Give Yourself a Wedgie!

by Zachary Lytle

As a four-time RoboGames champion, I am frequently asked how to get started in combat robotics. Personally, I always recommend building a wedge for your first robot because you don't want to start off with anything too complicated. Wedges are durable and easy to repair, which are the two most important qualities in your first robot. Plus, let's not forget that the current RoboGames heavyweight champion Original Sin is basically a gigantic wedge robot. In this article, I will show you how to build a wedge platform from scratch using common household tools. The boxes are locked, the lights are up, and the arena is waiting for you, so let's get started!

The tools and parts you'll need to construct your wedge are listed on the next page. The total cost of these parts should be around $320. Starting with the appropriate materials can save you a lot of trouble down the road. Let's begin.

BUILDER TIP: Always weigh your parts to see how much poundage you have to work with.

The tools you'll need are:
- Hand drill
- Soldering iron with solder
- Six inch caliper
- Lighter
- English Allen wrench set
- 1/8" drill
- Tin steps
- Wire stripper
- Sharpie™ pen
- Fine-grained file
- 2 x 3 inch clamps
- Bottle of CA glue

Optional:
- Dremel with cutoff wheel
- Drill press
- Five pound scale

The parts you'll need are:
- 6" x 6" titanium sheet
- 2x FingerTech Robotics 22-1 Silver Spark motors
- 2x FingerTech tinyESC v2 motor controllers
- 2x Lite Flite wheels, two inches in diameter
- 2x FingerTech Lite Hubs
- JST connector (female)
- DX 5E radio system
- Rhino 460 mAh 2S 7.4V Li-Poly pack and charger
- 6" x 6" polycarbonate sheet .040 inches thick
- 25x 4-40 button head screws 1/4 inch in length
- 2x BaneBots motor mounts

Most of the parts can be found at **FingerTechRobotics.com**; the metal and screws can be found at **www.mcmaster.com**; and the motor mounts are from **Banebots.com**.

MAKING THE TOP PLATE

This is the primary armor and structure for the entire robot. All of your components will be mounted to this single piece of metal. Some might call this "putting all your eggs in one basket," but I can tell you from experience this is the best approach.

By putting all your weight into a singular piece of metal, it allows you to build the frame and armor on top of each other, and this makes them inseparable. Designs that make the armor a removable piece typically get it ripped off and destroyed.

STEP 1: LAYING THE HOLE PATTERNS

Lay out the bolt hole patterns with the caliper. By locking the caliper at the desired dimension, you can use the caliper as a ruler to scribe lines.

Set the caliper at 1/8 inch and scribe a line down each side of the titanium sheet.

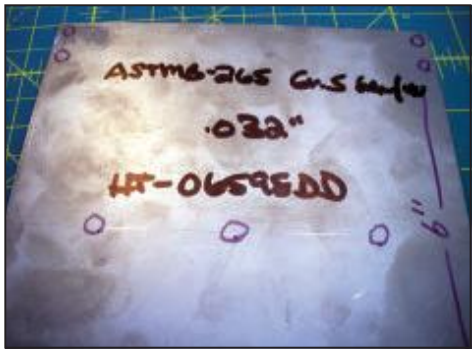
Set the caliper at 1/4 inch and scribe two additional lines, measuring from the top and intersecting your first two 1/8 inch lines. This will make a cross hair you will use to line up the drill.

Scribe a second set of small lines, 3/4 inches down from the top.

Next, scribe a line two inches off the bottom edge all the way across. Then, scribe a line directly in the middle, and scribe two additional lines 1-1/4 inches from the left and right hand side. This will create three cross hairs along the horizontal line. When you are done, you will have seven crosshairs.

STEP 2: MARKING THE HOLES

Be sure to take your time on this step. After making the seven scribed crosshairs, take the punch and the hammer and create a small divot over each cross hair. These small divots will guide the drill through the material. Hard metals — like grade 5 titanium — typically cause drills to "walk" off the desired location. By scribing and marking holes with the punch, you will gain a much higher level of accuracy with the drill.

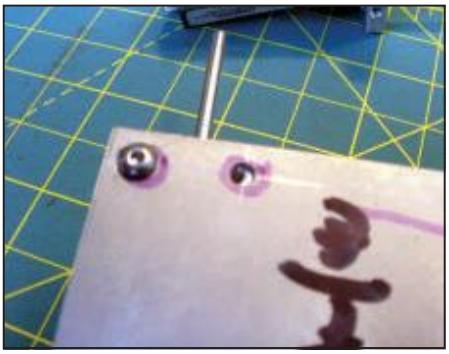


STEP 3: DRILLING THE HOLES

The last step for the titanium is to drill it. Put your hand drill on a low speed at approximately 500 rpm, and make sure the 1/8 inch bit is securely locked in the chuck. Place a block of wood underneath the titanium plate. Take your spray can of WD-40 and spray the drill and sheet before you start drilling. Place the drill in the divot and get lined up, straight up and down. Apply moderate pressure while drilling.

