

Pocket Sized Robot Arm #meArm V0.4

by [phenoptix](#) on July 29, 2014

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Author:phenoptix phenoptix - LEDs, Arduino, Etc

a UK based purveyor of cool things and open source goodness. A member of instructables since 2006 we're currently cruising at an improving 0.875 instructables a year...

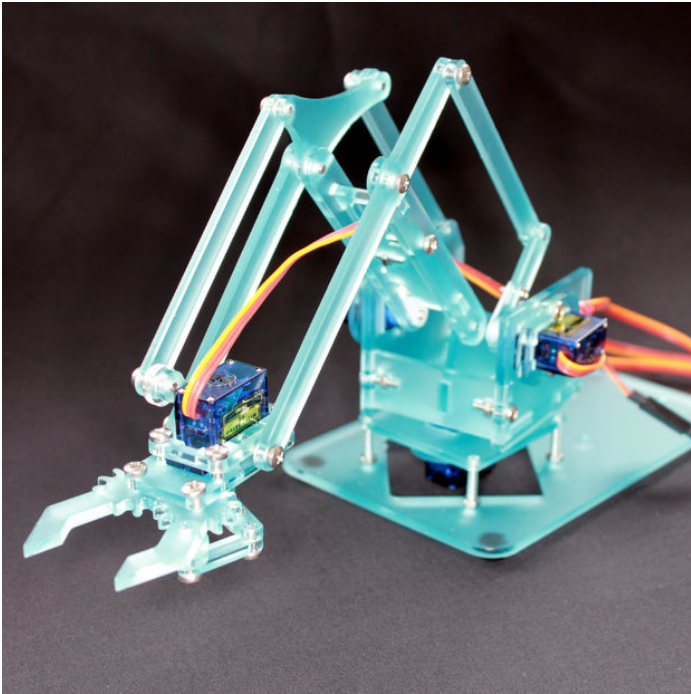
Intro: Pocket Sized Robot Arm #meArm V0.4

The #meArm is a Pocket Sized Robot Arm. It's a project started in February 2014, which has had a fantastically fast journey to its present state thanks to it Open Development as an Open Hardware project. Version 0.3 was featured on Instructables back in April 2014 and we've seen it built all over the world, from its home in the UK to the USA, Mexico, Switzerland and Japan to name but a few.

All of the previous builds have helped us iterate a thousand tiny improvements to the current version the v0.4 which is most likely going to be our v1.0.

All of the previous versions and this can be found on [thingiverse](#).

This guide covers how to build the v4.0. Currently there is code available for the [Arduino](#), [Raspberry Pi](#), [Beaglebone Black](#) and [Espruino](#).



File Downloads



MeArmV0.41.pdf (1 MB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'MeArmV0.41.pdf']

Step 1: Gather your parts!

The #meArm was designed with economy in mind. It is understood that laser cutters aren't the most common tools but there are more of them out there now than ever! First you'll need a set of parts. Grab the [dxf](#) and use a cnc mill or laser cutter. For the v0.3 we also had people 3D print the parts. If you get a kit from us or order the parts in acrylic you'll have to remove all of the protective covering. It's not the most fun job but the end result is better!

Next you'll need all of the screws and nuts. We use M3 (metric 3mm) standard parts. The number of these to build the latest version is:

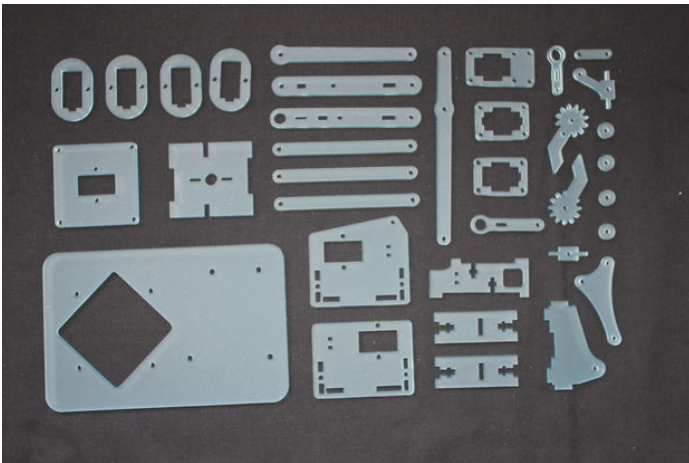
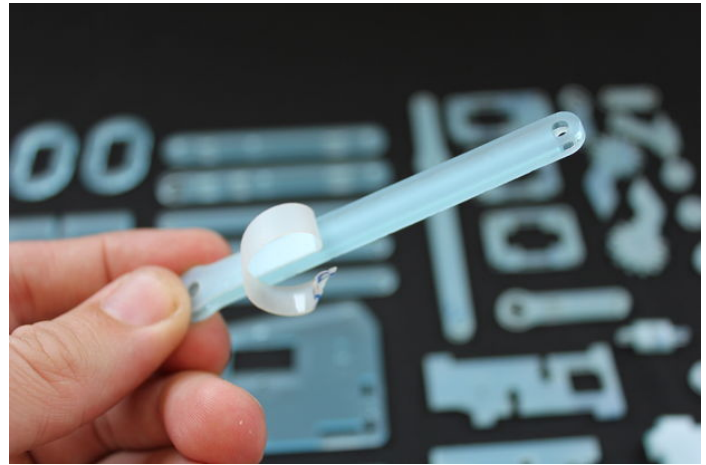
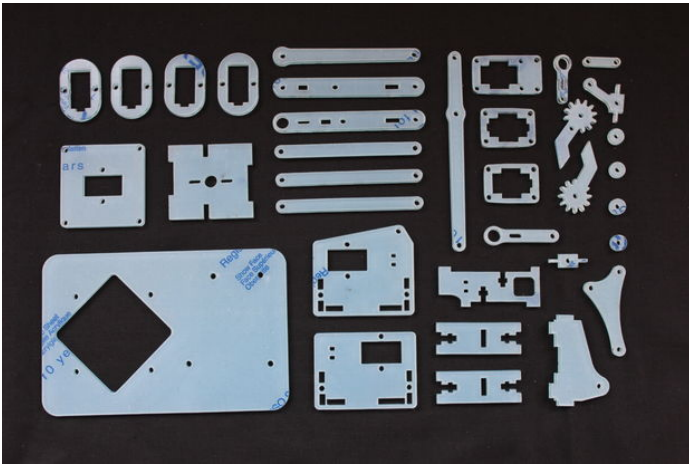
Nut x 10
6mm x 9
8mm x 12
10mm x 3
12mm x 7
20mm x 4

You could no doubt find imperial sized counterparts, as a nation you managed to get a man to the moon with foot pounds per square inch so I'll leave the conversions in your capable hands (in case of residents of Liberia or Myanmar ignore the bit about the moon).

You'll also need 4 hobby servos. We tend to use the 9g resin gear ones. The metal gear ones with the same footprint are better but they're more expensive.

Phenoptix is a commercial operation (when I remember) and we do have [complete kits](#) available as well as the component parts.





Step 2: Prepare the base!

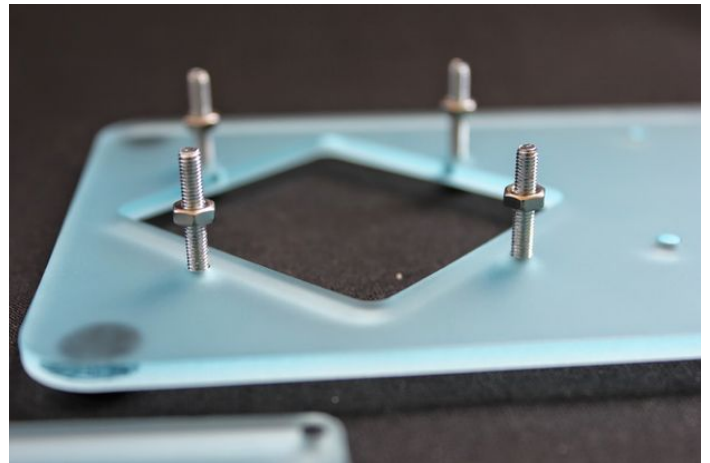
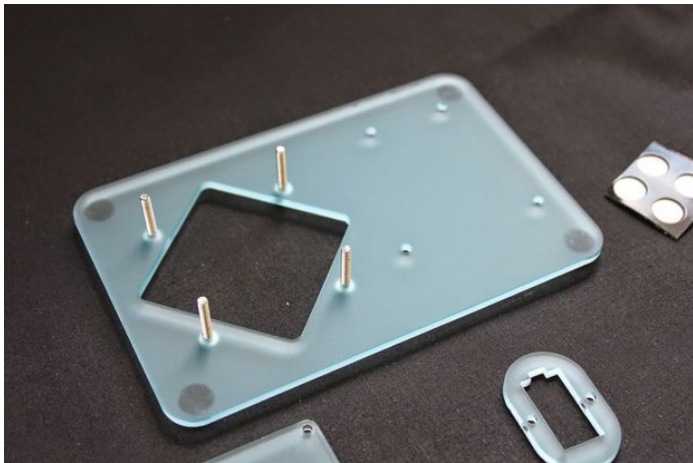
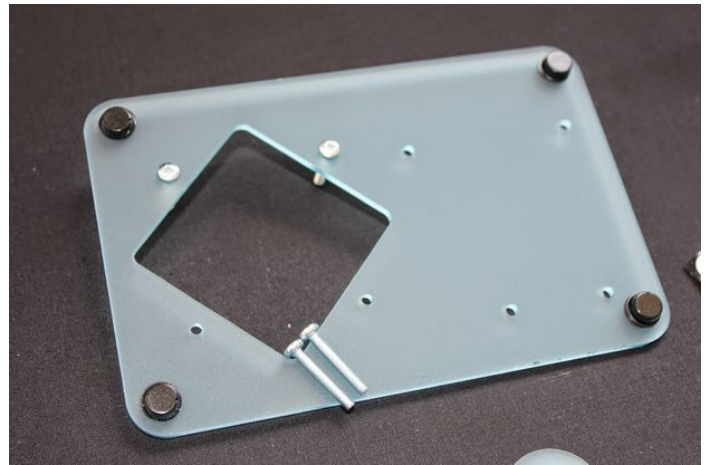
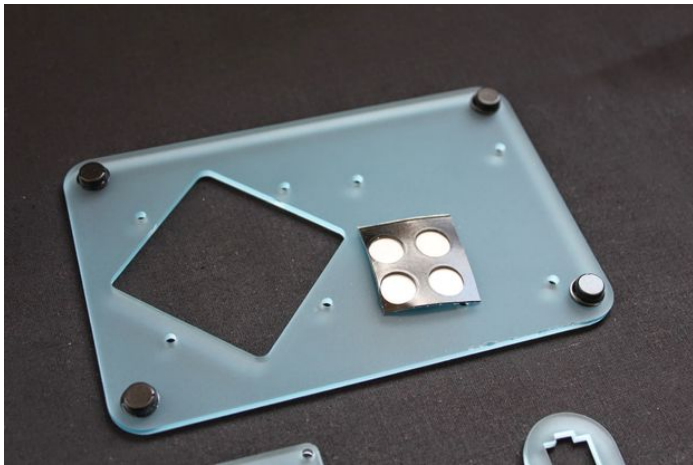
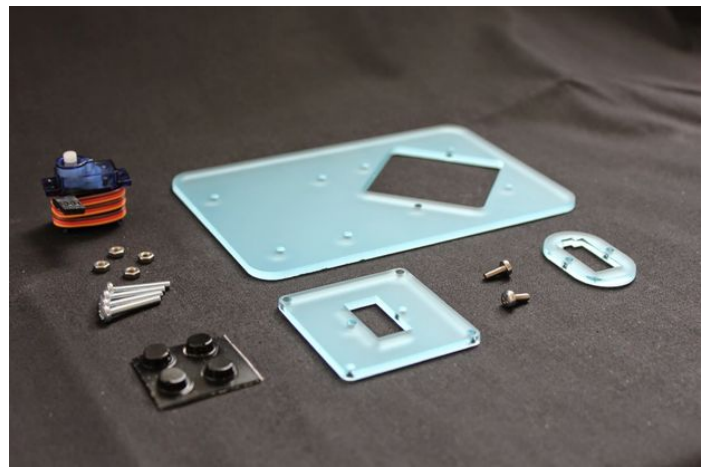
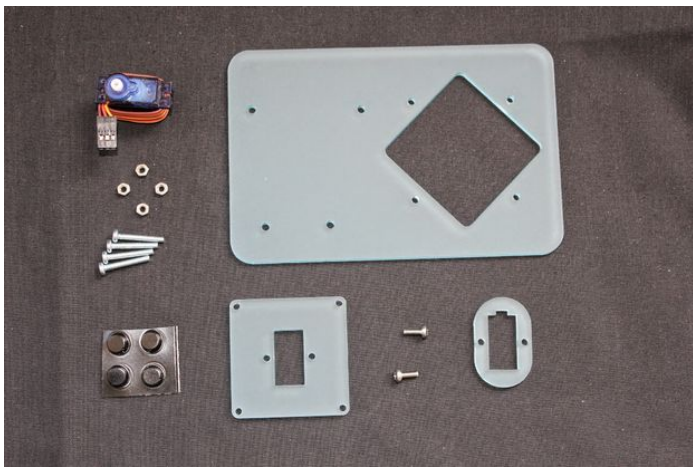
I like to get the base built first, it's a bit of a dull first step. But as Mao Tse-tung said "the journey to building a cool robot arm starts with a single, quite dull, step". I may be paraphrasing - but lets just get on with it eh?

The parts we use here are:

- Base - largest part you'll have
- Collar - one of the four supplied
- Square servo mount - fits directly into the hole on the base
- 4 x 20mm Screws
- 4 x Nuts
- 2 x 8mm Screws
- 4 x Sticky Feet
- 1 x Servo

First look carefully at your base. You'll notice that the holes cut into it aren't exactly square to the surface and have a slight angle to them, making the holes slightly conical. This is kerf, caused by the conical focus of the laser, throughout the build you can use this to your advantage. We'll call the thicker side of the holes the bottom of the base. Stick one of the four sticky feet in each of the corners of the base. Then start inserting the 20mm screws into the holes around the large square hole.

