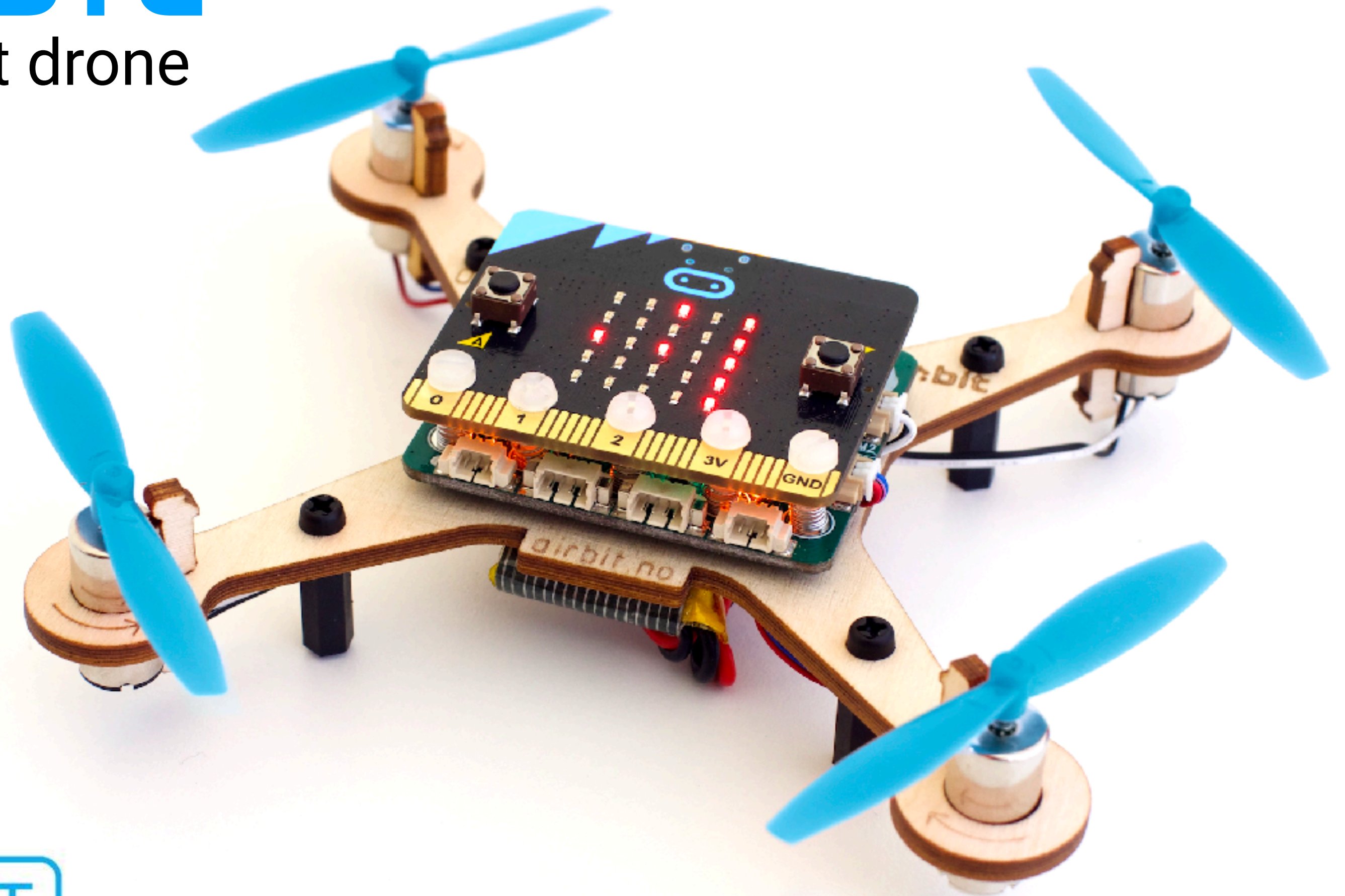


Air:bit

The micro:bit drone



**If you experience trouble getting the
air:bit to fly, please see page 54.**

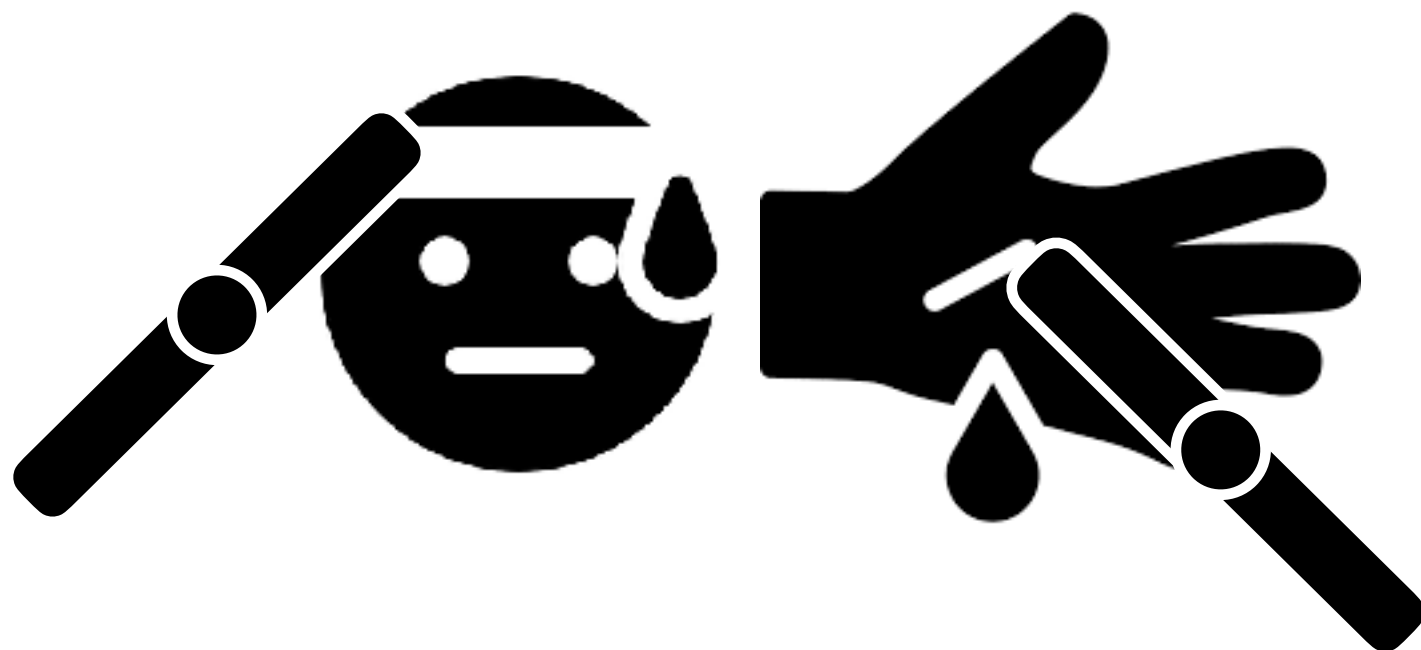


Safety warning

Fast rotation propellers can hurt humans and animals

To prevent injury, do:

- Mount the propellers at after all building and coding is done. Test that you can start and stop motors (shake to stop)
- Keep a distance when arming and flying the drone.
- Children under 8 years and animals must be kept at a safe distance, at least 5 meters away even indoors.
- Use propeller protector if possible
- Follow local FAA regulations



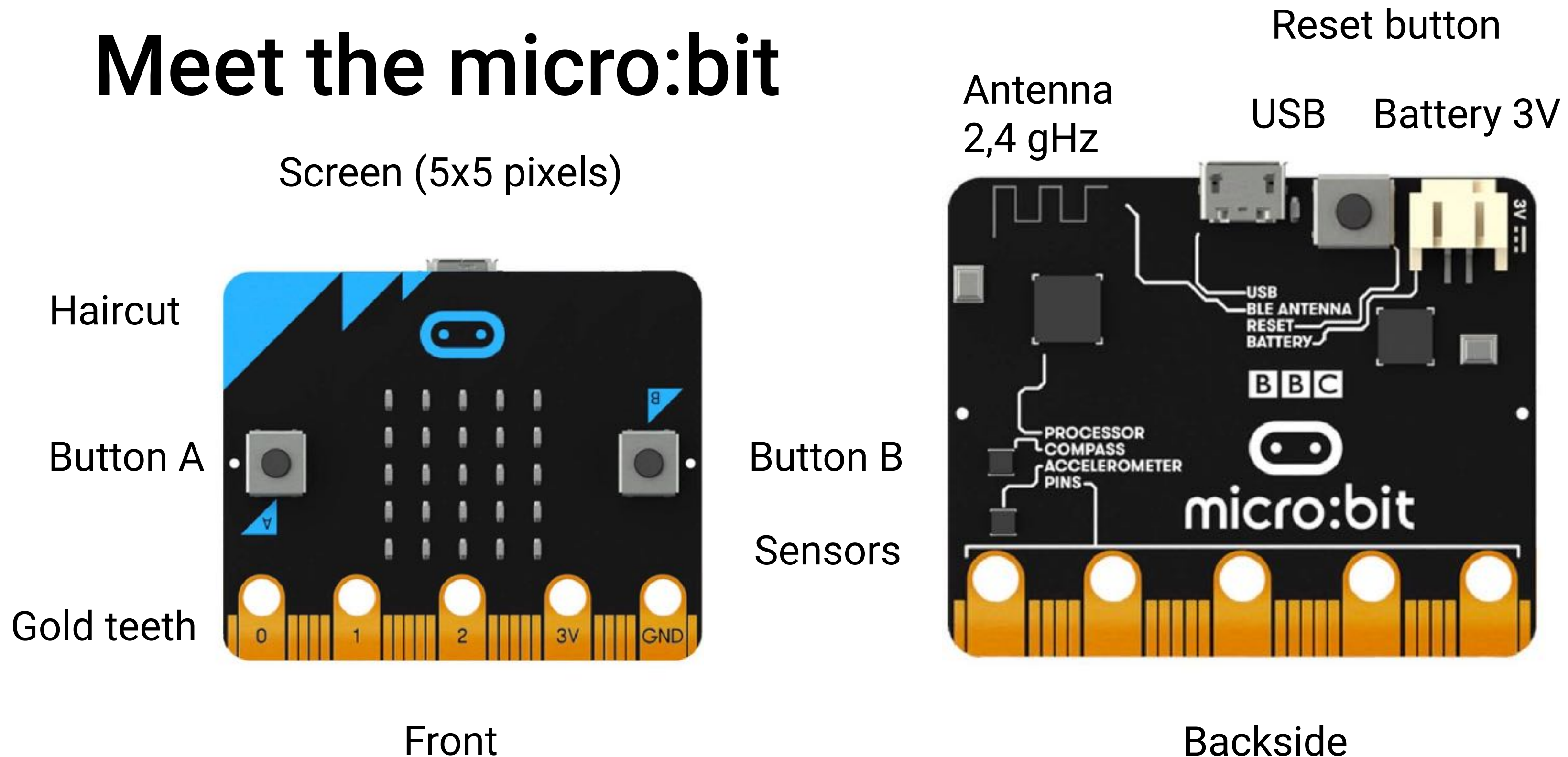
Lithium batteries can release smoke or cause a fire

To prevent damage, do:

- Don't charge the batteries unattended
- Don't use a damaged or punctured battery
- Do not short circuit the battery
- Avoid temperatures below -10 and above 50 degrees celcius.
- Don't use batteries that are colder than 15 degrees celcius
- Always have a plan for what to do in case of a fire: If you are indoor, open a window and get the battery outside to prevent smoke or fire.
- Do not open or modify the battery in any way.
- For optimal performance, store the battery at around 30% capacity and between 10 and 20 degrees celcius
- Follow airport regulations for carrying lithium batteries on airplanes. (Usually hand luggage only)



Meet the micro:bit



micro:bit is a small computer with prosessor, sensors, display and radio. It has connection pins for external components like LEDs, speakers or various sensors.

You can learn more at: <https://tech.microbit.org/hardware/>

Air:bit

World's first micro:bit drone

micro:bit with
Microsoft
make:code

Screen showing flight
directions and battery
status

Propeller
protection mount

Air:bit control
board with charger

10x20mm
coreless
dc-motors 3.7v
(replacable)

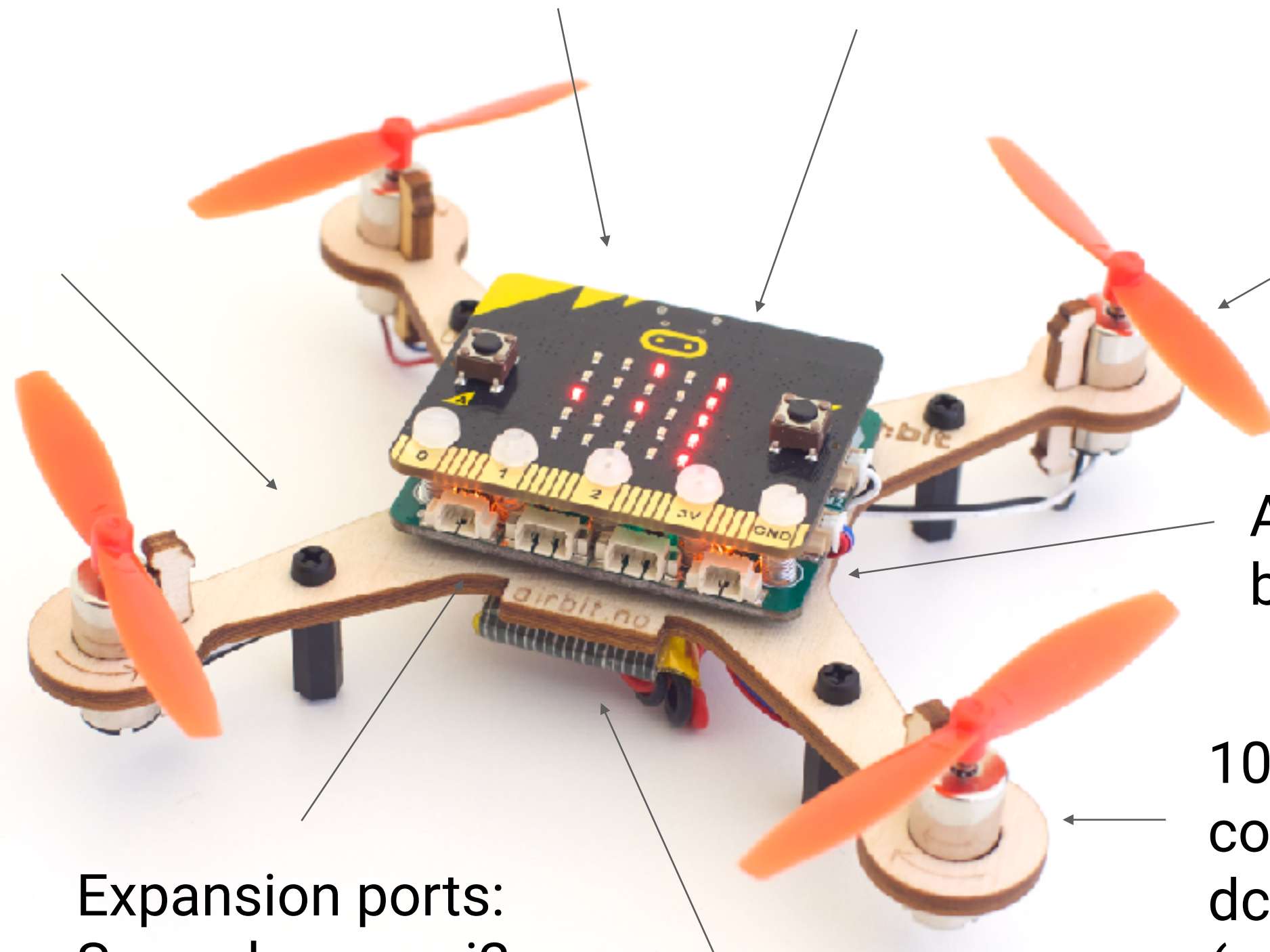
1 cell 3,7v
750 mAh
LiPo-battery

Expansion ports:
Servo, kamera, i2c,
serial (jst picoblade)

