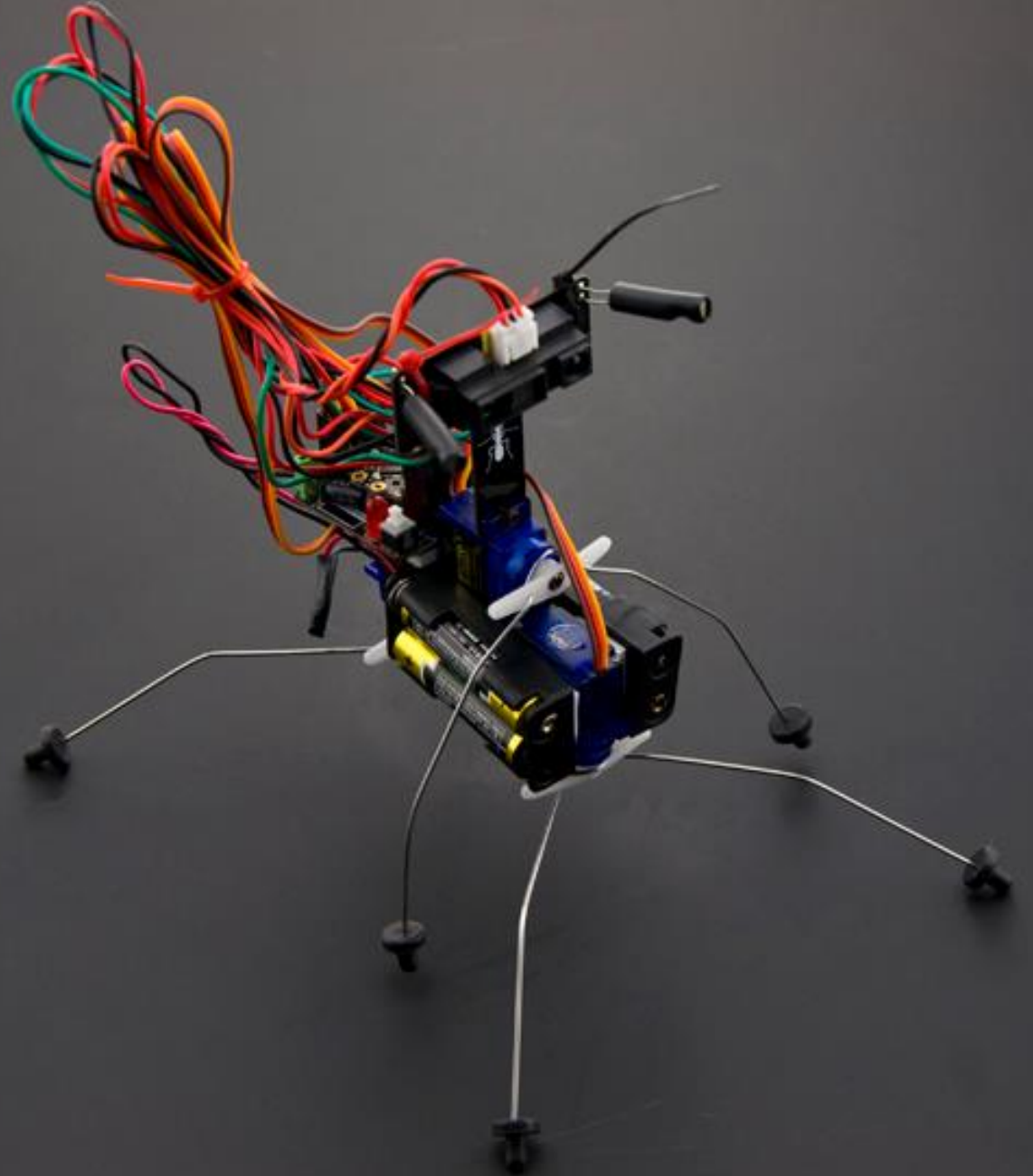# DFROBOT
DRIVE THE FUTURE

How to build an Insectbot!

Once you pick up an Insectbot, you won't be able to put it down!

Contents

Tools Required

Screwdriver

A screwdriver is used to tighten and loosen screws. It is an essential tool for making your Insectbot. You can get yourself a screwdriver kit with various types of fittings for making robots!

Long-nose Pliers

Long nose pliers are used to bend and cut things. We use long nose pliers in this project to twist steel wire. They can also be used to cut steel wire.

Scissors

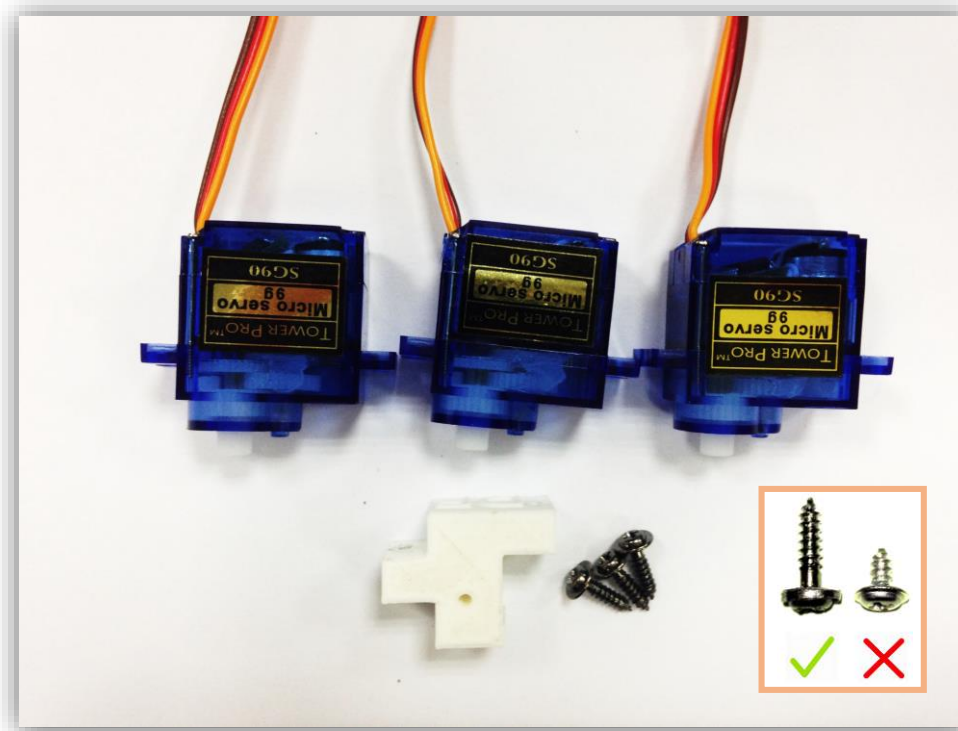Scissors are used to cut paper and other components.

Assembly Instructions

STEP 1: Insectbot Body

You will need:

- 3 x 9G Micro servos
- 1 x Block
- 3 x Long Screws (included in the servo accessory bag)

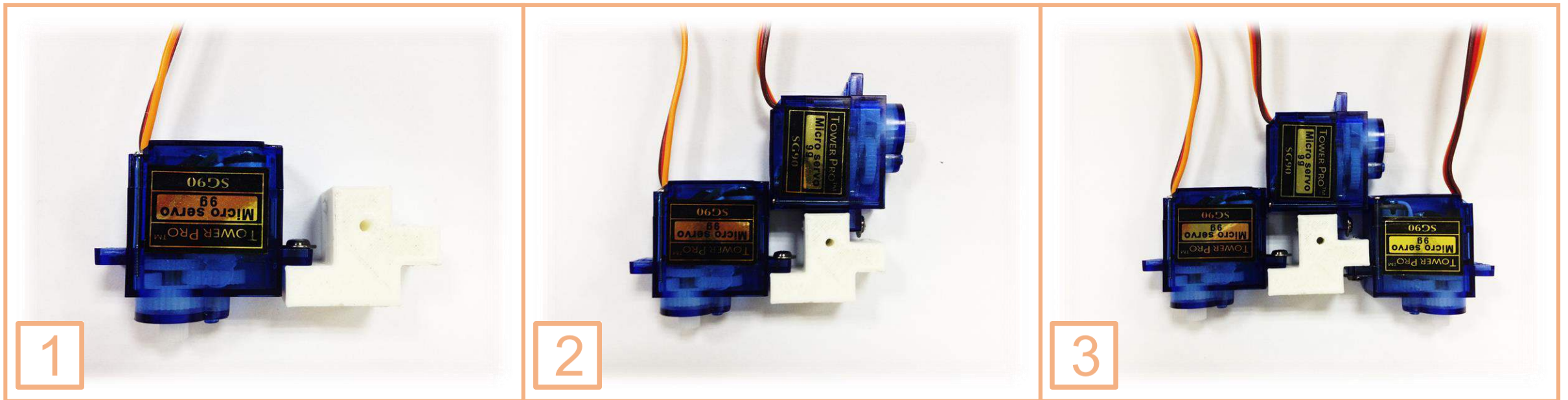**Note: see diagram for correct screws**

Assembly Instructions

STEP 1: Insectbot Body

Firmly attach the 3 micro servos to the block as pictured using long screws and a screwdriver. Pay careful attention to the direction that each micro servo faces

Note: Make sure each micro servo is securely fastened to the block so that it can't move
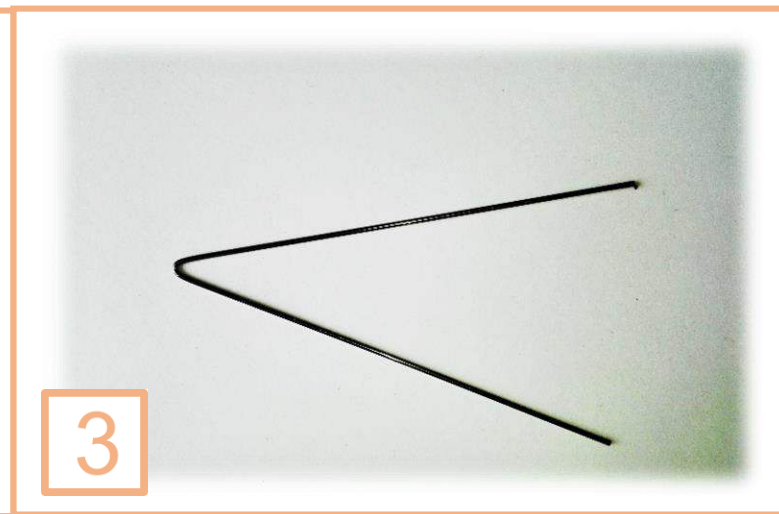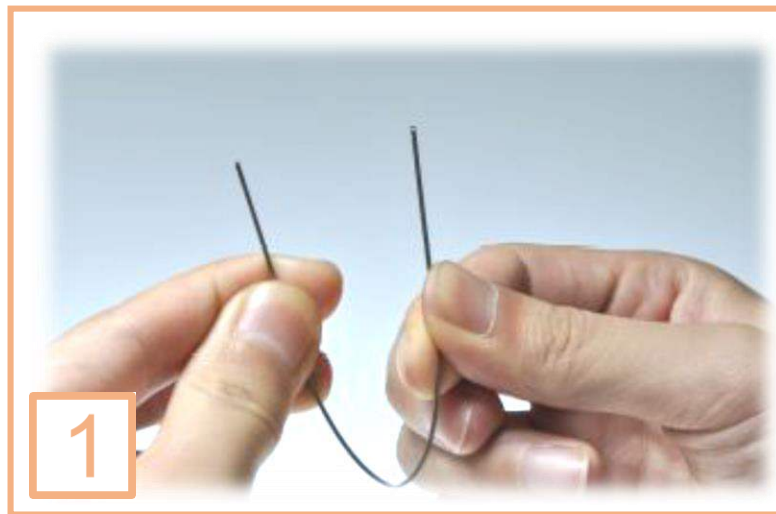
Assembly Instructions

