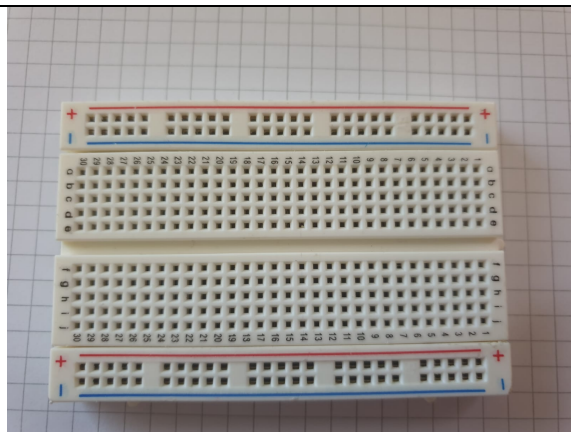


# Step by step guide to building the education robot

## Introduction

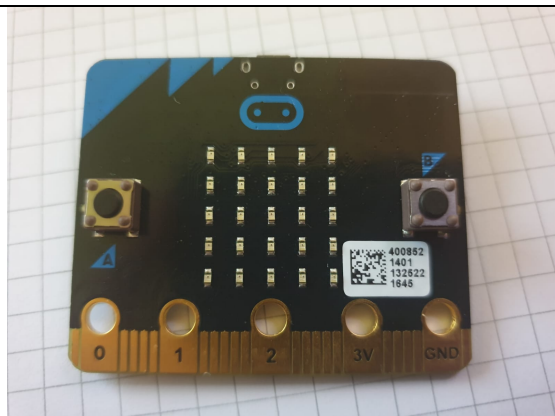
This is a step-to-step guide to building the educational robot. It assumes that you know electrical engineering basics such as wiring up a breadboard and solder safety. There is an accompanying instructional video that can be found here: [\[Link\]](#)

## List of Components and tools



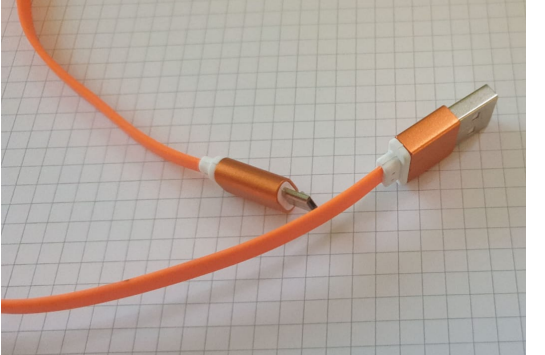
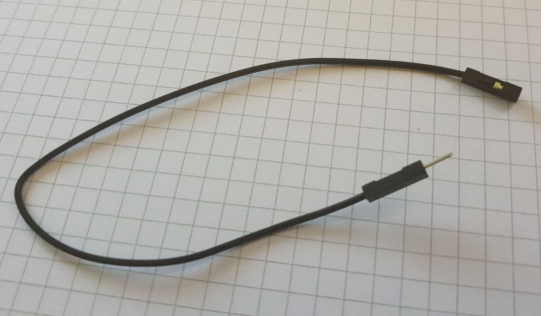
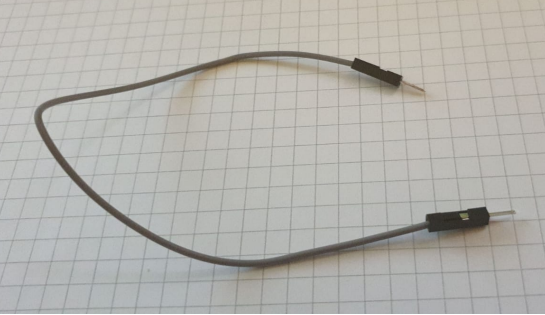


