Build The Ultimate Robot

Base Assembly

By Michael Simpson

Figure 1

Last month I showed you how to build the wheel assemblies for both the Firebot and the Megabot. This month I will show you how to build the main base assembly for both bots. Keep in mind that the dimensions and hole sizes given are based on the RS-64 actuator used on the Megabot and the RS-28 used on the Firebot. You are free to change these actuators, but some of the dimensions and hole locations may need to be changed accordingly.

In this series of articles the final robot is not as important as the journey that we take to get there. Many of you won't build the exact robots I outline in this series, but will instead take some of the techniques I present here and apply them to your own

creations. With that in mind, I want to go over some of the tools I used for this portion of the project.

Tool Used in Construction

Someone once said to me, “I don’t want a woodworking project I just want to build robots.” I’m sorry, unless you purchase a pre-fabricated kit; you have to dabble in woodworking, metalworking, or both. Many of us use woodworking as the materials and tools are readily available and inexpensive. Woodworking tools also work very well for many plastics.

Whether you prefer woodworking or metalworking, there are two tools that will prove indispensible when building robot projects.

Portable Drill

The portable drill like the one shown in Figure 2 is probably the most versatile tool in your arsenal. I don’t know of a single robot I have built that I did not use a drill to create a hole of some sort. Modern portable drills are very powerful and loaded with features.

Figure 2

Let’s take a look at some of the features to look for when purchasing a portable drill.

- Keyless Chuck
- Reversible Motor
- Variable Speed
- Adjustable Clutch
- High and Low Gear Settings

If you get a drill with high and low gear settings you can use it to drill and grind as well as drive nuts, bolts and screws.

A quick change driver set like the one shown in Figure 3 is the most used accessory on my drill. It allows you to drill and counter sink in a single operation. You then flip the bit and drive the screw.

Figure 3

If you can't afford a drill press or don't have the space, then this little $2 gadget will help you get great results from your portable drill. It's a simple round bubble level that sits on the back of your drill as shown in Figure 4. When drilling into a piece of wood, if you keep the bubble in the center your hole will be nice and straight. It really does help. I have seen these at woodworking centers and in a few home centers.

Figure 4

Portable Jig Saw

The next tool that you will find very useful is the jig saw. While in the past I have always used wired jig saws, I have found the newer cordless saws like the Ryobi shown in Figure 5 to be almost as powerful as a wired model. I can't tell you how many times I have pulled the plug out of the wall while cutting a piece of plywood. With this beauty it won't happen again.

Figure 5

Things to look for when purchasing a jig saw (portable or wired)

- Adjustable Orbital Setting
- Variable Speed Setting
- Toolless Blade Clamp
- 3/4" Blade Stroke
- Laser Guide

Most of the features above are self explanatory but I feel it's important to point out the value of the variable orbital setting. We all know that the blade in the jig saw goes up and down. The amount it moves up or down is called the stroke. The more stroke the more efficient the cut and the less wear on the blade. In an orbital saw the blade also moves forward during the upstroke and back during the down stroke. This allows the blade to make a more aggressive cut. So why would you want an adjustable orbit? It's simple, the more aggressive the cut the rougher the cut. With the orbit set to maximum it makes for a very splintered cut. When cutting finer materials you will get a better cut

with the orbital option turned off. When cutting metal I also use the minimum or non orbital option.

If you plan on using your jig saw on metals and plastic it's also important that you get a variable speed saw.

What Brands

I own many very expensive portable drills and most will do the job you need in robotics. As long as it has the features you are looking for it comes down to cost and how it feels in your hand.

I chose the Ryobi models for this project because they use an 18V li-Ion battery that I hope to utilize to power one of my robots. The battery is the most expensive part of the Ryobi system so once purchased the tools themselves are very inexpensive. The jig saw can be purchased for $49.95 from Home Depot. Li-Ion batteries aren't cheap. The one shown in Figure 7 will cost you $89.95. It's better to get them as part of a tool kit.

I will look into the Ryobi battery in more detail next month as we put one to use in our bot.

Figure 6

Other Tools

You will need a small set of screwdrivers like the ones shown in Figure 7. Both Philips and slot types, in at least two sizes are recommended. A set of needle nose pliers and diagonal wire cutters like the ones shown in Figure 8 will come in handy. There are times when you won't have a socket or wrench to fit a nut and you will be very happy to have the needle nose pliers.

A set of small sockets and wrenches will make your life a lot easier. Don't get a large automotive set. Most home centers and hardware centers will have small kits like those shown in Figure 9.

Figure 7

Figure 8

Figure 9

Firebot Base Construction

Let's start with the Firebot construction since it is the simplest.

Step 1

The Firebot has a round base that is exactly 11-1/8" in diameter. I made mine out of 1/8" thick hardboard that I picked up at my local home center for a couple of dollars. In the end we will have a lower base and an upper base so cut out two circles. Once cut, you can paint the base for a more refined look. I painted mine Blue.

