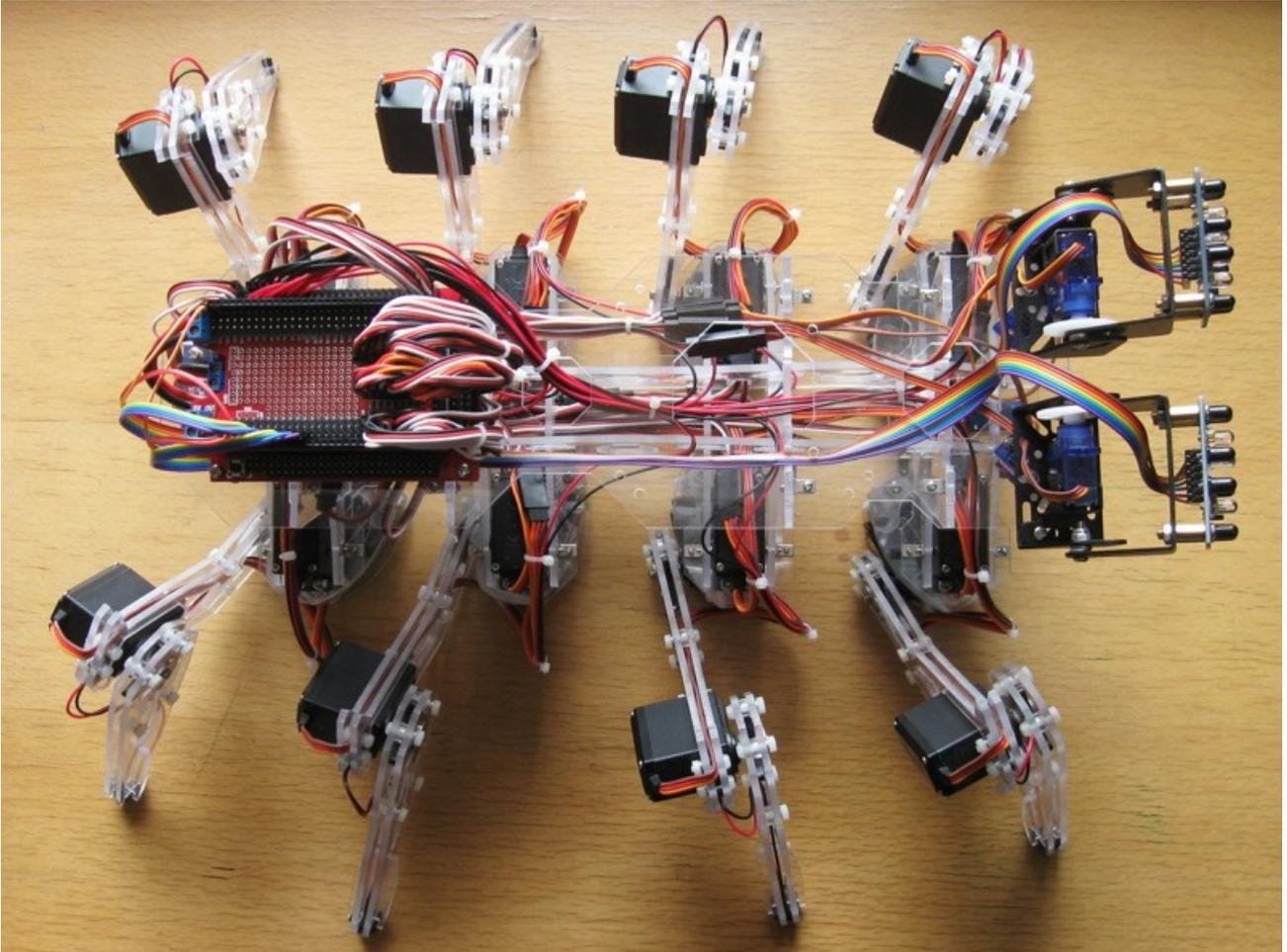


Chopsticks

Assembly Manual



Introduction:

The Chopsticks Spider Kit is a complete 8-legged robot with 3 degrees of freedom on each leg. All 24 leg joints have an adjustable shock absorber to protect the joints gear train from damage. The supplied controller is compatible with an Arduino Mega (1280) and can control up to 48 servos as well as providing up to 3A at 5V for additional processors and sensors.

The kit includes two pan / tilt assemblies and two IR compound eyes. Using the sample code provided the robot can track movement of two objects independently at close range and will attempt to follow those objects.

The CNC machined polycarbonate chassis is lightweight, tough and flexible. Weight is further reduced by using nylon nuts and bolts on the legs. A miniature servo mounted between the front legs allows an optional range finding sensor to scan the area in front of the robot.

Each rubber foot is fitted to a pressure switch allowing the robot to detect when a foot is touching the ground. This allows the robot to detect edges such as the top of a flight of stairs or the edge of a table.

The robot has a leg span of 650mm x 500mm (19.5 inches x 25.5 inches) when sitting on the ground with it's legs extended. It can raise its body 200mm (8 inches) above the ground when walking to clear obstacles.

The large size of the robot and its payload capacity of 1Kg make it an ideal experimental platform. The top deck of the robot provides room for a second processor or additional modules such as GPS, WiFi etc.

Contents

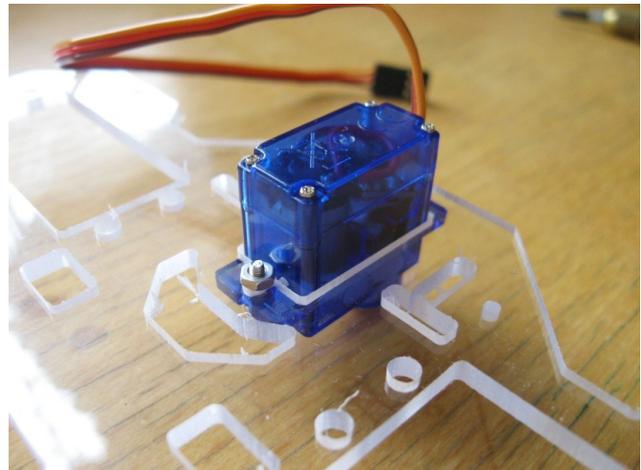
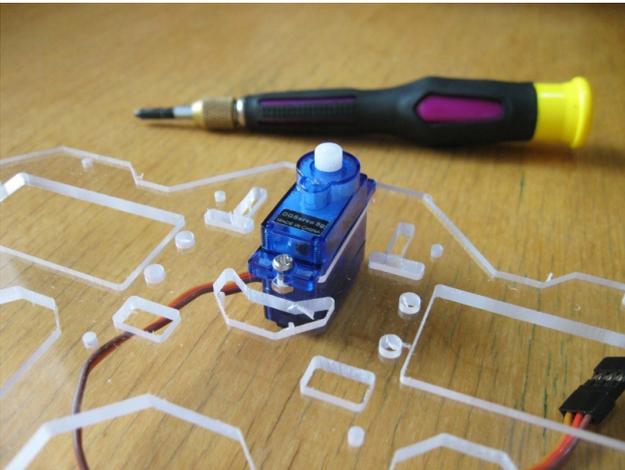
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Assembly of the body

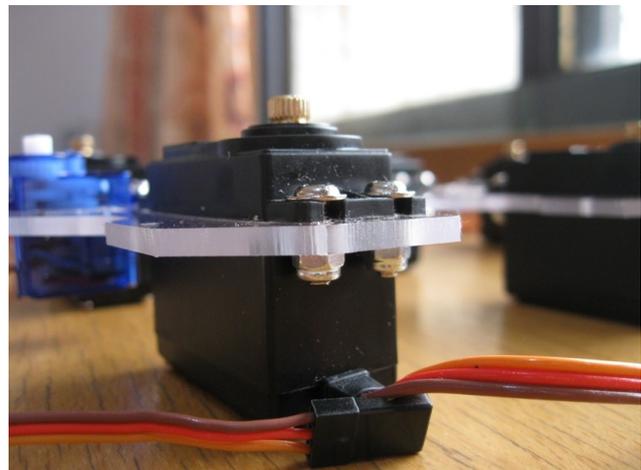
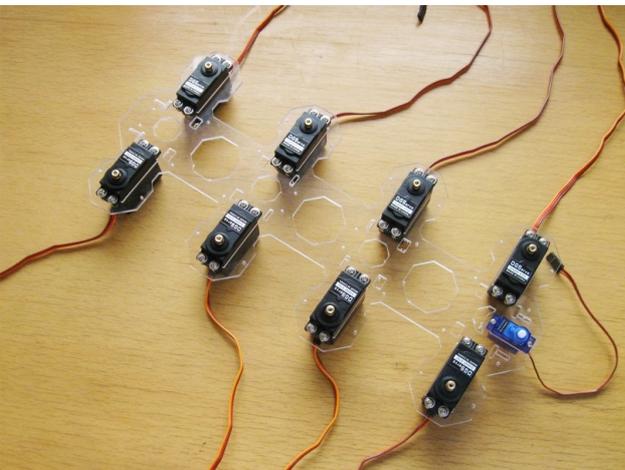
Open pack 1 which contains the pieces needed to assemble the body. Remove the protective layers from the polycarbonate pieces.



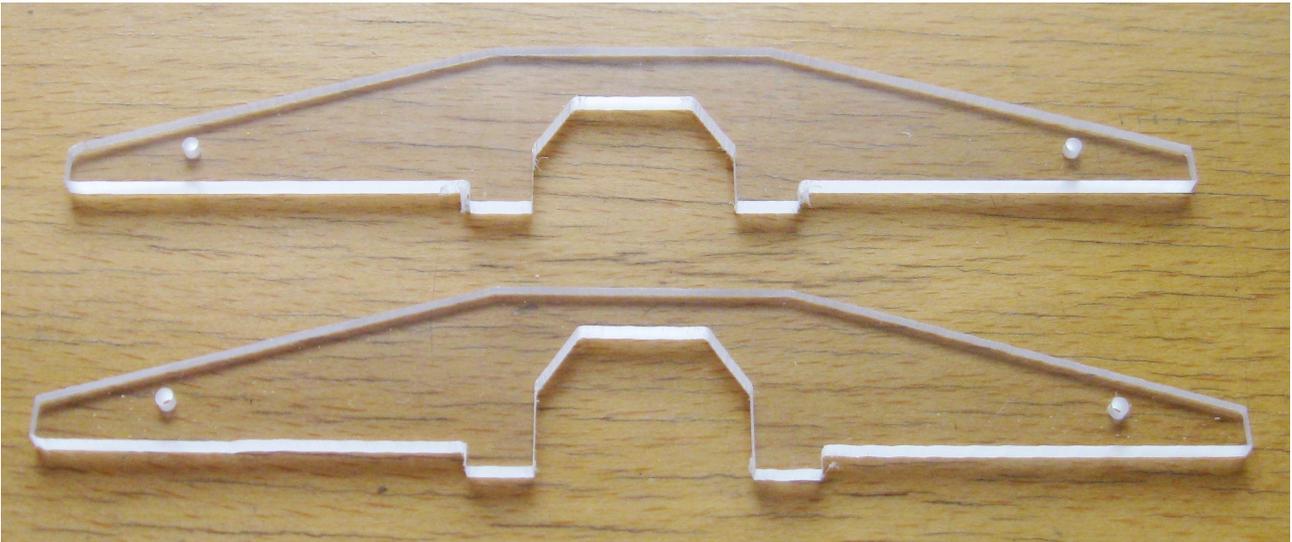
Mount the miniature servo at the front of the base plate using two M2 x 8 screws and M2 nuts.



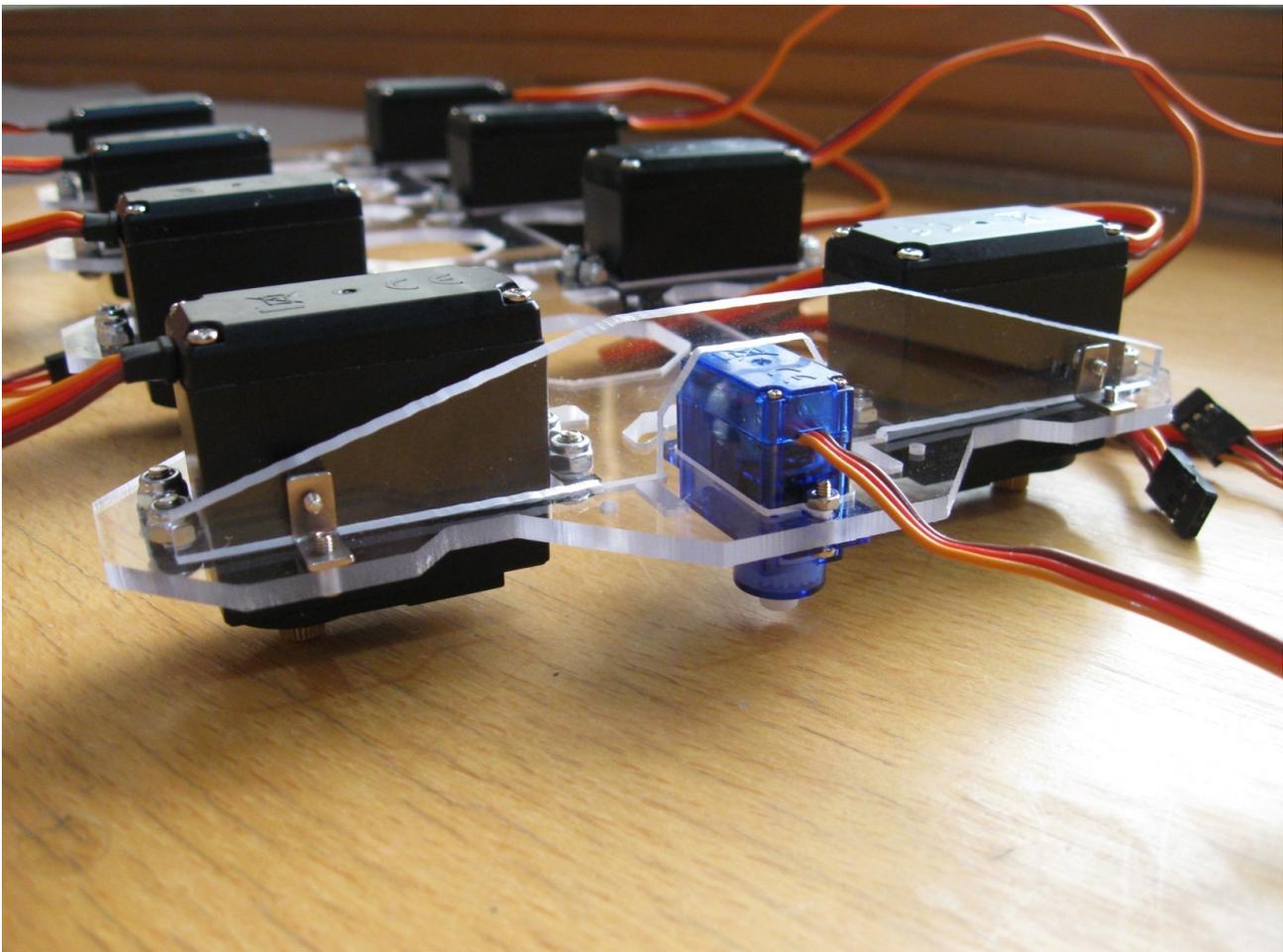
Now mount eight servos for the hips using M3 x 8 pan head screws and M3 nyloc nuts as shown. Make sure the output shaft is to the outside of the base plate.



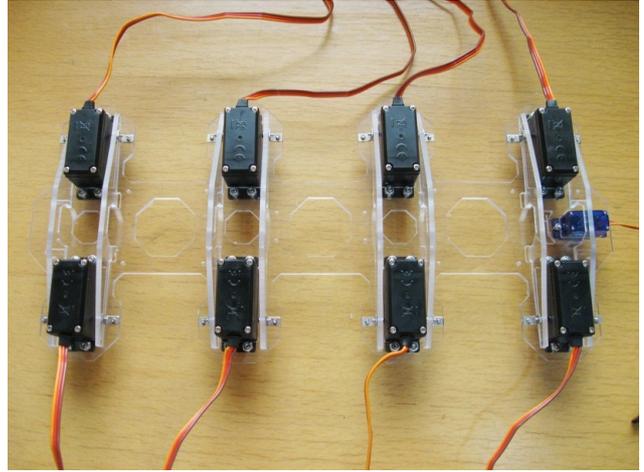
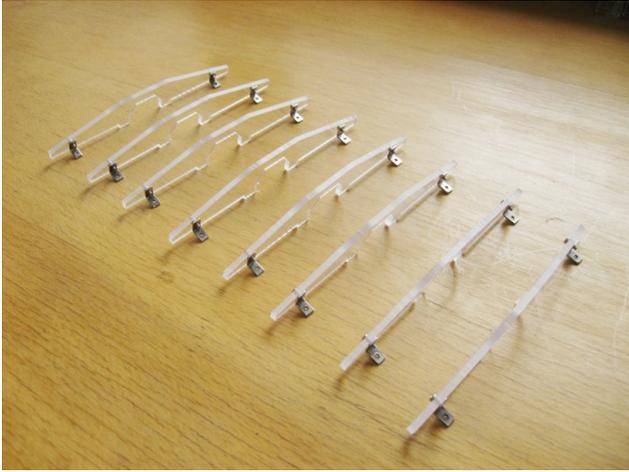
There are eight cross members. As you can see in the picture below, one has a thinner center section than the rest to make room for the miniature servo at the front.



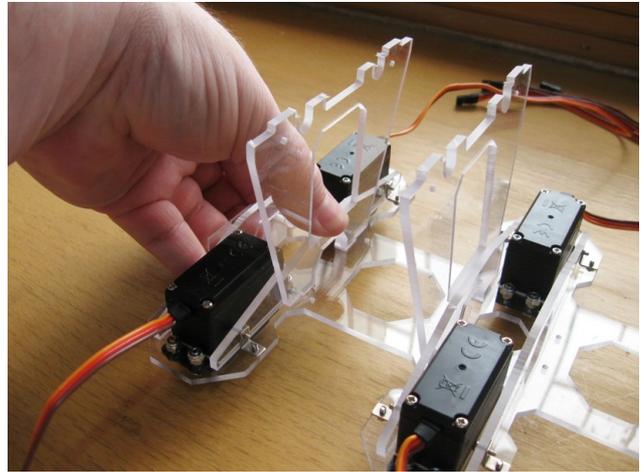
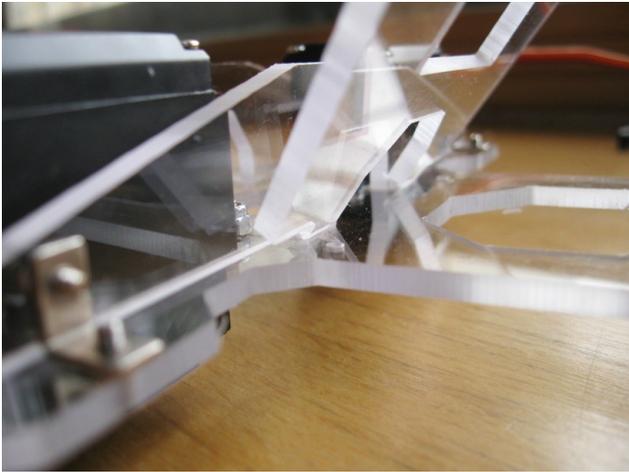
Fit two 90 degree mounting brackets to the cross member using M2 x 8 screws and then mount the cross member at the front of the base plate as shown using two more M2 x 8 screws.



