

Build The Ultimate Robot

Wheel Assembly

By Michael Simpson



Figure 1

I have built many robots in the past and the drive train always causes most of my grief. The type of drive train you decide on will dictate some of the factors used in the design of your robot, factors like the size of the robot and the size of the batteries. Since I am going to be building two robots I think it's important that I give them names to make referencing them throughout this series easier.

Megabot

This is the 6-wheeled RS-64 based robot. It will be approximately two feet in diameter and capable of carrying a large array of devices and instruments.

Firebot

This is a 2-wheeled RS-28 based robot. It will be less than 12" in diameter and sized so that it could be used in the Trinity Fire Fighting contest.

The wheel assembly

As I mentioned in the introduction to this project, we are going to be using the DU-BRO 550TV wheel and the Dynamixel RX-64 shown in Figure 2 for our wheel assembly. Since I will be building two robot bases in this series, you have a couple options: You can build two wheels for the 3-wheeled robot or six wheels for the 6-wheeled robot. If you plan on building Firebot you will need to use one of the Horn 28T sets for each wheel. These are needed because the original horn does not give you enough clearance.



Figure 2

Step 1

There is no way to attach the wheel directly to the RX-64. We need to create an intermediate plate that will attach to the servo horn of the RX-64 and then to the wheel. The plate is simply a circular piece of compressed PVC cut into a 58mm disk as shown in Figure 3.



Figure 3

The goal is for the disk to fit snugly inside the center of the tire as shown in Figure 4. I used a scroll saw to cut my disks. You can use a band saw or possibly a small coping saw. Cut the wheels slightly larger than 58mm. This way you can use a rotary tool with a sanding drum to trim the disk so that it fits snugly. The disk does not have to be perfect. As long as it fits snugly it will be ok. You may use other materials for this disk. My local craft store carries some 1/8" thick hobby plywood as well as some precut disks that only needed to be sanded to the exact size. Originally I used acrylic, but found that it cracked too easy. Compressed PVC can be purchased from various online sources as well as most sign shops. It should be 1/8" thick. 3mm stock will work as well.



Figure 4

Step 2

Once your disks are cut you need to prep the wheel in order to attach the disk. Take the wheel, and using a permanent marker, place four marks on the wheel as shown in Figure 5. Be sure to mark the side of the wheel that does not have the air valve.

The mark should be roughly 11mm from the groove. The goal here is to drill a hole far enough from the center of the wheel so that it does not interfere with the horn we are going to attach. We can't drill the holes too far from the center or they will cut into the rubber on the tire. A 11mm hole is a good starting point, but if you use a different wheel type or size you may want to make adjustments.



Figure 5

Step 3

Using a 1/8" drill bit, place a starter hole at each mark as shown in Figure 6. These holes should only be about 1/4" deep. Drill them at a 90 degree angle to the wheel. In other words, make them perpendicular to the wheel.



Figure 6

Step 4

Now take a 5/32" drill bit and drill the holes all the way through. Take it very slow and move the drill in and out as you proceed in order to clear the debris. It's very important that you keep the drill as perpendicular as possible. If you have a drill press this would be a good time to use it.

The bit may drift a little as you drill the holes. It's ok if they don't appear on the opposite side in the exact same location. These holes will be used later to attach the disk with 2" #6, machine screws.



Figure 7

Step 5

Take one of the disks and insert it into the center of the wheel as shown in Figure 8. Make sure you are using the same side of the wheel that you marked previously. Place an index mark on both the disk and wheel as shown. This will help you line things up later. Attach the disk to the wheel using four pieces of tape.



Figure 8

Step 6

Take a 2" #6 machine screw and insert it into each of the holes on the opposite side of the wheel, including the center hole. Press firmly and twist. You want to make marks on the disk as shown in Figure 9. Using the 5/32" drill, place a hole at each of the outer marks.

Drill out the center with a 3/8" drill bit as shown in Figure 9. At 3/8" the horn will be a little tight, so you will have to enlarge the hole slightly. You can use a knife or slide the drill bit up and down the hole while slightly skewing the disk. If you are using an RX-28, the hole should be 5/16" in order to fit the smaller horn.