STEP 4: CHECKING YOUR HOLES

Hold the motor mount up to the titanium plate and visually check to be sure you can see both tapped holes of the motor mount through the 1/8 inch holes in the titanium plate. If the holes are not visible, drill the holes out with a larger sized bit. Or, use a Dremel tool with an end mill ball attachment to turn the holes into slots. Make sure the motor mount will fit before moving to the next step.



BUILDER TIP:

If the titanium proves too hard to penetrate with a hand drill, use a drill press.

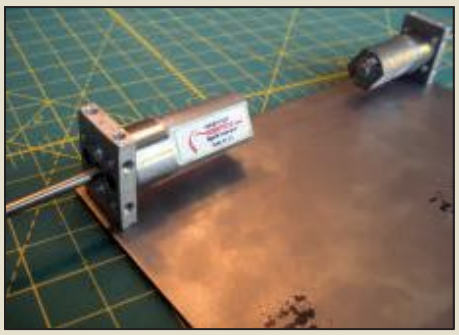
ASSEMBLING THE DRIVETRAIN

STEP 5: MOUNTING THE MOTOR MOUNTS

Attach the two motor mounts to the motors. Slide the motor mount over the motor shaft, and place it on the front of the gear box. Rotate the motor mount until the two tapped holes are visible through the guide holes on the motor mount. Using the 256 screws and the .05 inch Allen wrench, screw in two of the screws through the guide holes into the tapped holes on the motor. After mounting both motors to

the motor mounts, you will notice the motor mounts have tapped holes on all sides. Pick one of the two long sides and line up the tapped holes with the 1/16 inch holes on the titanium plate.

Using the 1/16 Allen wrench and two 440 screws, screw them through the guide holes on the titanium plate into the tapped holes on the motor mount. Repeat this process on the other side of the robot, so both motors are mounted to the titanium plate.



STEP 6: MOUNTING THE WHEELS

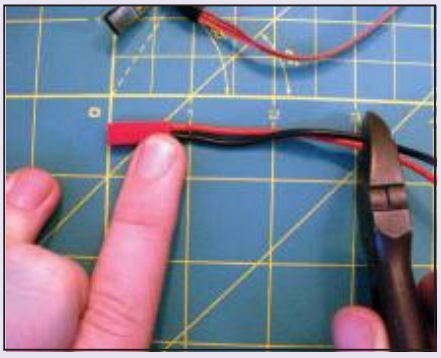
Take the FingerTech hubs and glue them to the lite flite tires. Start by running a line of glue down the length of the Fingertech hub, and slide a lite flite wheel over the shaft of the hub. Repeat this process on both wheels.

Slide both assembled wheels over the drive shafts of your robot. Line the set screw of the hub to the flat on the drive shaft. Warning: If this step is skipped, your wheels will fall off! Use the .05 inch Allen wrench to tighten the set screw in the hub.

SOLDERING THE ELECTRONICS TOGETHER

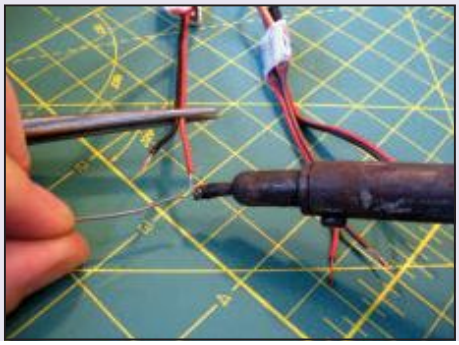
STEP 7: STRIPPING THE WIRES

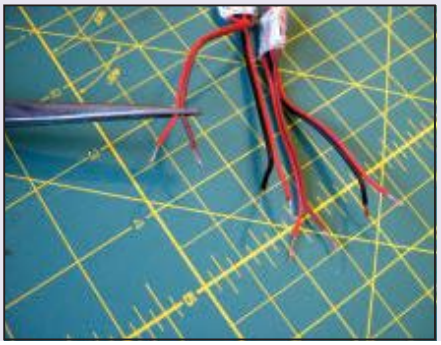
We are going to start by stripping the wires on both FingerTech controllers. Also strip the red and black wires on the female JST plug.



