

PROJECT

ASSEMBLY

GALLERY

VIDEO

DOWNLOAD

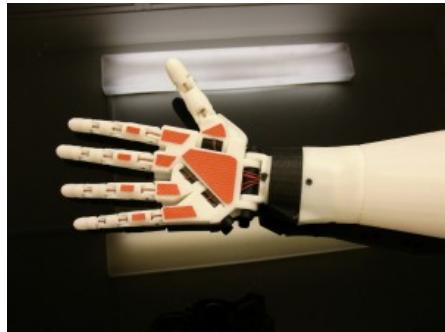
COMMUNITY

BLOG

FORUM

NEWS

Hand and Forarm



Print wristlarge, wristsmall, thumb with an infill of 30%, 3 shells, best with no support, no raft.
 Print Thumb, index3, majeure3, ringfinger3, auriculaire3, with an infill of 30%, 1 shell, best with no support, no raft.
 Print robpart2, robpart3, robpart4, robpart5 with an infill of 30%, 3 shell, best with raft, no support.
 Print coverfinger with an infill of 30%, 3 shells, with support. To get the best printing result on the covers is to print them standing up, instead laying them flat.

The wrist parts are good printed with an infill of 30%, 3 shells, with no raft, no support. The Gears of the wrist should be printed with the best quality your printer can give you.

Big bolts are now printable. (Strong enough for tests and even more!)

You can replace the 16x3mm for the fingers with pins/pegs of filament instead of bolts, it's cheap, easy, and strong enough. It was a suggestion of FreddyA.

1x8mmx8cm bolt to attach wristlarge to wristsmall.

1x8mmx4cm bolt to attach wriarge to thumbbottom.

1x8mmx6cm bolt for to attach wriarge to robpart1.

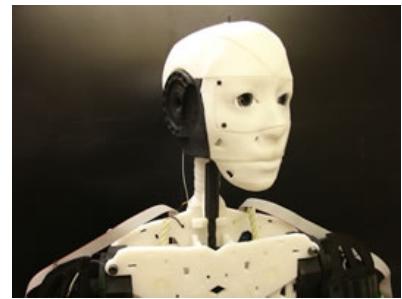
16x3mmx2cm bolts for all fingers hinges(I have recut each bolt to adapt to finger width)

These instructions are for the right hand. The left hand is similar but parts are mirrored.

Step1



Remove the antiwarp supports and trim with a knife, RobPart2, 3, 4 and 5



HELP ME EXPERIMENT



SEARCH

MEMBER ACTIVITIES



Dwayne Williams uploaded a new picture: opencv_fd_1.jpg
17 hours, 56 minutes ago



Rob is standing proud as a test bot for Grog.
He is very pleased to be a part of enhancing the Inmoov Nation.



Fred uploaded a new picture: Possible spring for...
1 day, 16 hours ago



Maybe a possible spring for tendons?



Assemble together Robpart2 and Robpart5



Jack Phillips posted an update 2 days, 11 hours ago

Head Connect to Torso. Using EZ Robot for programming interface for now. Printing arms and hands next. Not sure how to post video so here is the link.

<https://www.youtube.com/watch?v=czMIEDz9804&feature=c4-overview&list=UUNwlfeOZcu4UbOx3bcqjHQ>



Help yourself with pliers to hold the parts together while you glue them with Acetone (ABS) or Epoxy 2 components(PLA)



Gael Langevin posted an update 2 days, 16 hours ago

To Fred and others:

<https://groups.google.com/group/inmoov/attach/151d3d256a4108f0/spring%20tensioner1.jpg?part=4&authuser=0>

This is how I see a spring added to the retraction tendon. In this set up we avoid forcing on the servo either way of rotation and it also avoid losing tension in the tendons.



Avoid using glue on the outside other wise it won't look clean. Control that your parts are correctly aligned.



Fred uploaded a new picture: 69.jpg 3 days, 17 hours ago



Do the same with Robpart3 and 4.



Fred uploaded a new picture: 71.jpg 3 days, 17 hours ago



Redrill the holes on the side of Robpart2 with a 6mm drill. These are for to fix an extra servo to get a double actuated thumb. See: <http://www.thingiverse.com/thing:28124>

FOLLOW ME

gael langevin

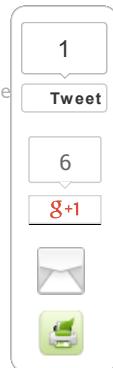
1 circle

413 followers

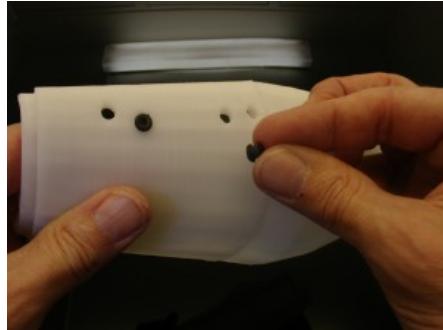
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- InMoov prosthetic hand almost ready
- InMoov in Moscow, Geek Picnic
- InMoov on the New Yorker
- Wow InMoov Santa!