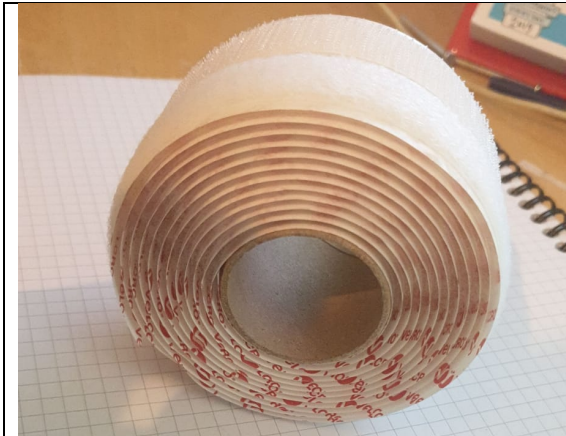
1 x small breadboard

Dimensions: 8cm x 6.5cm

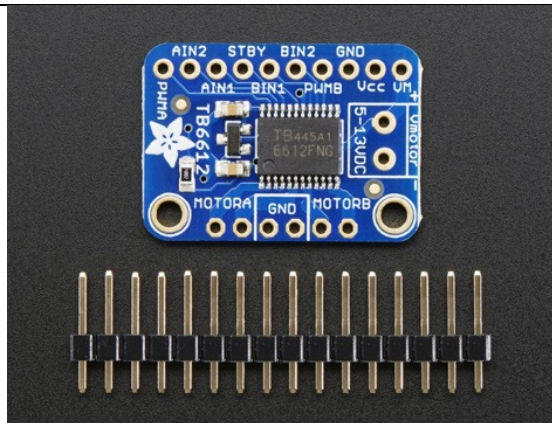


1x BBC Micro:bit microprocessor

	<p>2 x Plastic wheels</p> <p>Diameter: 6.5 cm</p>
	<p>1 x Upper Layer of the Chassis</p> <p>1 x Lower Layer of the Chassis</p> <p>Both laser cut using the open source SolidWorks file, accessible here:</p>
	<p>1x USB to MicroUSB cable</p>
	<p>20 x Male to Female wires</p>
	<p>20 x Male to Male wires</p>



1x Roll of Velcro



1x Adafruit TB6612 1.2A DC/Stepper Motor Driver Breakout Board



**Referred to in this guide as a H-Bridge or a Dual H-bridge**

Resources and a guide on soldering on the pins can be found here:

<https://learn.adafruit.com/adafruit-tb6612-h-bridge-dc-stepper-motor-driver-breakout>



2 x DC gear motors

	<p>1 x USB to Micro-USB splitter cable</p>
<p>Take picture of new power bank when it arrives</p>	<p>1 x Rechargeable Power bank</p>
	<p>4 x 5cm bolts 4 x Nuts</p>

#### Tools required

- Pair of scissors
- Soldering iron
- Wire strippers
- Ruler
- Marker

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### *Preparation*

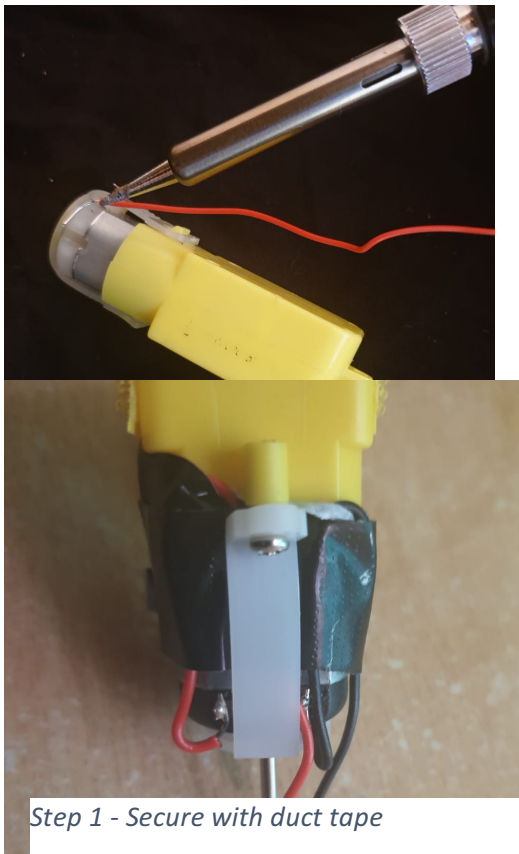
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1. If you haven't already cut the two layers of the chassis, use the link below to download the SolidWorks file and use a laser cutter to cut the two layers of the chassis.

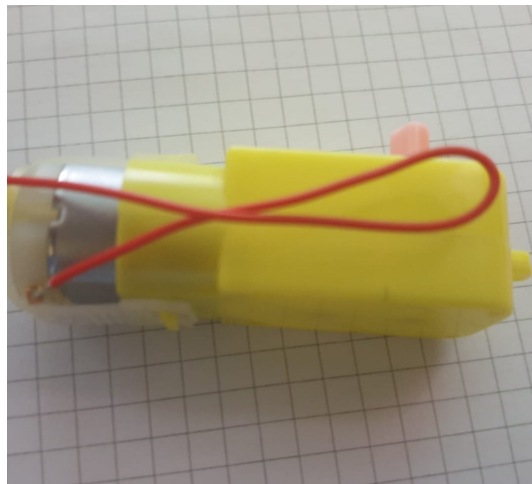
You can use any laser cutter friendly material but it needs to be structurally sound enough to bear the weight of the motors, power bank, breadboard and microprocessor as well as being able to withstand the process of the two layers being bolted together.