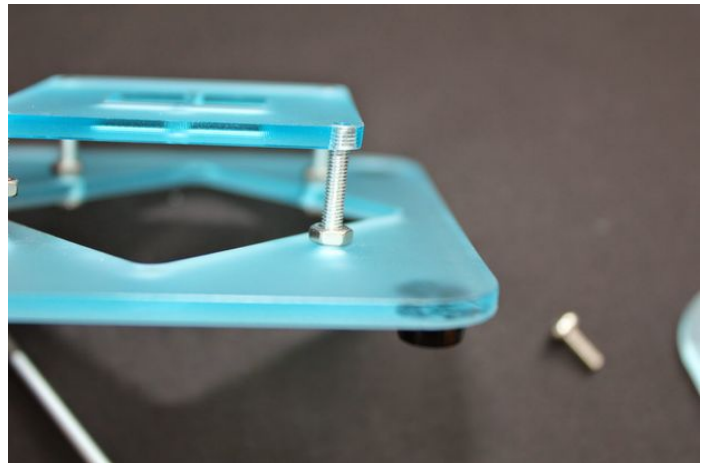
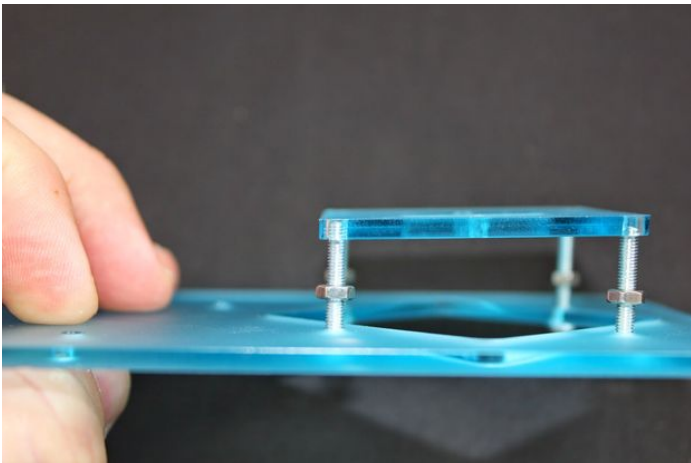
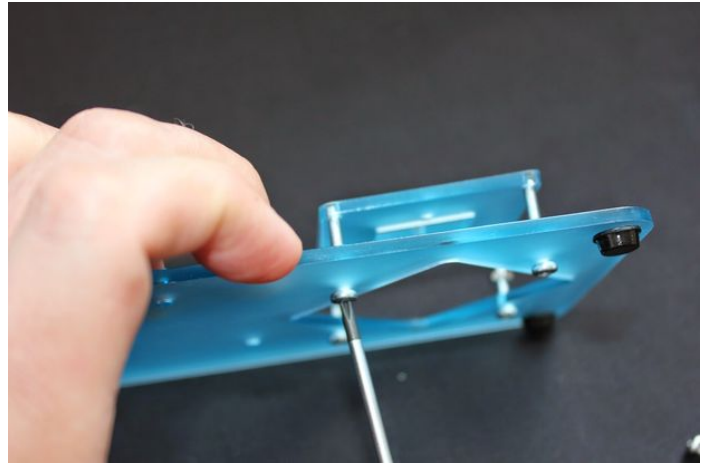
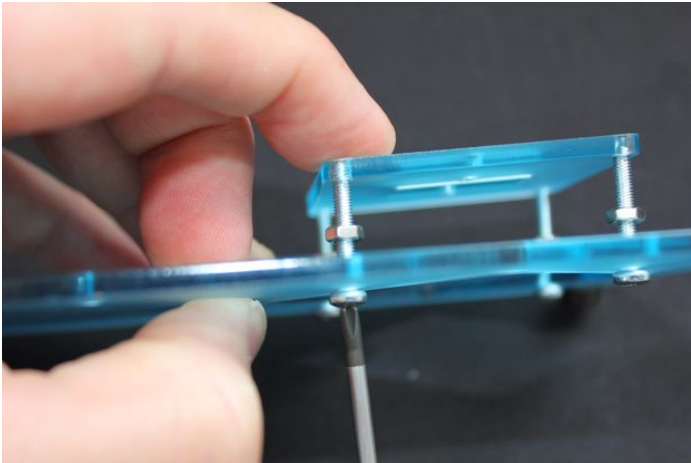
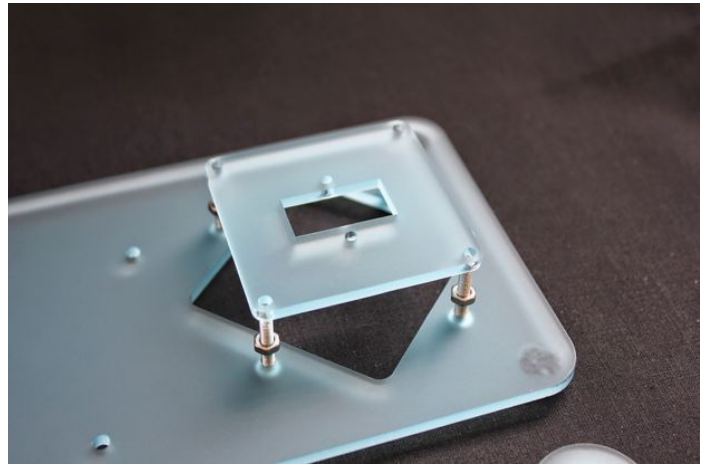
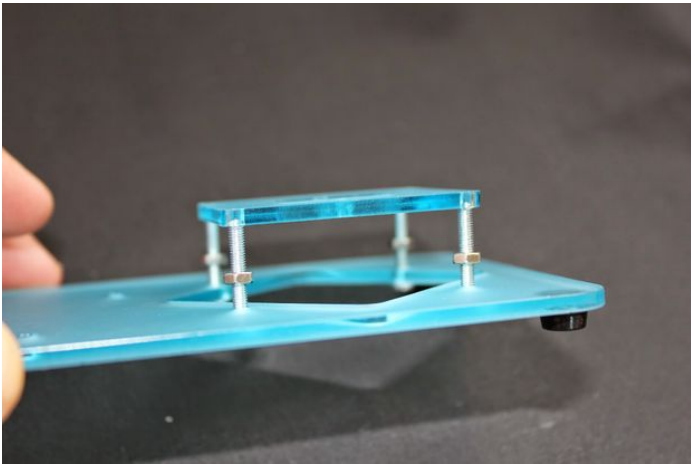
Now twist the nuts onto the 20mm screws from the top side until you're about half way down.

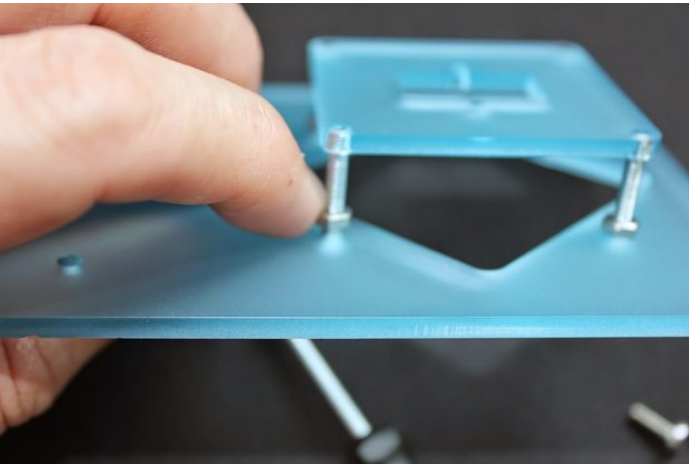


Step 3: Add the square

Next take the square part and place it on top of the 20mm screws, with the rectangle cut out in oriented the same way as the base (as shown in the picture).

With the holes on the square part lined up on the screws start to tighten the screws, they should start to self tap into the holes on the square part. Once you have screwed them all so they are flush with the top of the square part we'll move on and tighten the nuts down to the base board as shown.

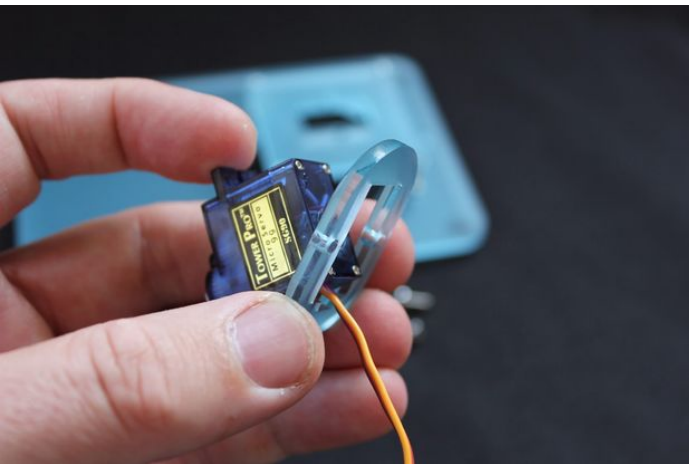
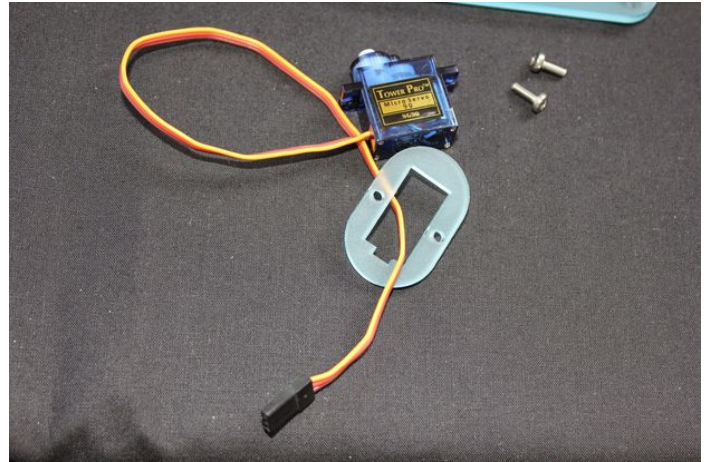
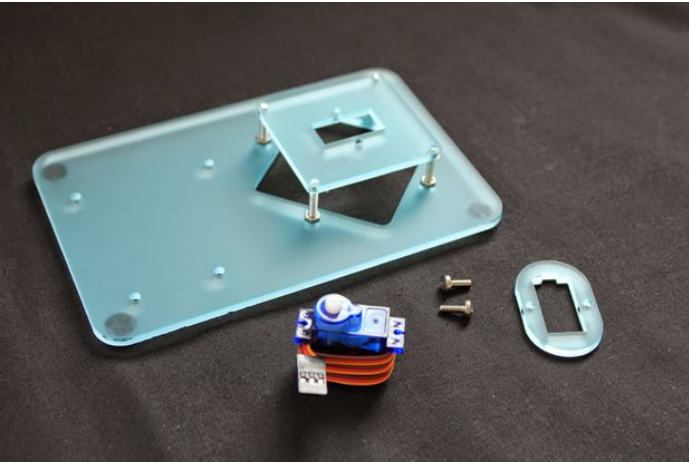


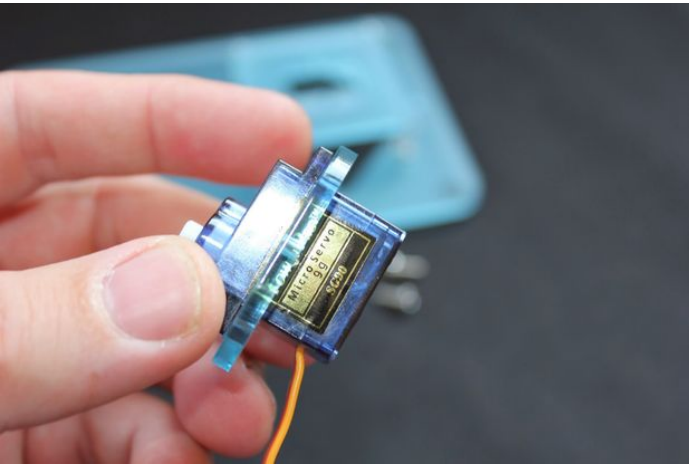


Step 4: Collar the servo

We found adding collars to the servos to be the best way to attach them to the arm. This is a technique we'll use a further three times.

