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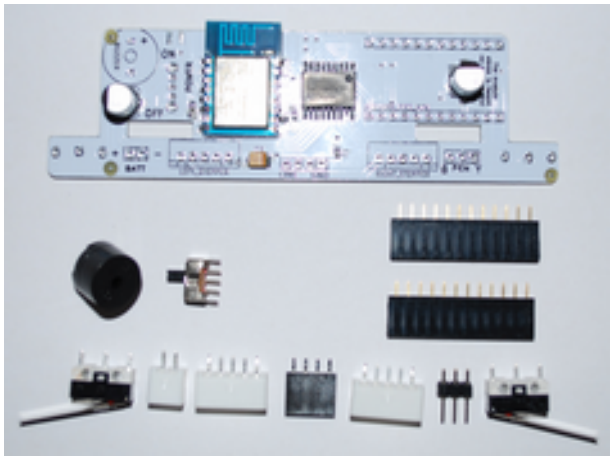
Mirobot v2
PCB soldering

OpenSTEM guide revision 2015-12-06

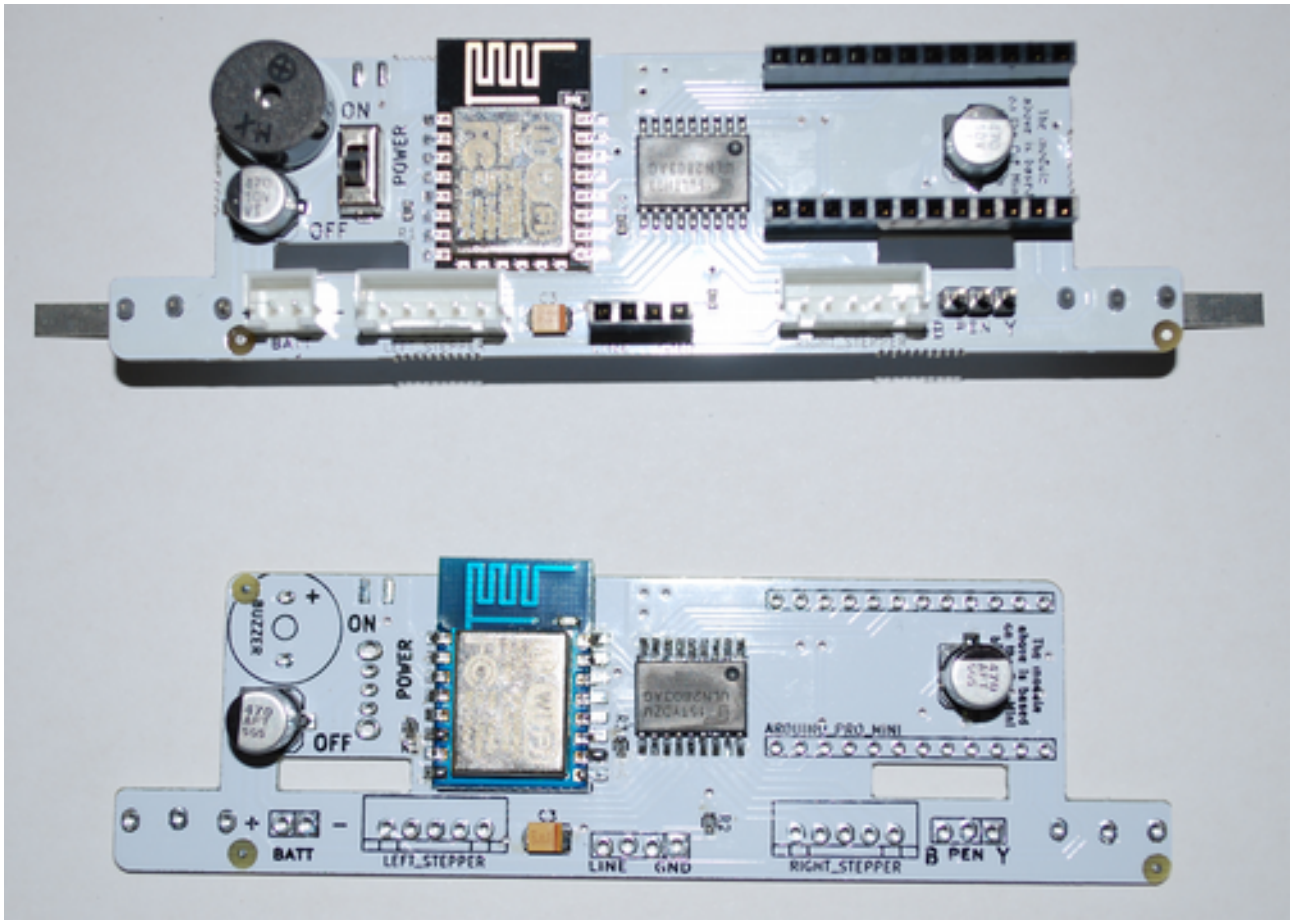


(photo by Ben Pirt)

1.1 Overview

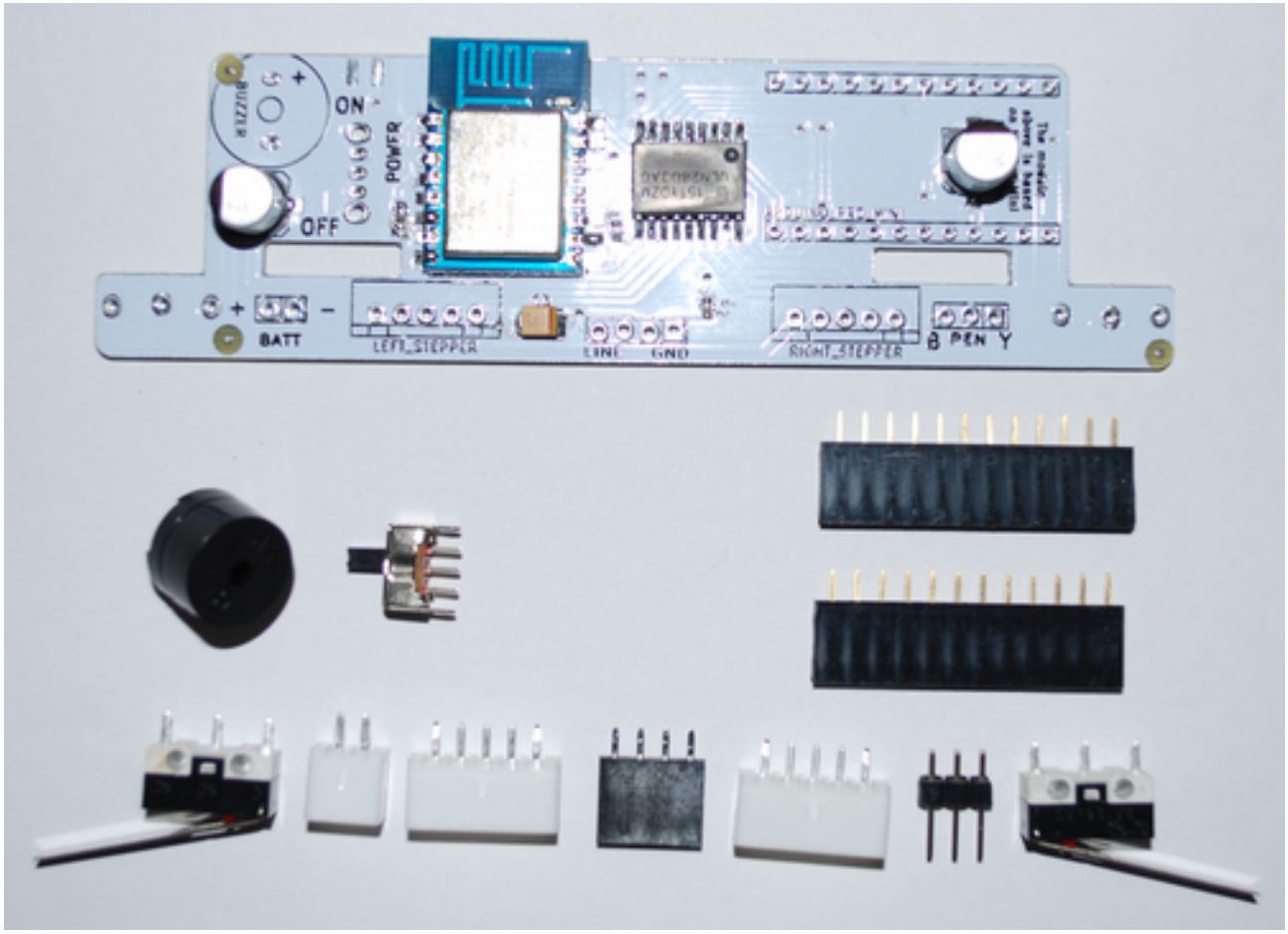
Soldering the Mirobot v2 is exclusively available via OpenSTEM. The default v2 are pre-soldered.

