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a UK based purveyor of cool things and open source goodness. A member of instructables since 2006 we're currently cruising at a mean 0.3 instructables a year...

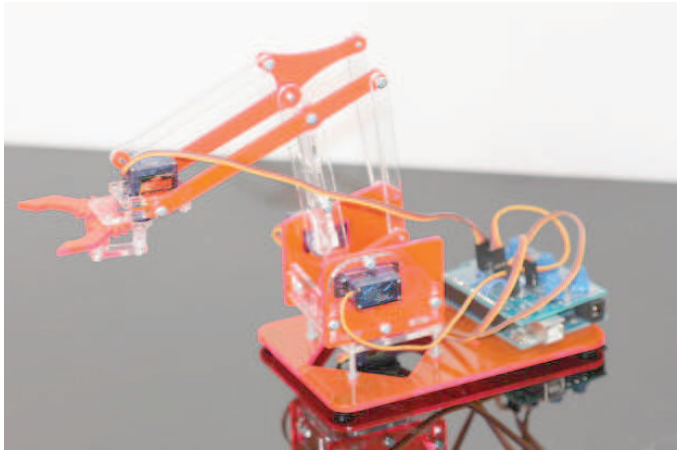
Intro: MeArm - Build a Small Hackable Robot Arm

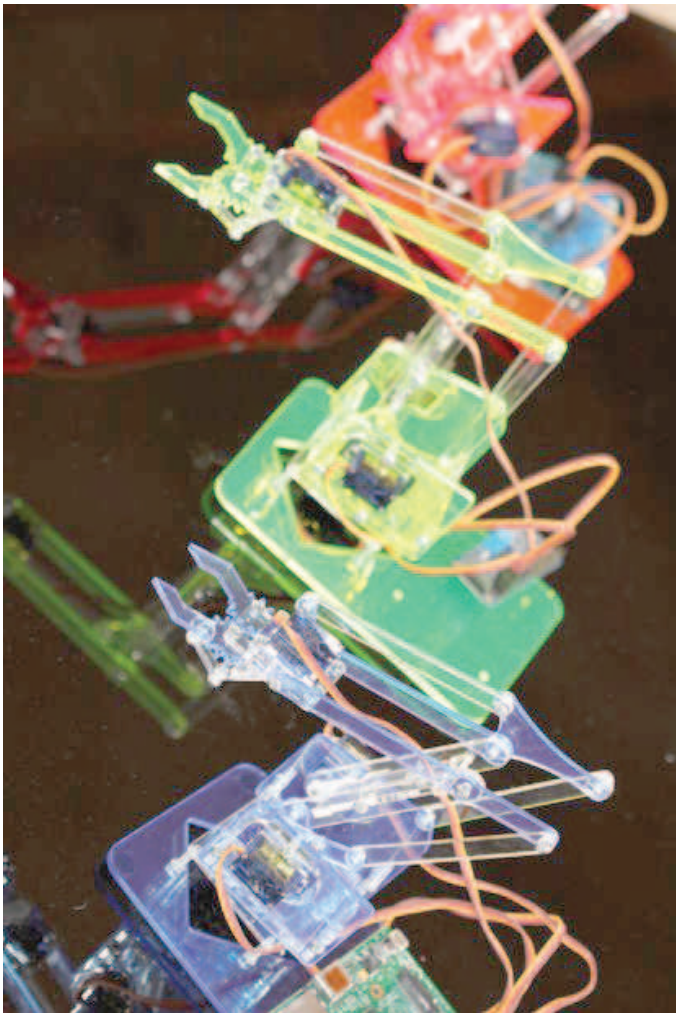
The MeArm is a small "Hackable" Robot Arm. It's an Open Source project by Benjamin Gray and Jack Howard. We set out to build a very low cost and fun to use Robot Arm. Our design brief was to keep the parts count to a small number of cheap parts.

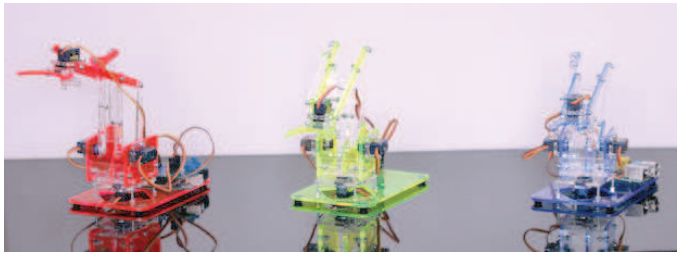
1. 4 hobby servos
2. M3 Fixing
3. No more than an A4 sheet of Acrylic

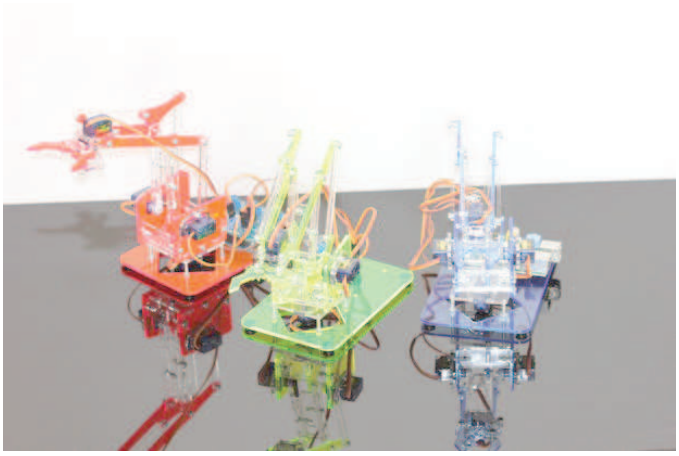
We've focused on the mechanical side up until now and it's still very much a work in progress. This instructable will concentrate on building the MeArm.

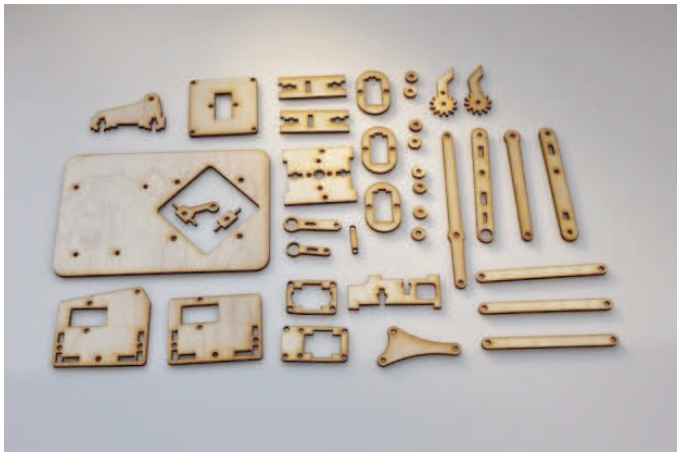
Using 4 potentiometers and very simple code this is an example of the kit in action.











Step 1: Gather your parts!

First step is gather your parts. The files for the MeArm are available on thingiverse:

- MeArm v0.3 (Current Version)
- 4 Hobby Servos (9g Type)
- M3 Fixings

We do sell a kit of all of these parts at www.phenoptix.com . If you have access to a laser cutter and don't mind waiting on parts from China you can put together the whole thing for under $10. Places like Ponoko will cut the files for you or even better find a local hackspace and learn how to use the laser cutter.

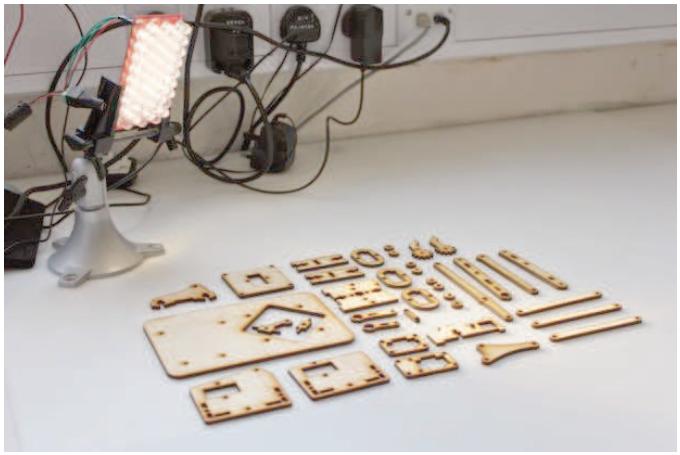
The M3 fixings you'll need are:

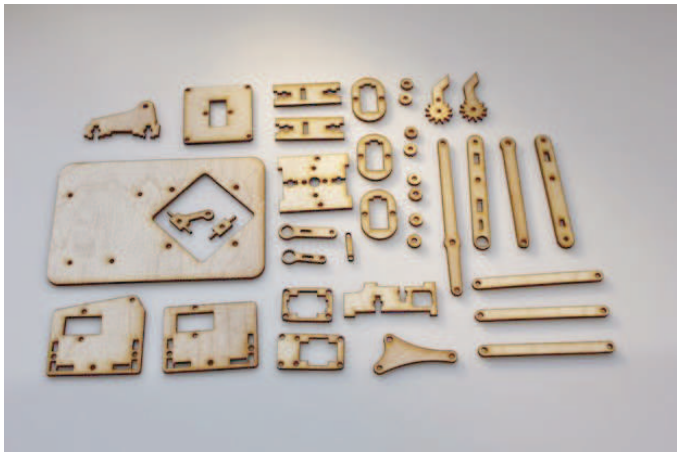
- 20mm x 4
- 10mm x 2
- 12 mm x 10
- 8mm x 13
- 6mm x 11
- Nuts x 14

Sorry to all the folks in the USA but imperial is a really stupid system!

Tools needed

- Screw Driver





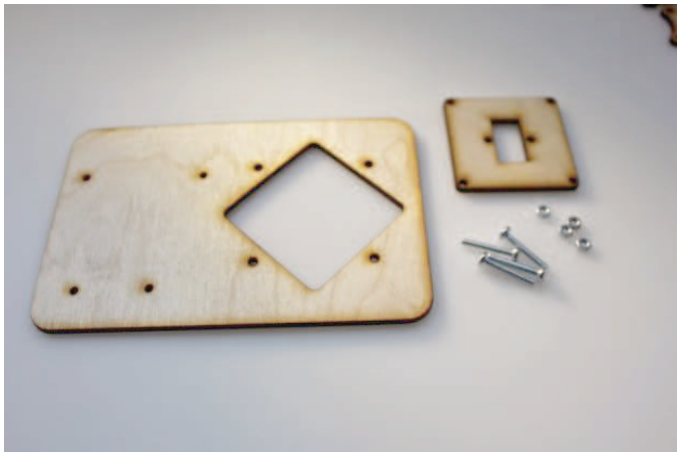
Step 2: Build the base

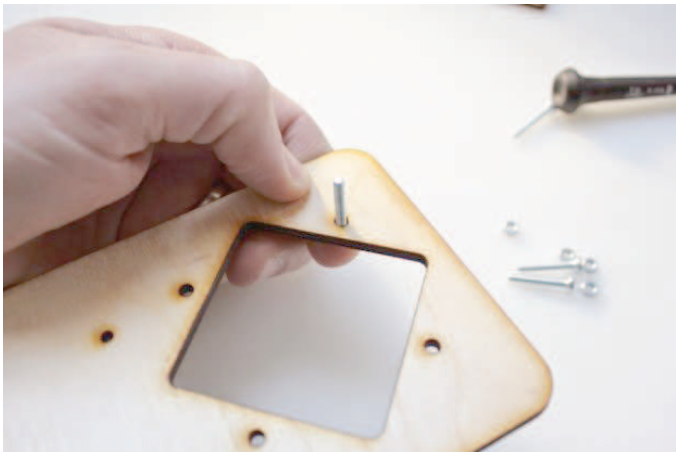
The base is probably the best place to start the build. Otherwise you have to deal with antigravity later on and that needs be invented.

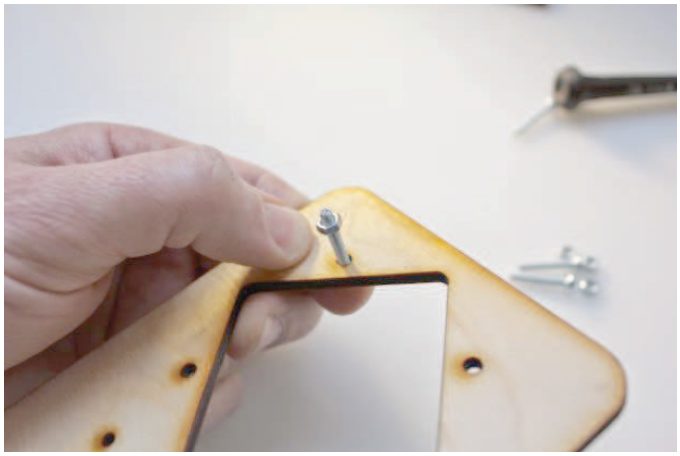
We're using a wooden version of the MeArm here. If you cut yours with wood note that the self tapping feature we've used to save on hardware doesn't work so well, but you can make up for that with longer screws and more nuts.

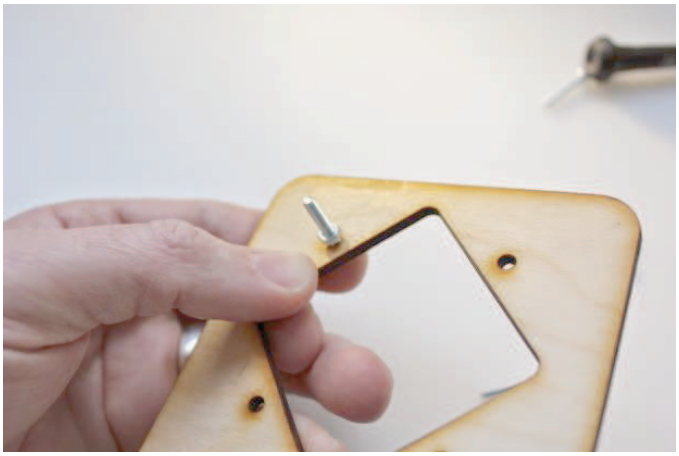
Take the four 20mm screws and four nuts. Insert the screws from the rear of the board and screw the nuts on about half way down. Hold the square part so the holes are in line with the screws and screw the ends into the holes until they're flush with the top of the square board. Once you've done this for all four screws then you can tighten the nuts to the base board.