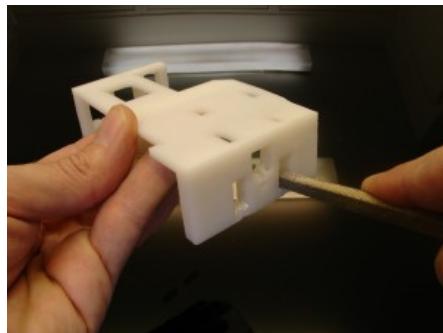
New wiring design for the hand



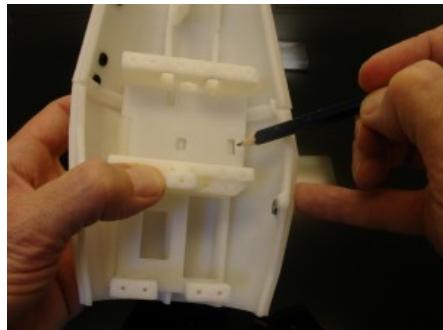
Use the silentblocs that came with your servos.



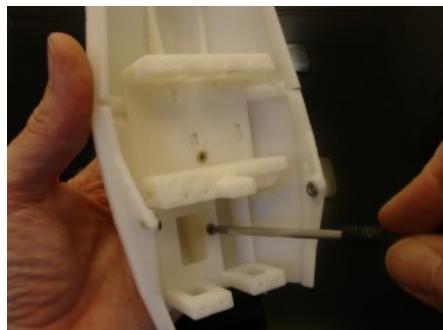
In Robpart5, insert two bolts for 4mm screws in the printed cavities. Mine were not fitting, due to overhang, I heated them with a flam to make them fit.



Trim/Fill the holes of the simple servo bed if there is overhang.



Set in Robpart5 the simple servo bed, make sure it is completely seated on the bottom.



Glue or screw the simple servo bed with 2 wood screws.

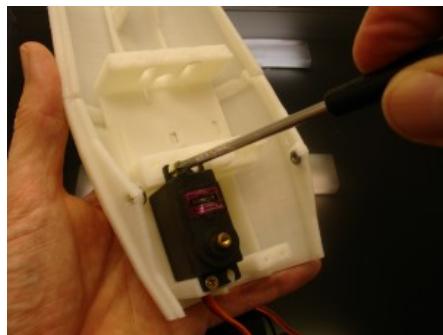
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- Gael Langevin on Hand and Forarm
- Tom on Hand and Forarm
- InMoov » InMoov prosthetic hand almost ready on Default Hardware Map
- Gael Langevin on Hand and Forarm
- Tom on Hand and Forarm

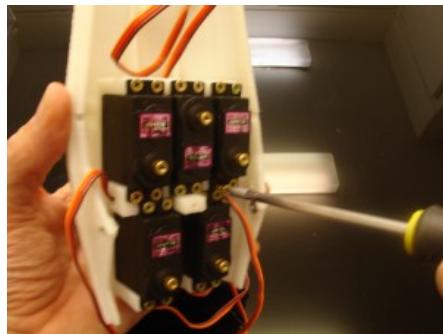
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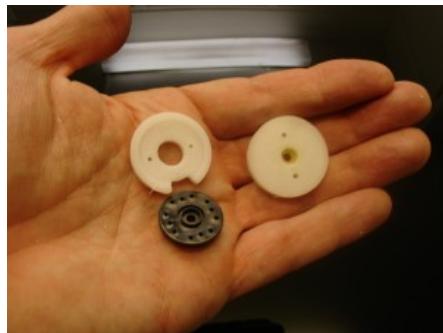
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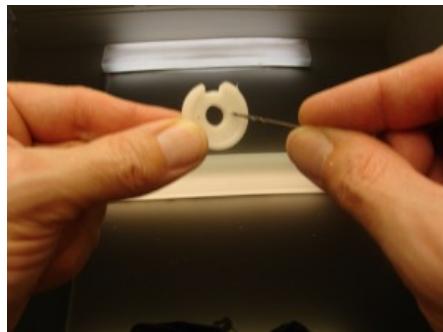
At this point we can mount the servos on simple servo bed.



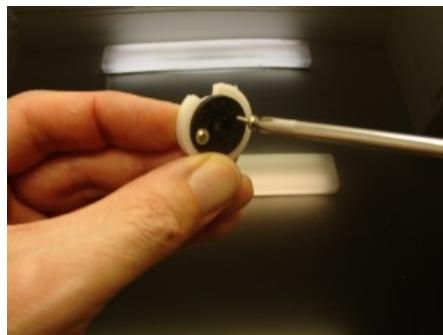
As you can see on my picture, I'm not using the HK15298 but some MG946r instead, for this tuto. The reason is that Hobbyking Europe is out of stock and I couldn't wait.



When you download my parts on Thingiverse, you can either choose to print RobRing or ServoPulley. It all depends, if you received with your servos the black actuator shown in my hand.



I personnaly use the ServoPulley. Redrill the holes with a 2mm drill.

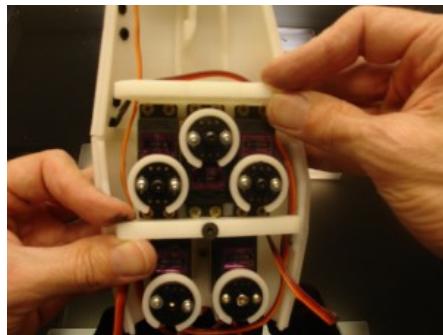
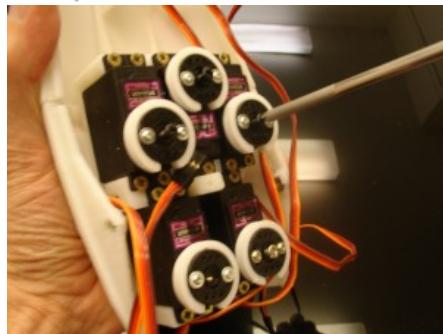


Use the screws that came with your servos to mount the black actuator.