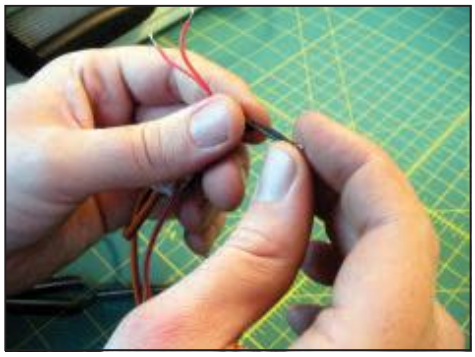
Tin all six leads. To tin each lead, get the soldering iron to full temperature. It usually takes about 10 minutes on most irons.

Heat the wire with the iron while placing the solder on the other side of the wire. If the wires are not taking the solder, apply a little bit of solder to the iron. After tinning all six leads, we will now join the three black leads together.



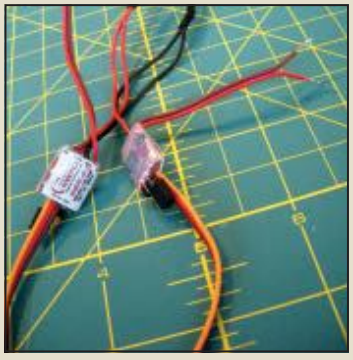


Slip a piece of heat shrink over the two black speed controller leads. Solder the JST connector to one of the speed controller leads. I recommend putting the speed controller lead in a vice or pair of pliers, then holding the soldering iron in your dominant hand and the JST connector in the other hand. Place them together so they are horizontally touching. Heat both wires with the iron until the tinned leads melt together.

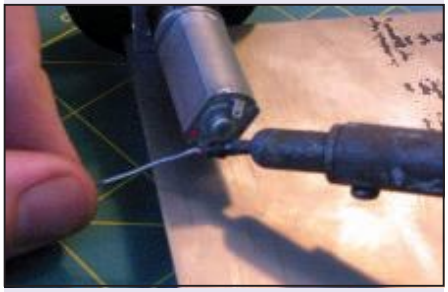
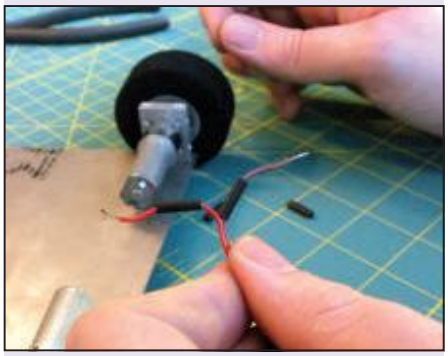



Once all three wires are soldered together, slip the heat shrink over the solder joint; make sure to cover all exposed wire. Use a lighter or other small flame to compress the heat shrink around the solder joint; make sure the flame does not touch the heat shrink. After joining the black leads together, repeat the process and join the red wires together using the same steps you did on the three black wires.



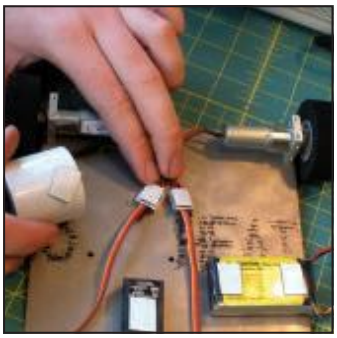
Now, let's solder the speed controllers to the motors. Tin the red and brown leads on both speed controllers, then tin both motor leads. When looking at the back of the motor, you will notice one lead has a red dot next to it. This indicates it is the positive lead. You will then solder the red wire to the positive lead on the motor. On the second motor lead — which is not marked — you will solder the brown wire. Repeat this process on both motors and speed controllers. Once you've soldered the last brown lead, you will have officially soldered together your first combat robot!

MOUNTING THE COMPONENTS

Cut out pieces of double-stick tape, and stick one piece to the back of the receiver and a second piece to the back of the Li-Poly battery. Stick the receiver just below the right motor, and stick the battery just below the left.

Now, cut two more small pieces of double-stick tape and attach them to the speed controllers down between the motors. Plug the long receiver leads coming off the speed controllers into the receiver in the aileron and elevator slots.



BUILDER TIP:

Put the double-stick tape on the label side of the speed controllers. Although this will cover the label, it will make the LED visible.