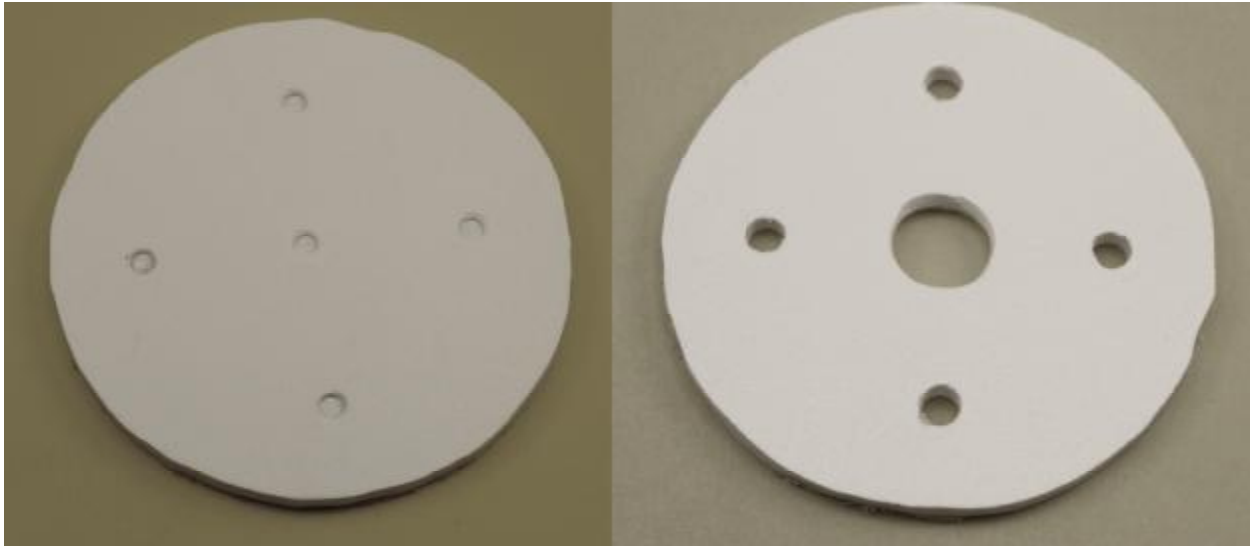


Figure 9

Step 9

Place the horn in the hole as shown in Figure 10. The holes are in sets of three. You will be using the rightmost holes. Mark each of the holes with a pencil.

Remove the horn and drill a hole at each mark with a 7/64" drill bit. Use a 5/64" bit if you are using an RX-28 horn.

Important:

If you are using an RX-28 horn, the small screws that come with the horn will not be able to reach the horn because they are not long enough. On the opposite side you will need to countersink the holes. (See Step 10)



Figure 10

Step 10

Using four of the smaller machine screws that came with the servo, attach the horn to the disk as shown in Figure 11. It's important that you add some sort of thread lock to the wheels or they may become loose and fall out over time. For the RX-64, tighten the screws until they are tight and slightly recessed. Don't over tighten. For the RX-28, you will have to place a small countersink hole with a larger drill bit so that the screws will go

all the way through the disk. Don't use a drill to do this. Hold the bit with your hand to make only a slight recess in the disk.