Lightweight plastic is the best option for this project,

2. You need to solder the one red and one black wire on to each motor. Solder the stripped ends of the wire onto the metal loops on the motors. These loops can be extremely fragile and can cause the wires to snap off so in order to provide support to the wires you need to loop them up and down each side of the motor and then wrap duct tape around the motor to secure the wires.



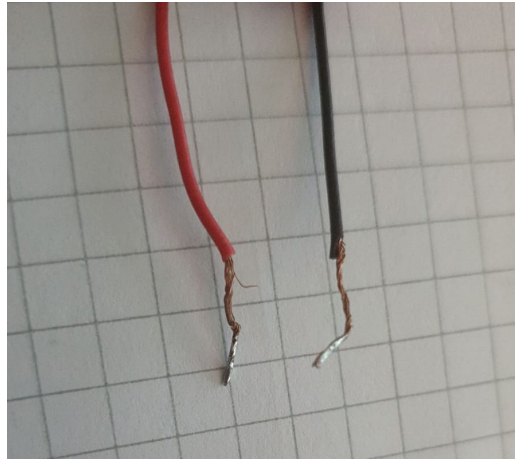
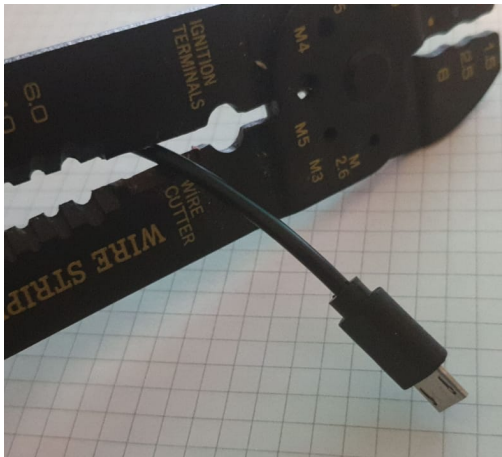
*Step 1 - Secure with duct tape*



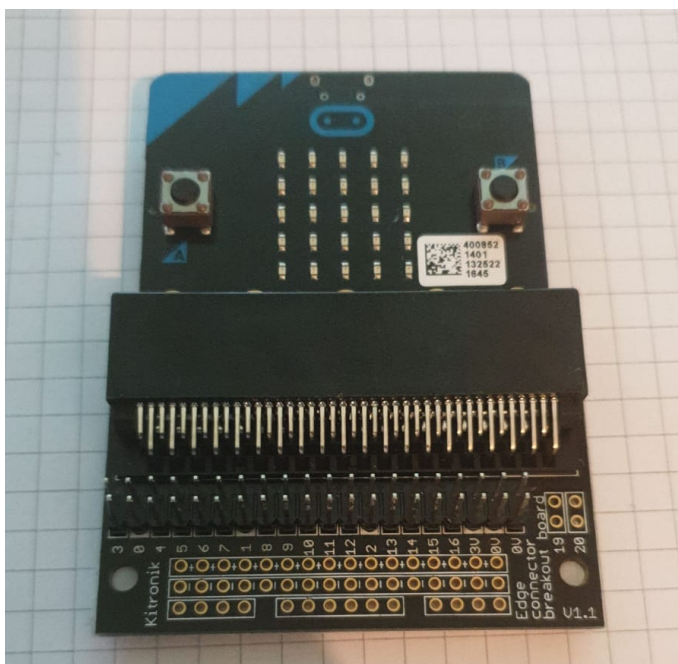
*Step 2 - Loop the wire around*



3. Using wire cutters you need to cut one of the microUSB ends off of the splitter cable, then you need to strip off the thick black wire, exposing the red and the black wires inside. You then need to strip the ends off of these wires and cover the ends in solder to stop them from fraying.



4. You need to solder the pins into the dual H-bridge, instructions on how to do this can be found in the Adafruit resources here [\[link\]](#)
5. Slot the BBC micro:bit into the Kitronik breakout board



6. Fully charge the power bank

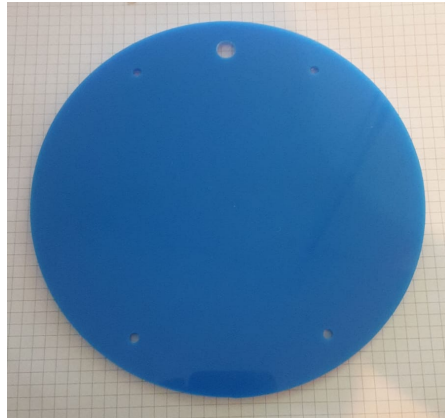
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### *Positioning the motors*

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The motor need to be positioned on a straight axis in order for the robot to be able to drive in a straight line, in order to do this they must be positioned accurately.