Propeller:
Gemfan 65mm
Polycarbonate

6 layers
"unbreakable"
birch plywood

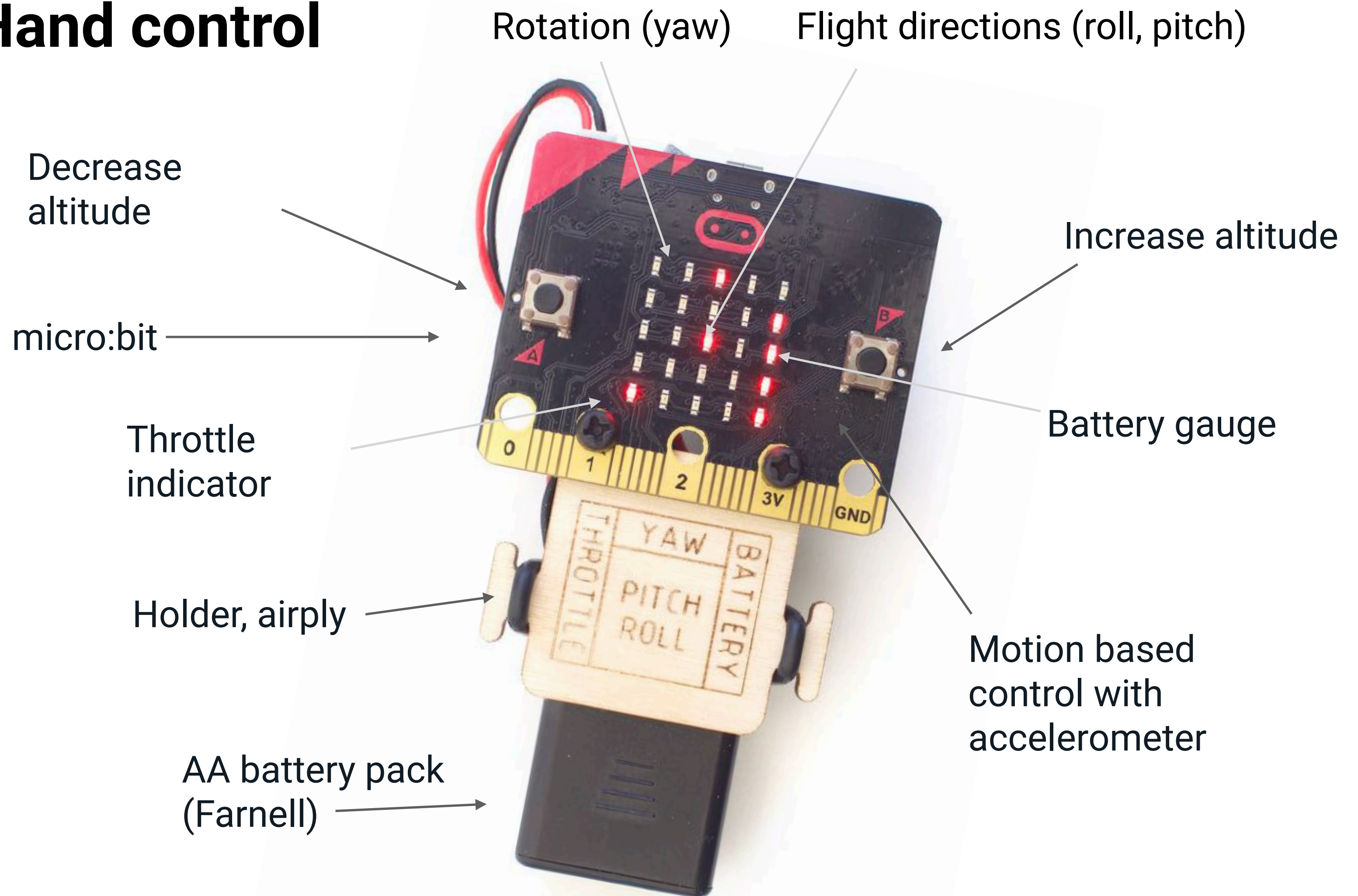
Nylons screws/
spacers M3



More info: Visit airbit.no



Hand control



Control board

By MakeKit and SPRacing

Charge port +
firmware update
(micro USB)

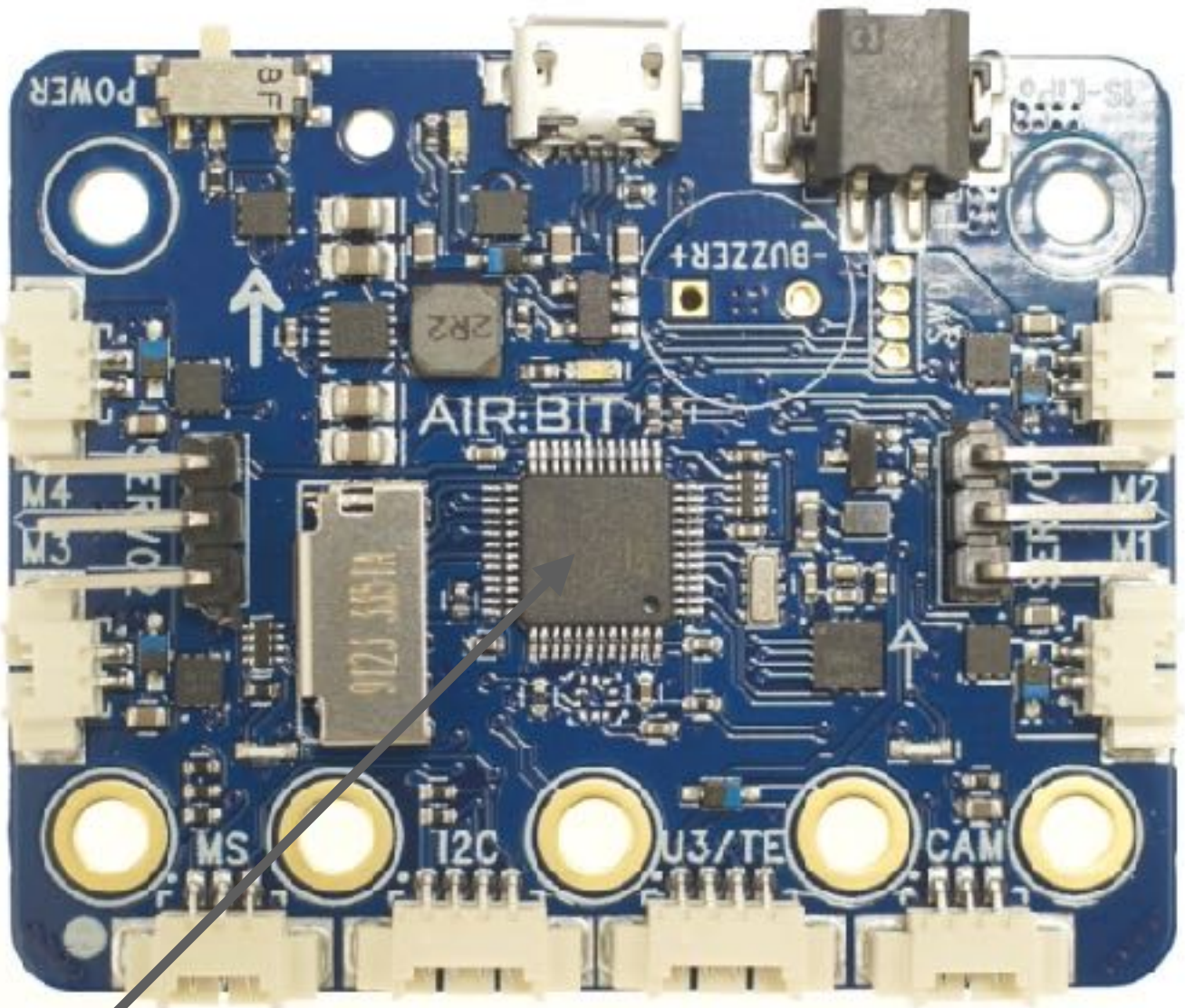
Main switch

Battery plug

Off On

Front-left motor
Servo connector
Back-left motor

Front-right motor
Servo connector
Back-right motor



Micro servo i2c serial camera

STM32 F303 processor
With Betaflight software



Parts



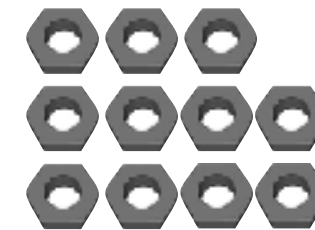
6 nylon screw m3x8



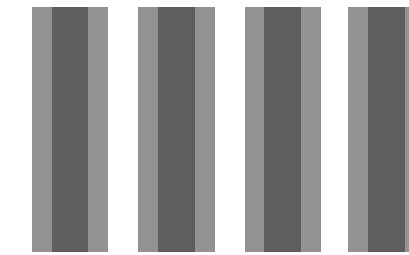
5 nylon screw m3x12



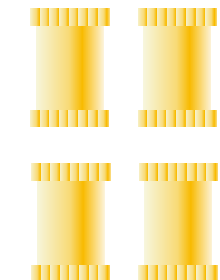
2 nylon screw countersunk



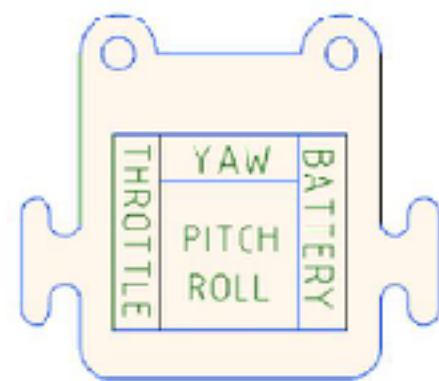
11 nylon nuts



4 spacers m3x20



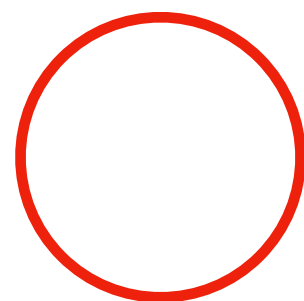
4 knurled barrel nuts



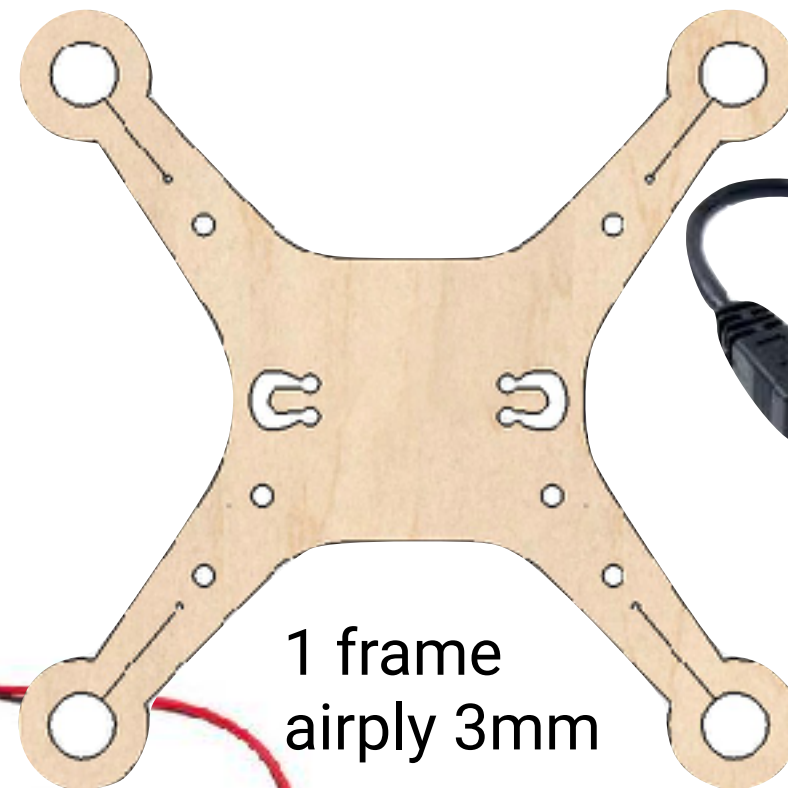
remote - holder



Micro:bit battery box*



Red silicone ring



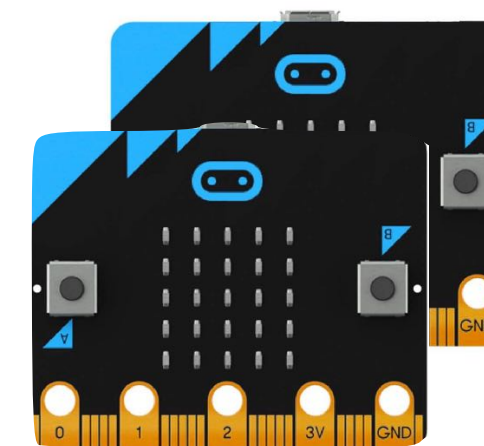
1 frame airply 3mm



1 Lithium (LiPo)-battery



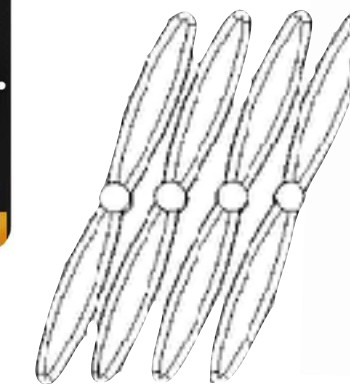
1 micro usb cable*



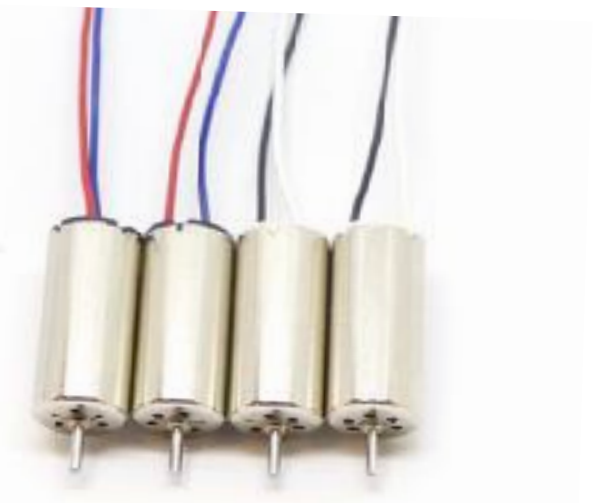
2 micro:bits*



Control board



4 propeller 2 CW, 2 CCW



Motors:
2 CW (red/blue)
2 CCW (white/black)



Rubber Band



4 wedges

Tools

Must have:



Small philips
screwdriver

Recommended:



Small cutting pliers
Nose pliers



Socket wrench
5.5mm

Charging

Parts:

Off / On Battery



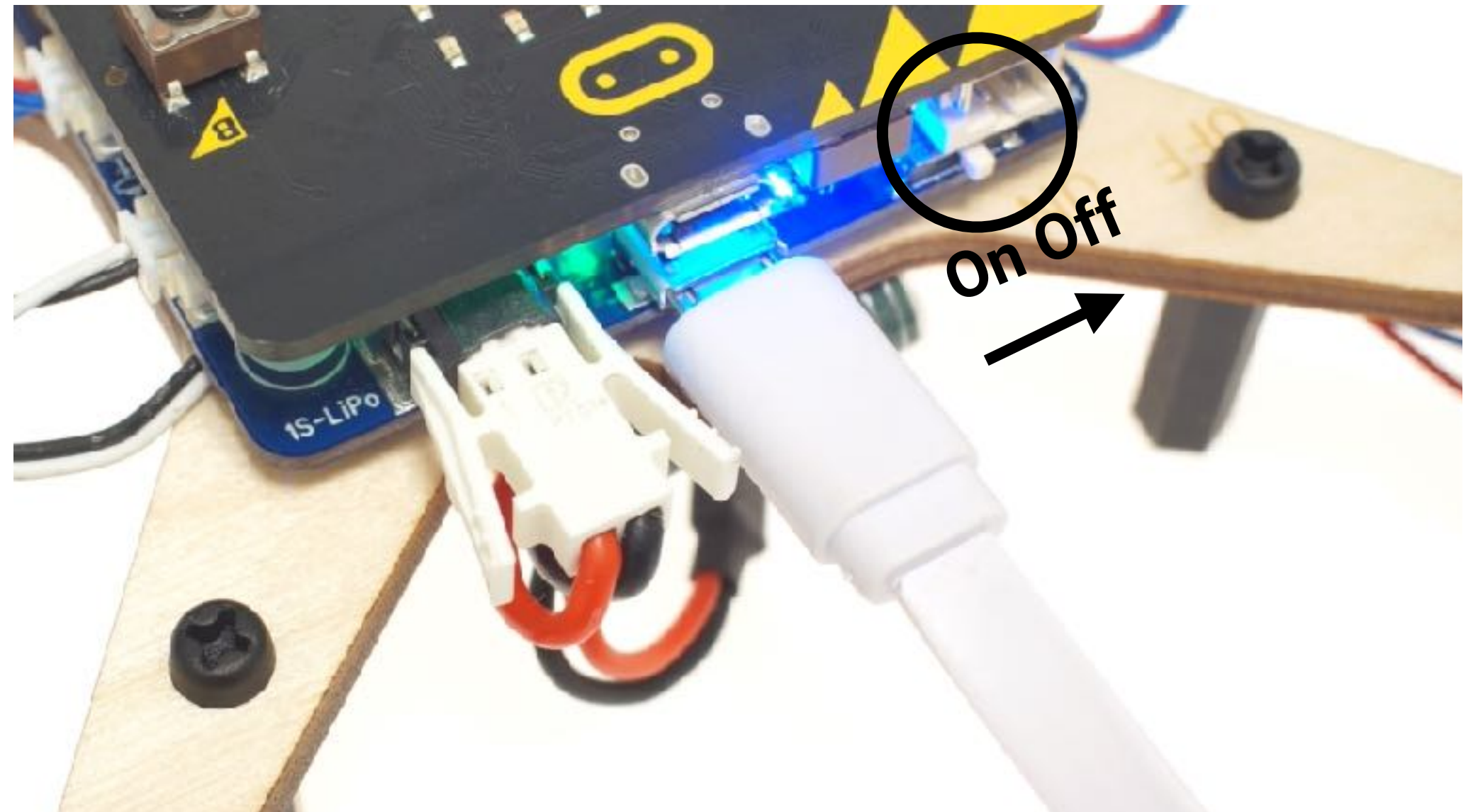
Air:bit control board



Lithium (LiPo)-
battery



Micro USB-
Cable



1. The battery can be charge with or without the micro:bit mounted
2. Switch off the power (top right in the image)
3. Plug the big white plug into the grey connector "1s LiPo"
4. Connect the micro USB into the Airbit control board (not the microbit)
5. Connect the other end into a USB charge outlet
6. Blue light indicates charging. When light goes off, charging is finished. (1-2 hours)

Fire hazard:
Never charge a Lithium battery unattended!



Assembly

Assemble the remote

Tools: Philips Screwdriver

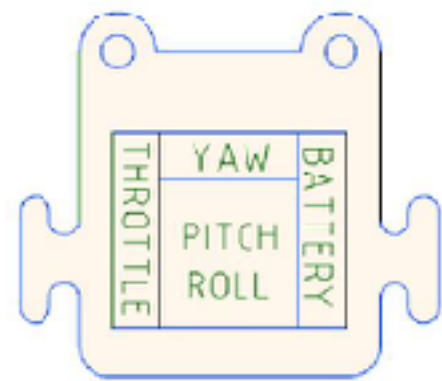
Parts:



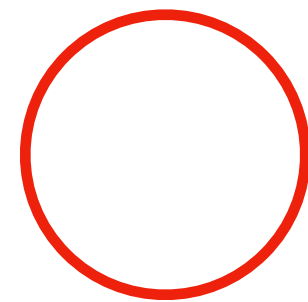
2 nylon screw
m3x8



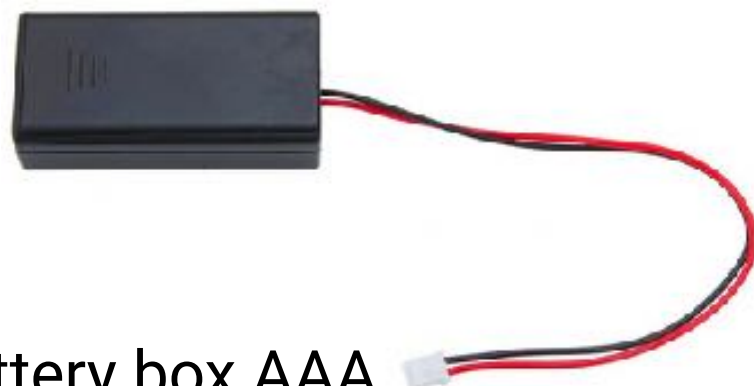
2 nylon
nuts m3



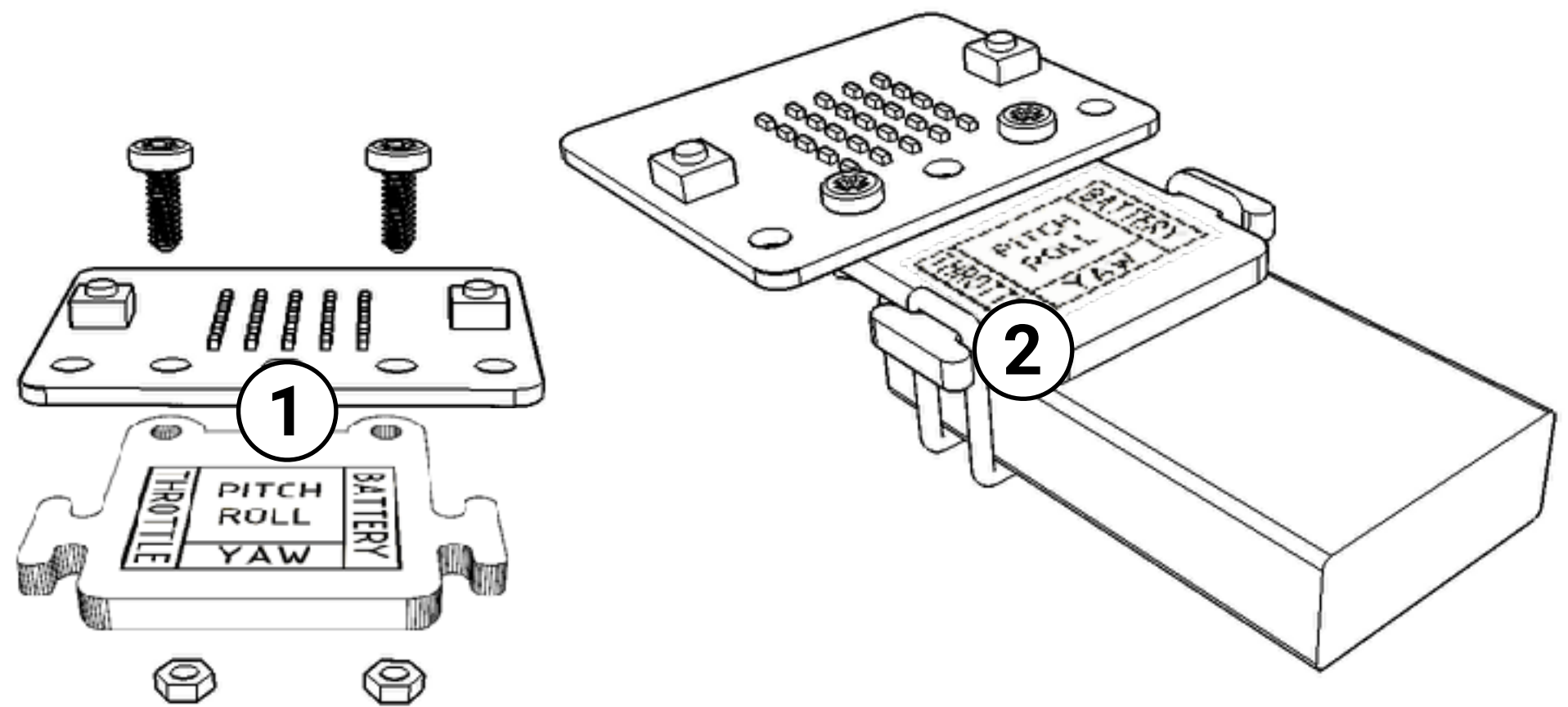
Remote holder



Red silicone ring



Battery box AAA



- Place the micro:bit with screen facing up on top of the holder (1)
- Mount battery box with the silicone ring (2)
- You can use different battery boxes

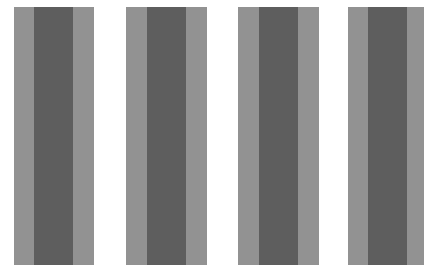
Mounting the frame

Tools: Philips Screwdriver

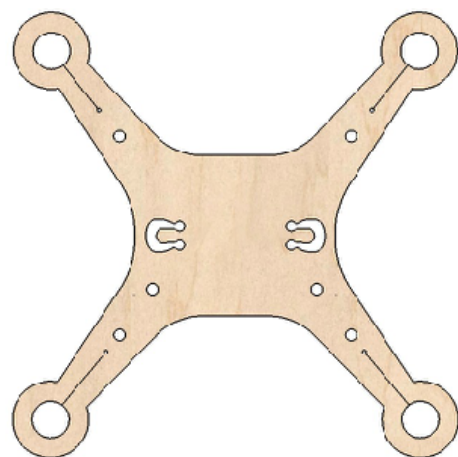
Parts:



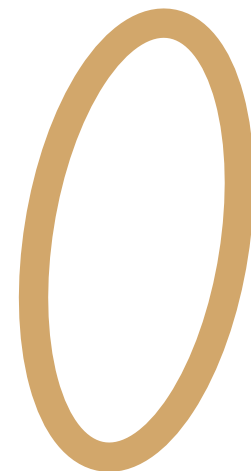
4 stk nylon screws m3x8



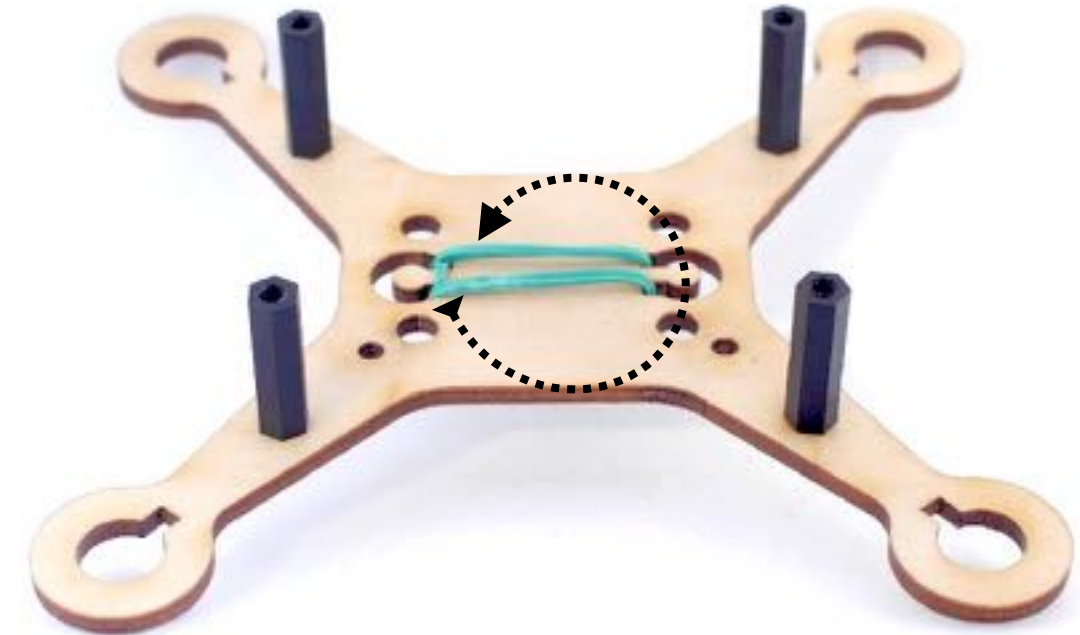
4 spacers
m3x20



Center frame

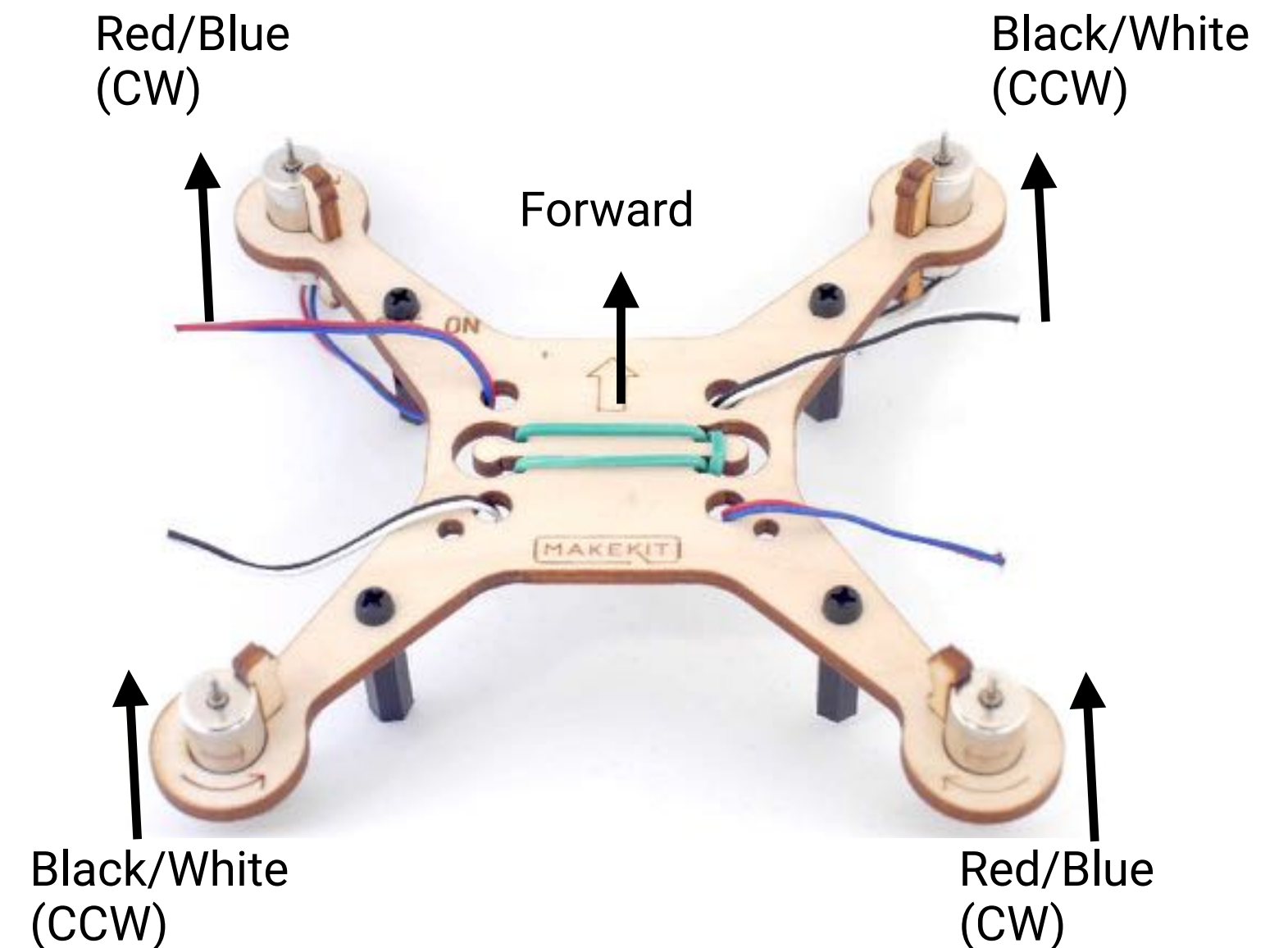
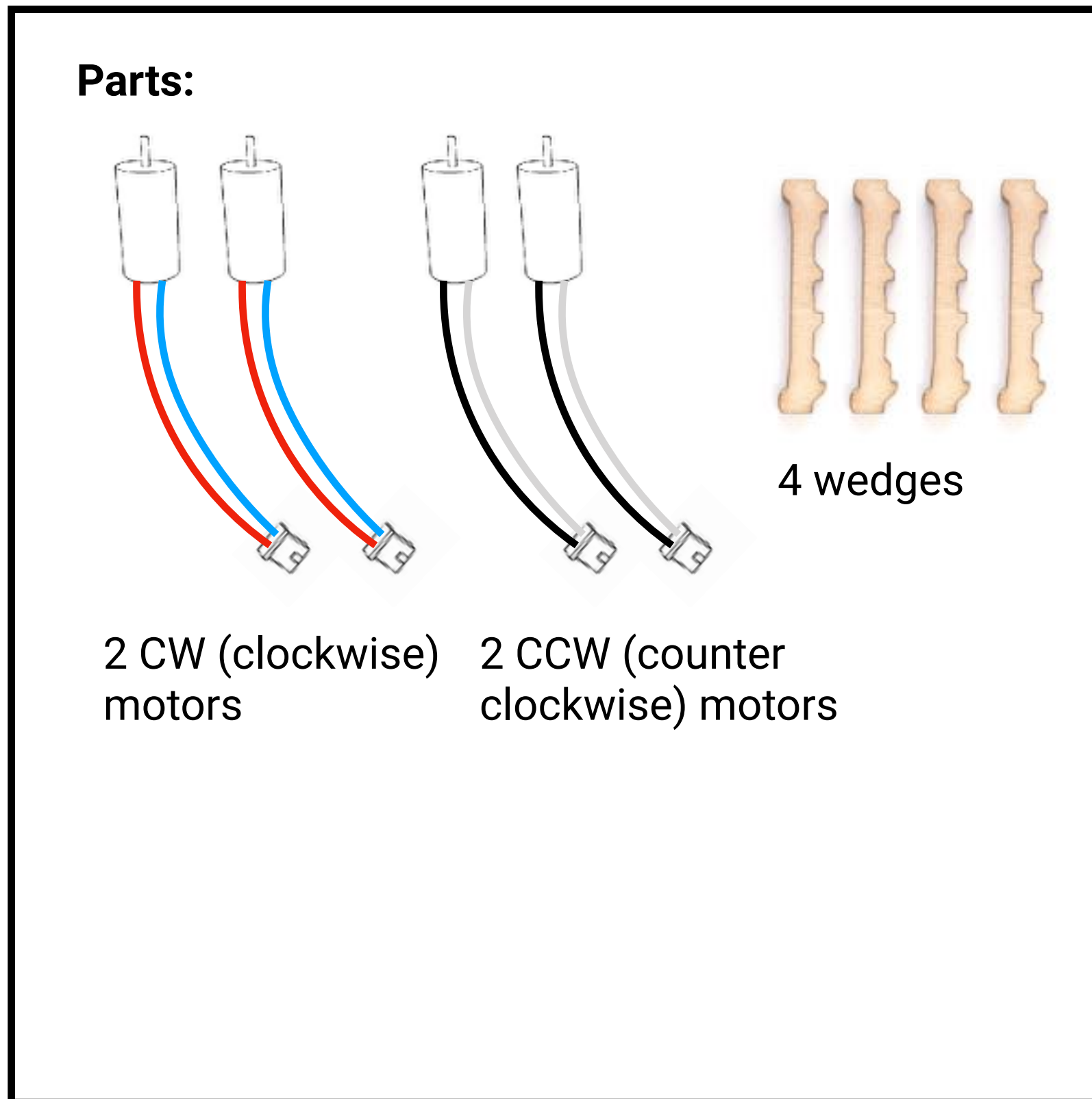


Rubber band



- Place the frame upside down (engravement facing down)
- Mount the spacers with the screws
- Hook the rubber band from one knob, under the frame, to the next hook, over the frame, and back.
- The rubber band will be visible on both sides of the frame

Mounting the motors



- Notice the placement for all motors
- First insert a wedge onto the frame, then push the motor upwards to click into place. (All 4 motors)
- Then pull the motor cables through each hole to tidy them up a bit.

Control board

Tools: Philips Screwdriver

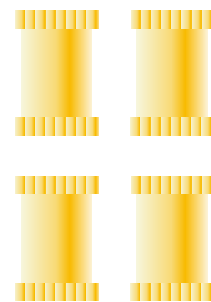
Parts:



4 stk nylon screws m3x12



Airbit control board



4 knurled
barrel nuts



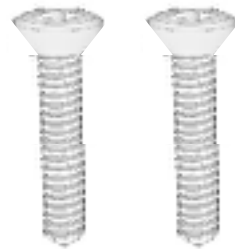
- Screw the barrel nuts to the control board. They will provide a connection to the micro:bit
- **Make sure they are "finger tight":**
 - Tight enough to provide a steady connection
 - Not so tight the screw is damaged

Notice! Ensure a tight contact between the barrel nuts, the control board and the micro:bit. Power and signals will go through them.

Countersunk screws

Tools: Philips Screwdriver

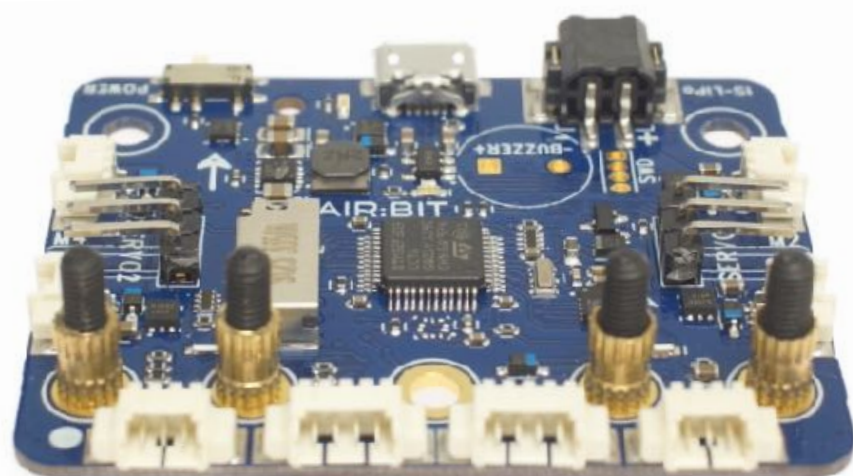
Parts:



2 x
countersunk
screws



2 x
Nylon nuts



Assembled control board



- Pull the screws through and attach the nuts on the bottom side of the board

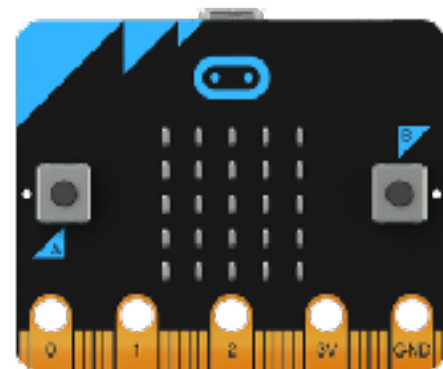
micro:bit

Tools: Philips Screwdriver, pipe wrench 5.5mm

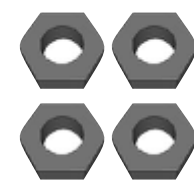
Parts:



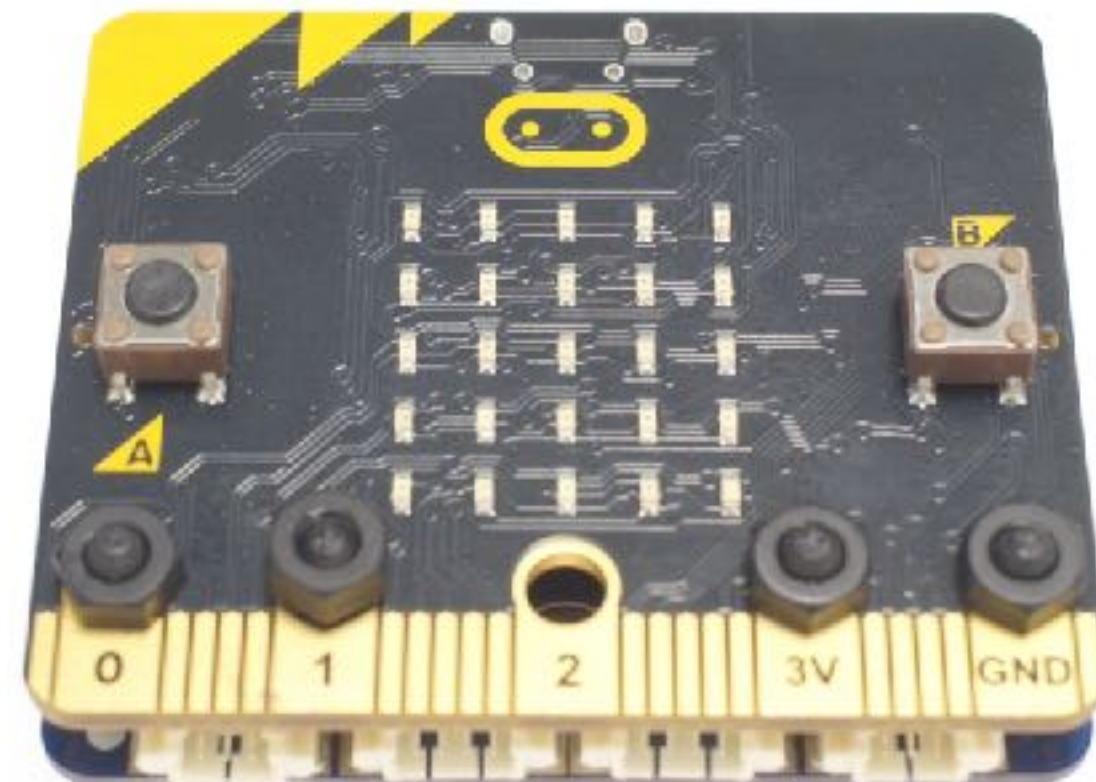
Assembled control board



micro:bit



4 nuts



- Place the micro:bit on the barrel nut on the control board
- Screw on the nuts “finger tight” so the connection is solid but you don’t damage the plastic screws.

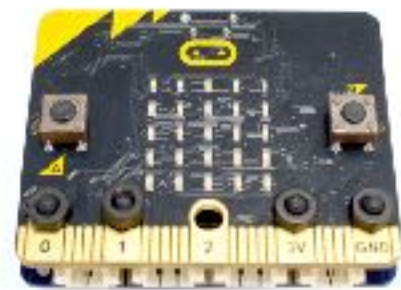
Assembling the drone

Verktøy: Pipenøkkel 5.5mm

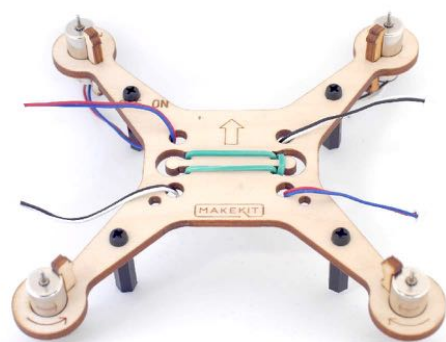
Parts:



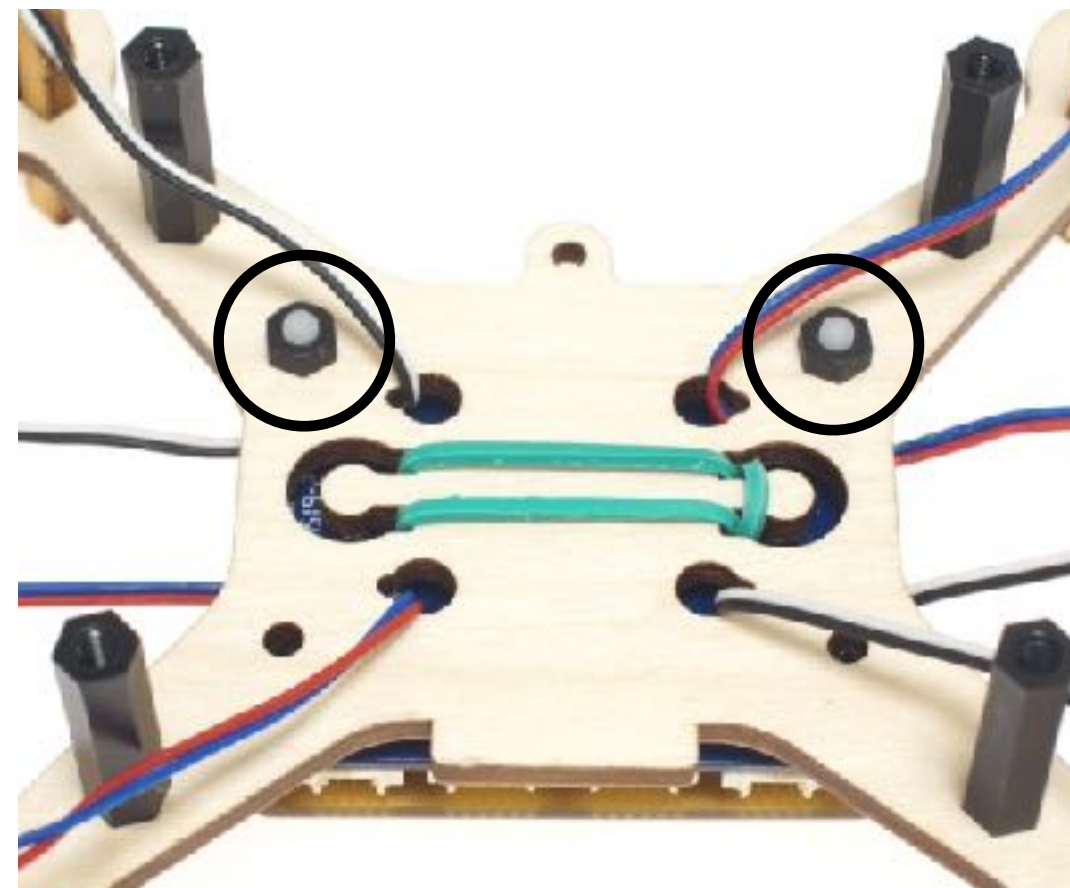
2x nylon nuts



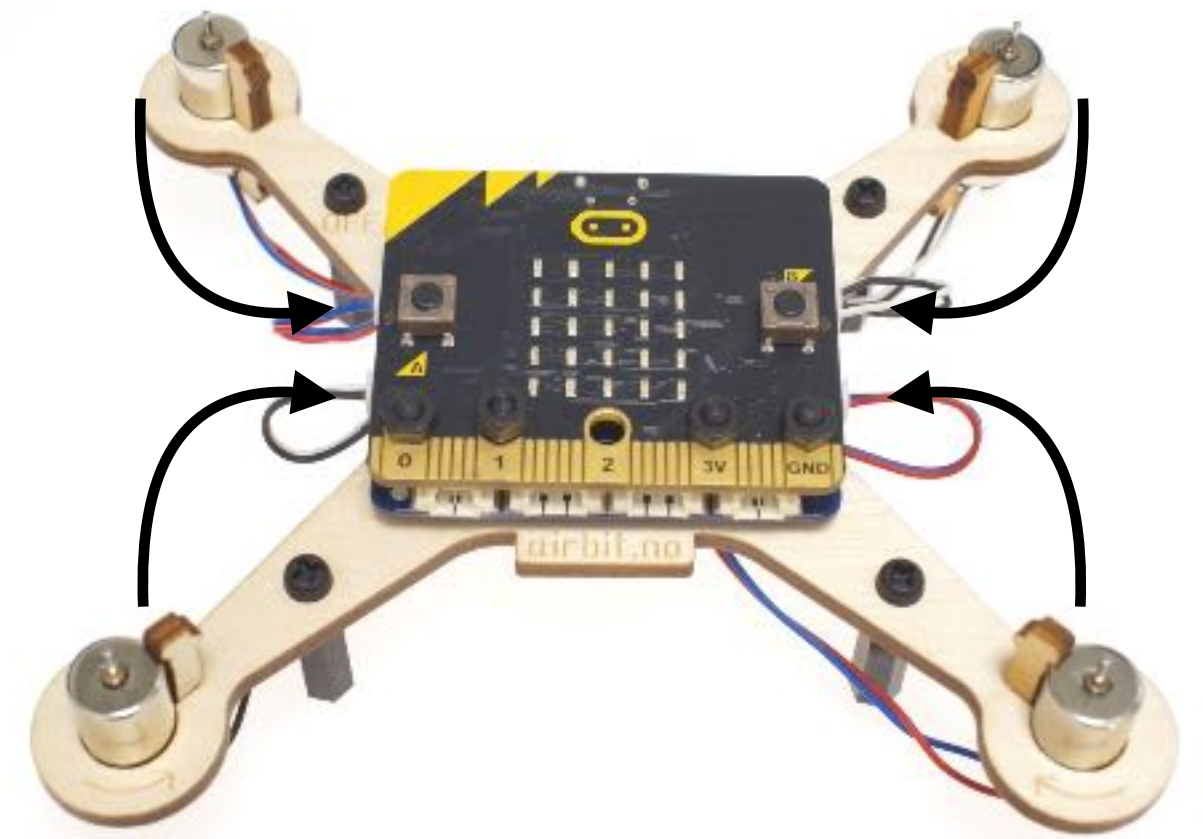
Control board assembly



Frame assembly



- Attach the control board with two nuts underneath the drone



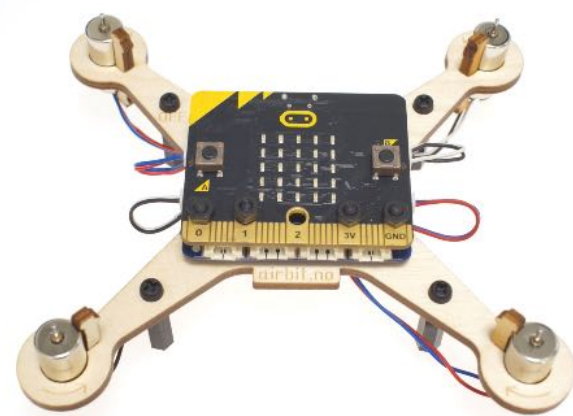
- Flip the drone
- Connect the four motors to each motor's nearest plug

Battery

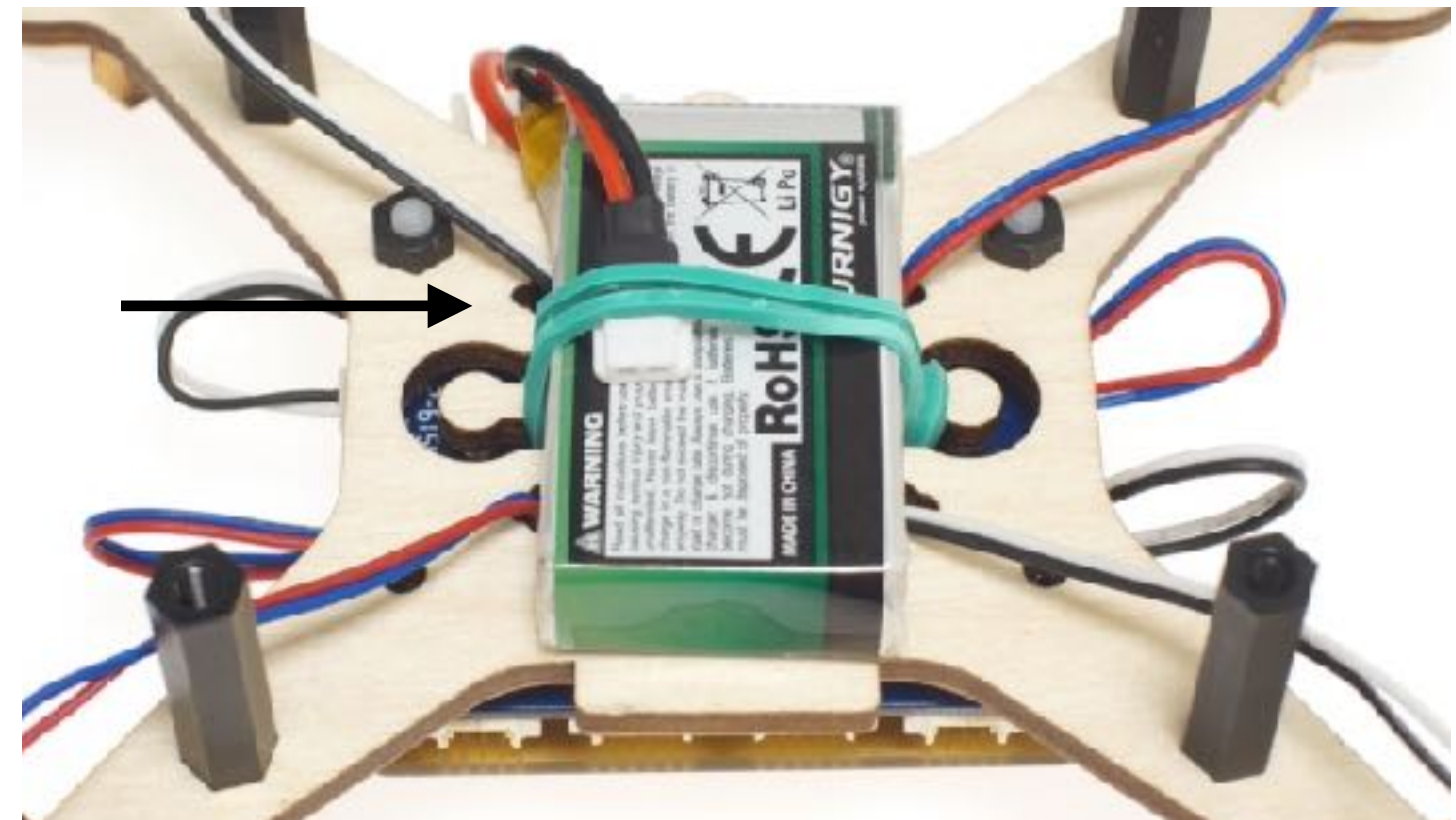
Parts:



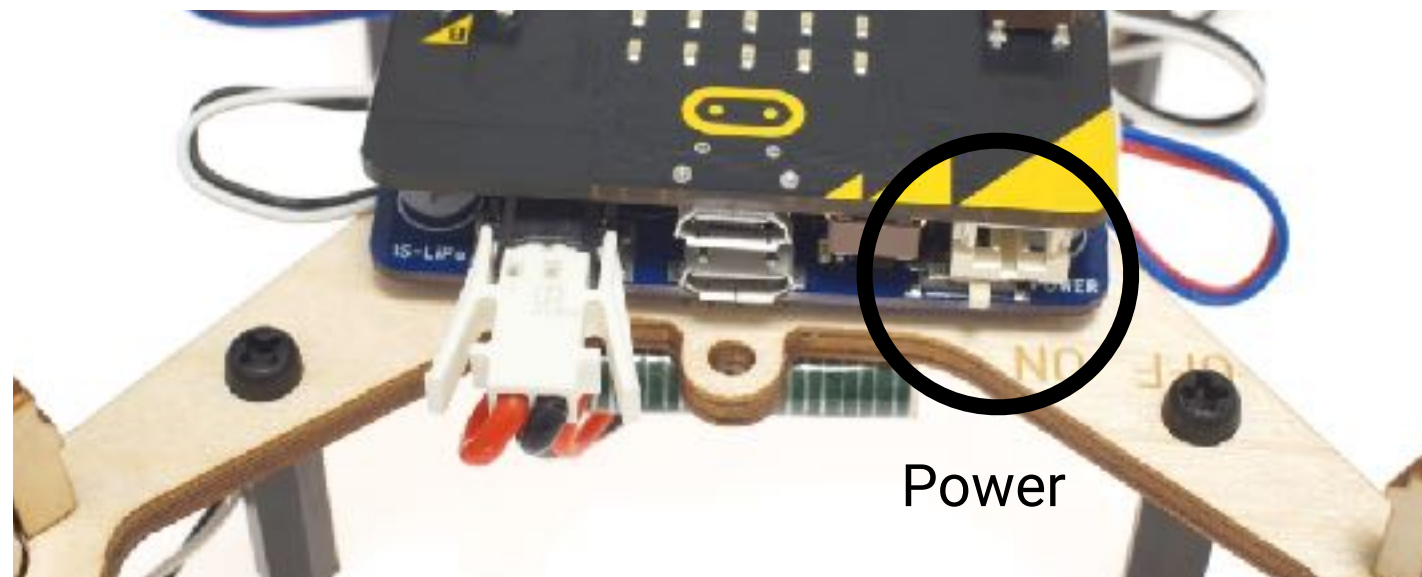
1 Lithium (LiPo)-battery



Air:bit drone



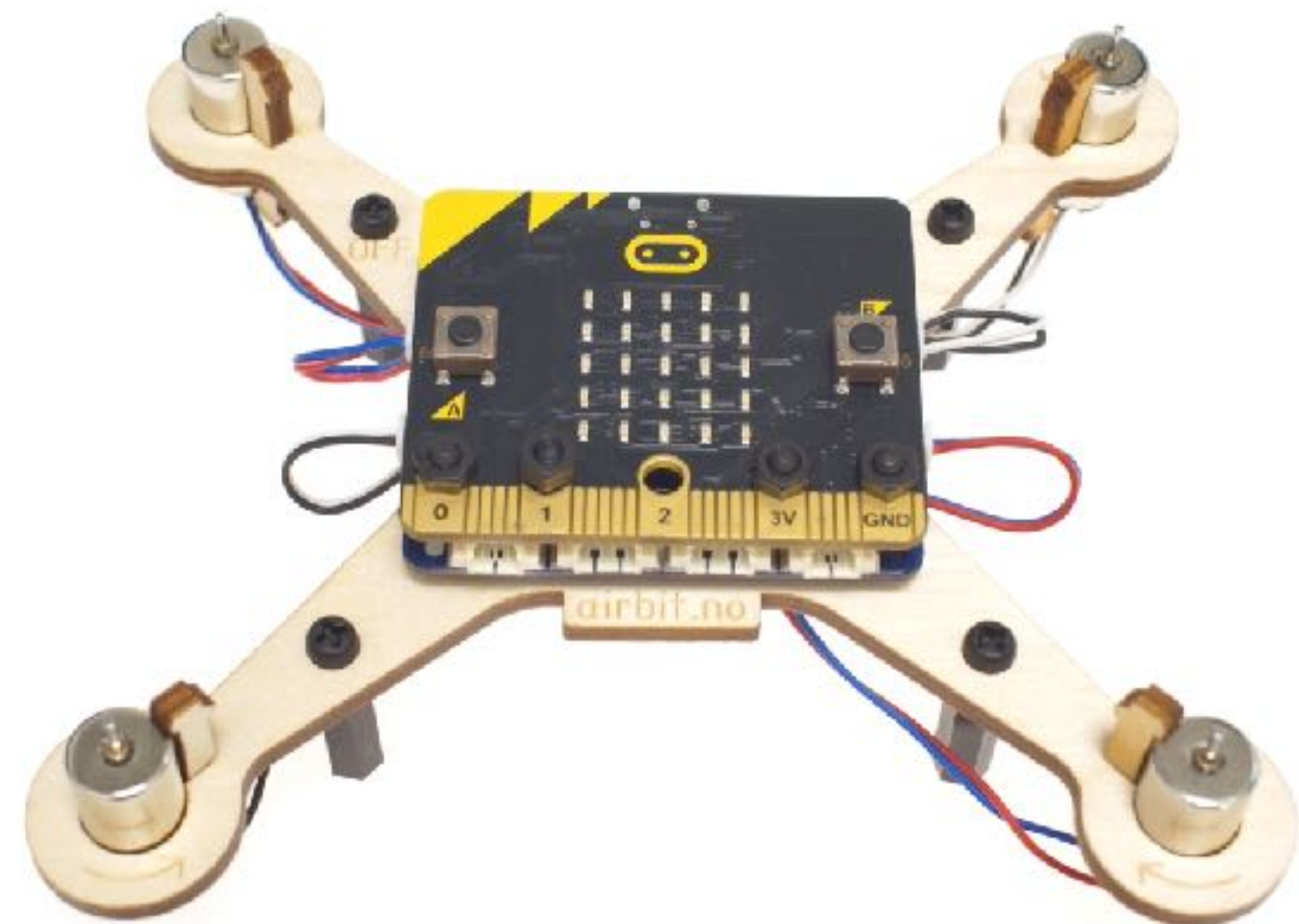
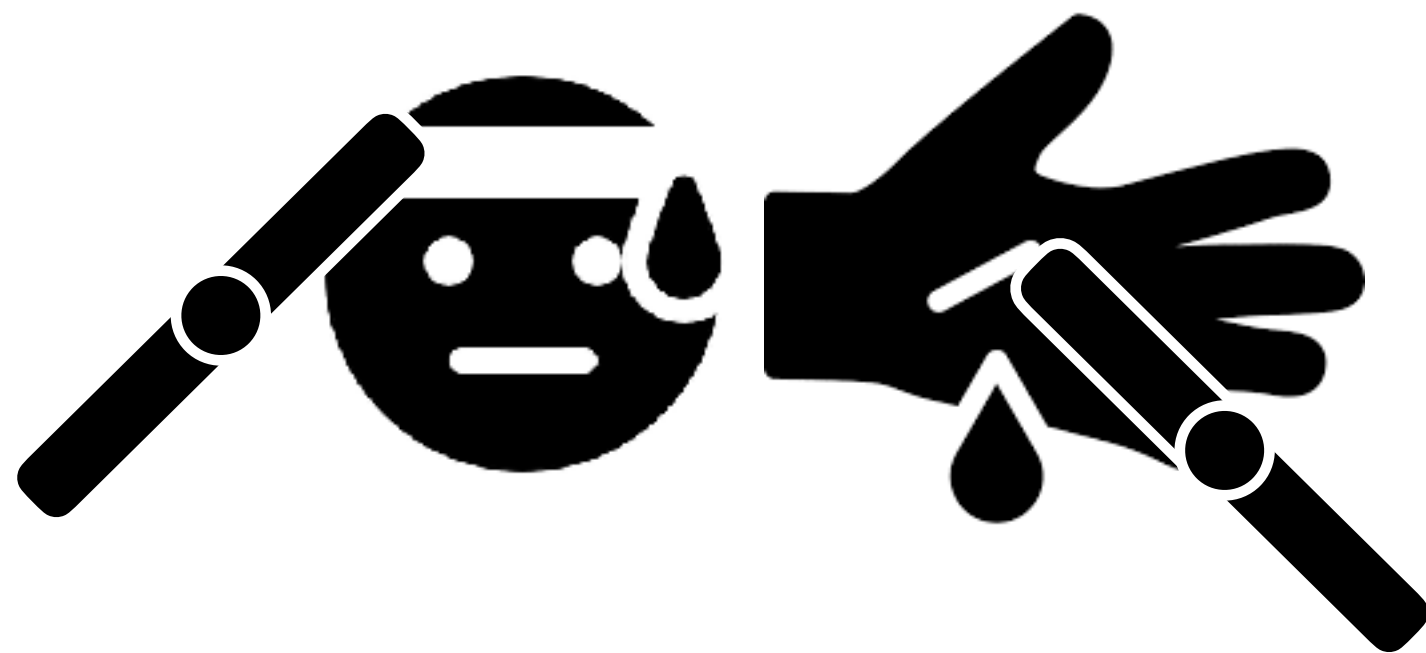
- Turn the drone upside down
- Attach the battery under the rubber band, in the very center of the drone.
- Place the smaller plug under the rubber band