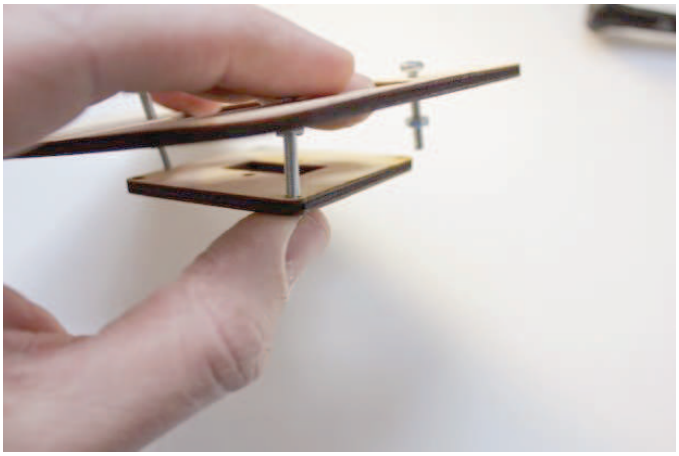
Add sticky feet to the corners of the base so the screws don't scratch the surface you're working on.

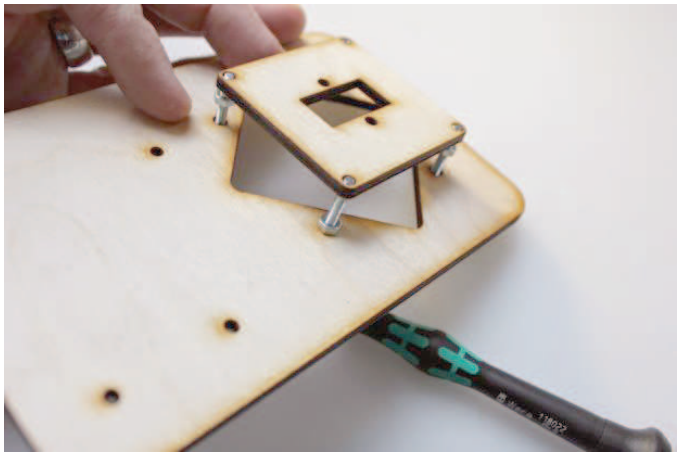


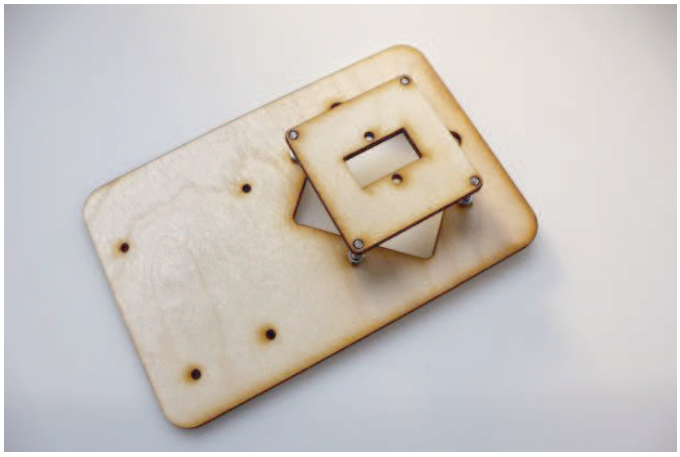


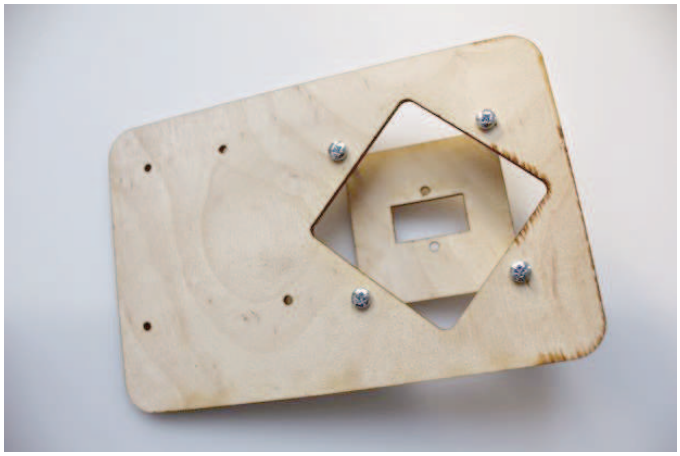


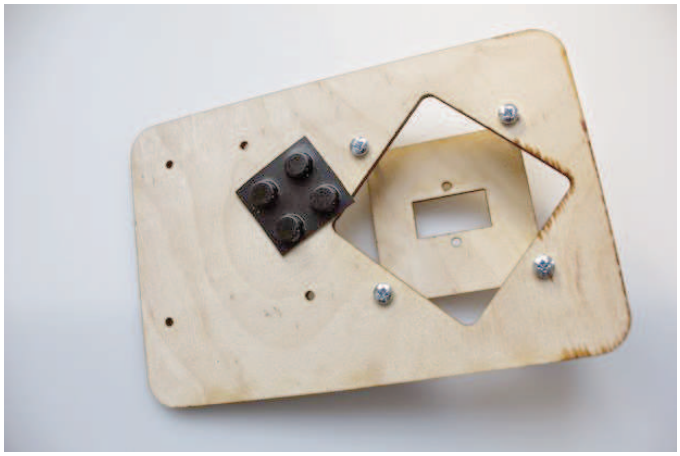


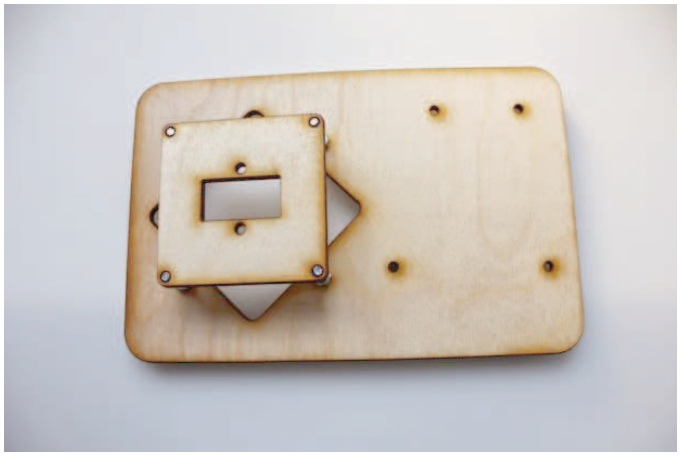










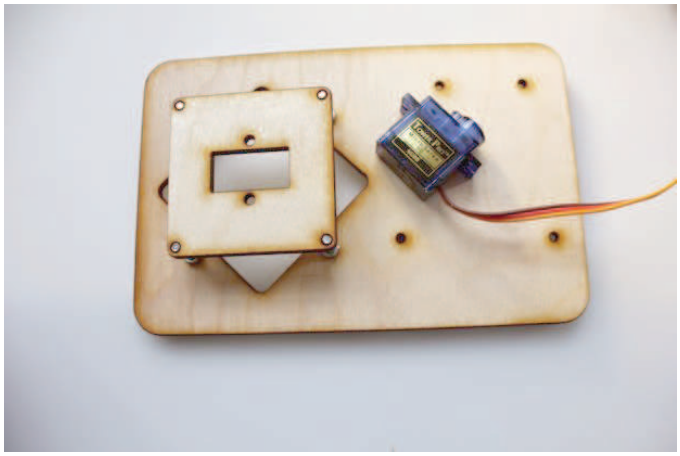


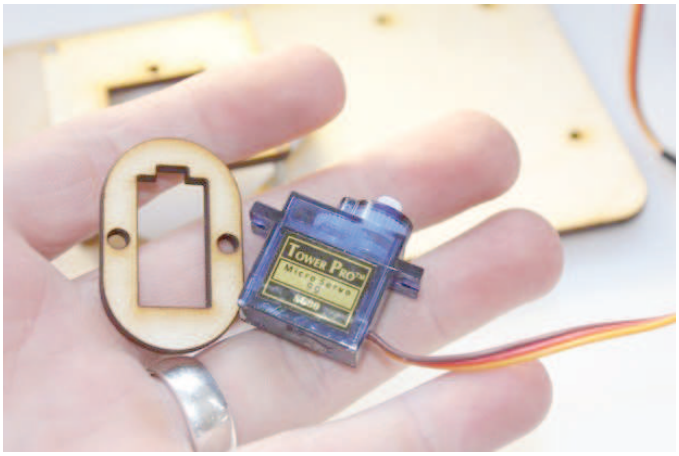
Step 3: First Servo!

Now we add the first servo.

The method used here will also be used to attach two more servos a bit later. What we're doing is putting a collar around the base of the servo, note the notch on one side of the collar, that's so your control wires don't get pinched. Use two 8mm screws from the underside of the servo collar and screw them into the square part you just attached to the base board. The screws should self tap until approximately level with the square board. Don't over tighten as you might snap the collar. In acrylic this self tapping works well. In wood not so much...

We'll worry about the orientation of the servo later as we're not attaching it to the next part just yet.

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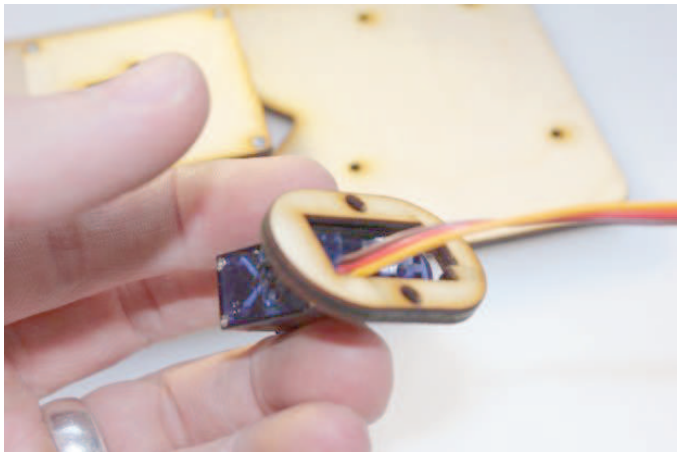
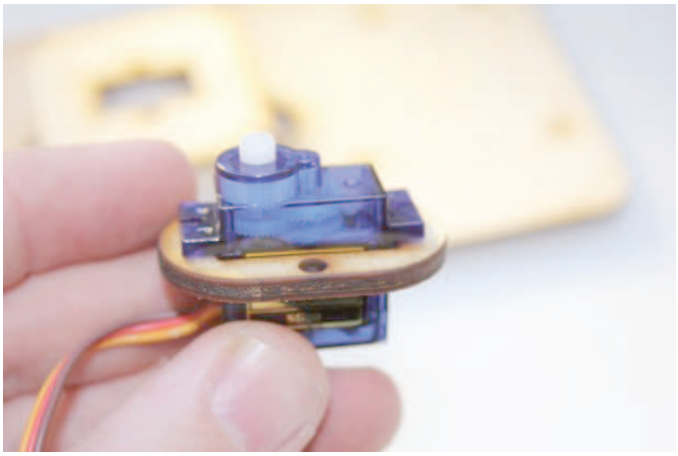
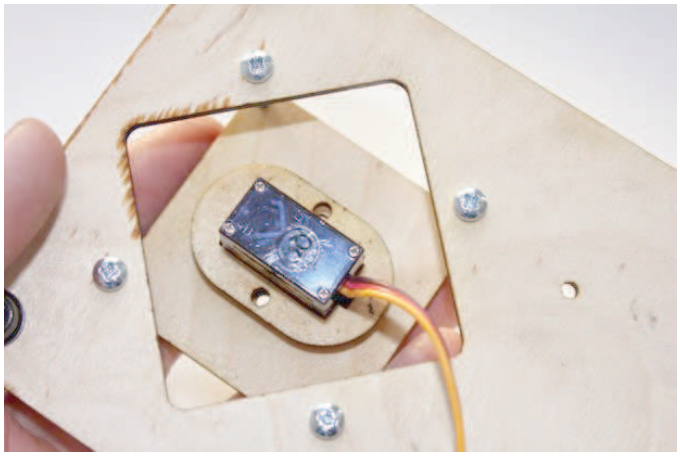
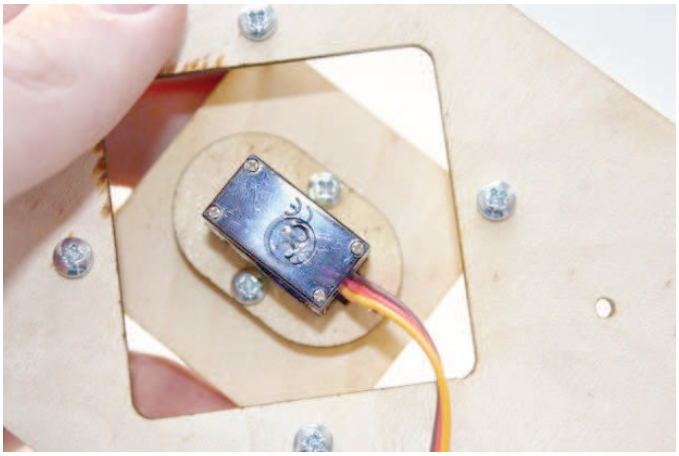
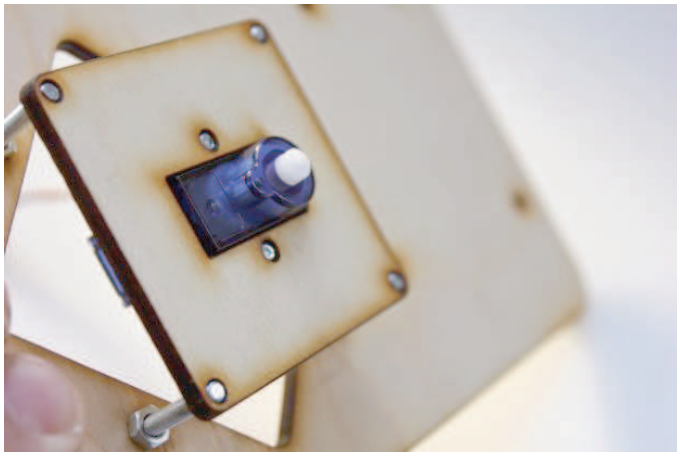










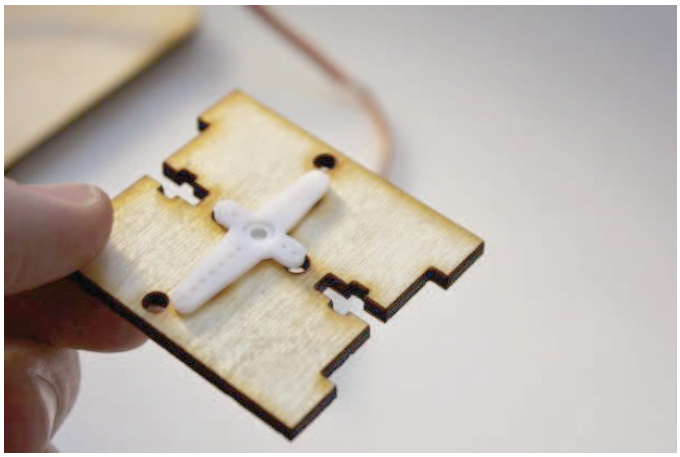
Step 4: Building the Waist

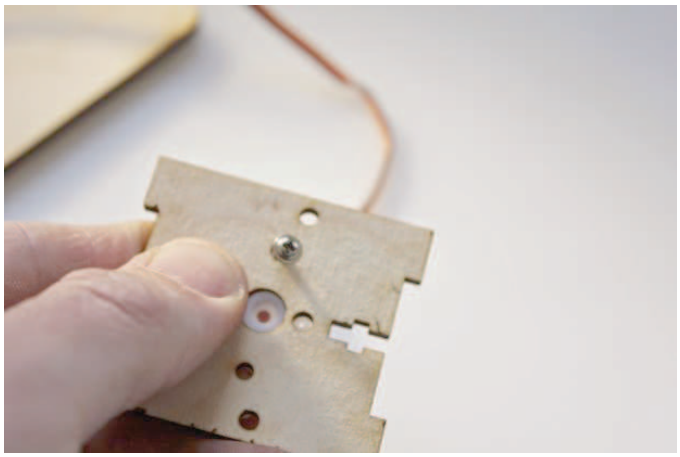
Now we build the part I think is called the waist. Use the cross "horn" that came with your servo and attach using the two long screws that came in the servo pack. Screw into the servo horn from the underside of the board. You should now have a board with horns attached and two spikey screws sticking out.