Step 2

Next, you need to make a couple of cutouts and drill some holes. This is best done with a template like the one shown in Figure 10. The best thing to do is to photocopy the template and enlarge it so the length is 11-1/8 long. I am referring to the white portion of the template.

Cut out the template and place it over the piece of hardboard that will become the lower base and mark the cutout and holes to be drilled. Then flip it over and mark the other side of the robot.

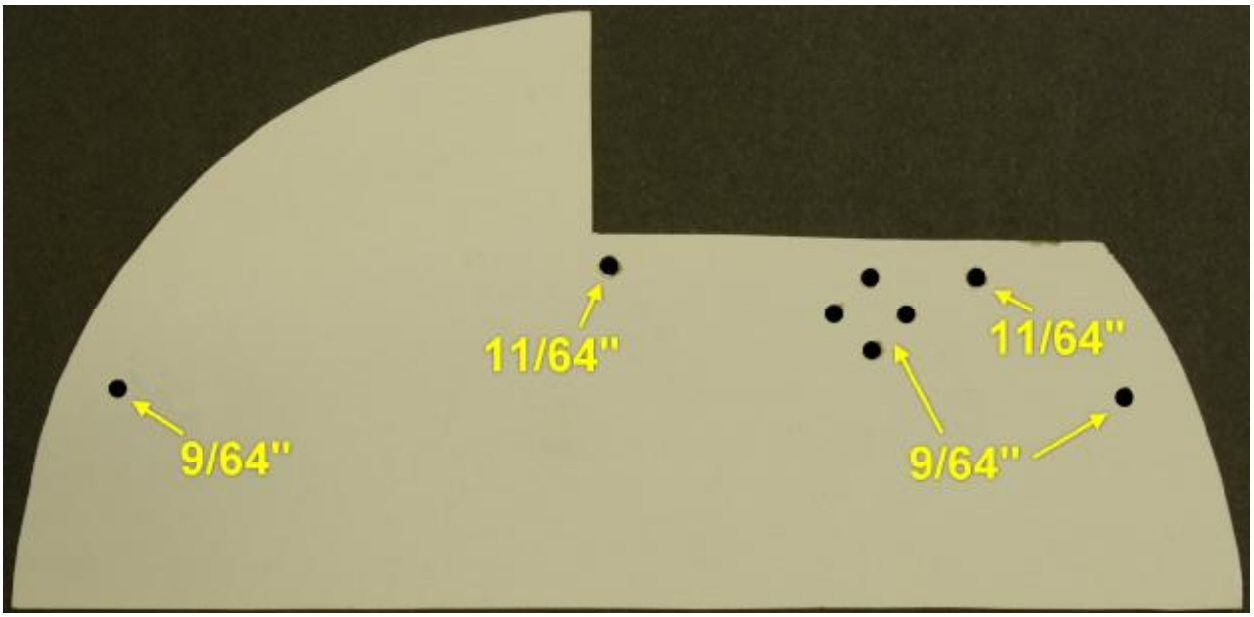

Figure 10

The drill hole sizes are shown on the template. The 4 holes with the diamond pattern are the most critical.

Step 3

You can now slip the 4 mounting screws on the completed RS-28 wheel assembly that you completed last month into the 4 holes as shown in Figure 11. If you were a little off on your holes you can enlarge the holes slightly by about 1/64 at a time until you can slip the wheel assembly in place.

Once in place, put a #6 washer and nut on each machine screw and tighten with a wrench.

Figure 11

Step 4

For this next step you will need a caster like the one shown in Figure 12. The caster needs to be sized so the Firebot is level when in place. If you followed my design exactly, this will be 4-3/8". A variance of 1/8" or so won't matter that much. I got lucky and found a heavy duty rubber caster that was perfect at my local home center.

Next, place the caster near the front of the bot and on the underside as shown in Figure 13. Mark 4 holes and drill them. I used 4 #10 machine screws and washers to mount mine. The size of the mounting holes on the caster may dictate different screws.

I actually used my tap set and drilled the holes and tapped them for my #10 machine screws.

Figure 12

Figure 13

Next, flip the bot over and add a washer and nut to each machine screw as shown in Figure 14.

Figure 14

MegaBot Base Construction

Megabot is a much larger robot so its construction takes a more robust approach.

Step 1

The Megabot has a round base that is 22.5” in diameter. You will need to use a thicker material for its construction. In my case I used 1/2” birch plywood. To make the base I used a homemade compass made from a dowel, pencil and a nail. You can also use a piece of string, nail and pencil. Just make sure the nail is 11.25” from the point of the pencil.

Place the nail in the center of the board and mark out thediameter of the base. You can use a scroll saw, band saw or jig saw to cut out the base as shown in Figure 15. If you have no way to cut the board you can always use a square base for you bot. This will work, but it will make it more difficult to maneuver your robot in tight places.

Figure 15

Step 2

To mount the wheels on the base we use a 4” x 14” x 3/4" piece of wood to create a wheel sub-assembly. You need to cut a 1-3/4” x 4-3/4” notch out of two ends of the board as shown in Figure 16. These notches are used to make space for the tires in our wheel assemblies.