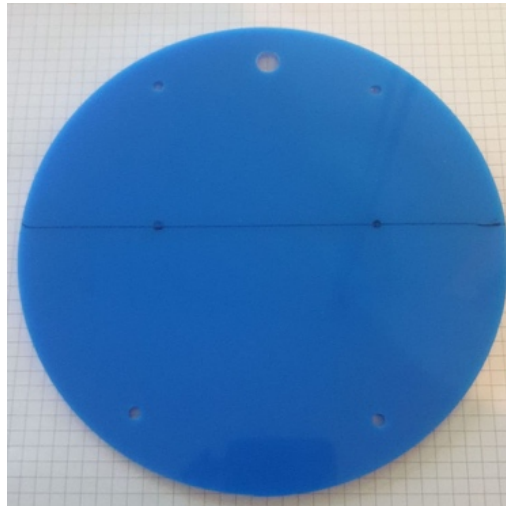
1. Position the lower level of the chassis with the pen hole facing upwards



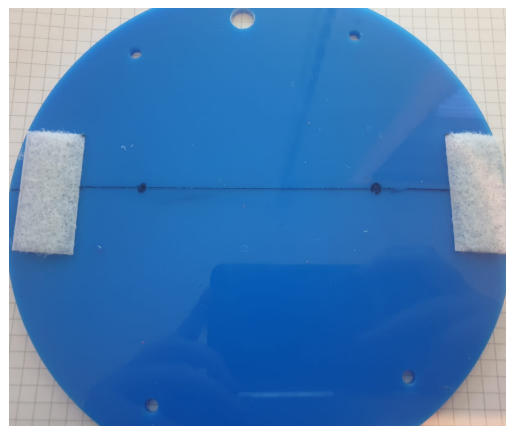
2. Using a ruler find the vertical centre points between the two sets of screw holes and mark them with a pen



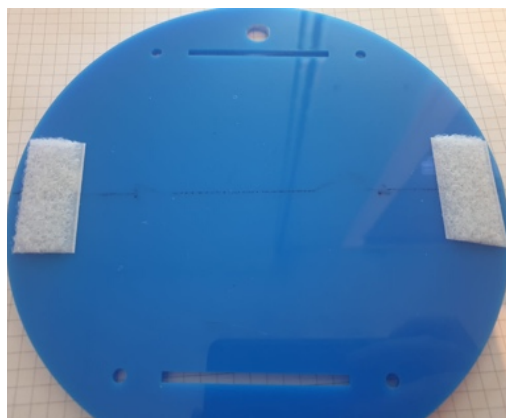
3. Draw a horizontal line through the marks you just made from one edge of the chassis to another`



4. Measure and cut off two 4 cm strips from the roll of Velcro
5. Stick the soft sides of Velcro on those strips on the edges of the chassis with the centre of the strips in aligned to the line you drew in step 3



6. Repeat this process on the upper layer of the robot



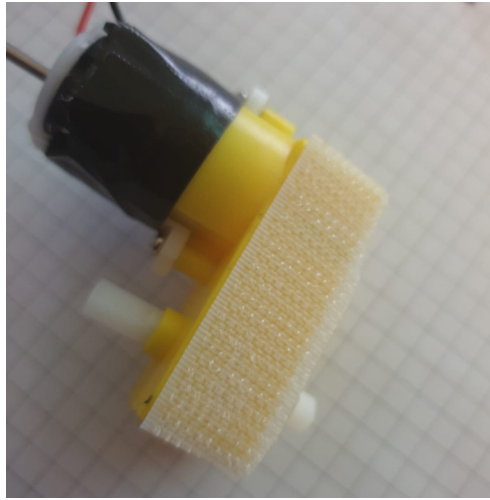


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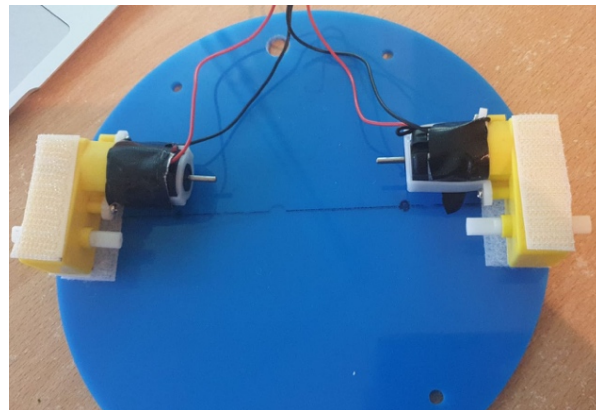
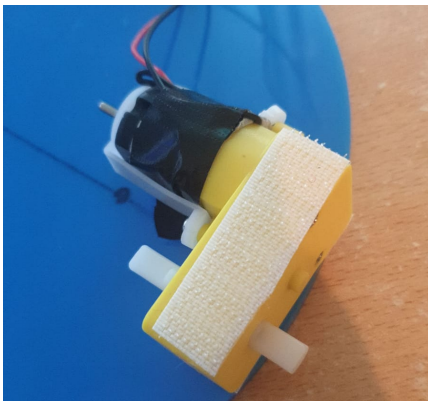
### *Attaching the motors*

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1. From the four strips of Velcro you cut earlier peel the rough sides off and attach one to each blank side of the two motors, cutting off any excess.