Cut the screws in the back with cutters.

Now use this [script](#) with your Arduino to set all your servos at 90 degrees. Set screw all the ServoPulleys in place as shown. Once the ServoPulleys are fixed, using the script again, set all the servos to Zero degrees. This will be for later when we attach the fishing lines. Avoid moving them during the next steps, otherwise you will need to reset them to Zero later.



Mount on Simple servo Bed, RobCableFront and RobCableBack.

Step2



On RotaWrist1 remove the support.



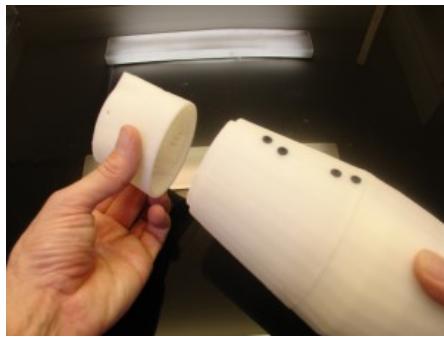
Redrill if necessary the holes for the lining.



Make sure it fits on the Robparts.



You can use a file to adapt it perfectly.



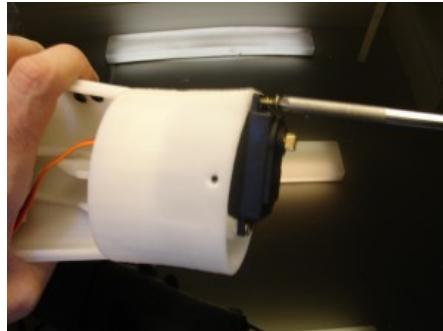
This is the correct way to mount it, see, the black holes are aligned with the square part of RotaWrist1. I have seen many assembly where the wrist was mounted the opposite way.



Back to RotaWrist1. Glue it to Robpart2. When doing this it is good to also set the Robpart3/4 cover to make sure the RotaWrist1 is correctly placed.



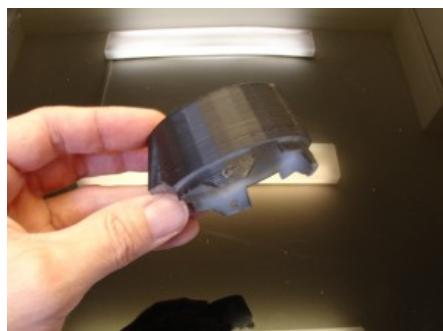
Insert your MG996 servo. Here we want a servo with 180 degree rotation. The HK15298 only rotates of 90 degrees.



Set the wood screws to fix your servo in place.



Redrill with a 2.5mm drill RotaWrist2.



I like to spray paint in black RotaWrist2 because the grease used inside makes the part become yellow after some time.



This picture is to show where to set the extra servo if you use the thumb with double actuation.



Redrill with 8mm RotaWrist3.



With your downloads there is two different small gears, use the one you think is most appropriate for your needs. Here is a previous tuto you might want [to read](#).



Use Epoxy two component glus to fix CableHolderWrist on the servo.





Use grease between the components.



Mount RotaWrist3 to the big Gear.

Step3



Time to redrill the finger hinges. I keep the fingers in separate bags to avoid mixing them.



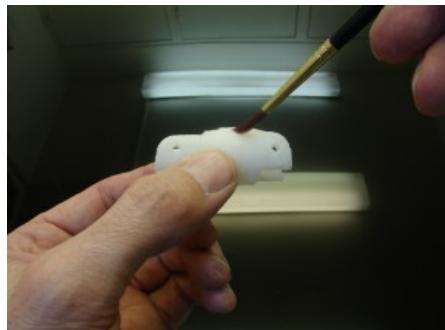
The outside hinge is redrilled with a 3mm drill.



The inside hinge is redrilled with a 3.2 or 3.5mm drill.



Fill the hinges to really adapt them the best.



Glue the parts together with Acetone(ABS)



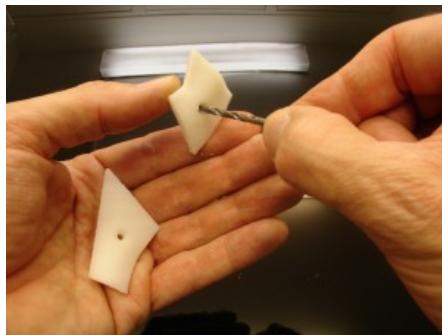
Use your 3mm filament to make pegs.



Cut with a knife the filament. If you don't have 3mm filament you will need to do this with bolts of 3mm. I recommend the filament, it's perfect, cheap and fast.

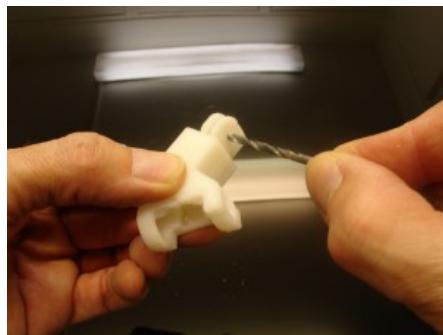


Redrill all holes of the covers with a 3mm drill.