In the following images, you can see a pre-soldered PCB (Printed Circuit Board) above, and an unsoldered PCB below. You will notice a few items are already on there, these are surface mounted components that are much more finicky to solder so they come pre-soldered.



Pre-soldered are the wifi module (the little circuit board), the stepper motor driver (the black chip), two large capacitors, one small yellow capacitor, and three tiny flea-size resistors that assist the wifi circuitry. All the other components you get to solder, and with the extension items (such as the bump sensors and the buzzer) now standard, there's plenty of work to be done!

Note that the two bump sensors (micro switches) are positioned on the reverse side of the PCB.



Here is an image of your PCB with the components to be soldered laid out roughly in their relative positions. The first thing to do is to make sure that you have all these parts! You could lay them out in the same way as in the photo, and perhaps on a little tray just to make sure they can't bounce off your work table.

Electronic components are classified in a number of categories:

1. **Mechanical**: headers and sockets, connectors;
2. **Electro-mechanical**: switches, piezo buzzers;
3. **Passive**: resistors, capacitors, transformers, speakers, microphones;
4. **Active**: transistors, integrated circuits, some diodes.

For more information, see https://en.wikipedia.org/wiki/Electronic_component

When soldering a PCB, we generally want to solder components in the order as laid out above (the exact “rules” are a bit more complex and somewhat fuzzy, but this is a good basis).

The reason for soldering in this order is that the more sensitive components get soldered later, and thus have less chance of getting overheated (“cooked”) while working on other things near them.

1.2 Complexity Level

We have chosen to use fairly informal language in this guide, but we don't dumb things down! We use all the proper technical terms (and explain them). If you see a term or acronym you don't know, scan back in the document to find where it is first used and explained.

Soldering can be done by anyone who has a reasonable level of fine motor control (dexterity).

People who do soldering more often will definitely get better at it. This kit does not contain particularly finicky or sensitive components to solder, so that makes it ideal as a first or early project.

If you've never done soldering before at all, it is good to first do some practice on a piece of experimental PCB and a strip of header (included in the OpenSTEM soldering kit). If you've done soldering in the classroom and are now working at home, just try to remember the things you learnt and had to think about. You'll get back in to it quickly!

1.3 What if Something Goes Wrong?

First thing to do: PANIC! *1-2-3 Aaargh!* Or perhaps not. Because panicking doesn't really help.

So, chill out. Sometimes things go wrong, it happens. No sense beating yourself up over it either or wondering who or what is to blame, the important thing is to see about fixing things up.

You may need to take a break first. Breaks are good: have a drink and perhaps a bite to eat, and move around or even go do something else entirely fit a bit! *(do unplug your soldering iron if you will be away from your work table for more than a few minutes.)*

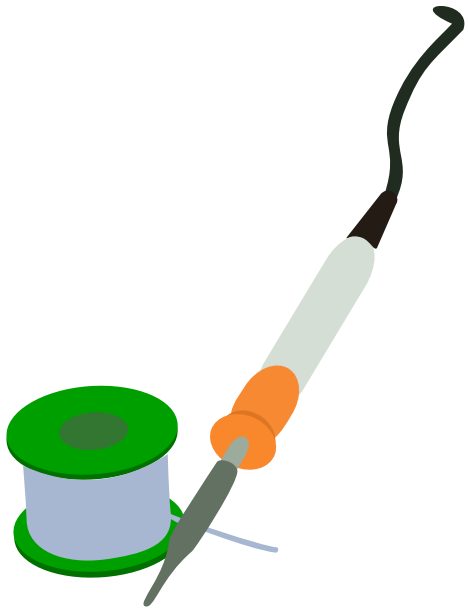
If you're tired or frustrated, don't continue but instead come back to it later. There's nothing wrong with that.

This guide contains a lot of hints, also for fixing up mistakes. Look back through the guide if something is unclear, or you remember seeing something but don't quite remember the details of how it worked.

The key is to focus. Practice *mindfulness*, stay on the task at hand. Doing this stuff while thinking about something else is not likely to work well, and it's very likely to see mistakes happen.

1.4 Soldering Hints

We recommend you use a small blog of blutac to hold components in place (and straight!). This is a very easy and cheap trick that saves a lot of hassle, as obviously the components will be underneath the PCB while you solder the other side. Of course it remains important to not push on any of the pins while soldering, as we want the component to stay flush with the circuit board. Straight positioning is not always critical (although it is with the two headers for the Arduino micro-controller!), but it'll make things look neat.



While not strictly required, a set of “helping hands” can be most useful, these allow you two clip in the PCB and hold it steady while you do the soldering. The ones in OpenSTEM's own Soldering Kit come with protected clips, if you use your own please make sure any hard or metal parts of the clips don't damage the PCB. It's best to cover them with a piece of heat-shrink.

When soldering, remember to hold the tip of the soldering iron right next to the pin you want to solder, allowing the pin and the pad to heat up but not too long (a few seconds is plenty). Then apply a little bit of solder between the pad and the pin and let it flow, then remove the iron. Clean the ironing tip by poking it into the metal cleaning ball just once. A good solder joint will be shiny and not contain too much solder. *Mind that sometimes a little fix-up is required, but often too much*

messing about just makes things worse.