STEP 2: Insectbot Legs

You will need steel wire. Find the midpoint of one piece of steel wire and then use the long-nose pliers to bend it in to a "v" shape, just like picture 3.
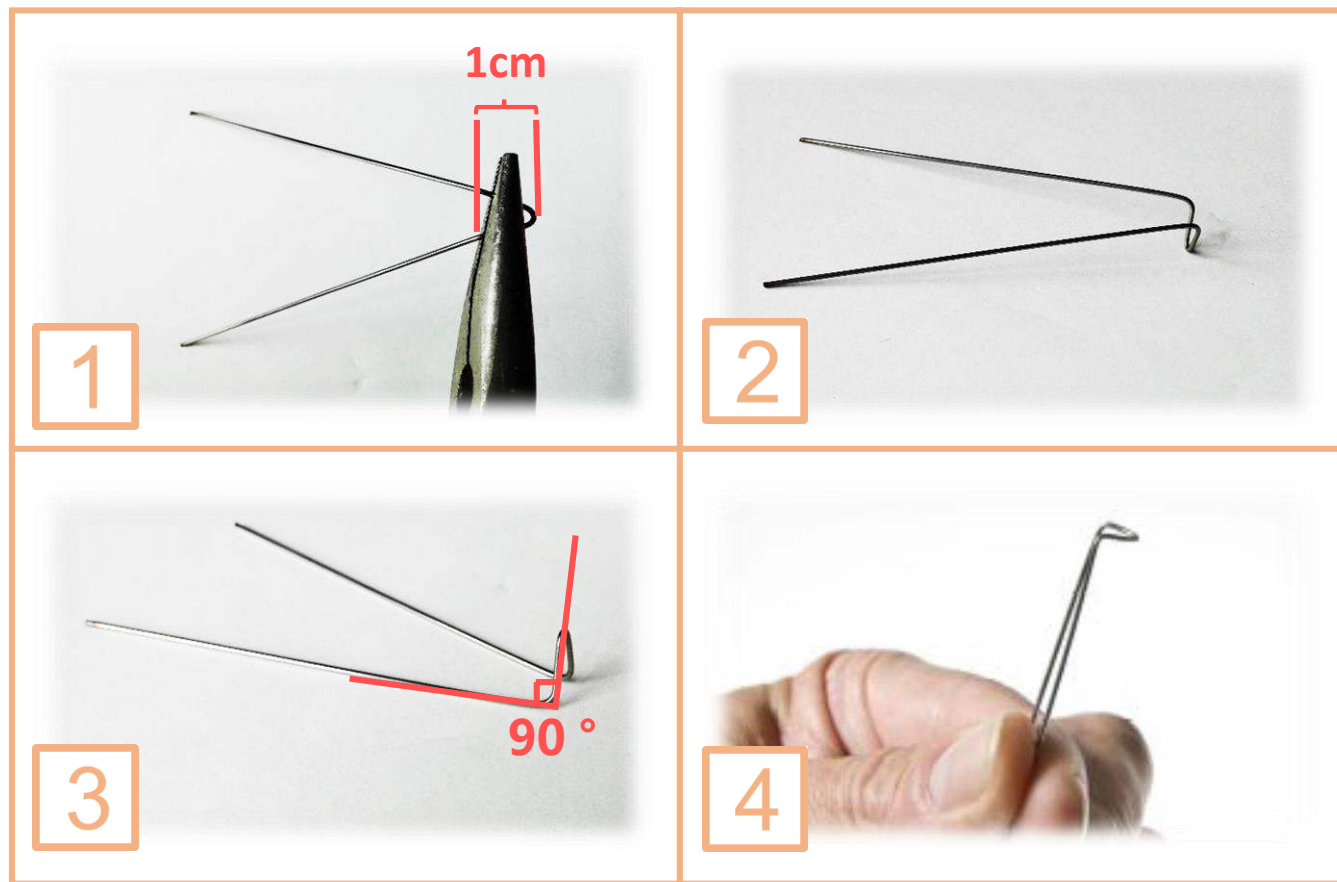
Assembly Instructions

STEP 2: Insectbot Legs

Twist the tip of the wire 1cm from the narrow edge of the "v" shape

Make three bent pieces of wire using this method

Assembly Instructions
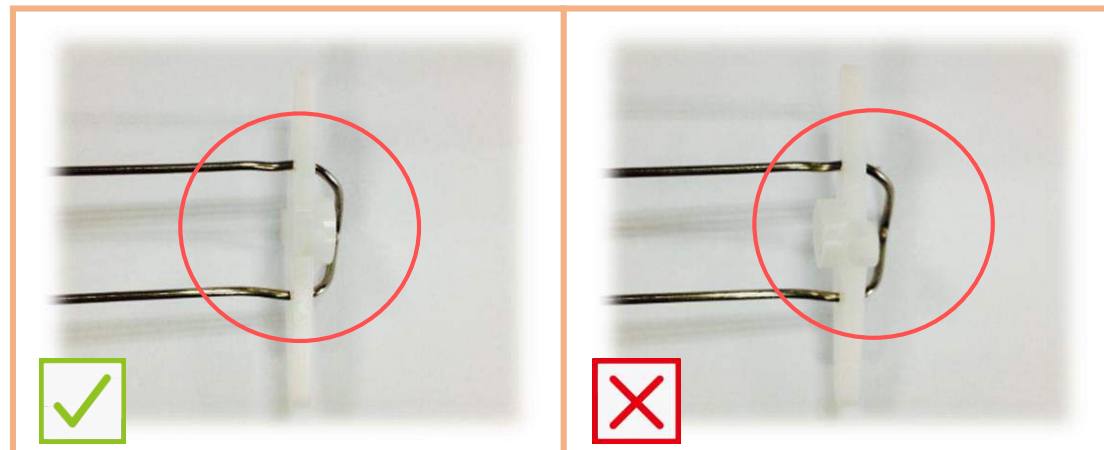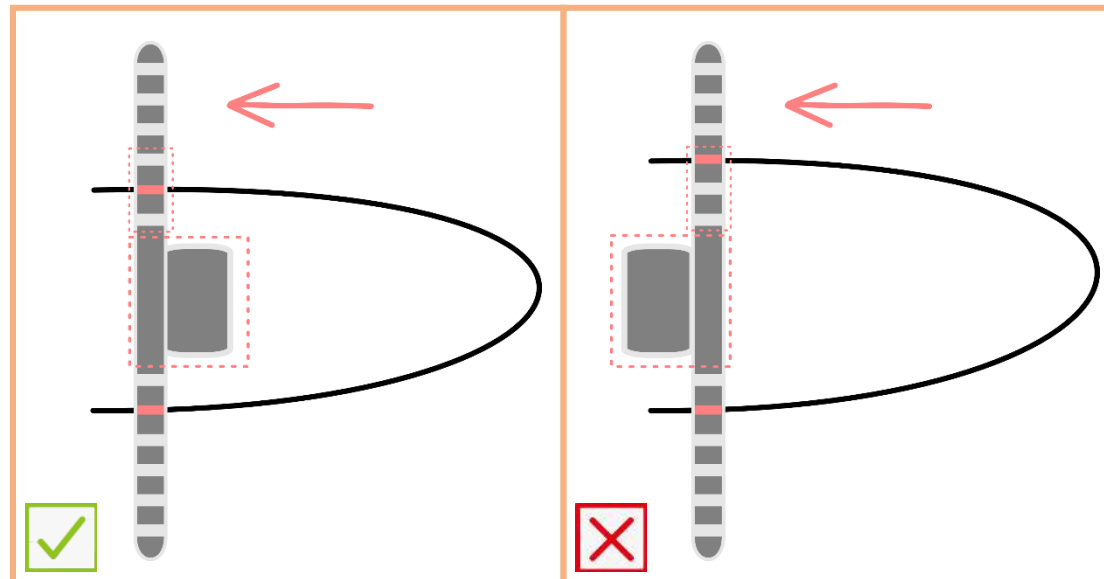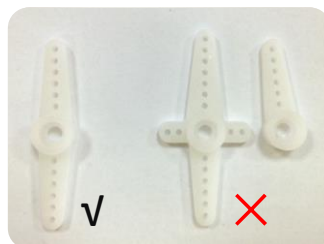
STEP 2: Insectbot Legs

Your micro servos come with accessories. Take a look inside the accessories bag and you will find some servo horns

Thread each piece of twisted wire through the holes on the servo horns as pictured on the right

Note:
Be careful that the servo horn is the correct way around - see the diagram for reference

⚠ Cauton: Adult supervision required!

Assembly Instructions

STEP 2: Insectbot Legs

Let's make the Insectbot's front and hind legs. They are both made of steel wire that is bent in the same way as before

1) Bend the narrow end of the "v" shape of the steel wire forward as in picture 1. Pay attention that the bent section is no longer than 0.5 cm
2) Find the bending point as it is shown in picture 2. This point is between *b* and *c*. Bend the wire so that it looks like picture 3
3) Repeat the process so that you have two sets of legs

Bending Point

a

b   c

a = 0.5cm， c = 2b
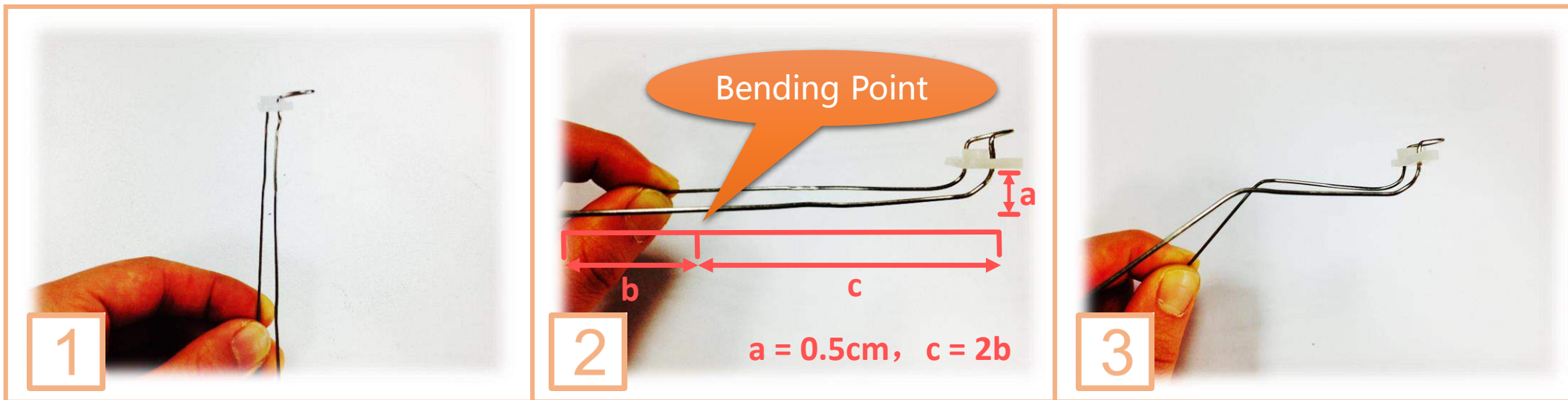
Assembly Instructions

STEP 2: Insectbot Legs

Attach the front legs and hind legs to the Insectbot body by attaching each leg's servo horn to a servo using a short screw. Pay attention to the diagram below to make sure you are using the correct length of screw!