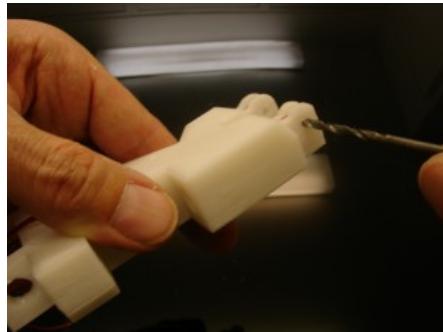


Redrill Wristmall and Wristlarge with a 2.5mm drill for to adapt the covers. If you don't have exactly these size of screws, it doesn't really matter. Use whatever you find at your hardware shop. Remember that the covers have a purpose and are necessary to have a correctly functional hand. They restrain Wristmall from going to the back of the hand. If you don't understand read [this](#).





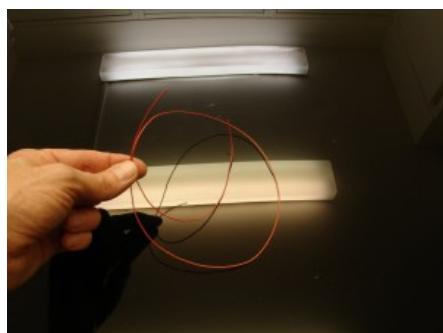
Redrill the hinges of Wristmall and Wristlarge with a 3.2 or 3.5mm drill



Redrill the big hinges with a 8mm drill.

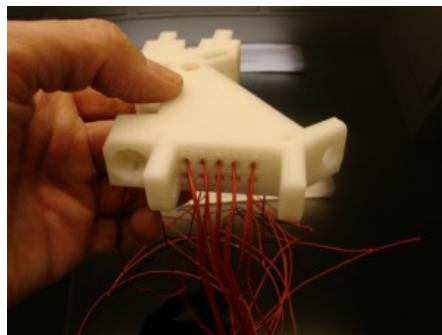


Ensure Bolts or printed Bolts run smoothly with no resistance but without wobbling.



Cut 10 pieces of 75cm long of your braided fish line 200LB. Don't use standard nylon because it stretches.

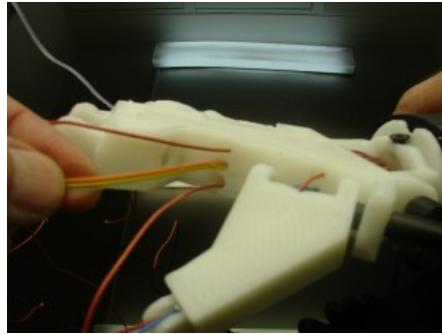
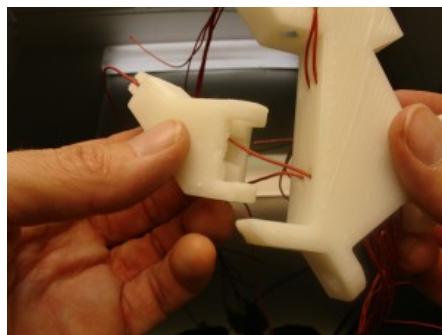
At this point it is good to decide if you want to have sensors on the tip of the fingers or not. You must have seen three holes above each other for the linings in WristLarge. The third hole (middle one) is for running electrical cables to wire up the sensors.



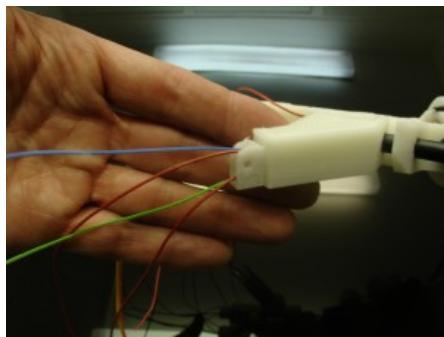
Insert the braided fish lines in the holes of Wristlarge. In this picture, I don't have electrical wires for sensor fingers because it was a previous version.



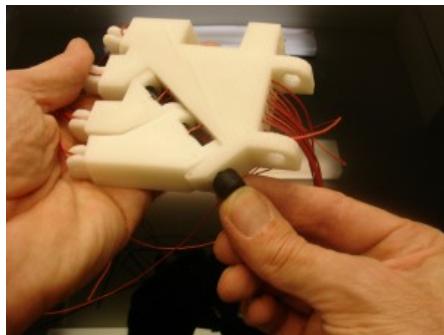
I have designed a little hole which can help you to guide the linings.



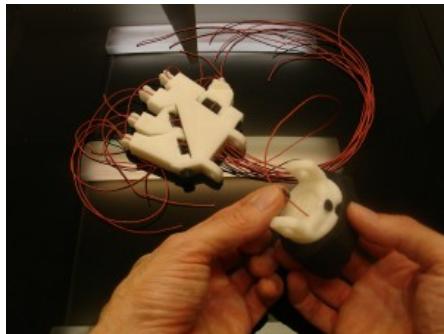
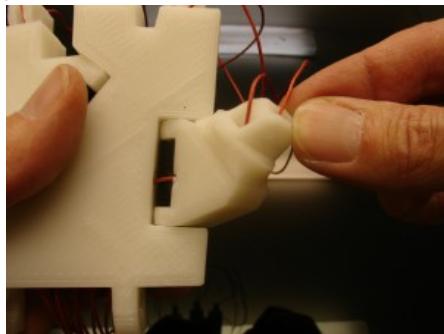
The electrical cables are running in the middle holes.