2. Then for both the motors stick them to the Velcro you attached to the lower chassis, with their metal axis pointing inwards.

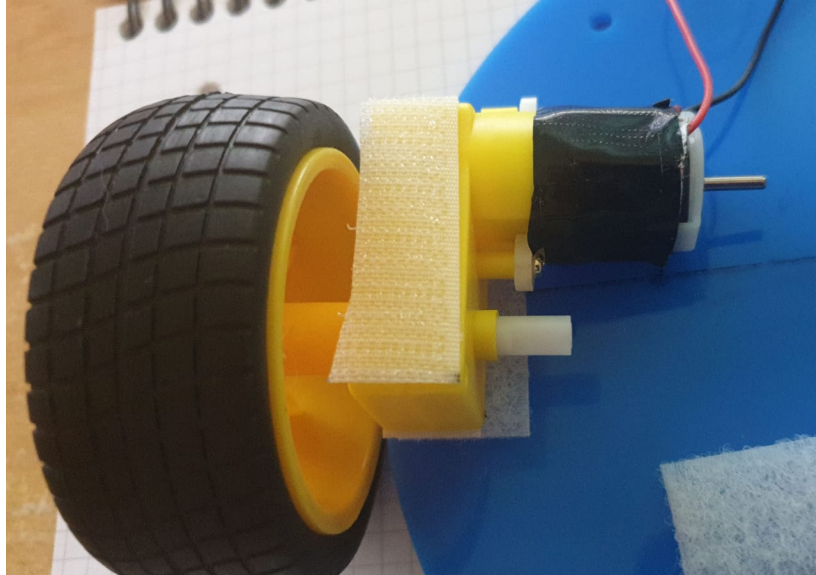


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### *Attaching the wheels*

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1. To attach the wheels simply slot them on to the plastic rods pointing externally, making sure there is enough space between the wheels and the edge of the chassis to ensure the wheels are free to turn

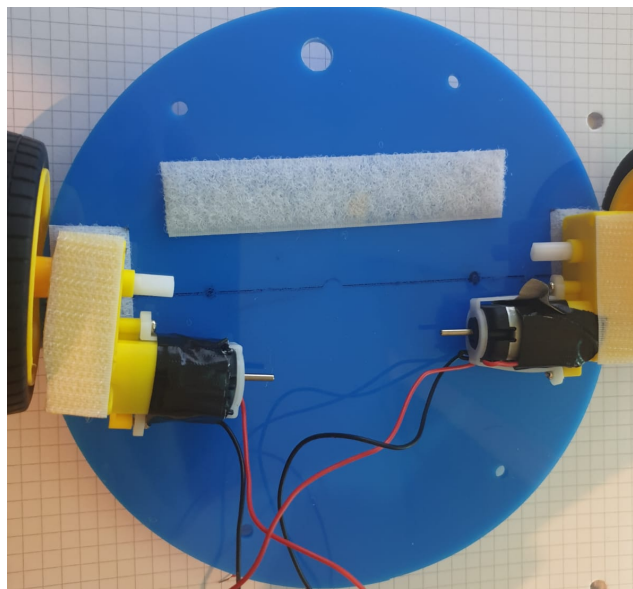


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### *Attaching the power bank*

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1. Measure out a strip of Velcro the exact length of the power bank
2. Stick the soft side on to the lower level of the chassis below the pen hole and the set of horizontal screw holes



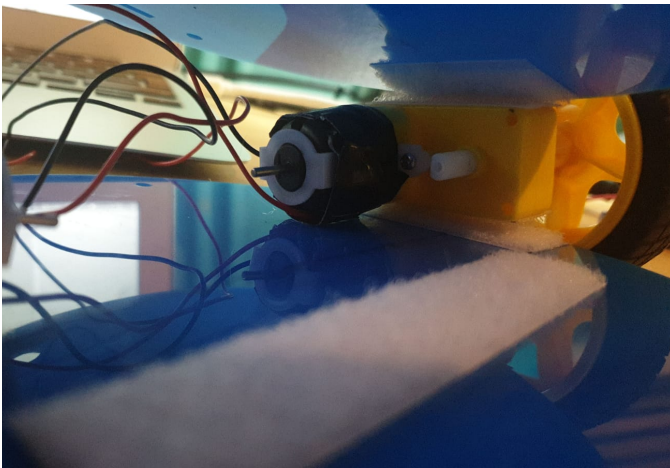
3. attach the rough side of that Velcro strip to the bottom of the power bank  
[ include image when new power bank arrives]
4. Stick the power bank on to the lower level of the chassis using the Velcro  
[include image once new power bank arrives]
5. Plug the USB end of the splitter cable into the power bank  
[include image once new power bank arrives.