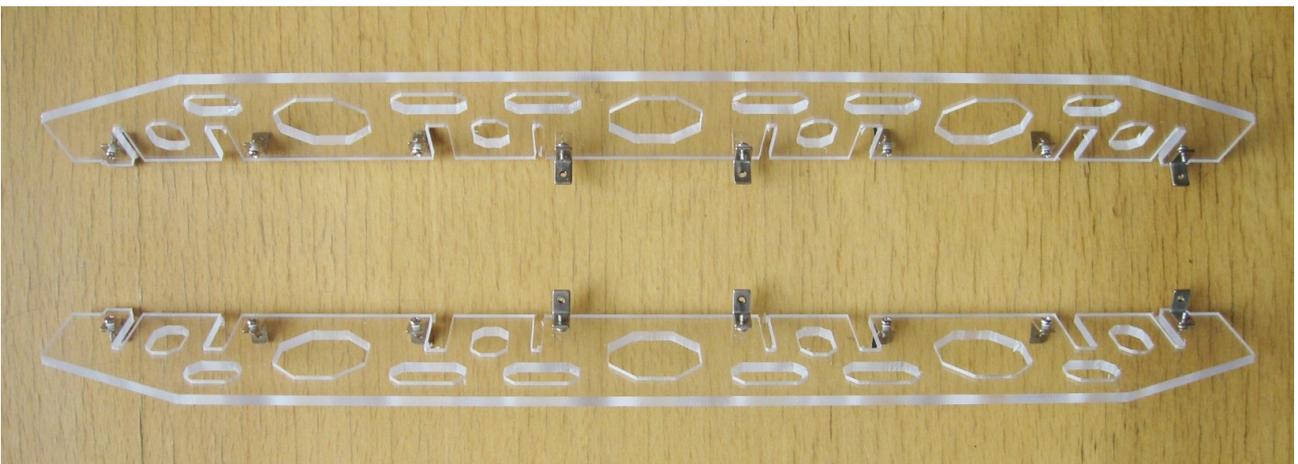
Now fit 90 degree mounting brackets to the rest of the cross members and fit them as shown in the photos below using M2 x 8mm screws.



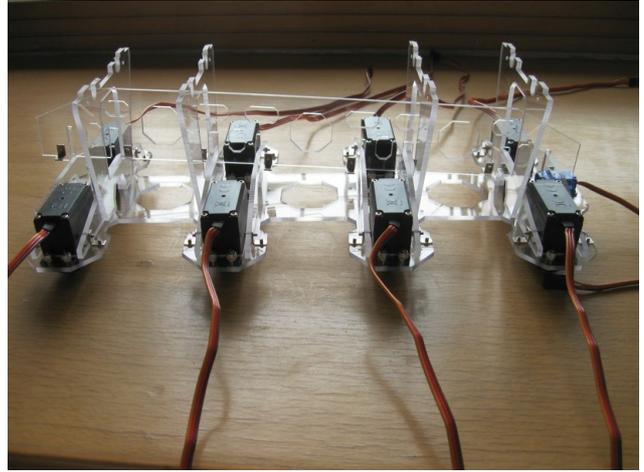
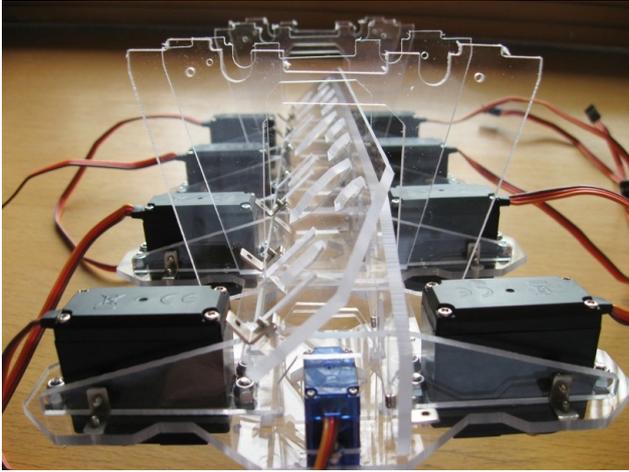
The four bulkheads can now be inserted into the base plate. These will be a firm fit so you will need to insert them at an angle and then press down as you straighten them up.



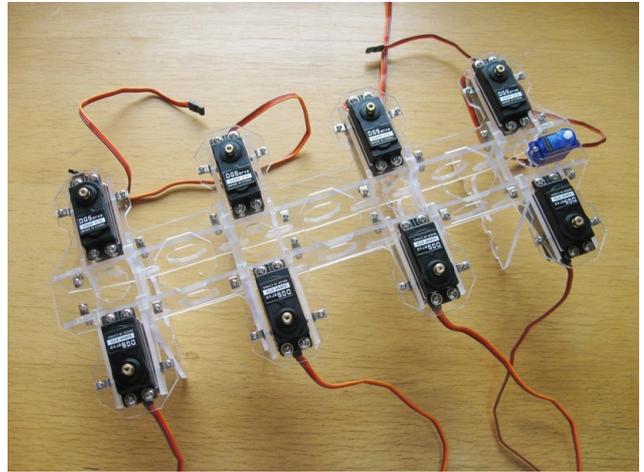
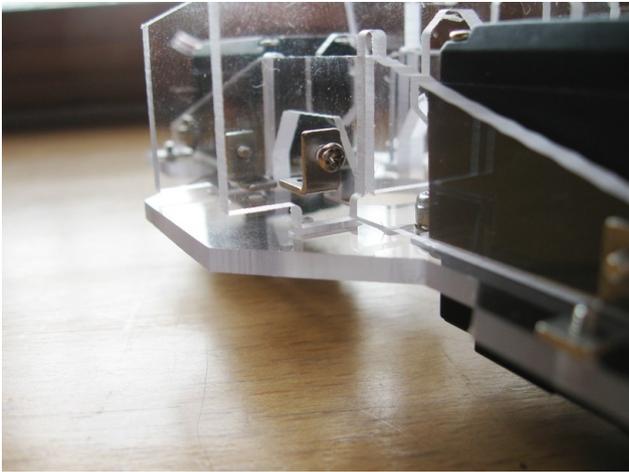
Now fit eight, 90 degree mounting brackets to each frame rail. The two frame rails should be mirror image to each other as shown in the photo below. Pay careful attention to the location of the brackets as they are fitted on both sides of the frame rails.



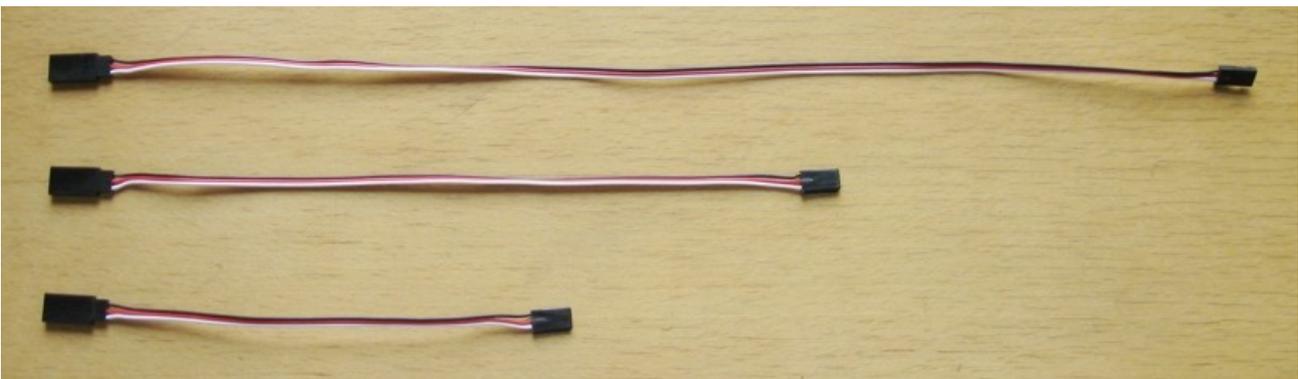
Gently insert one frame rail through the bulkheads making sure it is the correct way around. Press it firmly into position starting at the front and working your way towards the back.



Press the frame rail down all the way until the tabs at the front and back are in their slots. Then repeat the process with the second frame rail. Turn the body over and secure the frame rails with M2 x 8mm screws.

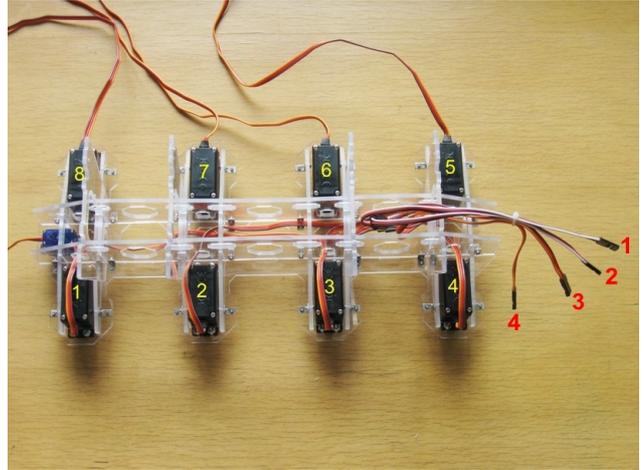
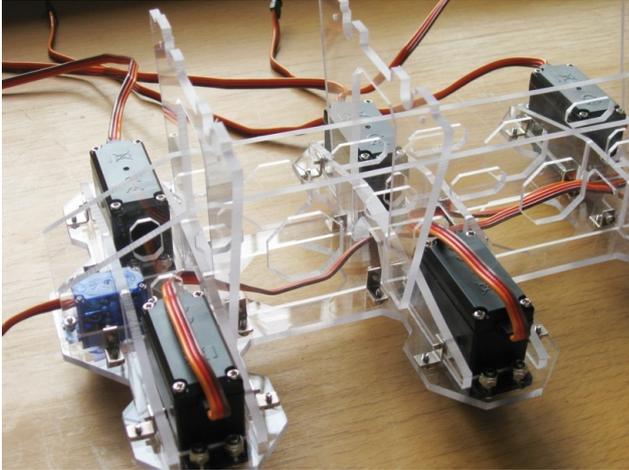


Next we need to run our servo cables down the spine of the robot. Included in the kit are servo extension cables. These come in 3 different lengths – short, medium and long. We will use these extension cables when necessary to make sure our servos can plug into the Spider controller.

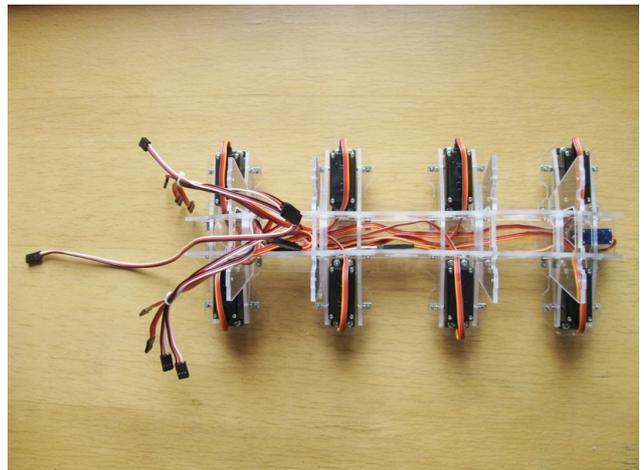
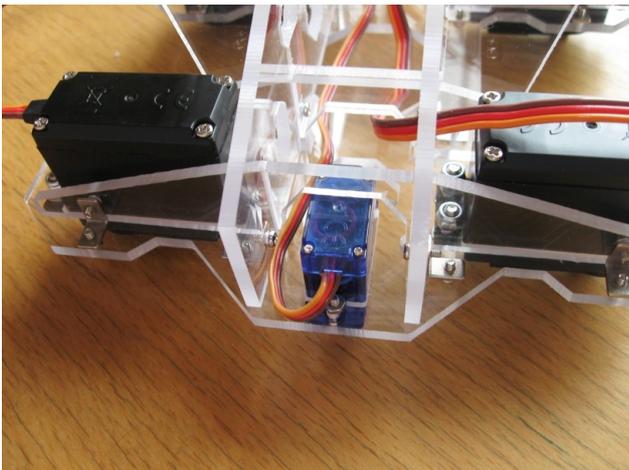


The legs are numbered from 1 to 8. Each leg has 3 servos. These servos are Hip, Thigh and Knee servos. We are now installing the cables for the Hip servos. We will start with hips 1-4 working from front to back. Run the cables as shown.

When you have a group of 4 then cable tie them together in order. A set of adhesive labels have been included in the kit for identification. Apply them to the servo cables as you assemble the robot.



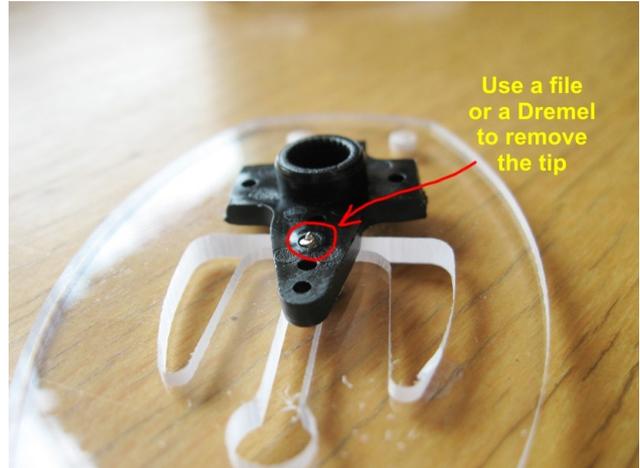
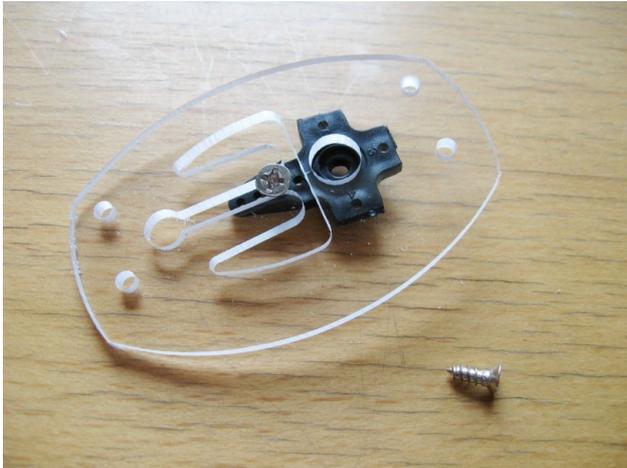
Use medium length servo extension cables for hip servos 1 and 8. Use short extension cables for hip servos 2 and 7. Use a long servo cable for the sensor servo at the front.



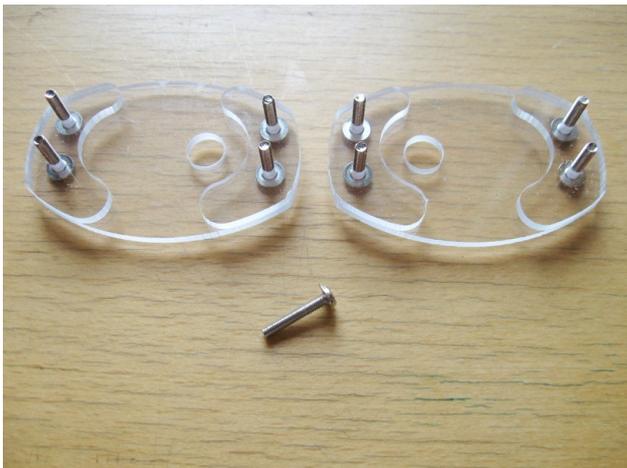
The main body is now complete and we can begin assembly of the legs. We will build the legs onto the body rather than making the legs separately. This allows us to continue running our cables in groups of 4.

Hip assemblies

Open pack 2, which contains all the parts needed for the hip assemblies. The hip assembly mounts onto the hip servos in the body. It contains a suspension system to protect the hip servos and is the housing for the thigh servos. Make these in left and right pairs.



Start by shortening 3 arms on the servo horn. Leave just 1 hole as shown. This provides the hip joint with better stability. Screw the servo horn to the hip suspension plate using a 3x 6mm countersunk self-tapping screw as shown. Remove the sharp point using a file or Dremel tool.



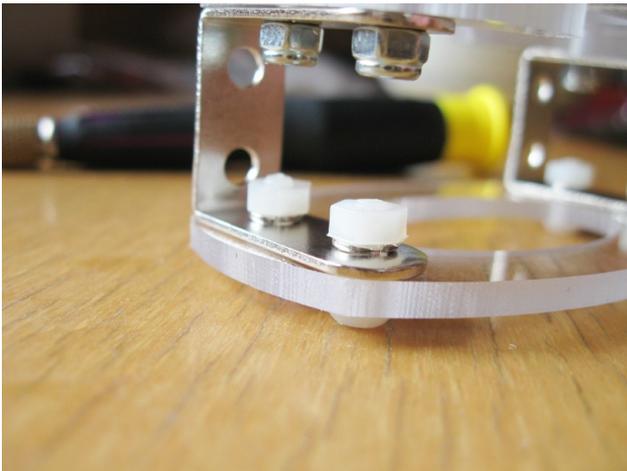
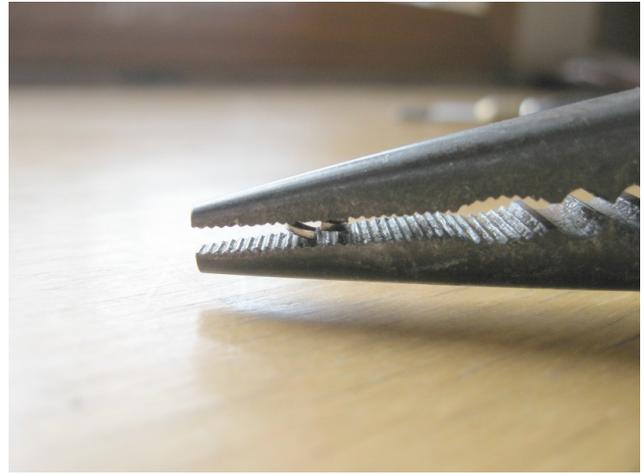
Take the top plate and fit two spacer plates using four M3x16mm pan head screws. Mount the suspension plate and another two spacer plates. Note that one end of the spacer plates is thicker than the other. If they do not fit neatly then remove and turn over. Now fit the thigh servo mounting brackets. Use M3 nyloc nuts but do not tighten too much as we will need to move these brackets slightly when fitting the servo.



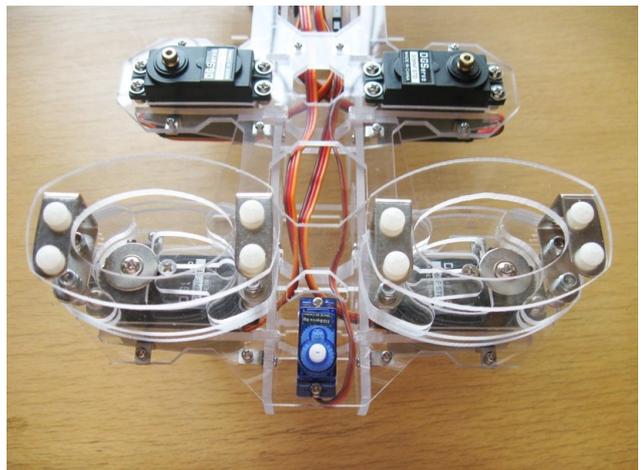
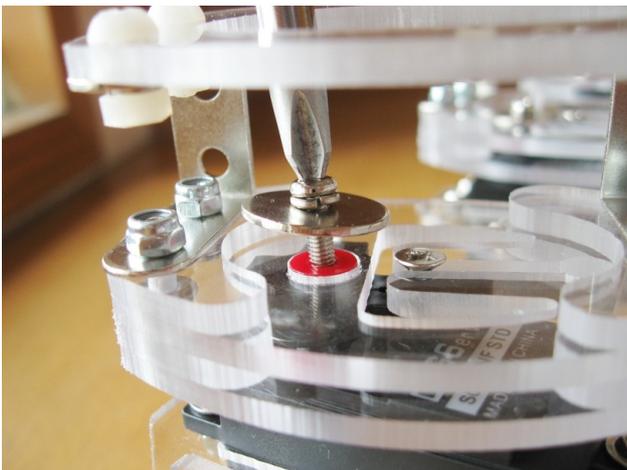
To help reduce the weight of the robot we use M3 nylon nuts and bolts when possible. To prevent these from vibrating loose we use spring washers (also known as split washers).