If you make a mistake, or for instance two pins get bridged by a blob of solder (joined together), this is easiest to fix with a piece of de-soldering wick. The OpenSTEM Soldering Kit includes this as well. Hold the end of the wick just over the area to be de-soldered, and then push on the tip of the iron. You'll see the solder getting soaked up pretty quickly. Then you're free to reposition the component (if needed) and re-solder.

1.5 Mirobot Soldering Support

As soldering is not part of the general Mirobot v2 product, please don't send questions on this topic to the general Mirobot mailing list. Instead, please email: *mirobot (at) openstem.com.au* and we'll try to help!

If you have a question about your soldering, do include an photo of the PCB area (from a suitable angle and with good lighting).

If you think something might not be working, please contact us first to discuss. If needed, you can send the PCB back to us for fixing or replacement. You cover the postage to us, we'll cover the return to you. Note that if you for instance burn a component, we will have to charge you for the work related to the replacement. Take care!

1.6 Credits

The Mirobot was designed by Ben Pirt of Pirt Design & Technology in the UK (http://mirobot.io).

Guide text and photos by Arjen Lentz.

2.0 The Soldering Job

So let's get on with it!

We will generally show a component's positioning from front (PCB component side – except for the bump sensors) and back (PCB soldering side for all components but the bump sensors).

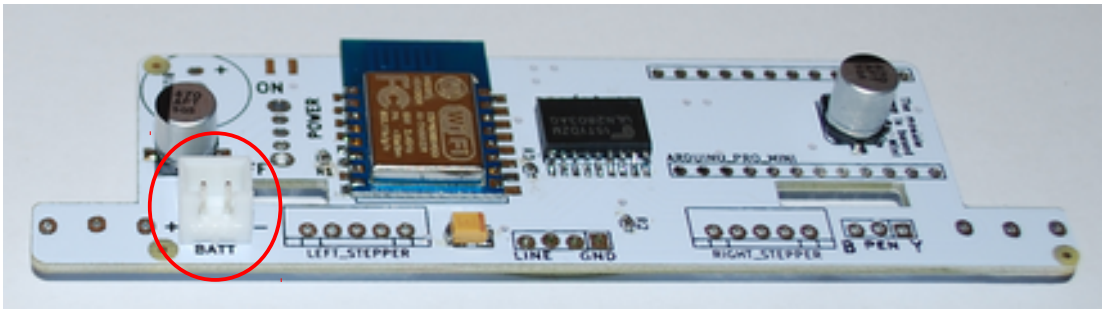
Sometimes we'll show a close-up for extra detail on something – for instance to clearly indicate which way round something goes, or to provide a hint on how to work the blutac.

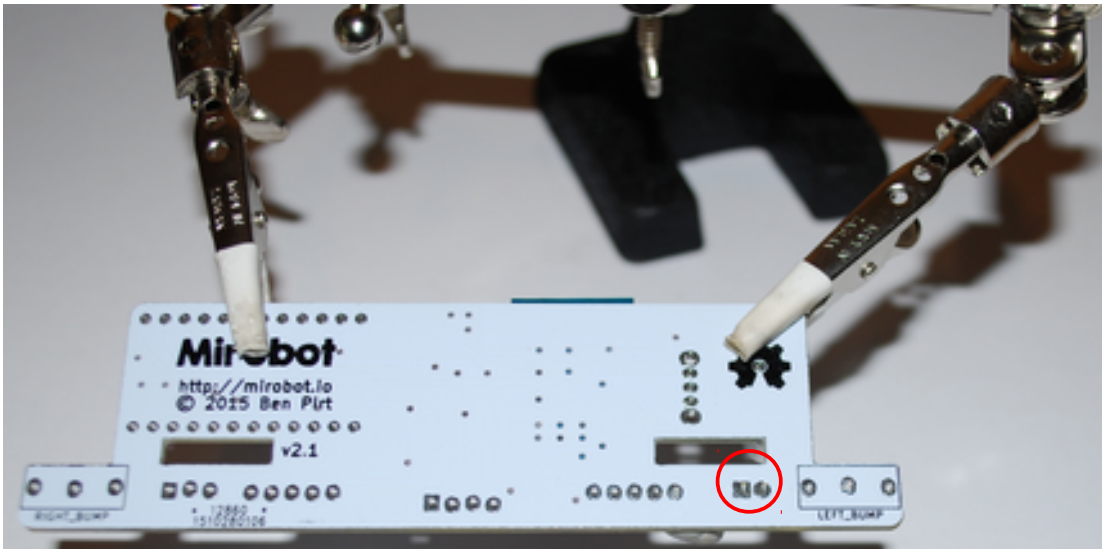
It is very important to always look really carefully at the shape of a component and any special indicators it might have, as well as checking out the photos and reading the text in this manual (and always check the next page to make sure you've read all bits relevant to what you're doing).

2.1 Battery Header

As mentioned, we'll first do all the (electro-)mechanical components, and first up is the battery header (with 2 pins). For this one, the positioning is important. As you can see, one side is somewhat open while the other is closed. This makes sure that the battery plug cannot go in the wrong way round – that is, provided you solder on this header the right way round!

When power is connected with its polarity (+/-) swapped, components can (and tend to) die. It's merely lucky if it doesn't destroy things, so it's just best to be focused and avoid such mishaps.





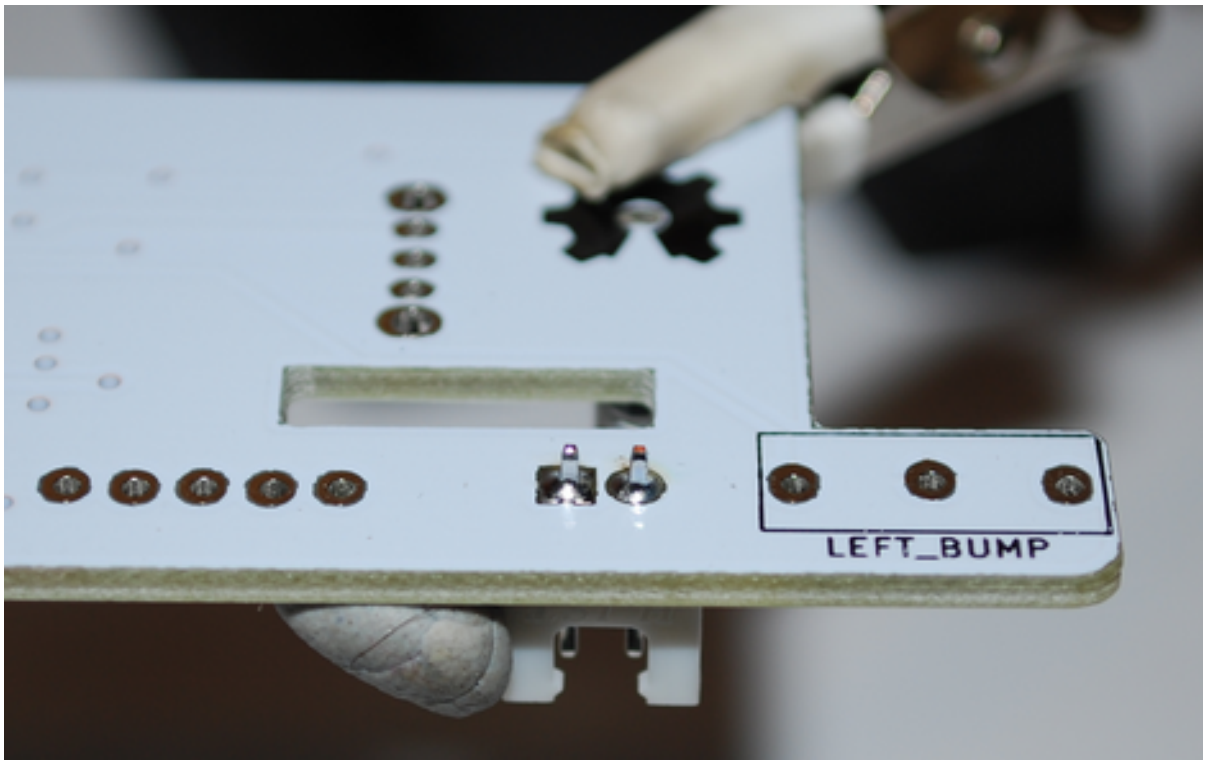
For each component we do we'll also show the back of the PCB. On this first photo, we're showing how we have clipped the PCB in to the helping hands as well. The helping hands have hinges everywhere, so you're able to flip the PCB between front and back while keeping it clipped in. Do also ensure that you put the component on the correct side of the PCB!

