Step 5 of the scorpion’s right claw**
Put on the ID-02 with the W2 wire, as seen in Figure 2-50.

**Figure 2-50.** Step 6 of the scorpion's right claw

Put on the ID-01 with the P34s, P49, and the P18, as seen in Figure 2-51.

**Figure 2-51.** Step 7 of the scorpion's right claw
Attach the last parts similar to the other claw, as shown in Figure 2-52.

**Figure 2-52. Step 8 of the scorpion’s right claw**

The Body of the Scorpion

Time to get the scorpion body made so all the parts will come together.

Start by getting out the MC Box, and attach the P48 fasteners as shown in Figure 2-53.

**Figure 2-53. Step 1 of the scorpion body**
Attach the P35 Pieces with the P48 fasteners as shown in Figure 2-54.

**Figure 2-54. Step 2 of the scorpion body**

Attach the P26 beams, and attach the P53 fasteners to them as shown in Figure 2-55, not to mention the P48 fasteners to the MC. Put on the C11 with the P48 fasteners, too.

**Figure 2-55. Step 3 of the scorpion body**
Attach the P34 pieces, and then the P46s, with P48 fasteners as shown in Figure 2-56. Don’t forget the P21s and the P47 fasteners as well.

**Figure 2-56.** Step 4 of the scorpion body

Time to attach the W4 wire to Port 7 of the MC Box, and then connect the other end to the P80 as shown in Figure 2-57. The P80 will be connected to the P47 fasteners of the previous step.

**Figure 2-57.** Step 5 of the scorpion body
Start fresh with two P24 beams and six P48 connectors as seen in Figure 2-58.

**Figure 2-58. Step 6 of the scorpion body**

Snap on the P21, P25, and P48 pieces as shown in Figure 2-59.

**Figure 2-59. Step 7 of the scorpion body**
Snap on the ten P48 fasteners with the P70 Cross Blocks as shown in Figure 2-60.

Figure 2-60. Step 8 of the scorpion body

Start from scratch with a P01 and four P48 fasteners as shown in Figure 2-61.

Figure 2-61. Step 9 of the scorpion body
Attach the P07 and four P48 fasteners as shown in Figure 2-62.

Figure 2-62. Step 10 of the scorpion body

Start again from scratch with a P02 and four P48 fasteners as shown in Figure 2-63.

Figure 2-63. Step 11 of the scorpion body
Attach the P07 and four P48 fasteners as shown in Figure 2-64.

**Figure 2-64. Step 12 of the scorpion body**

Add Steps 11–12 to Steps 6–8, as shown in Figure 2-65.

**Figure 2-65. Step 13 of the scorpion body**
Join Steps 6–8 with Steps 9–10, as seen in Figure 2-66.

**Figure 2-66.** Step 14 of the scorpion body

Combine Steps 1–8 with 9–14 until you see that you have what you see in Figure 2-67.

**Figure 2-67.** Step 15 of the scorpion body
Attach the W1 wire to Port 4 on the back of the MC as shown in Figure 2-68, and then add the three P22 beams.

![Image](image.png)

**Figure 2-68.** Step 16 of the scorpion body

Now it is time to join all the pieces together.

**Putting It All Together**

Slide the two front legs and two back legs on as shown in Figure 2-69. The front and back legs are essentially the same height, so the black rubber pads can be put down and keep the body flat on the floor.

![Image](image.png)

**Figure 2-69.** Step 1 of putting the scorpion's body together
Put on the right claw as shown in Figure 2-70. Use a W1 wire and attach it to Port 5 on the side.

Figure 2-70. Step 2 of putting the scorpion’s body together

Now it is time to put on the left claw, as seen in Figure 2-71. Use a W1 wire to connect it to Port 1 on the MC.

Figure 2-71. Step 3 in putting the scorpion’s body together
Attach the tail as seen in Figure 2-72.

Figure 2-72. Step 4 of putting the scorpion’s body together, which is the final step

Okay, that is all! We will program it in Chapter 3.

Summary

There are many ways to succeed in building with Jimu Robots, and it is suggested that you organize your parts and plan before you build. The scorpion is a good example of applying these principles, and you are of course encouraged to make adjustments if it can be made better.

Better yet, use the pieces to build something yourself, and I will tell you how to make it come to life in Chapter 3.
CHAPTER 3

The Jimu Robots Software Application

Now that we have lined out all the pieces of Jimu Robots, we should discuss what to do once we have fit a few together. I’m going to focus on the scorpion project discussed in Chapter 2, but these are instructions for programming that can apply to other future projects.

So if you skipped Chapter 2, you will need to download the Jimu Robots application. It is available from the Apple App Store and Google Play.

A New Model for Jimu Robots

From here, you can see a scrolling area where you can select a model from one of the Jimu Robots kits that we discussed in the first and second chapter.

However, this is what will happen if you want to hit “My Models” in the upper right corner, which you can see in Figure 3-1.
Once you have selected “New Model Create your own,” you can choose from “Animal,” “Machine,” “Robot” or “Others.” Each one gives you options for what you can do with them, as seen in Figure 3-2.

Figure 3-2. A selection of what you can build when you create a model
By the way, I have been told by UBTECH that it doesn’t really matter which particular option that you choose. I don’t know if that has changed at this point.

Assuming that you are doing the scorpion from Chapter 2, go ahead and select “Animal” and hit “Next,” and you will come to the screen in Figure 3-3.

**Figure 3-3. How to create a photo of your model**

From there, you can shoot a picture of what you have take, provided that you hit “Next.” You can select by going into your album if you took a picture of it already, or you can just use your camera and take a snapshot of it. See Figure 3-4 to see what that looks like.

**Figure 3-4. Selecting a photo of your model for a new model**
In my case, I decided to just take a new photo, so I clicked on “Camera”. From there, you will have the options of hitting “Select” or “Go Back” in the form of a check mark or arrow, as seen in Figure 3-5.

You can then play with the photo until you get it how you want it. For example, you can see the edges of the photobox that I used to take pictures of the models for this book. I can crop those out easily enough. You can see the controls there in Figure 3-6.

Figure 3-5. A snapshot taken of the scorpion to be used on a new model

Figure 3-6. Adjusting the photo for the new model
You will notice that you can adjust the degrees for a better focus, and it is also possible to rotate it 90 degrees. Go ahead and hit “DONE” when you have the right calibration.

You can then enter the model name, and I’ll leave you to decide what to name it as shown in Figure 3-7.

![Figure 3-7. Where to name a new model on the Jimu Robots application](image)

Once you see that you have a picture, you should set it up to make certain that your model is ready to be paired via Bluetooth with the button in the lower left corner, as seen in Figure 3-8. Be certain that the Switch piece (P80) is in the on position at this point.

![Figure 3-8. A new model and how to control it](image)
I’ll explain what the other buttons on the right side of the screen mean later in this chapter, but if you hit the Bluetooth button in the bottom left hand corner, you will see this screen for Figure 3-9.

**Figure 3-9.** What happens when you pair your Jimu Robots creation with the Jimu Robots application

You will then go through a pairing process, and eventually it will find your Jimu Main Control (MC) Box. If you have multiple Jimu Robots turned on, you can pair with the right one by matching the last 4 digits on the MC Box MAC address to the last 4 digits that follow “Jimu” as seen in Figure 3-10.

**Figure 3-10.** You can select the device that you want to connect to on the Jimu Robots application
When you select it, you should see that all your Servos are linked, as seen in Figure 3-11. You will not see all of the 11 that were used for the scorpion unless you scroll on them horizontally, but you should check if they are there.

If the proper number of Servos is not there, then it means that the MC Box has yet to identify them, and you should double-check the wires to make certain that everything is in order before hitting “Re-detect.”

Now, it is possible that your Servo is not aligned, and the Jimu Robots will tell you this. You will see a screen like in Figure 3-12.

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**Figure 3-11.** Confirmation of pairing with the MC Box with the Servos

**Figure 3-12.** What happens if the Servo is outside the permitted range
The reason why this happens is because your Servo might not be oriented correctly. If necessary, switch off your model and adjust the Servo so it is facing the right direction. When connected to another piece, the triangle on Servo Plate should be aligned with the groove on the Servo. This indicates the angle is at 0. From here, the Servo can rotate 118 to -118 degrees.

This would be a good time to take note of where the Servos are in relation to the rest of your model. Know that Servos ID-01 through ID-04 are on the Right Claw, the Servos ID-05 through ID-08 are on the Left Claw, and Servos ID-09 through ID-11 are in the tail.

Proper orientation of the Servos should insure that the adjustment screen will not appear, but if you want to adjust a Servo manually, you can do it at this prompt. You can use the plus or minus keys to adjust the angle of the Servo slowly, or use the green circle to adjust it faster.

**Important Warning!** It is possible to adjust the Servo too much for one angle, which will result in it a loud clicking noise. I hope that you don’t ever hear that, but keep in mind that pieces like the C1, C2, C3, and C7 connectors will only rotate on the Servo so far, and too far will result in a jam.

You should definitely switch off the model should you hear that sound, as too much of it could damage the Servo permanently. I cannot emphasize this point enough, and it can be a terrible thing to happen during your creation. I recommend using the plus and minus keys first to see if your Servo has movement, before adjusting the circular adjustment bar, as you might get too much movement that could cause a jam.

Once you have the Servos adjusted, you will see the screen similar to Figure 3-8, but the Bluetooth symbol in the lower left corner will be blue.

As for the buttons on the right, you will see four that I will talk about now:

1. **Actions:** This is where it is possible to program the actions that the robot takes, and I’ll discuss how to make them move.

2. **Coding:** This is where it gets really complicated, and I will spend an entire chapter covering this in Chapter 6.

3. **Controller:** How to get a controller working for full 360-degree rotation and more actions, which I will cover more in depth in Chapter 4.

4. **Publish:** This allows you to share your creation with the Jimu Robots community.

As stated before, I’m going to detail Coding and Controller later, but let me discuss Actions.

**Actions**

As you have no doubt noticed already, the Servos are the secret to the action in Jimu Robots. Anything that is on the spinner square is fair game for movement, provided it is oriented and set up correctly. Following the instructions for the scorpion in Chapter 2 will insure good movement, but feel free to make adjustments if you feel that it can be done better.