Check to see that the servo horns can move freely when attached to the servo. Check that there are no obstructions caused by the bent steel wire that stop the servo horn moving. The red circle in the diagram below shows one possible obstruction. If this happens, you can simply bend the wire forwards out of the way.
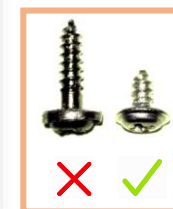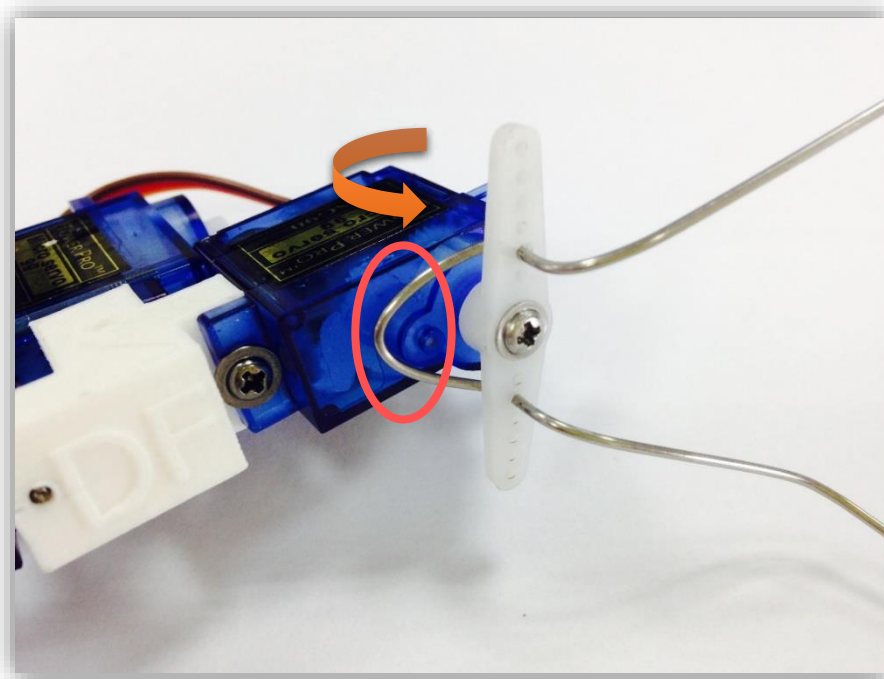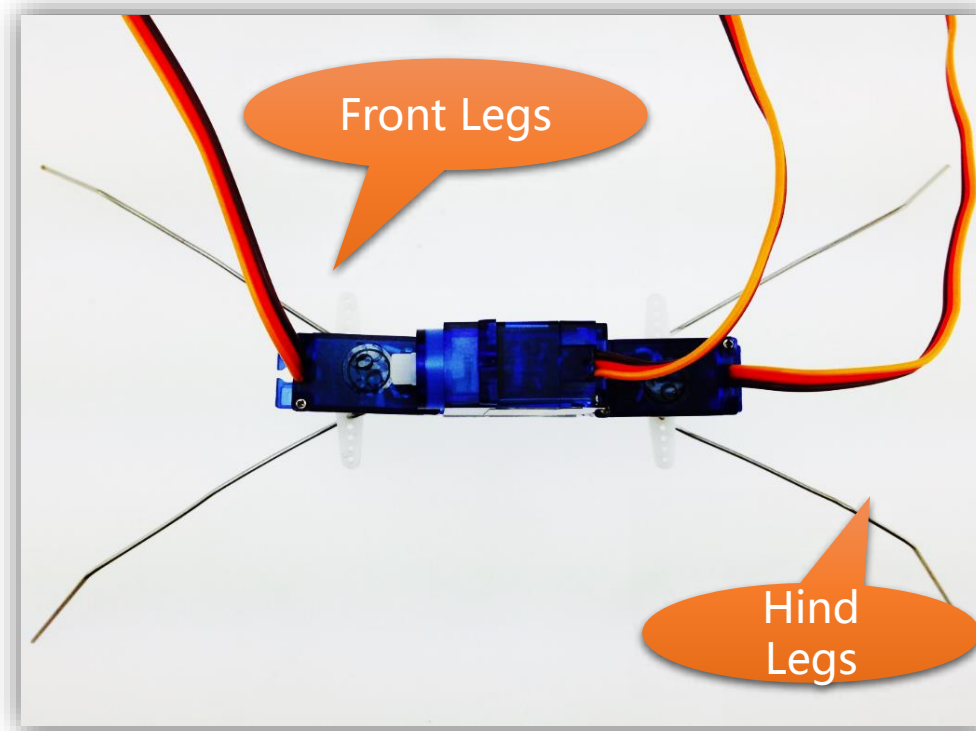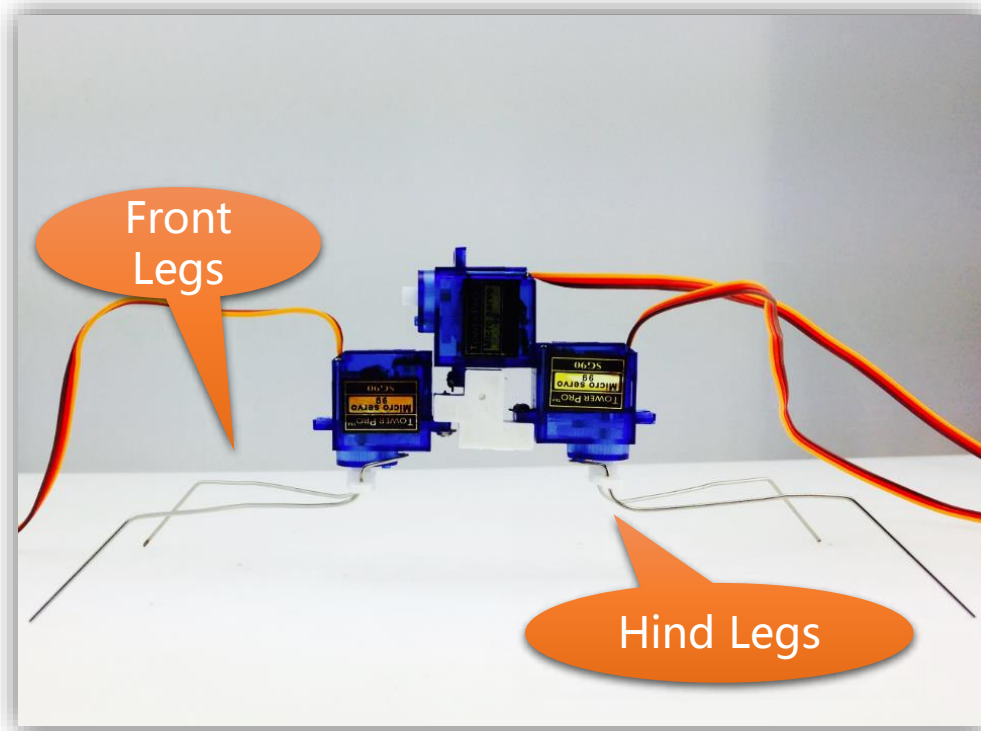
Assembly Instructions

STEP 2: Insectbot Legs

Place the Insectbot on a flat surface to make sure that it can stand flat and stable

Check that both the front and hind legs can touch the surface of the table

Assembly Instructions

STEP 2: Insectbot Legs

Now let's make the Insectbot's middle legs.

1) Bend the narrow end of the "v" shape of the steel wire forward as in picture 1, as you did with the other legs
2) Pay attention that the bent section is no longer than 0.5 cm
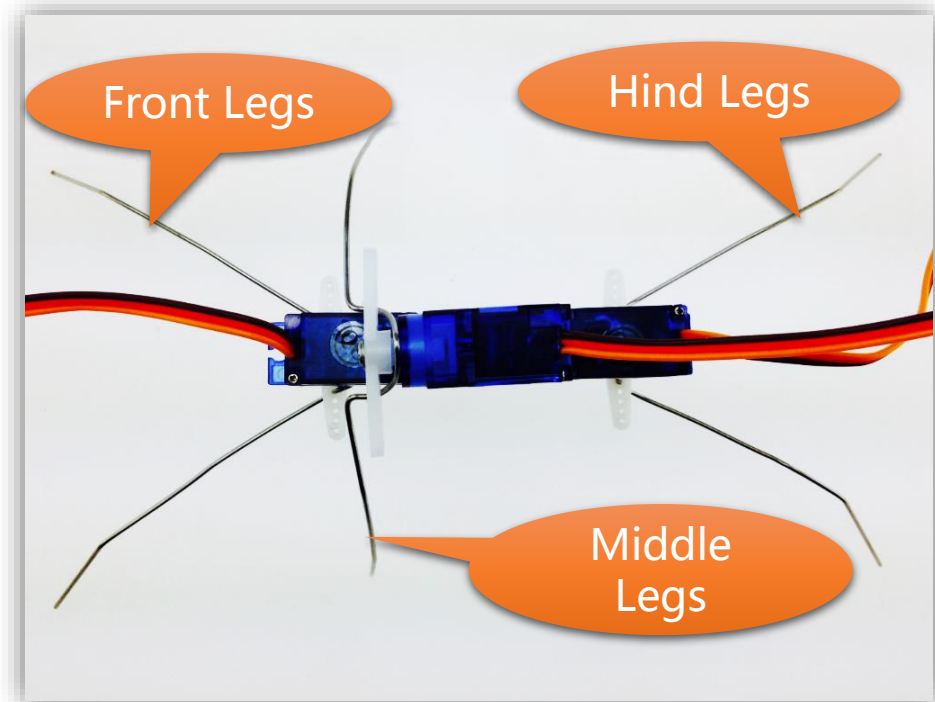3) Bend the wire in to an arch shape, as in picture 3
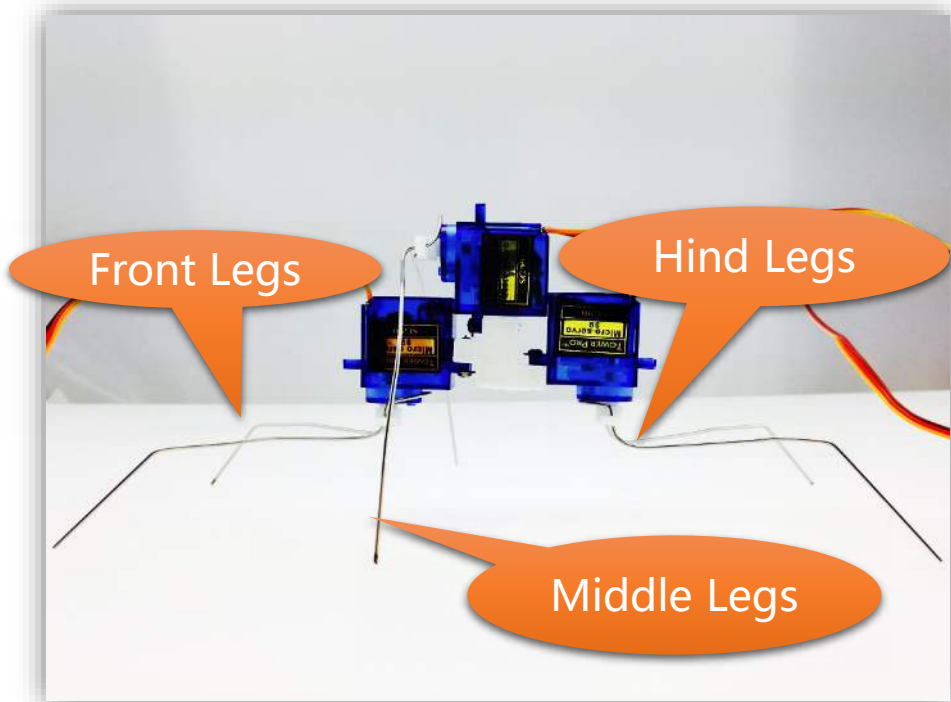

1

a

a = 0.5cm

2

3
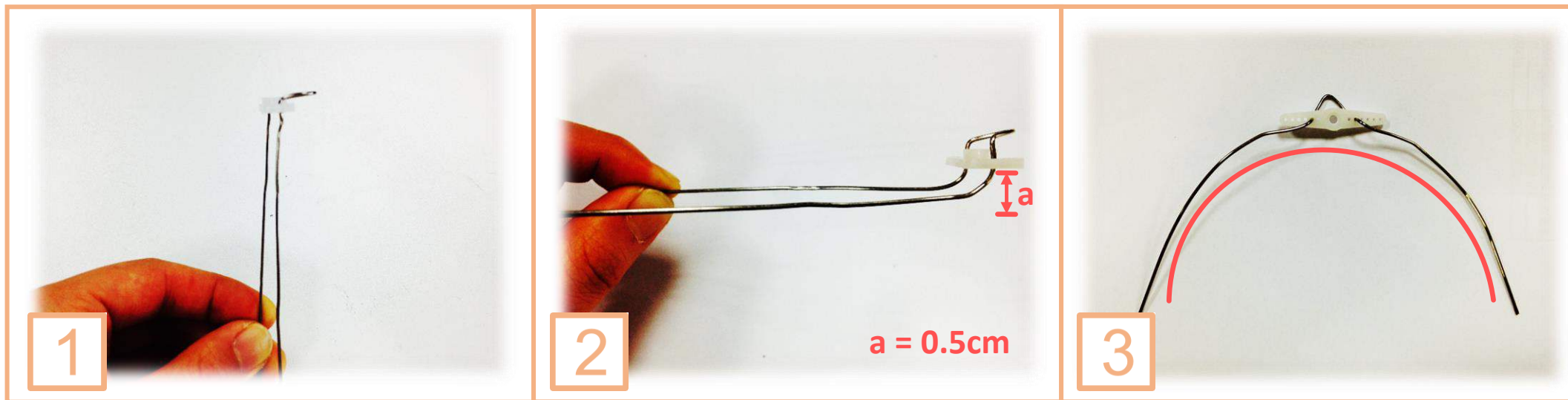
Assembly Instructions

STEP 2: Insectbot Legs

Attach the Insectbot's middle legs to the body using the same process as you did for the front legs and hind legs

Make sure that the Insectbot can stand firmly on a flat surface and that all six legs touch the surface. If the legs do not, bend them so that they do.
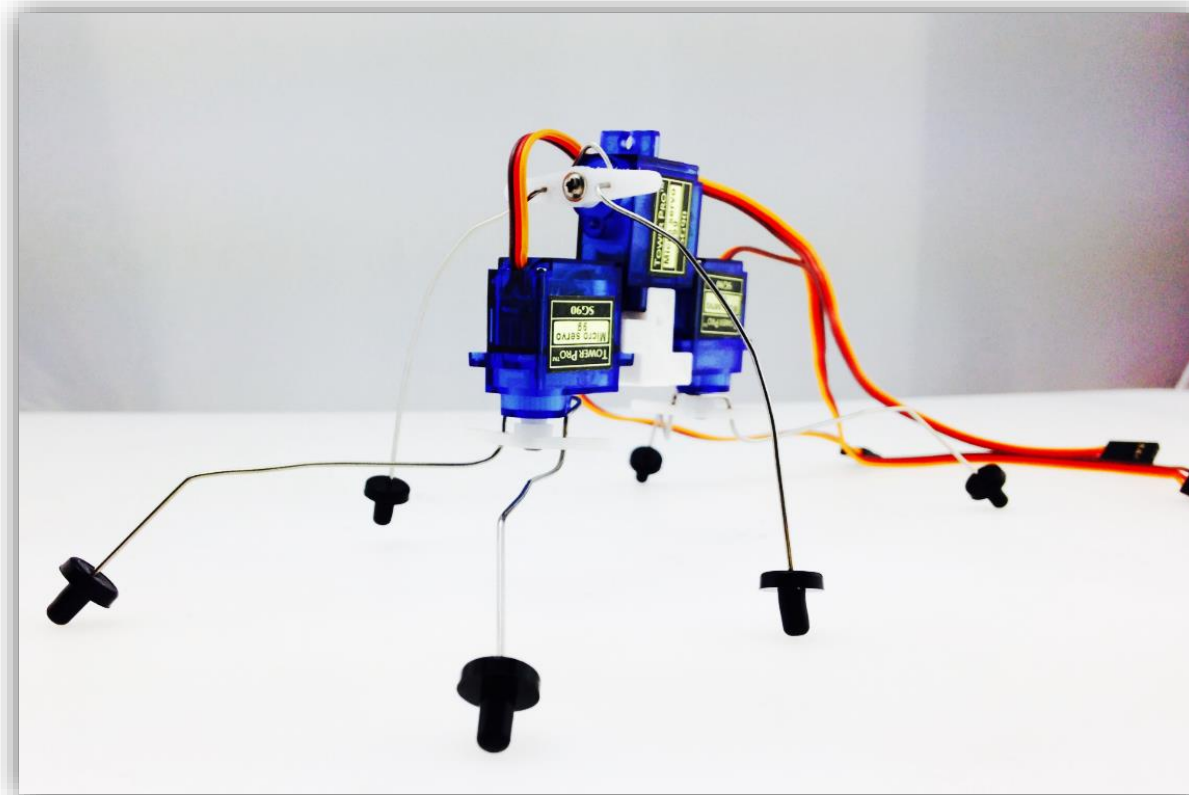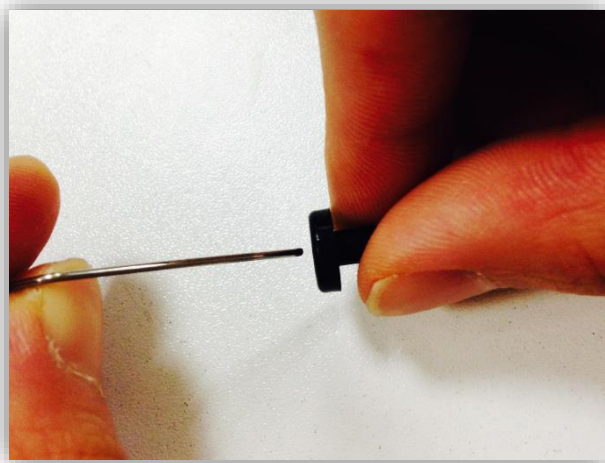
Assembly Instructions

STEP 2: Insectbot Legs

Carefully poke the end of each leg in to a rubber foot so that the sharp ends of the steel wire don't scratch your floors and furniture

Your Insectbot should look like the picture on the right when finished.