- Thread the wire of the servo through the collar
- Line the cut out on the collar up with the end of the servo where the wire attaches
- Bring the collar over the bottom of the servo
- Push home so it's flat with the flange on the servo





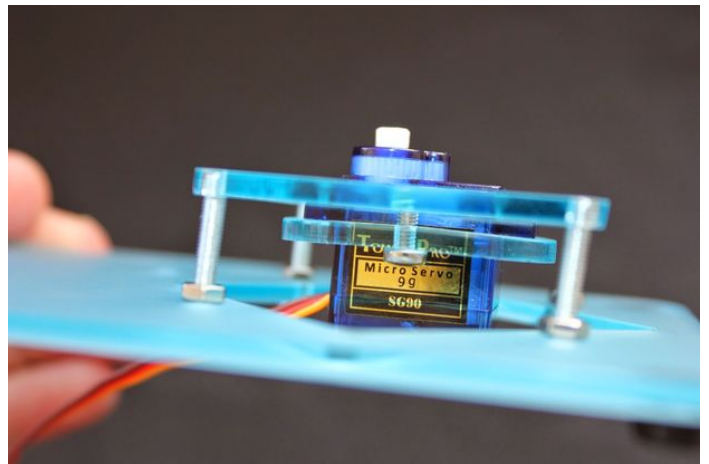
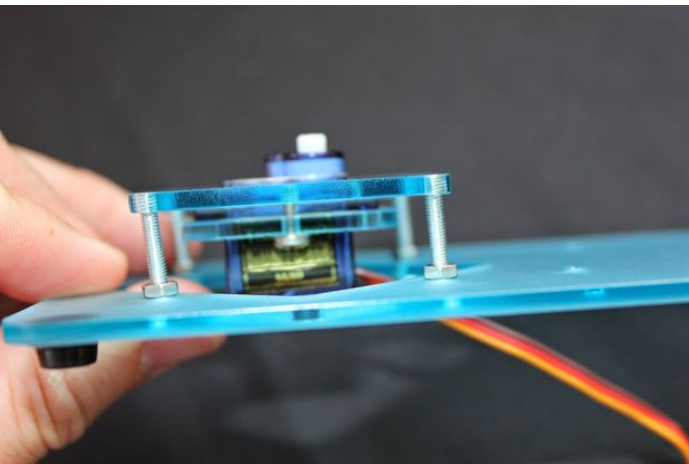
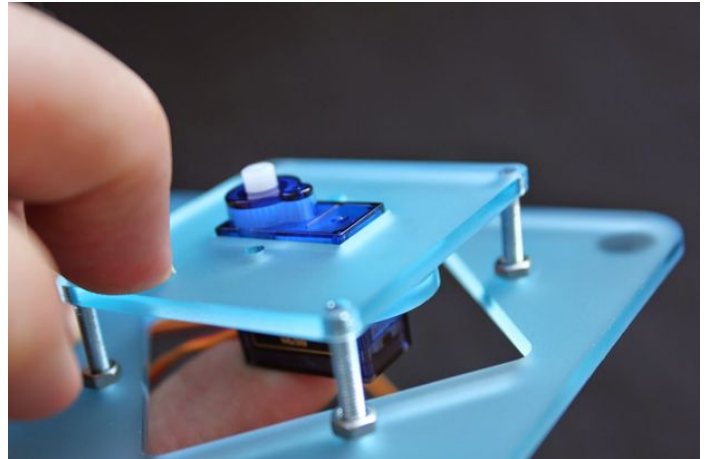
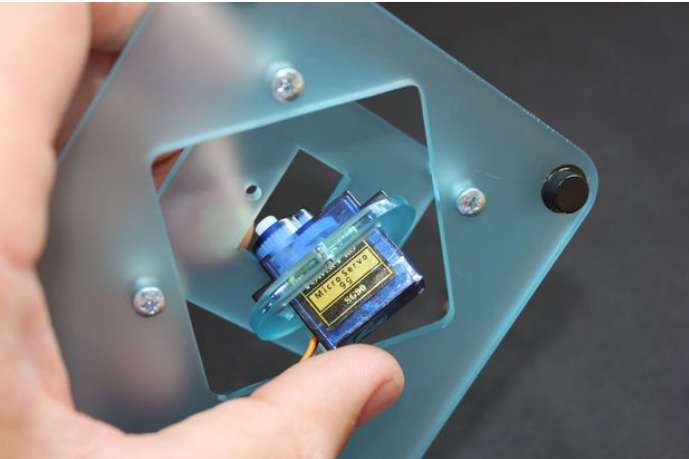
Step 5: Attach the collar to the square on the base

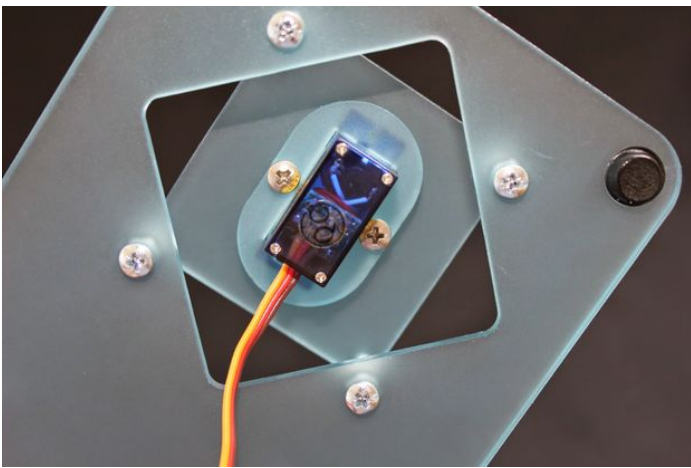
Now you've collared your servo line push it through the servo shaped hole on the square part.

Insert the two 8mm screws from underneath so they pass through the holes on the collar with little resistance and self tap into the square part. Tighten until the servo is held firmly. **Do not over tighten!**

Did you crack the collar? Told you not to over tighten... But you're not the first so we include a spare servo in the kit. Don't do it again!

We'll put the base aside for a little while now.



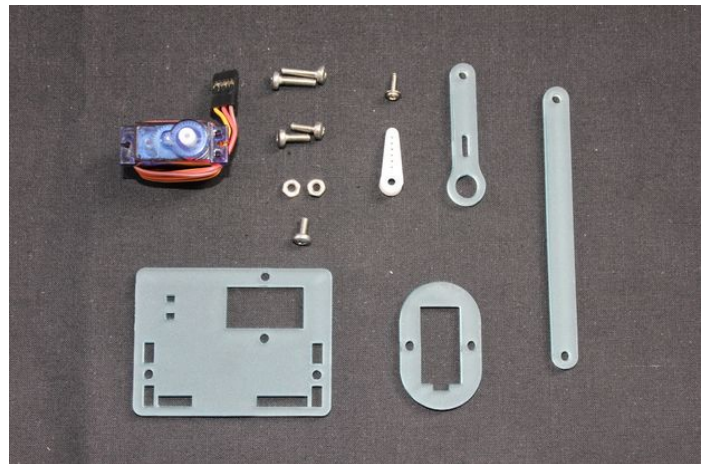
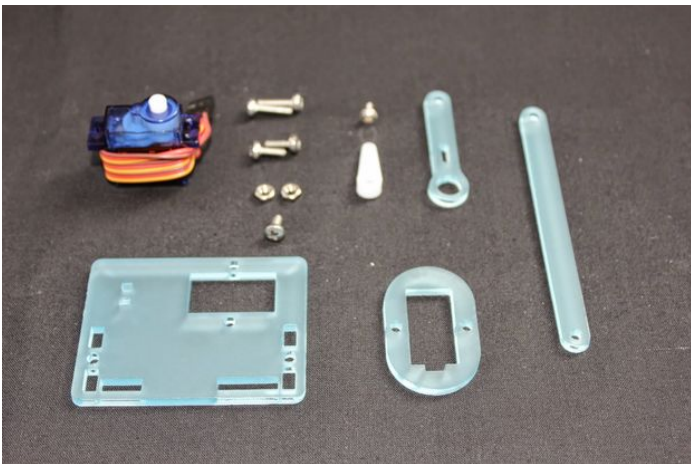


Step 6: Construct the left hand side

Please pay careful attention at this stage. We have keyed the parts to limit the number of possible wrong configurations to exactly one. This actually came in handy when making a larger arm where the orientation of the servos is reversed. However with the standard #meArm you'll want a **right handed version** as constructed here. That way all of the example code will work!

The parts needed here are:

- 2 x 8mm Screw
- 2 x 12mm Screw
- 2 x Nut
- 1 x 6mm Screw
- 1 x Collar
- 1 x Rectangular side part as pictured
- 1 x Servo mounting arm - the longer of the two you have
- 1 x Straight lever - you have three of these the same
- 1 x Servo
- 1 x Short servo screw
- 1 x Long servo screw

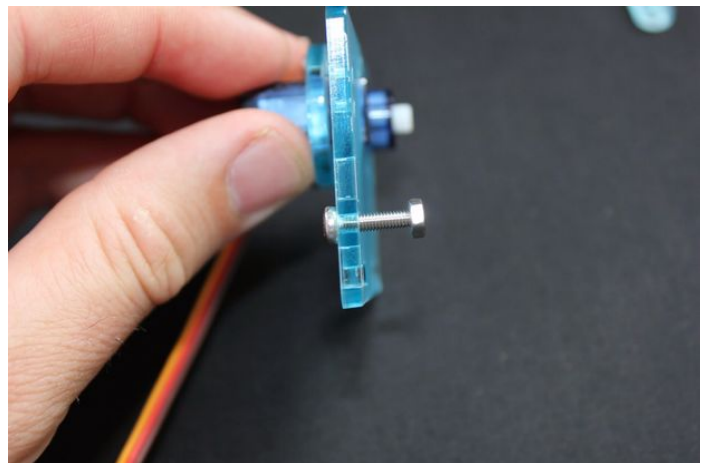
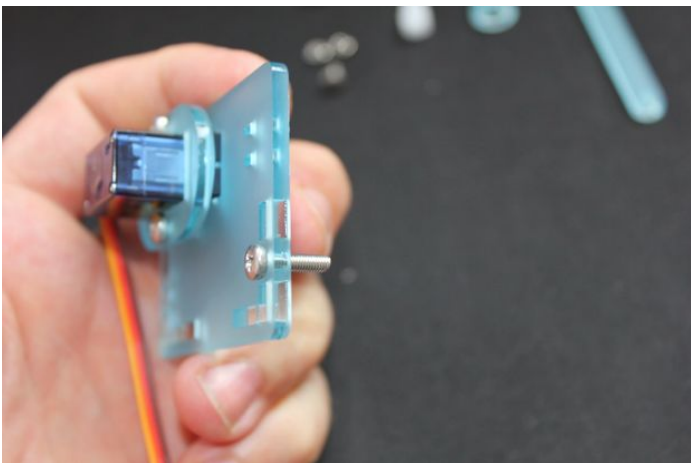
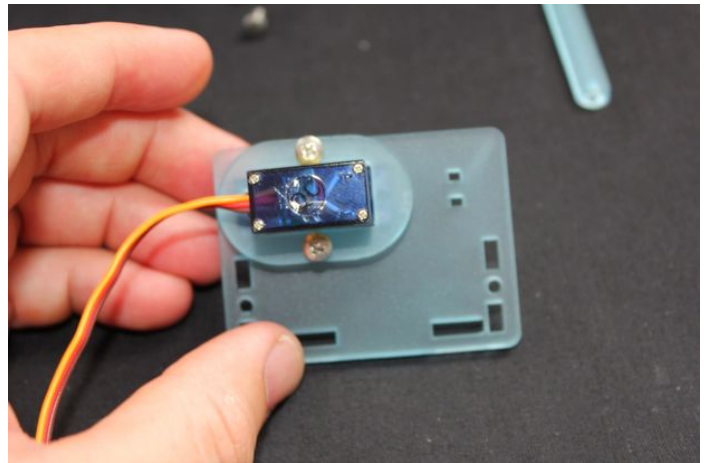
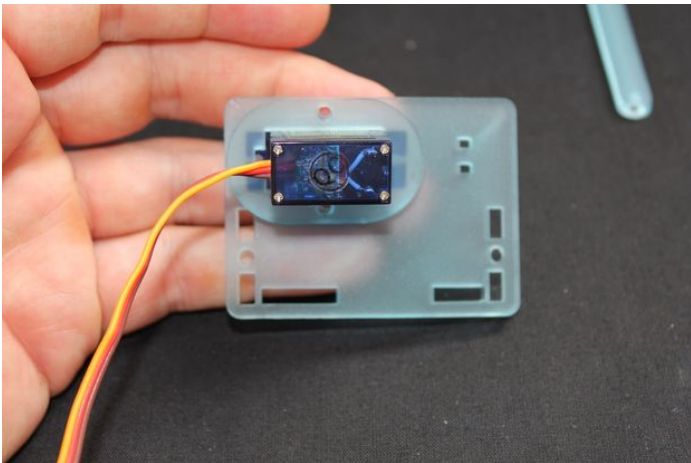
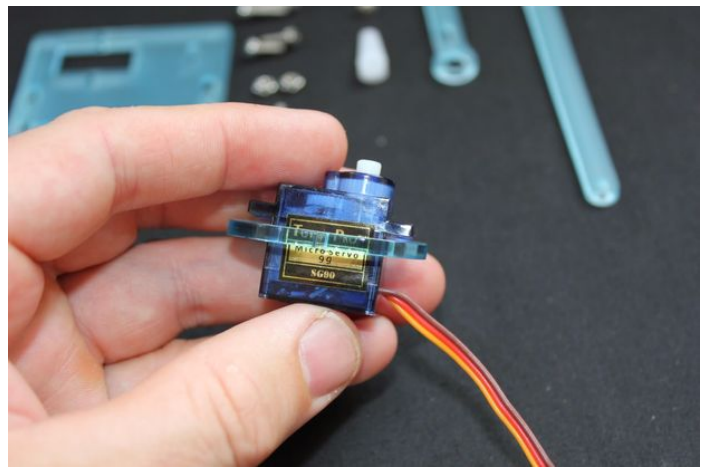
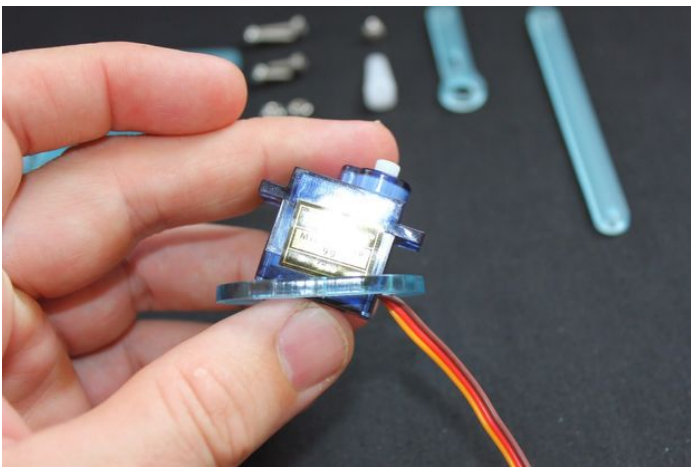


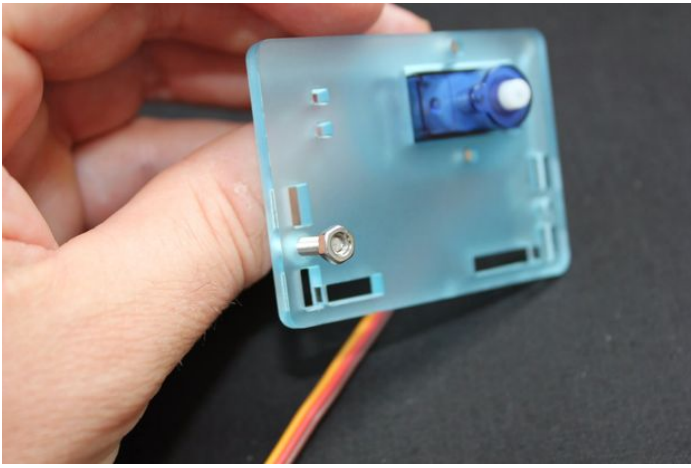
Step 7: Collar the servo and attach

Thread the servo through like before and screw onto the side piece using the 8mm screws.