There are two ways to create new actions for your Jimu. There’s the Drag and Drop method and the Pause, Record, and Playback (PRP) method. Both methods are explained through the following movement tutorials.
Scorpion Claw Movement—Drag and Drop

If you press Actions, you will see all the Servos below, and you can then drag and drop them up to the workspace in the center. This next set of programming instructions uses the scorpion model from Chapter 2.

We are going to start with a simple instruction of how to make the claws open. All that we need to do is program the Servo to move. Since we programmed Servos 1 and 5 to be the claws, this will move C1 or C2 so they will pinch, depending on which you select.

As you can see in Figure 3-13, I have selected Servo ID-01; you can hit plus or minus buttons to adjust it by degree, and you will see it move in real time. You can also move the small green circle that you can see there, but be warned when you do that, as it makes the Servo move fast, and it could result in a jam.

For example, you can see the Servo for the claw joint, and you can adjust it accordingly. You can simply drag and spin the Servo, or adjust it manually degree by degree with the plus or minus keys. You will note that you can only move the C1 so far, and you don’t want to push it past where it needs to go, or you will hear that previously mentioned loud clicking sound.

If you click on the “X,” it will kick you out of this and won’t save. I’ll explain what the other buttons do later, but let’s talk about how to save this command that you made.
Just click the check mark in the corner, and you will be sent to another screen (see Figure 3-14).

Once you realize what movement that you want, you can then name it by typing it in and then giving it a symbol, like the name of “Right Claw Open.” These symbols include a lot of arrows, which might be helpful for movement, but many of the symbols don’t really have any meaning at first sight.

When you hit “Confirm,” you will be taken to back to the previous screen, where you will see that your command with its symbol are now a permanent part of actions. You will note that hitting “Right Claw Open” will do nothing at first, and this is because the model is already in the position. If you move the other parts, then you can just hit “Right Claw Open” and your model will clench its right claw on your command.

Figure 3-14. How to save an action on the Jimu Robots screen

Spin the Scorpion Claws—Drag and Drop

Servos 2 and 7 are made to spin the respective right and left claws on their axis. In this manner, you can make the claws pivot so they can clench something at a different angle, just like you twist your wrist to grab something.

Here’s another warning for you. Unlike the claws, there is a greater risk of it twisting out of control; not only could it make that loud clicking sound, but tangle the wire as well. Believe me, I have done that, and hopefully you will not.
We’ll go ahead and make another action button so we can spin the claws, but this time we are going to move two Servos with one command. All that is required is selecting one Servo, and then dragging and dropping another to it so it forms into one, like in Figure 3-15.

![Figure 3-15. Moving two Servos at once with the Jimu Robots application](image)

You will want to adjust the speed of the claws. It is a very simple process, as you can click on the speed and adjust it with the plus or minus keys or the slider button. It can go up to 5000 ms, which is pretty fast. You will note the choosing of a relatively slow 180 ms here.
You will also note that you can have many actions take place within a single action, and even have Servos move at the same time. All that is required is dragging and dropping them in place. For example, you can make both claws spin and clench at the same time, with one taking place after the other, as seen in Figure 3-16.

![Figure 3-16. How to program several Servos at once](image)

You can then save the command just like you did before.

**Raise the Claws—PRP**

You will note the Servos ID-03 and Servos ID-07 with Servos ID-04 and ID-08 serve as the respective elbows and shoulder joints of the claws. I’ll go ahead and give some instructions on how to make the claws raise straight up.

Now, you could go through a lot of trouble and program the individual Servos of the claws, or you can just play it easy and do this step. You can see the red circle button on the side that you probably already know is a universal symbol for “record.”
What you need to do is click on the PRP (Pause, Record, and Playback) button, and you will see this on the screen as seen in Figure 3-17.

**Figure 3-17.** What records the robot movement on the Jimu Robots application

You will notice that the Servos on the model will go limp, and you can manipulate the Servos any way you want. Then, once you press the button, you will see exactly the commands that you put in.

**Figure 3-18.** What happens once actions are recorded
You will note that there are several Servos being manipulated here, so you can deal with actions that you have recorded. Keep in mind that whatever you move during PRP time will be recorded, so be very specific with your actions.

The Sting

Okay, it’s time to show me what you learned. As you know, there are Servos in the tail, and it is there so it can sting.

I will give you a hint that it requires taking control of Servos ID-09, ID-10, and ID-11, but you probably already knew that one. If you want, you can use the Drag and Drop or the PRP to do this. I would highly recommend that you adjust the speed, because giving your scorpion too much sting can result in pieces falling off. Keep working until you can get it, and good luck!

By the way, if you are concerned that the scorpion model can only stay in one place, that will change, as we will discuss mobility in the next chapter.

Summary

The Jimu Robots kits have a free application for your smartphone or tablet which syncs with the MC Box via Bluetooth in order to control the Servos. Servos are what really gives you, the user, control over your Jimu Robots creation, so be certain that you know which Servo does what on your particular model. Also, be certain that the Servos are made so they do not jam, and adjust accordingly if you are getting warnings that this could or does occur.

I would highly recommend building the scorpion and then playing with the Servos to see what you can make it do. Not only is the scorpion made so it can sting and pinch, but you can manipulate the claws so it waves its hands in the air like it literally just doesn’t care (because it doesn’t).

Can you think of ways to use the Servos to achieve greater control of the scorpion? Can you improve the design of the scorpion by rebuilding? By all means, do so. Make this project your own, and see what else you can bring to life.
CHAPTER 4

The Jimu Robots Vehicle and How to Make It Go

Now that you know how to build a structure with Jimu Robot kits, I want to talk about something that I’m sure that you already want me to address: how to make it move.

Within this chapter, I am going to show how to make a robot move on tank treads, four wheels (with four-wheel drive), and other methods of transport. Then, I’m going to show you how to go into the Jimu Robots app and make it move. Not only is your vehicle going to go back and forth, but it will be able to steer to the left and right.

I mentioned earlier how the scorpion robot can be created with the Inventor Kit, and you will need some other kits if you want to create the robots in this chapter. For the three-wheeled and four-wheeled vehicles, you will need the Karbot Kit, as this one has the wheels that you need. I am told that the Karbot Kit is only available in Europe, so hopefully you can get your hands on it if you don’t live in Europe.

Tank Treads Instructions

To build a robot with tank treads, you will need pieces from the Tankbot Kit. I’ll go ahead and start with how to build a scorpion robot with tank treads.

In fact, I’m going to be using the scorpion from Chapter 2 as a base model for this tank tread model, at Step 16 of the scorpion body. Of course, it is possible to do this other ways, and I am going to encourage you to do that.
So if you have the scorpion model, go ahead and remove the tail portion, the left claw, the right claw, the legs, and the area on the front with the Switch. Turn the model over and add on P47 fasteners as shown in Figure 4-1. Go ahead and keep the W1 wire in Port 4 and the W4 wire in Port 7, as you will need them later.

Slide on the P25 beams, and add the P48 fasteners on them as shown in Figure 4-2. Don’t forget the fasteners on the P38.
Snap on a pair of C8 connectors and another pair of C15 and C5 connectors as shown in Figure 4-3.

**Figure 4-3. The third step of the tank tread model**

Time to use three pairs of C6 connectors as shown in Figure 4-4.

**Figure 4-4. Step 4 of the tank tread model**
Add a C20 on each of the “posts” and put on C4s as seen in Figure 4-5.

Figure 4-5. Step 5 of the tank tread model

Go ahead and use the C15 and C5 connectors to “bridge” the posts you just made (see Figure 4-6).

Figure 4-6. Step 6 of the tank tread model
Slide on the ID-13 Servo and the W3 wires as seen in Figure 4-7.

![Figure 4-7. Step 7 of the tank tread model](image)

Slide on the ID-14 Servo and connect the W3 wire, as shown in Figure 4-8.

![Figure 4-8. Step 8 of the tank tread model](image)
Now it is time to work away from Steps 1–8; get out two C11 connectors and place the fasteners on them as shown in Figure 4-9.

![Figure 4-9. Step 9 of the tank tread model](image)

You will need two P67 (3 × 3 beams), as well as two P99 axles. Insert them on the C11 connectors as shown in Figure 4-10.

![Figure 4-10. Step 10 of the tank tread model](image)

Go ahead and slide on P86 Gears and then put on P100s to anchor them into place, as seen in Figure 4-11.

![Figure 4-11. Step 11 of the tank tread model](image)
Now it is time to get out another C11 connector with the P48 fasteners, and put P48 fasteners on the P86 Gear (see Figure 4-12).

![Figure 4-12. Step 12 of the tank tread model](image1)

Snap on the P86 Gear and C11 connector as seen in Figure 4-13.

![Figure 4-13. Step 13 of the tank tread model](image2)
Go ahead and attach the C11 connectors with their gears and other parts as seen in Figure 4-14.

**Figure 4-14.** Step 14 of the tank tread model
Go ahead and connect the tank treads on the Gears, with 35 treads on each, as seen in Figure 4-15. Use the C14 connectors to link the Servos on one side and C20 connectors on the opposite side.

*Figure 4-15. Step 15 of the tank tread model*

Now I’m going to devote attention to the front area of the scorpion that should have been removed in Step 1 of these tank treads. There are some instructions here in Step 16 (see Figure 4-16), but most of it will be built with the scorpion model, except the P48 fasteners.

*Figure 4-16. Step 16 of the tank tread model*
Snap on the P35s and the P48 fasteners as shown in Figure 4-17.

Figure 4-17. Step 17 of the tank tread model

Snap on the P24 beams, and put the P47 fasteners on top of them.

Figure 4-18. Step 18 of the tank tread model
Go ahead and snap on the S01 Sensor along with the W2 wire.

**Figure 4-19.** Step 19 of the tank tread model

Go ahead and snap on the left claw, right claw, tail, and the front section with the Sensor. Plug the wires into their appropriate ports, and the Sensor wire can be plugged into any spare port.