⚠️ Caution: Wire ends are sharp! Adult supervision required!
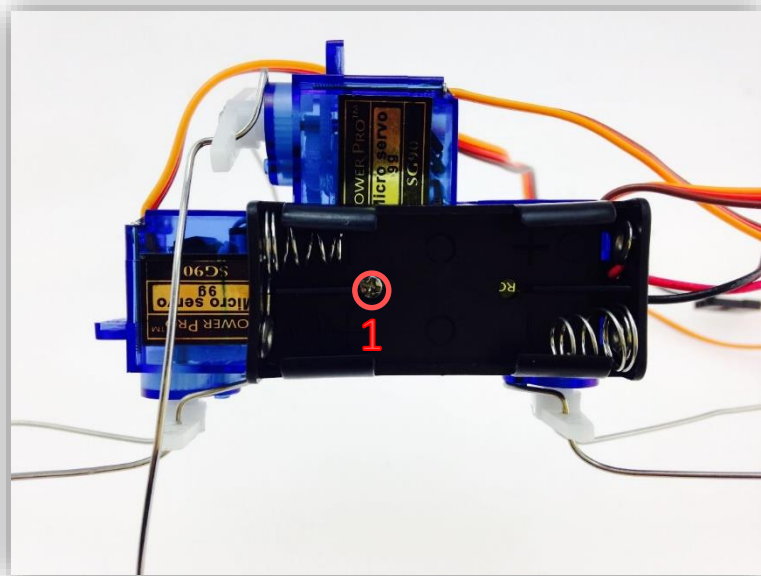
Assembly Instructions

STEP 3: Battery Holder

We need to add a battery holder to each side of Insectbot to give it power

Take out the screws inside the box and then fix them on to both sides of the its body. Be sure to use the correct sized screws as pictured. The first hole should be in line with the hole of the top servo's screw-hole on the body (picture 1)
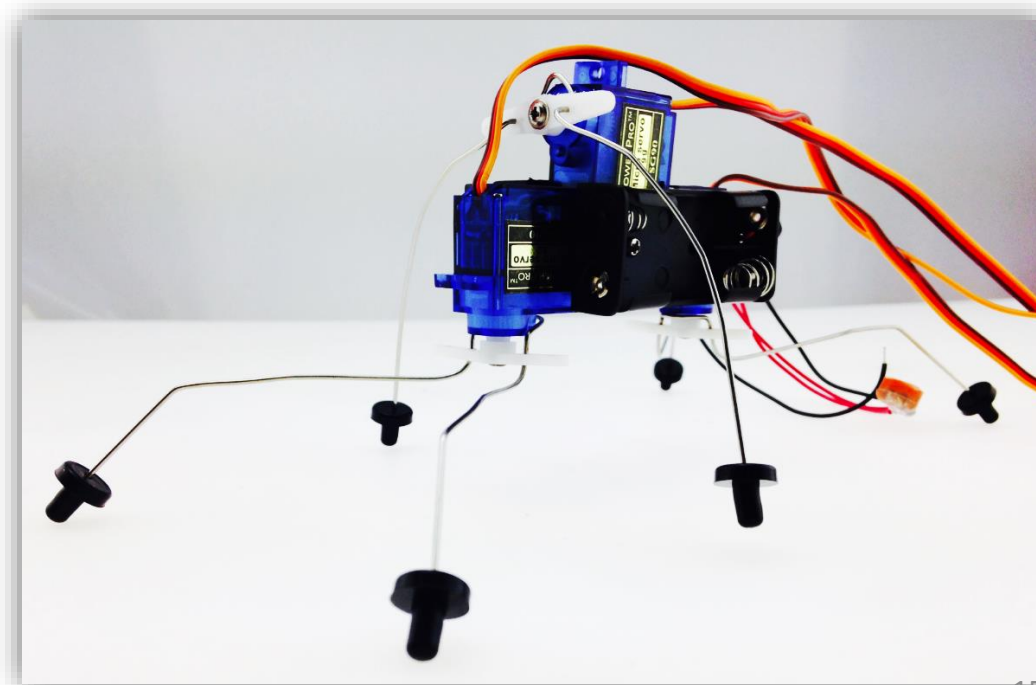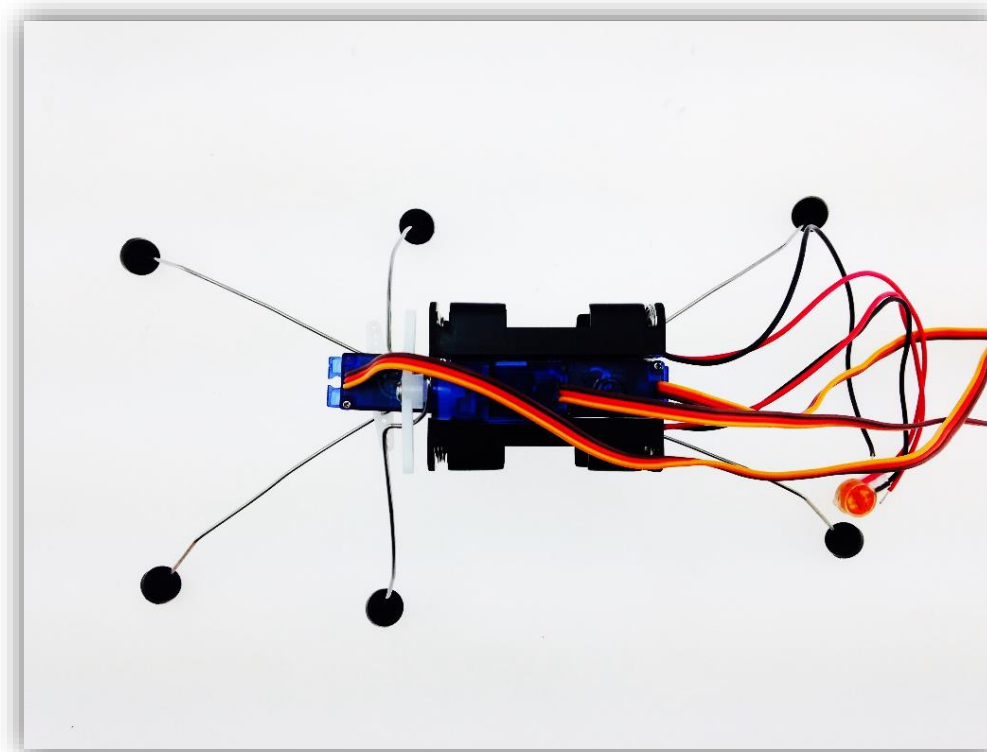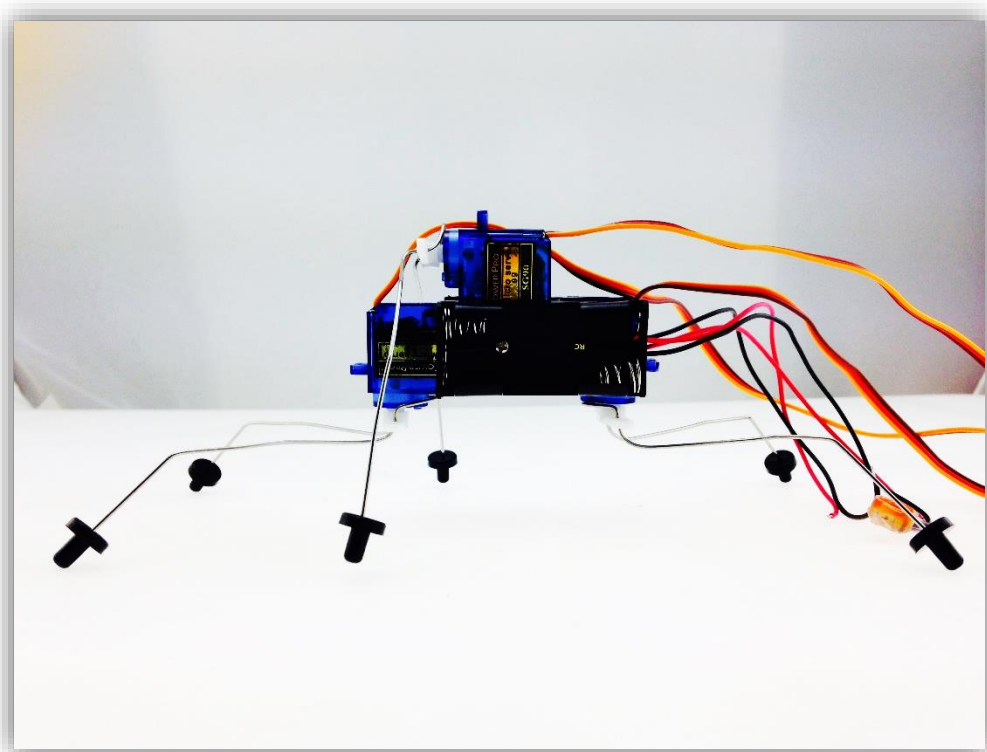
Assembly Instructions

STEP 3: Battery Holder

Use these photos as a reference to see if each battery holder is located in the right place

Assembly Instructions

STEP 4: Insectbot Eyes

Now let's make the Insectbot's eyes.

- Take out the IR distance sensor, PCB and two red nylon cable ties from the component bag
- Turn the PCB over so that the back is facing you
- Fix two red cable ties into the two holes along the top of the PCB and tighten them around the edge of it as pictured
- Connect the IR distance sensor to the PCB using the provided wire. Make sure the wire is fully seated in its socket
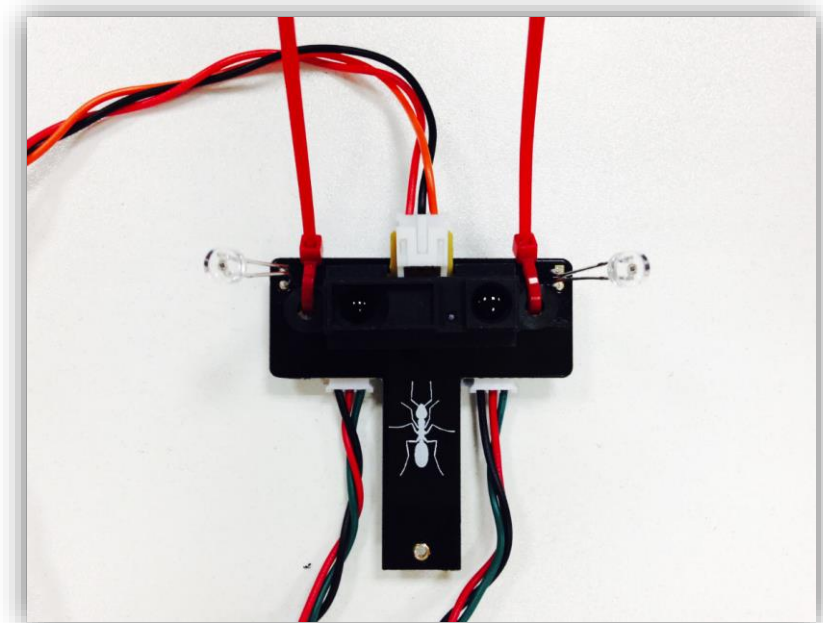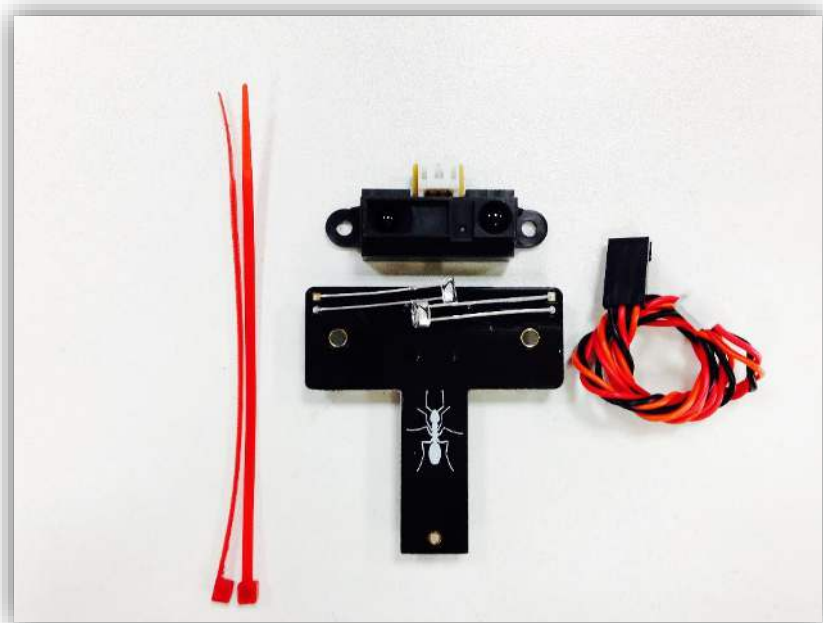
Assembly Instructions