Pay careful attention to the orientation here. Note the direction of the wire and the way the servo pokes out from the side piece.

Now thread the 12mm screws through the round holes that are left and put the nuts on just a half turn.

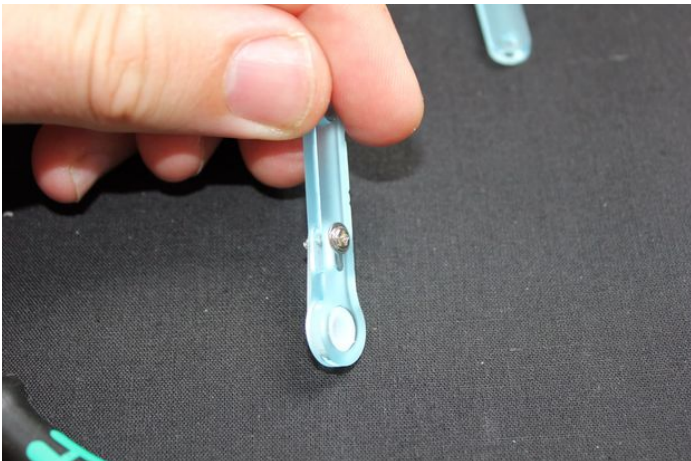
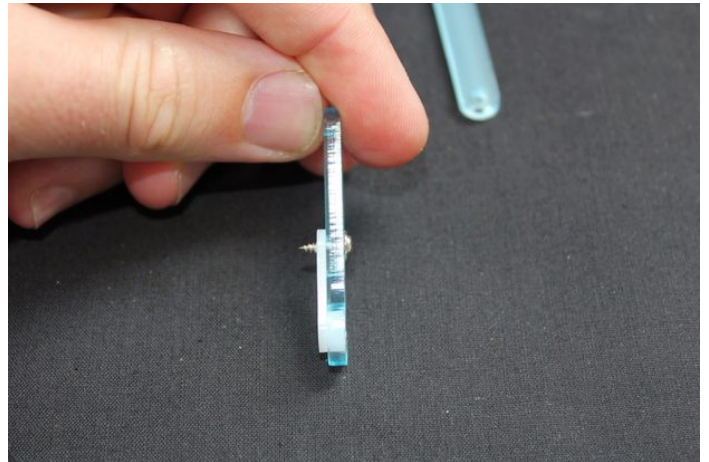


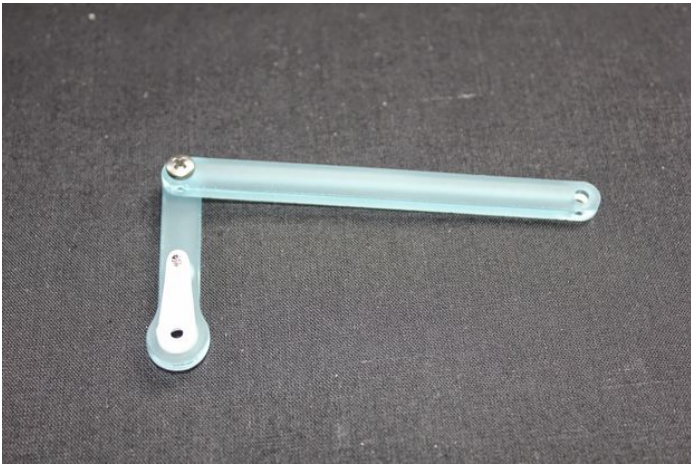


Step 8: Build your first levers

Attach the white plastic servo horn (as pictured) using the long servo screw. This will poke out the back of the resulting part and is a bit spikey. I trim them off once I'm confident I've put it together correctly!

Now attach the long lever to the servo lever, with the screw going through the same side as the servo horn.





Step 9: Attach lever and find your limits!

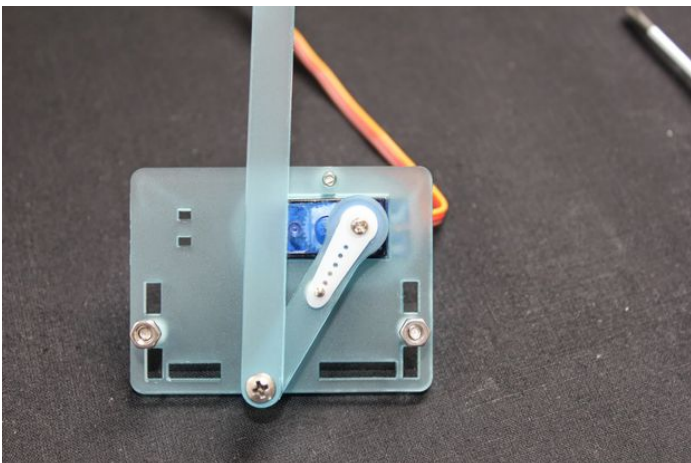
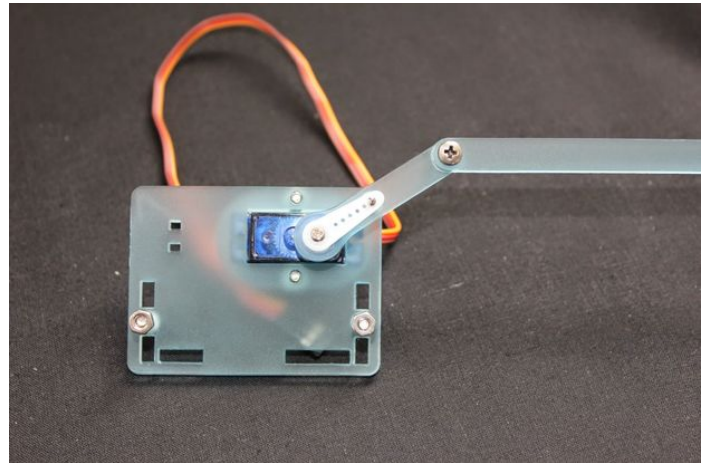
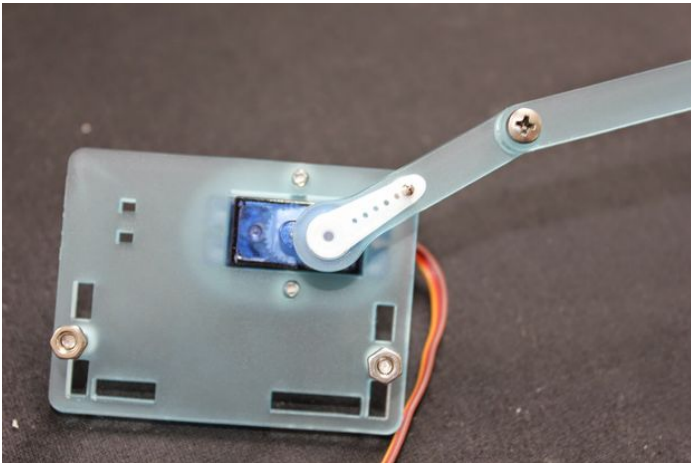
This part is important too. They're all important so if you're tiring have a break!

Attach the servo lever you've just made to the servo, it will just push on. These smaller servos will turn by hand, so gently turn it all the way clockwise until it stops. When it stops, pull the servo arm back off and put it on so it matches the first image shown here.

Put the small servo screw through the middle and tighten a little so it just grabs - don't over tighten - for some reason this screw can lock the servo and we don't want that.

When you've done that turn the servo counter-clockwise and it should go all the way to how it's shown in the last image here. If it doesn't, then remove the screw and repeat the step above.

If your servo clicks here it means it's jumping teeth and might need rebuilding, worse case a gear has cracked, but the servos are cheap so just replace it. All of our servos in the #meArm kits are tested so none will click out of the box.



Step 10: Build the right hand side

This, surprisingly, is similar to building the left.

Parts you'll need are

2 x 8mm Screw

2 x 12mm Screw

2 x Nut

1 x 6mm Screw

1 x Collar

1 x RH Side piece

1 x Long lever (like you just used)

1 x Central lever RHS (look carefully at the picture!)

1 x Servo

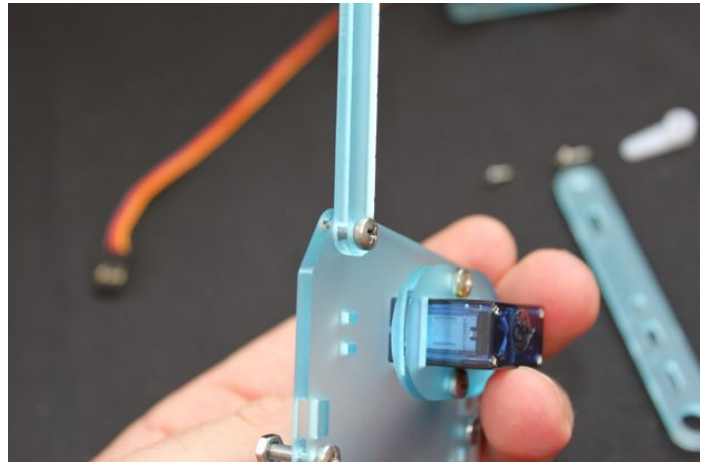
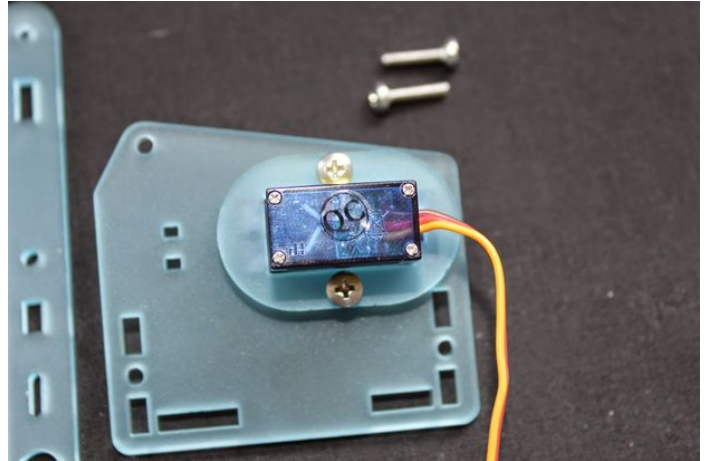
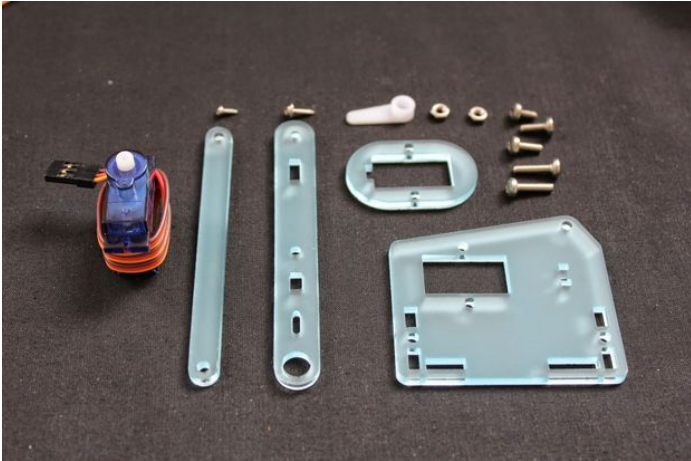
1 x Small servo screw

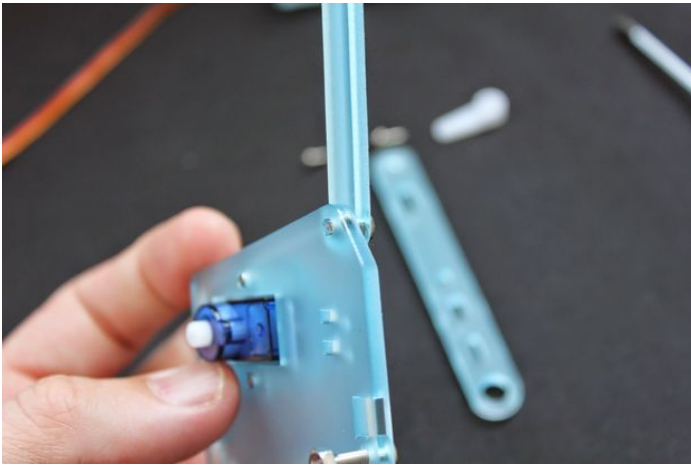
1 x Large servo screw

1 x Servo horn

Thread your collar and attach, noting carefully the orientation. Insert the 12mm screws and half turn the nuts.