**Figure 4-20.** Step 20 of the tank tread model

Now that you have the tank tread model, you can take control of it so it can move.
Tank Treads—Making It Move

Now that you have your tank base, the next step is to make it run. First, you turn on your Jimu robot and open the app. Once you're on the app, go to “New Model” and sync your Jimu robot, as explained in Chapter 3. This time, we will not use the “Actions” button to create a button for the control of the tank tread. Instead, go to the “Controller” icon as seen in Figure 4-21.

Figure 4-21. The settings screen for the controller

Once you are on the Controller screen, you will be directed to click on the Settings button at the top right corner.
The Settings button is small and has a blue outline of a gear as the icon. When clicked, controller button options will slide into the left side of the screen as seen in Figure 4-22.

**Figure 4-22.** The controller screen
It gives you the options to add a button for an individual action, a four-way directional pad, and two-way controls for forward-back and left-right movements. I'll discuss the functions of the two-way controls in detail later. For now, drag the four-way direction pad onto the controller grid, as seen in Figure 4-23.

![Figure 4-23. The controller set-up](image)

Once the four-way direction pad is in place, tap it to configure which Servos to set in wheel mode. A pop-up will appear as seen in Figure 4-24.

![Figure 4-24. How to set up the Servos for wheeled control](image)
For the treads to work, the Servos need to be able to rotate 360 degrees. When the pop-up to set up wheel mode appears, select “Confirm” and it will ask you to choose between Angle mode and Wheel mode, as seen in Figure 4-25.

**Figure 4-25. How to access wheel mode**

Select “Wheel mode” and click “Start Setup.” From here, the app will guide you to drag and drop the Servos into the box for Wheel mode, as seen in Figure 4-26.

**Figure 4-26. A way to bring the Servos from Angle mode to Wheel Mode**
Once you drag the Servos to Wheel mode, click the check mark in the upper right corner. Before proceeding, a pop-up warning as seen in Figure 4-27 will appear.

**Figure 4-27. To confirm a Servo in wheel mode**

Go ahead and confirm, then you will return to the Controller home screen, which should look still look like Figure 4-23. When you touch the controller again, you will have the choice of a vehicle type, as seen in Figure 4-28.

**Figure 4-28. How to select a vehicle type**
Chapter 4

Since our vehicle runs on treads, select “Two-wheel drive,” and you will see Figure 4-29.

Figure 4-29. How to set up the wheels

You can drag the Servos as shown in Figure 4-30. As you proceed, the side with the wheels will be the front of your vehicle.

Figure 4-30. Aligning the wheels
Once you click on the upper right check mark, you will be back to the main Controller screen, where you need to confirm and save your settings.

Now you have a direction pad to navigate your tank in different directions! All that is required now is put your tank vehicle on the floor, and then use the controller like a joystick. It will be able to go forward and backward, as well as left and right. Try it for yourself, and don’t be afraid to make adjustments if you think you can do this better.

Four-Wheeled, Four-Wheel Drive Vehicle

Now that we have tank treads, let’s build one with four wheels. You will need to start by taking off the claws and tail, but leave the front part with the Sensor.

Before we begin, I will say that all the P47s and P48 are different colors than those before. We will start with the C4 and C15 connectors, attached to the MC Box as seen in Figure 4-31.

Figure 4-31. Step 1 of the four-wheel drive vehicle
Go ahead and attach C8 connectors to each, and add the 12 P48 fasteners on as shown in Figure 4-32.

**Figure 4-32.** Step 2 of the four-wheel drive vehicle

The next step may look complex, but it’s easier than it looks. You attach P22 11 hole beams. Then, add the P47 and P48 fasteners as shown in Figure 4-33. The P47 fasteners will need to be centered on the P22 beams.

**Figure 4-33.** Step 3 of the four-wheel drive vehicle
Add on the C8 connectors and P48 fasteners, as seen in Figure 4-34.

**Figure 4-34.** Step 4 of the four-wheel drive vehicle

Go ahead and put on the two 13 through-hole P21 beams with the C4 connectors as seen in Figure 4-35.

**Figure 4-35.** Step 5 of the four-wheel drive model
Chapter 4: The Jimu Robots Vehicle and How to Make It Go

Slide on C4 and C15 connectors as seen in Figure 4-36.

**Figure 4-36.** Step 6 of the four-wheel drive model

Snap on the C8 connectors as well as the P48 fasteners, as seen in Figure 4-37.

**Figure 4-37.** Step 7 of the four-wheel drive model
Insert the four P22 beams and the fasteners, as shown in Figure 4-38.

**Figure 4-38.** Step 8 of the four-wheel drive vehicle

Use the C8 connectors and the fasteners as shown in Figure 4-39.

**Figure 4-39.** Step 9 of the four-wheel drive vehicle
Put on the P21 beam and the C4 connectors. At this point, your model should look like Figure 4-40.

**Figure 4-40.** Step 10 of the four-wheel drive vehicle

To prepare for the wheels, attach C6 connectors, the P35 beams, and the fasteners as shown in Figure 4-41.

**Figure 4-41.** Step 11 of the four-wheel drive vehicle
CHAPTER 4  ■  THE JIMU ROBOTS VEHICLE AND HOW TO MAKE IT GO

Attach the fasteners and P35 beams like in Figure 4-42.

**Figure 4-42.** Step 12 of the four-wheel drive vehicle

Put on P23 beams as shown in Figure 4-43, along with the fasteners.

**Figure 4-43.** Step 13 of the four-wheel drive vehicle
Put on the P22 beams and the P48 fasteners as seen in Figure 4-44.

Figure 4-44. Step 14 of the four-wheel drive vehicle
The next step involves the use of four Servos as you can see in Figure 4-45. Don’t worry about what direction the spinner square is facing in this case. Connect the odd-numbered and even-numbered Servos together with W1 wires, as seen in Figure 4-45.

Figure 4-45. Step 15 of the four-wheel drive vehicle
Snap on the P72s on the front and the back of the vehicle. Attach the ID-03 with the W2 wire, as shown in Figure 4-46.

Figure 4-46. Step 16 of the four-wheel drive vehicle
Get out four C11 connectors and install sixteen P48 fasteners as shown in Figure 4-47.

Figure 4-47. Step 17 of the four-wheel drive vehicle

Put the P84 tires onto the P82 wheels and then put them on the C11 connectors.

Figure 4-48. Step 18 of the four-wheel drive vehicle
Connect the ID-05 with the ID-06 with a W1 wire, as seen in Figure 4-49.

**Figure 4-49. Step 19 of the four-wheel drive vehicle**

Once you have the wheels set up, you can put on the claws and tail and begin the scorpion once again. Of course, you will need to set it up for control.
Setting Up for Servos with the Same Number

As you may have noticed, you are using four Servos for the wheels that are numbered ID-01, ID-02, ID-03, and ID-04. Some of you have noticed that if you use the same ID numbers for the scorpion claw, then you will get this message when you attempt to create a new model, as seen in Figure 4-50.

Figure 4-50. What you will see if you use two duplicate Servos
What you need to do is just go to the home screen and hit the Settings button in the upper right hand corner. Then scroll through the choices and click on “Change ID,” as shown in Figure 4-51.

![Figure 4-51. The settings page for Jimu Robots](image)

From here, you will see the instructions, starting with Step 1, as seen in Figure 4-52.

![Figure 4-52. The first step of the change ID process](image)
Just to let you know, you can only change the ID number of one Servo at a time. So go ahead and start with ID-01, and click on “Next Step.” You will see the next screen in Figure 4-53.

**Figure 4-53. Step 2 of the Change ID process**

Go ahead and disconnect all of the Servos that don’t need to be modified, which is about every one but the second ID-01. Go ahead and hit “Next Step” and see the next screen in Figure 4-54.

**Figure 4-54. Step 3 of the Change ID process**
You will need to connect your mobile device with the Jimu phone by hitting the connect button, and you will see the screen as in Figure 4-55.

![Modify ID](image)

**Figure 4-55.** Change the ID of the Servo

You can change the name of it, which we can call 19. Once you hit “Confirm,” you will see the screen as shown in Figure 4-56.

![Modify ID](image)

**Figure 4-56.** Confirmation that that Servo ID number has been changed
From there, you can go back to the creation, and you will see that the Servo has been appropriately named, as seen in Figure 4-57.

**Figure 4-57. A Servo that has been renumbered**

Now that you have done that, go ahead and renumber all of the repeated numbers, and it is time to take control of your four-wheeled vehicle.
Controls of the Four-Wheeled Vehicle

To make this four-wheeled model move, complete the following step displayed in Figure 4-58.

Similar to how we set up the 2 Servos for the tank treads in the last section, we change our 4 Servos for our car wheels to “Wheel Mode.” Instead of selecting “Two-wheel drive,” we select “Four-wheel drive” and place each Servo in its respective location. Once saved, the controller can command the vehicle to move forward and backwards.

![Figure 4-58. Four-wheel drive controls](image)

Summary

The Jimu Robots kits are set up so that they can have wheels with the Servos. It is possible to put Tank Treads on them, and to work them with the Controller. It is also possible to use four Servos with four wheels and have four-wheel drive.

There are other ways of doing wheels on a vehicle. For example, you can use two Servos and the P116 part for turning. It is even possible to use three Servos, with one for turning. You can follow the instructions for the Karbot kit if you want to try that out for yourself.
CHAPTER 5

The Jimu Robots Walking Vehicle

Jimu Robots can do all sorts of things, as long as they are built correctly along with the right programs. One of the more difficult aspects is building a robot that can walk.

One of our first accomplishments as children is learning to walk. None of us can remember that time, but as babies we learn how to properly put one foot in front of the other without falling over.

Without even knowing it, walking is a very complicated action. We can do it now without thinking, but when you set up legs with joints like a human or animal, you have to figure out how to move one leg without your whole creation falling over.

This chapter is going to detail how to create a Jimu Robot creation that can not only walk, but can do all kinds of other things as well.

Four-Legged Walker

This is the formula for creating a four-legged creation. You will note that the Servos are used for joints, as well as a way to make the creation turn as it is walking. It can be applied to the scorpion from Chapter 2, and can be used on other creations as well.
Let’s start with getting the power switch ready in the first three steps. It begins with putting a C11 on the Main Control (MC) Box as shown in Figure 5-1, along with the P48 fasteners.