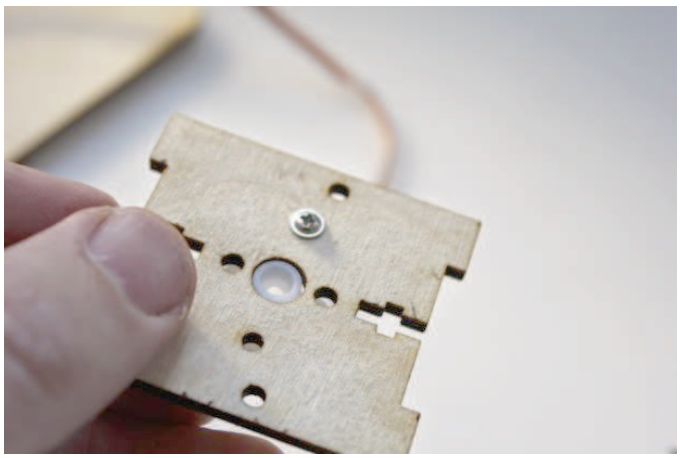
Now we're going to add the central part. This uses another method we're going to use again. From the underside of the board insert two 12mm screws and screw on two nuts so they are just on. Take a close look at the pictures on this step. The hole on the top of this next piece should be at what we're going to consider the front and the the holes you've just put through the last piece should be on the left hand side.

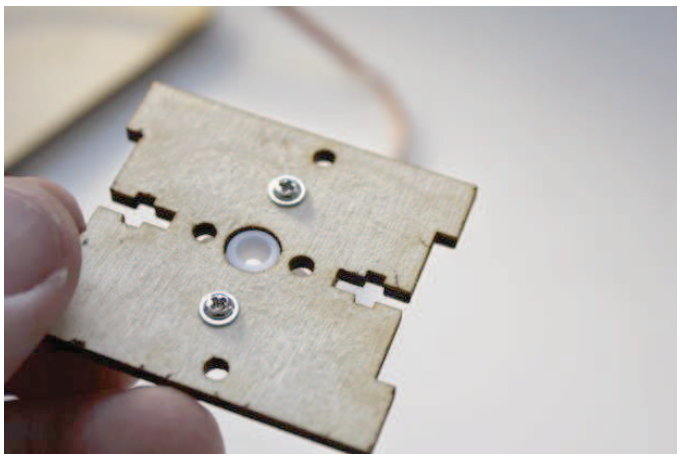
Line up the notches in the central part and screw the nuts to tighten it to the base part. It can come out of alignment here so take a bit of care. Thinking about it we should probably add a notch if we rotated the placement of the horns 90 degrees and removed the fixing placement on the base. Apologies for making notes as I go but as mentioned this is a work in progress and should serve as the build for the v0.3!

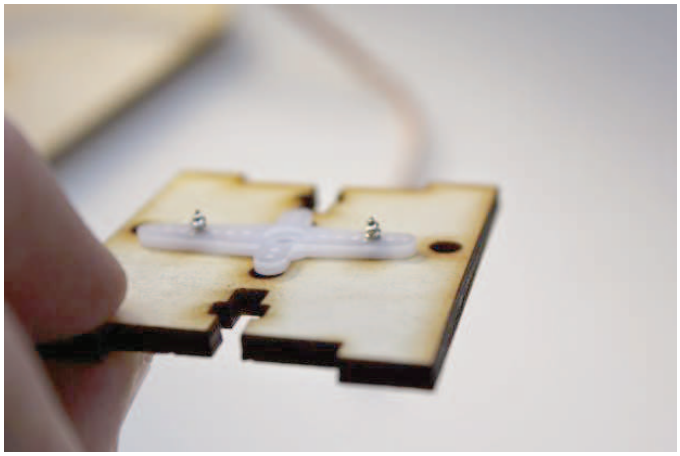
Now onto the first part of the Bicep. This should go on the left with the hole towards the middle of the piece closest to the bottom. Use a 6mm screw inserted from the right, through the central part to self tap into the bicep part. Should really number these! Tighten enough to allow freeish movement of the parts with minimal wiggle.

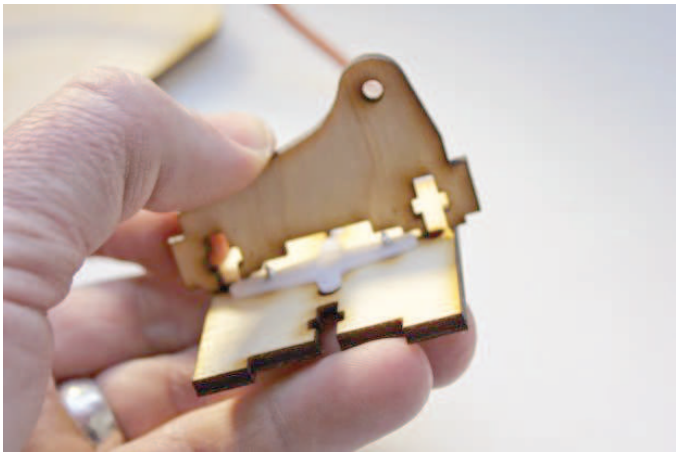


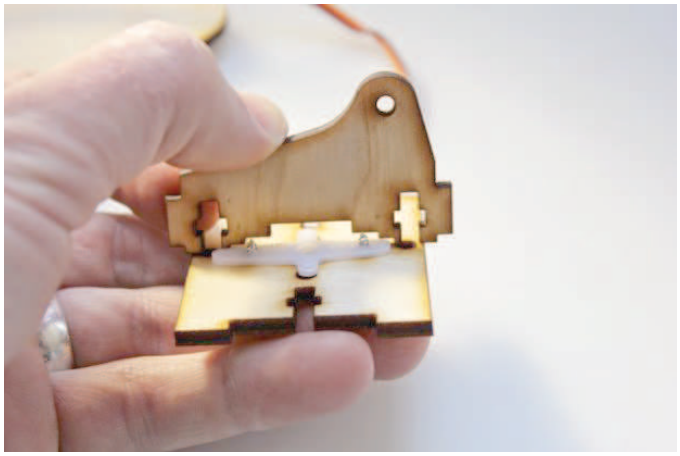


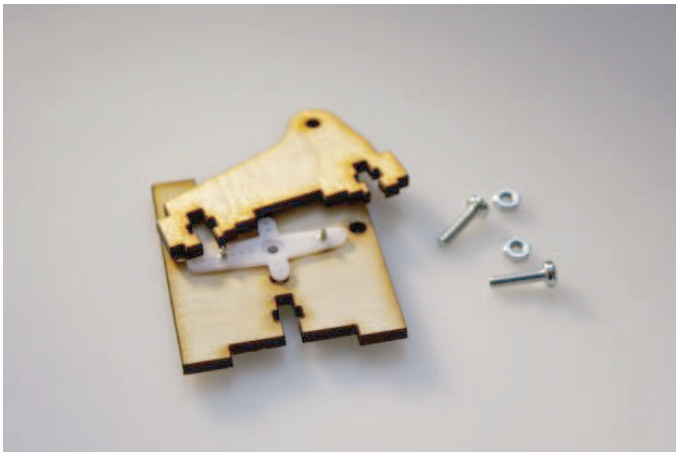


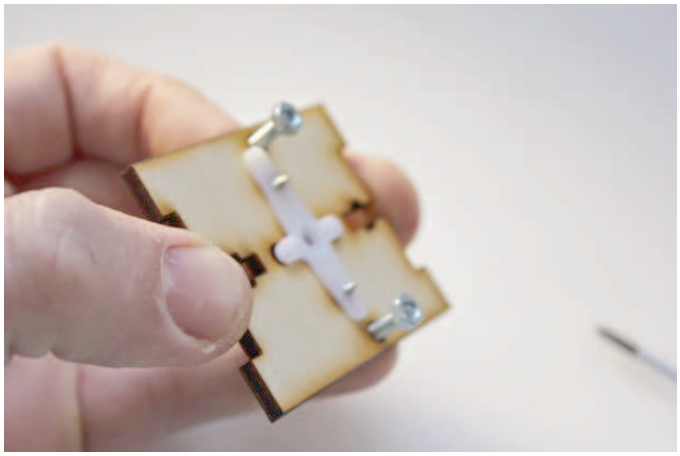


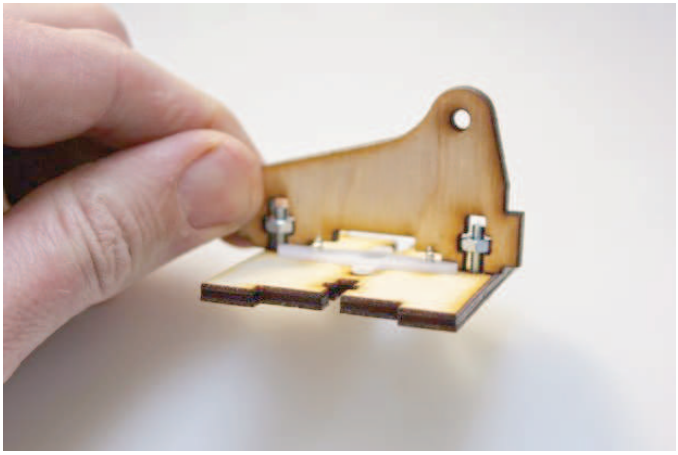


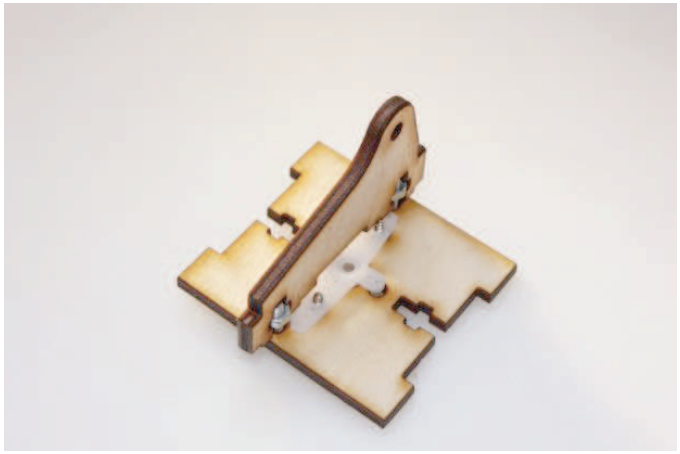
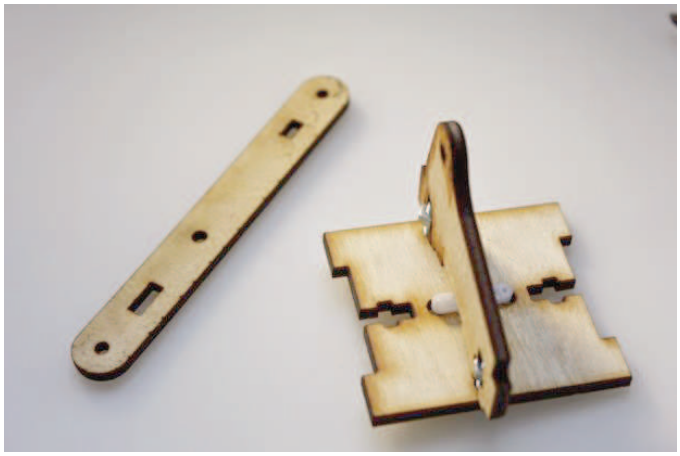
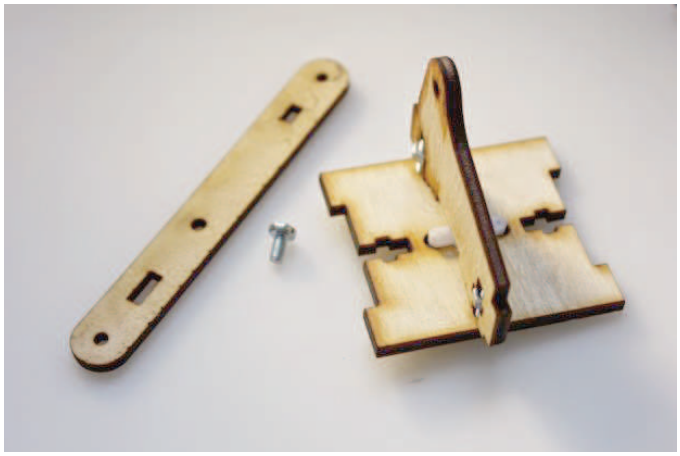
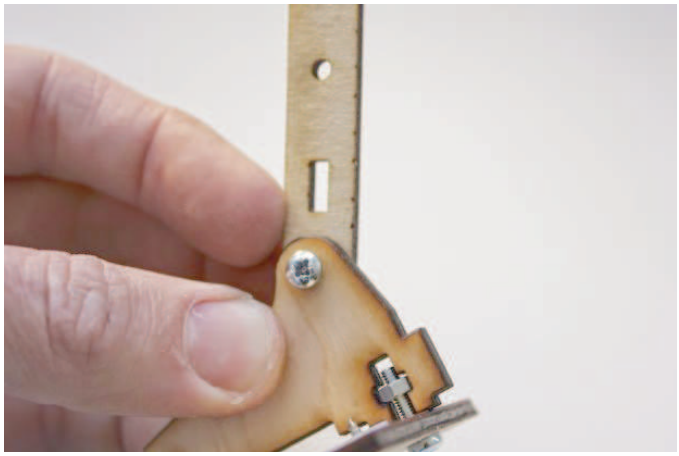
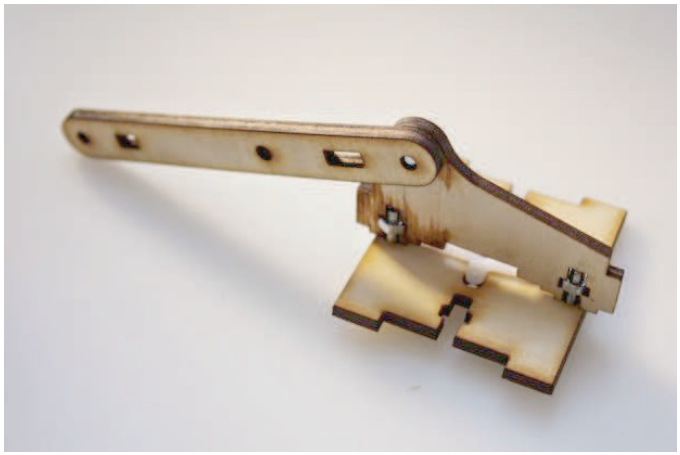
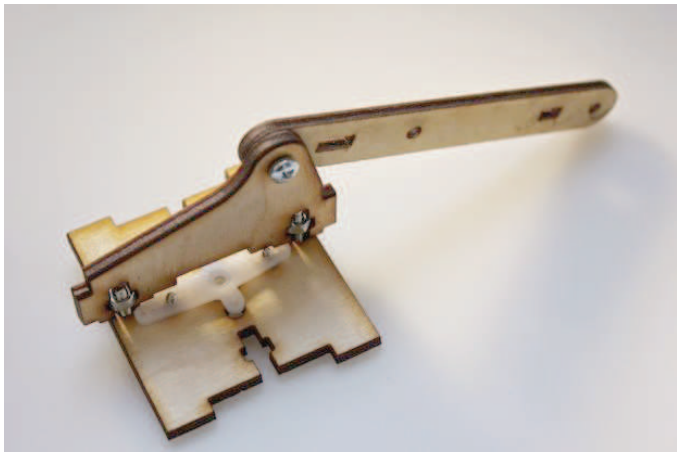