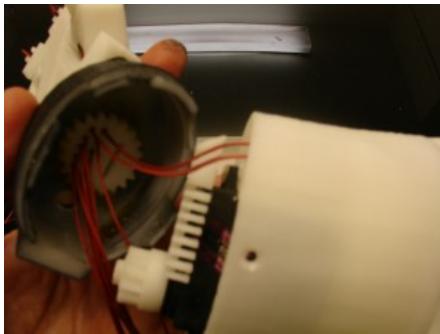
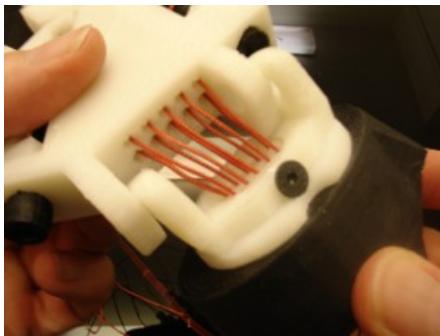
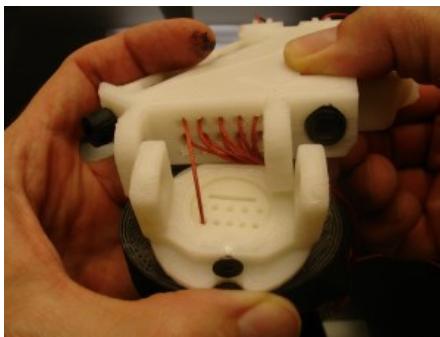
Run the linings into Wristmall. Make sure not to twist them on the way through. If you mix them up, the servos won't be able to actuate the fingers correctly.



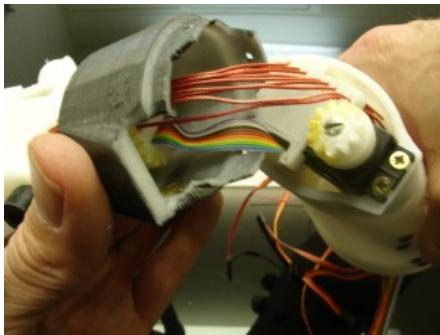
Repeat the wiring with the thumb. If you are using electrical cables don't use the "Entretoise", as shown above, otherwise you won't be able to run the electric cables.



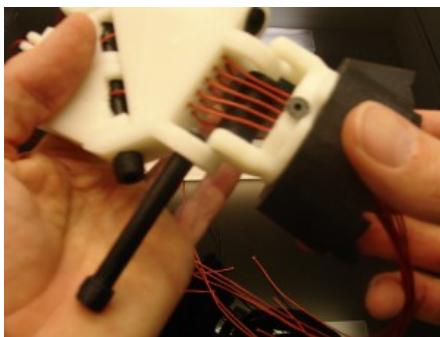
Line up the hand to the wrist.



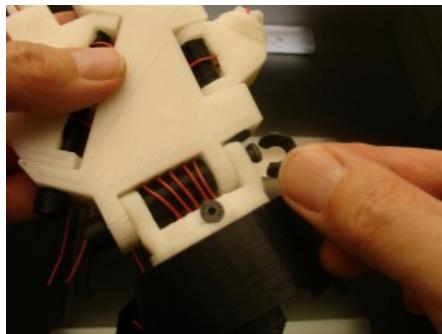
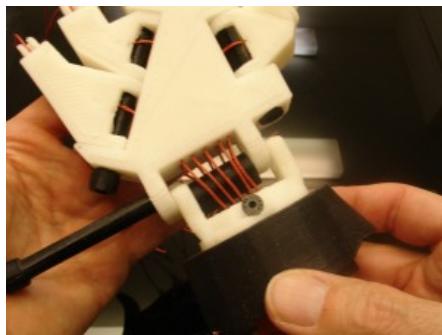
Now wire up the Wrist to the forearm, each lining has a slot.



If you have electrical cable it will be like this. Using color ribbon is a good idea because you know what wire correspond to which finger and connection.



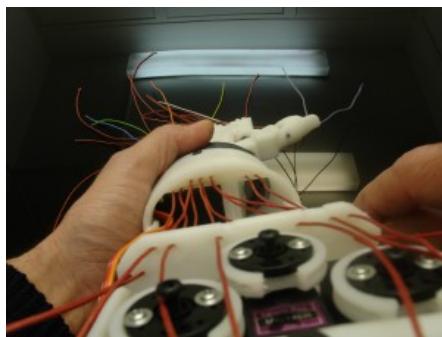
Add the "Entretoise" between the cables



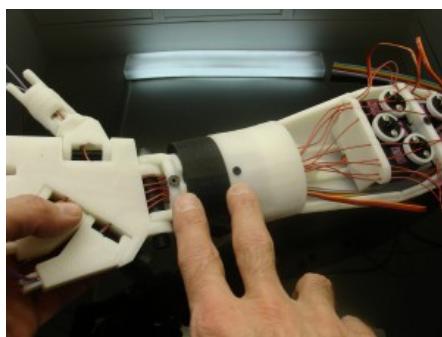
Use the "C" ring to end stop the bolt from coming out.



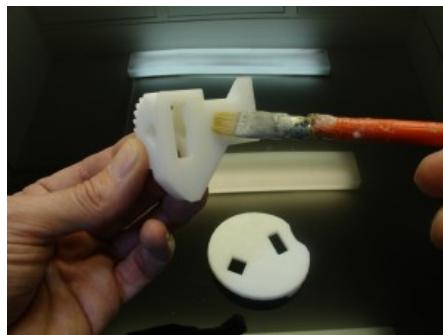
This is the back of the hand, you can see how I have set the cables. I'm not sure it is the best solution but, like you, I'm learning and discovering.