**Figure 5-1. The first step of the four-legged walker**

Two 9 hole P23 beams should then be put on the fastener pegs, and then another set of fastener pegs (the long form, P47) can be put in as shown in Figure 5-2.

**Figure 5-2. The second step of the four-legged walker**
The P80 Switch can then be snapped into place on the P47 fasteners, and then the W4 wire can be attached at the proper port as in Figure 5-3.

**Figure 5-3. The third step of the four-legged walker**

Now that the MC Box is taken care of, it is time to turn our attention to building the steering controls for the legs. Start by putting on the C4 connectors as shown in Figure 5-4.

**Figure 5-4. The fourth step of the four-legged walker**
The next step involves the two Servos of ID-05 and ID-08 connecting the W1 wires as shown in the AB slots. Also put on the C4 connectors as seen in Figure 5-5.

**Figure 5-5.** The fifth step for the four-legged walker
Go ahead and slide on the Servos from Step 5 as shown in Figure 5-6. Put ID-08 on the side with the Switch, and plug the W1 wire into Port 5. Then plug the W1 wire from ID-05 into a Port from 1-3.

Figure 5-6. The sixth step of the four-legged walker

It is time to switch off to another part of the walker, starting with the first pair of legs. Go ahead and put the C1 and C2 connectors on the C14 connector as shown in Figure 5-7.

Figure 5-7. The seventh step of the four-legged walker
Now it is time to put in the two Servos of ID-01 and ID-02 as shown in Figure 5-8, with the W3 wires in the ports as shown. Put on the C5 connectors at the ends of the Servos as shown. The triangle on the spinning square will be pointed up into the C1 and C2 connectors.

**Figure 5-8.** *The eighth step of the four-legged walker*

Attach ID-13 to ID-01 and ID-14 to ID-02, along with the W3 wires, as shown in Figure 5-9.

**Figure 5-9.** *The ninth step of the four-legged walker*
Put on the W2 wires to the Servos as shown, as well as the C3 connectors. You will need to put the circle on the spinning squares to the C3 tab.

*Figure 5-10. The 10th step of the four-legged walker*

Go on and put on the C15 connectors and put the C8 connectors on the C3 connectors, as seen in *Figure 5-11.*

*Figure 5-11. The 11th step of the four-legged walker*
The next step is identical to Step 7, with the C1, C2, and C14 connectors as shown in Figure 5-12.

![Figure 5-12. The 12th step of the four-legged walker](image)

Go ahead and attach the ID-03 and ID-04 Servos to the C2 and C1, as well as the W3 wires to those Servos (see Figure 5-13). Place the C5 connectors at the end of the Servos.

![Figure 5-13. The 13th step of the four-legged walker](image)
Go ahead and attach Servo ID-15 to the ID-03 and the Servo ID-16 to the ID-04, and connect the W3 wires, as shown in Figure 5-14.

![Figure 5-14. The 14th step of the four-legged walker](image1)

Attach the C3 connectors to the ends of the ID-15 and ID-16, as shown in Figure 5-15. Put the circle of the spinning square into the C3 first.

![Figure 5-15. The 15th step of the four-legged walker](image2)
Add on the C8 and C15 connectors as shown in Figure 5-16.

**Figure 5-16. The 16th step of the four-legged walker**

Attach the legs as shown in Figure 5-17.

**Figure 5-17. The 17th step of the four-legged walker**
Getting the Walker to Walk

Of course, if you have this walker, then you are going to want to make it walk. The way to do that is to make the Servos become the joints of these legs, and shifting them around causes them to take steps.

Stepping Forward

Go ahead and set up “My Models,” and make certain that all the directions of the Servo spinners line up. Be certain that the Servos are as straight as possible, and the way to do that is by going into “Actions” and set them all to zero, as seen in Figure 5-18. You should probably save the action to something easy to remember and descriptive, like “Stand Up Straight.”

Figure 5-18. A way to get the “straighten the legs” for the walker
The next step is to prepare the walker for its first steps. The issue is that you need to alternate the leg positions in order to simulate walking. One of them is to make the legs lean back. The way to do that is to make them bend at an angle. Set ID-02, ID-03, ID-13, and ID-16 to –30 degrees and ID-01, ID-04, ID-14, and ID-15 to 30 degrees, as shown in Figure 5-19. Save the move as “Lean Back” or something easy and descriptive to remember.

![Figure 5-19. How to get the walker’s legs to lean back](image)

From this position, you can adjust it to the next position required to take a step. What you will need to do is put the left legs in, and the right legs out. This means that the legs on the left side of the walker will slant inward, while the legs on the right side of the walker will slant outward. It is as easy as adjusting ID-01 and ID-15 to –30 degrees and ID-03 and ID-13 to 30 degrees, as seen in Figure 5-20. It can be saved as “Left In/Right Out” or “L In R Out.”
The next step is to lean all legs forward, which can be done by adjusting ID-04 and ID-14 to ~30 degrees and ID-02 and ID-16 to 30 degrees. Save it as something like “Forward Lean,” as seen in Figure 5-21.

**Figure 5-20.** The instructions for “Left In Right Out”

**Figure 5-21.** The way to set your walker’s legs for “Forward Lean”
So to get the walker to take steps forward, just hit the buttons of “Lean Back,” “L In R Out,” and “Forward Lean.” You can write an action that will link these steps together as seen in Figure 5-22.

**Figure 5-22.** A way to link action steps so the walker can take a step forward
Step Backward

In case you want your creation to walk backward, you will need to program a step with the left feet in and the right feet out. Just start with the “Forward Lean” and then program an “L Out R In” function as seen in Figure 5-23. Just adjust ID-03 and ID-13 to -30 degrees and ID-01 and ID-15 to 30 degrees.

Figure 5-23. A way to program the walker to move backward

Making the walker travel backward is as simple as commands of “Forward Lean,” “L Out R In,” and “Back Lean.” You can then link up the commands as well.

Turning

As you can see, the walker is pretty one-dimensional in its movement, capable of only going forward and backward. However, you want a walker that can walk around, capable of turning to the left or right. I’m sure that you have noticed that I have not addressed the two Servos that have appeared at the beginning of the legs with ID-05 and ID-08.
One good way to do a turn is to get a set of legs to swivel, and then have that set of legs move. In this case, the front legs can be moved by turning Servo ID-08 at -45 degrees. Just make certain that you are in "Forward Lean" mode, and then adjust it as seen in Figure 5-24.

![Figure 5-24. Setting the walker to turn](image)

You will then need to put just the front right foot forward, which can be programmed by moving ID-01 to -30 degrees, and then ID-13 to 30 degrees, as seen in Figure 5-25.

![Figure 5-25. A way to make the walker step forward and turn](image)
You should be able to program the right leg to move forward as well. Just go to the "Actions" and adjust ID-02 to 30 degrees and ID-14 to –30 degrees.

You will notice that your walker will take a step to the right, and you can keep going and hit the "Stand Up Straight" button when you have the proper direction where you want the walker to face, as in Figure 5-26.

Figure 5-26. A way to continue turning the walker
There are other ways to do turning, like using the back legs and moving backward. Just make certain that it turned 45 degrees, as shown in Figure 5-27.

Figure 5-27. A way to turn walker by turning its back legs

This is another one of those times where I have given you the steps to succeed, and you will need to figure out which way to go. I have already shown you how to move forward and turn, so just move backward and turn the other way.

Summary

Jimu Robots kits are set up with the Servos necessary in order to build creations that can literally walk. All is necessary is to make legs that can support your creation’s weight, and then program them to move in order to take steps backward and forward. To make your creation turn, it is necessary to put in some kind of joint in the legs. Applying the proper action steps to make the walker move forward, backward, and turning will enable it to come to life as it will be able to move freely on an even surface.
CHAPTER 6

Advanced Programming Techniques

Since the previous chapters laid the foundation for building your own Jimu Robot and making it move, this chapter covers the capabilities of coding on the Jimu app. Coding is the actual letters and numbers that form commands that make up every program, whether it is run on your computer or your smartphone/tablet. Many programs have lines of code that run in the millions.

Jimu uses Blockly coding, a drag and drop language created by Google. Each block is accessed from the side of the screen and dragged to the main working area, where the block will serve its purpose. Like pieces of a puzzle, the programming blocks link together to form code, which enables the user to do all kinds of actions. Whether it’s your first time coding or you have previous experience, Blockly is a fun way to learn coding techniques while playing with your Jimu.

Accessing the Coding Screen

To access the Coding screen, just open the model you want to work with (it can be an Official Model or your own creation), and then tap the Coding button located between Actions and Controller. Your Coding screen should look like the screenshot in Figure 6-1.
You can see that there are a lot interesting of things that you can do, thanks to the buttons. Before I get to the buttons on the left, let me talk about the buttons in the upper right, which I will detail from left to right.

1. Save: When you are finished creating a program, you can click on this floppy disk button and save it, where you can type in a Project name, as you can see in Figure 6-2.
2. Open: This will allow you to open a program that you have saved in the past, and it will display all the coding programs that you previously saved, as shown in Figure 6-3.

![Figure 6-3. Opening a program in coding](image)

You will note that there is a “plus” sign in the upper right corner, which allows you to open a new program, where you will open a new screen like Figure 6-1. As for the pencil in the upper right corner, this will allow you to remove programs by clicking on the trash can buttons, as seen in Figure 6-4.

![Figure 6-4. How to remove projects in coding](image)
3. Code: This will allow you to view any code you create as a Swift code, and an example of this is in Figure 6-5. You can then copy and paste this code to be used elsewhere.

![Swift code example](image)

**Figure 6-5.** Turning a program into code

4. Bluetooth: If you are not connected to your Jimu via Bluetooth, this button will be red. Pressing it will allow the setup for Bluetooth once more, where it will turn Blue, but we have already discussed this process in Chapter 2.

5. Help: This will reveal what the buttons on the left do, also known as the programming blocks, which I will detail more in this chapter. However, you might want to press that button if you need a refresher and do not have this book handy.

### Programming Blocks

The coding program works by taking out blocks and dragging them together so they work together. The blocks connect to each other depending on their shape, and can be discarded by dragging them into the trash can. You will note that they have notches in them like puzzles pieces, but not all notches will fit together.