Here you see how we use the blutac to hold the unsoldered component in place on the circuit board. There are expensive bits of equipment used by professionals to do the same thing, but this works

perfectly fine!

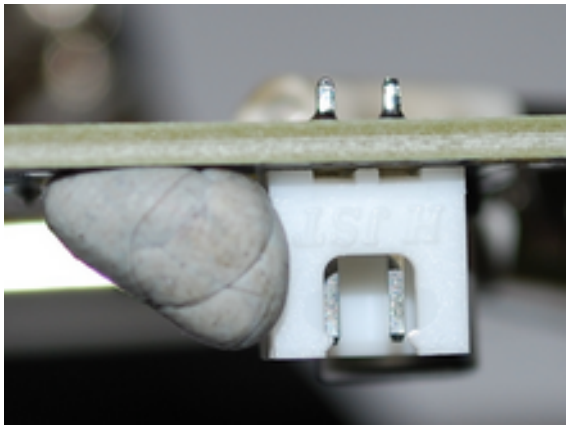
The component has to be flush with the PCB – that is, there must be no space between the PCB and the component. *Components that aren't in all the way can easily break off, as it'd be their tiny pins or wires instead of their main body that's holding them.*

Some components can also jiggle sideways or turn a bit. This often (but not always!) harmless, but we do like to set everything as straight as possible as it makes for a much neater look in the end. *We reckon that when you're going through the effort of doing something, you might as well do it properly.*



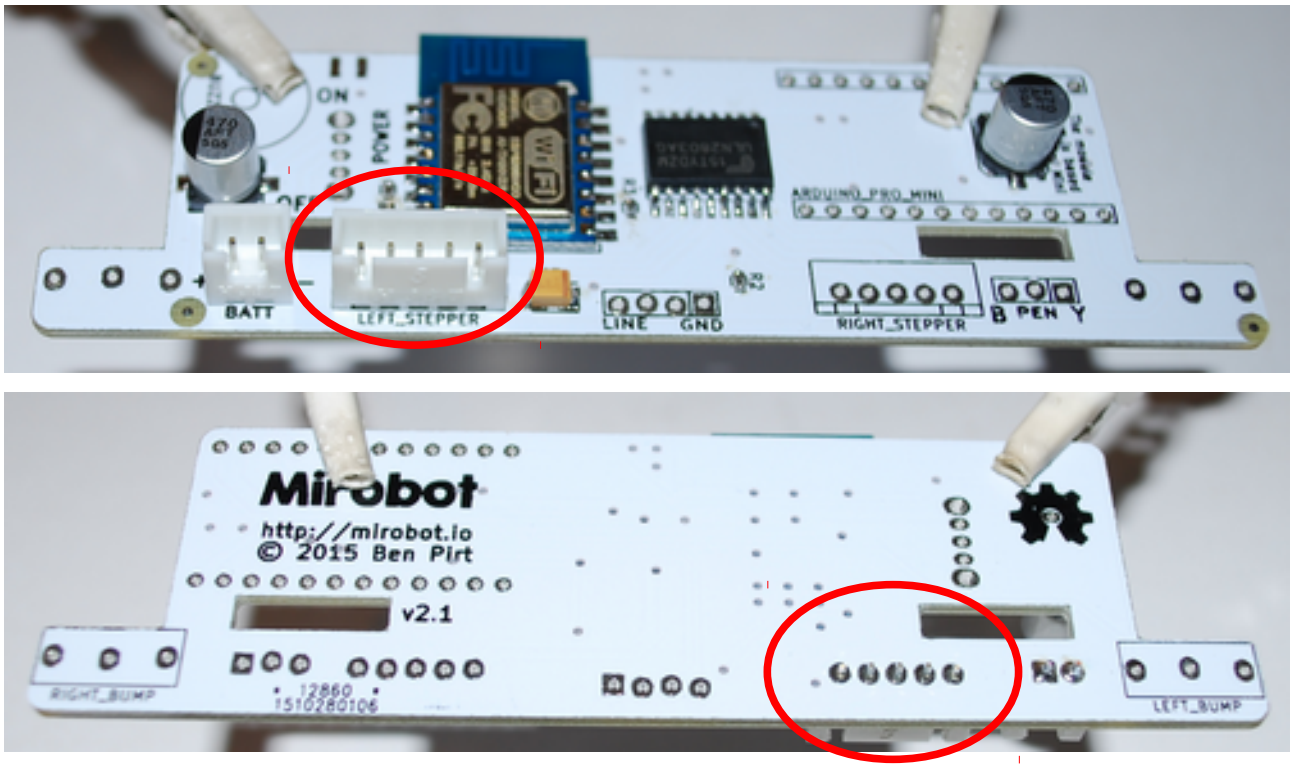
Now on with the soldering of these first two pins! Check that the positioning is still good after you've done the first pin, as it's easy to fix up one pin. Once multiple pins are soldered, it's much harder.

Above is a photo showing how we want things to look after that job. Remember you want the pad to end up shiny, and not use too much solder.



From this side-on photo, you can also see how we've used the blutac to keep the component flush and straight on the PCB.