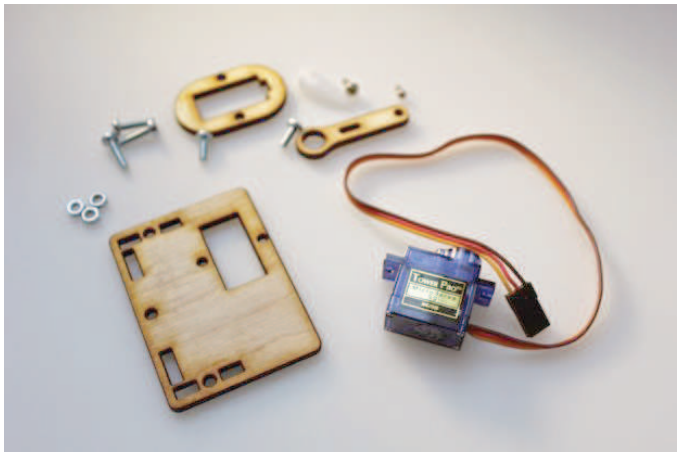







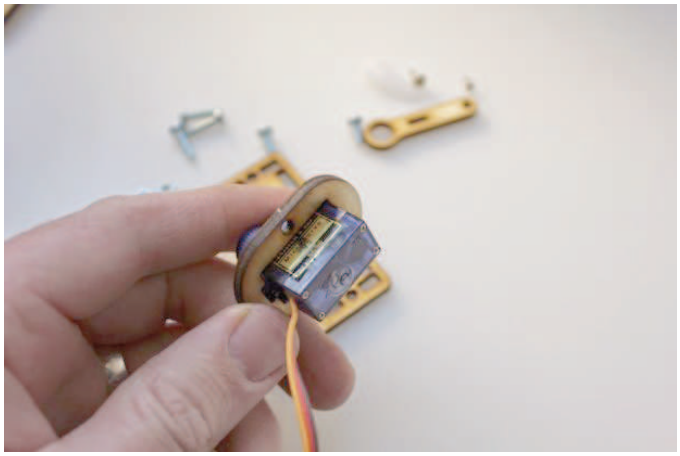
Step 5: Building the Left Shoulder

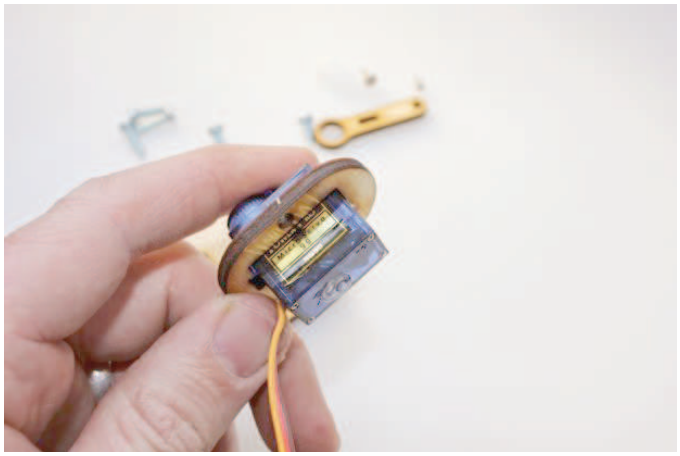
Offer the larger part shown here up to what you've just put together. The hole for the servo should go to the front in line with the bicep. We should key these parts to make it impossible to put the wrong way around. You won't get far with it wrong but it is annoying!

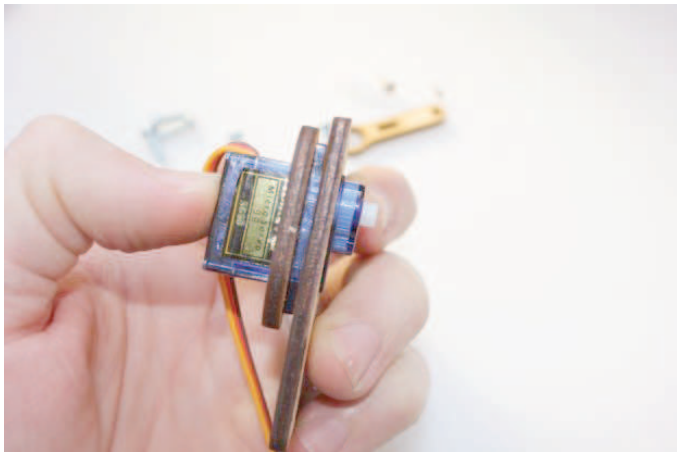
Add the collar to the servo as earlier, and insert from the outside using the two 12mm screws.

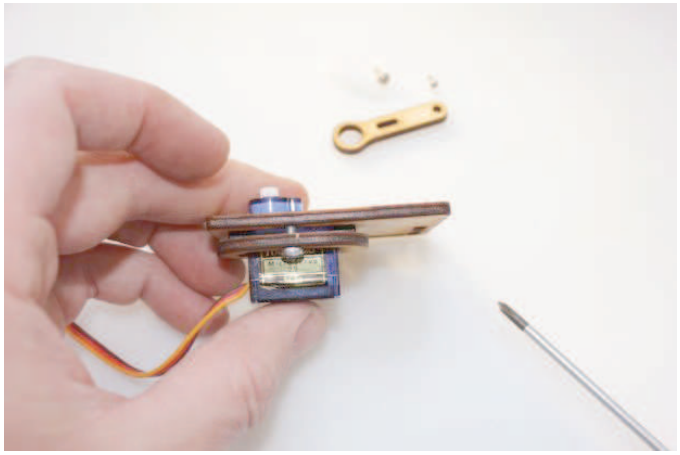
Attach the small arm to the single servo horn using the method from before. This time we're going to attach it. Look at the images below. These should be the far ends of your servos movement and it should rotate away from the holes on the base.

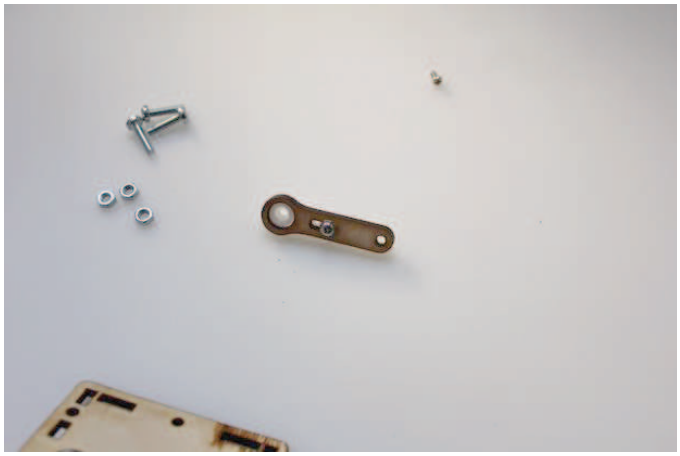


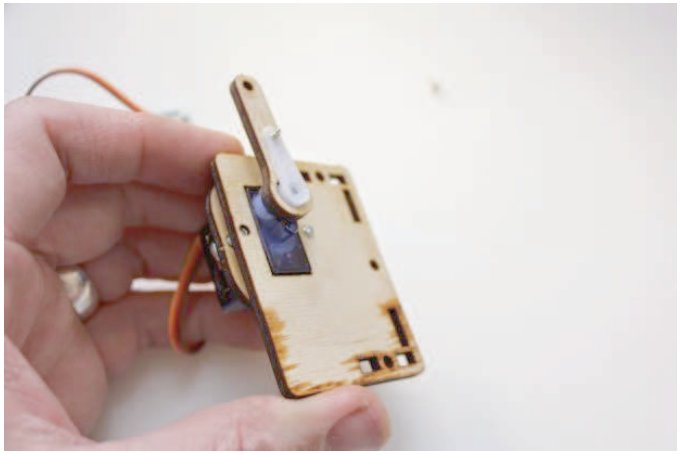


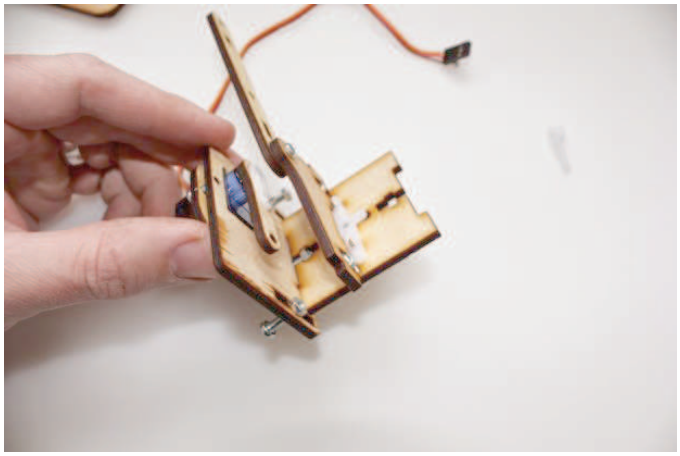


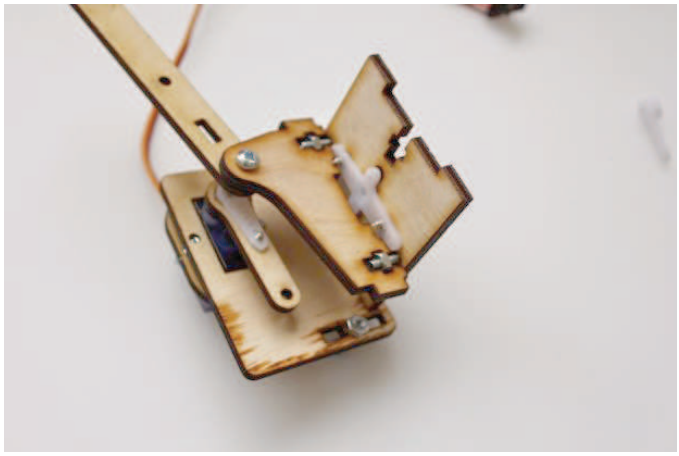










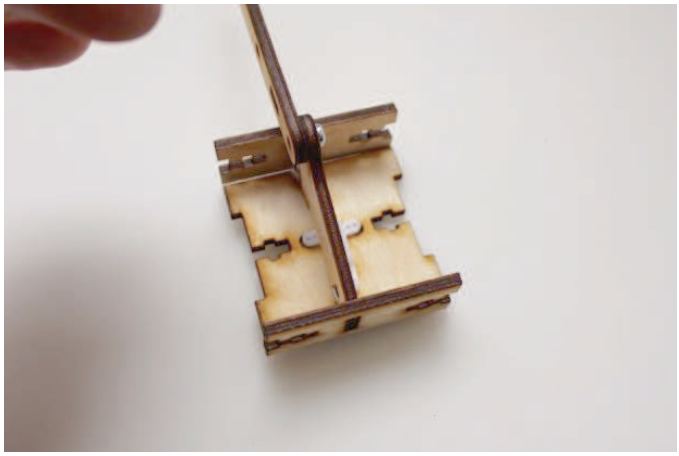


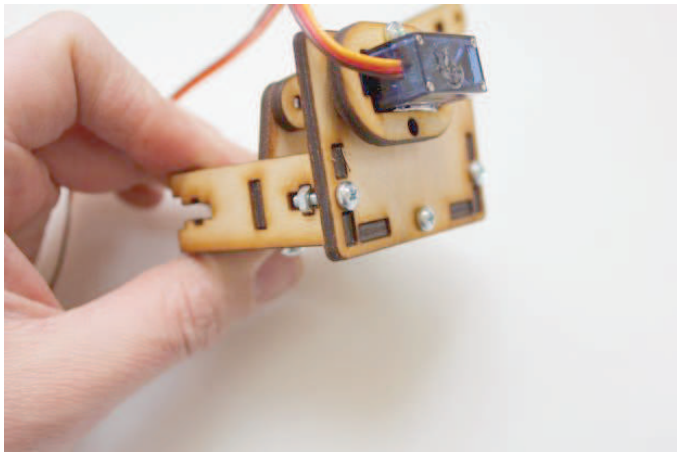
Step 6: Attach Left Shoulder to Waist

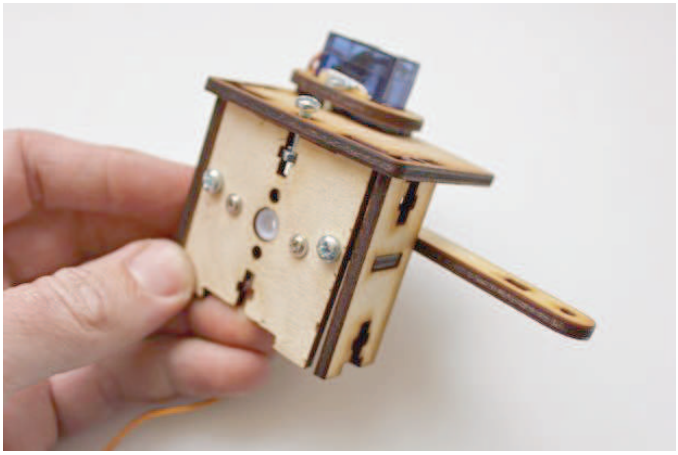
First you're going to push on the two end pieces, it will all be screwed together soon so don't worry if they move about a bit.