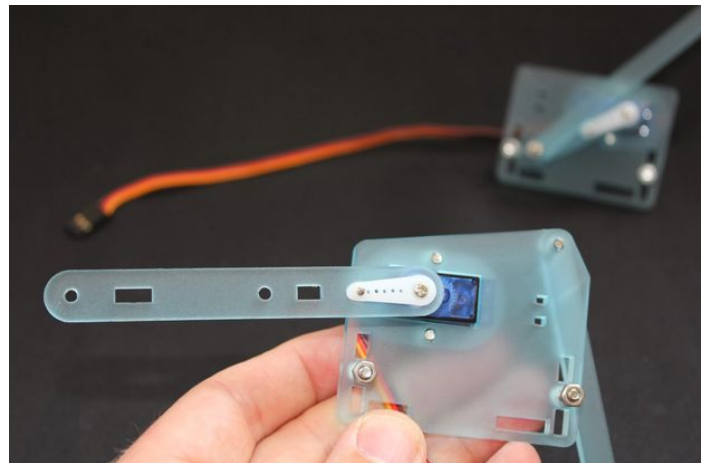
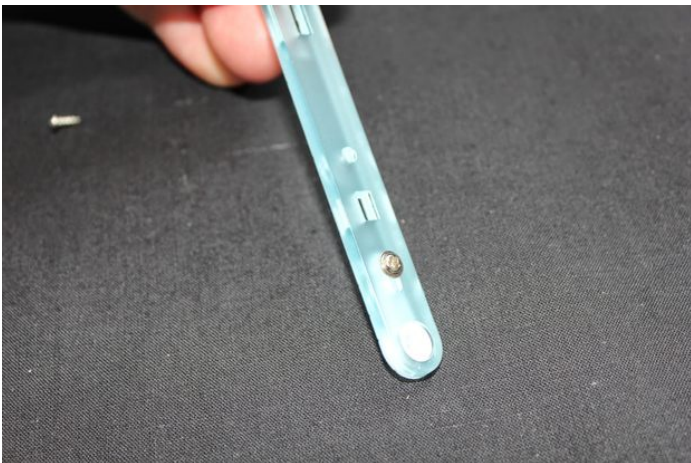
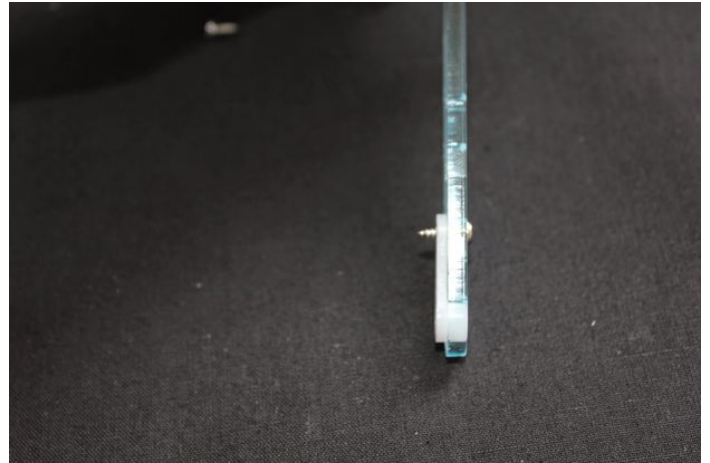
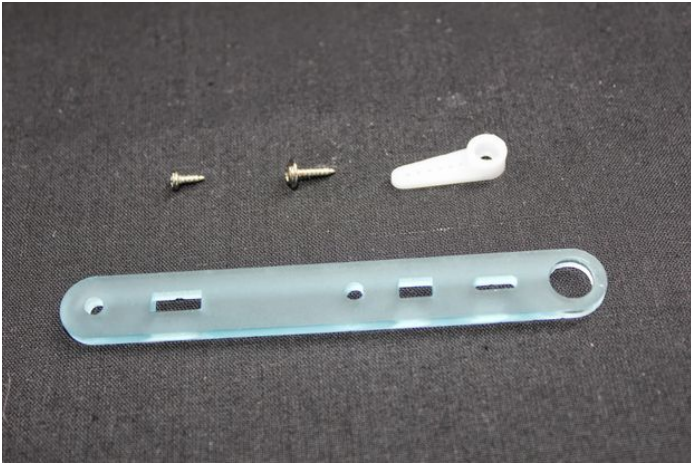
Attach the long lever to the outside of the RH Side piece with the 6mm screw.

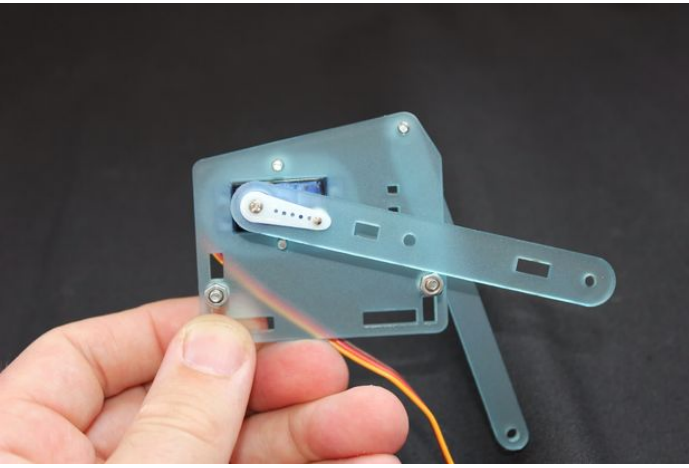




Step 11: Attach to servo and set limits

Again take the plastic servo horn and attach it to the long middle section. Push this onto the servo and turn the servo gently all the way counter clockwise. Remove the lever and put it back on to match the first of the three images shown of the attached lever here. Insert the small screw (not too tightly again!) and wind it clockwise so it matches the last image shown here.





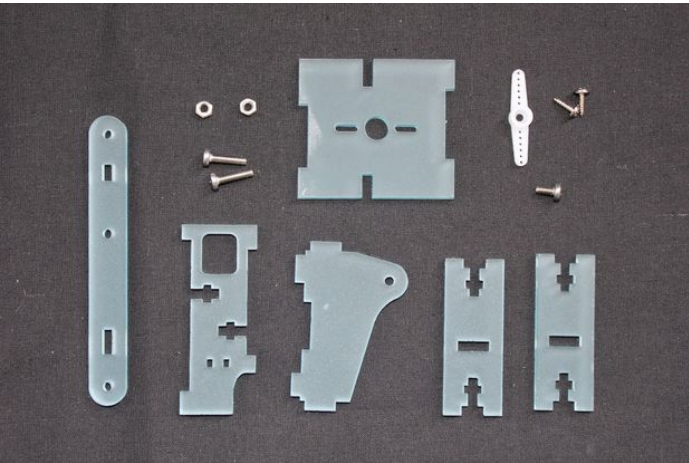
Step 12: Bringing the sides together and meeting the pig

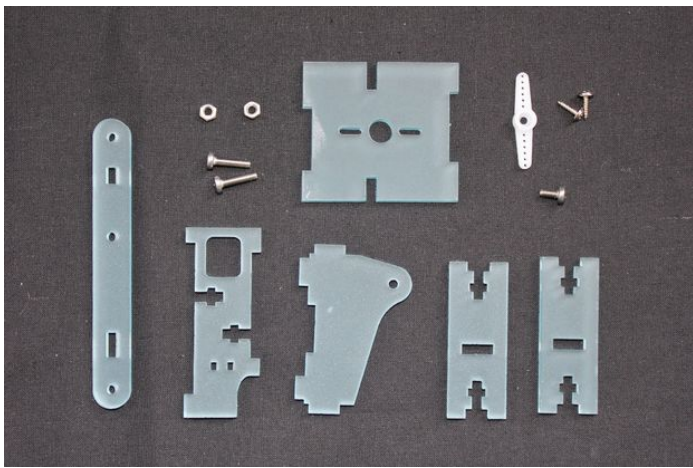
Now we're going to join the sides together with the central parts and meet one of my personal favourite pieces "the Pig". The Pig is shown in the second image here attached to a long lever, one of the iterations of this part looked a lot like a pig and the name has stuck with me. That is all!

Parts needed:

- 2 x 12mm Screw
- 2 x Nut
- 1 x 6mm Screw
- 1 x Cradle base (squarish bit)
- 1 x LH Central lever
- 2 x Cradle ends
- 1 x "The Pig"
- 1 x Central section of central lever...
- 1 x Long servo horn
- 2 x Long servo screws
- 1 x Short servo screw

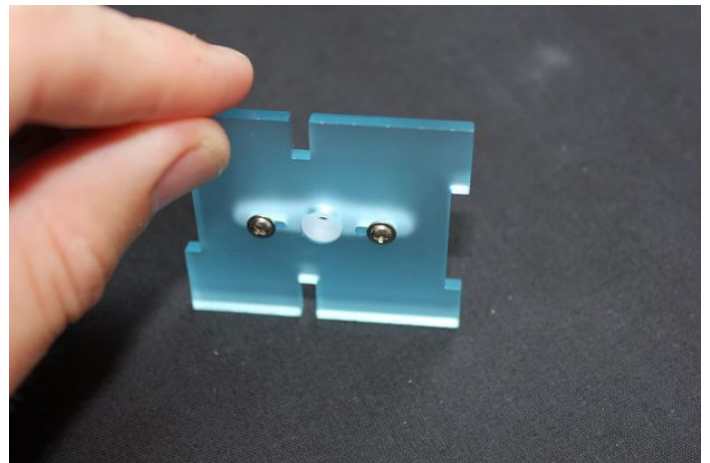
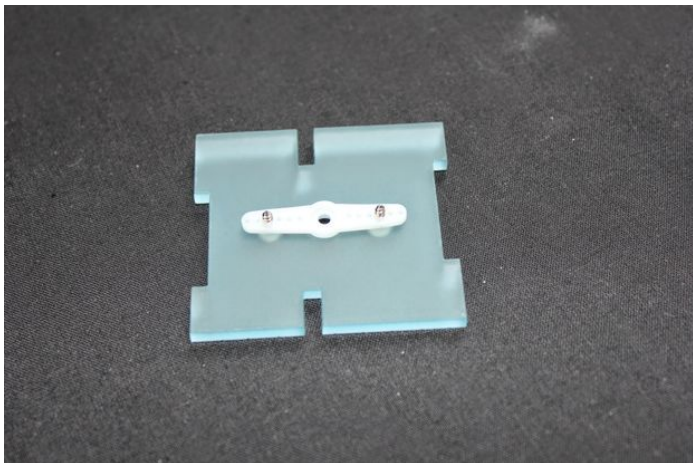
Attach the Pig to the LH Central lever, as ever not the orientation of that screw! This time at lease any mistakes will be apparent quickly.





Step 13: Attach the servo horn to the base

Short step but best done now. Use the two long screws to attach this horn. Cutouts to the left like the picture.



Step 14: Meeting old friends!

Now we introduce all of the parts we've made over a very short time frame.

This part is fiddly and really requires more hands than you have. Look at the pictures and read this through first.

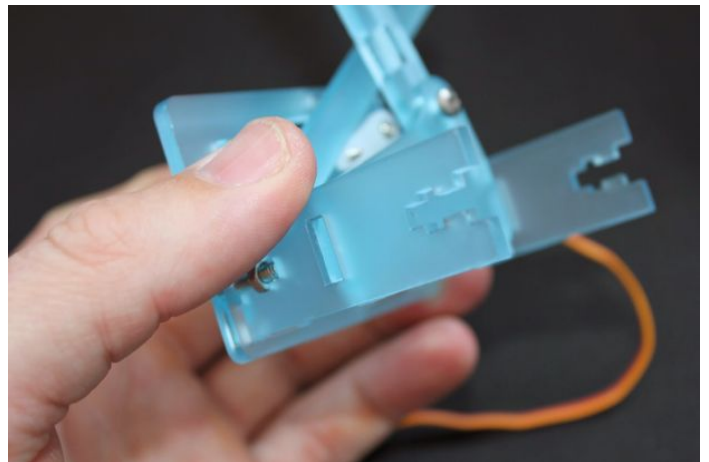
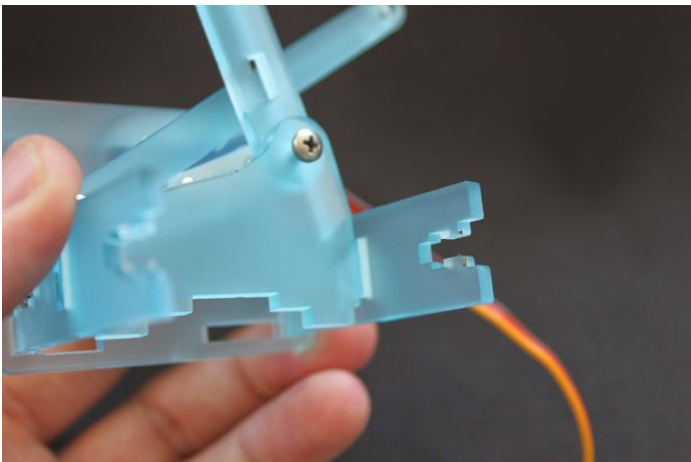
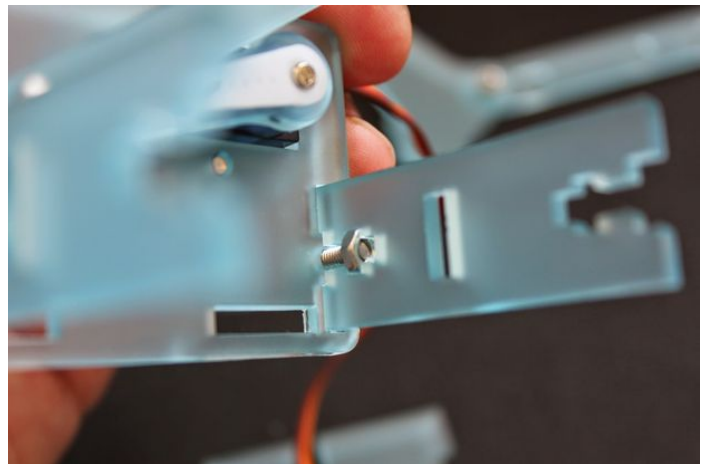
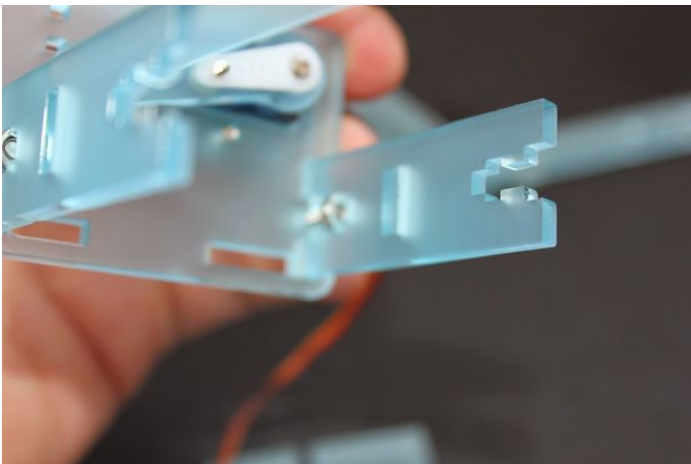
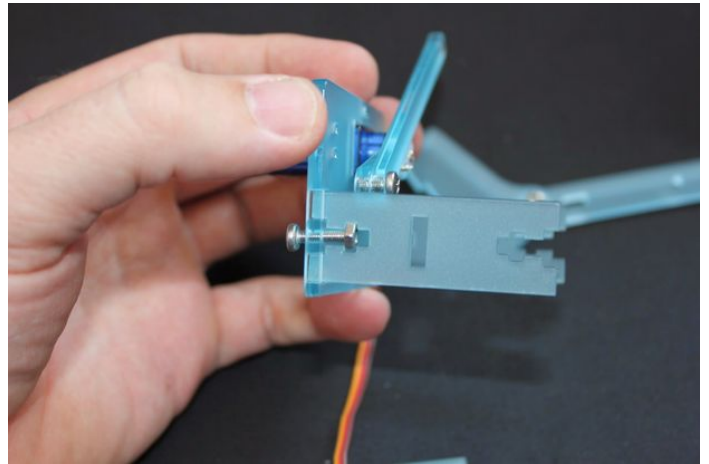
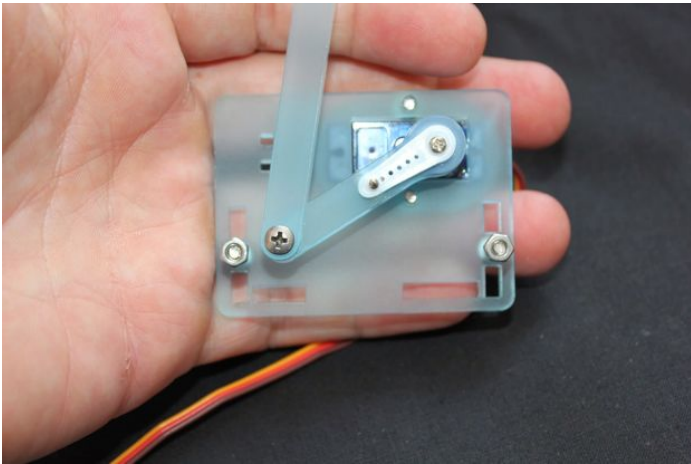
Take the assembled LHS (left hand side!) making sure the 12mm screws we attached earlier are pushed right through insert an end cradle piece so that the cutout is **closest to the left hand side**. Tighten that screw one or two turns, but not all the way.