2.2 Left Stepper Header

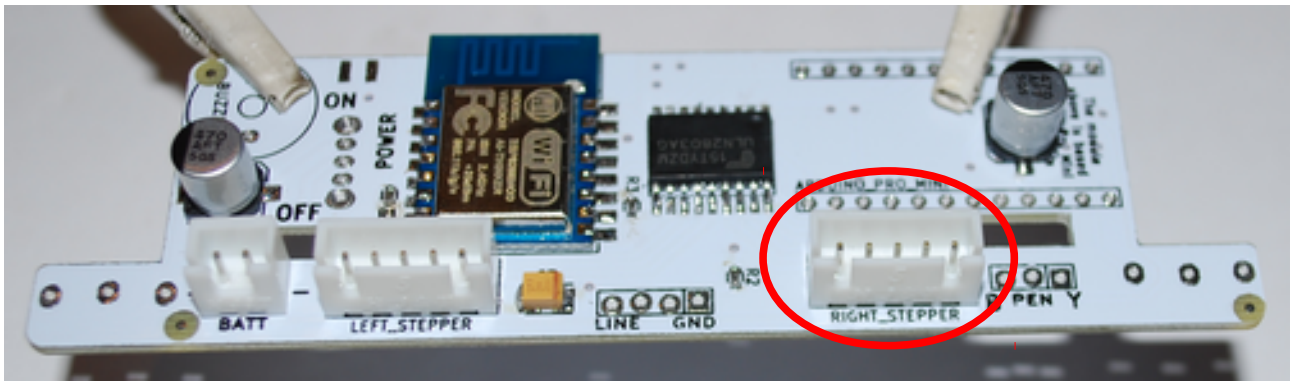


There are two 5-pin stepper headers, to which the two stepper motors that control the wheels of the robot get connected. These two headers the same, but again positioning is important. For stepper motors, if you swap wiring then –depending on the type of wiring– the stepper might just not turn, or get damaged, or turn the wrong way. Again, best to avoid.

For this header, the slits at the front are an indication and you see that the component outline of the PCB shows the same slits. This is typically done by PCB designers to help us (and themselves!) prevent mistakes.

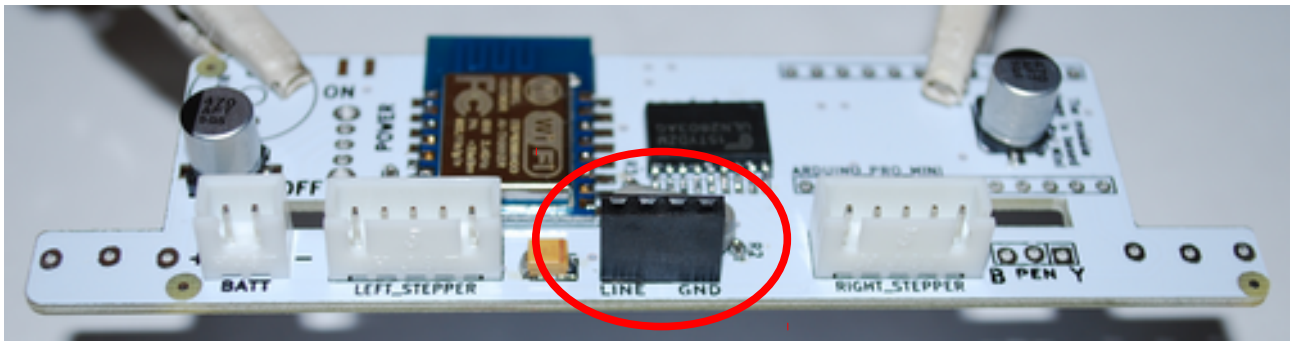
Here even more so than for the battery header, it's important to check the positioning after you've soldered the first pin, before soldering the others. It's generally best to first solder a pin at one end, or in the case of this header perhaps the middle one.

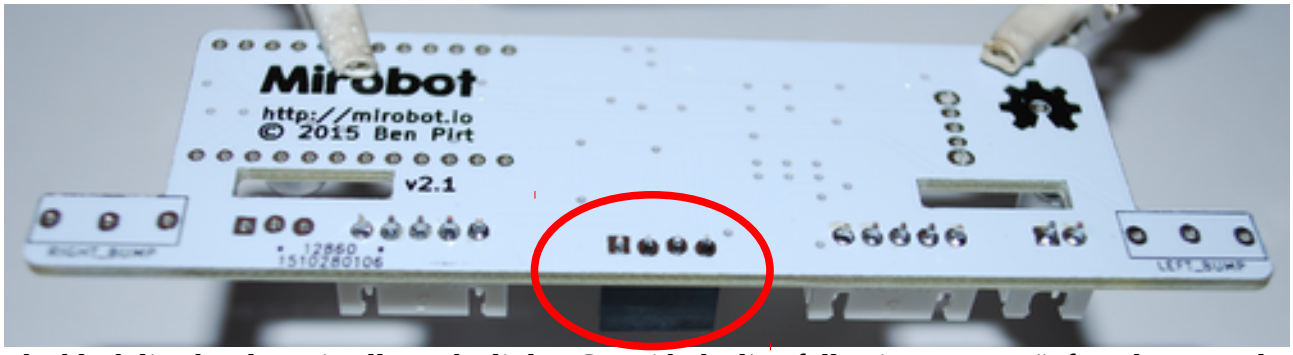
2.3 Right Stepper Header



The right stepper header is pretty much the same as the left. In electronics and soldering work, often parts are repeated elsewhere in the circuit – the important thing is to not get slack. In this case, check the positioning: make sure the component is the correct way round and on the correct side of the PCB!

2.4 Line Header

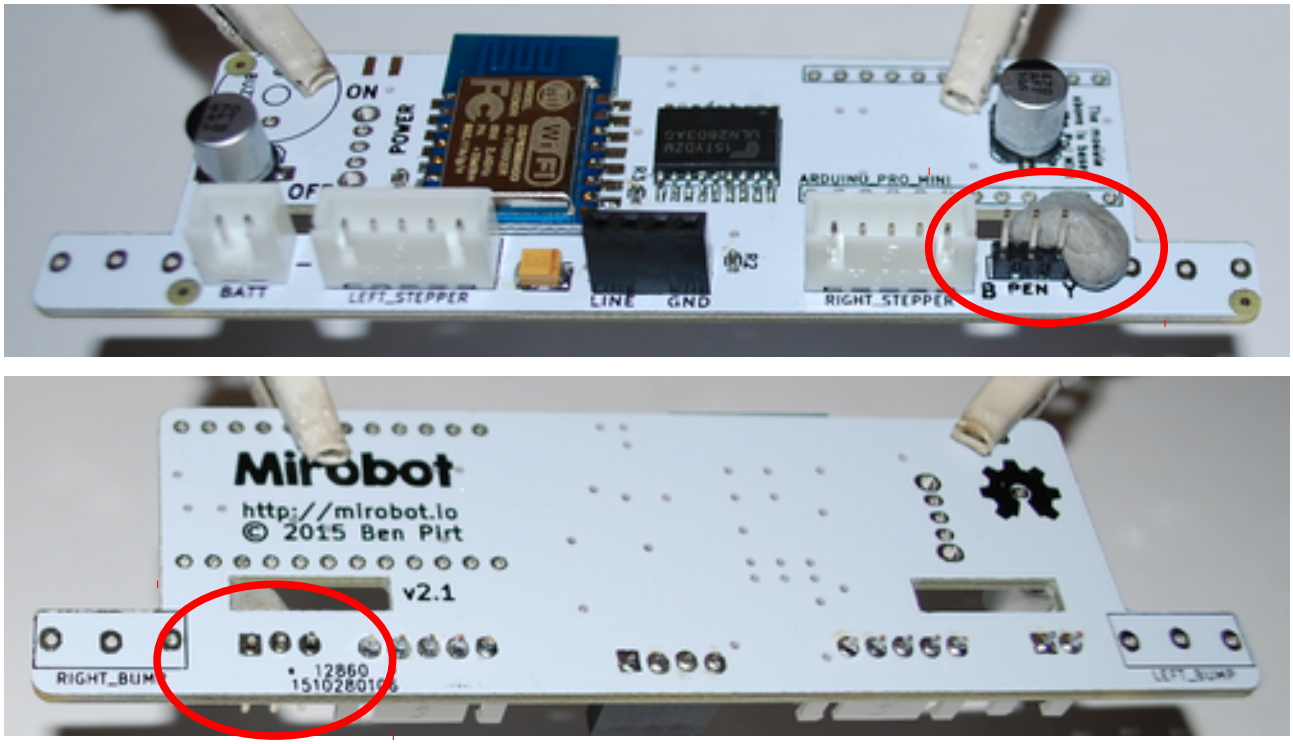




The black line header strip allows the little PCB with the line following sensors (infrared LED and