As the spring washers are designed for steel nuts and bolts we need to squeeze them with our pliers first. This reduces the spring tension enough that the nylon nuts can compress them without stripping their thread. This should be done whenever nylon nuts and bolts are used in these instructions.

Note the orientation of the support bracket, one side is wider than the other. Mount the servo support plate using M3x 8mm nylon bolts, spring washers and M3 nylon nuts as shown but do not tighten all the way.



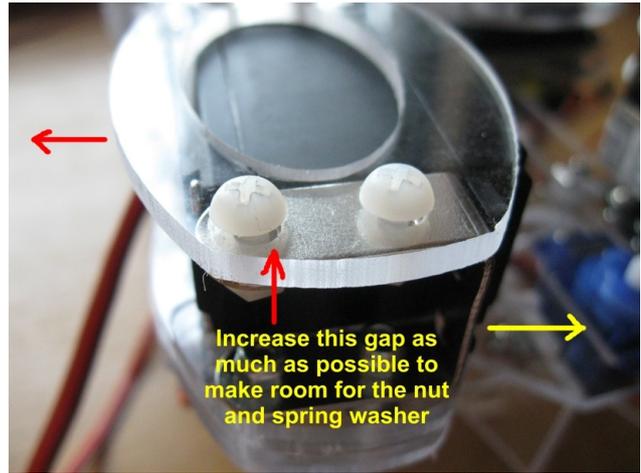
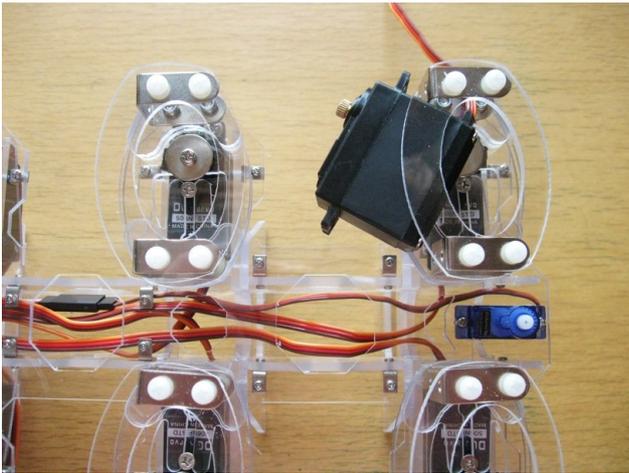
The hip assembly can now be fitted to the hip servo using an M3x16mm screw, a M3 spring washer, a large flat M3 washer and a red acrylic 2.5mm thick spacer as shown. Make sure to remove the protective film from both sides of the red acrylic spacer. Mount your left and right assemblies as shown. They should be able to rotate just over 90 degrees in both directions. If not then re-seat on the servo spline.



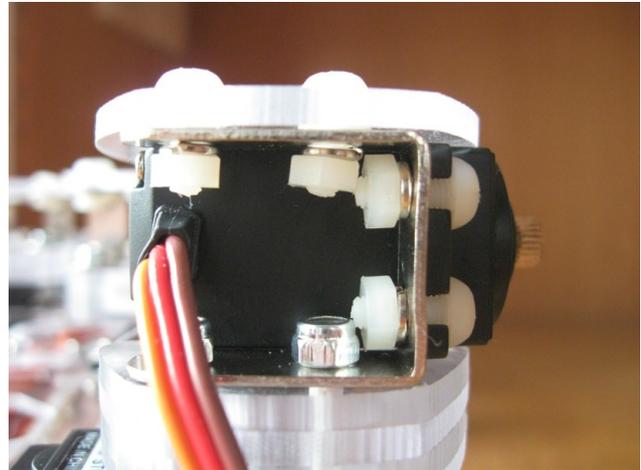
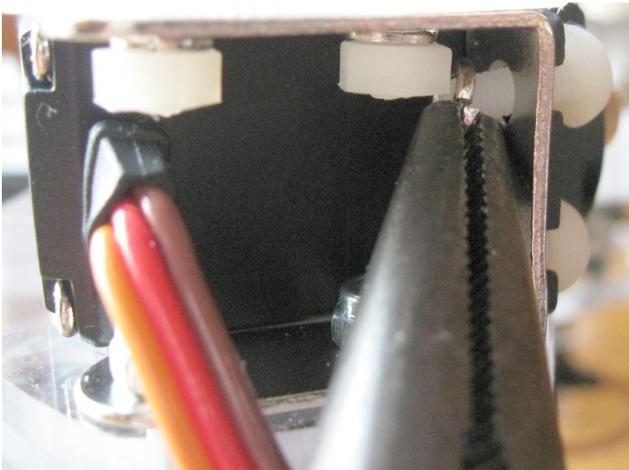
If you rotate the hip assembly back and forth by hand you should see and feel the spring action of the suspension. This will extend the life of your servos. You can make the suspension harder by changing the position of the screw in the servo horn but soft suspension is recommended.

Should the suspension plate be overstressed and permanently deformed then gentle heating of the plate can restore it in some cases. Heat the part in an oven set to 180 degrees Celsius (456 F) for 15 minutes and allow it to cool slowly.

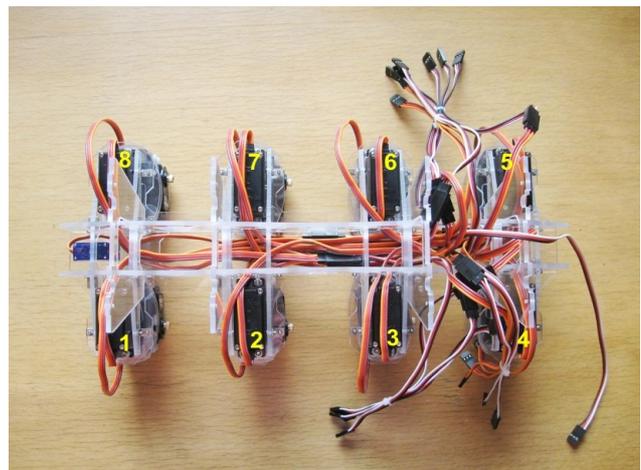
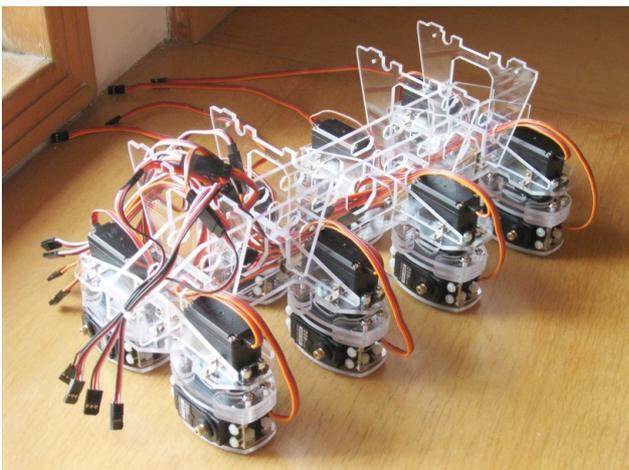
Once all your hip assemblies are mounted then we can install the thigh servos. Insert your servo cable first as shown. Mount the servo using M3x8mm nylon screws and nuts with a M3 spring washer.



Insert your spring washer using long nose pliers or tweezers. Then insert your nylon nut. It is a tight fit and some patience will be required. Start at the front of the robot and work towards the back.



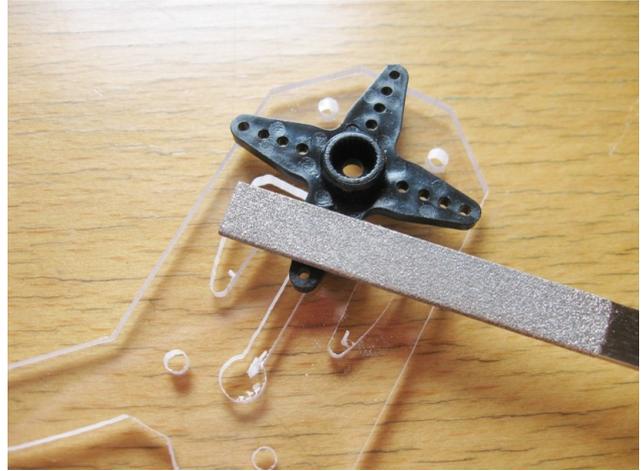
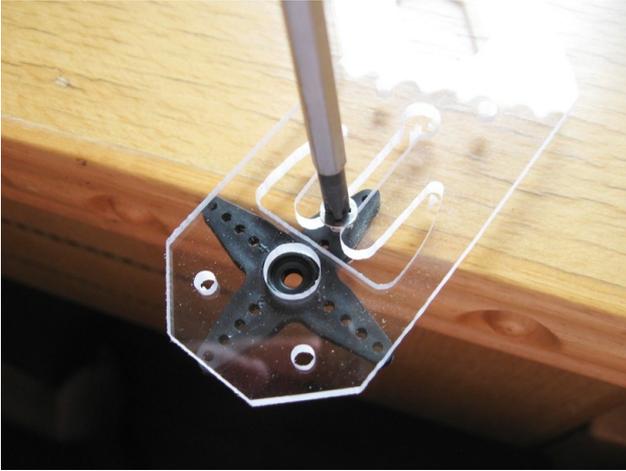
Run your thigh servo cables in the same manner as the hip servos. First run the left side and then the right side from front to back and cable tie each group in order. Make sure you leave enough cable that the hip can rotate 180 degrees without pulling on the thigh servo cable too much.



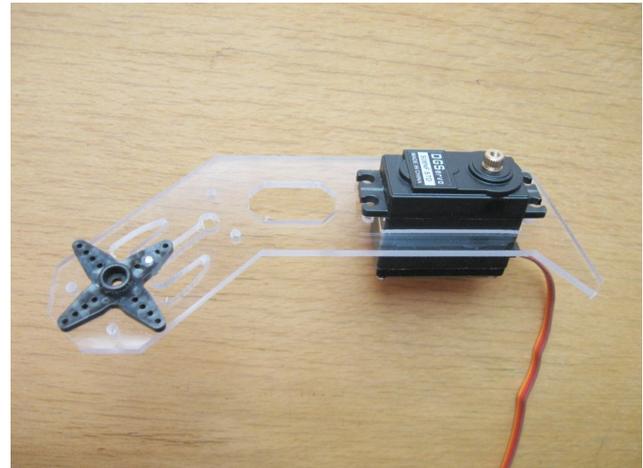
Use medium length servo extension cables for thigh servos 1 and 8. Use short extension cables for thigh servos 2 – 7.

Thigh assemblies

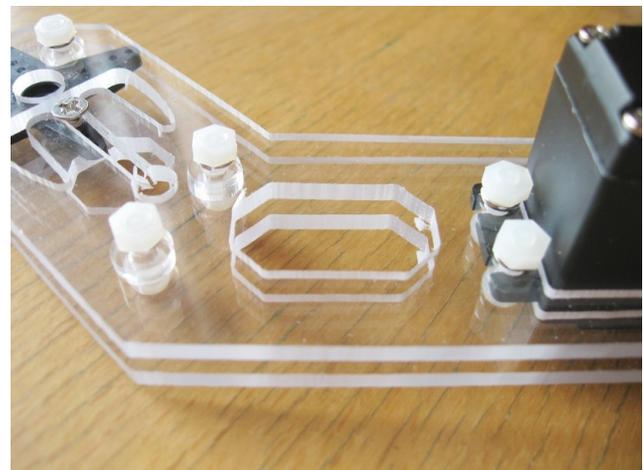
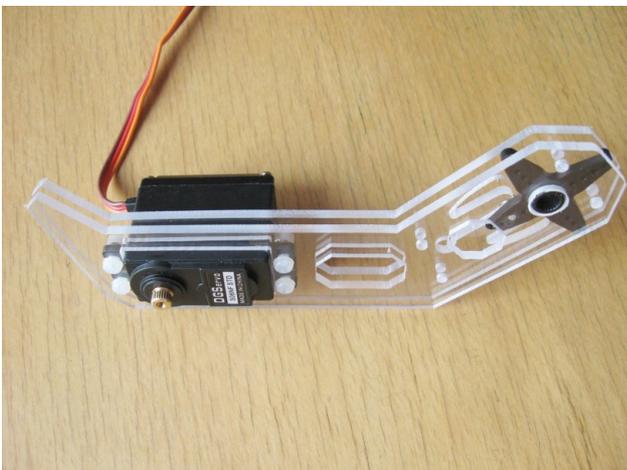
Open pack 3, which contains all the parts necessary to build the robots thighs. Start by screwing the servo horn onto the thigh suspension plate using a 3x6mm countersunk self-tapping screw. Use a file or a Dremel tool to remove the sharp point.



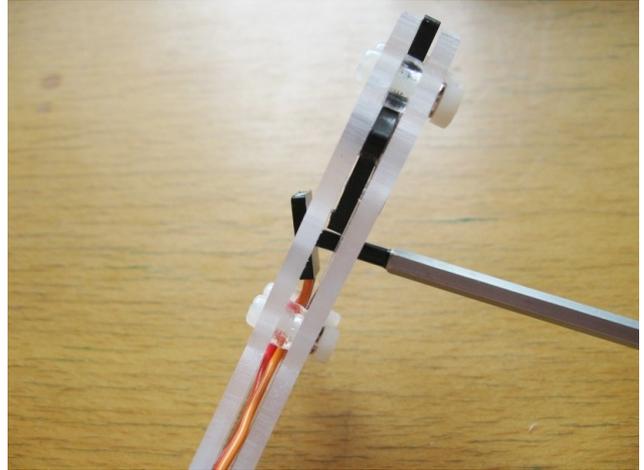
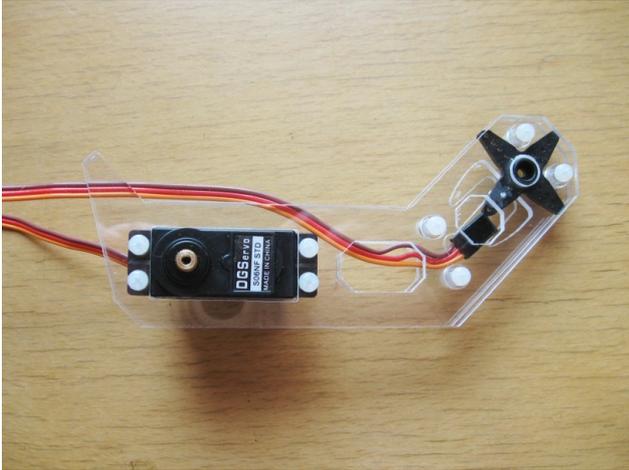
Check your knee servos and if necessary trim the mounting tabs so they are completely flat. Insert the knee servo into the thigh suspension plate cable first as shown.



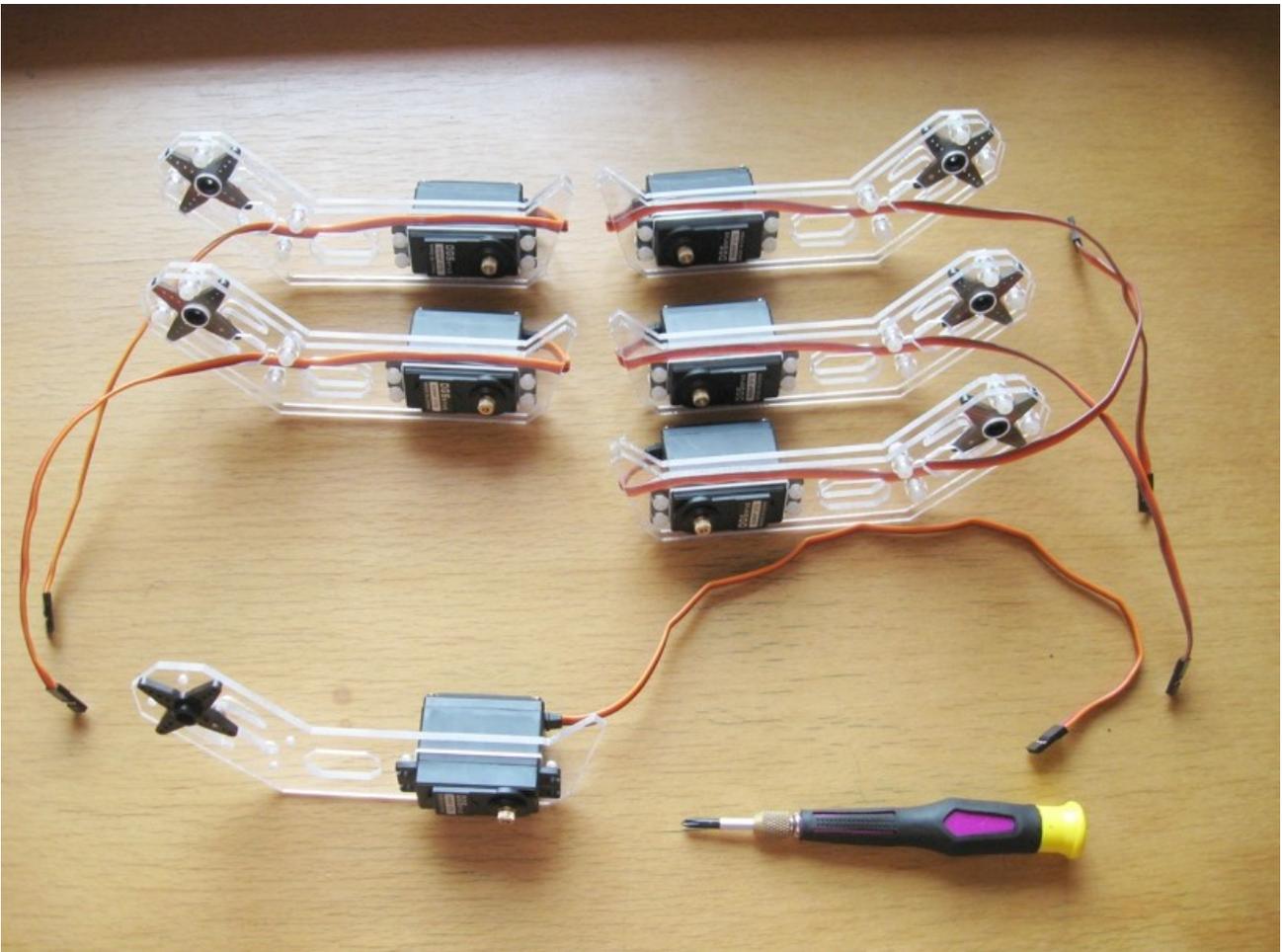
Now place the thigh base plate on top of the servo and use four M3x12mm nylon screws, spring washers and nylon nuts to mount the servo between the thigh plates. Included in the pack are 3mm thick laser cut clear acrylic spacers. Remove their protective film and place them between the thigh suspension and base plates. Hold them in place using M3x12mm nylon nuts, spring washers and nylon nuts. These spacers prevent the plates from clamping down on the servo horn.