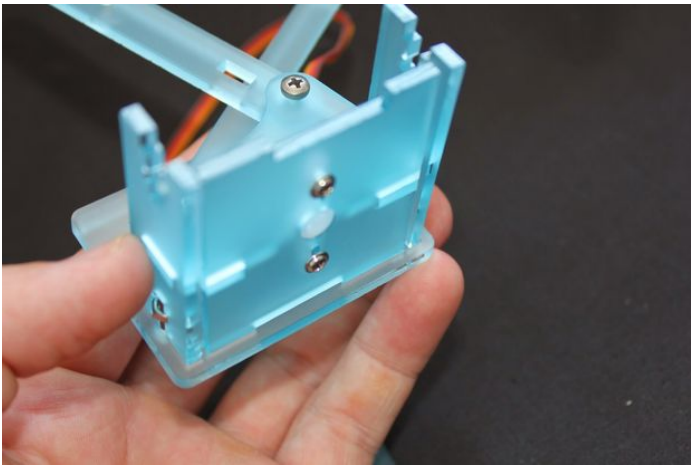
Now do the same with the other end part. With the screws loose try to insert the pig between the cut outs, it should just fit and hold, however depending on the cut and your luck it might not, loosen a screw if you need to. Nuts might fall, and you might well curse me right now. I deserve it. Please keep it together - literally and metaphorically.

Once you've got that together and still with some slack in the screws you can slot in the cradle base.

Now tighten but don't over tighten.

Check all of the parts look like these pictures.





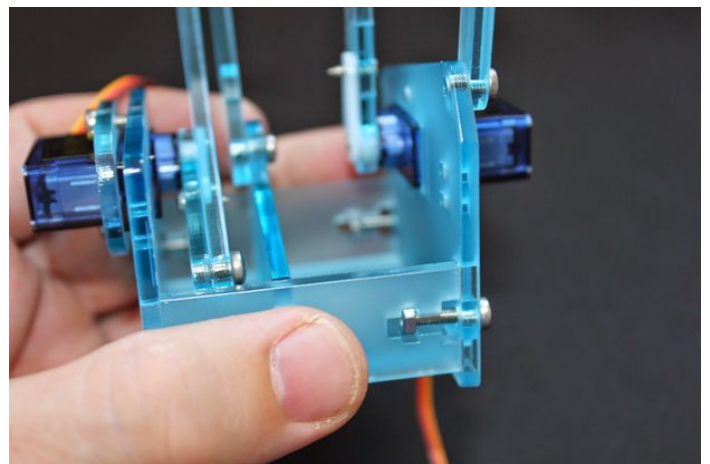
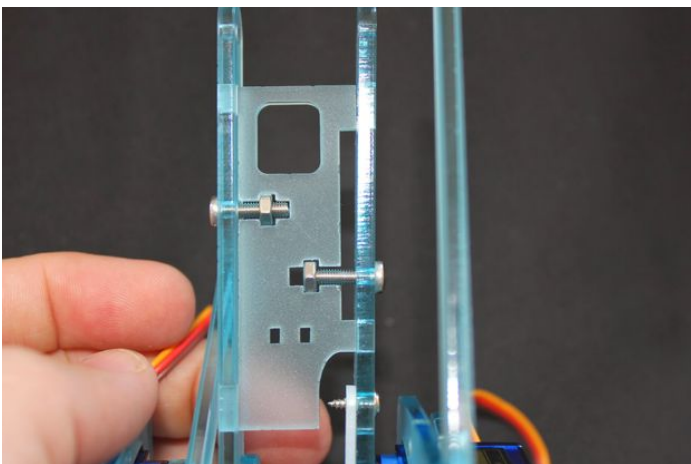
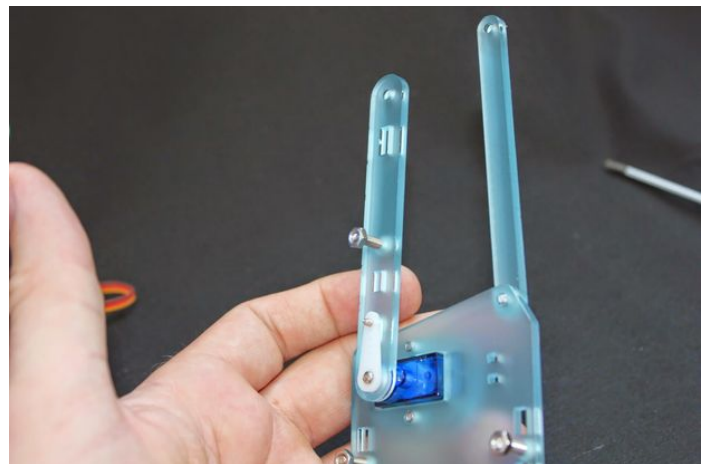
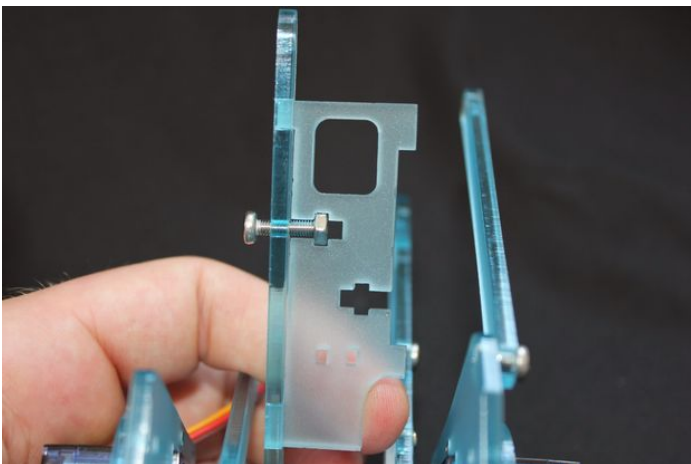
Step 15: Add the RHS

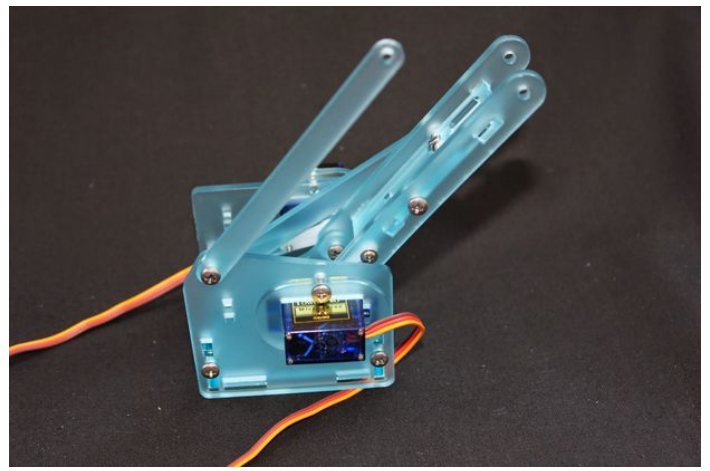
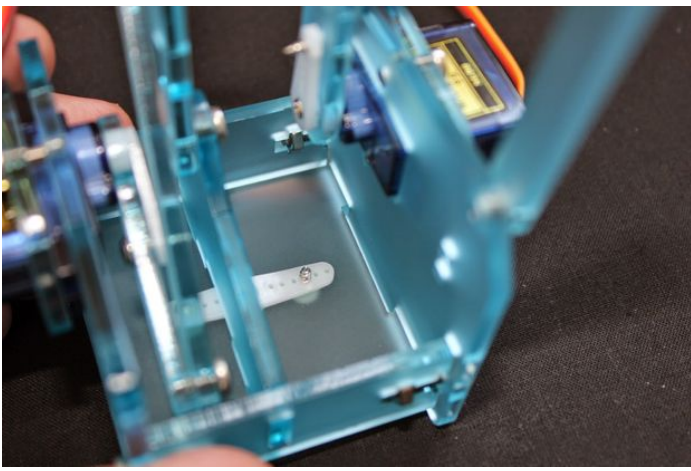
Now we're going to bring the RHS to the party.

Using the two remaining nuts and two 12mm screws connect the central lever together loosely.

Guide the base and LHS that you've just put together over the 12mm screws and nuts on the RHS and tighten everything up (do not over tighten!).

That's the hardest part over with. It will look like you still have a lot of parts left but that's mainly the claw! Now for some easy wins...



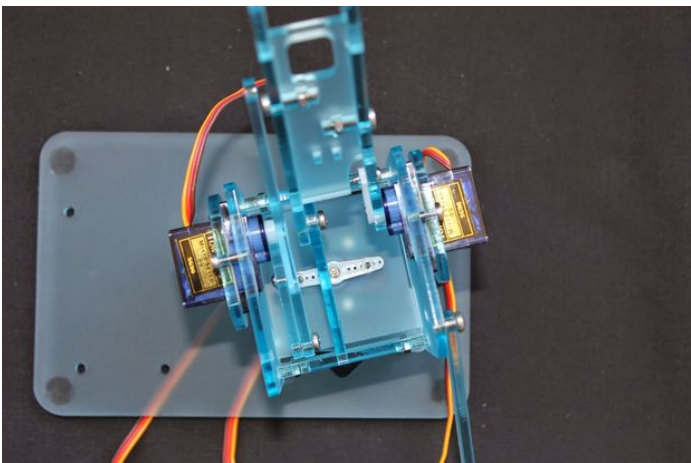
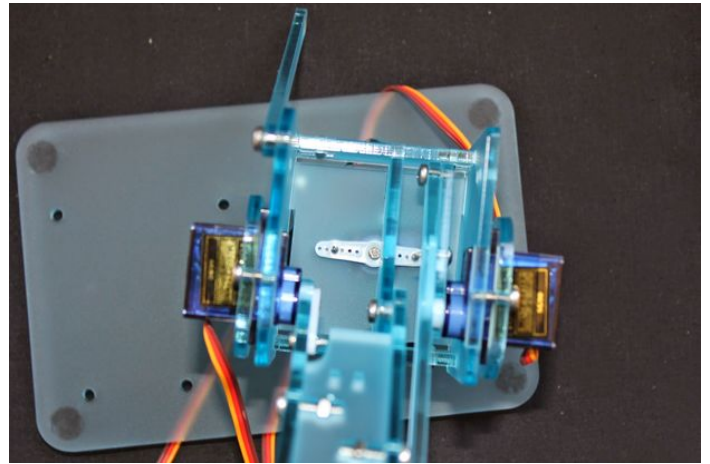
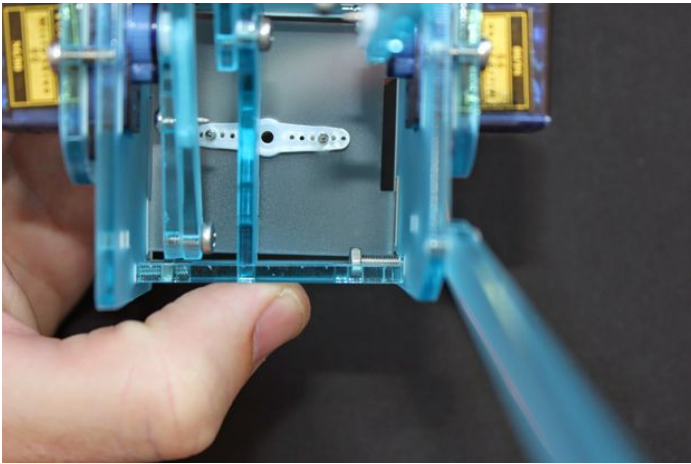


Step 16: Marry to the base!