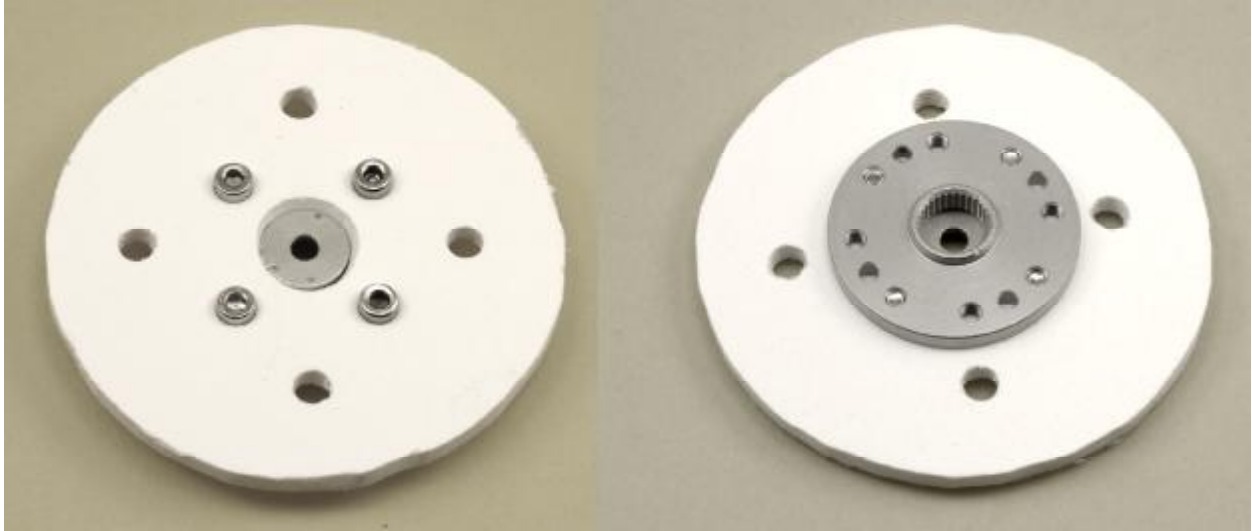


Figure 11

Step 11

Use a 7/32" bit and drill out the center hole on the wheel. This needs to be done so that the horn screw will be able to fit through the hole.

Next, place the disk on the wheel and insert four, #6 2" machine screws in through the disk and wheel. On the opposite side of the wheel, place a washer and #6 locknut on each screw as shown in Figure 12. Tighten them just enough to snug the nuts.

I recommend that you use a cutoff wheel on a rotary tool to cut off the screw ends that are sticking out of the lock nuts.

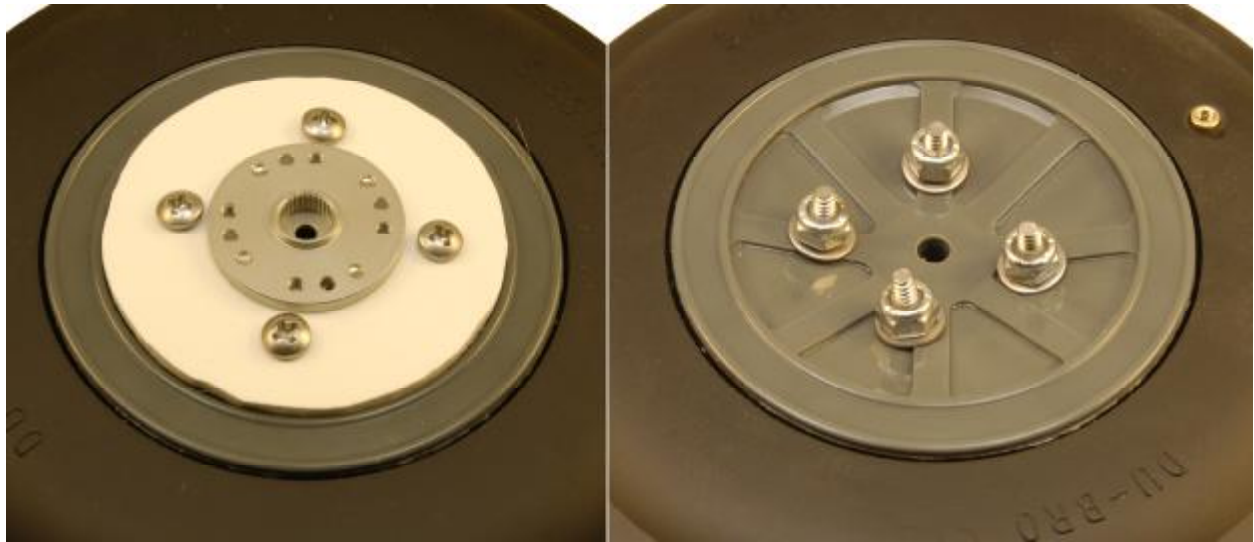


Figure 12

At this point the wheels are ready to attach to the RX actuator.