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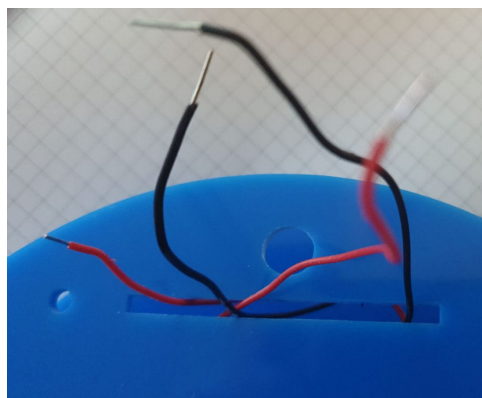
### *Affixing the upper layer*

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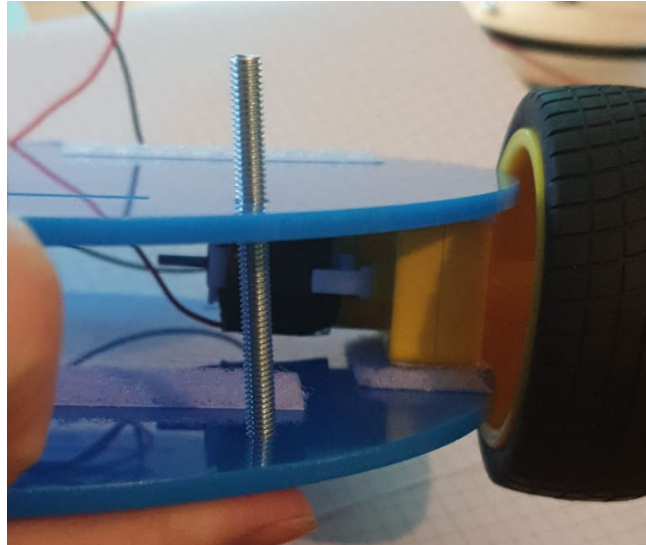
1. Take the upper layer, with the Velcro you attached earlier facing downward, and press it on to the tops of the motors lining up the strips of Velcro, sandwiching the motors between the two layers



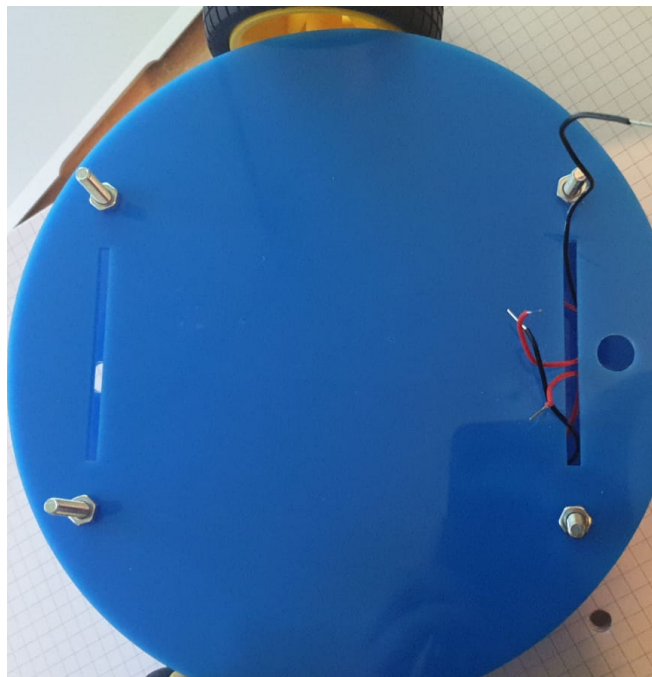
2. Thread the motors wires through the cutout in the upper level



3. Thread the 4 screws, pointing upwards, through all four sets of screw holes in the chassis layers



4. Use the nuts to secure the bolts in place, ensuring when you are tightening them that the upper layer is remaining level