STEP 4: Insectbot Eyes

Fix the eye assembly on to the top of Insectbot's body with the same short screws used for the battery holder. The lower picture shows what the completed assembly should look like – note the direction of the PCB
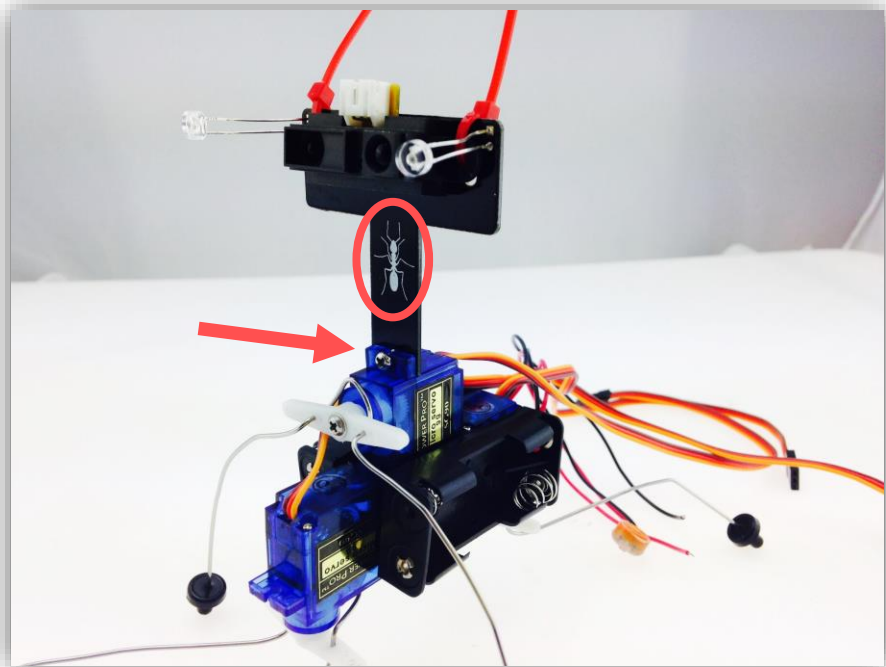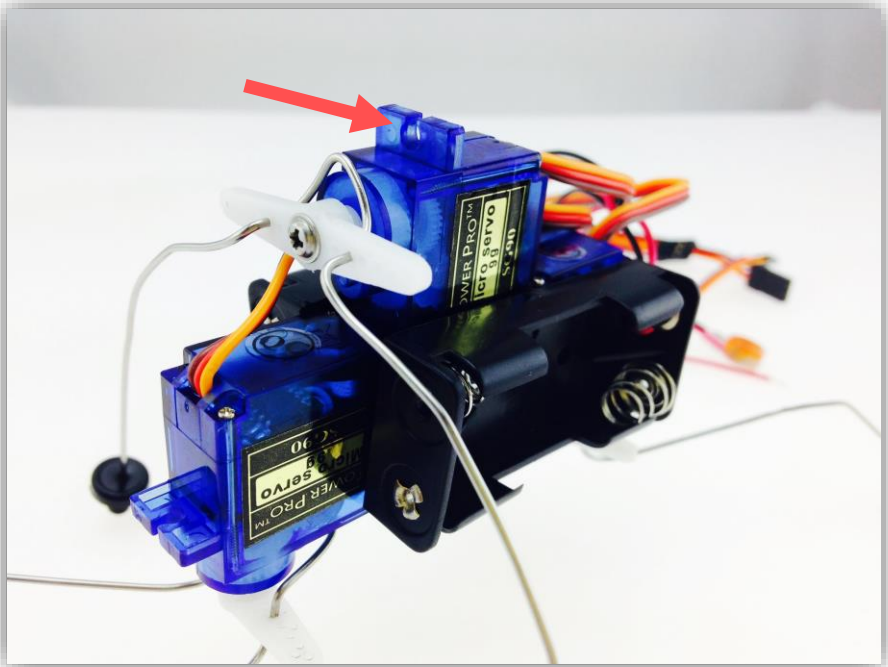
Assembly Instructions

STEP 5: Insectbot Brain

Take the provided 3M double sided tape and draw a 3.5 x 2.5cm square on it. Cut it out using scissors. Stick one side of the tape to the back of the Insectbot's body as pictured
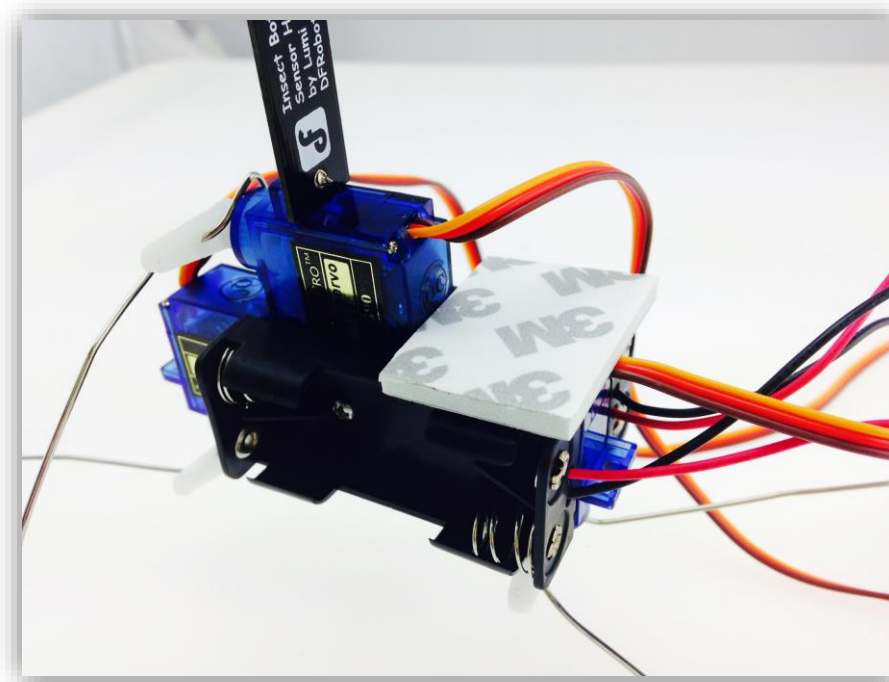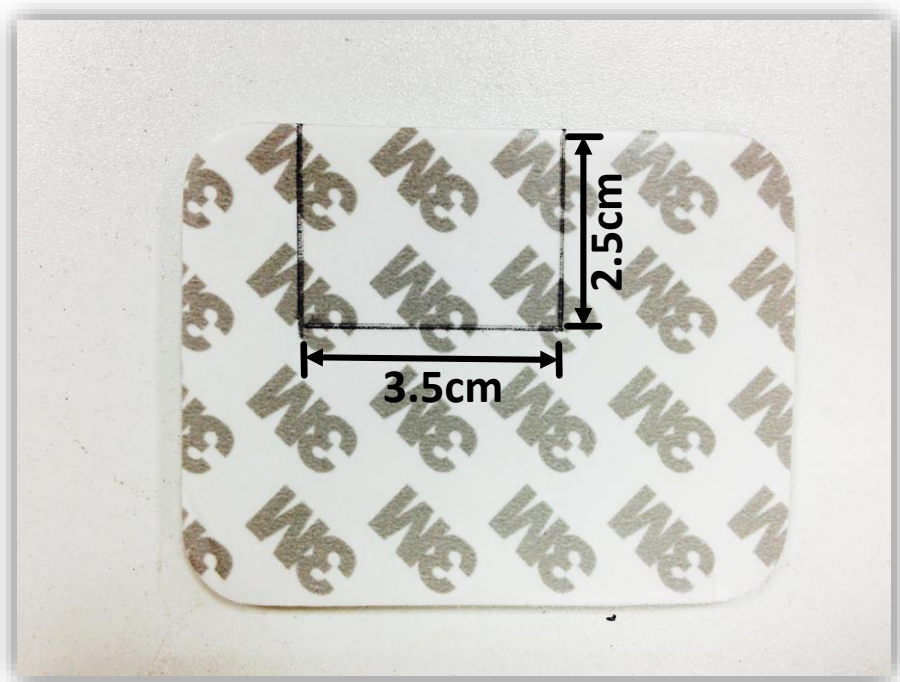
Assembly Instructions

STEP 5: Insectbot Brain

Take out the Beetle Shield. This is the Insectbot's brain!

Stick the shield on to the adhesive pad with the power switch and USB connector of the shield facing towards the rear of the Insectbot

Assembly Instructions

STEP 6: Hardware Connections

You are only one step away from getting your Insectbot moving! All you have to do is complete the circuit connections according to the diagram on the right. Then you can install batteries and play!

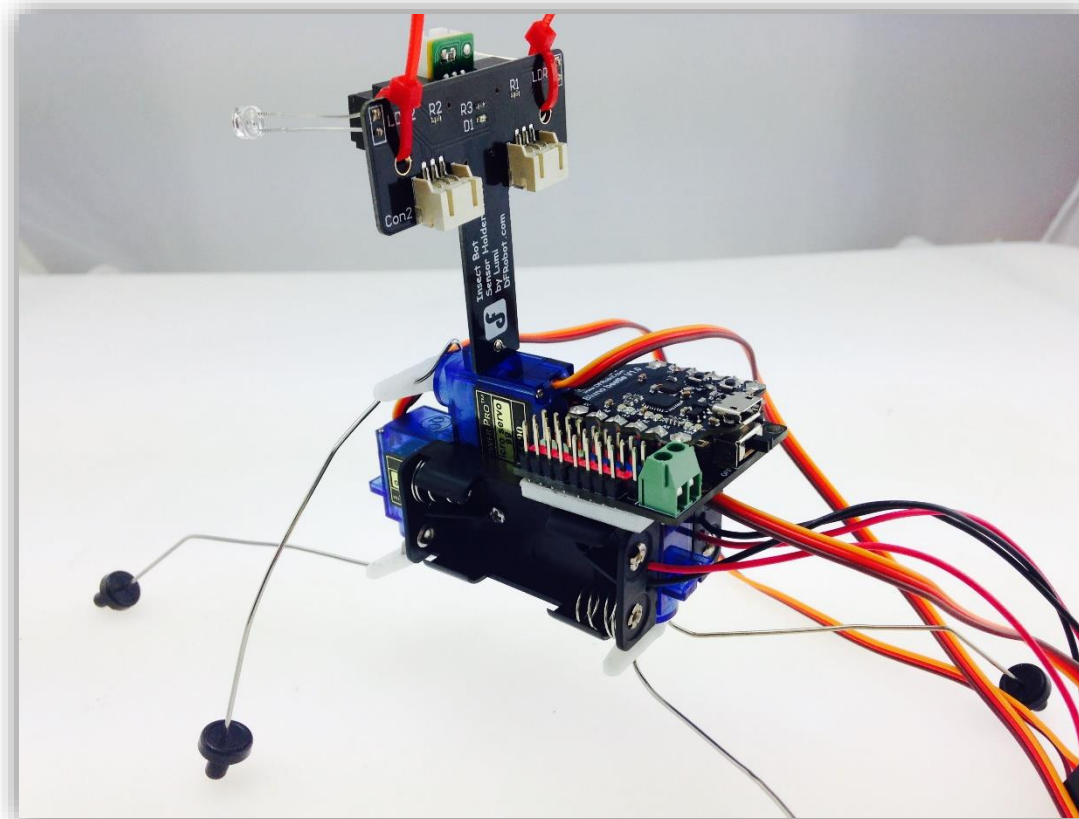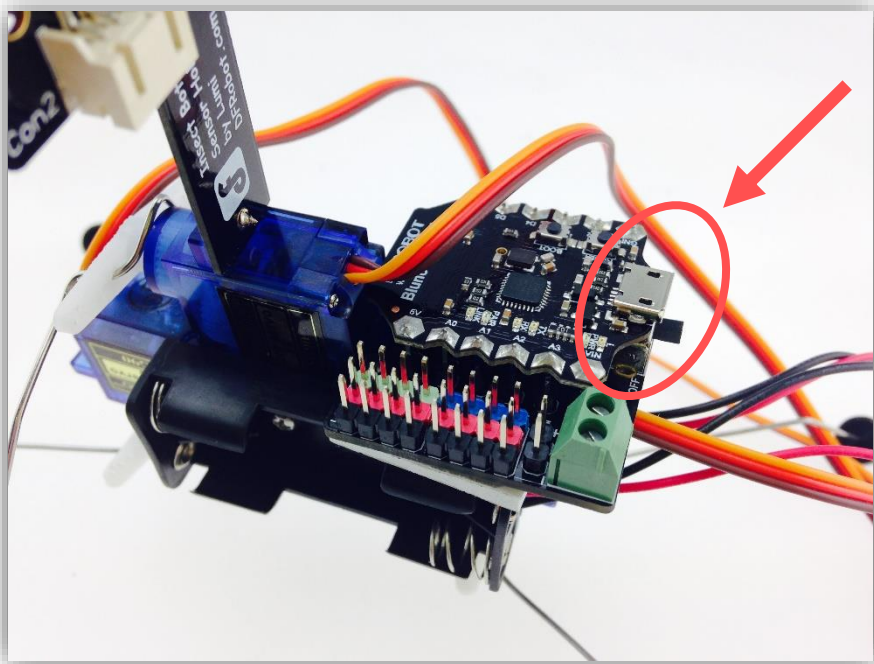**NOTE: When connecting the cables, please pay attention to the order of the connections. They must be attached exactly as shown in the map.**

Pay particular attention to the upper right of the circuit board with the following symbols: + (red wire), – (black/brown wire) and S (orange/green wire).