Attach the Wheel

Let's start by looking at how we are going to attach the actuator to the robot base. While there are a couple of different ways to do this, the best way is by using the OF-64S frame on the RX-64 actuator and the OF-RX28S on the RX-28 actuators. The only downside to using these frame pieces are the fact that they use very small metric screws, so I placed some threaded holes to use them with #6-32 machine screws.

We do this with a very simple tool called a tap. A tap is used to cut the female threads into a hole. Each particular tap has a matching hole size that is needed. Because these sizes tend to fall in between normal drill bit sizes, you have to purchase special bits. For instance, a #6-32 tap needs a #21 drill bit for the hole. You can often purchase both tap and drill bit together for a couple of dollars. You will need a small holder for the tap like the one shown in Figure 13.



Figure 13

Because I am often tapping holes in my various projects, I purchased a complete set like the one shown in Figure 14.



Figure 14

Step 1

Let's start by drilling the holes into the frames. Use the holes indicated by the arrows shown in Figure 15. The OF-64S frame holes are already the perfect size so we don't need to drill them. The holes in the OF-RX28S are too small so those will need to be drilled out with a #21 bit.

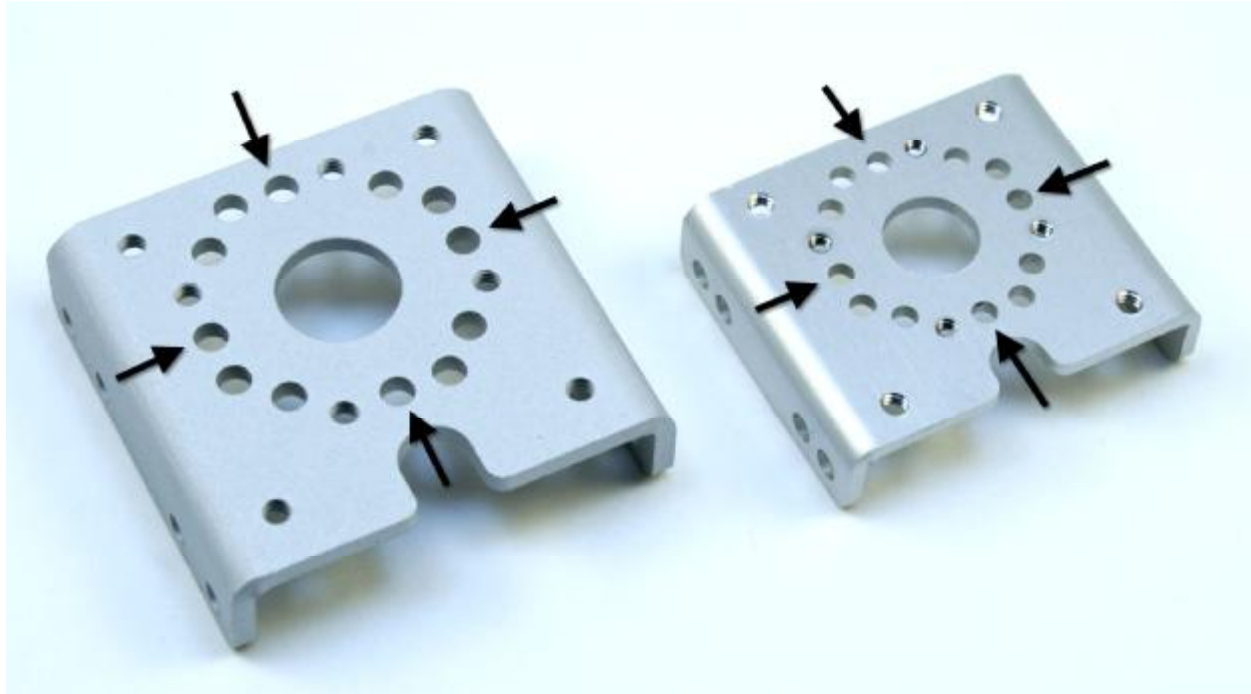


Figure 15

Step 2

Using the tap, cut the threads into the holes you just drilled. When tapping the holes try to keep the tap as perpendicular to the hole as possible. Keep a steady downward pressure on the tap as you turn it clockwise. If the tap binds, back it out and start again. Once the tap is all the way through the hole, clear the flashing from the threads of the tap and back it out of the hole. If you have never tapped a hole before, I recommend you drill a hole in some other material and practice. Once you get the hang of it, it's a real simple process.

Step 3

Next you need to attach four, #6-32 machine screws to the frame as shown in Figure 16. The screws are inserted from the underside of the frame and tightened. Place a small drop of thread lock on the base of the screw near the head. The actual length of the screw is determined by the thickness of the material to which we will be attaching it. In my case, I used a 3/4" machine screw on the RX-64 based Megabot and a 3/8" machine screw on the RX-28 based Firebot.



Figure 16

Step 4

Take four of the included nuts and insert them into the slots on the RX-64 or RX-28 actuator as shown in Figure 17. You may want to hold the nuts in place with a small piece of tape. While I was assembling my wheels the nuts kept falling out.