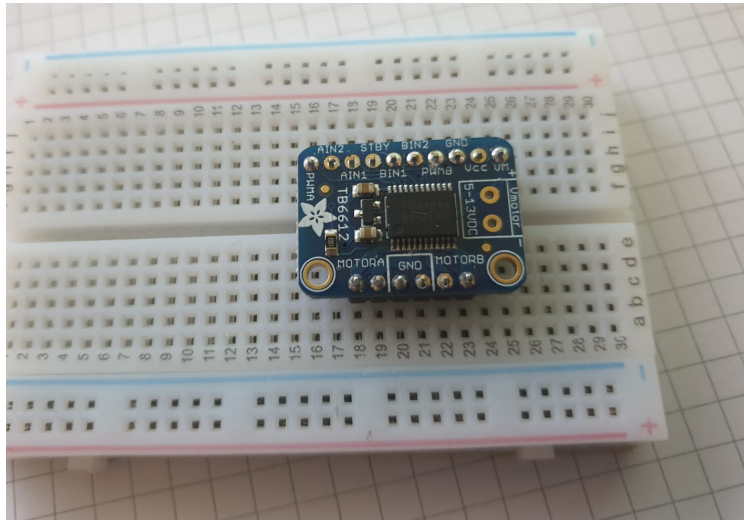
5. Check the wheels can move without obstruction

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## *Affixing the breadboard*

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1. Plug the H-bridge into the centre of the breadboard

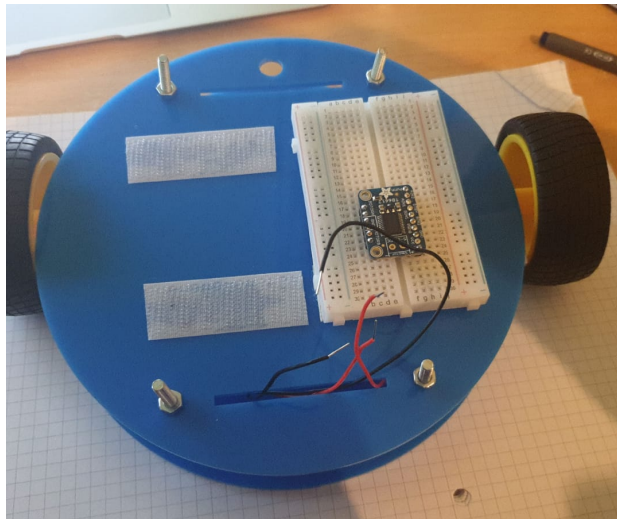


2. Measure out and cut two 5cm strips of Velcro sticking the soft sides on along the top and bottom of the underside of the breadboard

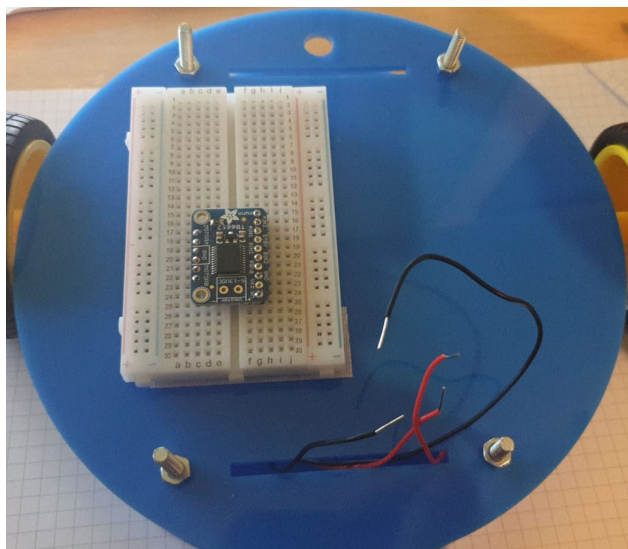




3. Positioning the robot with the pen hole at the top, the breadboard is going to be stuck vertically on the left hand side so temporarily place the breadboard on the right hand side, using it to work out where to stick the rough sides of the Velcro