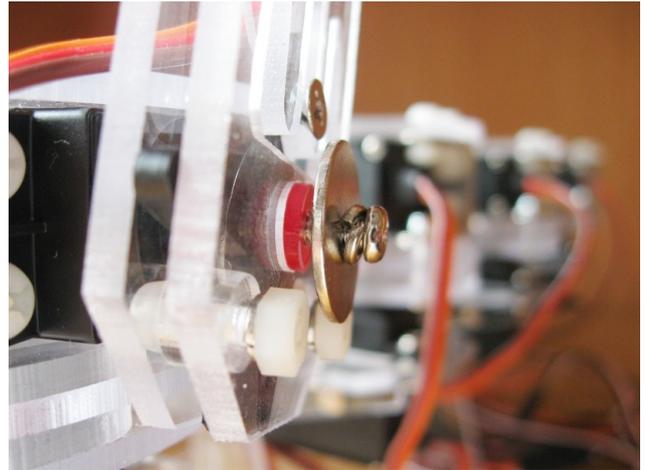
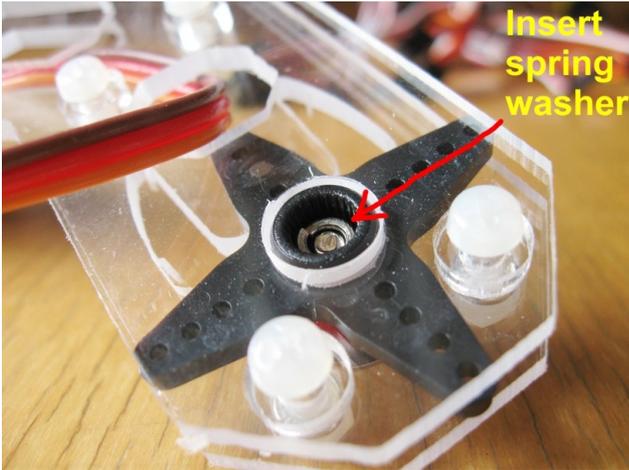
Now thread the servo cable between the two plates and out through the octagonal hole near the servo horn. Use a screwdriver to poke it through the hole.



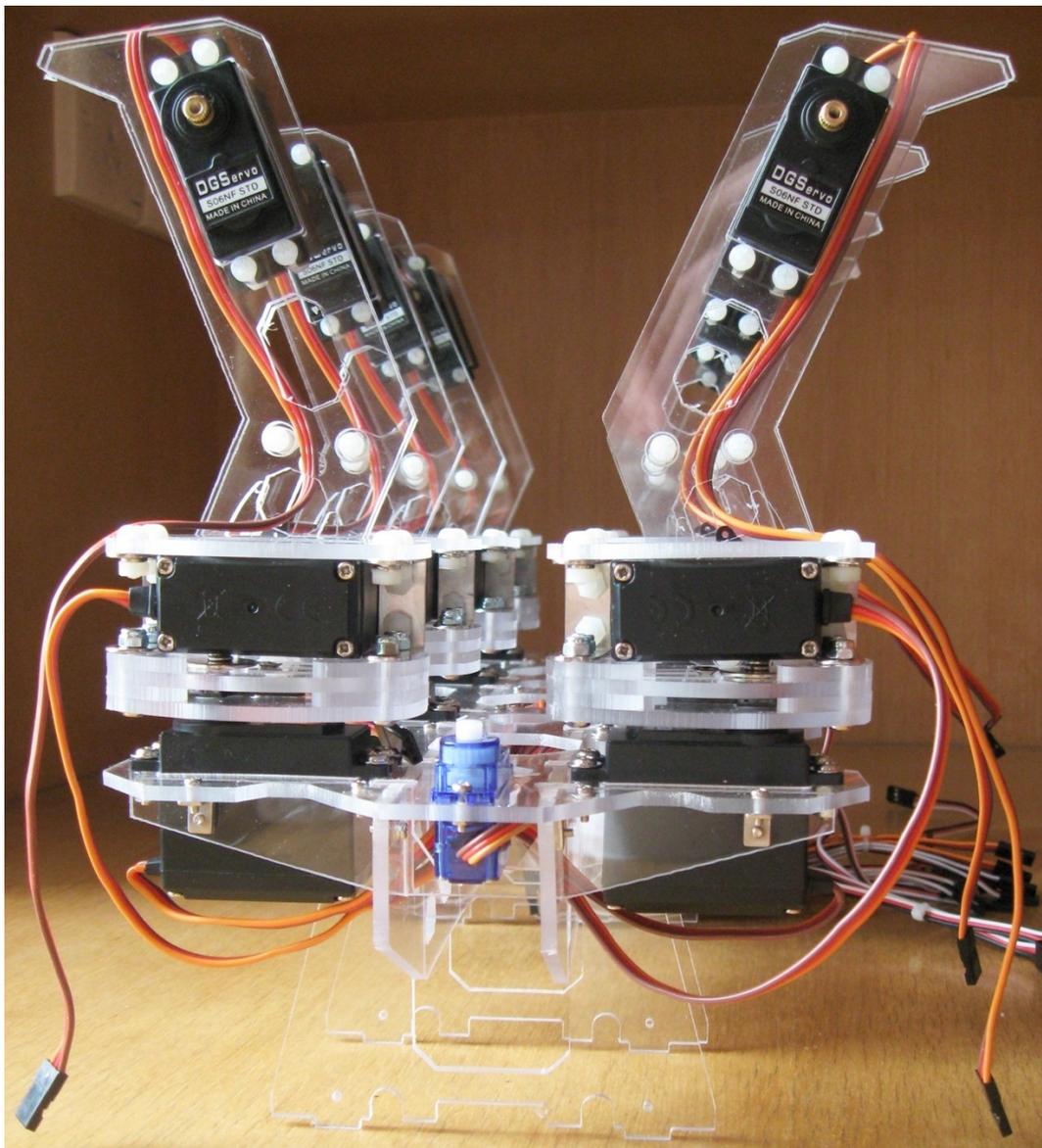
Make your thighs in left and right mirror image pairs.



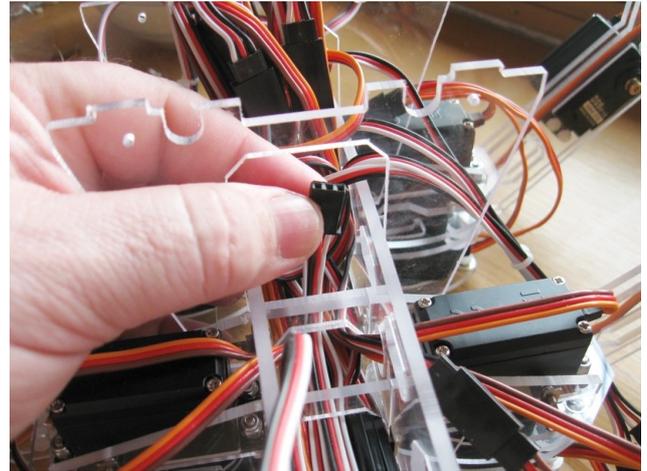
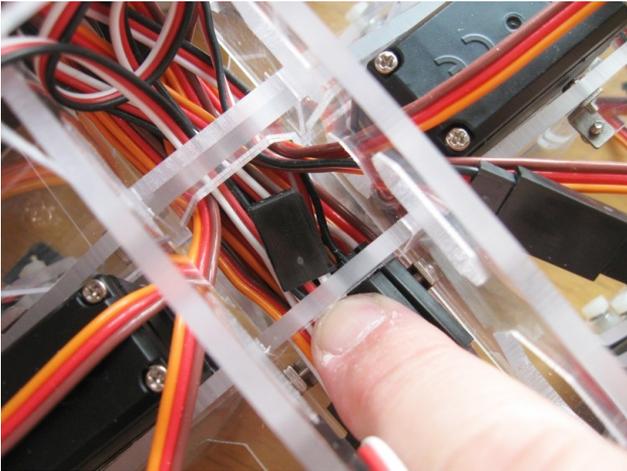
Once all your thighs have been assembled they can be mounted on the thigh servos. Start by placing a spring washer inside the servo horn. This will prevent the heads of the nylon screws hitting the servo housing.



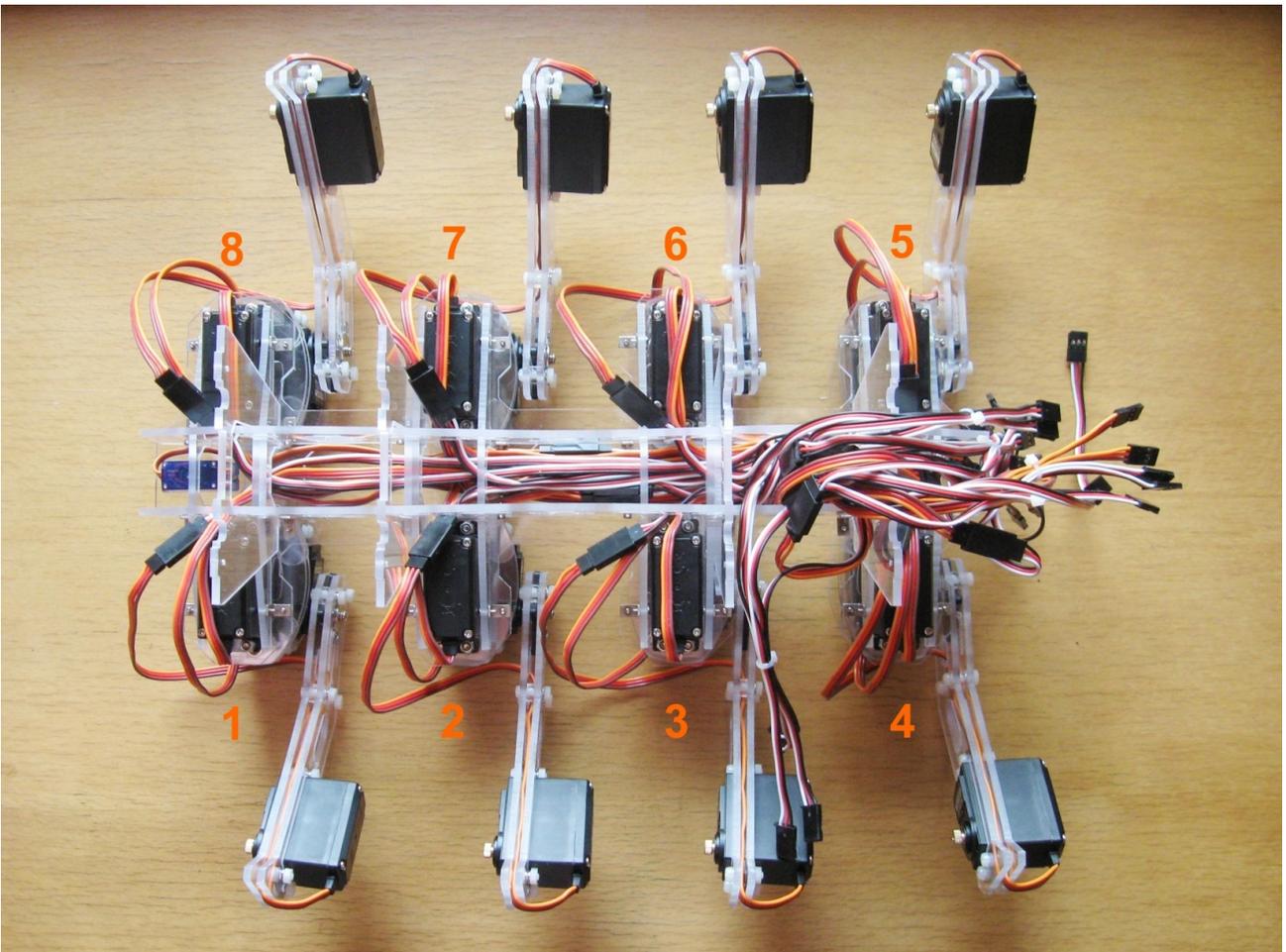
Each thigh is mounted on the servo using an M3x16 screw, M3 spring washer, M3 large flat washer and a red 2.5mm thick acrylic spacer. Before you attach the thighs we must align them on the splines of the thigh servos. With the thighs down **as far as they can go** they should be in the position shown below.



Once all the thighs are mounted turn the robot over and run your servo cables down the spine. Although we have many cables running down the spine now you should still find it fairly easy to thread the cables through. Press down gently as you guide them under the cross members. The holes in the bulkhead allow easy access to the cables.

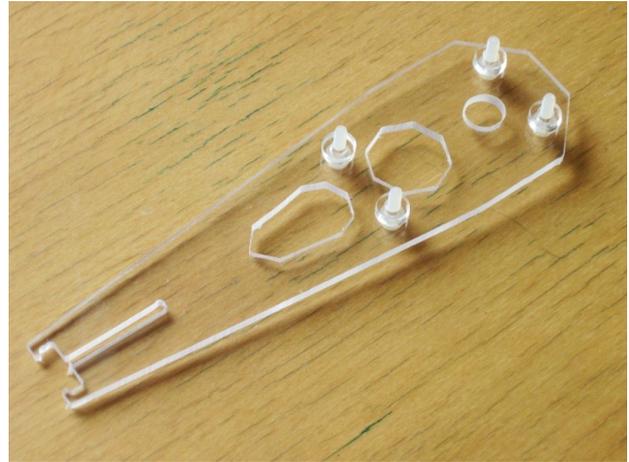


As mentioned previously, start from the front and work your way to the back. Use long servo extension cables for knee servos 1,2,7 and 8. Use medium extension cables for knee servos 3,4,5 and 6. Cable tie the cables in two groups of 4.



Leg assemblies

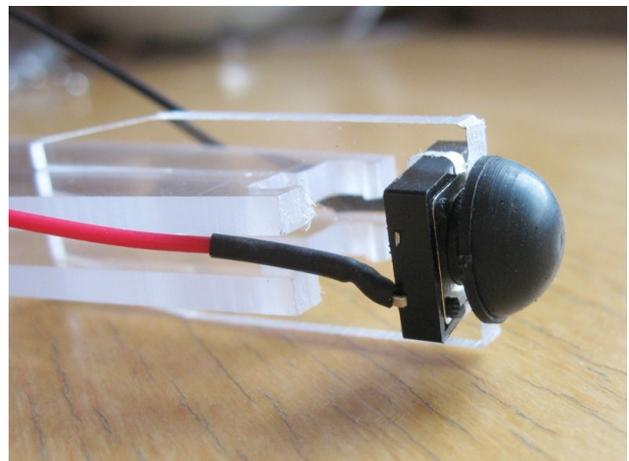
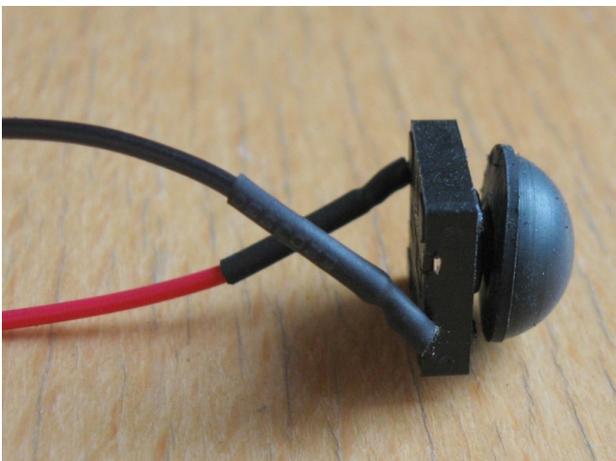
Open pack 4, which contains all the parts necessary to build the robots legs. Start by screwing the servo horn onto the leg suspension plate using a 3x6mm countersunk self-tapping screw. Use a file or a Dremel tool to remove the sharp point. Insert four M3x12 nylon screws into the leg base plate and then fit 3mm thick laser cut clear acrylic spacers.



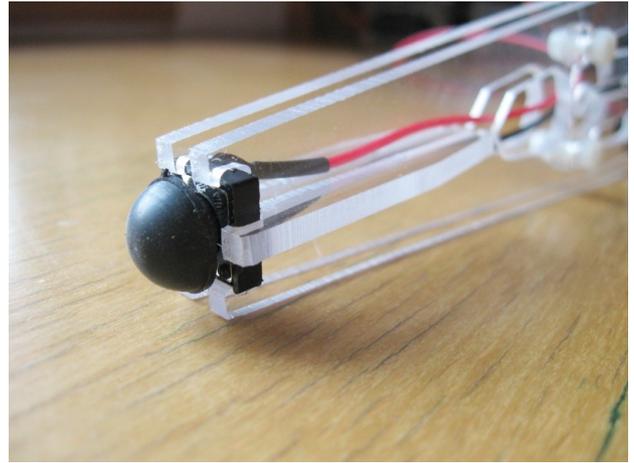
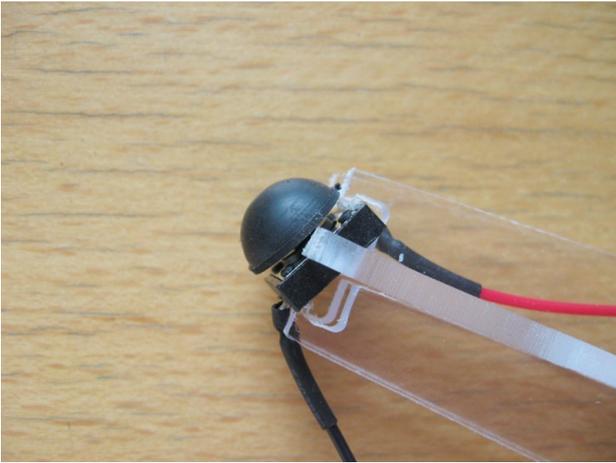
Mount the suspension plate onto the base plate with the 3mm spacers between them. Now add four spring washers and use four nylon nuts to hold the leg assembly together.



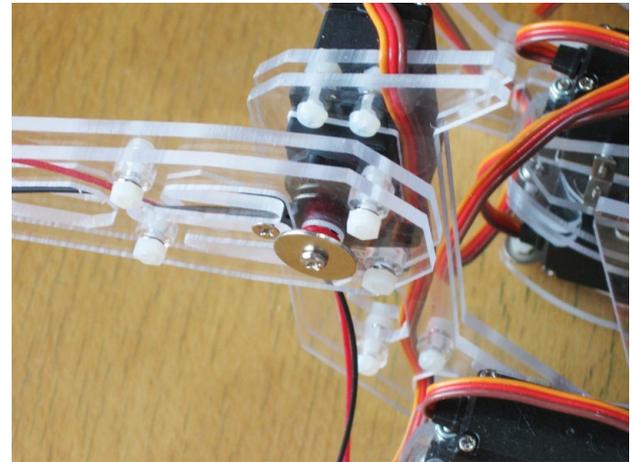
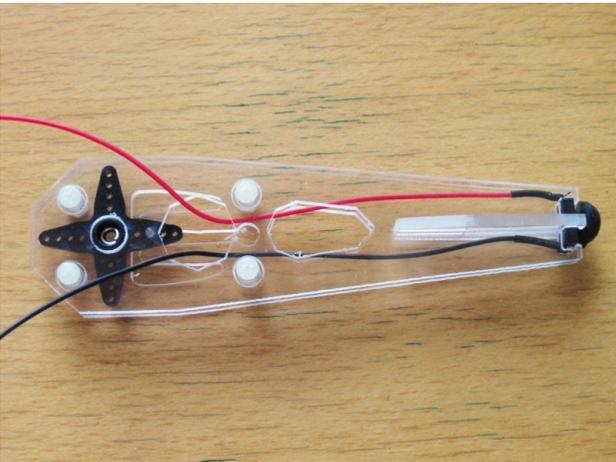
The foot consist of a rubber dome on a pressure switch. Press the dome onto the switch. This should be a tight fit. If necessary, use a drop of instant adhesive to keep it in place. Place the switch into the footplate and fit the footplate into the leg assembly. Guide the wires between the leg plates.