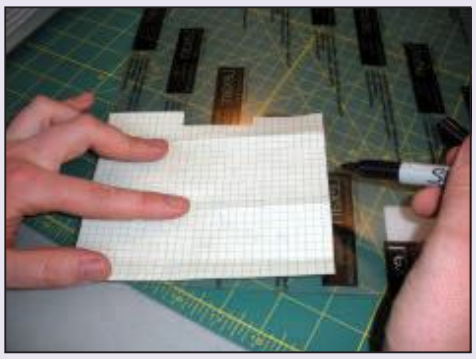
CONNECTING THE RADIO TO THE RECEIVER

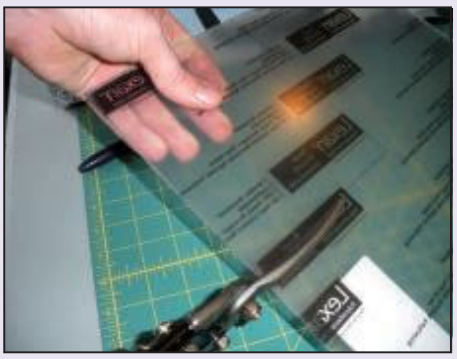
Plug the "bind" plug into the receiver on the battery port. Then, power on the robot by plugging the 7.4 volt battery into the JST lead. The receiver should start, showing a blinking orange light. Now, on your radio, flip the mix channel to the upright position. Flip the elevator and mix switches to the upright position, as well.

Hold the "train" switch and turn the radio on. You will wait to see the blinking light on the receiver and the transmitter go solid. This indicates the transmitter has "bound" to the receiver.

MAKING THE BOTTOM PLATE

When I originally designed the bottom plate for this wedge, I used a piece of cardboard (or "cardboard aided design"). I have provided a cut-out for you at the article link to trace onto polycarbonate. With polycarbonate this thin, you can cut it with hand shears and bend it in a vice. Carefully lay the pattern out and with either a pencil or fine-tip Sharpie, trace the pattern onto the polycarbonate. Then, using the hand shears, cut out the bottom plate. The dotted lines on the pattern represent where it will be bent in the vice.





One special note: I don't drill the holes until after the material is bent. This goes against many shop practices, however, for garage and hand tools I believe this is a better approach. Start by bending the front of the plate to a 30 degree angle. With polycarbonate, you will need to bend it past the point and see where it returns. Move to the dotted line — 1.5 inches from the top — and bend it to 30 degrees. The tip of the plate and the middle of the plate should be lined up and pointed in the same direction.

Flip the plate over and bend the back panel to 90 degrees. Bend the two small side tabs up to 90 degrees. Place the covering over the two motor mounts, and check the fit. You may need some additional tweaking to get the piece to sit flat against the two motor mounts and the front of the titanium sheet.

FINISHING YOUR ROBOT

Once the bottom plate sits flat on the robot, use the fine-tip Sharpie and mark the locations of the tapped holes on the motor mount. Because the polycarbonate is clear, you can lay it on the robot and see where the tapped holes are. Once you have marked them with a pen, use the same punch, hammer, and drill technique described previously to drill out the marked holes.

Screw down the polycarbonate plate with four 440 screws. Then, place your robot face up on a block of wood; make sure you can see the wood through the three titanium holes on the front of the robot. Using your 1/8 inch drill, penetrate through the polycarbonate sheet and titanium plate. After drilling each hole, add 440 screws to help hold the polycarbonate sheet in place.

"WHEELS ON THE GROUND" TEST

If the robot's steering is incorrect, try flipping the aileron and elevator switches to different positions. There should be four different combinations. If none of the four combinations work, you will have to open the robot and flip the two speed controller plugs to opposite ports. However, your first power-on should be correct.

You have now finished a one pound version of my 150 gram robot Wadgie. Wadgie has served me faithfully for five years now. He has endured more hits than any of my other robots. The design has worked well for me. I hope it will work well for you.

READY FOR THE ROAR OF THE CROWD

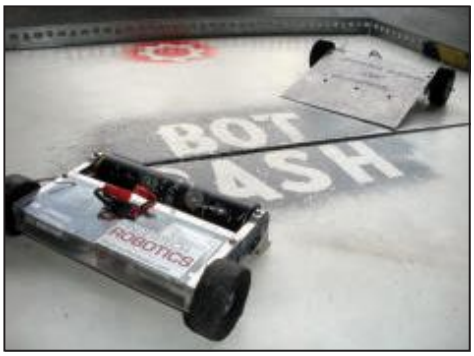
Learning how to construct an actual platform for a robot is an important first step. Once you have mastered the basics with your durable wedge bot, you can then put your imagination and your newly learned building techniques to work to construct a robot entirely of your own creation. A further benefit is you will have a basic wedge robot to practice against. I never started winning matches until I had two robots and practiced driving them at home.

Please remember to be safe and follow good safety procedures. Wear safety glasses through the entire build process. Do not use power tools you're unfamiliar with.

Stay tuned to *SERVO Magazine* for a future article where I will show you how to add a lifter or a clamp onto your robot.

I wish you good building and I hope to see you in the ring.

SV



BUILDER TIP:
You can make your wedge flush to the ground by filing the edge of it.

www.servomagazine.com/index.php?/magazine/article/ctober2012_Lytle

Discuss this article in the *SERVO Magazine* forums at http://forum.servomagazine.com