These are the basic programming blocks and their functions:

- **Start:** These green blocks are used for activation.
- **Moves:** These blue blocks allow specific control of the Servo rotation and Actions.
• Control: These purple blocks allow certain actions to occur, mostly with specific conditions.
• Events: These orange blocks are programming catalysts that begin functions with the use of tilting, Sensor activation, and more.
• Show: These green blocks allow your program to play sounds and control LEDs.
• Sensor: These yellow blocks are for the Sensor’s conditions.
• Math: This will allow all kinds of arithmetic functions for your program, including the use of integers and logic.

These blocks have several types, which I will detail as follows with examples.

Start
There are five different functions for “Start”, as you can see in Figure 6-6.

![Figure 6-6. The functions for the start](image)

**Click Run to Start**
The Click Run to Start block is necessary for any program, and it will always appear on the screen. You simply cannot write a program without using it, and what it does is exactly what it describes: Click Run to Start.

Yes, I should mention that once you have your programs all “blocked-out” and ready to go, you will need to hit the Run button in the lower left corner to get it going. Depending on how long your program goes, you will need to get it to stop.
For example, you will notice that two of the Start blocks have some interesting features to them. One of them is a controller for the Tilt controls, and the other is for the Touch Sensor.

**Phone/Tablet Tilt**

The Tilt activation allows you the user to do things to your Jimu Robots creation by simply tilting the smartphone or tablet. All you need to do is select the block, and then click on it to see Figure 6-7, and you will see controls for Tilt left, Tilt right, Tilt swing, Tilt up, and Tilt down.

![Figure 6-7. A way to manipulate the tilt controls](image)

We’ll discuss how to use these controls later, but the Tilt shift will make the program only work if it starts that way. For example, if you start it in Tilt left, then you will have to tilt the smartphone/tablet to the left to make anything happen. Otherwise, the program will not function at all even if you hit the Run button. By the way, Tilt swing is design to initiate and action when the smartphone or tablet is flipped over.

**Touch Sensor**

The Touch Sensor gives you another way to interact with your Jimu Robot using the Touch Sensor that was discussed briefly in Chapter 1. You can do single, double, or hold tap/touch to initiate coding sequences. Like the Tilt shift, nothing will happen unless the button is properly engaged.

You will notice in Figure 6-6 that this particular block is colored gray, while the others are emerald green. That is because I didn’t have the Touch Sensor connected to the Jimu Robot MC Box. This is a pattern that you will notice for other hardware accessories as well.
IR Sensor

The IR Sensor command is made for the IR Sensor, which will need to be connected to your model before you begin. If this is used, you can essentially program a function to begin when it comes close to the Sensor. You can program more than one Sensor, by the way.

You can set the Sensor to “less than or equal to” or “greater than or equal to.” You can then set the distance by hitting the number on it. You will then see a screen as in Figure 6-8.

![Infrared Sensor Setting](image)

Figure 6-8. The infrared Sensor controls

From here, you can adjust the length of the Sensor, and you can use your hand to test out the length of the Sensor detection. Like the Phone/Tablet Tilt block, this will only operate if the condition exists. For example, if it is set to less than or equal to 17, then it will not start if an obstacle is 18 units away.

Go To Start

The last function is the Go to Start, and this function comes in handy all the time. To put this at the end of any program will cause the program to loop, or continually run and not end until the user hits “Stop” at the Run button. While the program is running, the “Run” button will become a “Stop” button.

Moves

These blocks give specific actions for the model, like the adjustments that you can do on the Actions screen. You can see the three options available for these blocks in Figure 6-9, but there will be more if you have programmed specific actions. This is what you see in the programs of “Left Turn” and “Right Turn,” which were actions that I programmed earlier.
You will also see this particular screen when doing an action.

**Rotate Servos**

For using the “Rotate Servos” with ID:Angle during a certain amount of time, you can program the Servos to move at a certain angle for a certain time period.

For the sake of example, let’s do a “Run to Start” to the Rotate Servos block; you will see the screen of Figure 6-10.
You will note that it defaults to no particular Servo ID, to 400 ms. What you will need to do is click on the "ID:Angle," and you will go to this screen for Figure 6-11.

![Set rotation angle for servo motor](image)

**Figure 6-11. To set the rotation for the Servo motor**

What you can do on this screen is program a certain Servo (in our case, ID-09 or 12) to move at a certain angle, which we will do at 35 degrees. Just select the Servo that you want on the left side.

Keep in mind, that the Servos should be in Angle mode and not in Rotate mode, which was something that we discussed in Chapter 4. Any Servos not in Angle mode will not appear on the left side.

You can use the plus and minus signs to do the moving for you, but I found that these don’t adjust by single degrees, but a handful, perhaps 3 or 4 with every push. The other alternative is programming by variable, and we will discuss that when we get to the Math section.

You can then select the time period allowed, which will give you a screen similar to Figure 6-12.
You can set the value from 0 to 5000 ms, with it set to 80 ms as in our example. This will affect the speed of the turn on the Servo.

Keep in mind, that you can finish the coding and hit “Run,” and have nothing happen. This is because, technically, you will have already moved the Sensor to that angle.

**Rotate Servo**

The Rotate Servo 360 particular control is made for those Servos that move at 360 degrees, such as the ones on the wheels, as we discussed in Chapter 4.

For the sake of example, we’ll set up the Phone/Tablet, which always defaults to “Tilt left,” and use “Rotate Servo,” as seen in Figure 6-13. Don’t forget to put on the “Go to Start” at the end.
Go ahead and set up the Phone/Tablet for Tilt up, and then click on “Rotate Servo” to program that. You can make Servos move Clockwise, Stop, or Anti-clockwise by touching the button and seeing the screen on Figure 6-14.

Figure 6-13. Set up a program for rotate Servo

Figure 6-14. Setting the rotating mode
The Servos will need to be in Rotate mode (not Angle mode) for them to be selectable. You will note that you program the Servos to the speeds Very Slow (VS), Slow (S), Medium (M), Fast (F), or Very Fast (VF). By the way, you can program more than one to spin if you wish; there is a possibility of doing Servo 6 to Medium Anti-clockwise and Servo 11 to Fast Clockwise.

The program will then spin those Servos, provided it is tilted up and you hit “Run.” It will stop when it isn’t in the Tilt Up position anymore.

Run to Action

In addition to programming the individual Servos to move or spin, you can also tell your creation to perform a specific action with . . . well, Action.

We’ll go ahead and set up an IR Sensor Start, and default the ID-1 to less than or equal to 10. You can then set up the Run to Action moves, as well as a Go to Start as seen in Figure 6-15.

This will set up an action that we can program, which you need to program with this particular screen as seen in Figure 6-16.
You will need to flip the switch, which will make the Servos easy to turn, and you can put them in whatever position that you want, very similar to PRP as discussed in Chapter 1. You can then hit “OK,” and name this position, like “Good Pose,” as in Figure 6-17.

Now that the program is in place, it will go into that pose every time you have an obstacle in front of the IR-01 Sensor less than 10 units away, as established by the program.
Events

I realize that “Events” comes after “Control” on the list, but I have a reason for discussing this section first. The reason is that many of the Control blocks will not work without the Events. These particular functions fit really well into the first part of the Control blocks, creating a condition for the function that can be seen in Figure 6-18.

![Figure 6-18. The events screen](image)

Most of these Events are similar to the conditions of the Start blocks, the first being an exception.

Low Power

This is what happens when the battery on the Jimu Robots Main Control (MC) Box gets low and needs to be charged. This is very good at creating an indicator for when you are working with your Jimu Robot creation and the MC Box needs charging.

IR Sensor

This is where you can create a condition where a programmed Sensor will read something. It can be used for “greater than,” “less than,” “equal to,” and “not equal to,” with programming similar to the Start block.
Gyroscope

This is made for the gyroscope controls. You can set the Roll angle. At the time of this writing, I don’t have a gyroscope to test this out with. This is why that this particular block is in gray. The purpose of this particular function is to do something if the Jimu Robots creation is off-balance.

Tilt

This is made for Tilt controls, which we have previously discussed in this chapter, and can be programmed very easily.

Control

This is where you can command specific actions, and these will come in all kinds of interesting forms, as seen in Figure 6-19.

![Figure 6-19. What one can access with the controls](image)
If/Do tells the program to perform a certain action if something is performed on it. For example, let’s say you create a tilt control to make the four-wheel car from Chapter 4 go forward. Then all you need to do is use the If/Do to make it go. It only requires linking the If/Do with Events of Tilt up, and then set all the wheels on each individual Servo to rotate forward, as seen in Figure 6-20.

Figure 6-20. An If/Do control

Of course, the issue with this is that the only way to stop it is to literally hit “Stop” in the lower left-hand corner. You are going to want to stop this, which can be helped with the If/Else.
If/Else

This will perform a certain action if something is done. If that action is not done, then you can specify the program to run something else.

Let’s use the same four-wheel drive car, and use the same If/Else with the same beginning, but change the ending. The Else function will program the Servos to stop spinning if the phone/tablet is tilted some other direction than up. See Figure 6-21 to see how.

![Figure 6-21. An If/Else program](image)

Okay, that is giving you control, but it is clear that you want more; here’s a way to take complete control of the car with Tilt shifting.

While/Repeat

This tells the program to run a certain function, provided another function is running.

Now let’s say that you want to make your four-wheeled car go forward and backward, with tilt control. The first while condition specifies that the Servos will rotate so the vehicle goes forward when the phone/tablet is tilted up, but the second while condition specifies a downward tilt to get the Servos rotating the other way. This can happen with While/Repeat; just set it up like Figure 6-22.
Chapter 6  Advanced Programming Techniques

Now it is time to see if it is possible to take control of the car with only Tilting.

Repeat/Until

This will tell the program to run a function until another specific function starts running.

The way to get this function working is to use Repeat/Until, and feel free to use four If/Do Controls. The basic method is make it so tilting up moves the car forward, with tilting down to move backward. Then make the wheels on the left side spin in the opposite direction from the wheels on the right to create steering controls. You can see how it works in Figure 6-23, with the Tilt Swing (turning the phone/tablet upside down) used to end the program.