Next, take an extra OF-64S Actuator mount and mark 4 holes as shown in Figure 16. Then, drill a 11/64” hole all the way through the boards at each of the marks.

You will need to make two of these wheel sub assemblies.

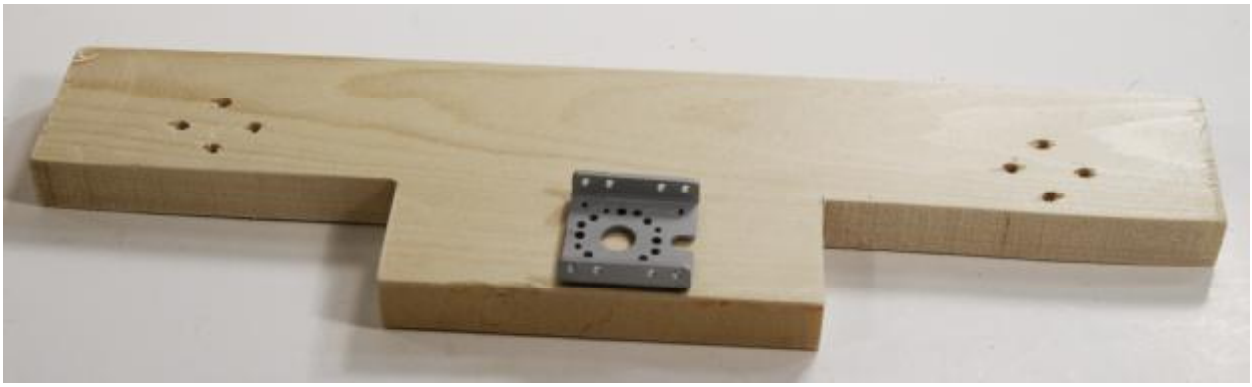

Figure 16

Step 3

Lay the boards out so that the cutouts are oriented as shown in Figure 19 and drill a 1/2" hole 3/8” deep into each of the holes as shown in Figure 17.

Figure 17

Step 4

Now take a wheel assembly and insert the 4 bolts into the four holes as shown in Figure 18. Note that you are inserting into the side of the board without the counter sunk holes that you created in Step 3.

Figure 18

Step 5

I recommend that you install some sort of bumper around the robot. In my case I purchased some 3/4" pipe insulation from my local home center. Simply cut it to size and wrap it around the base as shown in Figure 19. Attach the two ends with hot glue. I found that you can also use exterior based glue, like the kind used on gutters.

Next, mark a line down the center of the base as shown in Figure 19.

Figure 19

Step 6

Now mark two lines 4” from the center as shown in Figure 20. These lines will be used when you mount each wheel assembly.

Figure 20

Step 7

Make a line across the center of the base that is perpendicular to the three lines. The easiest way to do this is to use a piece of paper lined up against the center line with one corner at the center point on the base.

Place a mark on the center of the wheel assembly as shown in Figure 21. Then place the assembly on the base with the center mark lined up with the new perpendicular line.

Figure 21

Step 8

Use three wood screws to attach the assembly to the base. Place them at the positions shown in Figure 22. Do the same with the other wheel sub-assembly on the opposite side of the base. Use screws that are not long enough to protrude through the opposite side of the base. I used 1" screws I picked up from my home center. I recommend a pilot hole and slight counter sink to prevent the wood on the wheel sub-assembly from splitting.

Figure 22

That completes the Megabot base. Just flip the base over and it should look like the one shown in Figure 23. As you can see there is quite a-bit of room for our power system and controllers. You may have noticed that I staggered the wheels when I built the wheel sub assembly. This was done for a couple of reasons. This allowed me to use less space and pull the wheels in tighter. In a differential steering system the closer the wheels are together the easier it is to turn.

Figure 23

Whats Next

Next month we will look into our power system and get those wheels moving. I'm going to be looking at using the Ryobi Li-Ion 18v battery as well as a Li-Ion External laptop battery for our power supply. I will also show you how to use a PC to get those actuators turning.

Be sure to check out the KronosRobotics website for updates to this project at:

http://www.kronosrobotics.com/Projects/megabot.shtml

Parts

The following are the components needed to build this portion of the project.

Firebot

8, #6 Hex Nuts

8, #6 Washers

4, #10 3/4" Machine Screws

4, #10 Hex Nuts

8, #10 Washers

1, Large Caster (See Text)

1, 12” x 12” x 1/8” Hardboard

Mega Bot

24, #6 Hex Nuts

24, #6 Washers

1, 6” section of 3/4" Pipe Insulation

1, 2’ x 2’ x 1/2" Birch Plywood

2, 4” x 14” x 3/4" Pine

6, 3/4" Black Phosphate Screws

Links

Crustcrawler

RS-64 and Components

http://www.crustcrawler.com/motors/RX64/index.php?prod=67

RS-28 and Components

http://www.crustcrawler.com/motors/RX28/index.php?prod=66

Treaded Wheels

http://www.crustcrawler.com/products/rover/wheels.php?prod=28