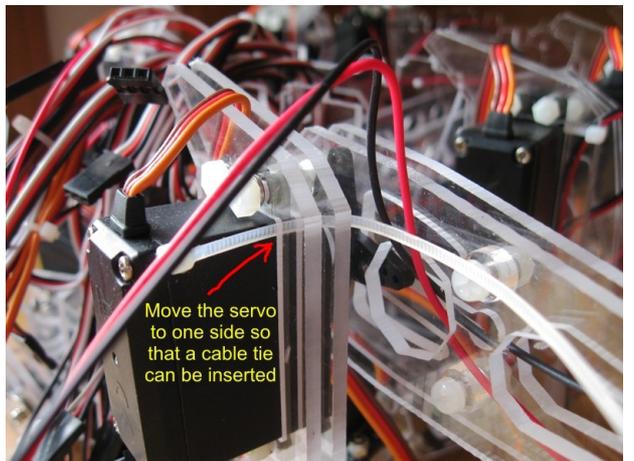
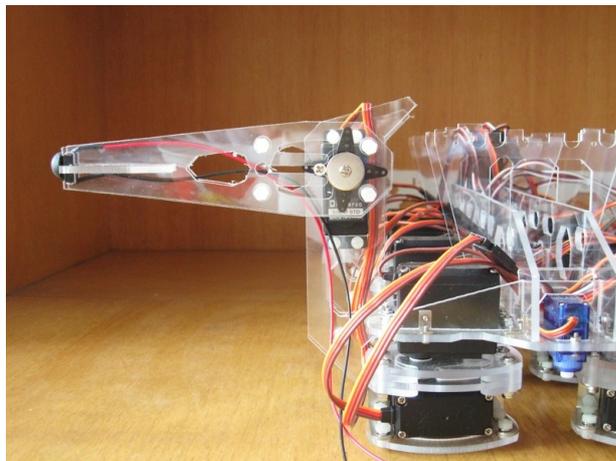
The footplate is a tight fit so as not to vibrate loose when the robot is walking. Gently tap it down with a small hammer. Do not hit the switch button or you may damage it. Tilt the switch before tapping down all the way to make it clip in place more easily.



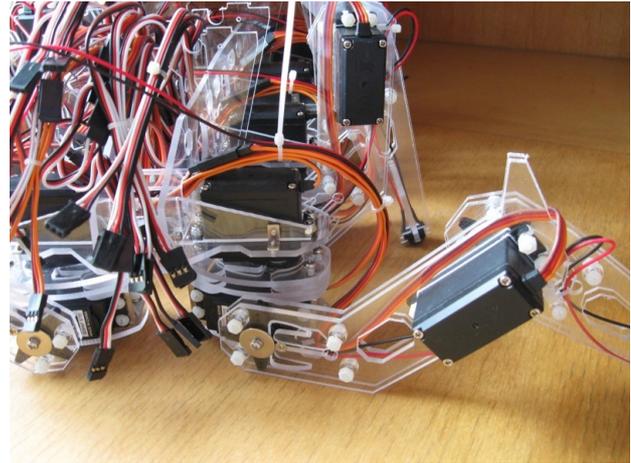
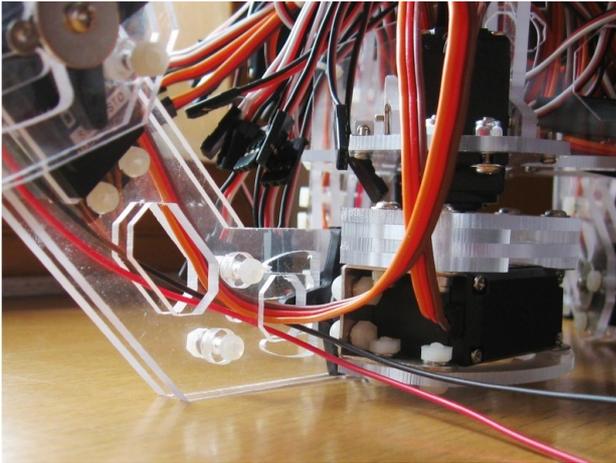
Run the switch wires through the leg and attach the leg to the knee servo using an M3x16mm screw, a large flat washer and a red 2.5mm thick spacer. Put a spring washer inside the servo horn to ensure the heads of the nylon screws on the leg do not hit the knee servo.



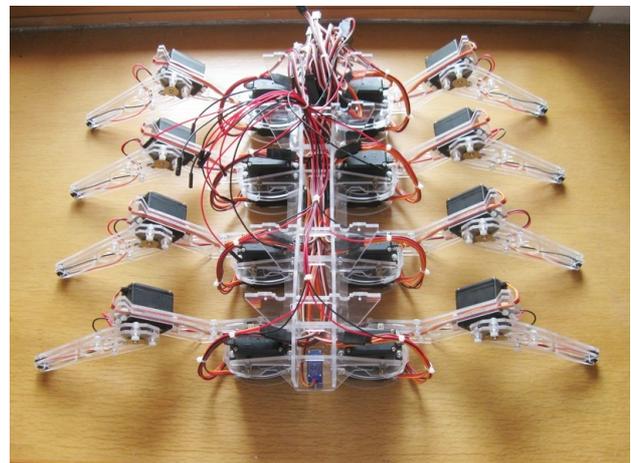
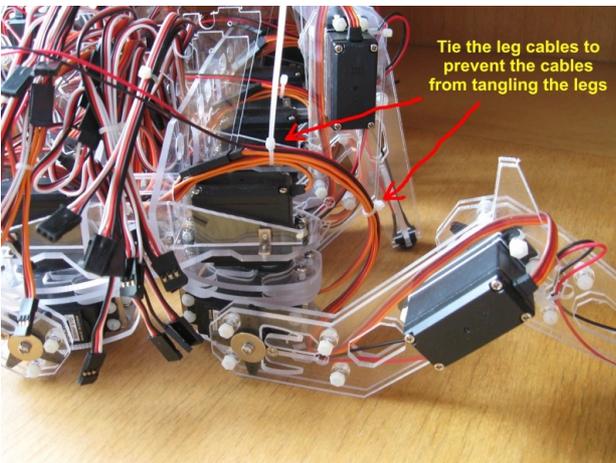
With the knee servo in the center position the leg should be at 90 degrees to the thigh. Run the switch wires through the thigh segment. Use a cable tie at the knee servo to keep the wires tidy but do not over tighten. You may need to adjust the wires. Make sure there is enough slack in the wires for the knee to move freely.



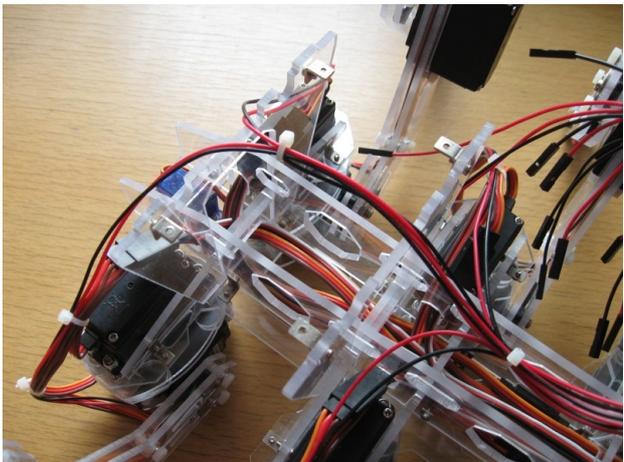
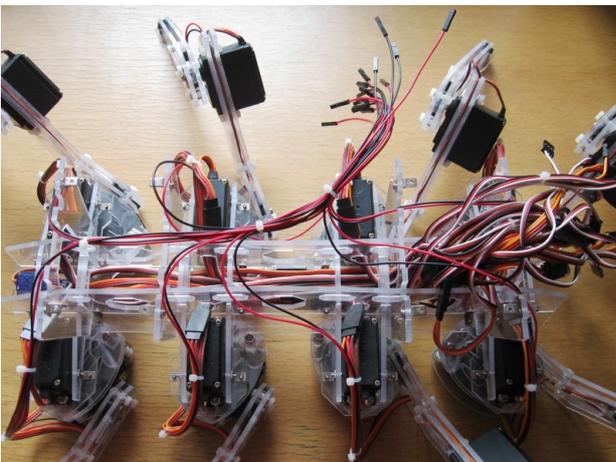
Continue the switch wires through the Thigh assembly. They should exit from the same hole as the knee servo cable. Tie the cables loosely and check there is enough slack for the leg to move freely over the entire range of movement. Do not over - tighten the cable ties.



Repeat this process with all the legs working from the front to the back. When all the legs are complete, loosely tie the switch wires along the top of the body. These wires are run as a separate group to the servo cables to reduce electrical noise.



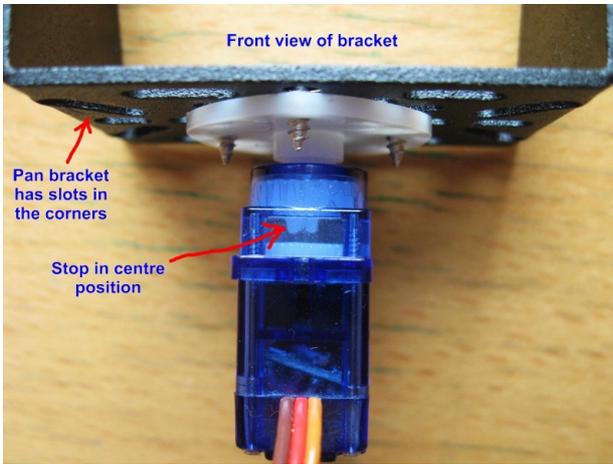
Angle brackets can now be fitted to the top of the bulkheads. These brackets will be used to mount the top deck. Pay careful attention to the position and orientation of the brackets in the photos below.



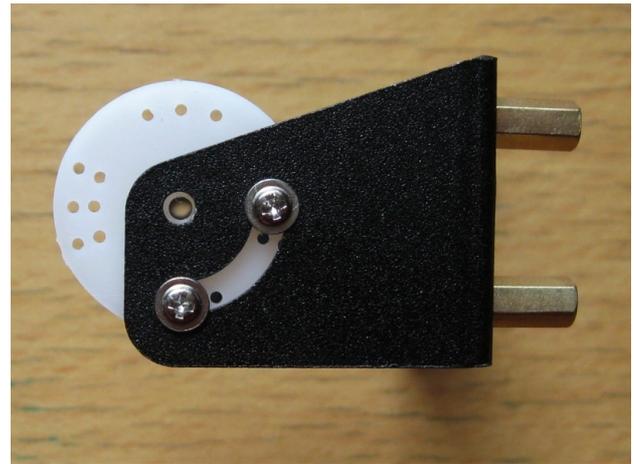
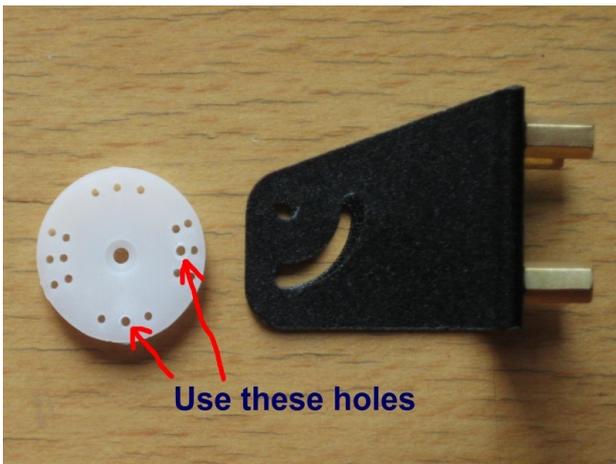
Pan / Tilt assemblies

The pan / tilt kits comes with two large brackets. Each bracket has a different hole pattern on it to suit many different sensors. Look at the photo below and make sure you attach the correct bracket to the pan servo, as the compound eye only fits one bracket.

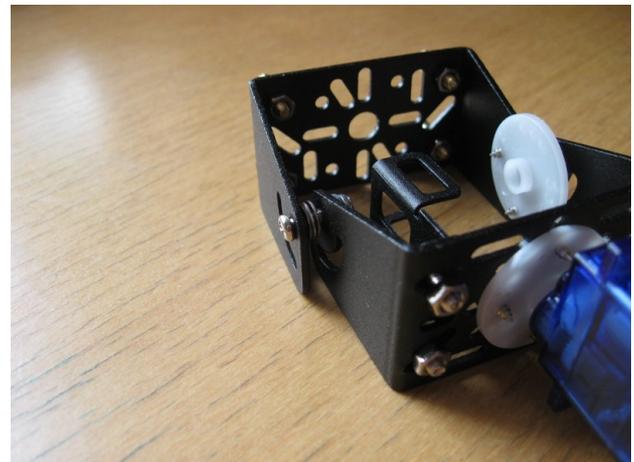
Use 2x6mm pan head, self-tapping screws to mount the bracket to the round servo horn and another 2x6mm pan head, self tapping screw to mount the servo horn onto the pan servo as shown. Mount the brass spacers included with the IR compound eye on the opposite bracket with the M3 nuts provided.



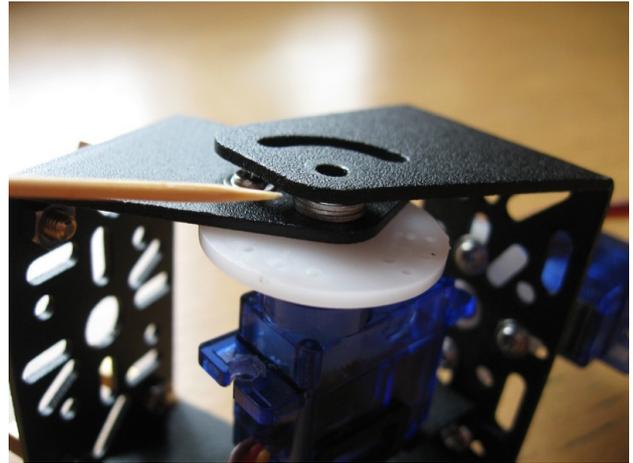
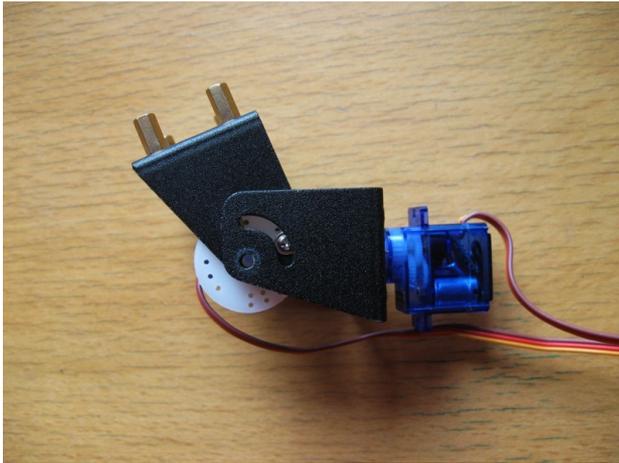
Note: Make sure the servo stop is in centre position with the servo cable to the front of the bracket. This will give the IR compound eye the best range of movement when assembly is complete.



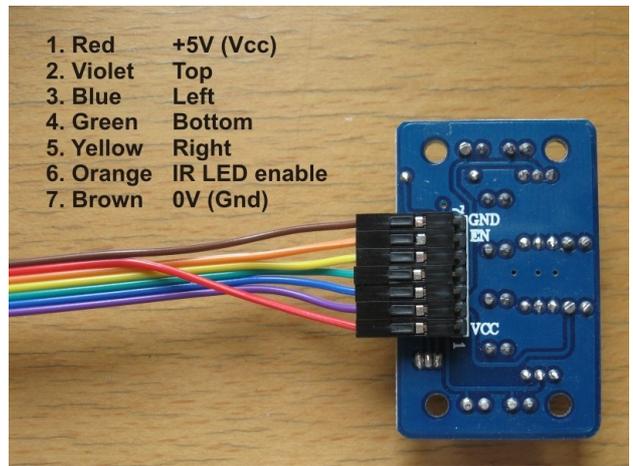
Mount a round servo horn onto the tilt bracket as shown using 2x6mm self-tapping pan head screws. Make sure the centre of the horn lines up with the screw hole in the tilt bracket. Mount the tilt servo support bracket on the pan bracket using M3x6mm screws. Leave the nuts loose until the servo is fitted. Join the pan and tilt brackets as shown using an M3x12mm screw and nyloc nut. Use 3 washers for spacers and leave loose.



To complete the joining of the pan and tilt brackets, slide the tilt servo into the tilt servo support bracket and line it up with the servo horn. With the servo stop in the centre position the tilt bracket should be tilted up slightly, about 10-15 degrees.

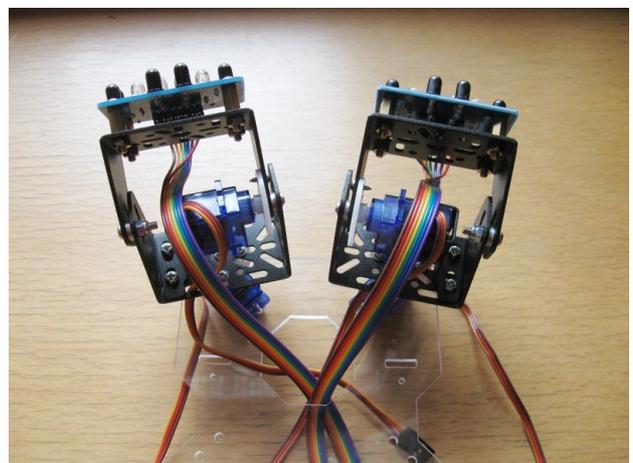
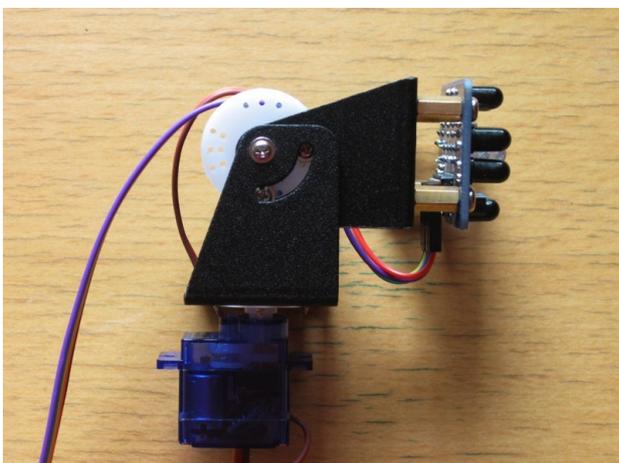


Use a toothpick or cable tie to slide a stack of 3 flat washers between the pan and tilt brackets. Insert a 2.3x10mm self-tapping pan head screw through the brackets and washers into the tilt servo. Tighten the screw and then back off $\frac{3}{4}$ of a turn so that the tilt bracket can move freely. The tilt servo support bracket mounting screws can now be tightened.