Figure 6-22. A While/Repeat program

Figure 6-23. A Repeat/Until Program
It might be a little complicated, but this is the type of program that you will need to construct in order to get your creation to do complicated things. By the way, this program was written by my 13-year-old son, who set it up within a half-hour after very quickly learning the coding method. Yes, it was Jimu Robots that allowed my son to teach me a thing or two about coding.

**Wait For**

This tells the program to wait for a specific action. In fact, the program will do absolutely nothing unless you give it an event. For example, I set up the Servos to spin when there is a Tilt Up motion in Figure 6-24.

![Figure 6-24. Wait For program](image)

**Repeat x Times**

For some reason, this program defaults to 3, but you can input up to 20. This will cause the same action to repeat × number of times, and then stop.

Here is an example of how to make the walker in Chapter 5 take two steps by combining a few steps together, as shown in Figure 6-25.
**Wait**

This is a simple function that just tells the program to wait a certain number of milliseconds, and absolutely nothing happens. I can't seem to input more than 9999 here and didn't see a need to put an example, as it kind of speaks for itself.

**Show**

With these particular controls you can do some very interesting things with sight and sound, as seen in Figure 6-26.
**Play Effect**

This is where you can play a sound from the smartphone or tablet, unless the Bluetooth speaker is hooked up. You can see in Figure 6-27 the variety of them, and I couldn’t show them all. Note that unless you click the switch for “delay,“ (located in the top left corner) you will only hear part of a sound effect when you attempt to play it.

**Figure 6-26.** What is seen for Show

**Figure 6-27.** How to set a sound effect
You will note that you can select from types of five sound effects, including:

**Animal**
Includes all manner of 15 animal sounds, which you can click and discover on your own, and they essentially what you would expect. The exception is the Giraffe, which sounds more like Homer Simpson than that tall ungulate.

**Machine**
This is named because it sounds like machines running a function of some kind, and you should check them all out.

**Emotion**
This includes some weird mechanical sounds that sound like an emotion, or actually what it would sound like if a robot had an emotion. It also comes with four default songs. Song 1 and Song 2 sounded like they were more recent hits, but Song 3 was definitely “London Bridge Is Falling Down” and Song 4 was “Yankee Doodle” on violin.

**Command**
These are different mechanical noises, and they sound like a command type of sound often made with a mechanical noise.

**Recording**
You can simply take a sound off of your own phone. All that is required is to hit the microphone and you can see it in the upper right corner. You will then see the sign of it recording and you can make the noise into your smartphone or tablet. As in Figure 6-28. If you don’t like your recording, you can select the trash can, and mark the sound you want to delete as well.
Play Tune

The Play Tune function will allow you to play some musical notes on a keyboard. To program a singular note, just click on it and you will see it as in Figure 6-29.

You can go ahead and string several notes together to make a tune, using the delay to help draw out the note.
Show Emoji

The final Show commands are for the Light Sensor. I briefly mentioned the Light Sensor in Chapter 1, and I didn’t really go into detail about what it could do.

This time, I want to talk about all of the neat things that it can do, provided it is connected to your MC Box. We will start with the emoji, and when you click on it, you will see this screen in Figure 6-30.

![Figure 6-30. The Show Emoji options](image)

You will note the emojis of Blink, Shy, Tears, Flashing Tears, Cry, Dizzy, but what you can’t see are six other options of Happy, Surprised, Breath, Flash, Fan, and Wipers. You can choose the color of red, orange, yellow, green, light blue, blue, purple, light purple, or white. On the Show Emoji choice, you can chose how many times it will go off.

The end result will create a kind of effect of an emoji on the circular Light Sensor, in whatever color that you desire.
Show Light Display

Of course, there are other ways to create a light display, and clicking the block for the Set Up Light Display will reveal this screen in Figure 6-31.

Figure 6-31. Set Up Light Display options

There are four options for the Set Up Light Display block that you can see:

- 7 Colored Lights: Generates a spinning pattern of lights with all of the colors
- Disco: A continuous blinking flash of lights
- Primary: Flashes the primary colors of light with red, green, and blue
- Color Stacking: A way of spinning the colors in a very creative way
Show LEDs

The Show LEDs block gives you the ability to set the color of the eight sections, and you can click on them (see Figure 6-32).

Figure 6-32. Options for Setting Light

You have the option for selecting a particular color for the section, including no color at all. From here, you can make your own patterns if you wish.
Sensor

This is where the Sensor can be used, as seen in Figure 6-33.

You will note that the first three of these options have a tab on them, which means that they plug into the number area. This is because they represent a certain numerical value, at least for the first three examples.

- IR Sensor ID reflectance between obstacle: This is the number in between the Sensor and the obstacle.
- Gyroscope ID Roll angle: This is the number of the gyroscope reading.
- Servo ID Angle: The angle number of the Servo spinning square.
- Set gyroscope ID all angle to zero degrees: A way of setting the gyroscope of whatever Sensor you have selected to zero, which is good at resetting your program.

*Figure 6-33. The Sensor function*
Math

This is where you can create all kinds of functions, as seen in Figure 6-34.

As you can see, there are a lot of options for what you can do with math.

**Integer Value**

Here, you can set the value of a constant integer to whatever you want, and plug it into another function. You have already seen how this works on other blocks, and it is very easy to get it to work here, so I don’t think I need to talk about it any further. What is interesting is how you can enter any number here and essentially plug it into any block later.

**Define Variable**

Here is where you can set the value of a variable. Not only that, you can rename this variable, not to mention creating a new variable.

**Assign Variable**

This is where you can set the integer value of the variable, and it can be a renamed variable or a new one altogether. Go ahead and get the Set Variable to 30 as shown in Figure 6-35.
Since you have that named, you can hit “New Variable,” where you can type out a name for it. Think of it as algebra, as you can name your variable anything, like “Shoe,” as seen in Figure 6-36.
Once that variable has been named “Shoe,” that means that anytime it is used, the value will be 30. So you can set the value of the Servo to this variable, for the ones that have to be in the position of forward lean. All that is required is setting up a Moves block and going to the program ID-01, ID-04, ID-14, and ID-15 to the variable, like in Figure 6-37.

![Figure 6-37. Set a variable on a Servo motor](image)

Of course, this setting of 30 degrees on those Servos won’t be enough to put the legs in forward lean, but there are several ways to fix that with variables.

**Variable Increase or Decrease**

This is where you can increase (via addition) or decrease (via subtraction) the numerical value of a variable by any value that you wish. In fact, you can even use other variables in equations with this function.

You recall that it requires a –30 degree angle to make some of the Servos work, so what you need to do is set the variable of “Shoe” to –30. There is another way, but all you need to do is subtract –60 from the 30 degrees until it becomes –30. Set ID-02, ID-03, ID-13, and ID-16 to “Shoe” in another Moves block, but add in the variable increase or decrease that you see here in Figure 6-38.
Perform Arithmetic

If you need to add, subtract, multiply, or divide, this is where you can do that. It is just simple math, and this is a way that you can set the proper Servos.

For example, you can just change the Servo IDs that you need to be –30 degrees by just setting the variable of “Shoe” to its negative value. All you need to do is set a value, and then Perform Arithmetic by multiplying –1 by the variable of “Shoe.” Set the variable by clicking on it, as seen in Figure 6-39.

Figure 6-38. Variable increase or decrease function

Figure 6-39. Perform arithmetic math function
Just set ID-01, ID-04, ID-14, and ID-15 to “Shoe,” and set ID-02, ID-03, ID-13, and ID-16 to “Sock.” Both options will be available to you in Moves, as seen in Figure 6-40. You can then use these variables to program the walker’s legs, if you wish.

Figure 6-40. Set a rotation angle with multiple variables

Random Integer

If you ever need some random integer for your program, this is where you can obtain it from.

For example, let’s say that you want the legs to be in a completely random angle, but you don’t want to go too far with this calculation. In that case, set a Random Integer like you see in Figure 6-41.
Figure 6-41. Setting a random integer

Set Minimum and Maximum Amounts

This will create a maximum or minimum amount in certain ranges. This is very helpful for when you don’t want your Servos to bend at a certain angle, but don’t want them to bend outside their bounds.

Determine Larger

This will allow you to create a function with inequalities. Not only is it good for greater than or less than, but also greater than or equal to, less than or equal to, or equal to and non-equal.

As an example of this, I used the Wait For control in combination with the Sensor readings for two of them. You can see in Figure 6-42 how it is the reading from ID-1 needs to be less than the reading from ID-2 in order to have the Servos spin.
Figure 6-42. *A determine larger math function*

**Truth**

If you know anything about truth tables, then you know what happens with and/or functions. This allows you to put one in your function. It is similar to the “determine larger” function, only you can use the “and” and “or” function.

**Not**

This is a way of establishing a truth statement using a “not.”

**Summary**

One of the best bragging points about Jimu Robots is that it teaches how to code. This is incredibly evident with the Coding function, which allows for a lot of combinations including Start, Moves, Control, Events, Show, Sensor, and Math.

Using the coding function is a lot like programming, which is helpful for all kinds of tasks in a technological age. It is highly recommended that you open up the Coding screen on whatever Jimu Robots creation that you are working on and seeing just what it can do. You might surprise yourself with what you can do with the Coding screen vs. the Action screen.
CHAPTER 7

UBTECH Forklift

The first six chapters have discussed the basics of model making and how to program them, with elementary creations like robots (Chapters 2–3), the wheeled vehicle (Chapter 4), and the walking creations (Chapter 5). Of course, you can build any type of creation that you want, but the challenge is how to build it strong, as well as programming it to do what you want with the use of the Servos and other programmable parts.

Sometimes you have to “think outside the box” when it comes to Jimu Robots parts. Yes, that metaphor has been done to death, but it really applies when it comes to constructing something in Jimu Robots that does not come with a set of prepared instructions. Such is the case for the forklift in this chapter.

One of the most popular models for a construction toy is a piece of construction equipment, like a crane, bulldozer, or other heavy piece of equipment that is common with a building under construction. For example, you might want to create a piece of useful equipment with a forklift, and the instructions here will show you how to build a forklift that can not only lift items but can even tilt back and forth. As someone who has worked with a real forklift around the back room, I can tell you that both features come in real handy.