- ● Infrared Sensor – A1
  - S = Orange
  - + = Red
  - - = Black

- ● Light Sensor Con2 – A0
- ● Light Sensor Con1 – A2
  - S = Green
  - + = Red
  - - = Black

- ● Forelegs' Steering Gear– D3
- ● Middle legs' Steering Gear– D5
- ● Hind Legs' Steering Gear– D4
  - S = Orange
  - + = Red
  - - = Brown

- ● Battery Holder Red Wire – Beetle terminal +
- ● Battery Holder Black Wire – Beetle terminal -
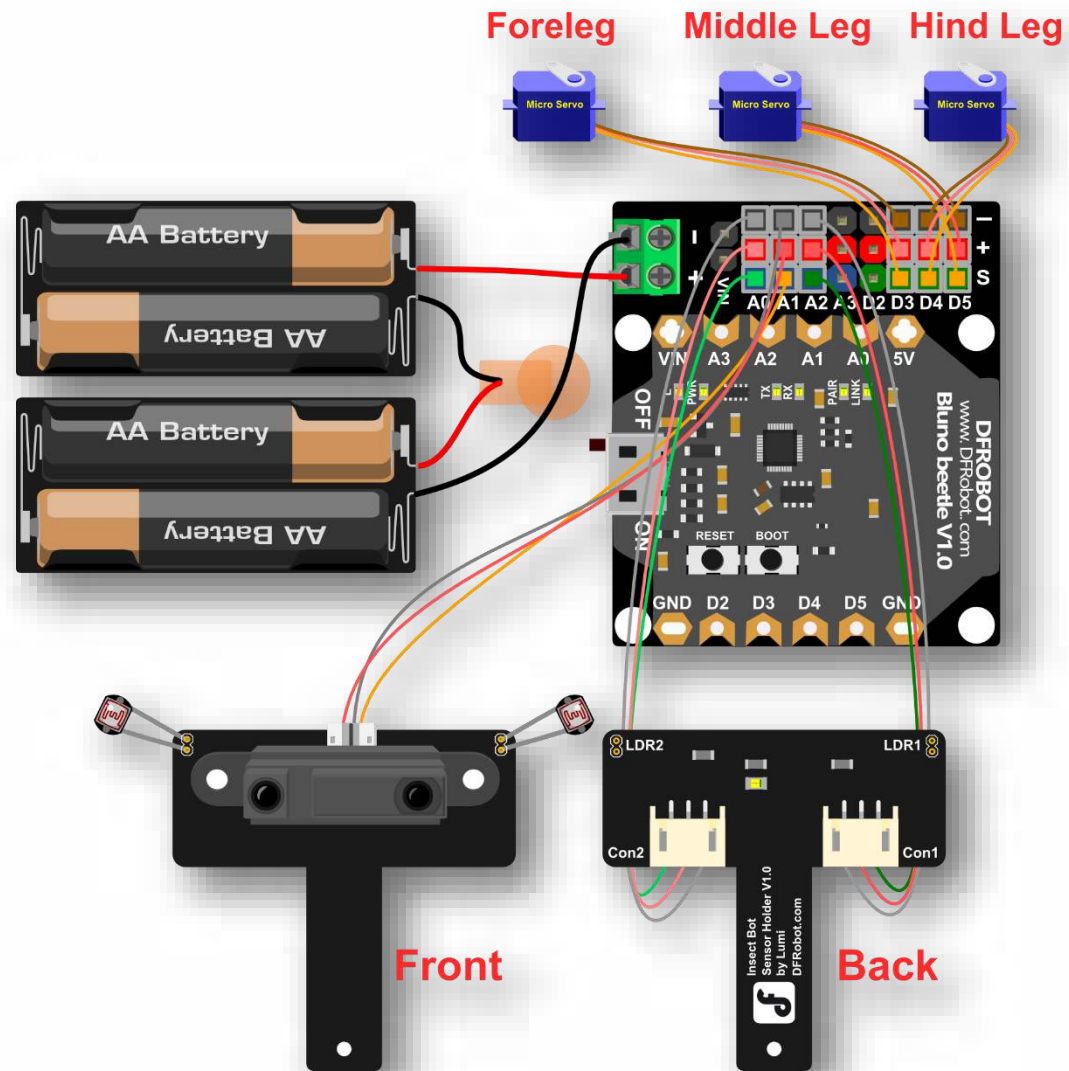
⚠️ Be sure that all cables are connected correctly or you risk damaging your components!

Foreleg   Middle Leg   Hind Leg

Front

Back

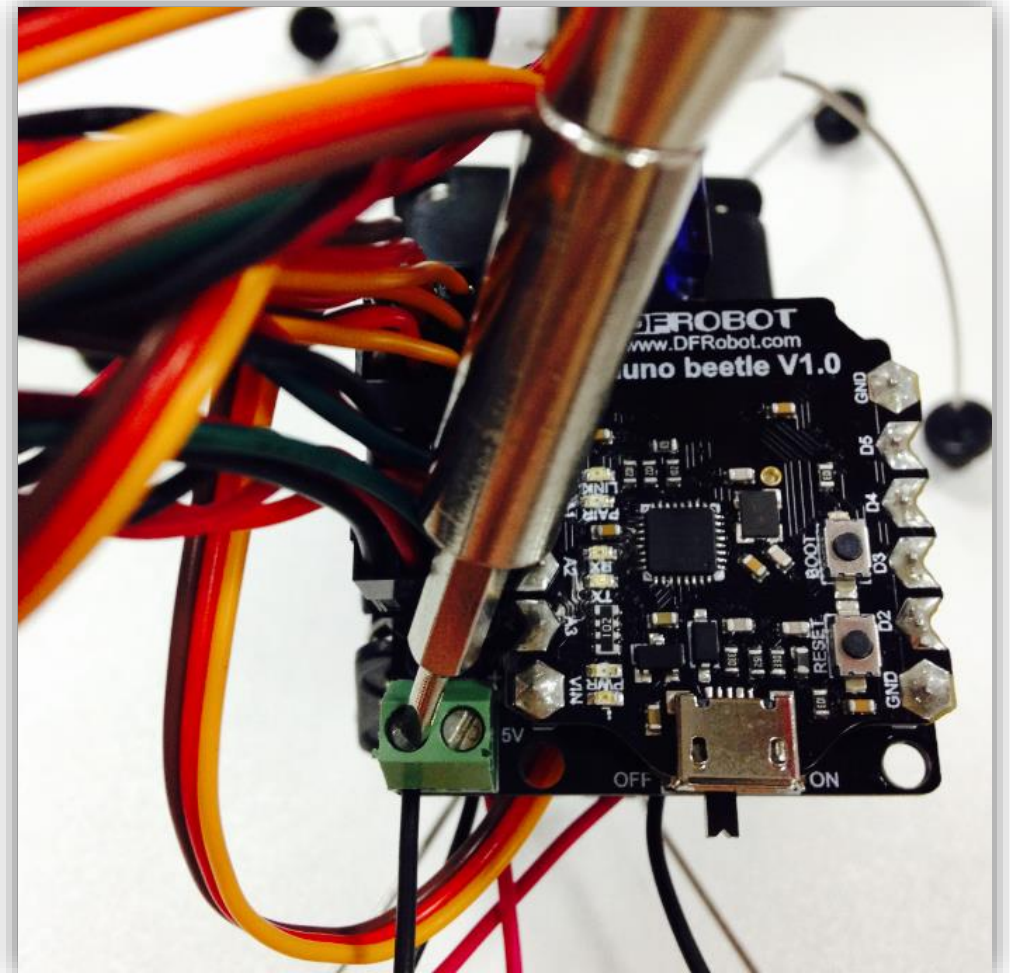# Assembly Instructions

STEP 6: Hardware Connections

How to use screw terminals:

1. Loosen the screws on the terminal with a screwdriver

2. Place wires inside holes in terminal. Be sure that the red and black wires are in the correct holes:

● Battery Holder Red Wire – Beetle terminal +
● Battery Holder Black Wire – Beetle terminal –

3. Tighten the screws of the terminal with a screwdriver

Assembly Instructions

STEP 7: Battery Installation

Place 4 x AAA batteries in to the battery holders. Be sure that they are installed the correct way around (see diagram to the right for reference)

Turn on your Insectbot using the power switch. Does it work?
If so, congratulations! You can now tidy the wiring with cable ties.
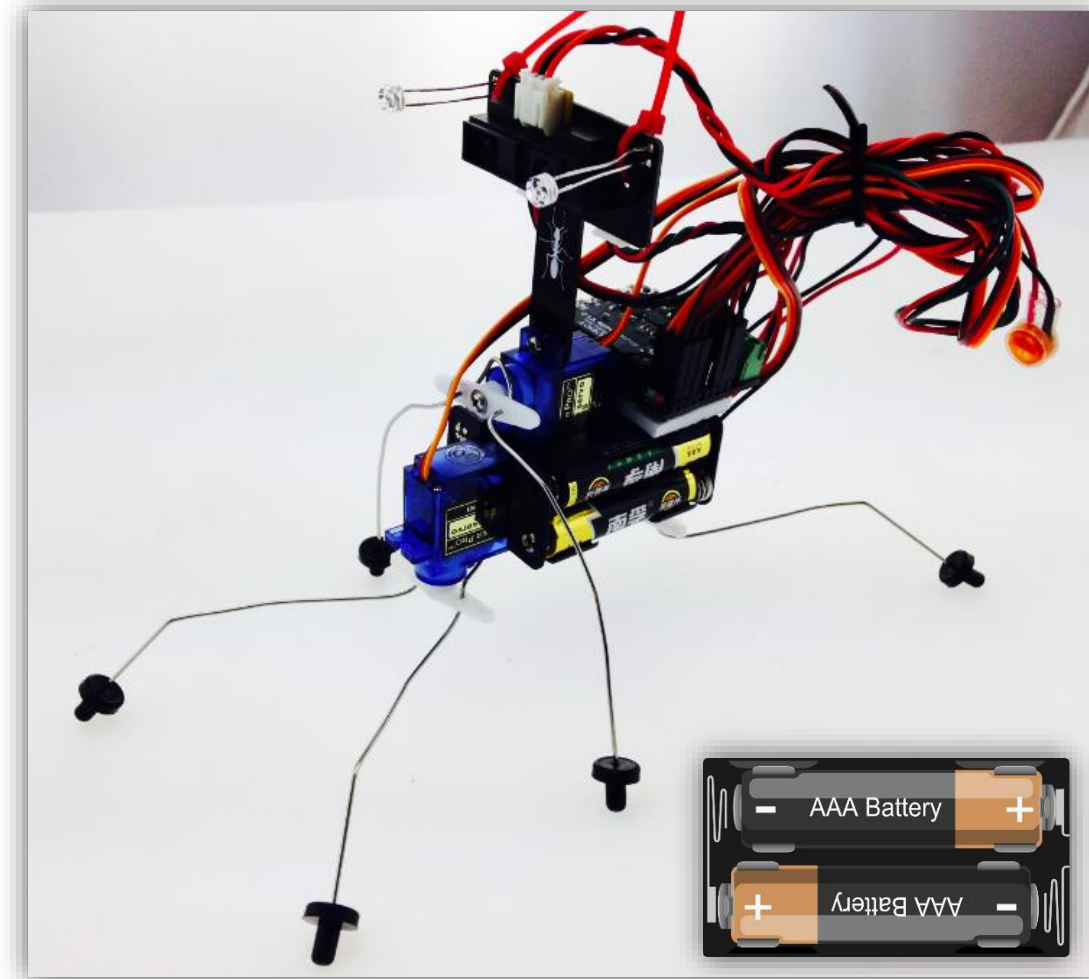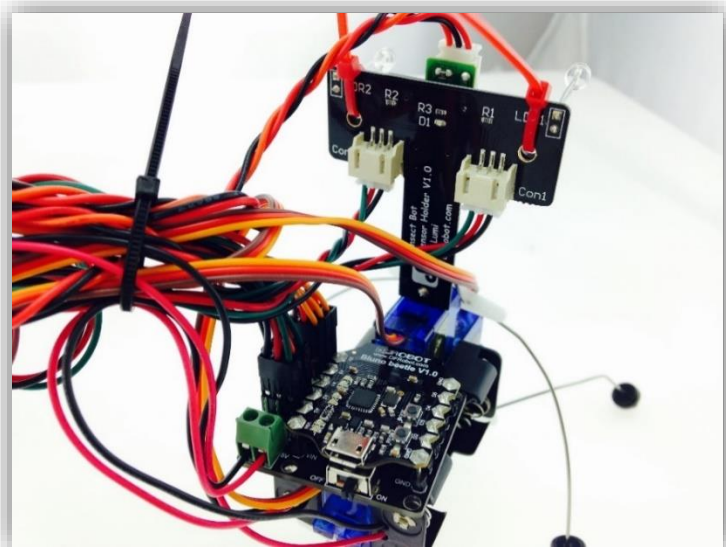
Assembly Instructions

STEP 8: Testing

Turn on your Insectbot using the power switch (as shown in the diagram). You should see a red power indication light.