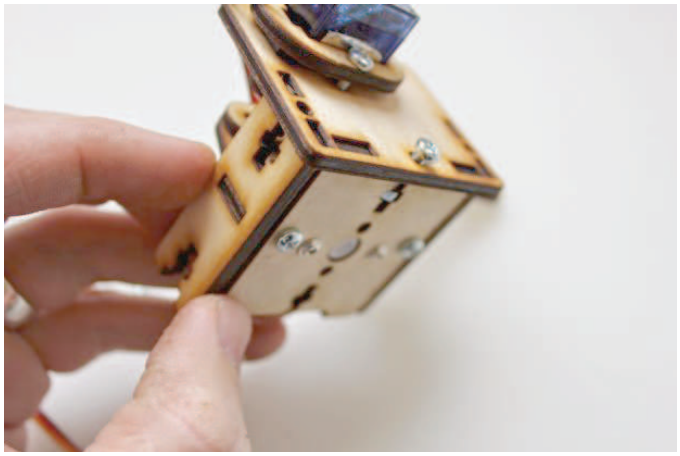
Now push on the assembled left shoulder. In v0.3 there are three fixings to screw in but I think we'll probably lose the bottom one and make some improvements to the base plate of the waist.

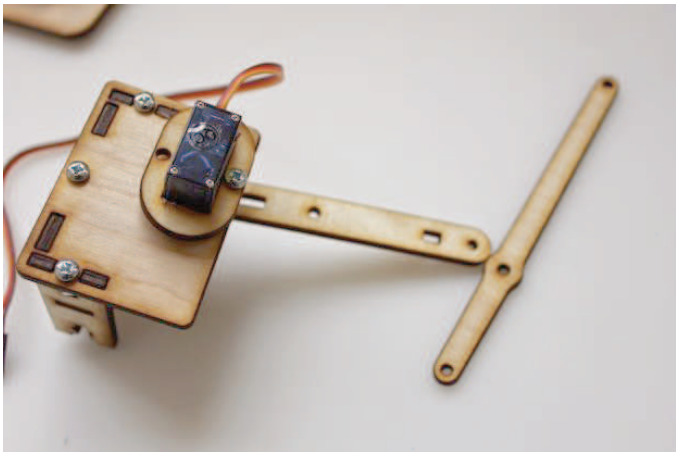
Now that's attached we're going for some easy wins. Attach the parts shown below with 6mm fixings to gain a controllable forearm! Grab a 12mm screw and nut and add the central part of the bicep.

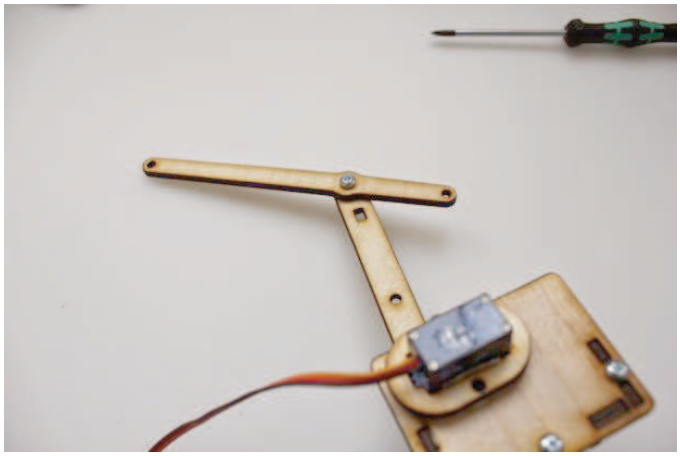


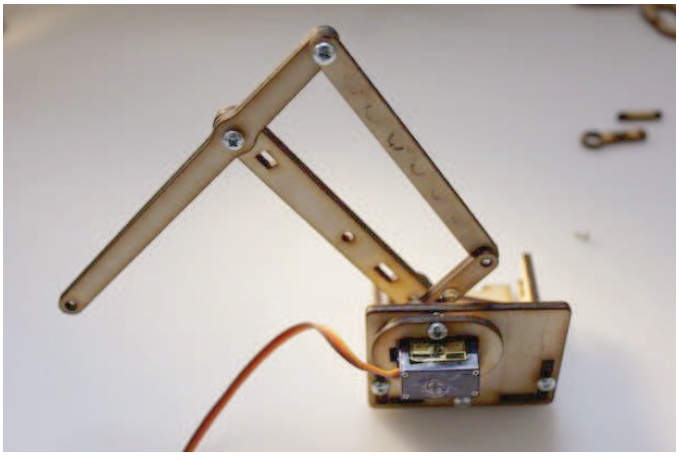


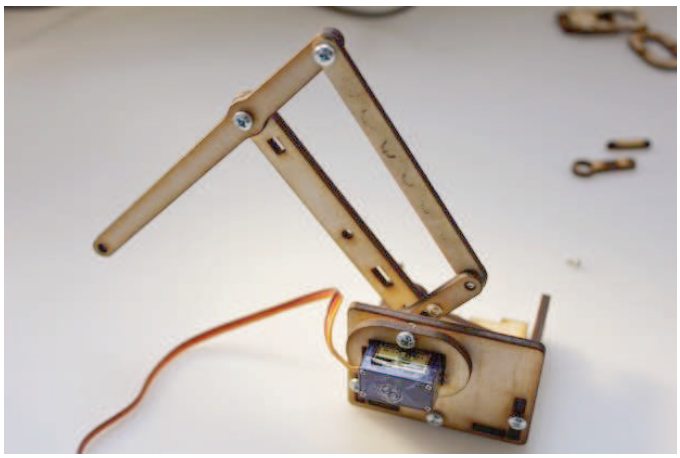


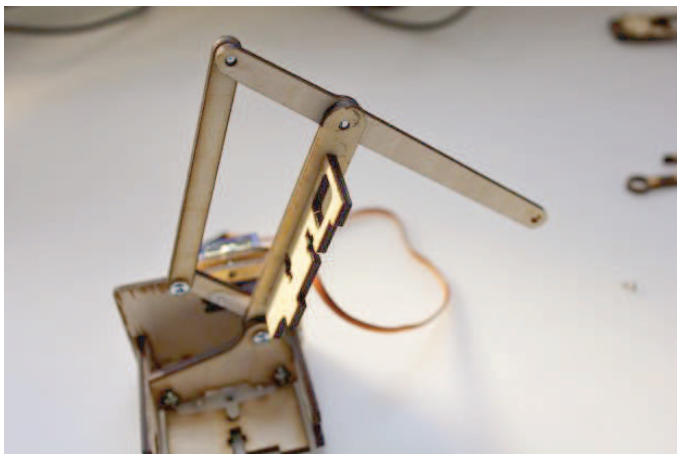


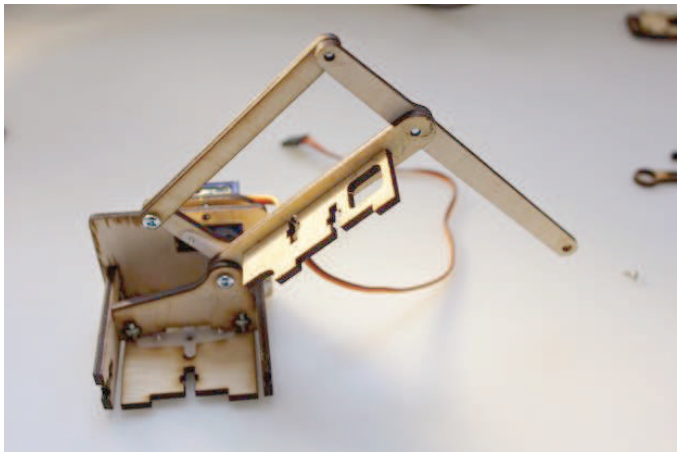


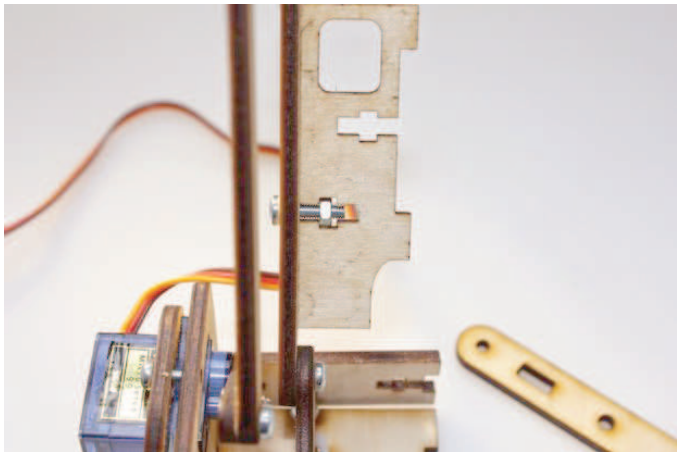






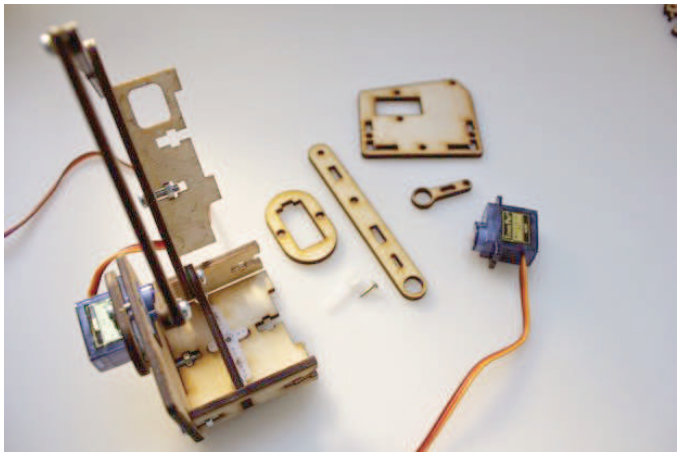


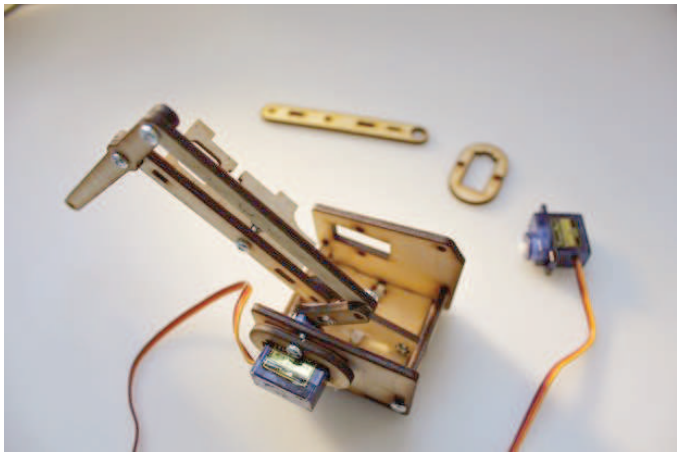


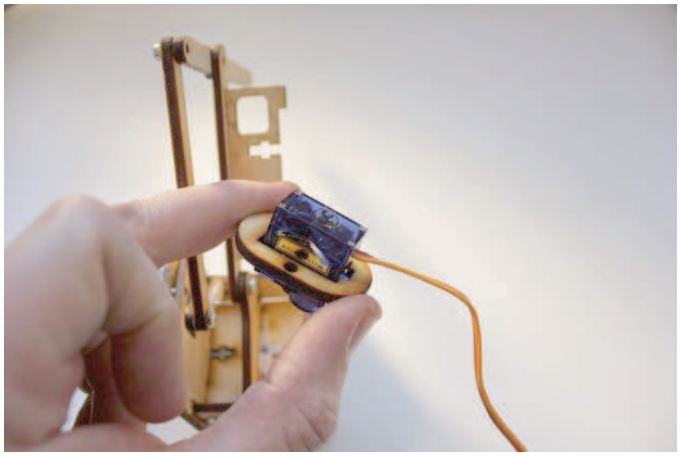


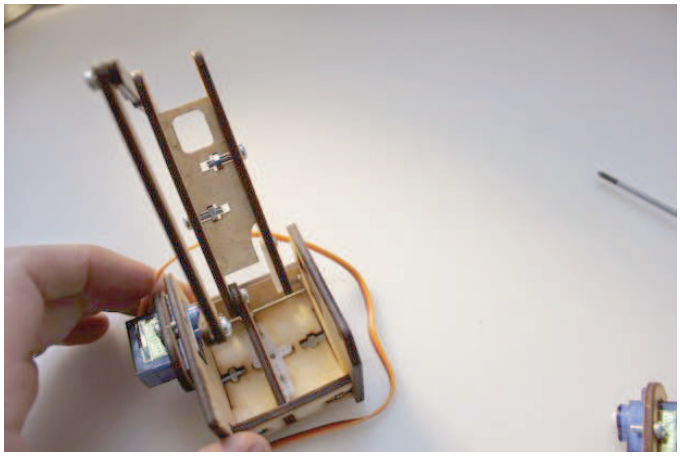
Step 7: Right Arm Construction

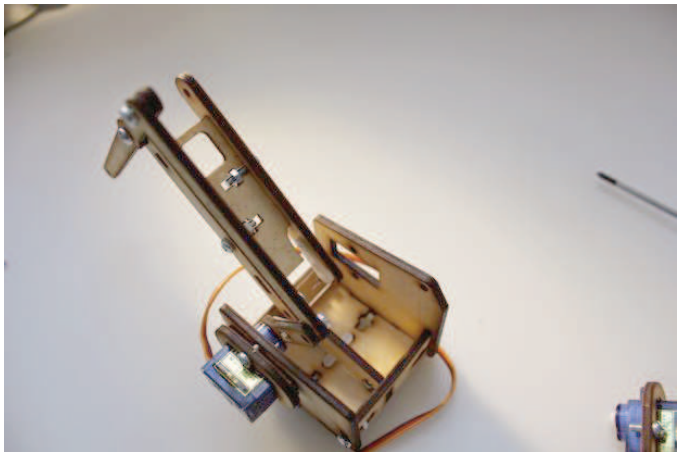
You should be fairly used to the construction techniques by now so see how you get on with just images here.