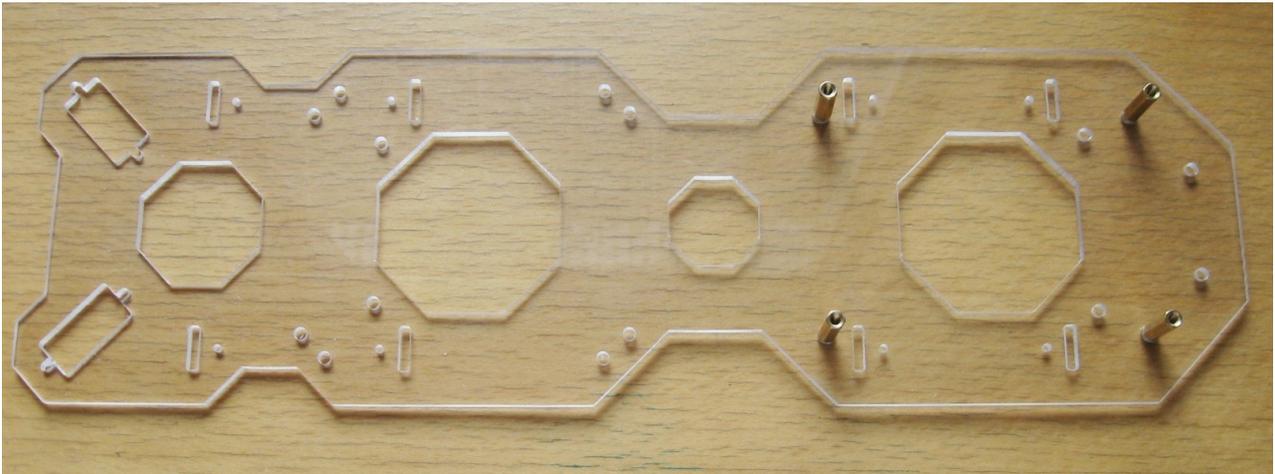
The rainbow cable can now be connected to the IR compound eye as shown. The cable is threaded under the eye and then over the tilt servo as shown to ensure free movement of the tilt bracket. If this cable does not have enough free movement then it can restrain the pan and tilt servos, preventing normal operation.

Make your second pan/tilt assembly mirror image to the first giving you a left and right eye as shown in the photo below. **Note:** the servo horn and tilt servo support bracket are on opposite sides.

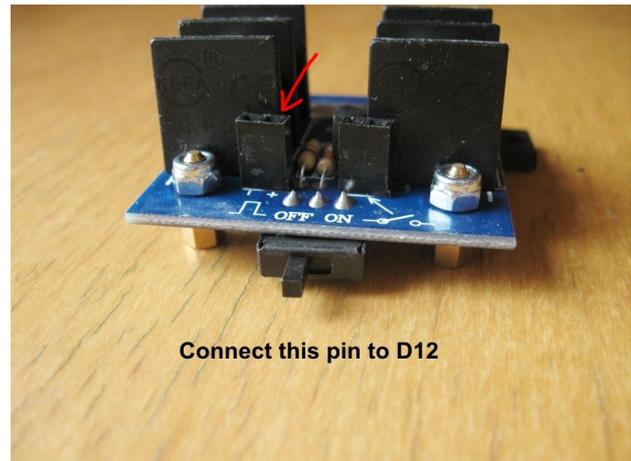
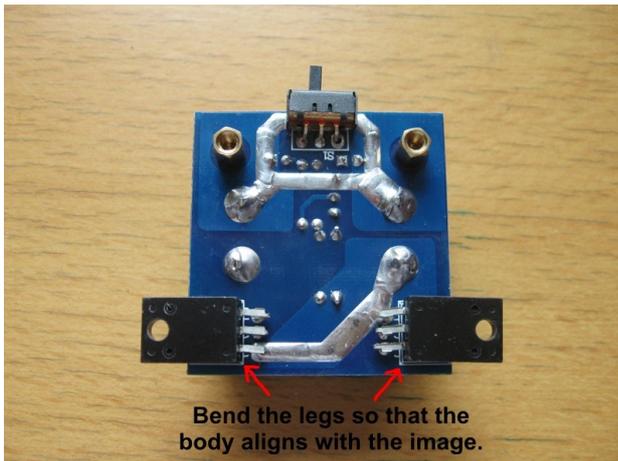


Top Deck assembly

Mount four 16mm female-female hex spacers on the top deck as shown using M3x8mm screws. These will hold the Spider controller high enough above the deck to allow the servo cables to come out underneath.

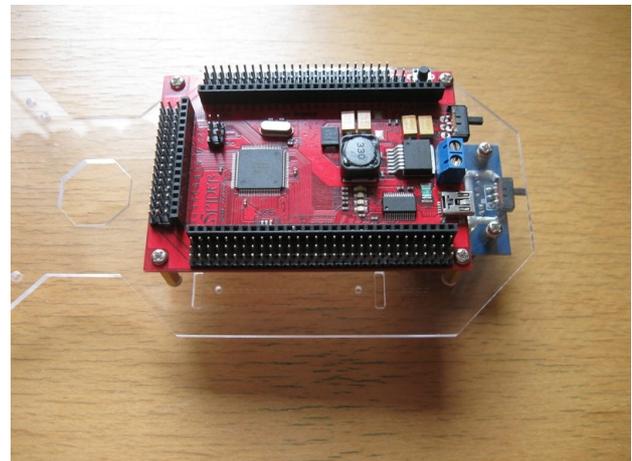
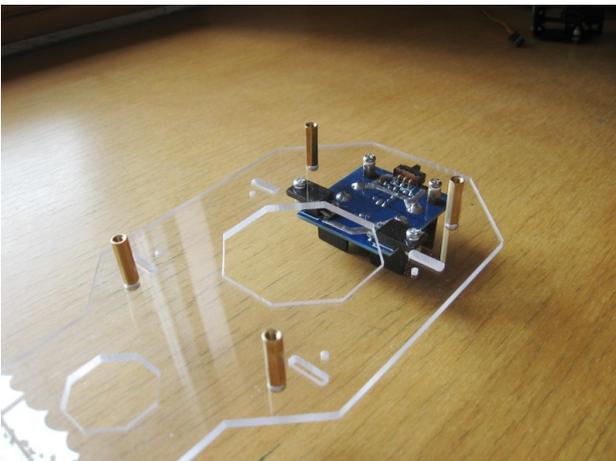


Fit the supplied 6mm male-female hex spacers to the high power solid-state switch with M3 nyloc nuts as shown. If necessary, bend the legs of the FET transistors so that their bodies line up with the image on the PCB. This multi-purpose switch allows the Spider controller to control power to the servos, which can draw in excess of 15A when the robot is operational.

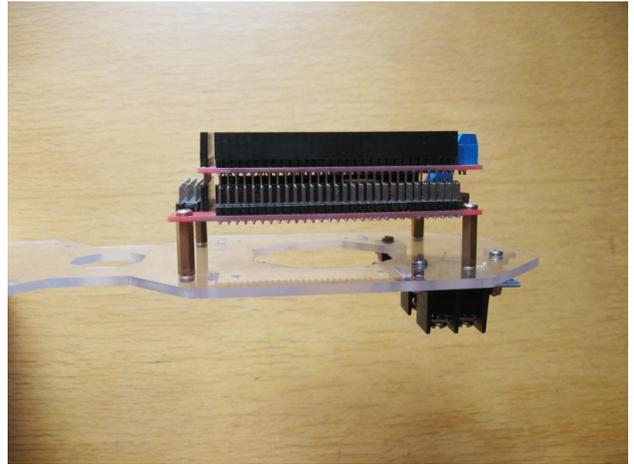
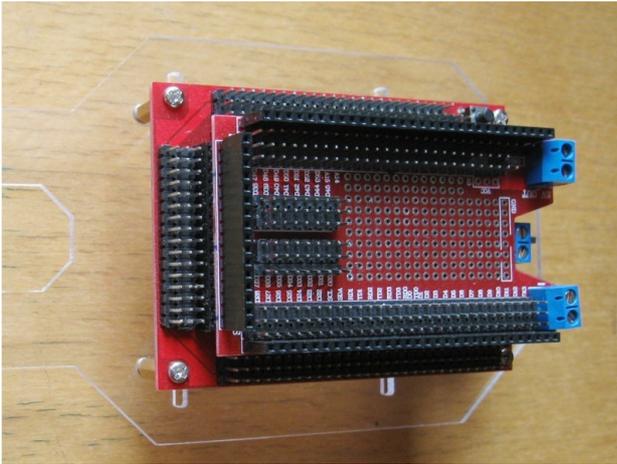


Mount the switch underneath as shown. Use M3x6mm screws to mount the hex spacers and M3x10mm screws with nyloc nuts to mount the FET transistors.

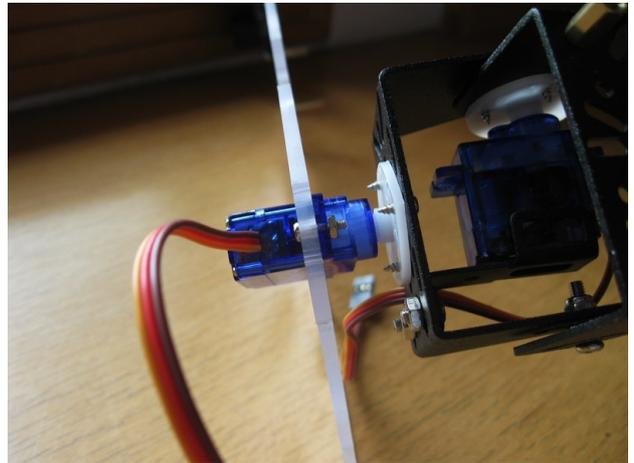
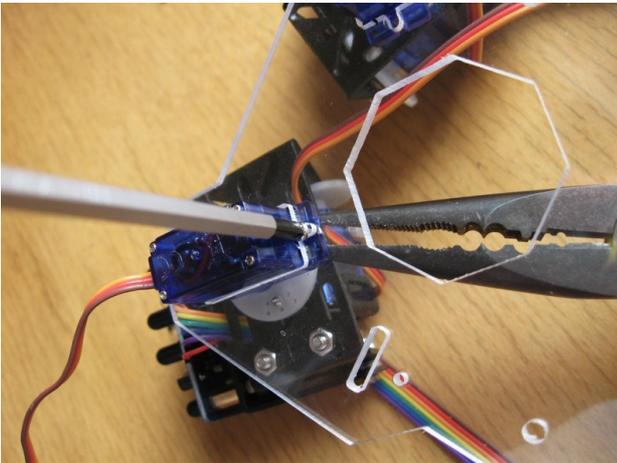
Mount the Spider controller using M3x6mm screws. We will have to remove it later when feeding the servo cables through the top deck but first we will fit the power cables to get the correct length.



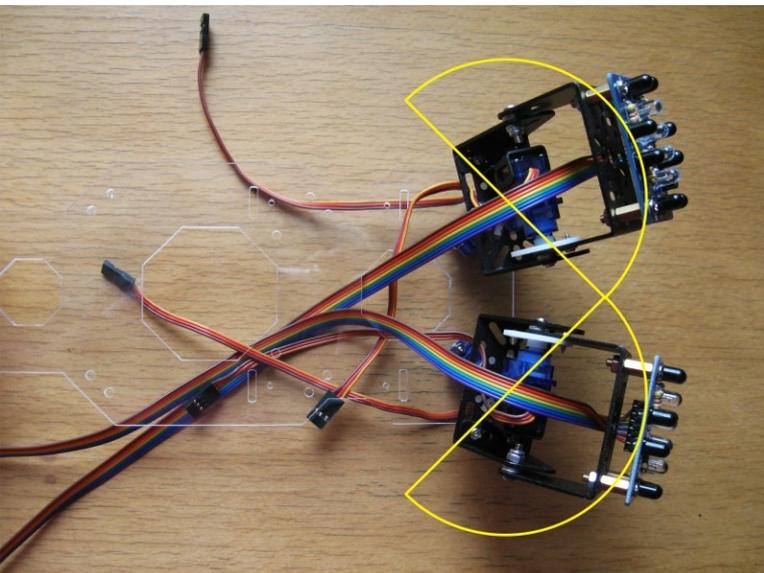
Mount the servo shield on top of the Spider controller. This shield allows the controller to control high-powered servos that are powered directly from the battery. It does not block the Spiders pins allowing the small pan, tilt and front sensor servos to be powered from the Spider's regulated 5V supply.



Mount the pan/tilt assemblies on the topdeck using M2x8mm screws and M2 nuts. Make sure you install them so that the servo cables are away from the large hexagonal hole. This increases the distance between the two eyes and reduces the chance of them hitting each other.



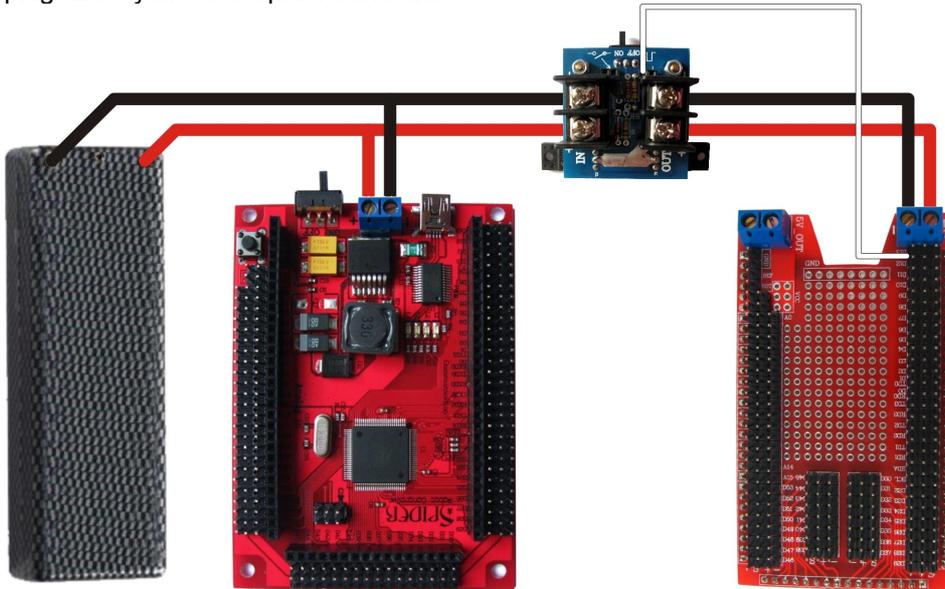
Gently turn your pan / tilt assemblies by hand. Each assembly should be able to look back 135°. Working together the two eyes should be able to scan 270°.



Wiring

The wiring diagram below should help you understand how the power is distributed and controlled. The battery connects directly to the Spider controller and solid-state switch. The switch on the Spider controller is your master on/off switch. Once the controller is powered up and the program is running, a signal from D12 switches power to the servo shield. The manual switch on the solid-state switch is not used and can be left in the “OFF” position.

Although the Spider controller can power servos directly, its outputs are all 5V and it can only deliver 3A of current total. To power 24 servos at 7.4V we use a servo shield that powers the servos directly from the battery. Do not connect the small blue servos to this shield, as they are only rated for 6V maximum. They will plug directly into the Spider controller.



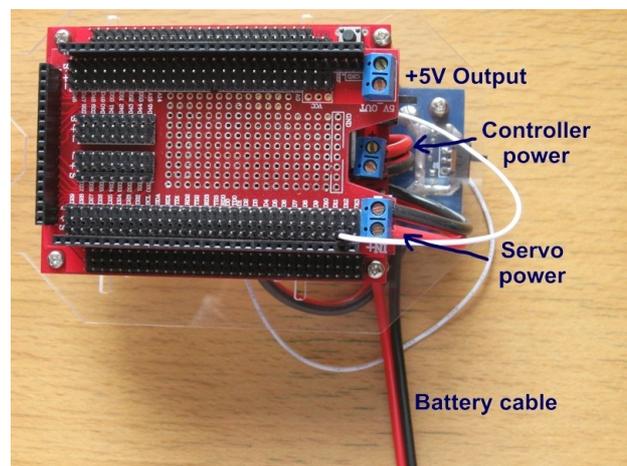
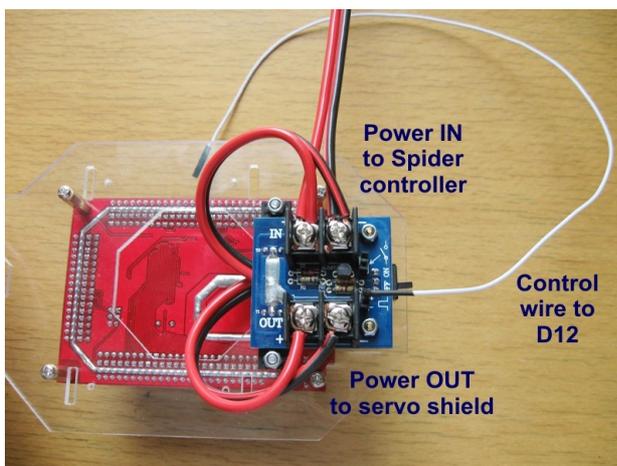
The photos below show where to connect the wires. Make sure to always use red for the positive wire. If the power is accidentally connected the wrong way then the circuitry will be permanently damaged.

The kit comes with 50cm of heavy-duty power cable. Cut it into 3 lengths:

20cm to connect the battery to the input of the solid-state switch.

16cm to connect from the output of the solid-state switch to the input of the servo shield.

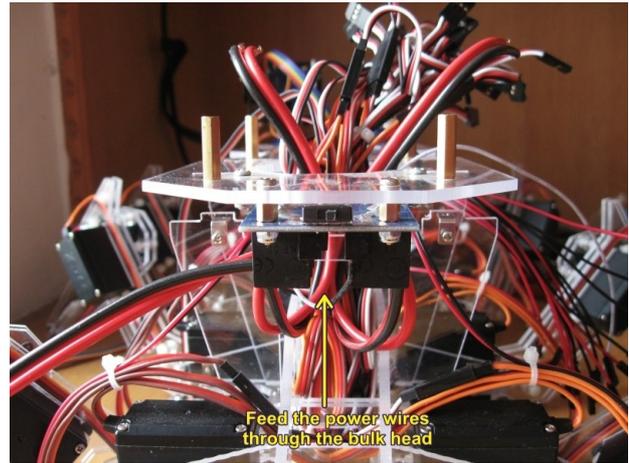
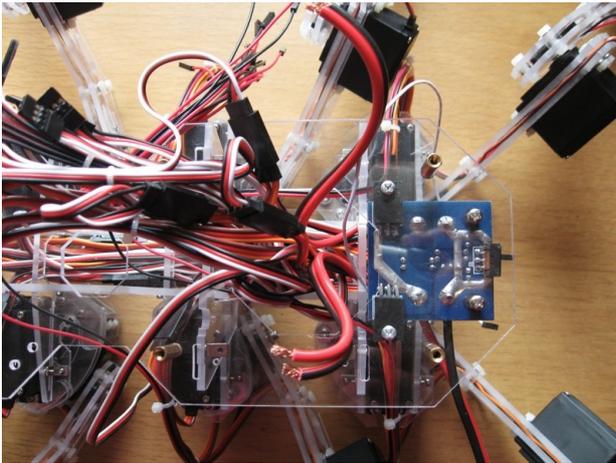
14cm to connect from the input of the solid-state switch to the input of the Spider controller.