Power Indication Light

Assembly Instructions

STEP 8: Testing

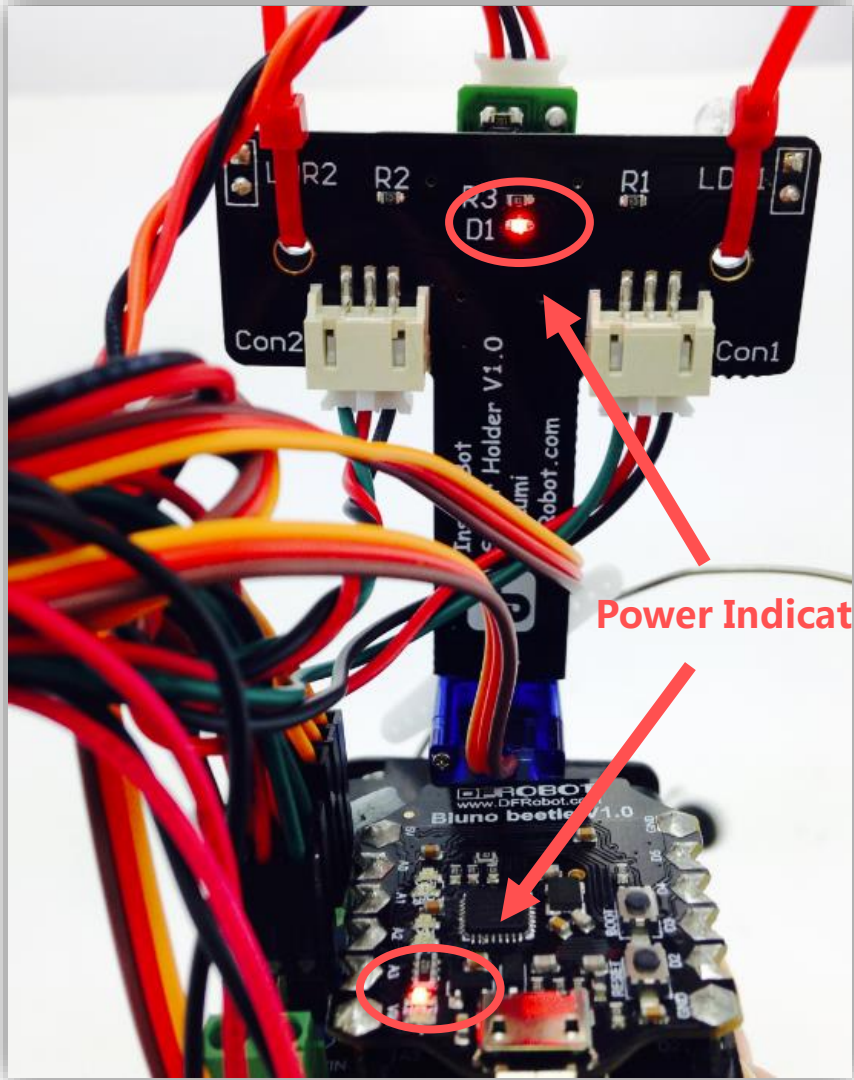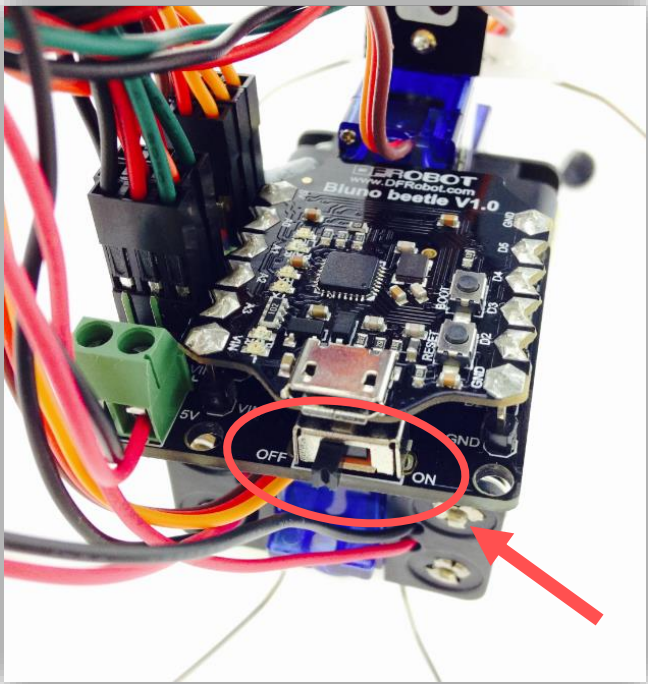Once powered on, your Insectbot can move.
If it can't walk properly, don't worry – you just need to adjust the servos.
Refer to the next page for details…
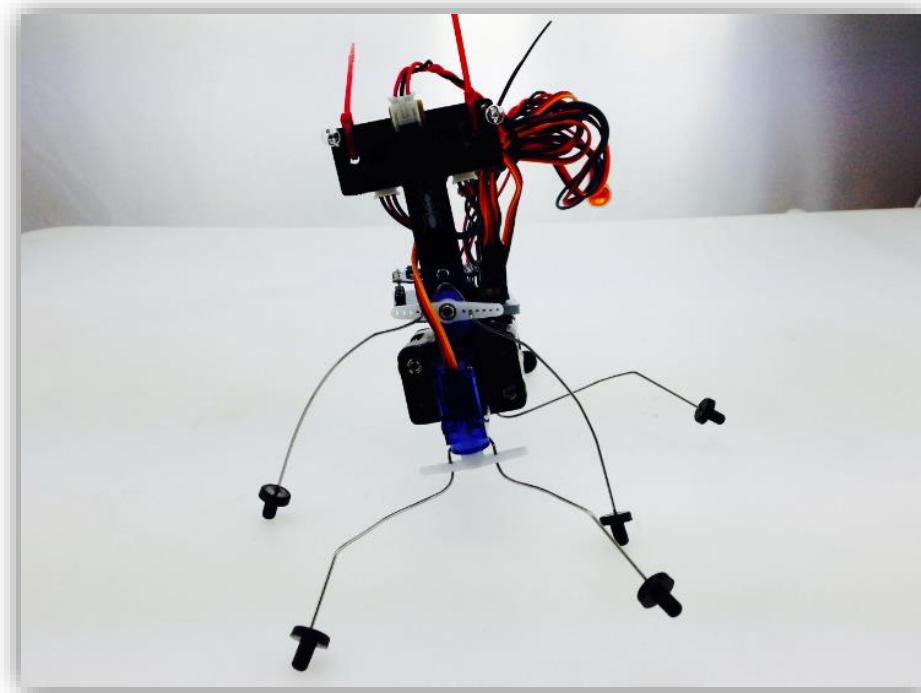
Assembly Instructions

STEP 8: Testing

STEPS FOR TESTING & ADJUSTMENT

- Power on the Insectbot for 2 seconds and then power it off
- Loosen the servo horn screw ensuring that the legs stay still (picture 1)
- Remove the servo horn **completely** (picture 2) and reinstall it at a different angle (picture 3)
- Tighten the servo horn screw again (picture 4)
- Test and adjust the other two servos in the same way

STEP 9: Heat Shrink

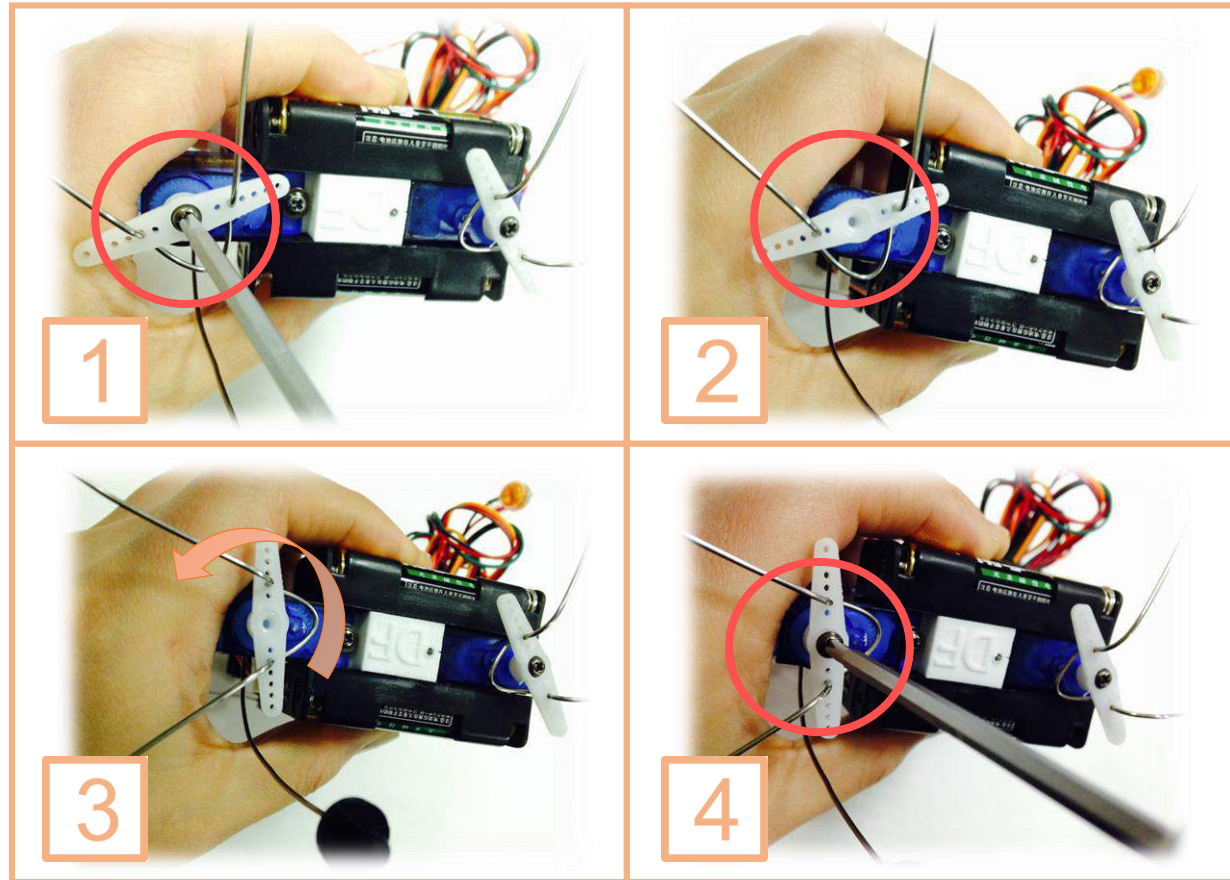In the last assembly step for our Insectbot, we need to use heat shrink.

Heat shrink is a special tube that will shrink once heated. It's electronically insulated so that it can protect wires from short circuits. It also adds mechanical resistance to parts it is applied to.