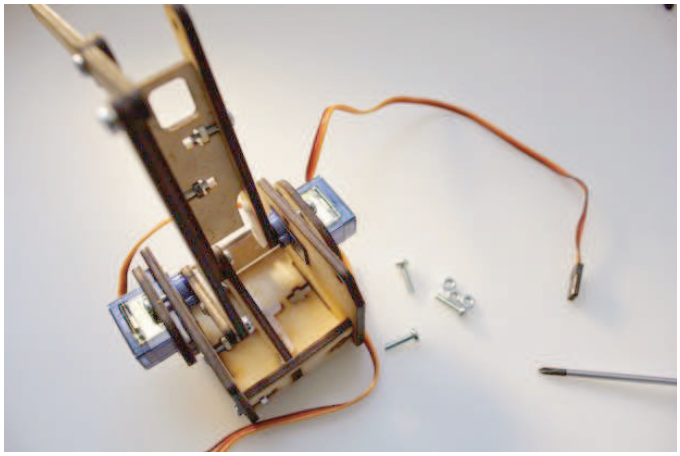












Step 8: Add remaining arm parts!

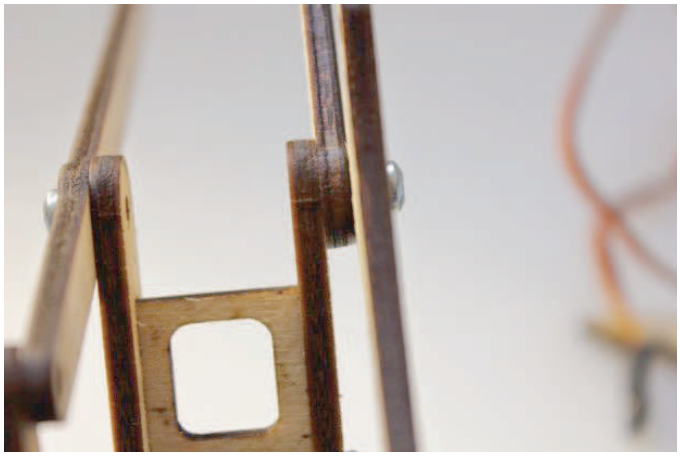
Now don't worry about the gripper in this image, I went ahead and built it but we'll do that next. Add the remaining arm parts next as well as the triangular part that keeps the wrist fixed.

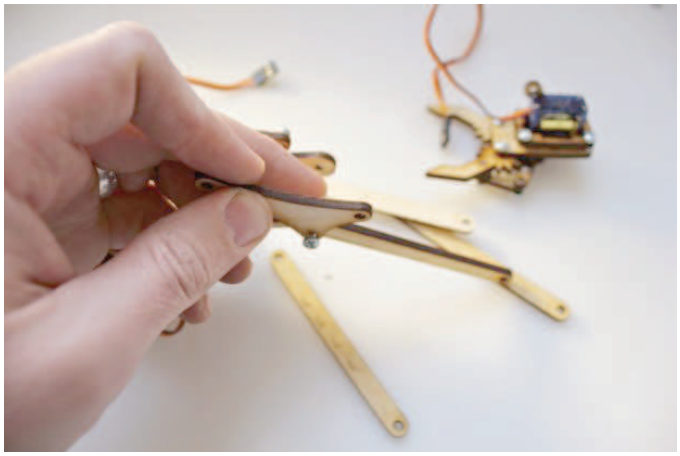
Grab the two 10mm screws for this.

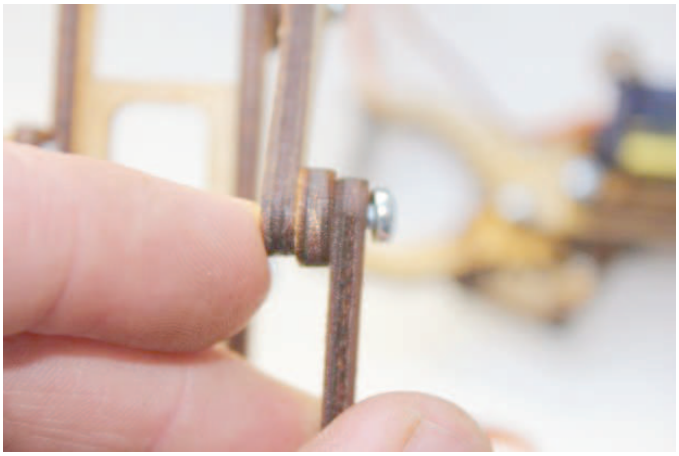
You'll want the triangle part on the outside, the remaining forearm length in the middle, all attached to the bicep. The forearm is different from the other two long bits you have left which should be identical.

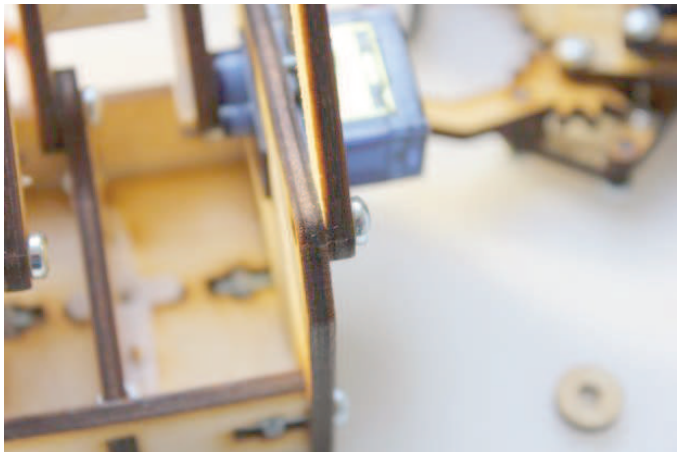
Secure the back of the triangle with a spacer the last 10mm screw and one of those two identical parts. The other end of that part will attach to the back of the right shoulder with a 6mm screw.

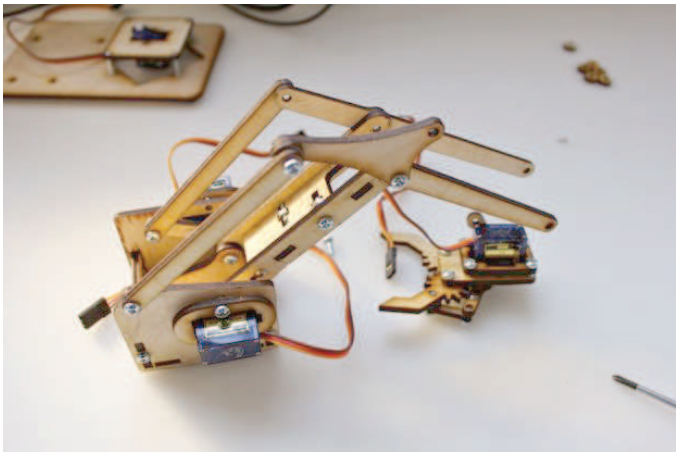
Now lets build that gripper.

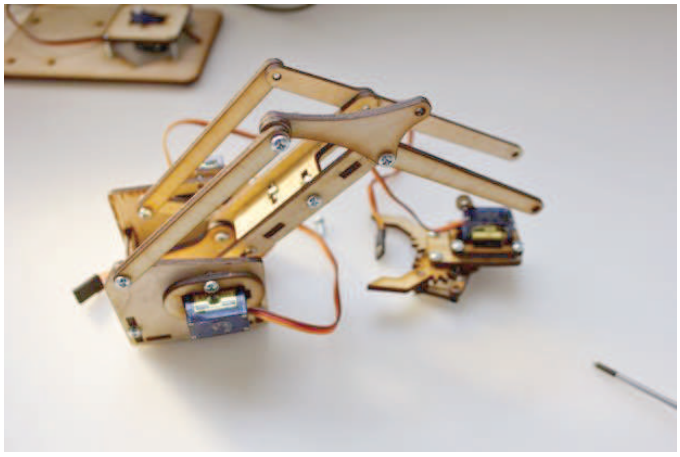






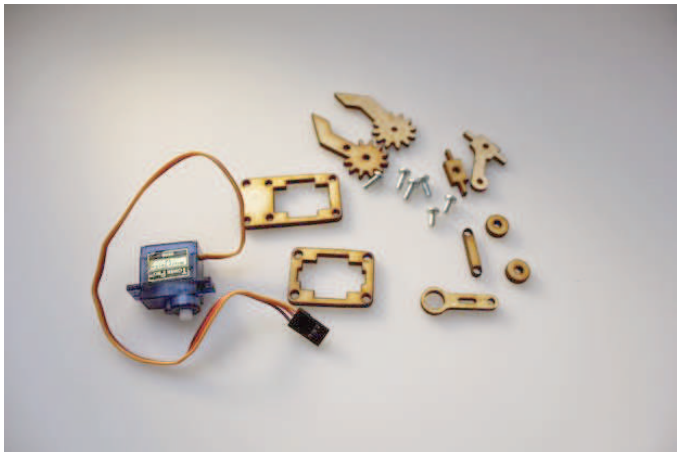


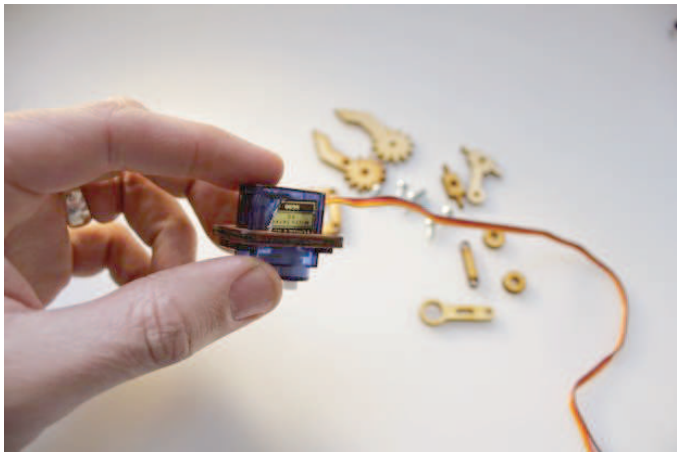


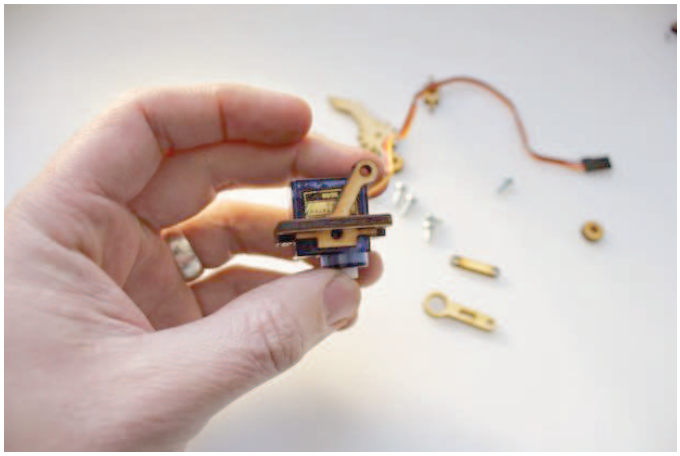


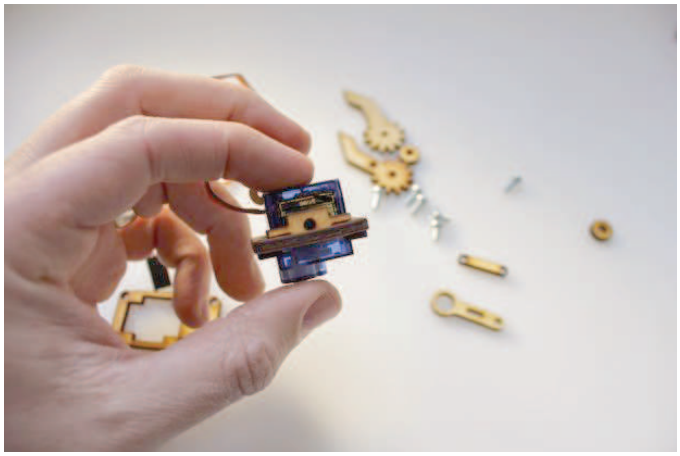
Step 9: Gripper!!

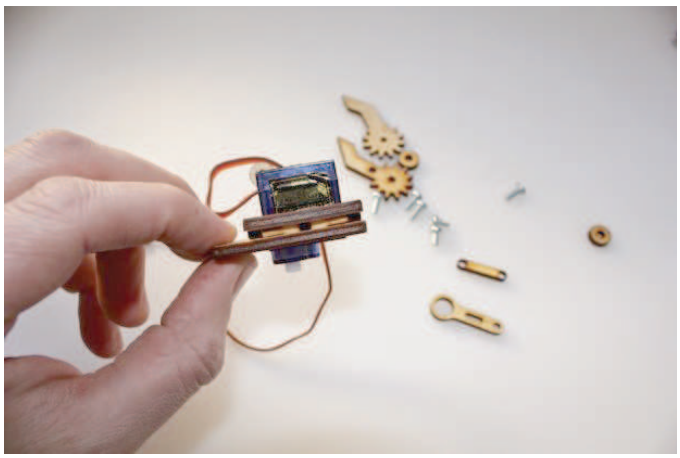
The gripper is the most complex part. We'll let the pictures do the talking here as there are a number of steps. One thing to note is that most images show two spacers and only one is used. Making two spacers in the whole build. You'll have some spares!
If you find yourself building this part and thinking "my that is clever" that was all Jack Howard. If anything needs more detail please let me know!