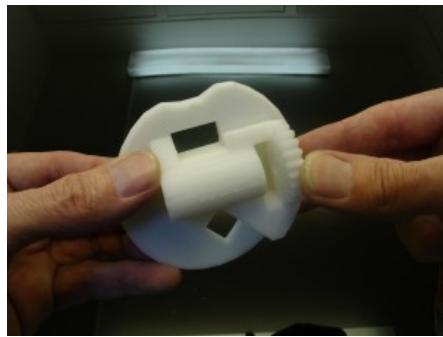
Here is how the lining should look up to the wrist.



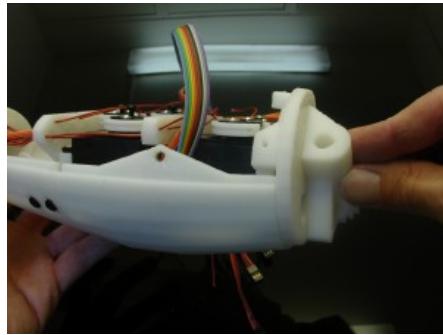
When you assemble the wrist make sure the servo is set at 90 degree and that the two screws on the picture are aligned. Until now I never did recommandation about this, and unfortunatly many of the gestures I created can't be reproduced by other InMoov because the wrist isn't set the same than mine.



Glue RobCap to ElbowShaftGear.

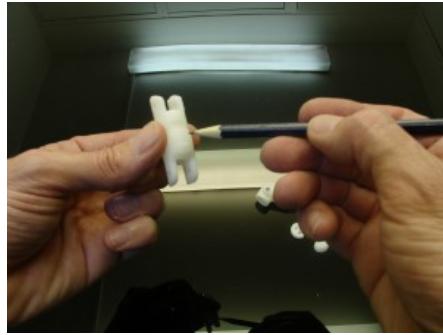


Aligning the square hole is the way to do it. If you are using ABS and acetone, I can tell you there is no need to add screws if both of your surfaces are correctly flat.



Now glue this assembly to RobPart5, make sure it is correctly aligned in the slots.

Step 4



When assembling the fingers there are marks that can help you to see in which order it has to be done. I won't go into those details here but you can find more instructions in the [finger starter tutorial](#). The finger starter has numbers for an easy comprehension, the normal fingers don't have those numbers, but the parts are the same.





Now that you have all your fingers assembled, for those that want to add sensors here is how we are going to proceed.



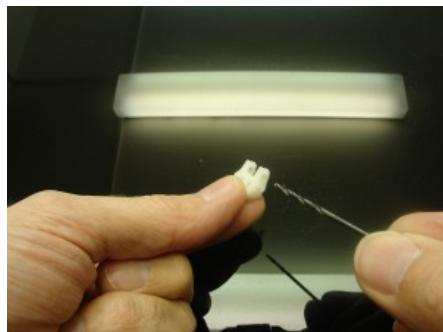
Finger sensor prints.



Glue the tip of the finger to the hinge tip. Make sure to align the nail lines, it will look better 😊



Sorry for the blurry picture.



Redrill the holes of the hinge with a 2mm drill.



Redrill the hole of the tip hinge with the same bit.



Add the hinge to the tip hinge and redrill them together to make sure they fit nicely.



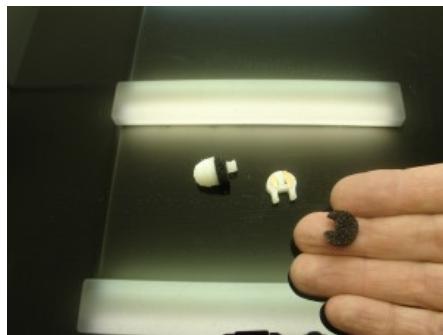
I used non flat metal nails instead of filament here, because the size of these parts are small. I just cut them at the size needed.



Cut some strips of copper of about 3 to 4mm large.



Recut those strips in tiny triangles. These are going to be contactors for the antistatic foam.

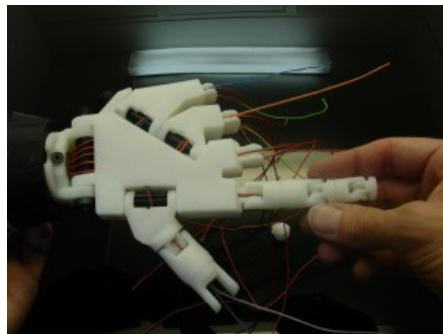


Cut with scissors some nice little rounds in your 4/5mm thick antistatic foam. This foam is sold with electronic components to avoid electric shocks. Most of the time we just throw it away when we buy components, you can also buy it in many electronic shops. It contains carbon which is an electrical conductor. When the foam is pressed against the 2 contactors, the carbon lets the current flow between them. More the foam is pressed and more current goes through. This is the info we will send to the Arduino Analog pins.

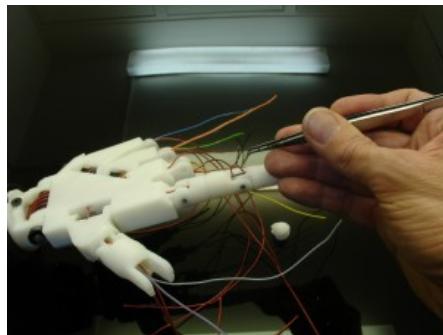
Glue with 2 components epoxy the foam to tip hinge part as shown on the picture.