Figure 17

Step 5

Place the frame on the actuator as shown in Figure 18. Using four of the machine screws, attach the frame. Make sure you place some thread lock on the four machine screws. Make sure the frames are oriented as shown.



Figure 18

Step 6

For the Firebot wheel you need to place the small bushing on top of the horn as shown in Figure 19. Take the appropriate actuator and insert it into the horn as shown in Figure 20. In place, it will be a very tight fit. I found that if you work the actuator in and out it will be much easier in the future to remove the wheel. Once seated, take the included servo horn screw and drop it through the center hole on the opposite side of the wheel and tighten with the appropriately sized Allen wrench.



Figure 19



Figure 20

That's it for the wheel assembly. For the 6-wheeled Megabot you will need six wheel assemblies based on the RX-64 . The 2-wheeled Firebot will require two wheel assemblies based on the RX-28 actuator. I recommend you build the first few wheel assemblies one at a time until you get the hang of it.

Feel free to use the RX-28 in lieu of the RX-64. Both the actuator and supporting components are cheaper. On the same note, you can use the RX-64 on the Firebot as well. In both cases you can build the Firebot, then later build the megabot. If you have never built a robot of this caliber before, then I recommend starting with the Firebot.

What's Next

Next month we will cut the base assemblies and attach the wheels.

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

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

Parts

All the hardware can be purchased from just about any hardware or home center. The RX-28, RX64, and supporting frame sets can be purchased from Crustcrawler. The wheels can be purchased from your local hobby store. If they don't stock them they can probably order them for you.

On the Megabot you will need the following for each RX-64 based wheel assembly. (6 Wheel Assemblies)

- Eight #6 Lock Nuts
- Eight #6 Washers
- Four #6 2" Machine Screws
- 1/8" thick Plastic or Wood for Mounting Disk (See Text)
- RX-64 Actuator
- OF-64S Frame
- Four #6 3/4" Machine Screws
- DU-BRO 550T Wheel

On the Firebot you will need the following for each RX-28 based wheel assembly.

- Eight #6 Lock Nuts
- Eight #6 Washers

- Four #6 2" Machine Screws
- 1/8" thick Plastic or Wood for Mounting Disk (See Text)
- RX-28 Actuator
- OF-RX28S Frame
- Horn 28T
- Four #6 3/8" Machine Screws
- DU-BRO 550T Wheel

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>

Kronos Robotics

1/8" Expanded PVC

<http://www.kronosrobotics.com/xcart/product.php?productid=16393>