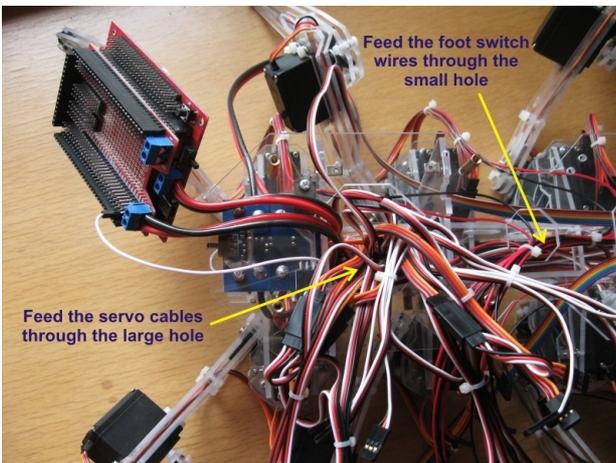
In most cases you should be able to get a suitable connector for your battery from a hobby store. Otherwise a high current terminal block has been included in the kit allowing the battery to be connected to the robot.

CAUTION! – Never allow the battery terminals to short circuit. LiPo and NiMh batteries can deliver very high currents and can catch fire or explode if short circuited.

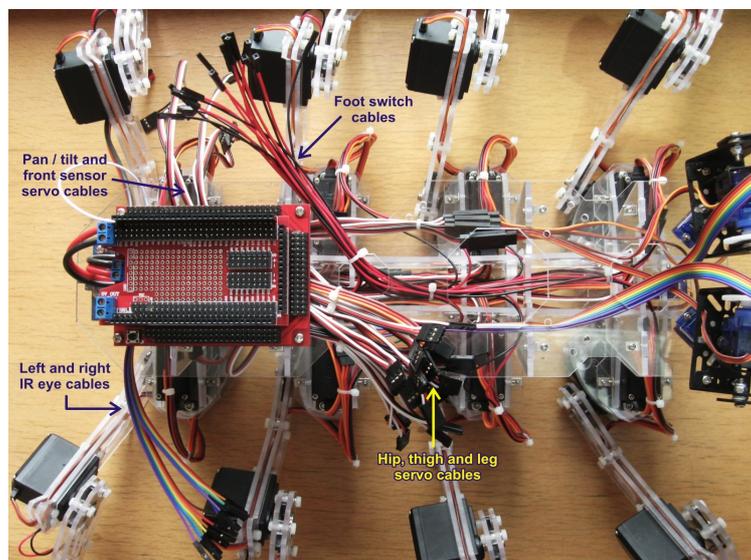
Once the power cable has been cut to the correct lengths we need to remove the Spider controller so that we can feed the servo cables through the hole underneath. Disconnect the power wires from the Spider controller as they will need to feed through the rear bulkhead of the body.



Sit the top deck on the body and feed your servo cables through the large octagonal hole at the back. The foot switch wires are feed through the smaller hole in front. The Spider controller can now be re-attached.



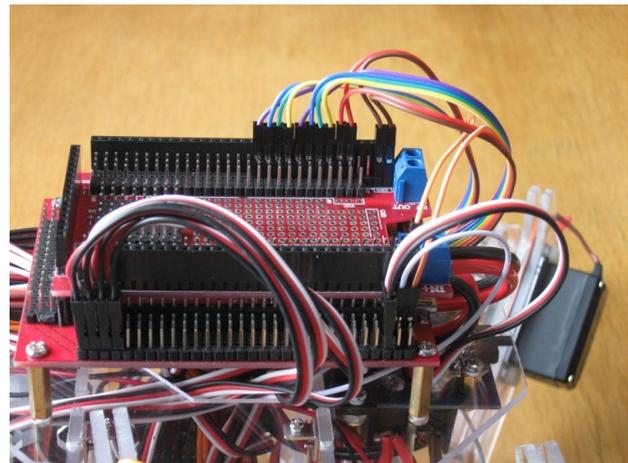
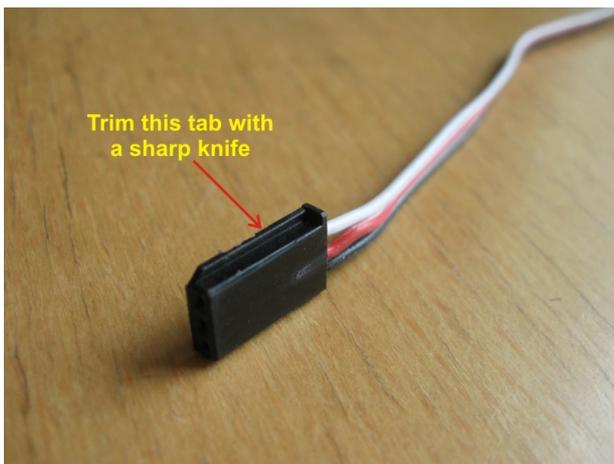
Starting from the front, use M2x6mm screws to attach the top deck to the bulkheads. As you work from front to back, make sure no cables get pinched between the top deck and the bulkheads. Re-mount your Spider controller and servo shield with the cables coming out from underneath as shown in the photo below.



Connect the servos, switches and eyes according to the table bellow. Note the signal pin is the closest pin to the female header. On the Controller the ground pin is closest to the edge of the PCB. On the Shield the ground pin is closest to the center of the PCB. V+ is 5V on the Spider controller and Battery voltage on the servo shield.

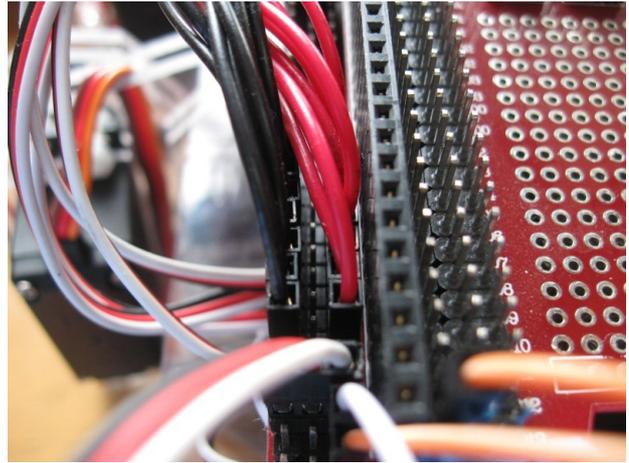
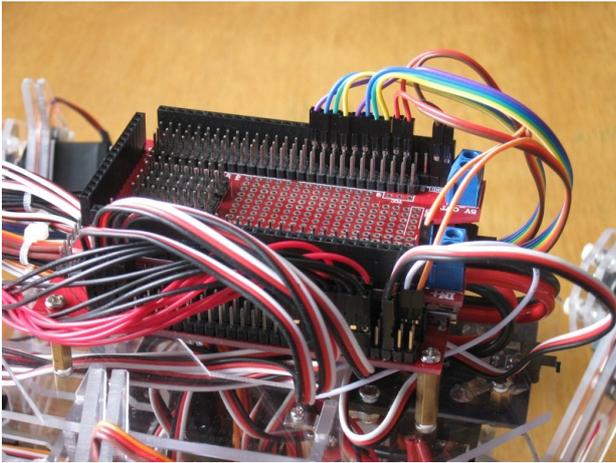
D2-D9	Foot switches 1-8				
D10	Spare			D26	Left pan servo
D11	Front sensor servo			D27	Left tilt servo
D12	Servo power control			D28	Right pan servo
D13	IR LEDs for left and right eyes			D29	Right tilt servo
D30	Thigh 4			D42	Hip 8
D31	Thigh 3			D43	Hip 7
D32	Thigh 2			D44	Hip 6
D33	Thigh 1			D45	Hip 5
D34	Knee 4			D46	Knee 8
D35	Knee 3			D47	Knee 7
D36	Knee 2			D48	Knee 6
D37	Knee 1			D49	Knee 5
D38	Hip 4			D50	Thigh 8
D39	Hip 3			D51	Thigh 7
D40	Hip 2			D52	Thigh 6
D41	Hip 1			D53	Thigh 5
A0	Left Eye: Yellow			A4	Right Eye: Yellow
A1	Left Eye: Green			A5	Right Eye: Green
A2	Left Eye: Blue			A6	Right Eye: Blue
A3	Left Eye: Violet			A7	Right Eye: Violet

Start with the IR compound eye and small blue servo connections first. Then connect the footswitches making sure the red wire connects to the signal pin and not Vcc. **Note:** the servo connectors may need to be trimmed with a sharp knife or side-cutters to fit neatly.

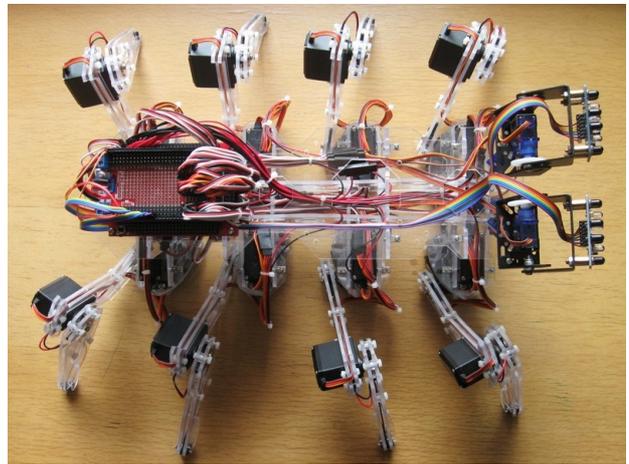
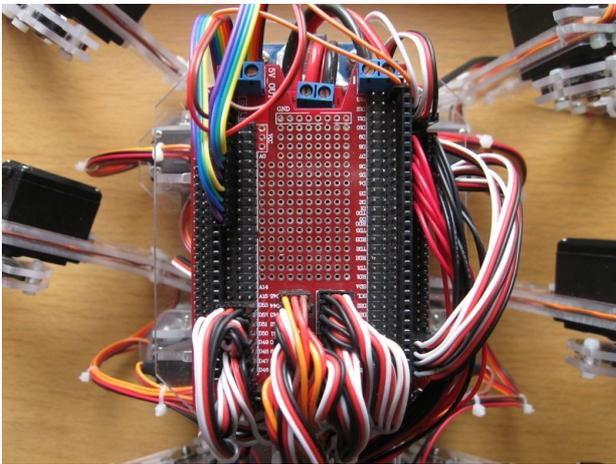


Pay careful attention to the position and orientation of all connections. **Note:** Servo cables use black or brown for ground, red for +V and either white or orange for the signal wire. Do not plug the small blue servos into the upper servo shield as the shield's +V is too high and could damage them.

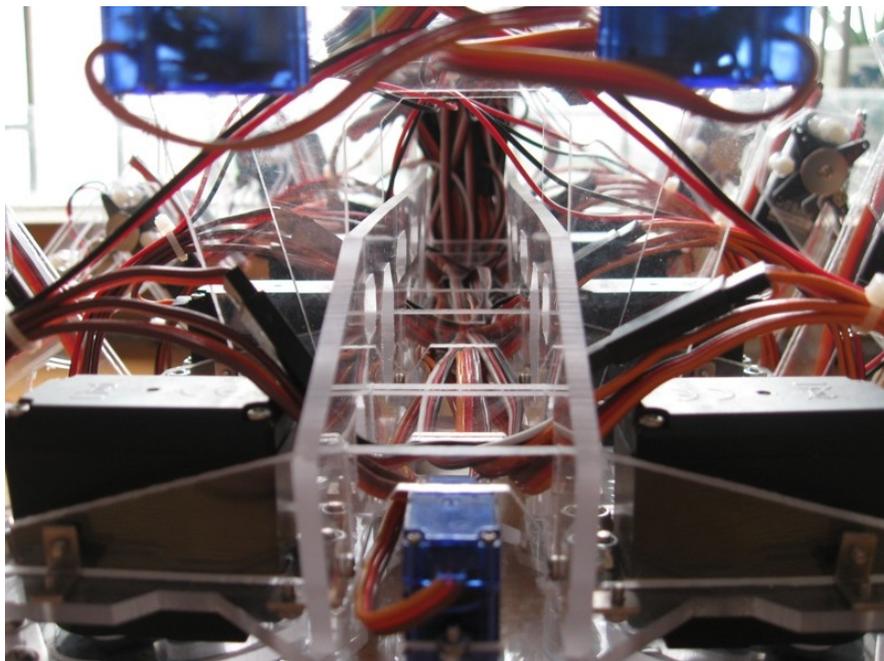
Connect the red foot switch wires 1-8 to the signal pins D2-D9 first. The black wires all connect to ground. Be careful not to connect the red wires to Vcc by mistake otherwise the foot switches will short the power supply.



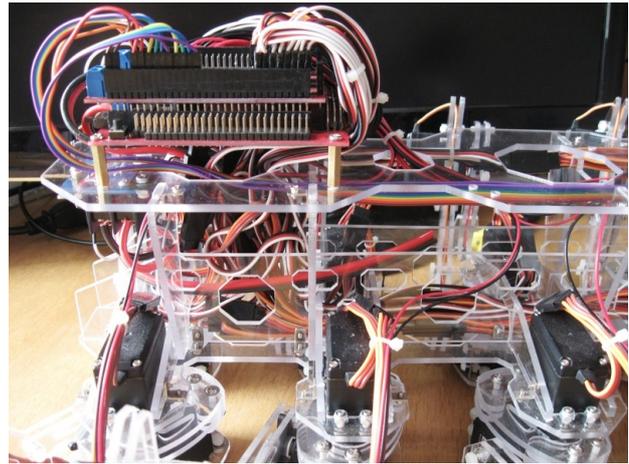
Finally plug in your hip, thigh and knee servos. The servo shield has "S + -" at the top of each column of servo pins to help you correctly orientate your servo plugs.



Finally you are ready to install your battery. The body has a channel down the center that will accept standard 7.2V NiMH or 7.4V LiPo battery packs used in radio controlled models. The battery slides in from the front and can easily be cable tied in place. A 5000mAH LiPo battery pack is recommended.



The power cable reaches around from the solid state switch at the back and should be terminated so that the battery can be easily disconnected for recharging if necessary.



Below is a typical NiMh battery pack terminated with the supplied terminal block. Make sure all power switches are in the "off" position while connecting the battery. Connect the ground wire (black) first and then the red wire.



Software

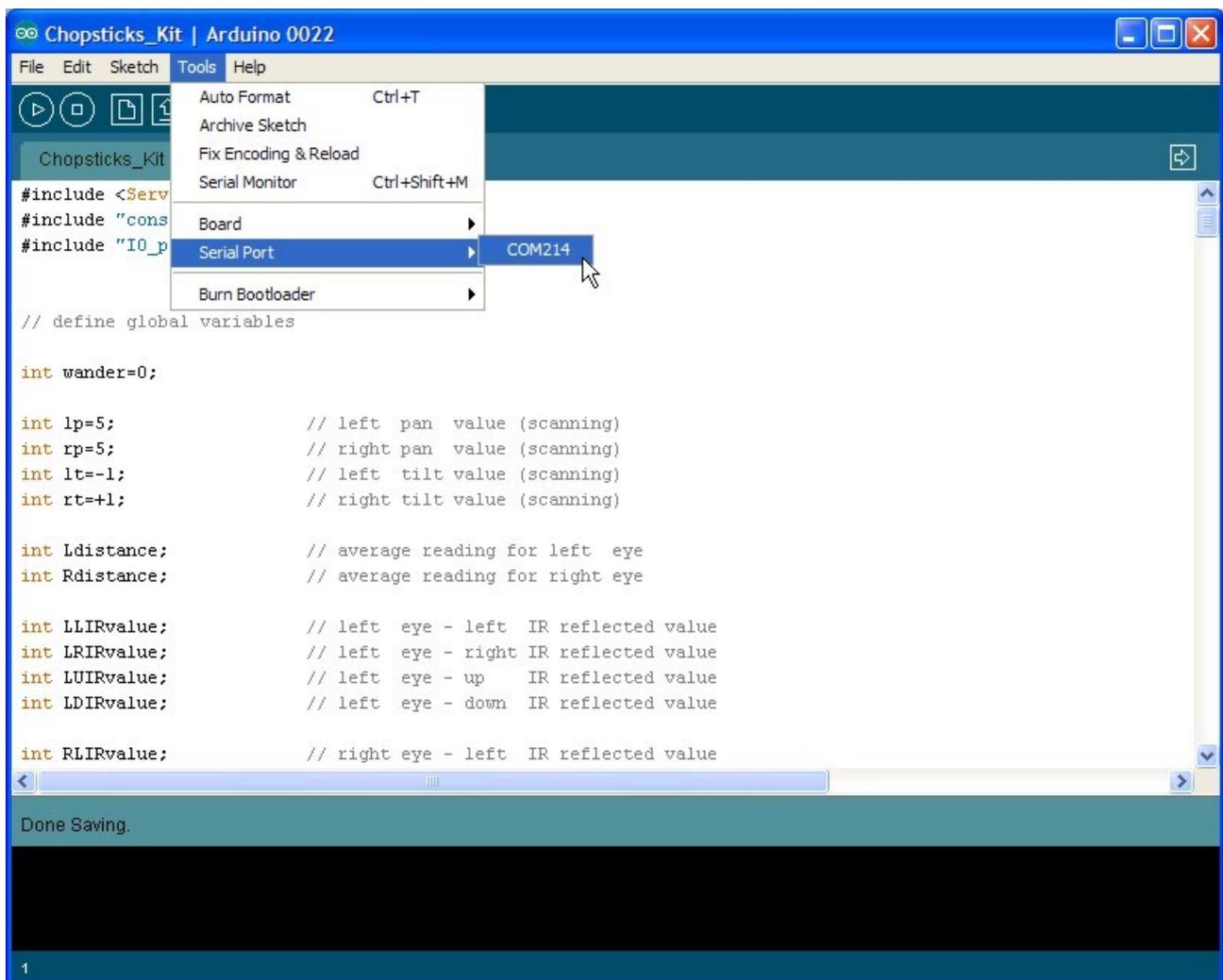
The Spider controller is 100% software compatible with the Arduino Mega (1280) and comes with the bootloader pre-installed. If you do not have the Arduino IDE on your computer already then you can download and install the Arduino IDE version 0022 or later from here: <http://arduino.cc/en/Main/Software>

Once you have installed the Arduino IDE download the sample code from here: <https://sites.google.com/site/daguproducts/>

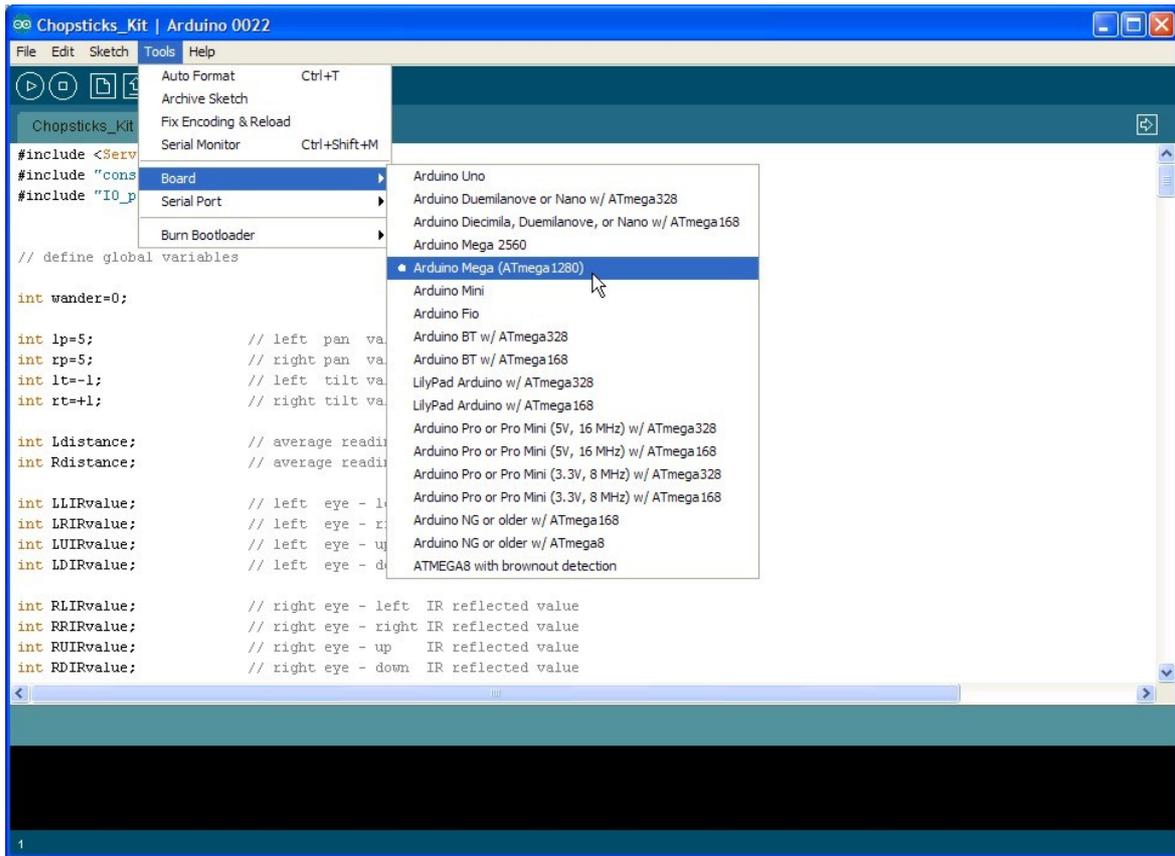
Open the "Chopsticks_Kit.pde" file, turn on your Spider controller. The solid-state switch should have its manual switch in the "off" position. The LED on the Spider controller should be blinking.