4. Once you have stuck the pieces of Velcro to the top layer of the robot attach the breadboard to them



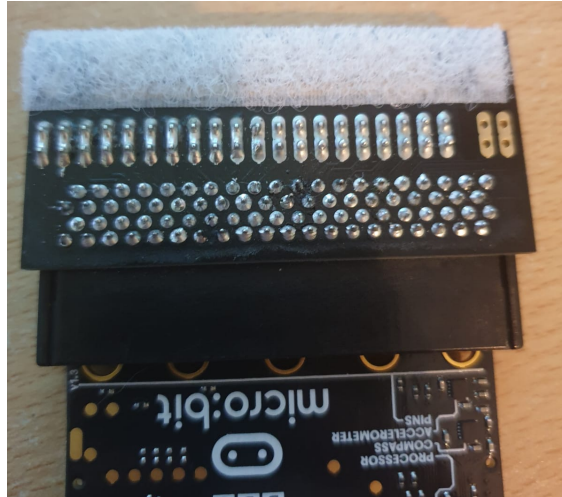


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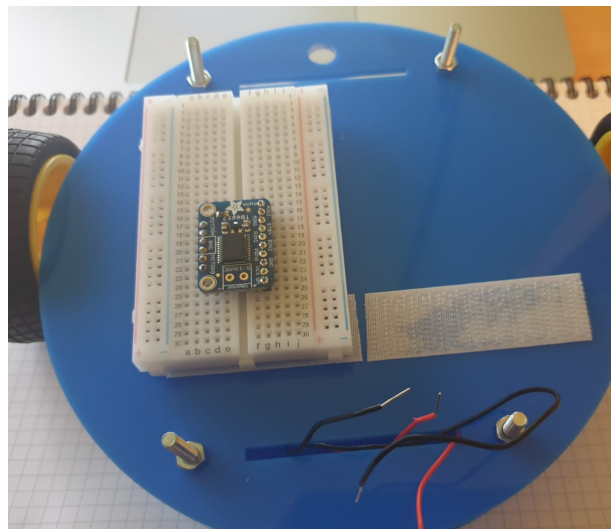
### *Attaching the microprocessor*

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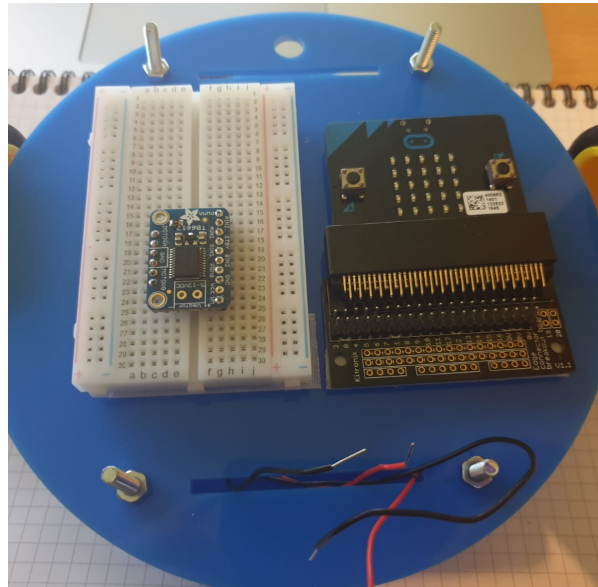
1. Cut a 6 cm strip of Velcro off of the roll and stick the soft side to the edge of the underside of the Microbits edge connector, cutting off any excess with scissors



2. Positioning the robot with the pen hole at the top, stick the rough layer of Velcro to the upper layer in the robot, aligning it with the bottom edge of the breadboard



3. You can now stick the microprocessor on to the upper level of the robot



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### *Wiring up the robot*

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With the main build of the robot complete it is time to wire up the microprocessor, H-bridge, power source and motors so we can get the robot driving. This is where it gets complicated!

1. First Attach the ground and 3V pins on the microprocessor to the corresponding strips on the breadboard
2. Now refer to this table to see what to do with each pin on the H-bridge

H-bridge Pins	Action
PWMA	Using a male to male wire plug this pin into the positive strip on the breadboard
PWMB	Using a male to male wire plug this pin into the positive strip on the breadboard
AIN1	Plug this pin into pin 16 on the Microbit with a male to female wire
AIN2	Plug this pin into pin 15 on the Microbit with a male to female wire
BIN1	Plug this pin into pin 14 on the Microbit with a male to female wire

BIN2	Plug this pin into pin 13 on the Microbit with a male to female wire
STBY	Plug this into pin 10 on the Microbit with a male to female wire
GND	Using a male to male wire plug this into the ground strip on the breadboard
Vcc	Using a male to male wire plug this into the positive strip on the breadboard
VMotor	Connect the red wire from the splitter cable to this pin

3. To make the next step clear we are going to label the motor parallel to the breadboard 'Motor A' and the motor parallel to the Microbit 'Motor B'

MotorA pins	Connect the red and black wires from Motor A into these pins. The order you put them in determines the direction the motor spins in, plug them in in any order for now as these can be changed later when the code is uploaded
MotorB pins	Connect the red and black wires from Motor B into these pins. The order you put them in determines the direction the motor spins in, plug them in in any order for now as these can be changed later when the code is uploaded
GND pins	Connect these to the ground strip on the breadboard

4. Plug the black motor wire into the ground strip on the breadboard
5. Finally, plug the microUSB end of the splitter cable into the Microprocessor and you are good to go!