The Forklift

It is somewhat difficult to get a forklift going because it involves building a track and getting something to move on it in a controlled fashion. However, just because it is difficult, it does not mean that it is impossible. One of the things that you will have to learn as a Jimu Robots builder is how to work within your limitations, creating something that perhaps the parts were not intended for, but can still be used do something new. This was the challenge with creating a forklift that can raise up its forks, but the tank treads allowed this to work.

You will want something to move these raising forks around, so you will need to start with the four-wheel drive vehicle from Chapter 4. Of course this is not the only type of wheeled mount that you can give your forklift, and I’ll let you create whatever improvements that you want to that.
What you have to do is remove the P72, the P22 beams, and the P35 parts in front. Also, take off the Switch from the front, and place it on its side. Go ahead and add on three P47 fasteners as shown in Figure 7-1.

**Figure 7-1.** Step 1 of the forklift
Go ahead and get two P21 beams and put on the P48 fasteners as shown in Figure 7-2.

**Figure 7-2.** Step 2 of the forklift
Take a C8 connector and snap it on each side, which will hold the P21 beams firmly in place. Don’t forget to attach the P48 fasteners as seen in Figure 7-3.

Figure 7-3. Step 3 of the forklift
Put on the P48 fasteners as shown in Figure 7-4, and slide on the C4 and C15 connectors.

**Figure 7-4.** Step 4 of the forklift
Slide on a C14 connector, then put on the P48 fasteners as shown in Figure 7-5.

Figure 7-5. Step 5 of the forklift
Snap on the P37 beams and put on the P48 fasteners as shown in Figure 7-6.

**Figure 7-6.** Step 6 of the forklift
Add on the P38 beams as well as the P24 beams, to create some strength for the lift, as shown in Figure 7-7.

Figure 7-7. Step 7 of the forklift

The rest of the instructions will focus on the actual forklift portion, as we start with the P86 gear and put a P99 axle through the center of it. Center the P47 fasteners and put a P67 on one side, as shown in Figure 7-8.

Figure 7-8. Step 8 of the forklift
Snap on a C11, and slide on a P91 with two P48 fasteners, as shown in Figure 7-9.

![Figure 7-9. Step 9 of the forklift](image)

Get out two Servos, and put the C16 and three fasteners on the ID-05 as seen in Figure 7-10. Put Steps 7–9 on them as shown, with the C11 on the ID-06 spinner square, and center the P48 on the three holes. Go on and plug in the W1 wires into the Servos.

![Figure 7-10. Step 10 of the forklift](image)
Go ahead and slide the C5 and C15 connectors on the Servos, as shown in Figure 7-11.

**Figure 7-11.** Step 11 of the forklift
Snap on the C15 connectors on each side, with the C5 connectors as shown in Figure 7-12.

**Figure 7-12. Step 12 of the forklift**

Put on the C15 and C5 connectors. Go ahead and snap on the C20 connectors on the end of the big structure, as seen in Figure 7-13.

**Figure 7-13. Step 13 of the forklift**
Go ahead and put aside Steps 8–13 for now and set up these new parts. Insert the P47 fasteners in the P86 gear as shown in Figure 7-14.

**Figure 7-14. Step 14 of the forklift**

Put P67 parts on the opposite sides of the gear, and center the P53 as shown in Figure 7-15.

**Figure 7-15. Step 15 of the forklift**
Put on the section from Steps 14–15 with two C11 connectors, and then put on two other C11 connectors with the P47 and P48 fasteners as shown in Figure 7-16.

**Figure 7-16. Step 16 of the forklift**

Snap on the C8 connectors with the P48 and P49 fasteners, and put on the P38 and P47 and P48 fasteners as shown in Figure 7-17.

**Figure 7-17. Step 17 of the forklift**
Put on the P22 beams, and then put the P47 and P48 fasteners on them as shown in Figure 7-18.

Figure 7-18. Step 18 of the forklift

Put on the P24 beams, and put on the P48 fasteners as seen in Figure 7-19.

Figure 7-19. Step 19 of the forklift
Connect the P22 beams, and then put on the P48 fasteners as shown in Figure 7-20.

**Figure 7-20.** *Step 20 of the forklift*

Put on the P22 beams, and put on the P48 fasteners as shown in Figure 7-21.

**Figure 7-21.** *Step 21 of the forklift*
Put on the P23 beams on the sides, and then the P20 beam on the end. Don’t forget to add P47 fasteners as shown in Figure 7-22.

**Figure 7-22. Step 22 of the forklift**

Put on the 65 treads on the gears. Slide on the axles, and then snap on the P49 fasteners as seen in Figure 7-23.

**Figure 7-23. Step 23 of the forklift**
Snap on the three P20 beams, and put on the P47 and P48 fasteners as shown in Figure 7-24.

Figure 7-24. Step 24 of the forklift

Slide on the P70, and put on the P48 fasteners and the P100 parts as shown in Figure 7-25.

Figure 7-25. Step 25 of the forklift
Snap on the P38 L-shaped beams, and put the P48 fasteners on that. Put on the P25 beams and P47 fasteners as shown in Figure 7-26.

**Figure 7-26. Step 26 of the forklift**

Put on the P24 beams in order to lock that assembly together. Put on the four P26 beams on the sides, and add the P23 beams on top of that. Don’t forget the P48 fasteners in Figure 7-27.

**Figure 7-27. Step 27 of the forklift**
Put on the P25 beams, and attach the P24s using the P48 fasteners as shown in Figure 7-28.

Figure 7-28. Step 28 of the Forklift

Put on the P25s and attach the P48 fasteners, as seen in Figure 7-29.

Figure 7-29. Step 29 of the forklift
Put on the P21 and P23 beams and then put on the P48 fasteners, as shown in Figure 7-30.

**Figure 7-30.** Step 30 of the forklift

Put on the P21 beams, first making certain to attach the P26 beams to them. You can see an example in Figure 7-31.

**Figure 7-31.** Step 31 of the forklift
Put on the P35 L-beams along with the P48 fasteners, as shown in Figure 7-32.

Figure 7-32. Step 32 of the forklift

In this final step, put on the P21 beams on the P35 parts. The bottom part with the Servos will lock into place on the four-wheeled vehicle. Attach the forklift to the 4-wheeled construction, as shown in Figure 7-33, and don’t forget to plug in the W1 wires to the MC Box at whatever port that you choose.
Getting the Forklift to Work

The best part about getting the forklift to work is that it requires all of the controller functions to work.

The first is the four-wheel drive vehicle, which is something that we discussed in Chapter 4.

The second is how to lift the forks. What you need to do is set up Servo ID-5 with the vertical slider, as seen in Figure 7-34.
Once you have brought out the vertical slider, you will need to tap it to set up Servo 5. You will need to set it up to be a certain mode (rotates 360 degrees), as shown in Chapter 4, and then select Servo 5.

You will need to set up the Servo rotation for whatever you like in the next screen that will appear, as shown in Figure 7-35.

*Figure 7-34. A way to take control of the raising of the fork*

*Figure 7-35. Setting the direction of rotation*
Once that is set up, you can simply use the controller to raise or lower the forks. You will have to make certain that you don’t go too high or too low, and you also don’t want to put too much weight on the forks.

Now, when it comes to making the forks lean, you can also use the controller. What you need to do is bring out the horizontal slider, as you can see in Figure 7-36.

Figure 7-36. The angle controller

Go ahead and select the proper Servo, which would be ID-06. What you need to do is adjust the minimum angle on the left side with the circle, and hit the “Set as minimum value” button. You can then do the same on the right side with the circle, and hit the “Set as maximum value” button, like in Figure 7-37.
Once you hit “Confirm,” you will see the range of the angles on the controller, as seen in Figure 7-38.

Figure 7-37. Setting the angular range for a Servo

Now that you can set the controller, you can make the forklift go where you want and raise the forks. You can even tilt the motion of the forks for subtlety.

Figure 7-38. The angle range for the controller
Summary

One of the great things about Jimu Robots is the ability to create just about anything. The forklift can be a challenge, as it requires using a tank tread in an unorthodox fashion, but it does work.

As a Jimu Robots creator, you will need to figure out how to make your creations work and take proper control. You might want to get your mind going as to how to create a bulldozer, or, if you really want to think outside the box, try to make a crane.
In addition to the robot vehicles and other things that I have taught in this book, I thought it would be good to spotlight another project that many will want to do: the robotic hand or robot hand.

This one I will have to admit was not my idea, but something that I saw when I visited UBTECH on a trip to Los Angeles. There was something about a robotic hand that I have always loved, and science fiction films often have characters with bionic hands that I believe inspired real-life prosthetic devices.

A good example of the robotic hand in fiction is the Disney movie *Treasure Planet*, the company’s 2-D and 3-D hybrid that was a science-fiction version of Robert Louis Steveson’s classic *Treasure Island*. In that film, the sympathetic villain Silver had a mechanical hand that looks a lot like this one.

The advantage of this robot hand is that the user can hold it and work it as if it is his or her own hand. Granted, you will have to use the smartphone or tablet to work it, so it’s kind of using your own hand to work another hand. Yes, it is impractical, but the end result is still kind of neat in its own way. Best of all, it is very easy to program once the Robot Hand is constructed.

### Constructing the Robot Hand

Creating a robot hand is all about getting the fingers right, along with the thumb. For those who want to use this new limb, it has to be made strong so the user’s real hand can grab it.

You will note that in these instuctions, I don’t specify what numbers of Servos you should use for the “fingers” and “thumb” of this robotic hand. This is because it really doesn’t matter, and I figure that by now you can figure out how to program these yourself. I will let you decide which ones you want to use, and I have given instructions on what to do if you have duplicate numbers of Servos.
Start with getting out the Main Control (MC) Box, and put on the P47 and P48 fasteners as shown in Figure 8-1.

![Figure 8-1. Step 1 of the robot hand](image)

Go ahead and snap on the P21 beams, and then put on the P48 fasteners as seen in Figure 8-2.

![Figure 8-2. Step 2 of the robot hand](image)
Put on two C8 connectors as shown, and put on the P47 fasteners and the P22 beams as shown in Figure 8-3.

Figure 8-3. Step 3 of the robot hand

Snap on the C8 connectors as well as the the nine P48 fasteners on each of them, as shown in Figure 8-4.