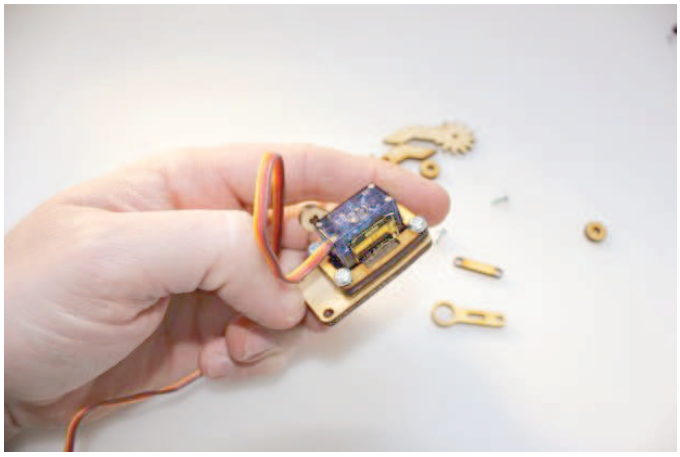


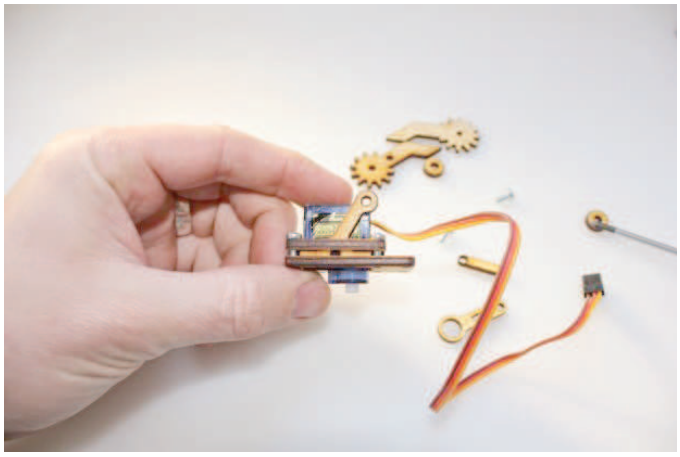


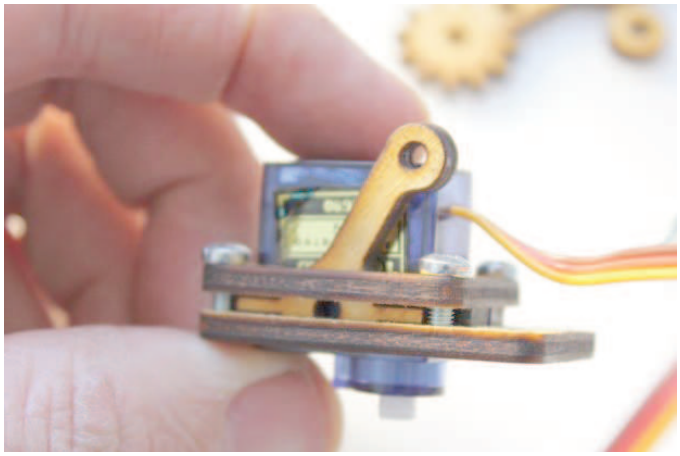


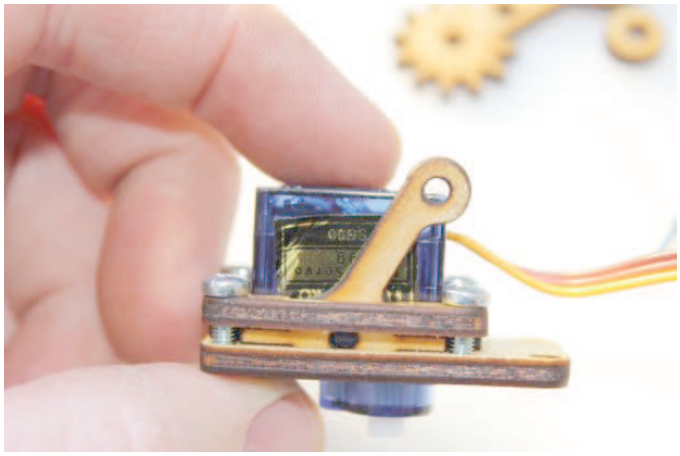


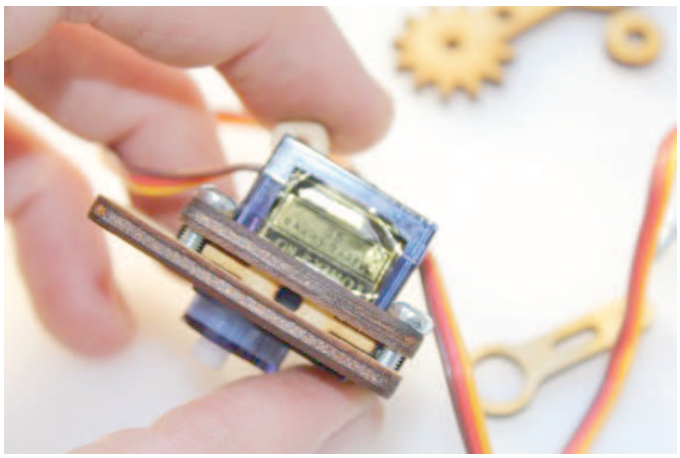


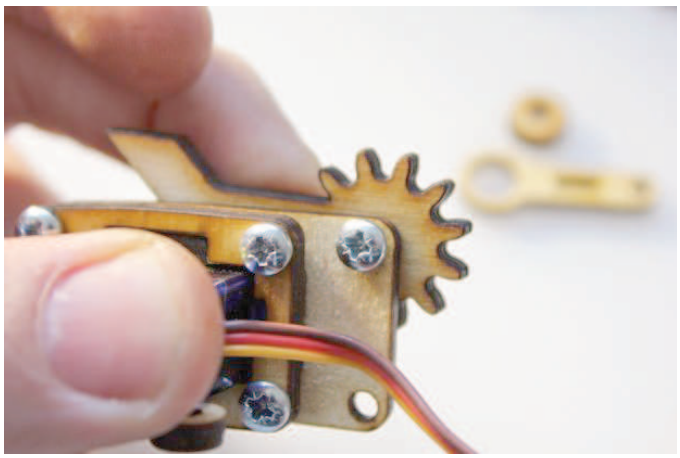


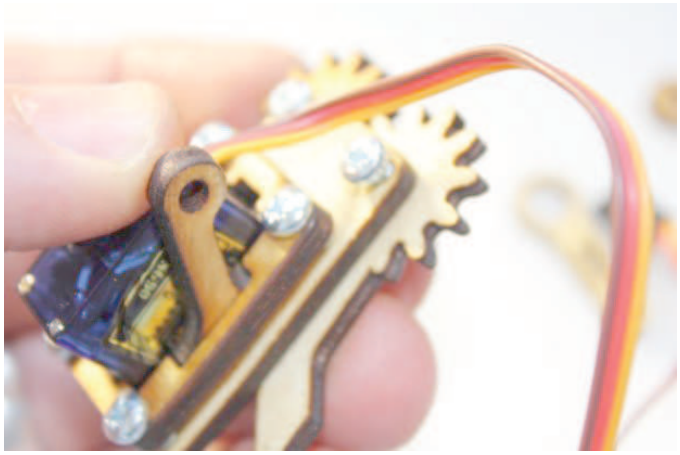


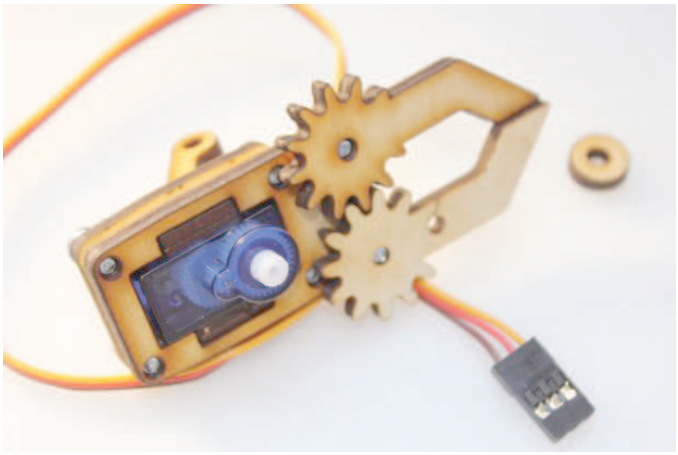


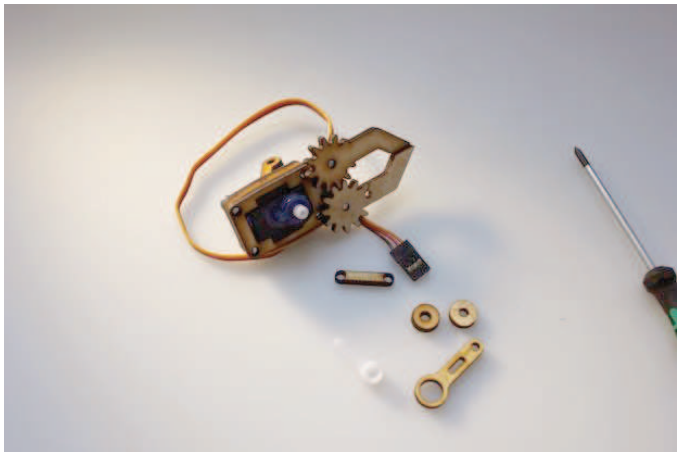


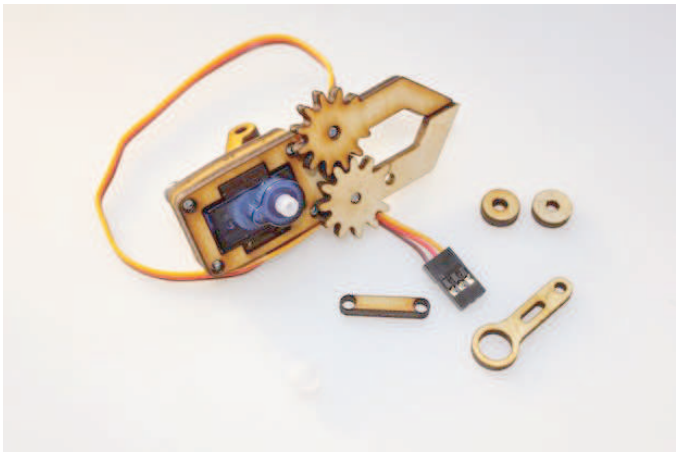


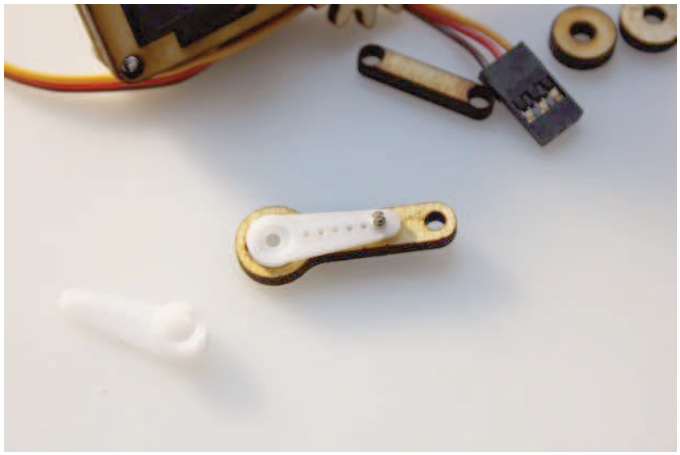


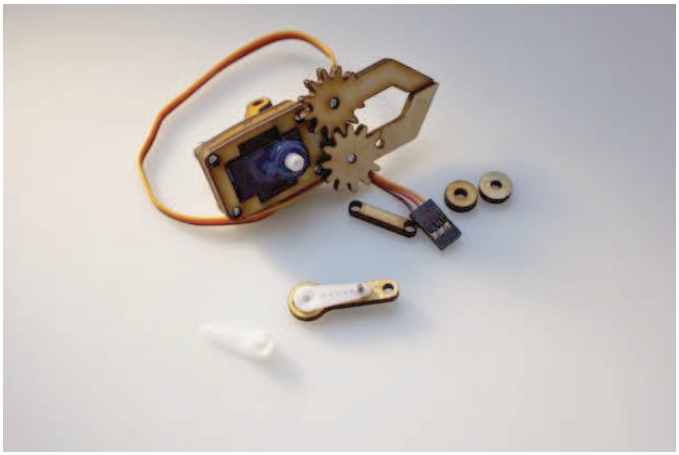


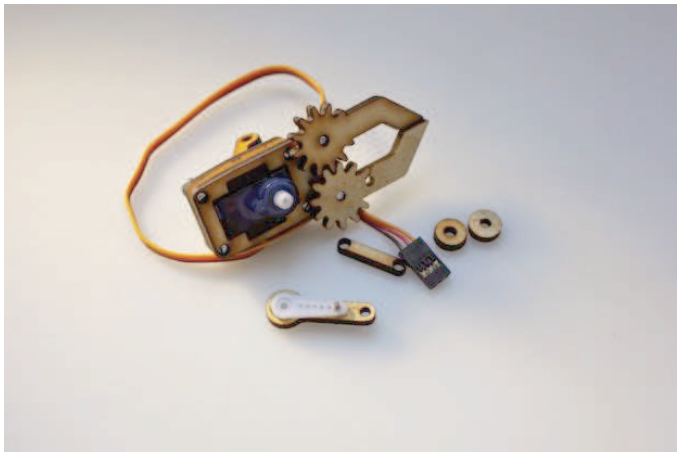


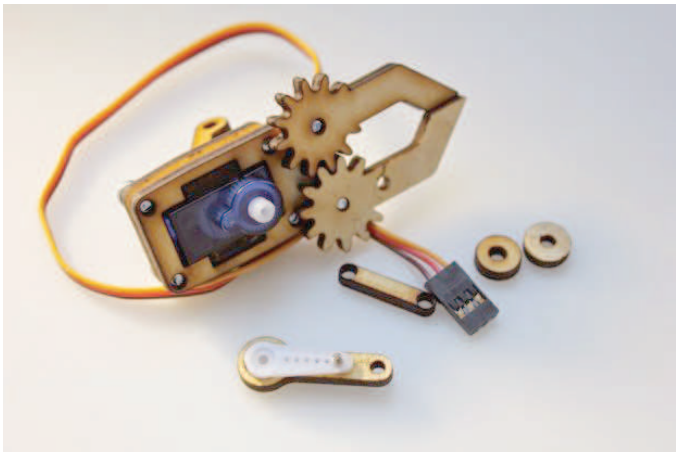


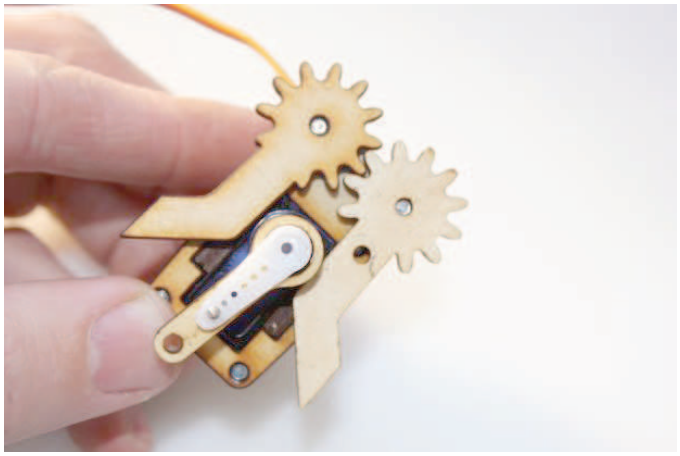


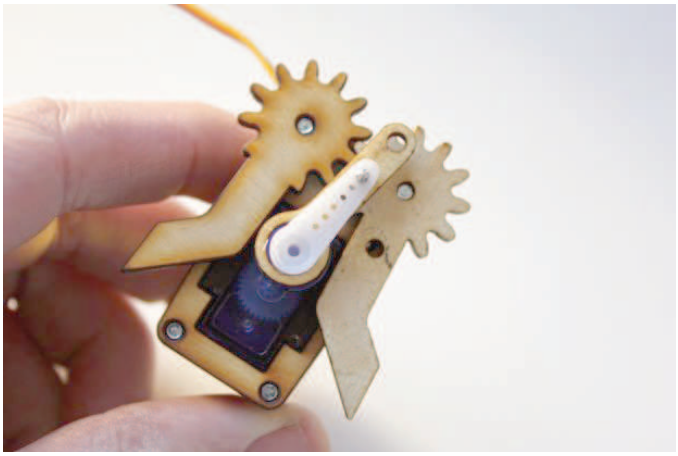


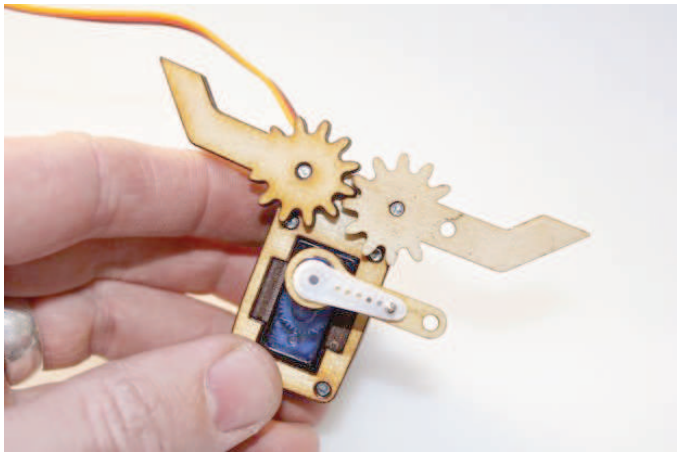


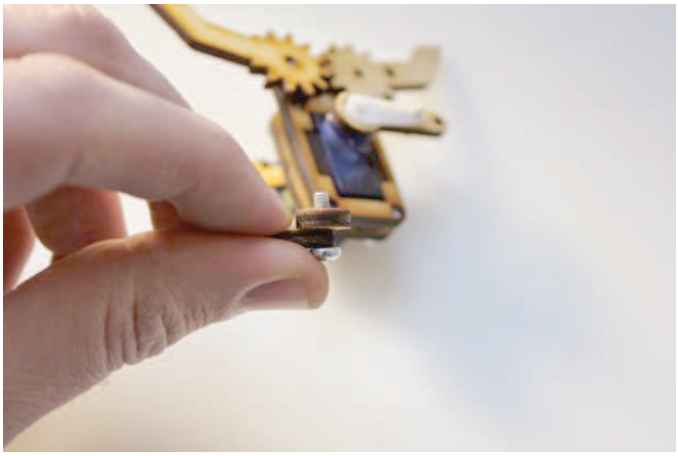


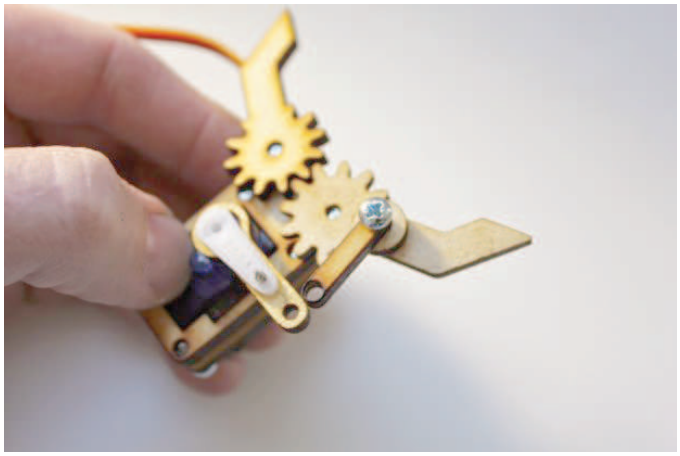


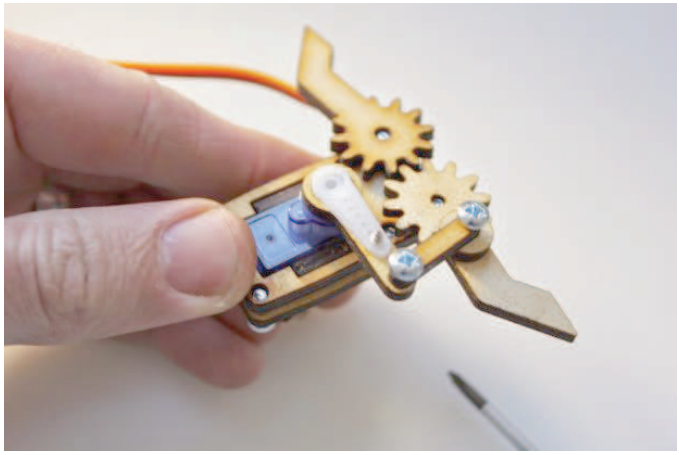


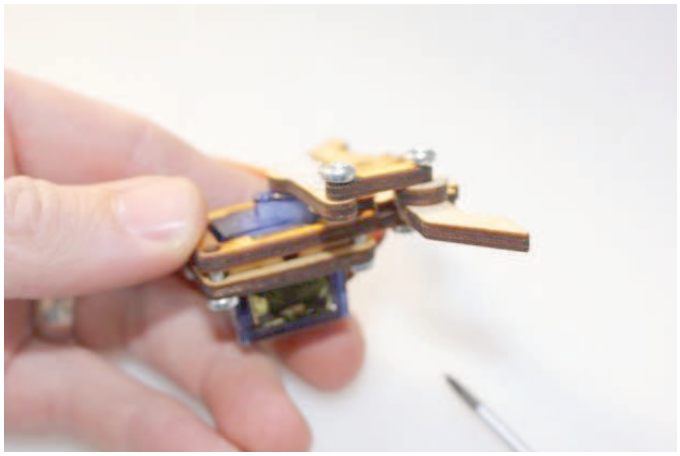










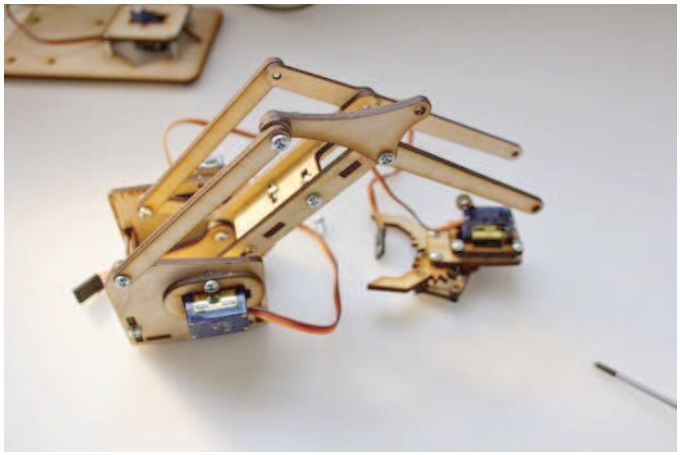


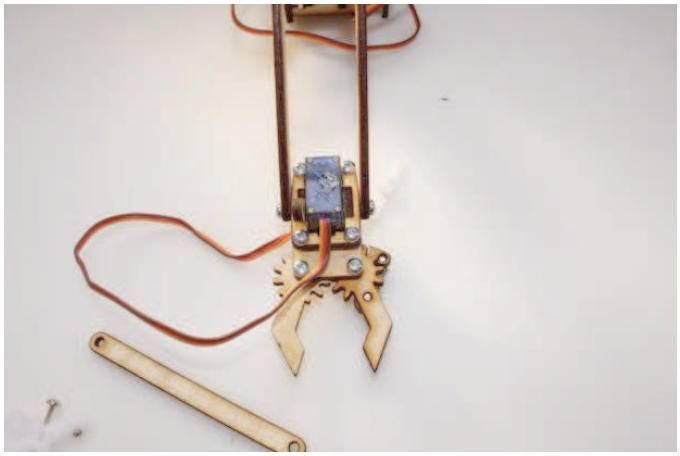
Step 10: Attach the Gripper and Fix to Base

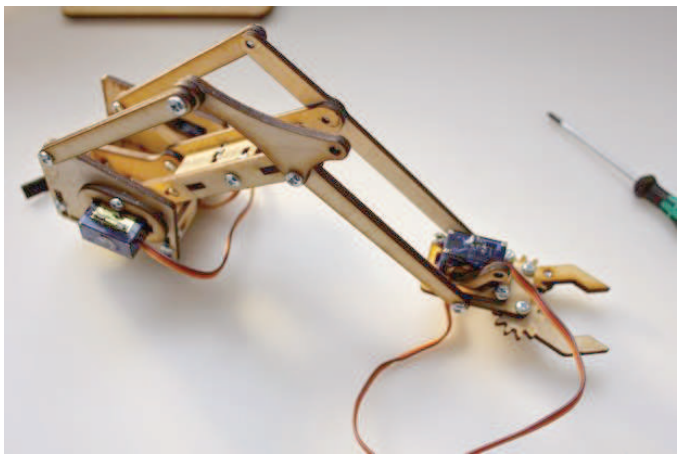
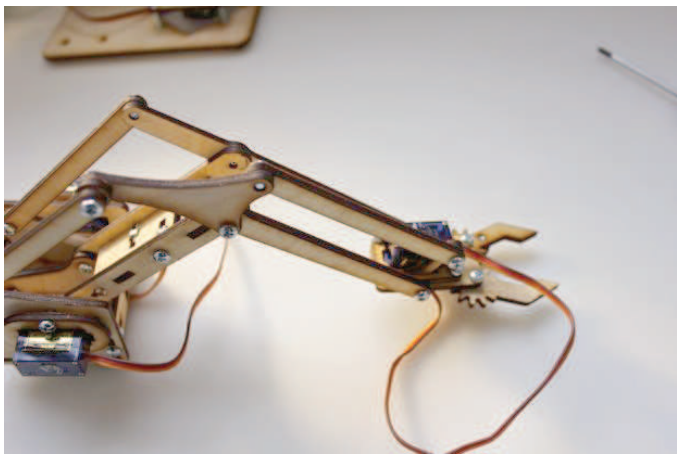