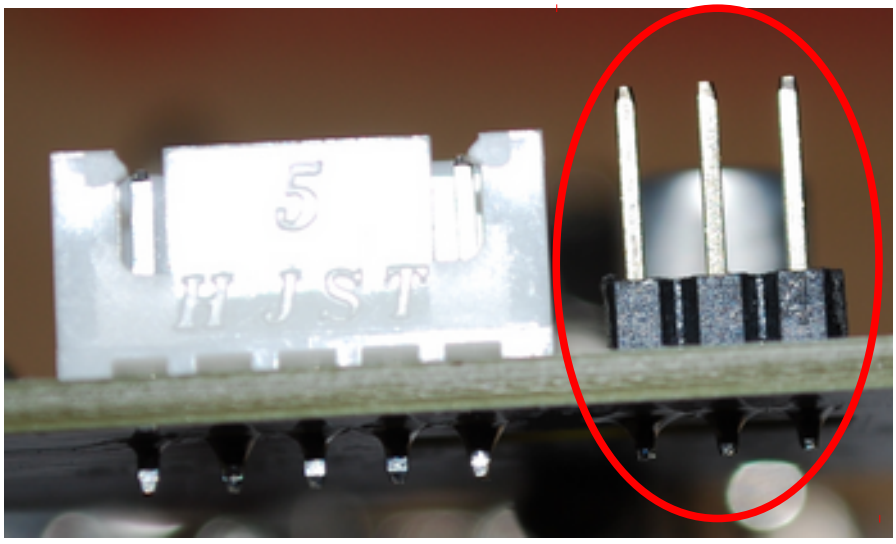
photo transistors) to be plugged in. Make sure it's straight and flush on the PCB, always use the blutac.

2.5 Pen Header



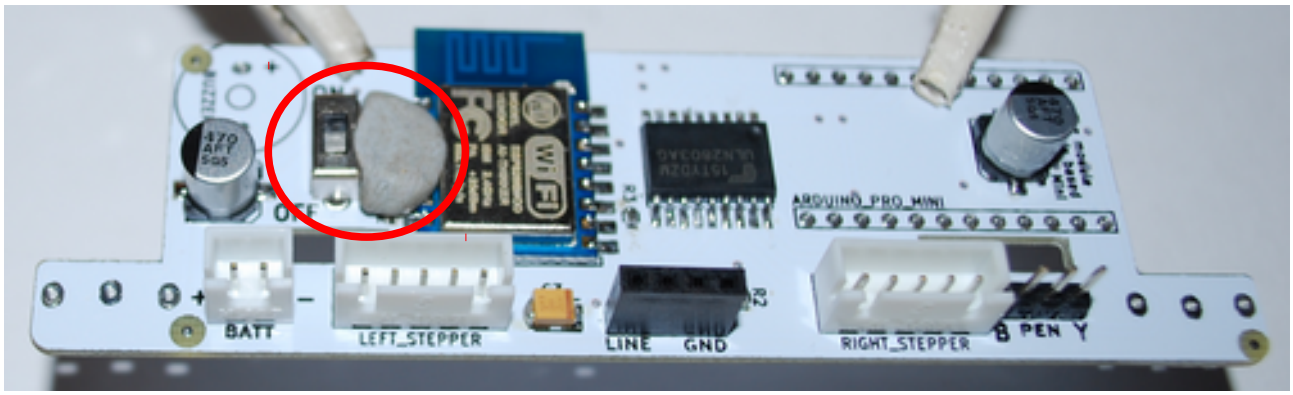
The pen header strip is where the servo motor connector will get plugged in to, the servo takes care of moving the pen up and down. Later on it will be important to get the wiring the correct way round (note the B and Y on the PCB, indicating where the brown and the yellow wire of the plug should go).

What is critical with this header is to make absolutely sure you put the *short* side of the pins through the PCB, so the long side sticks up next to the other headers. This is shown in the photo below.



This was the last of the headers on this row, later on we'll just have to do the two header strips for the Arduino microcontroller.

2.6 On/Off Switch

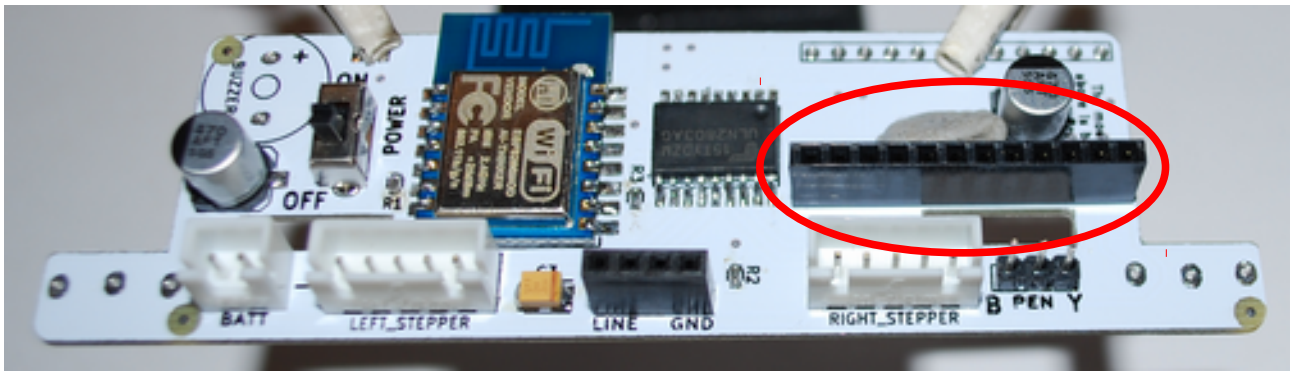


This switch model can go either way round, as it has three contact pins (the two outer pins are part of the metal chassis and are merely helpful in keeping the switch solidly in its place), and depending on the position of the switch the middle pin will connect to either of the two others inside the switch. This also means that on the PCB itself, one of the pins won't actually go anywhere. But we want it all soldered anyway.

Here you'll find it easiest to solder one of the middle pins first. Since the outer pins are part of the metal casing of the switch, your soldering iron tip has to heat up that entire metal structure and obviously that'll take a bit longer. If any adjustments need to be made to the positioning, having to re-heat such a pin becomes a nuisance, so therefore we pick one of the other pins to solder first.