Connect your USB cable and wait for the computer to detect the Spider controller. If your computer cannot detect the USB interface then you may need to install USB drivers. These can be found in the Arduino folder on your computer. You can also download the latest drivers from here: <http://www.ftdichip.com/FTDrivers.htm>

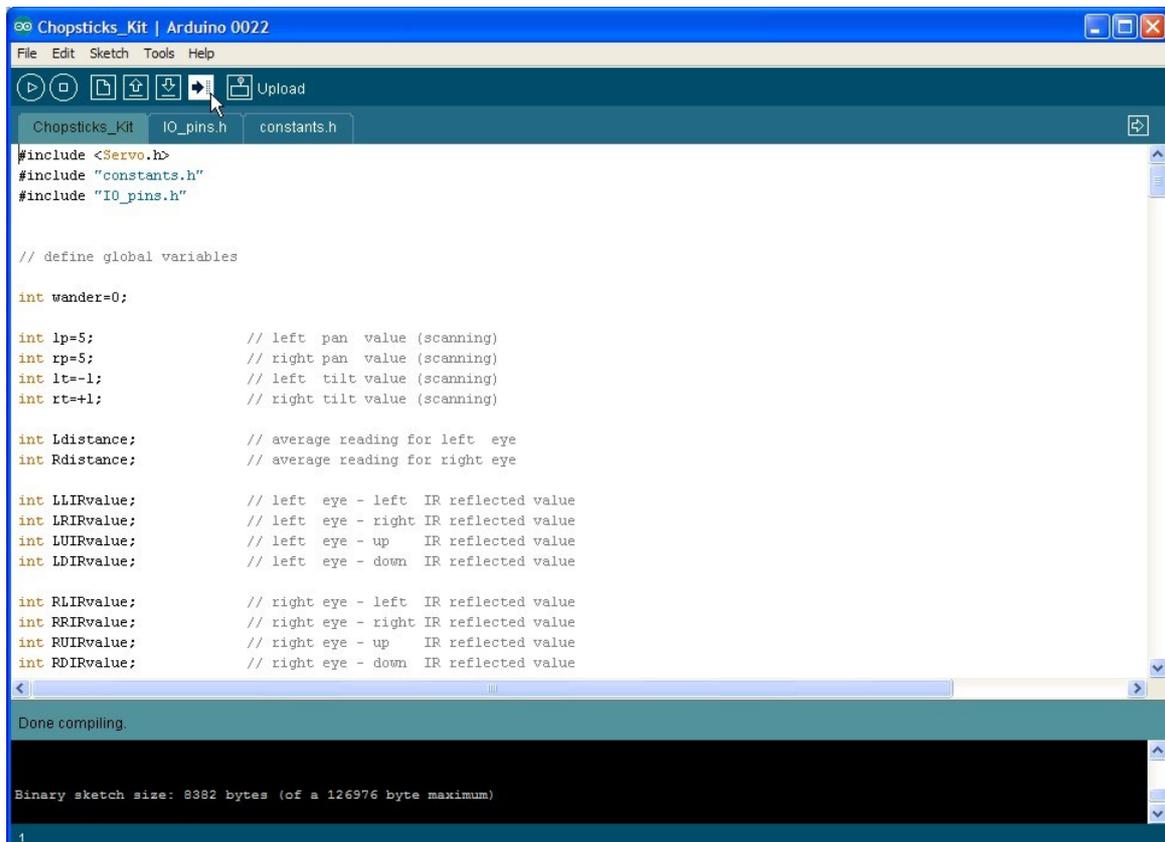
Once the Spider controllers USB / serial interface has been detected by your computer you can select it from the "Tools" menu in the Arduino IDE.



Before you can upload the software to the Spider controller you must tell the Arduino what board type you are using. The Spider controller is the equivalent of an Arduino Mega (ATmega1280).

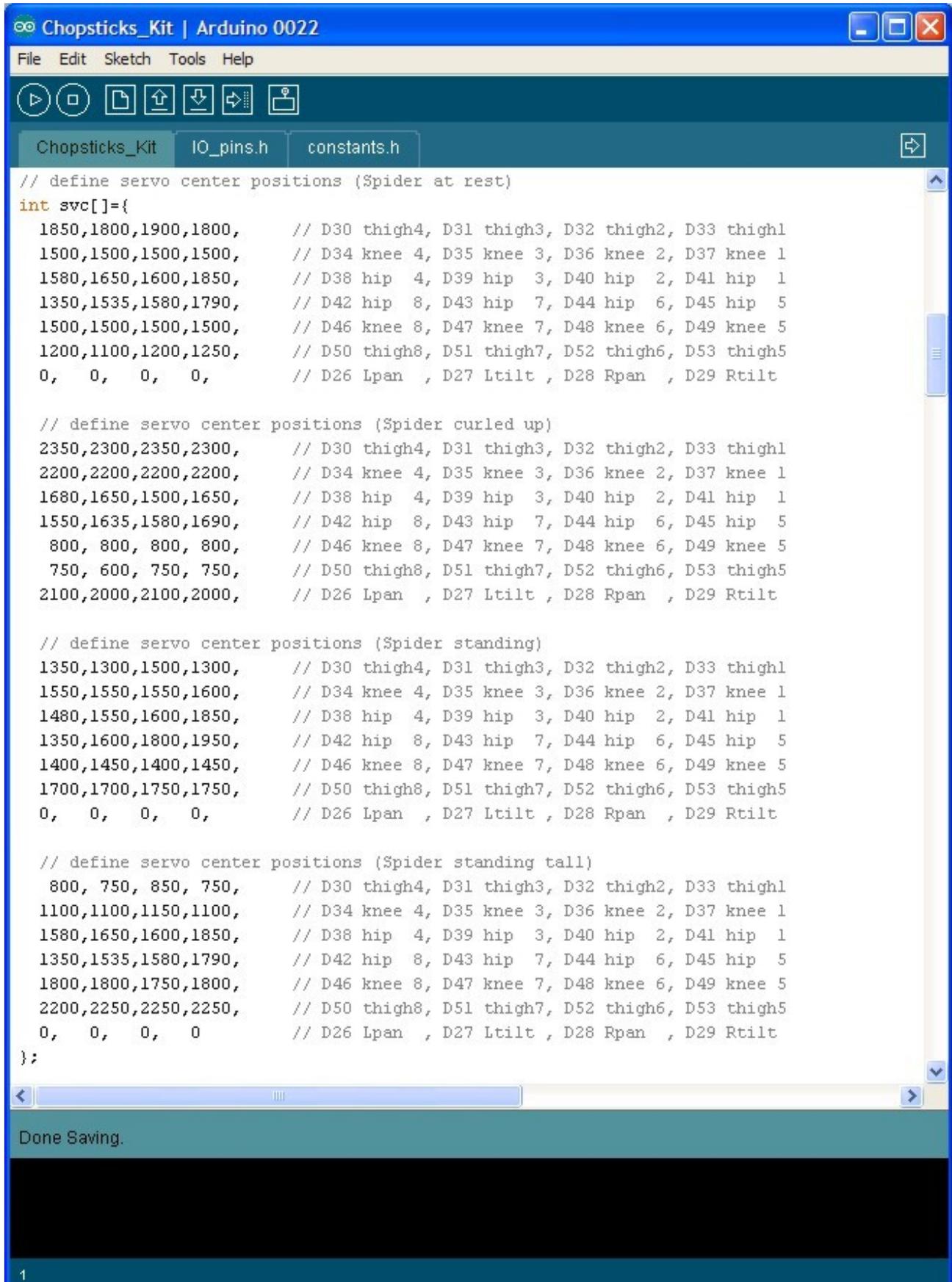


Now that the board type and serial port have been selected you can upload the program to the Spider. For the first test, disconnect the wire from D11. This will prevent the legs from getting power but will still allow the sensor servo and pan/tilt assemblies to work. Make sure these servos are not obstructed otherwise they may break their gearbox trying to move.



Servo calibration

Once the program has loaded the eyes should look straight ahead and upward slightly. If not then they may need to have their servo center positions calibrated. Near the start of the program is an array definition where all servo center positions are stored.



```
Chopsticks_Kit | Arduino 0022
File Edit Sketch Tools Help
Chopsticks_Kit IO_pins.h constants.h
// define servo center positions (Spider at rest)
int svc[]={
  1850,1800,1900,1800, // D30 thigh4, D31 thigh3, D32 thigh2, D33 thigh1
  1500,1500,1500,1500, // D34 knee 4, D35 knee 3, D36 knee 2, D37 knee 1
  1580,1650,1600,1850, // D38 hip 4, D39 hip 3, D40 hip 2, D41 hip 1
  1350,1535,1580,1790, // D42 hip 8, D43 hip 7, D44 hip 6, D45 hip 5
  1500,1500,1500,1500, // D46 knee 8, D47 knee 7, D48 knee 6, D49 knee 5
  1200,1100,1200,1250, // D50 thigh8, D51 thigh7, D52 thigh6, D53 thigh5
  0, 0, 0, 0, // D26 Lpan , D27 Ltilt , D28 Rpan , D29 Rttilt

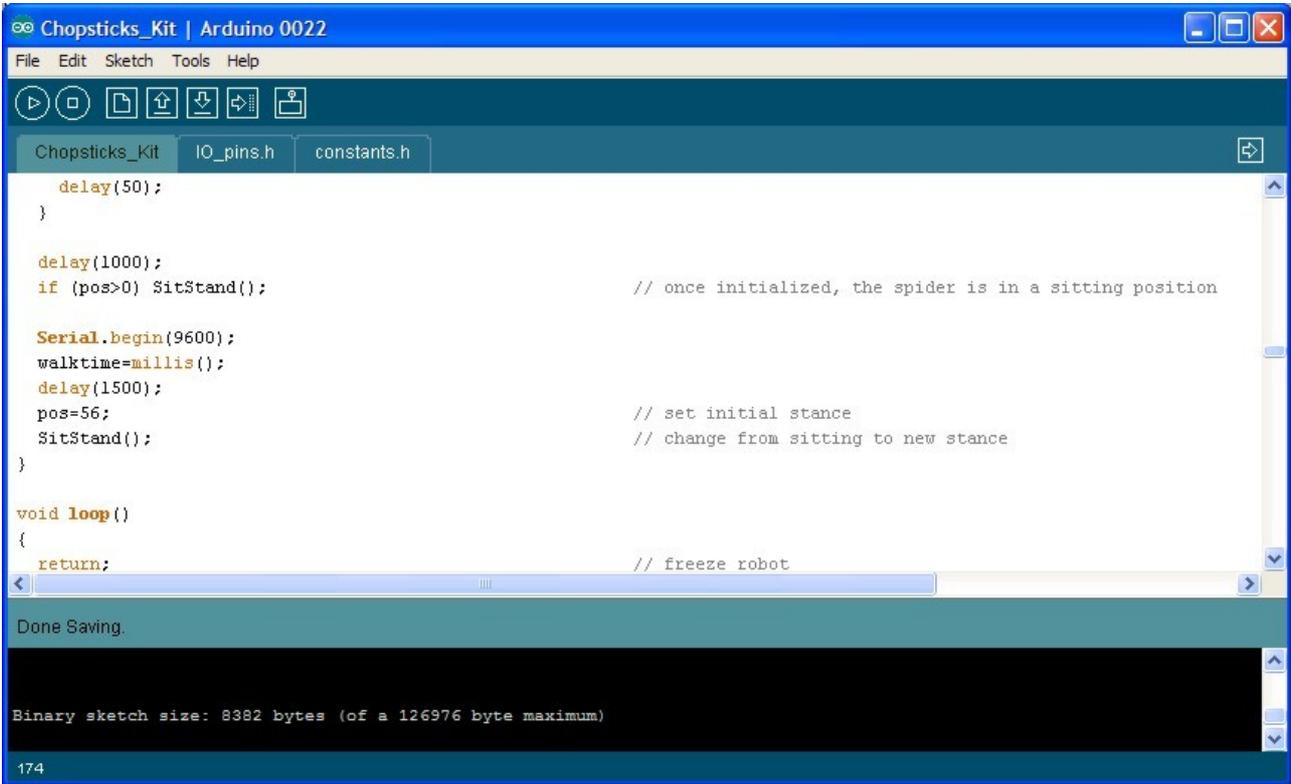
  // define servo center positions (Spider curled up)
  2350,2300,2350,2300, // D30 thigh4, D31 thigh3, D32 thigh2, D33 thigh1
  2200,2200,2200,2200, // D34 knee 4, D35 knee 3, D36 knee 2, D37 knee 1
  1680,1650,1500,1650, // D38 hip 4, D39 hip 3, D40 hip 2, D41 hip 1
  1550,1635,1580,1690, // D42 hip 8, D43 hip 7, D44 hip 6, D45 hip 5
  800, 800, 800, 800, // D46 knee 8, D47 knee 7, D48 knee 6, D49 knee 5
  750, 600, 750, 750, // D50 thigh8, D51 thigh7, D52 thigh6, D53 thigh5
  2100,2000,2100,2000, // D26 Lpan , D27 Ltilt , D28 Rpan , D29 Rttilt

  // define servo center positions (Spider standing)
  1350,1300,1500,1300, // D30 thigh4, D31 thigh3, D32 thigh2, D33 thigh1
  1550,1550,1550,1600, // D34 knee 4, D35 knee 3, D36 knee 2, D37 knee 1
  1480,1550,1600,1850, // D38 hip 4, D39 hip 3, D40 hip 2, D41 hip 1
  1350,1600,1800,1950, // D42 hip 8, D43 hip 7, D44 hip 6, D45 hip 5
  1400,1450,1400,1450, // D46 knee 8, D47 knee 7, D48 knee 6, D49 knee 5
  1700,1700,1750,1750, // D50 thigh8, D51 thigh7, D52 thigh6, D53 thigh5
  0, 0, 0, 0, // D26 Lpan , D27 Ltilt , D28 Rpan , D29 Rttilt

  // define servo center positions (Spider standing tall)
  800, 750, 850, 750, // D30 thigh4, D31 thigh3, D32 thigh2, D33 thigh1
  1100,1100,1150,1100, // D34 knee 4, D35 knee 3, D36 knee 2, D37 knee 1
  1580,1650,1600,1850, // D38 hip 4, D39 hip 3, D40 hip 2, D41 hip 1
  1350,1535,1580,1790, // D42 hip 8, D43 hip 7, D44 hip 6, D45 hip 5
  1800,1800,1750,1800, // D46 knee 8, D47 knee 7, D48 knee 6, D49 knee 5
  2200,2250,2250,2250, // D50 thigh8, D51 thigh7, D52 thigh6, D53 thigh5
  0, 0, 0, 0 // D26 Lpan , D27 Ltilt , D28 Rpan , D29 Rttilt
};
Done Saving.
1
```

This array called “svc” stores the center positions of all servos for different positions. The reason for storing “center” positions is that when walking, the servos positions will change relative to these center positions. The advantage of this system is that the robot can change it’s height when walking by changing these values only rather than having all new gait sequences.

To calibrate the servo center positions, select the stance to be calibrated by changing the initial “pos” value and add a “return;” statement at the beginning of the loop.



```
Chopsticks_Kit | Arduino 0022
File Edit Sketch Tools Help
Chopsticks_Kit IO_pins.h constants.h
delay(50);
}

delay(1000);
if (pos>0) SitStand(); // once initialized, the spider is in a sitting position

Serial.begin(9600);
walktime=millis();
delay(1500);
pos=56; // set initial stance
SitStand(); // change from sitting to new stance
}

void loop()
{
return; // freeze robot
}

Done Saving.

Binary sketch size: 8382 bytes (of a 126976 byte maximum)

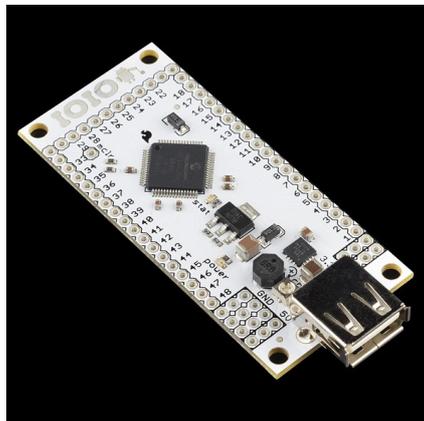
174
```

You can now see the robots stance for each position and change the values of the svc array until the stance is correct. It is best to have the robot upside down when first calibrating the servos so that the servos are under minimum load.

The sample code is supplied for testing the robot and to help the customer learn how to use the robot. It does not use the front sensor sweep servo. This servo has been included to facilitate the use of optional range finding sensors and therefore it is up to the customer to add their own code for the range finder and sweep servo.

What Next?

Between the Spider controller and the pan / tilt assemblies is an area to mount a second controller or mobile phone. By mounting an Android compatible phone and IOIO interface in this space your robot can be controlled by your phone.



Find out more about the IOIO interface here: <http://www.sparkfun.com/products/10748>

Troubleshooting

The Spider robot is a complex robot. This list will be updated as new common faults are found. If you cannot find the solution here then make sure you have downloaded the latest version of the manual.

Problem: The program will not compile.

Solution: Check that the board type has been correctly selected.

Problem: The program will not upload.

Solution: Check the robot is turned on and the correct serial port has been selected.

Check that all wiring is connected properly as a short circuit can prevent upload.

Problem: The robot does not track my hand movements.

Solution: Check that the pan / tilt assemblies are installed on the correct side.

Check that the cable from the eye to the controller is connected correctly.

Check that the pan / tilt assemblies are assembled correctly and the eye is not upside-down.

Problem: The robot does not walk correctly.

Solution: Check that all servo cables are fully plugged in and in the correct socket.

Check that all servos can move freely when the power is off.

Check the servos are calibrated properly.

Problem: The robot moves away from my hand instead of following it.

Reason: The robot does not want to play with you anymore.