A nice easy step to follow that lot!

Push your assembled cradle onto the base servo. Turn all the way clockwise and remove, put it back on as shown in the second image here and put the small screw in (not too tight!).

Check that it turns anticlockwise and looks similar to the last picture here.



Step 17: Left and right forearms

The left is super simple. One part with two 6mm screws. Make it look like the second picture here!

The right forearm requires a spacer and you finally get to use two of those 10mm that you've been mistaking for the 12mm for the last hour!

The connection to the central lever on the right goes, central lever, forearm lever, triangle bit. At the back it's triangle bit, spacer, long lever (the one attached to the RHS from earlier).

Finally (for this step, don't get excited!) use the last long lever with a 6mm screw on the inside as shown on the last image here.

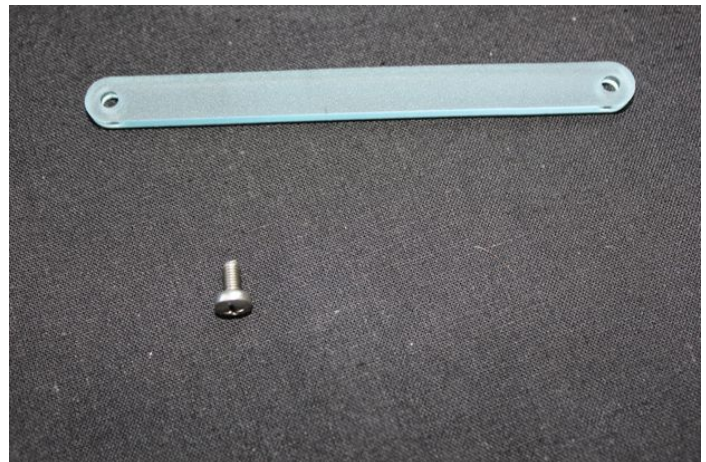
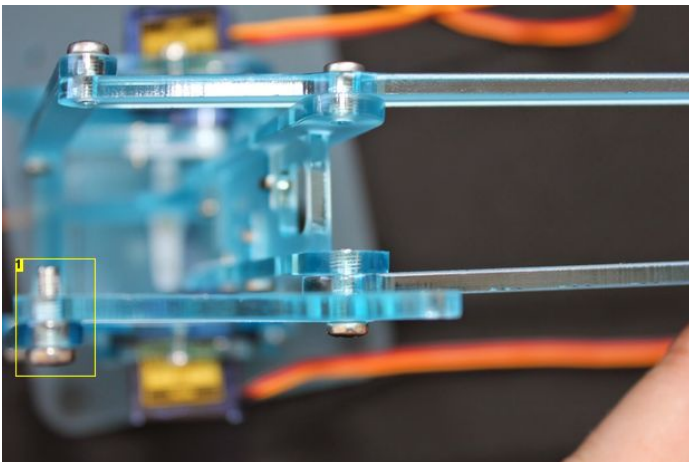
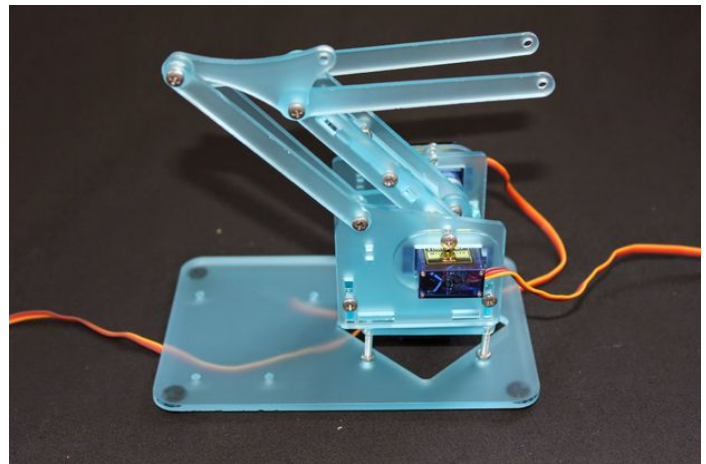
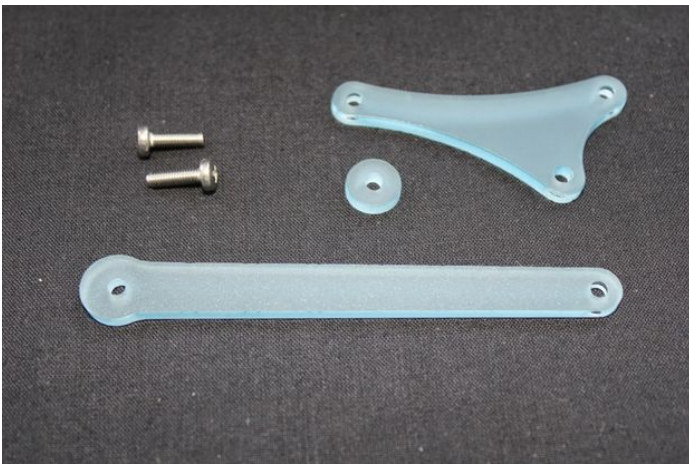
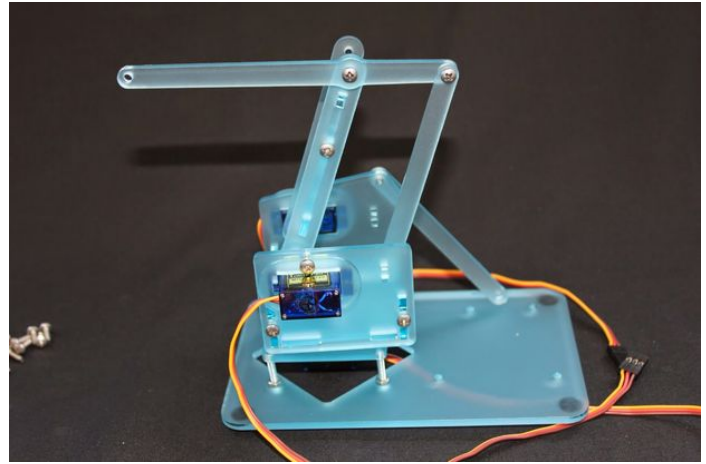
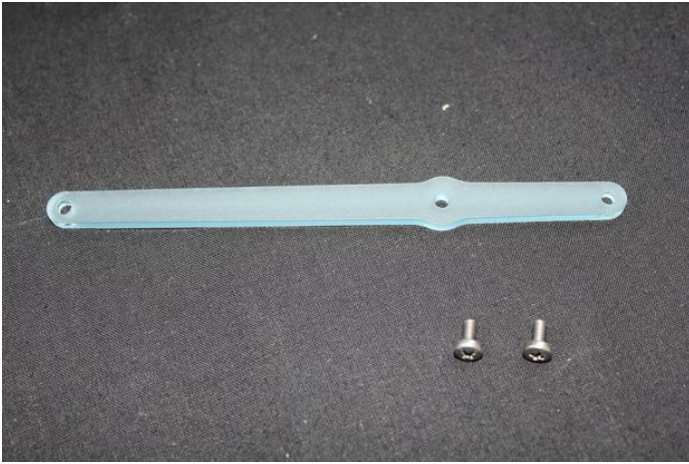


Image Notes

1. Spacer should go here!

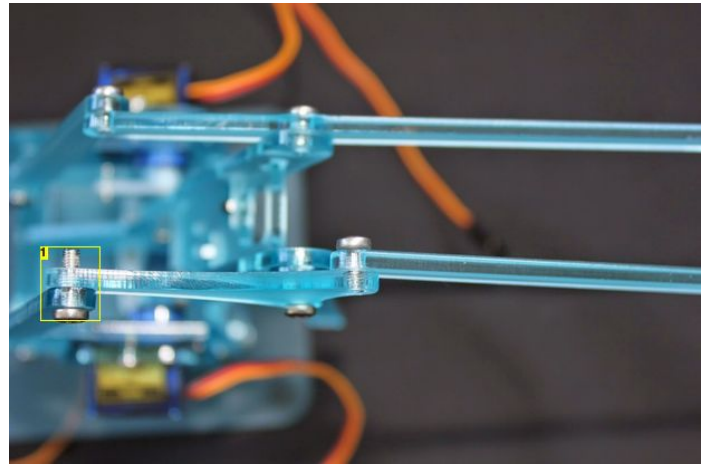
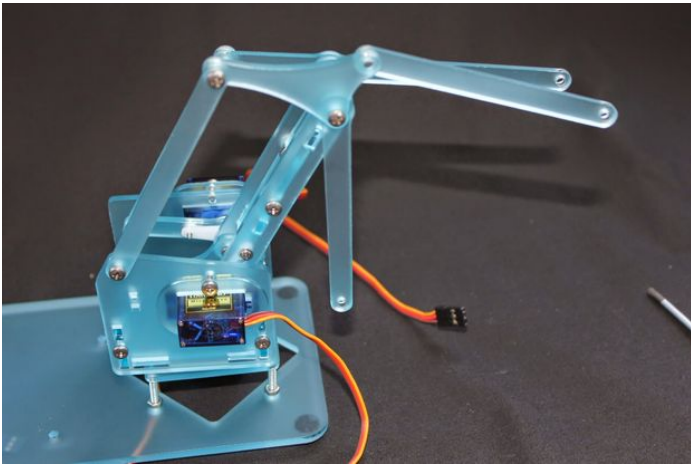


Image Notes

1. Spacer should go here!

Step 18: The Claw! (the claw...)

This the beginning of the end you'll be pleased to hear!

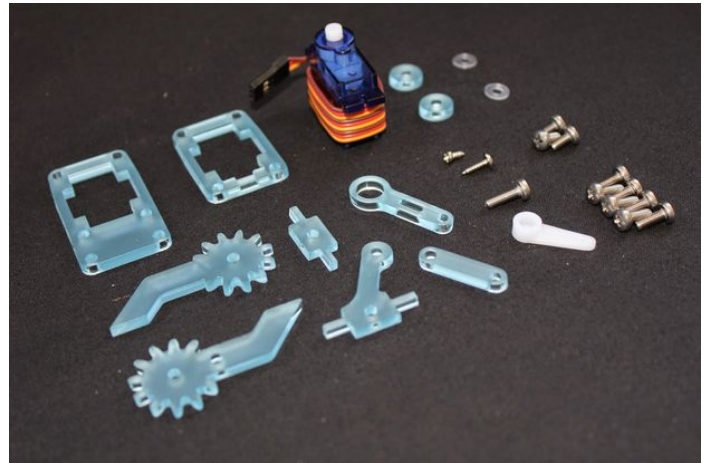
Now we'll use the rest of the bits. Except:

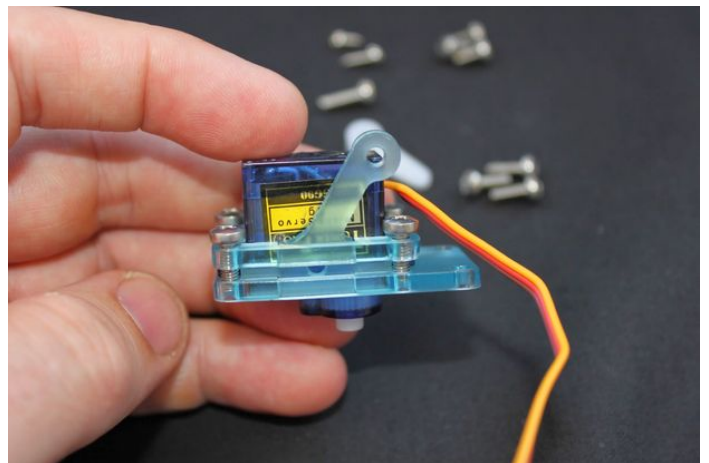
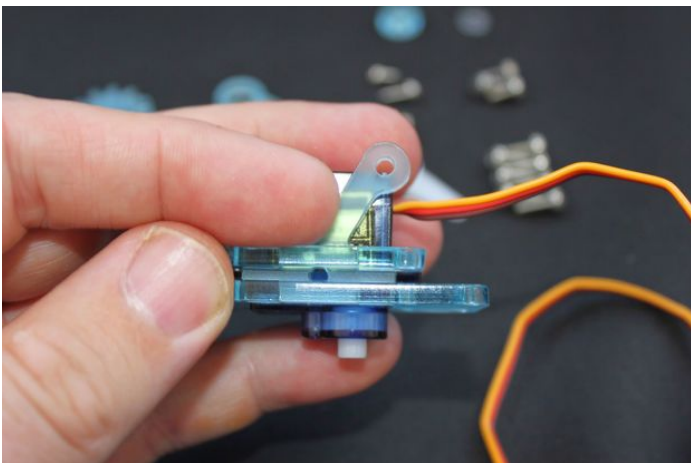
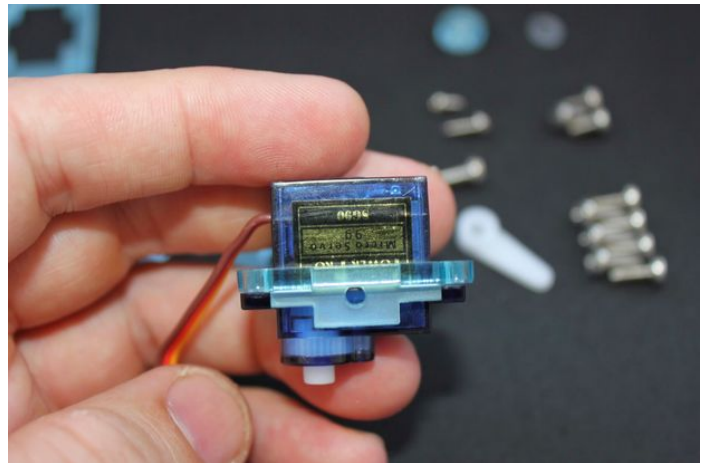
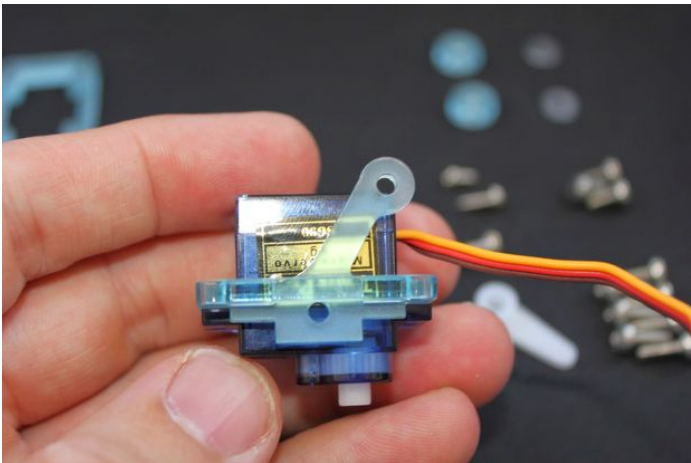
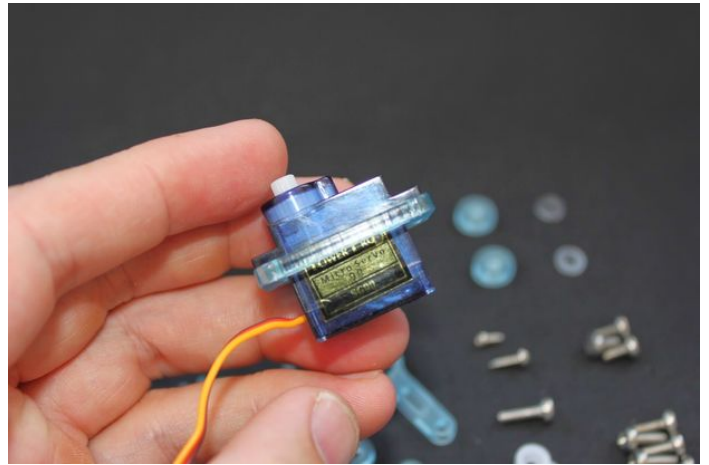
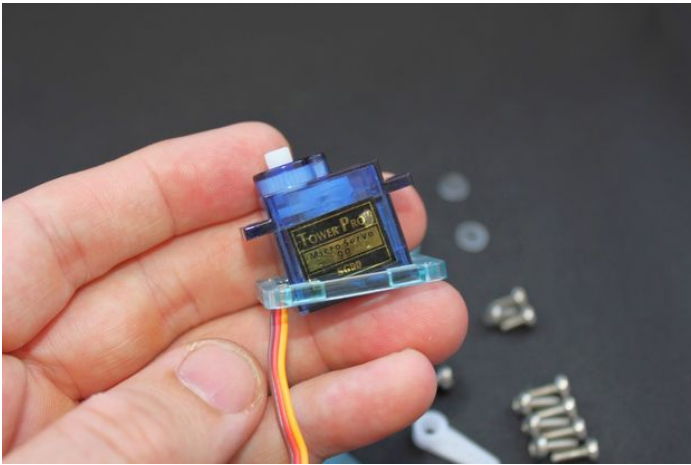
- 1 x Collar (Spare)
- 1 x Spacer (Spare)
- 2 x 8mm Screw
- 1 x 10mm Screw

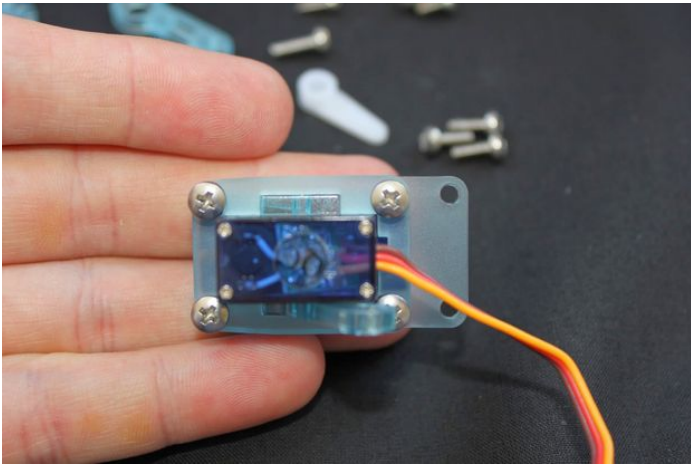
Find the shorter of the two rectangular parts. This is a specialised collar! Thread this like you've done the other three (or four if you broke one!).

Next use the thin parts shown in images five and six here. Note the orientation. These slide in the side and will act as mounts. I think this construction is very clever and it's the work of Jack Howard, co-creator of the #meArm.

Now the larger rectangular part can be placed over the bottom of the composite part you've just made. Check the orientation a final time and reach for four of your remaining 8mm screws and don't over tighten them! But do tighten them. Make sure none protrudes from the base of the part you've just made.







Step 19: Jaws

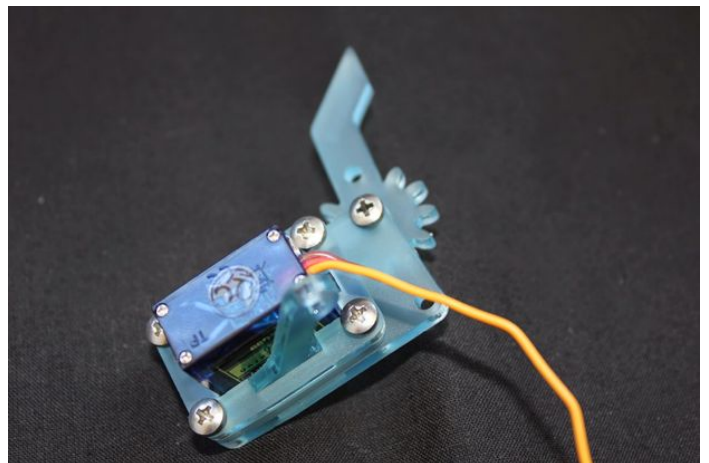
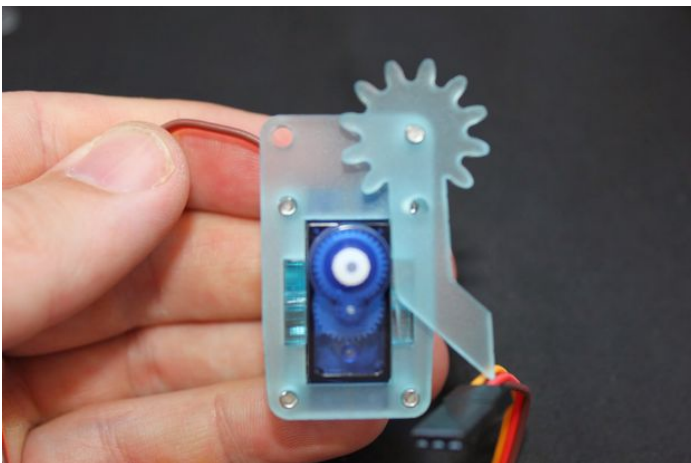
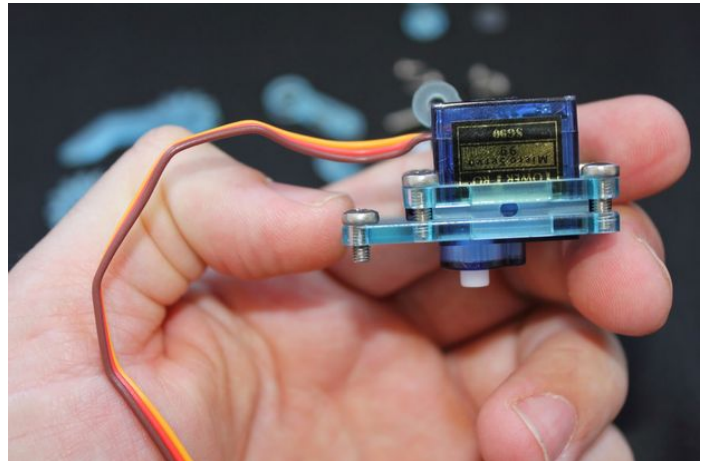
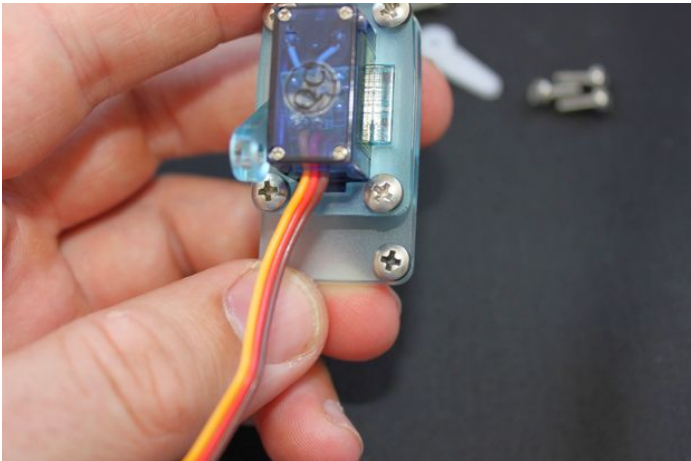
Take a 6mm screw and attach the toothed jaw with two holes to the left hand side of the claw. For best results make sure these two parts are as flush as possible as you self tap the screw.

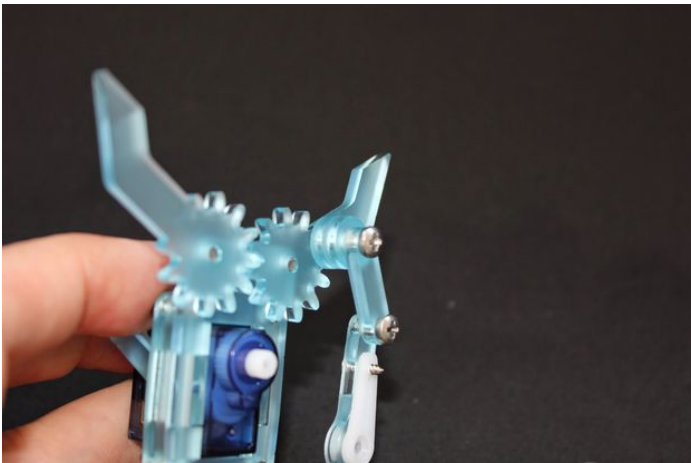
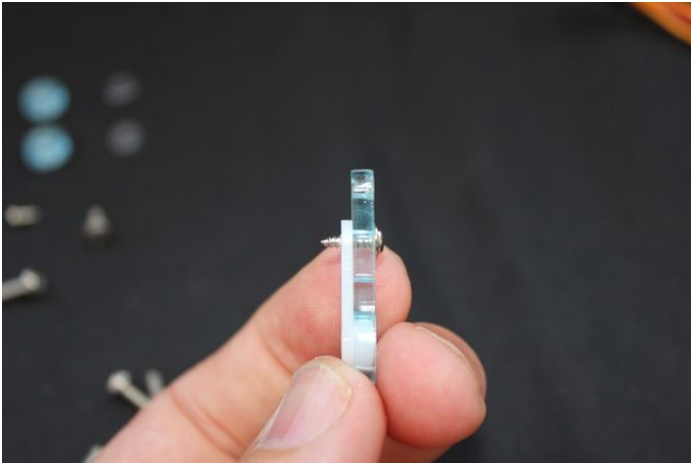
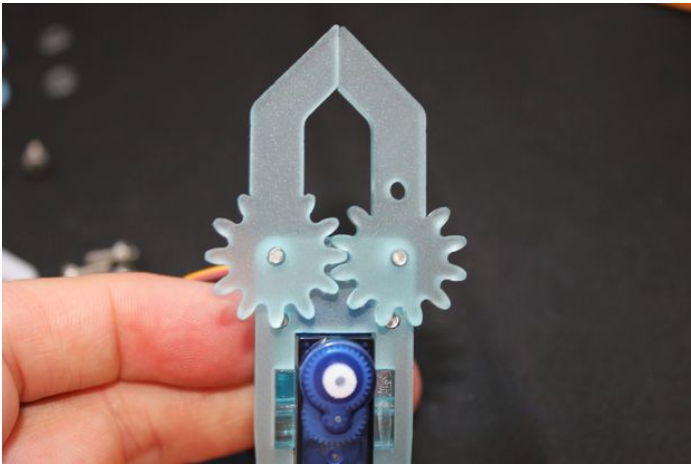
Line up the other jaw to mesh correctly and attach that flush with another 6mm screw.

Next we'll make the linkage to connect the servo and jaws together. Attach your remaining horn to the short servo connecting lever. Then connect this to the little tiny linking part. That should have been your last 6mm screw.

Now with the last 12mm you have push it through the tiny linking part, add two spacers and possibly the washers we include and attach to the spare hole in the left hand jaw.

I tend to leave this unconnected to the servo until I have microcontroller control and can decide where the close position is.





Step 20: The final step!

All that remains is to attach the claw to the rest of the robot! Use two 8mm screws into the pivot of the claw and the final 10mm with a spacer to secure the wrist.

Now it's time to connect it to your favourite controller! Links are on the front page of the instructable to the available code and connection guides are with each.

Once connected you might find you need to make fine adjustments to the build, most likely you've over tightened parts and will need to give them a little slack.

I hope you've enjoyed this Open Source build! I look forward to seeing your #meArms in action!