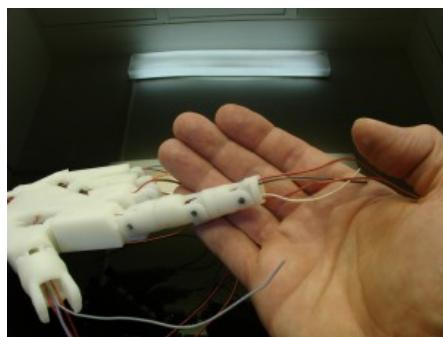
Try to assemble the two parts and see if it moves. The hinge design is supposed to stop the hinge from opening further than the 5mm thickness of the foam.



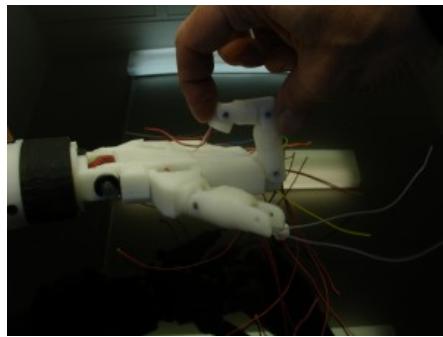
Time to mount the finger to Wristlarge. Notice the last hinge of the finger, this will receive the finger tip sensor assembly. All the holes in those finger parts should be cleared and large enough to have the 2 tension cables and the 2 electrical cables.



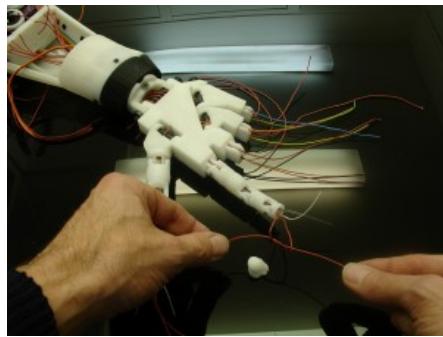
Run the tension cables and the electrical cables. One of each on the up side and one of each on the down side. Make sure to avoid any twisting of cables, this would cause to get unfunctional fingers.



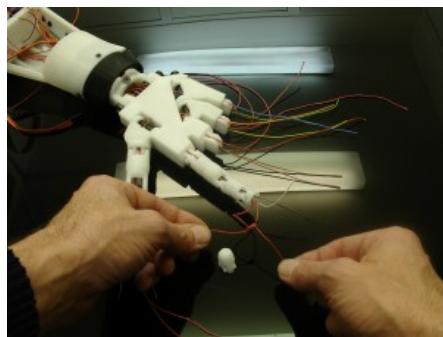
The color ribbon again is handy in this task.



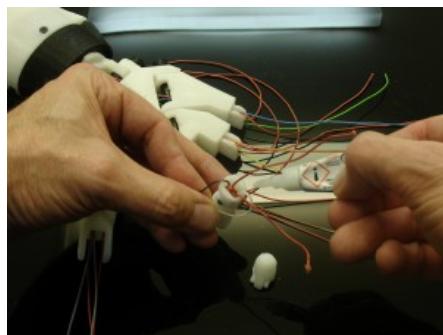
Fold the fingers to smooth up a bit the cables in their path.



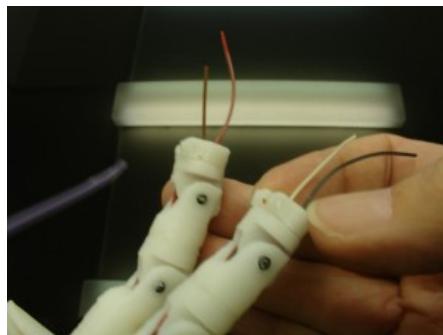
Make knots with the tension cables.



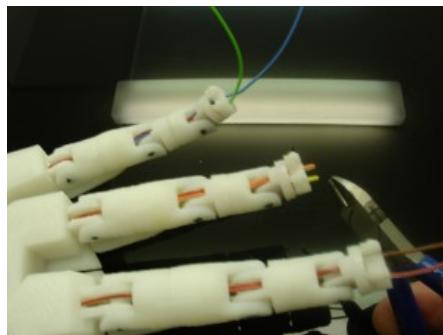
A bunch of them is necessary because we don't want them to go through the holes when the servos are pulling hard on them.



What I do is even add glue to ensure any bad surprise. I also glue the electrical cables at the same time. When doing so, it is good to have the finger folded otherwise the electrical cables could later restrain the full motion of the finger.



Cut the remains of the tension cables. Now glue the hinge of the finger tip to the last hinge of the finger. Notice the position, don't glue them upside down. Remember I mentioned the tip hinge was design to avoid opening further than the thickness of the foam.



Cut each electrical wire at a 4/5mm length. Scary moment because too short would mean to redo all the wiring. 😊



Cut and clear up the plastic on the electrical cable and solder the copper triangles.



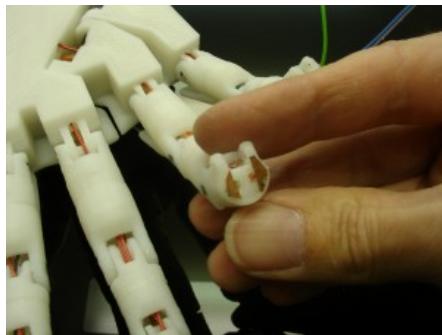
Once done, fold the cable and lay the copper triangles in a flat position.



Add 2 component glue under.



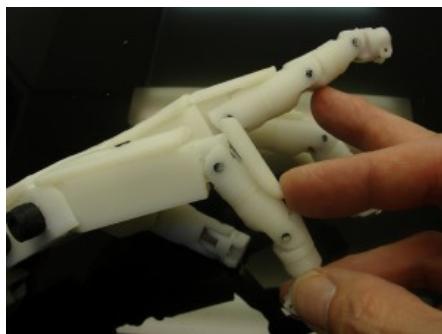
To maintain them flat during the time the glue gets hard, I used some tape. Look out for the tape you use as it maybe glued as well to the finger tips.