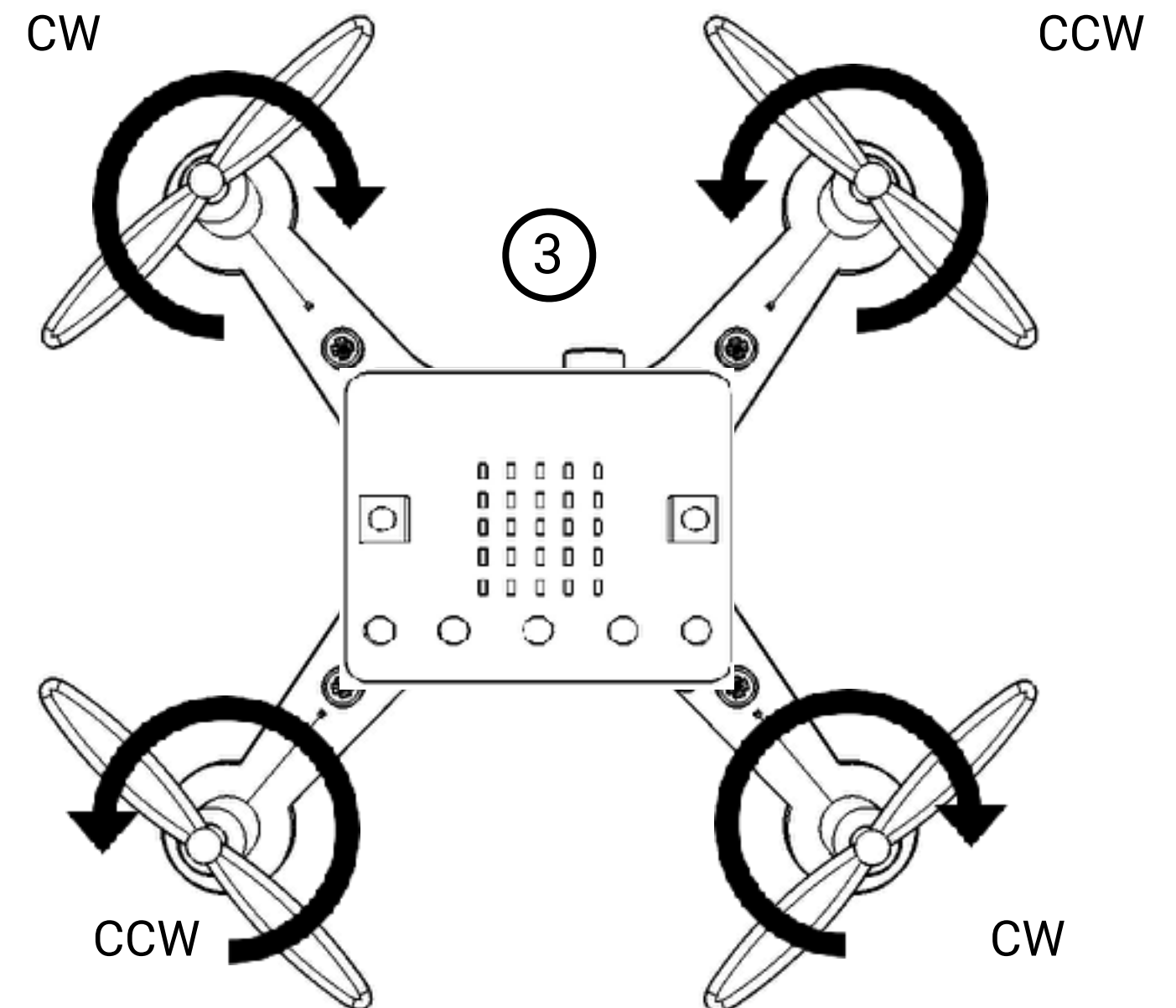
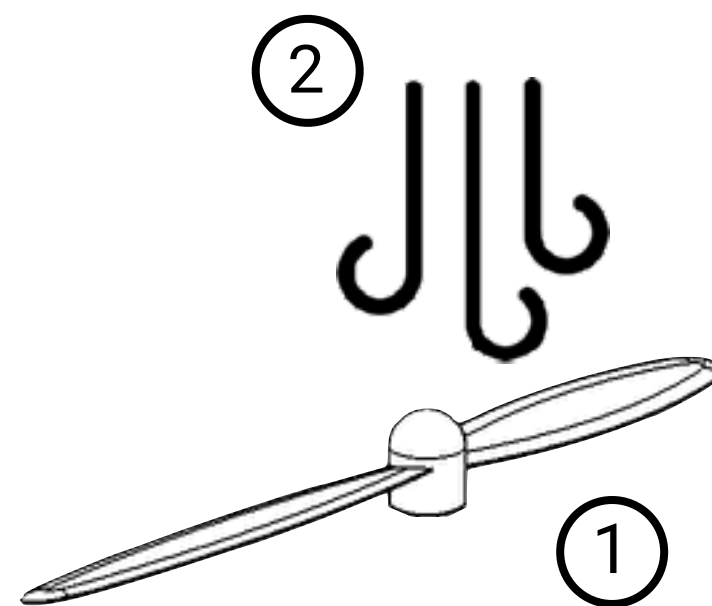
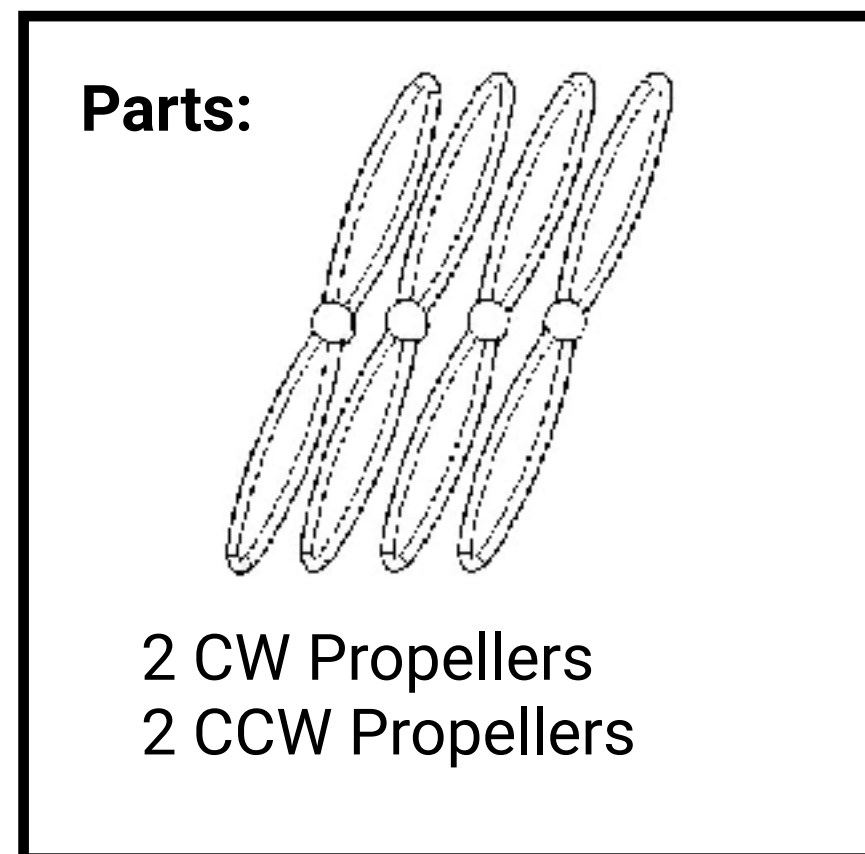
- Plug the big white connector into the control board
- Leave the micro:bit's white connector unplugged
- Notice the power switch on the right hand side

For your safety

Mount the propellers after testing the drone. Can you start and stop the motors in a controlled manner?



Propellers



- Switch off the drone
- Identify your propellers between CW (clockwise) and CCW (counter clock wise):
 - Take a random propeller. Place it on a table, able to spin (1)
 - Blow gently straight down above (2)
 - If it rotates with the clock, its a CW propeller
 - If it rotates against the clock, its a CCW propeller
- Place all four propeller on the correct motors

Feb. 16, 1926.

G. DE BOTHEZAT

1,573,228

HELICOPTER

Filed June 27, 1923

3 Sheets-Sheet 1

Coding

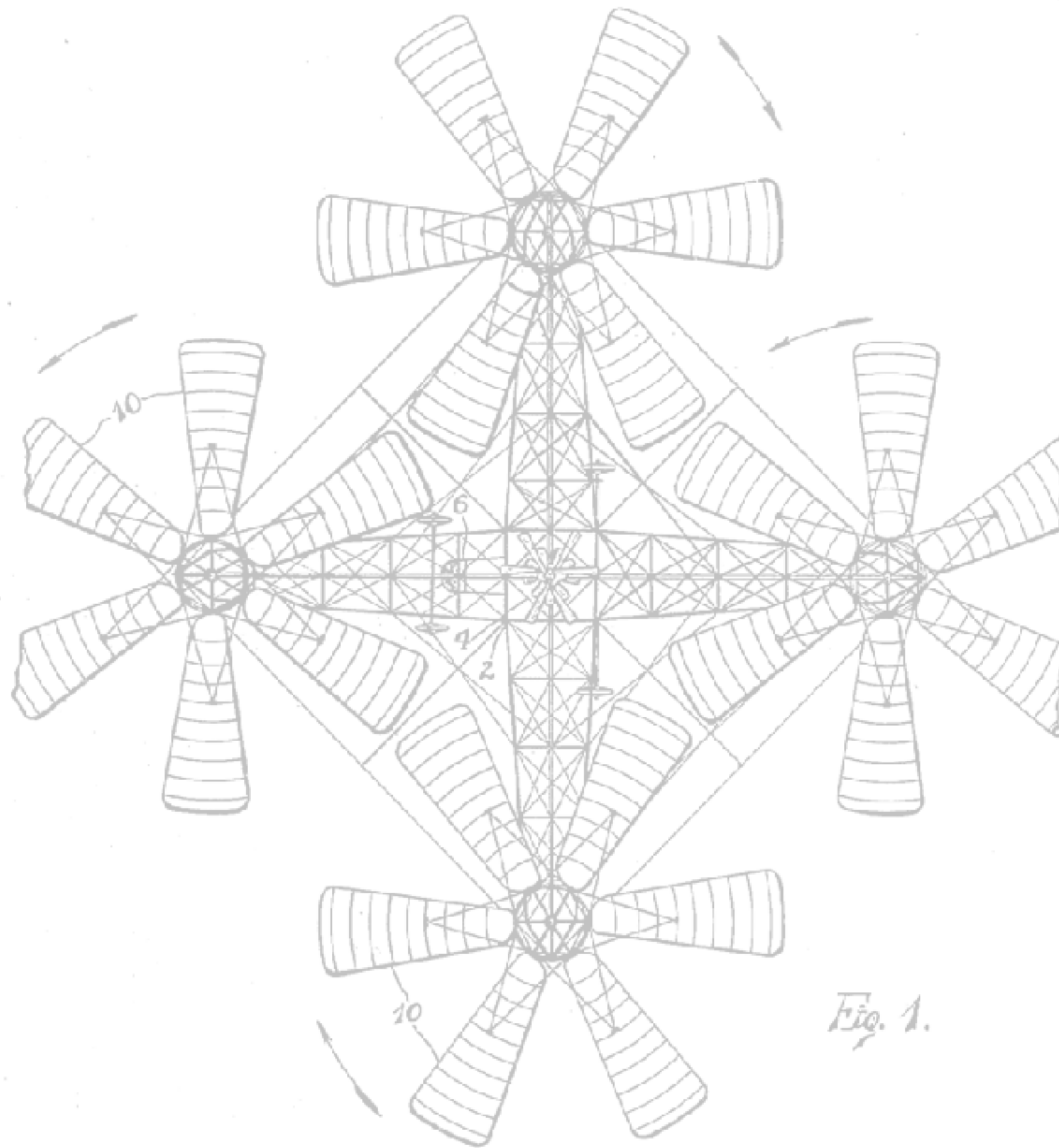


Fig. 1.