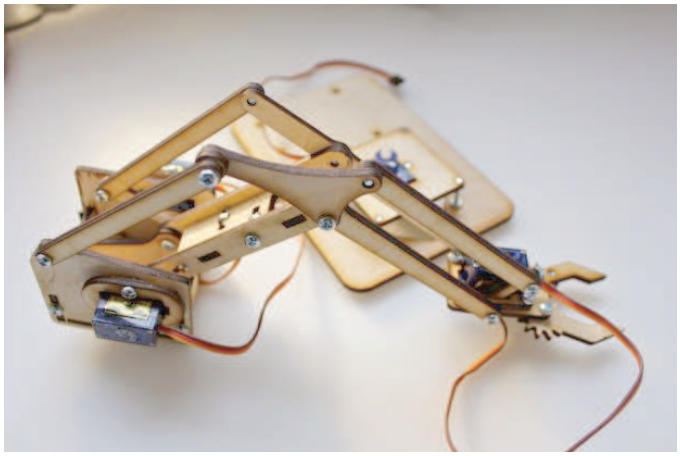
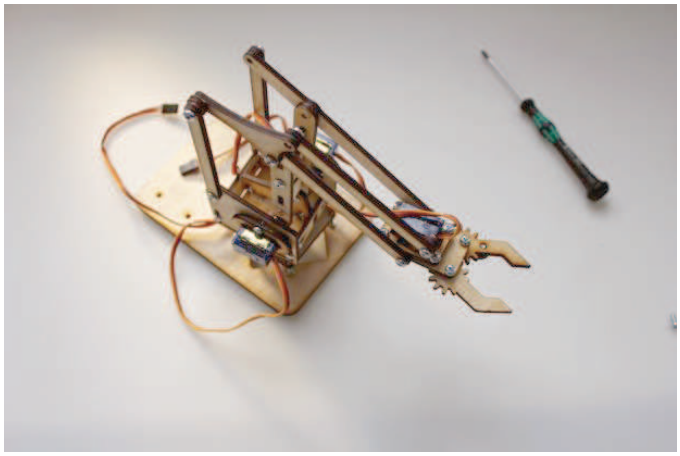
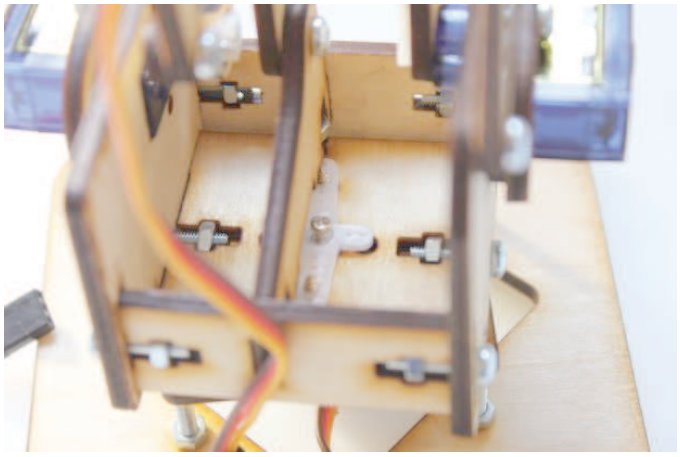
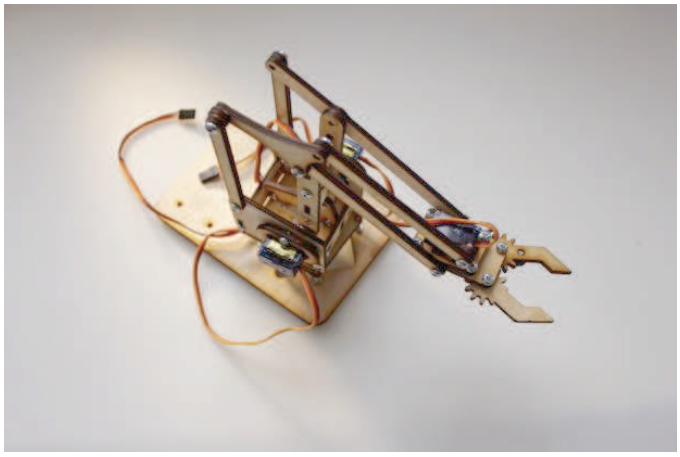
This is the last bit. Just need to attach the last long part with a 6mm screw to the triangle part and the other end of it to the high part on the gripper. Then two 8mm screws through the ends of the forearm parts and into the side of the gripper. These cut slightly on their way to the holes so try to be fairly accurate when lining them up.

Next you'll want to take the whole construction and add it to the base we made in part one. Use the screw that came with the servo to secure the base.

That's the mechanical part done!





Step 11: Stand back, admire, think about controlling it

Now it's finished you'll want to control it. One of the simplest ways is with an Arduino and four potentiometers.
We have a simple sketch on GitHub to do just that.

- Github Arduino Sketch

With this sketch manual control is fairly easy and you can get started with coding or just playing, which is where the project is at the moment

Please let us know what you think!