Assembly Instructions

STEP 9: Heat Shrink

⚠️ This step should be carried out by adults only

- Take the black heat shrink in your kit and cut it to be the same length as the light sensor
- Insert the light sensor into the heat shrink
- Use a regular lighter and gently flame the heat shrink so that it heats up and shrinks around the joint. Don't light it for too long or the heat shrink will burn!
- The light sensor should be tightly wrapped by the heat shrink
- Repeat for the other sensor
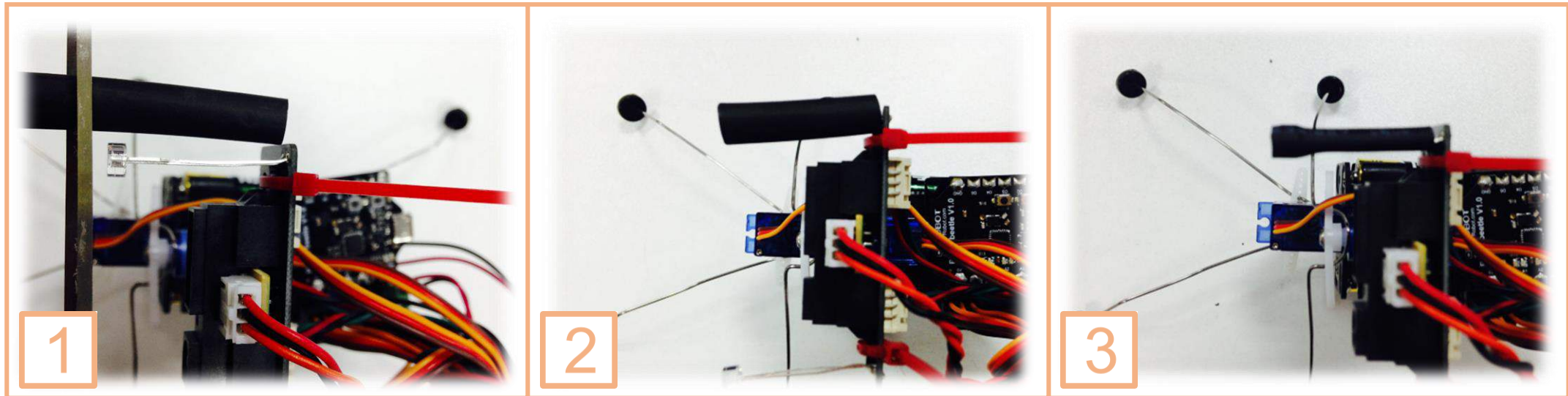
Ways to play with your Insectbot

Your Insectbot is alive! What can you do with it now?

Primary Level:

The Insectbot can move around the room and avoid objects. When it senses an obstacle, the Insectbot will step back and then slowly turn around.

Advanced Level:

There is a micro USB connector provided in the kit that you can use to upload code for your Insectbot.
By using this, you can start programming your own code to change the Insectbot's behavior!
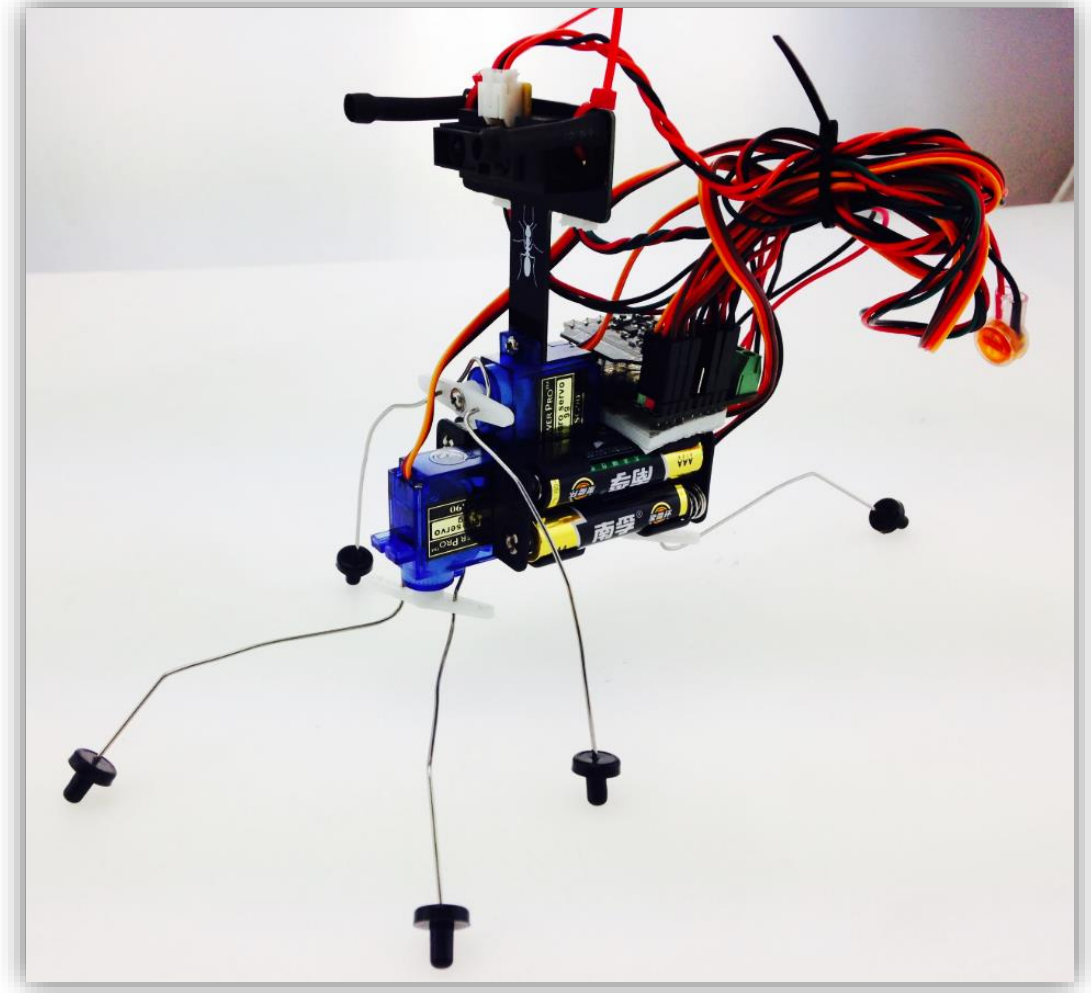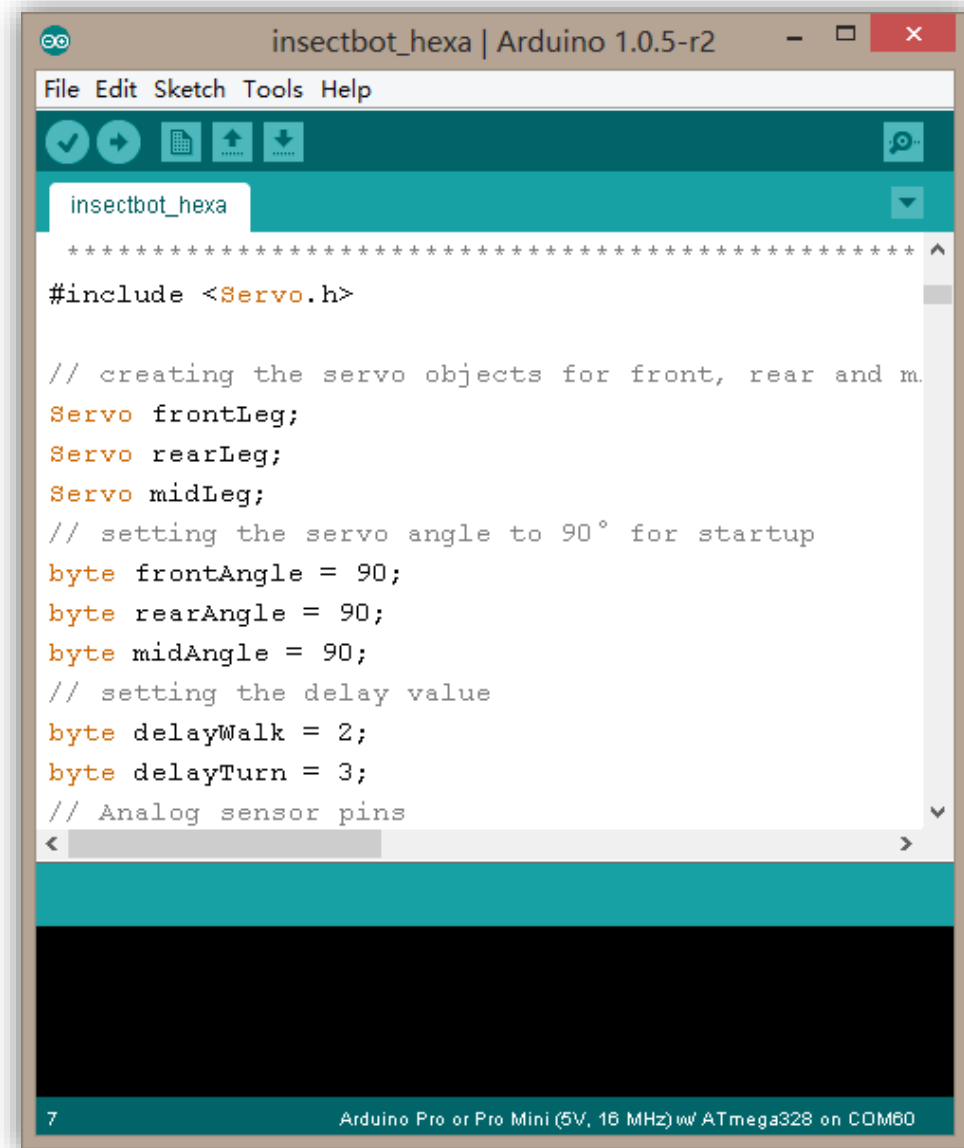
Arduino

The Insectbot's brain is based on an Arduino platform.

Arduino is an open source electronics prototyping platform based on flexible, easy-to-use hardware and software.

Arduino can sense its environment by receiving inputs from sensors. It can also interact with its environment by controlling lights, motors and other actuators.
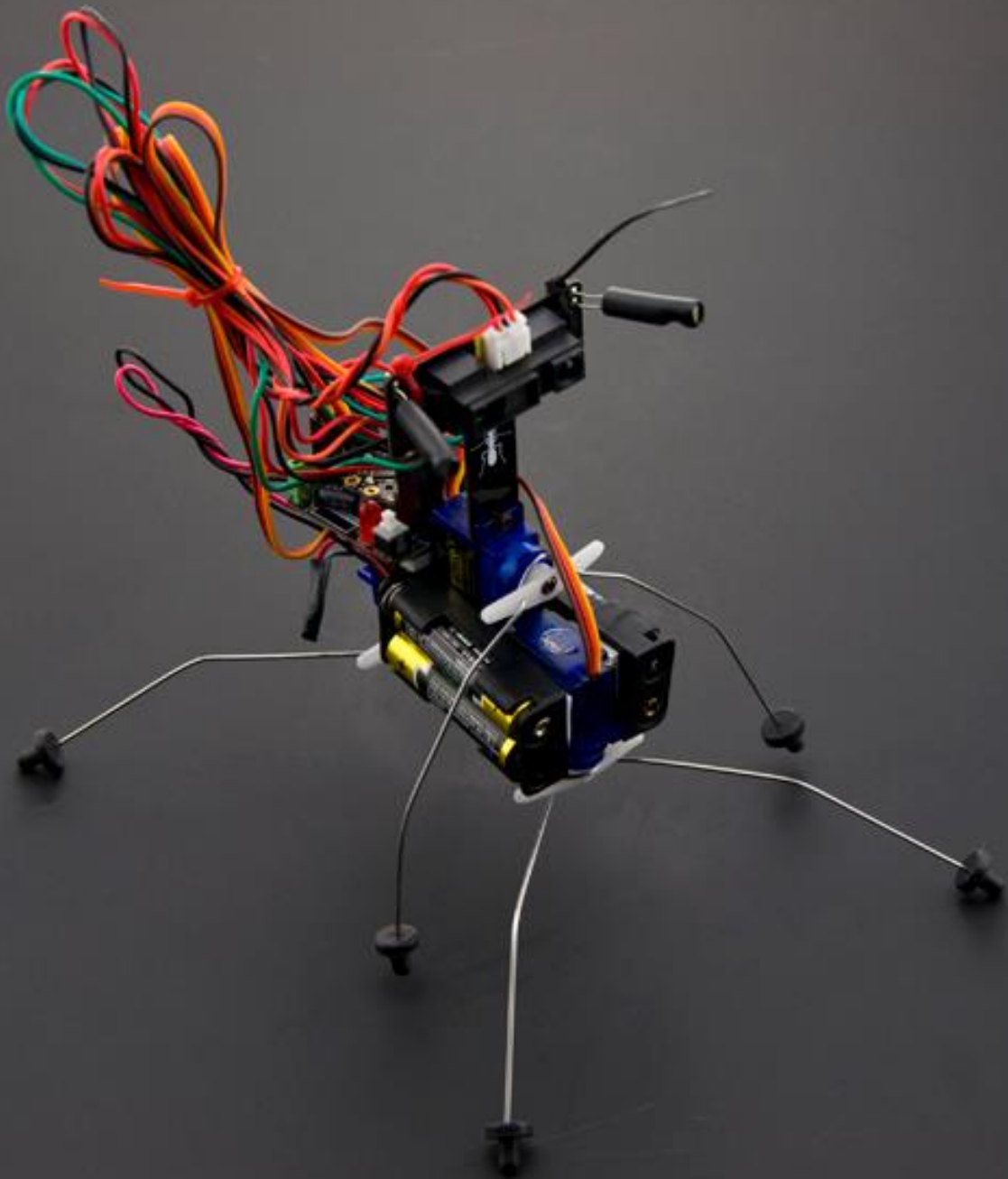
If you need the example code, you can click on the icon above to download it.

Screenshot of Arduino IDE:

```
insectbot_hexa | Arduino 1.0.5-r2

File  Edit  Sketch  Tools  Help

insectbot_hexa

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
#include <Servo.h>

// creating the servo objects for front, rear and m
Servo frontLeg;
Servo rearLeg;
Servo midLeg;
// setting the servo angle to 90° for startup
byte frontAngle = 90;
byte rearAngle = 90;
byte midAngle = 90;
// setting the delay value
byte delayWalk = 2;
byte delayTurn = 3;
// Analog sensor pins
```

7   Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328 on COM60

DFROBOT

DRIVE THE FUTURE