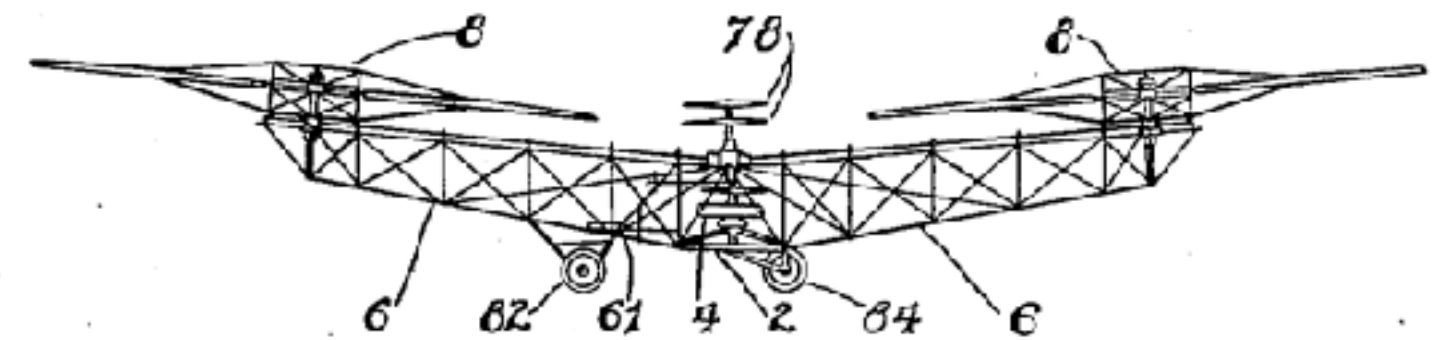
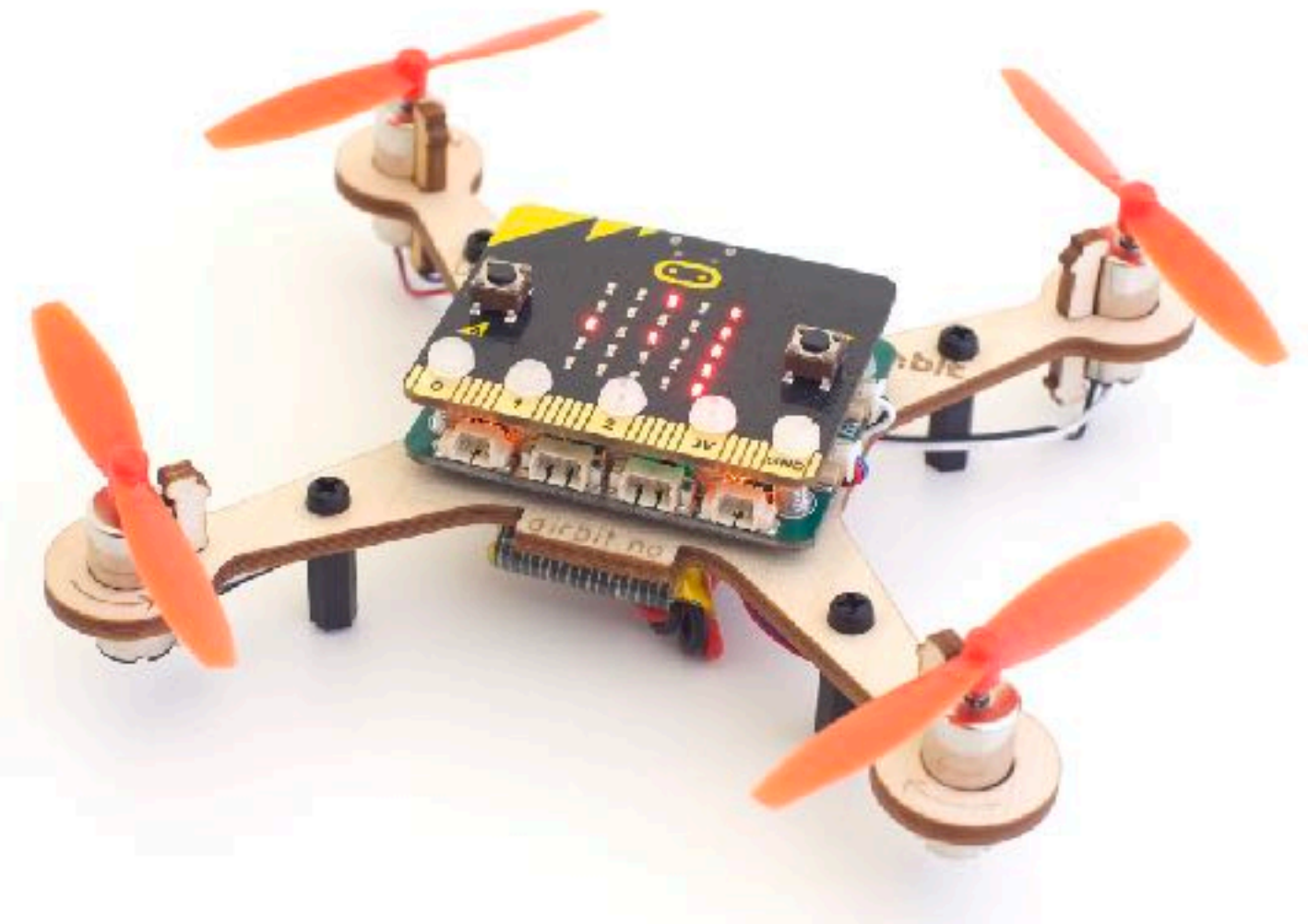
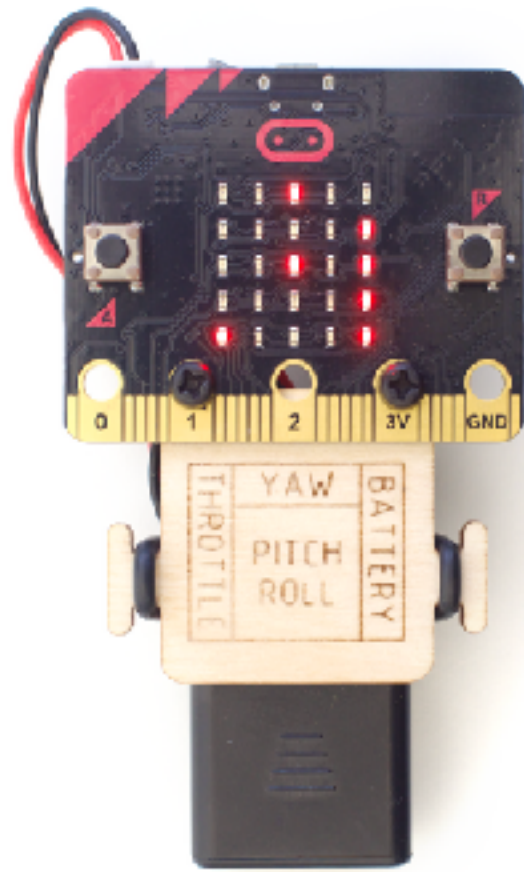


Fig. 2.

INVENTOR

BY George de Bothezat

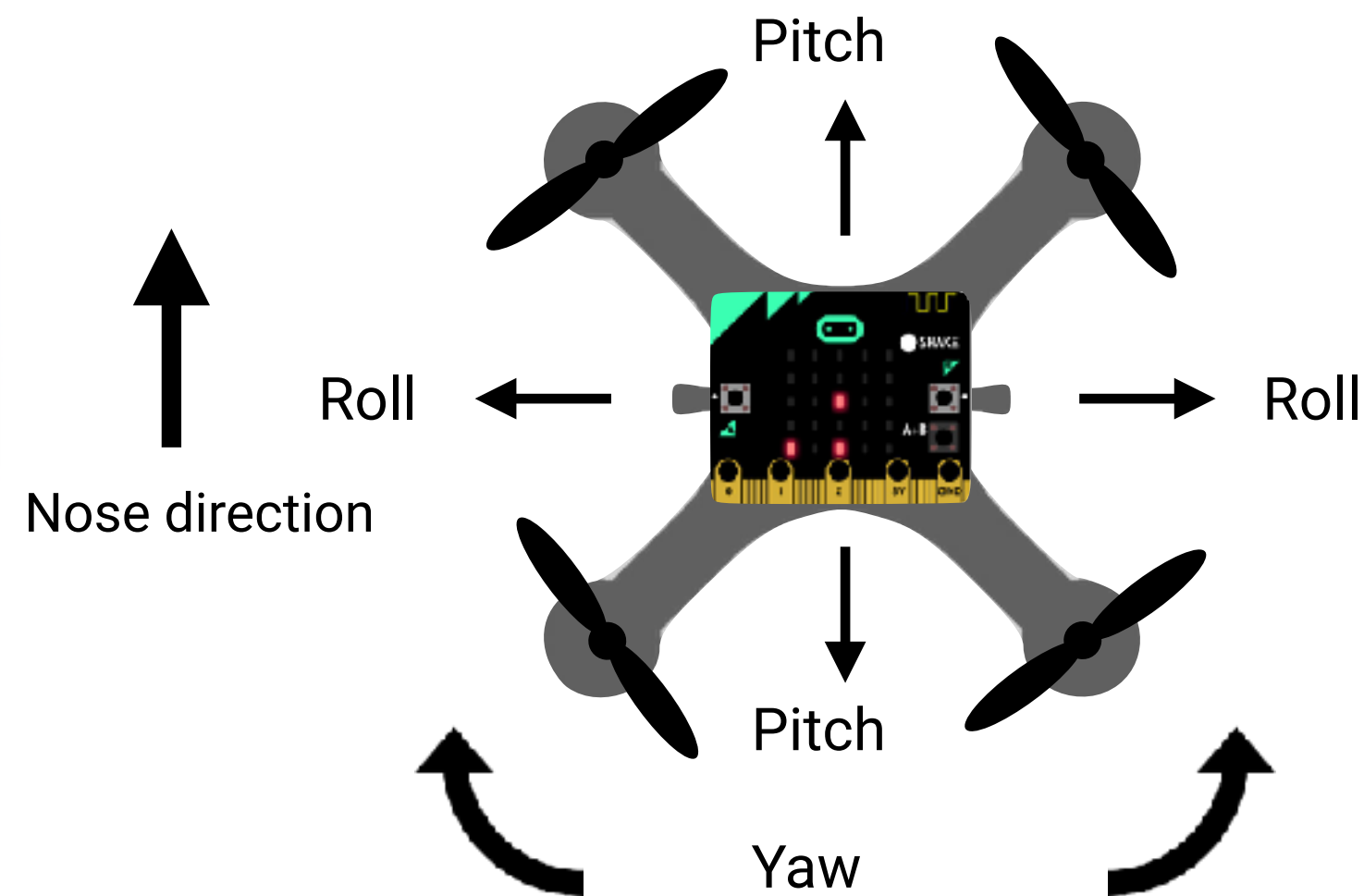
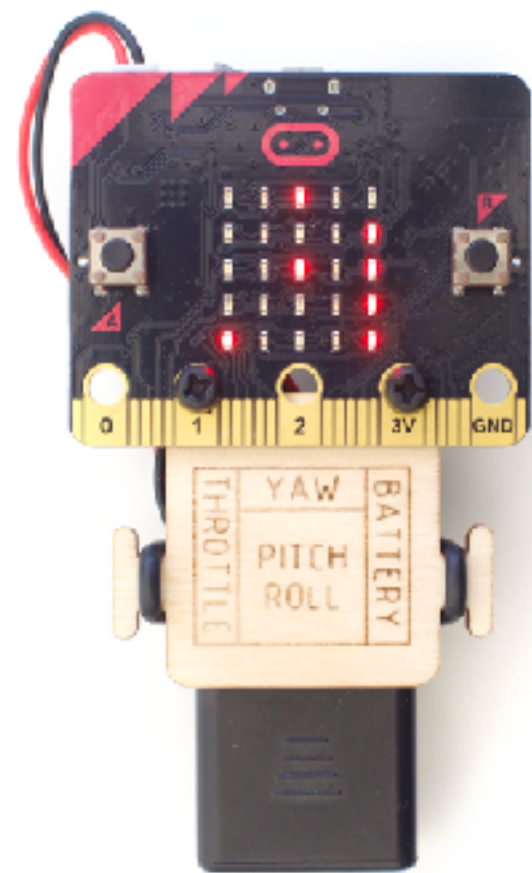
Robert H. Young ATTORNEY



PARTY

Five values to control the drone

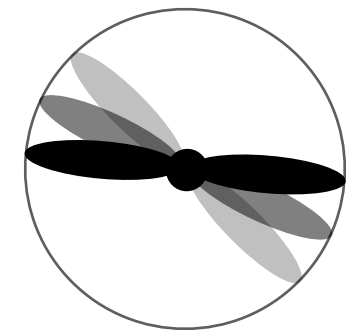
Flight directions



PARTY

pitch, arm, roll, throttle, yaw

Arm:
Start propeller

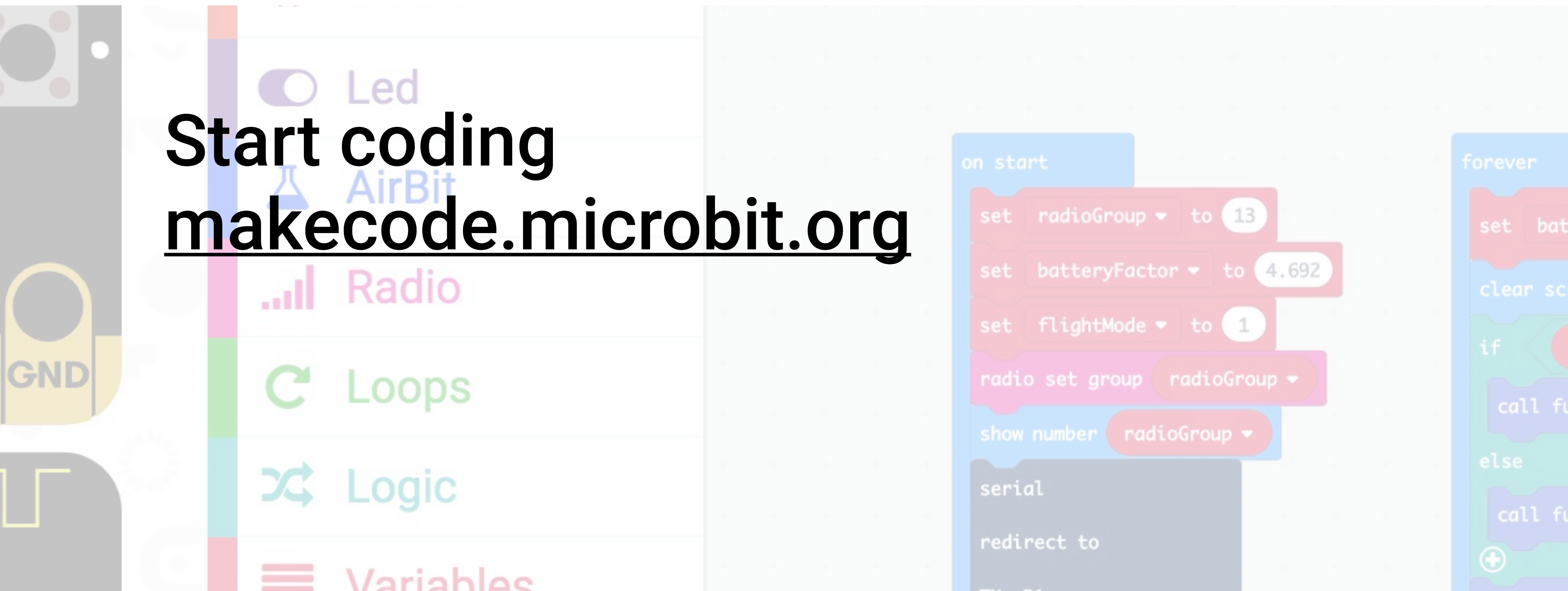


Control the drone using 5 parameters:

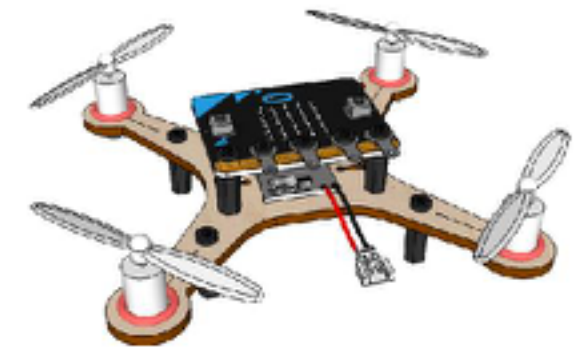
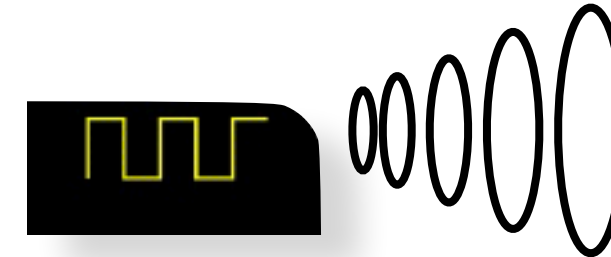
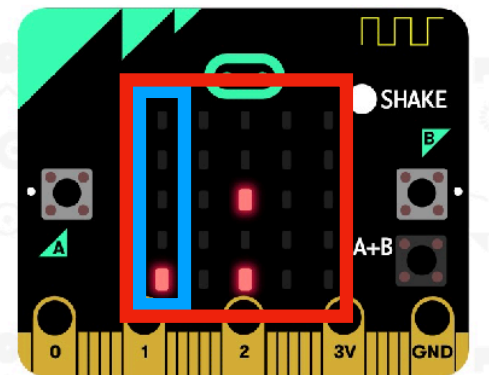
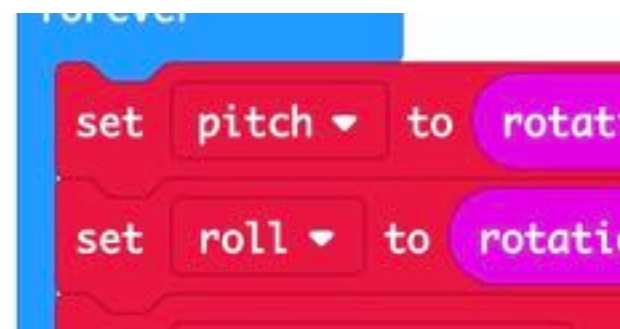
Variable:	Minimum	Neutral	Maximum
Arm	0		1
Throttle	0	50	100
Pitch	-45	0	45
Roll	-45	0	45
Yaw	-30	0	30