Figure 8-4. Step 4 of the robot hand
Once you place the P21 beams as shown, the C8 connectors will be on very strong. Go ahead and put on the four P48 and six P47 fasteners on the front of the MC Box as shown in Figure 8-5.

Figure 8-5. Step 5 of the robot hand

Put on the P35 L-Shaped beams on the fasteners from the last step as shown. Then put on the P48 fasteners as shown in Figure 8-6.

Figure 8-6. Step 6 of the robot hand
Go on and put on the P22 beams, with the P47 and P48 fasteners as shown in Figure 8-7.

Figure 8-7. Step 7 of the robot hand

Put on the P20 beams and the P47, P48, and P53 fasteners. Don’t forget to put on the C4 connector as shown in Figure 8-8.

Figure 8-8. Step 8 of the robot hand
Put on the P35 L-beams with the P47 and P48 fasteners, as shown in Figure 8-9. Don’t forget the C6 connector.

Figure 8-9. Step 9 of the robot hand

Put on the P23 and P24 beams, and then put on the P48 and P53 fasteners as shown in Figure 8-10.

Figure 8-10. Step 10 of the robot hand
Put on the C5 and C11 connectors, as shown in Figure 8-11.

Figure 8-11. Step 11 of the robot hand

Snap on the two styles of P22 beams as shown in Figure 8-12, and put on the P48 fasteners.

Figure 8-12. Step 12 of the robot hand
CHAPTER 8 • THE JIMU ROBOTS ROBOT HAND

Put on the C8 and C15 connectors as shown in Figure 8-13, and put on the P48 fasteners as well.

![Figure 8-13. Step 13 of the robot hand](image)

Put on the P35 L-beams, and you can see where to put on the P47 fasteners as seen in Figure 8-14, to join together strong.

![Figure 8-14. Step 14 of the robot hand](image)

212
Go ahead and put on the P23 beams and the P48 fasteners as shown in Figure 8-15.

**Figure 8-15.** Step 15 of the robot hand
Place the P21 beams with the P48 fasteners as shown in Figure 8-16.

**Figure 8-16.** Step 16 of the robot hand
Go ahead and put on the P67 3 × 3 Squares, and then put on the P26 beams. Attach the P80 Switch and the W4 wire, as well as the C14 connector as shown in Figure 8-17.

Figure 8-17. Step 17 of robot hand
Turn over the creation, and put on the C1 and C2 connectors on one side as shown in Figure 8-18. Plug in all of the W1 wires in every port except Port 6.

Figure 8-18. Step 18 of the robot hand

Time to put on the Servos. It is important to put the Servos on the C1 with the circles first in the slot, and the Servos on the C2 with the squares first in the slot. Connect the wires as shown in Figure 8-19, along with the C5 connectors.
Put on the C15 connectors and the C5s in between. Put on the C3 connectors at the end of those as shown in Figure 8-20.

**Figure 8-19.** Step 19 of the robot hand

**Figure 8-20.** Step 20 of the robot hand
Time to put on another set of Servos, and all four of them need to have their triangle side flush. Don’t forget to add the W1 wires and C5s as shown in Figure 8-21.

Attach the C1 and C2 connectors as shown, along with the C15 and C5 connectors as shown in Figure 8-22.
Put on the Servos as shown in Figure 8-23. It is important to put the Servos on the C1s with the circles first in the slot, and the Servos on the C2s with the squares first in the slot.

Figure 8-23. Step 23 of the robot hand
Attach a Servo on the C6 connector as shown in Figure 8-24. Put the C7 on, and make certain that the square side is flush with the slot.

**Figure 8-24.** Step 24 of the robot hand
Put on another Servo with the triangle flush with the slot on the C7, and then add the C4, C5, and C15 as shown in Figure 8-25.

**Figure 8-25.** Step 25 of the robot hand
Put the P79 rubber pads on the C8 connectors with the P48 fasteners. Then slide these on the Servos as shown in Figure 8-26.

![Figure 8-26. Step 26 of the robot hand](image)

**Programming the Robot Hand**

By now, you should be able to see that these collections of Servos form the fingers and thumb. As a user, you can pick up this right hand by clenching your fingers around the beams formed in steps 15–17, with your fingers pressed up against the C14 connector. Try it for yourself, and you will see how well it works.

The best way to program these fingers is by using the PRP. This will allow you to bend the fingers in the direction that you want them to, so you can form a fist, point with the index finger, as well as making motion gestures like waving (flexing all fingers at once).

I’m going to let you figure out how to do that, because it is as simple as hitting the PRP record button and flexing the fingers to the proper places. I was able to program these fingers in a few minutes, and you can definitely make more complex things with the programming skills in Chapter 6.

**Summary**

Creating the robot hand is really all about making a solid structure, and then using the Servos as knuckles or joints. Programming it is even simpler with the PRP function, and there is a lot to be done with it.
Index

A
Advanced programming techniques
  arithmetic math function, 175–176
  assign variable function, 172–174
Coding screen, 145–148
  definition, variable, 172
  determine larger math function, 177–178
  integer value, 172
  LEDs, 170
  math functions, 172
  Play Tune function, 167
  programming blocks (see Programming blocks)
  random integer, 176–177
  Sensor, 171
  set minimum and maximum amounts, 177
  Set Up Light Display, 169
  Show Emoji command, 168
  sound
    animal sounds, 166
    command type, 166
    emotion, 166
    machine, 166
    recording, 166
  truth tables, 178
  variable increase/decrease function, 174–175

B
Builderbots Kit, 20, 35
Buzzbot models, 23

C
C6 connectors, 93, 113
C8 connectors, 93, 109–112
C11 connectors, 96–98, 118
C20 connectors, 99
Character parts, 4
  connectors, 14

D, E
Disassembly tool, 13

F, G, H
Fasteners, 12
  Forklift
    angle controller, 202
    angular range for Servo, 203
    C5 and C15 connectors, 188, 189
    controller functions, 200–201
    direction of rotation, 201
    P20 beams, 195
    P21 beams, 181–182, 198–199
    P22 beams, 192–193
    P23 beams, 194, 196, 198
    P24 beams, 186, 192, 196
    P25 beams, 196–197
    P26 beams, 196, 198
    P37 beams, 185
    P38 beams, 186
    P38 fasteners, 191
    P47 fasteners, 180, 186, 190, 191, 195, 196
    P48 fasteners, 181–184, 187, 191–199
For lift (cont.)
  P49 fasteners, 191, 194
  P35 L-beams, 199

I
ID-14 Servo, 95
Inventor Kit, 25, 40

J
Jimu Main Control (MC) Box, 82
Jimu Robots
  actions, 84
  application, 38
  axles, 8
  beams, 4–5
  Builderbots Kit, 20
  Buzzbot and Muttbot models, 23
  character parts, 4
  community, 39
  connectors, 14–15
  creations, 37, 38
  cross blocks, 9
  fasteners, 12
  flats, 7
  gears and wheels, 11
  kits, 36
  LED light, 18
  model of, 77–84
  raise the claws (PRP), 88–90
  scorpion claw movement (drag and drop), 85–86
  Servos, 90
  spin the scorpion claws (drag and drop), 86–88
  sting, 90
  Tankbot set, 11
  wings, 6
  wires, 19
Jimu Robots vehicle
  controller screen, 102–104
  controls, four-wheeled vehicle, 125
  four-wheel drive vehicle, 108–119
  scorpion robot, 91
  servos and P116 part, 125
  servos with same number, 120–124
  tank treads, 91–101
  vehicle type, 106
walking vehicle
  accomplishments, 127
  four-walker instructions, 127–136
  step backward, 141
  stepping forward, 137–140
  turning, 141–144
  wheeled control, 104
  wheel mode, 105–106
  wheels, 107

K
Karbot Kit, 29, 37

L
LED light, 18

M, N, O
Main Control (MC) Box, 3, 16, 18, 37, 66, 206
  battery, 38
  Muttbot models, 23

P, Q
P24 beams, 100
P25 beams, 92
P26 beams, 67
P48 connectors, 41, 54, 66
P49 connectors, 60
P34 Cross Blocks, 55
P47 fasteners, 49–50, 92, 100
P48 fasteners, 50, 92, 97, 99–100, 109–111, 115, 118
P86 Gear, 96, 97
Pause, Record and Playback (PRP)
  method, 84
Programming blocks
  Click Run to Start block, 149
  control, 159
  events, 158
  and functions, 148
  Go to Start function, 151
  gyroscope control, 159
  If/Do control, 160
  If/Else program, 161
  IR Sensor, 151, 158
INDEX

low power, 158
move function, 151–152
Phone/Tablet Tilt, 150
Repeat × Times program, 163–164
Repeat/Until Program, 162
Rotate Servos, 152–156
run to action program, 156–157
show program, 164–165
start function, 149
tilt controls, 159
touch sensor, 150
Wait For program, 163
wait program, 164
While/Repeat program, 161–162

R
Robot hand
C5 connectors, 211, 218
C6 connector, 220
C8 connectors, 212, 222
C11 connectors, 211
C15 connectors, 212, 217, 218
Main Control (MC) Box, 206
P20 beams, 209
P21 beams, 206, 208, 214
P22 beams, 207, 209, 211
P23 beams, 210, 213
P24 beams, 210
P26 beams, 215
P47 fasteners, 206, 207, 209–210, 212
P48 fasteners, 206–214, 222
P53 fasteners, 209, 210
P35 L-beams, 210, 212
PRP, 222
Servos, 216, 218

Robotic Servo Motors, 17
Rubbery P28s, 55
Rudder, 17

S
Scorpion
back legs, 41–43
body, 66, 68, 71–72, 75
front legs, 45
left claw, 57–59
right claw, 62, 63, 65
tail, 46, 51, 54
Servo spinner, 57
STEM education
definition, 1
Jimu robots and LEGO, 3
LEGO Mindstorms, 3
LEGO technic, 3
rubber pieces, 10
Technic/MINDSTORMS editions, 2
UBTECH, 1

T
Tankbot kit, 10, 33

U, V, W, X, Y, Z
UBTECH Jimu Robots
color, 37
construction kits, 37
instructions, 38
Model button, 39
scorpion, 40
servos and wires, 37