After you're done soldering all five pins of the switch and remove the blutac, just make sure you put the switch in the Off position (as indicated on the PCB). That's just one of those good habits that can sometimes prevent later trouble.

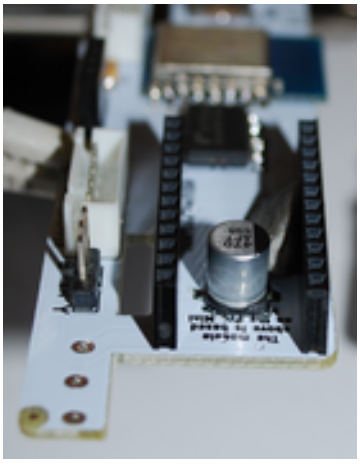
2.7 Arduino Headers



We're doing the two Arduino headers last because their positioning is the most critical. They can't go the wrong way round, but it is vital you solder them in absolutely flush and straight as otherwise the Arduino controller board won't fit on!

The reason the design uses two header strips rather than a single socket (such as Mirobot v1 did) is that the two strips will poke through a slit in the Mirobot frame, and then when the Arduino module is put on, it keeps the entire PCB in place. Nifty design.

When you put on the first strip and apply the blutac to the side to keep it in place, make sure the header is absolutely down flush with the PCB, and as straight as you can make it. Check this from every angle you can to make sure. Solder one pin near the middle first, again check the positioning. Leave the other pins unsoldered for the moment, we'll get back to those.



Now put on the second Arduino header strip, and move the blutac blob to hold this one in place. Line it up as best you can, then solder one pin near the middle, just like we did with the other strip.

Remove the blutac.

Now find the Arduino Pro Mini micro-controller board in the Mirobot box (it'll be near the top underneath the battery holder). Carefully push the Arduino on to the two headers – there's no need to push it in completely, we just want to make sure that everything is lined up so that it'll fit later! Because we soldered only the middle pin there'll be some room for the headers to shift slightly to make the Arduino fit. Don't apply force!

Although it doesn't really matter right now as we're not going to be turning anything on yet, the Arduino side with the 6-pin programming header goes towards the edge of the PCB – as shown on the photo above.

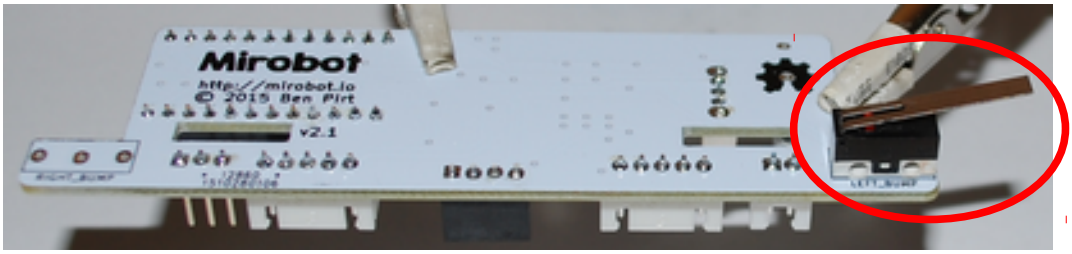
With a bit of luck, the Arduino can be made to slide in. Now, leaving the Arduino in, flip over the PCB in the helping hands, and first briefly re-heat the two pins you soldered before. This will release any tension, while the Arduino on the other side will keep things in place. When you're satisfied that everything is straight and good, you can solder all the other pins on both header strips. Because the Arduino is not completely in the header socket it won't be directly heated, but do be careful not to overheat things anyway. Arduino boards are fairly tolerant, but they can get cooked.

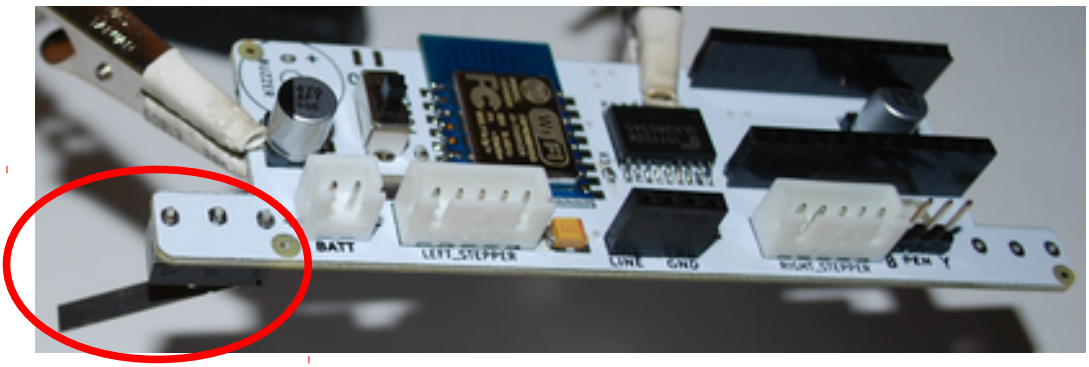
When you're done with this section, you can take out the Arduino and put it back in the box to keep it safe. Should the Arduino be in too far and thus somewhat stuck in the socket, you can lever it out really carefully by putting a finger in between the Arduino and the PCB and wedging it gently upwards. The way components (and circuit boards like the little Arduino Pro Mini) click into sockets, they tend to come loose with a jolt – if you're being forceful, the legs (pins) on the other side will get bent or even break. You can bend things back, but the metal will wear out (metal fatigue!) and break more easily later. Being gentle and careful is definitely the best approach.

2.8 Left Bump Sensor

The two bump sensors are placed on the back of the PCB, so where you've done all the soldering thus far – and the soldering for the sensors is on the side where the other components are.

First we'll do the left bump sensor:

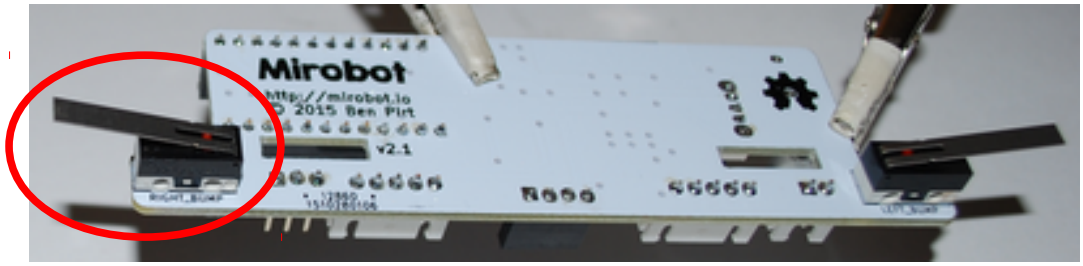


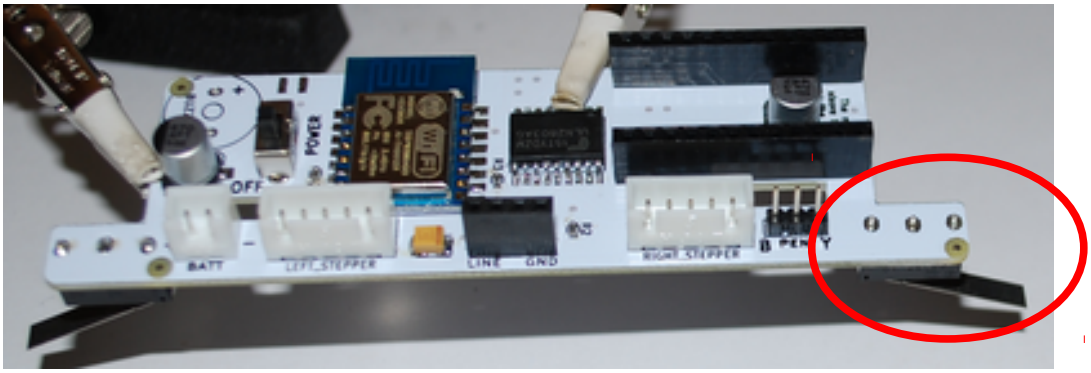


Most likely you'll not need the blutac, the switches tend to “click” in to the PCB and stay put. Make sure the metal strip faces outwards.

Do take care with the metal lip of these micro switches, if they get caught or forced they can easily break off and that'd be the end of that switch.

2.9 Right Bump Sensor



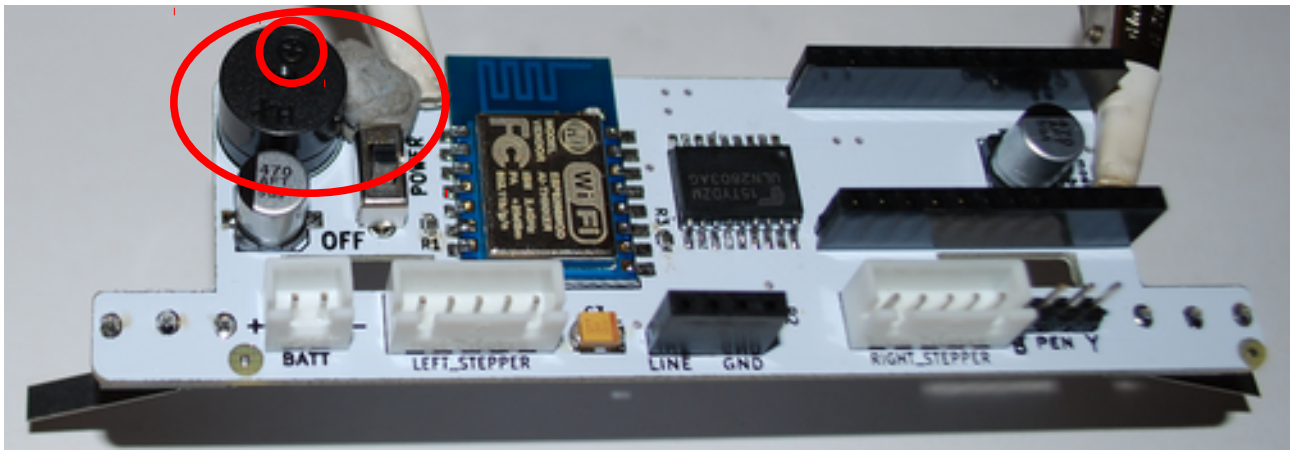


The right bump sensor is soldered the same way as the left one, described above.

2.10 Buzzer

Our final component, the buzzer, has a + and – side (polarity), see the indicators when we look on the pin side:

When placing the buzzer on to the PCB (component side again now), place the + side near the edge of the PCB as shown. The top of the buzzer also has a + visible in the plastic to show the polarity.



As per usual, use the blutac to keep the buzzer in place while soldering.

2.11 Final Check

Alrighty – that's all the components done. Your PCB should now look like this:

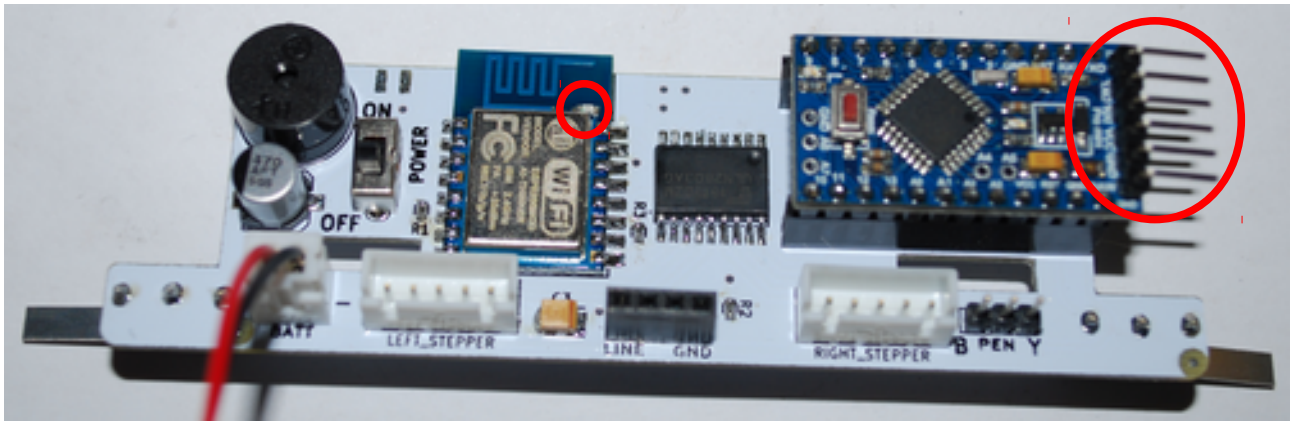
This is the time to make sure the all the soldering looks right. Each soldered pin should make good contact with the PCB through a bit of solder, and there should be no two pins “bridged” with solder blobs.

Do any fixups that are required.

Now we're ready to test!

2.12 Testing

We can now test the board. Take the PCB out of the helping hands, just to prevent any metal bits making contact and creating shorts. Place the PCB on a piece of paper, cardboard of plastic card on the table.



Ensure again that the power switch is set to the Off position.

Place the Arduino board in its header socket, this time gently pushing it down all the way. Note the orientation of the Arduino board, with the the 6 pin programming header positioned over the edge of the PCB (see the large red circle on the above photo).

Connect the battery holder with its 4xAA batteries (1.5V ones please, not 1.2V rechargeables – sorry!)

When you set the power switch to the on position, you should see a brief blue blink on the wifi module (the LED position is indicated with the small red circle on the photo above).

On the Arduino, LEDs should also go on and possibly blink.

If you don't get LEDs to come on, immediately turn off the board and remove the battery connector, then again carefully review all the soldering. If you get stuck, refer to the Support section near the start of this guide.

This is as far as we need to go at this point – since none of the motors and sensors are connected, there's not much else we could test. Connecting from your computer should work – refer to the end of the chassis instruction guide for information on that.

2.13 What's Next

Now you can continue with the assembly of the chassis. The instructions for that are contained in the little booklet of the Mirobot v2 box, and also available online at

http://learn.mirobot.io/docs/building-the-v2-mirobot/

Remember to unplug the soldering iron!