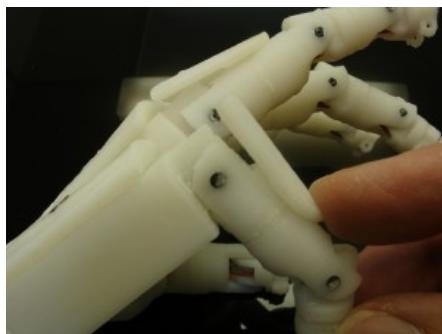
This is the result.



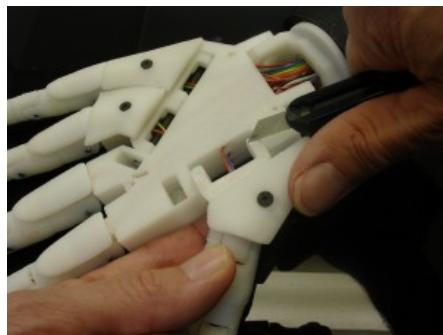
Now you can add the finger tip with the nail and you should have a sensor ready to be pressed and give feedback.



Glue the finger covers on the fingers.



These are used to avoid the finger going to much in a backward position and they also add a look to the design 😊



Do the same with the Thumb cover and Wristsmall. Actually I glue them first and then I add the screw, that keeps them well in place. Recut with a knife the two corners on the thumb hinge. If you don't the hinge will be forcing against the hand cover.



Add the hand cover and check if the fingers are moving nicely.

You can add Sugru on the finger tips, and ping pong surface in the palm of the hand for a better gripping. I found also some kitchen heat protectors for 1,50 euros with silicone surface. It is even better. Ideally for the finger tips it would be to have what they do today with silicone grips on the tooth brushes.



Hey it looks like you are set to tension the fishing braided

lines!!

In the next tuto there is steps I'm going through again and they might also look a bit different. The reason is because of updates. Actually the next tuto was done before the tuto you just followed above.

Go to this tutorial [for tensioning the Linings](#).

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12 COMMENTS

[InMoov » New wiring design for the hand](#)

December 22, 2013 2:05 am [Log in to Reply](#)

[...] Hand and Forarm [...]



Vinícius

January 8, 2014 3:28 am [Log in to Reply](#)

Ol.....queria saber onde conseguiu os arduínos e os motores para mover o dedos...
também queria saber como se conecta o eletrodos no braço!!



Gael Langevin

January 9, 2014 3:14 am [Log in to Reply](#)

Hi, can you translate in English? Thanks



Renato Brígido

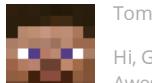
January 12, 2014 7:03 am [Log in to Reply](#)

Hi Gael, Vinicius wants to know where did you get the arduino components and the motors that move the fingers, and , also, how to conect the electrodes in the arm.

Gael Langevin

January 12, 2014 8:03 pm [Log in to Reply](#)

Hi, the Arduino for the arm and hand is a Arduino Uno, you can get it everywhere on the net (Adafruit for exemple), for the motors I use some HK15298 from Hobbyking.
The connection map is [here](#)
The connectors are [here](#)



Tom

February 24, 2014 8:58 am [Log in to Reply](#)

Hi, Gael

Awesome work! I'm going to print the parts and make one. But where should the Arduino Uno be settled in Inmoov's hand? I didn't find it in this tuto. Maybe u could give me some directions? Thank u.

BTW, for 3D print, are these 4 files enough for this tuto?

Hand_robot_InMoov

Adjustable_thumb_for_InMoov

Simple_Servo_Bed_for_InMoov

Inmoov_Robot_Rotation_Wrist

Thanks again! Hope I can finish it.



Gael Langevin

February 24, 2014 2:16 pm [Log in to Reply](#)

Yes this 4 files are enough. You can fit an Arduino Uno inside the forearm, there is space enough although it isn't designed to do that. I had difficulties to get the USB cable inserted. If you want easy set up, go for Arduino Nano.



Tom

February 28, 2014 10:32 am [Log in to Reply](#)

Hi, Gael

Nice work and I really want to make one. But I find out that it is really expensive to print these things (I mean hand) totally, since I have no 3d printer myself. I ask a company to print this, but need 18000 hkd, which is about 2400 us dollar. So I want to ask whether it needs such money? How much may this cost by yourself? It is too big number for me, since I'm still student... I thought this may cost me about 200 us dollar. Or do you have any suggestion? Thank u very much!! Really love your work !



Tom

February 28, 2014 10:34 am [Log in to Reply](#)

I'm still student not steel student... Sorry for the mistake in last comment.



Gael Langevin

February 28, 2014 7:24 pm [Log in to Reply](#)

No problem 😊



Tom

March 2, 2014 5:44 am [Log in to Reply](#)

Hi, Gael. So the question about the budget ? How much will it take for the 3d print of this part? I mean the hand and forearm. I may have no enough money for it. Any suggestion? Thank you



Gael Langevin

March 2, 2014 11:38 am [Log in to Reply](#)

Hi, it is hard for me to say because it all depends on your material and printer experience. I would say that with 15 to 20 euros of ABS it is largely enough to print those parts. If I remember correctly, the hand and forearm have a total weight of 750Gr. But you need to have a 3D printer.

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