Start coding
makecode.microbit.org



Four steps



Collect
data

Visualize
data

Send
data

Receive
data,
fly

Collecting data for
Pitch, Arm, Roll,
Throttle, Yaw

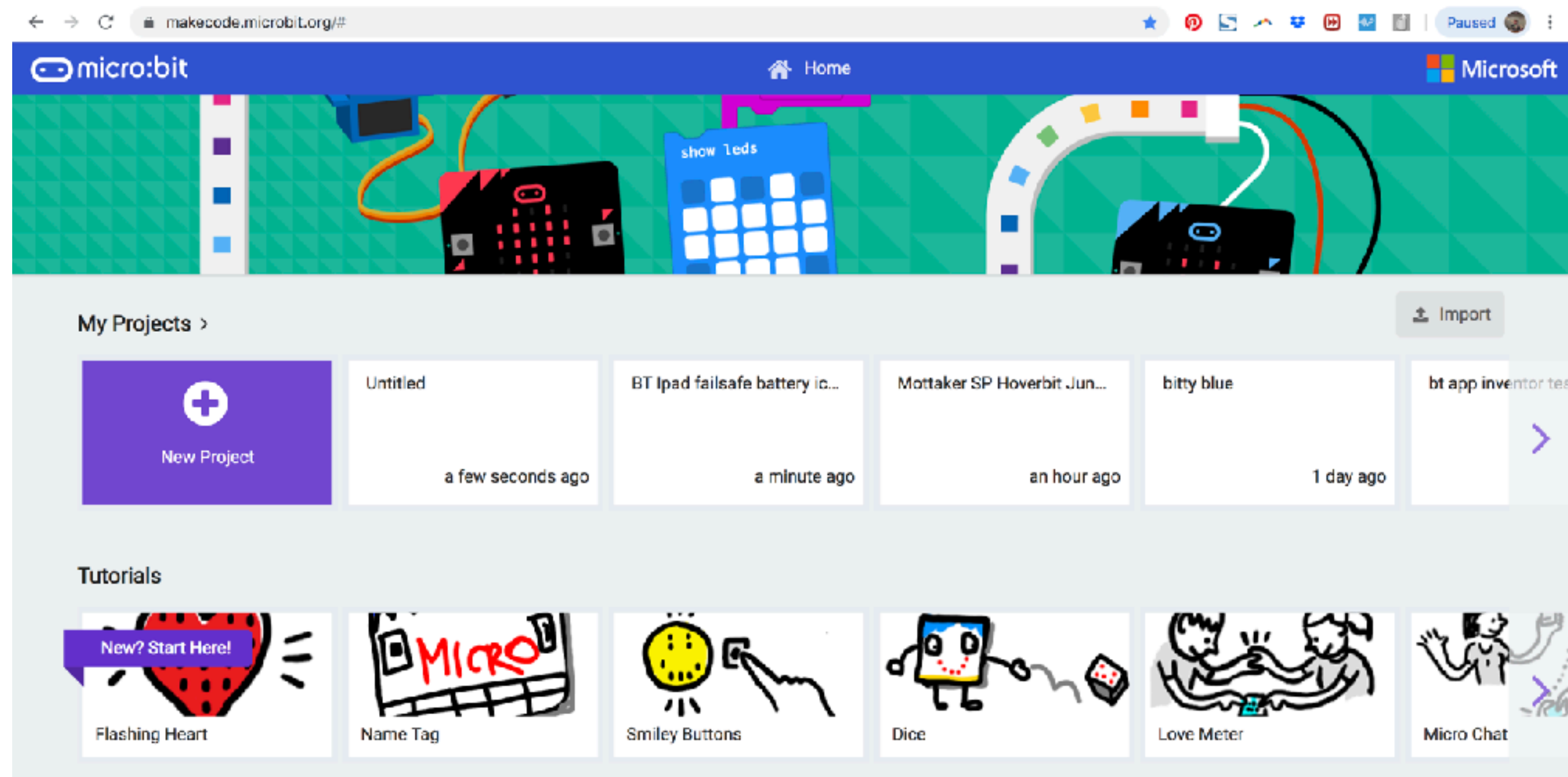
Convert the values to
coordinates for the
display

Send the value over
the radio

Receive the values
and turn the into
control signal for the
Air:bit control board

Start at makecode.microbit.org

Chrome is recommended for better connection with the micro:bit



Select “New project”.

PS. If you’re new to micro:bit you should try one of the tutorials above first.

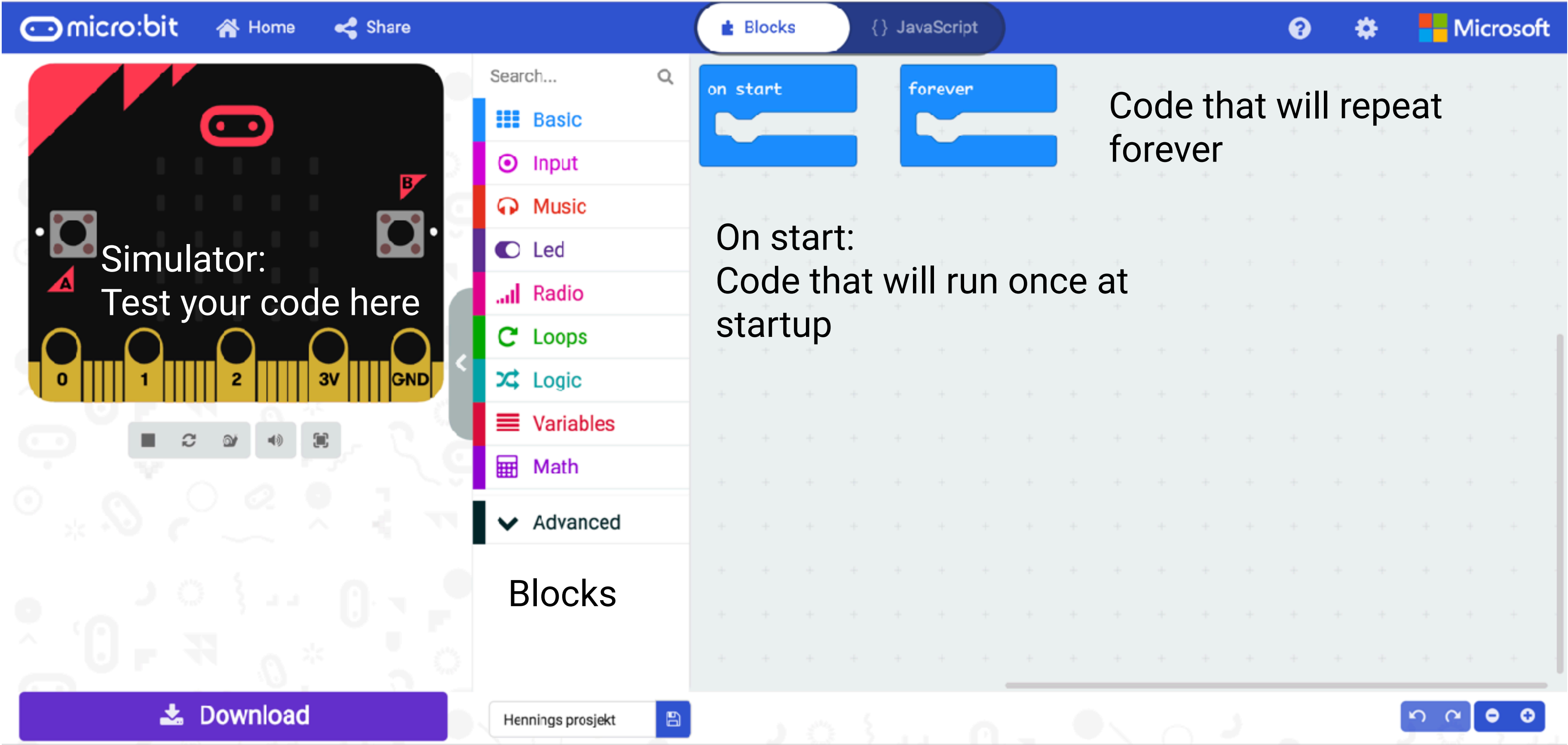
The editor

Main menu

Share your code

Block mode Javascript mode

Settings



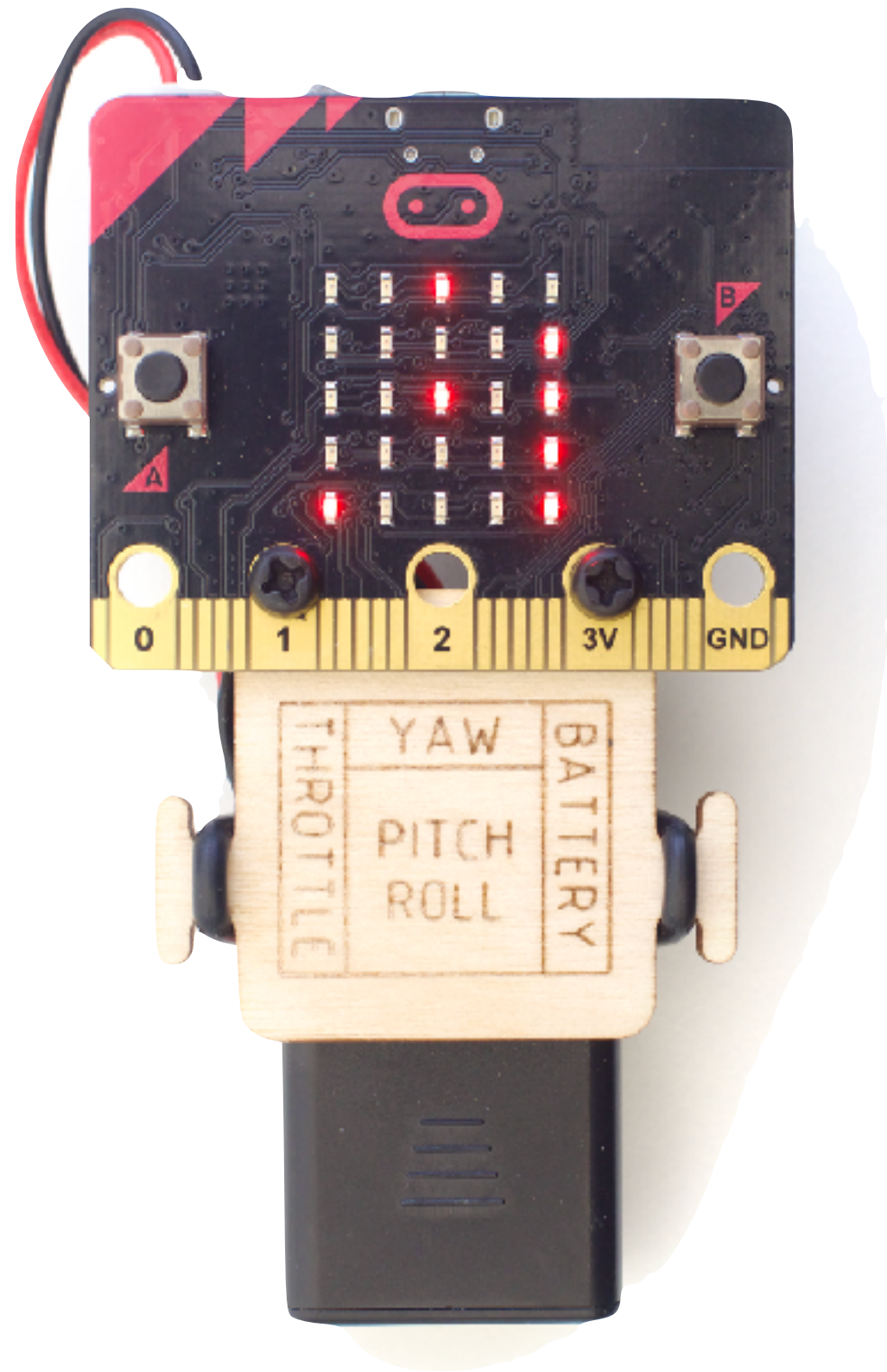
Save a backup

Undo zoom

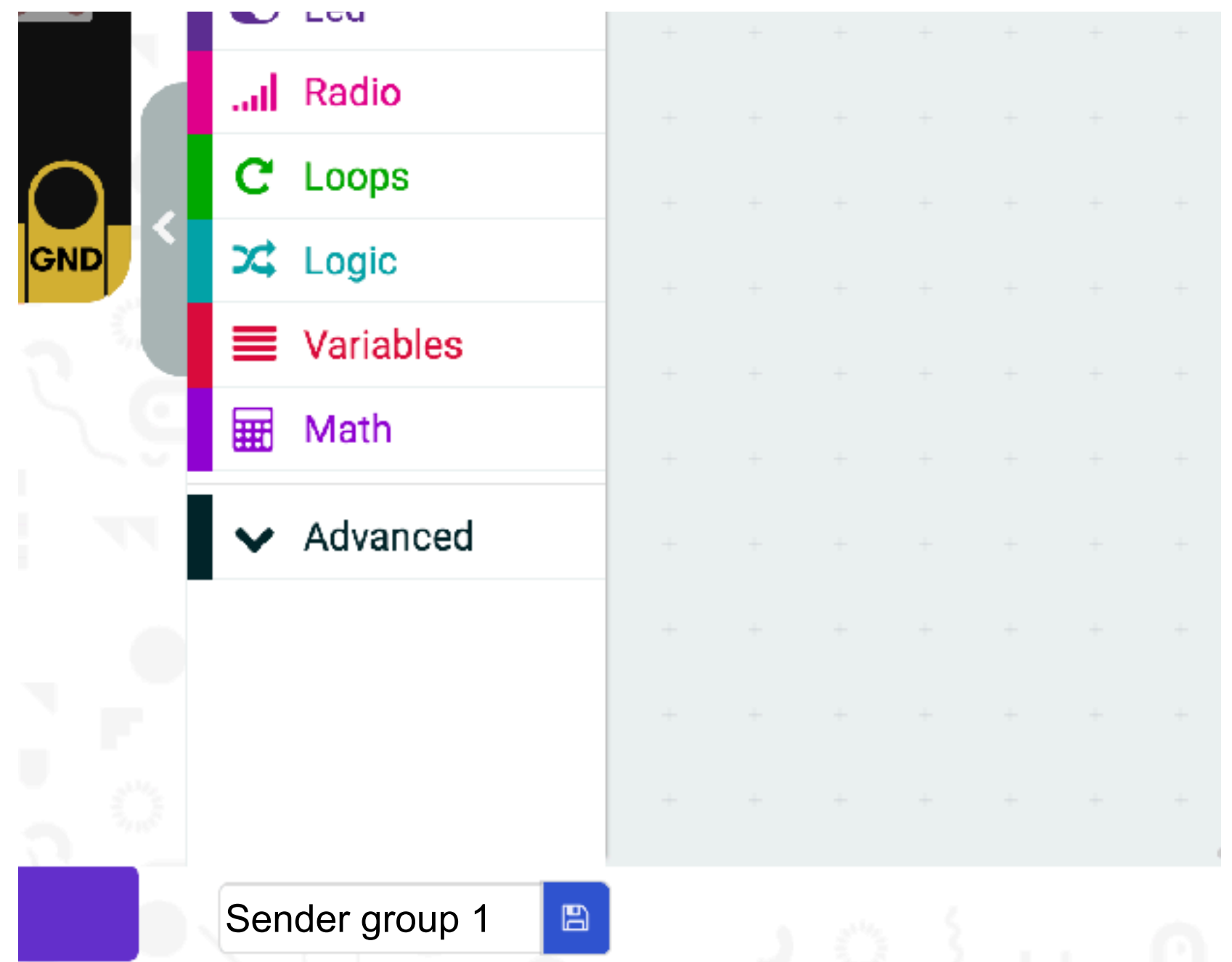
Download to micro:bit

Name your project

Get the variables and code the remote

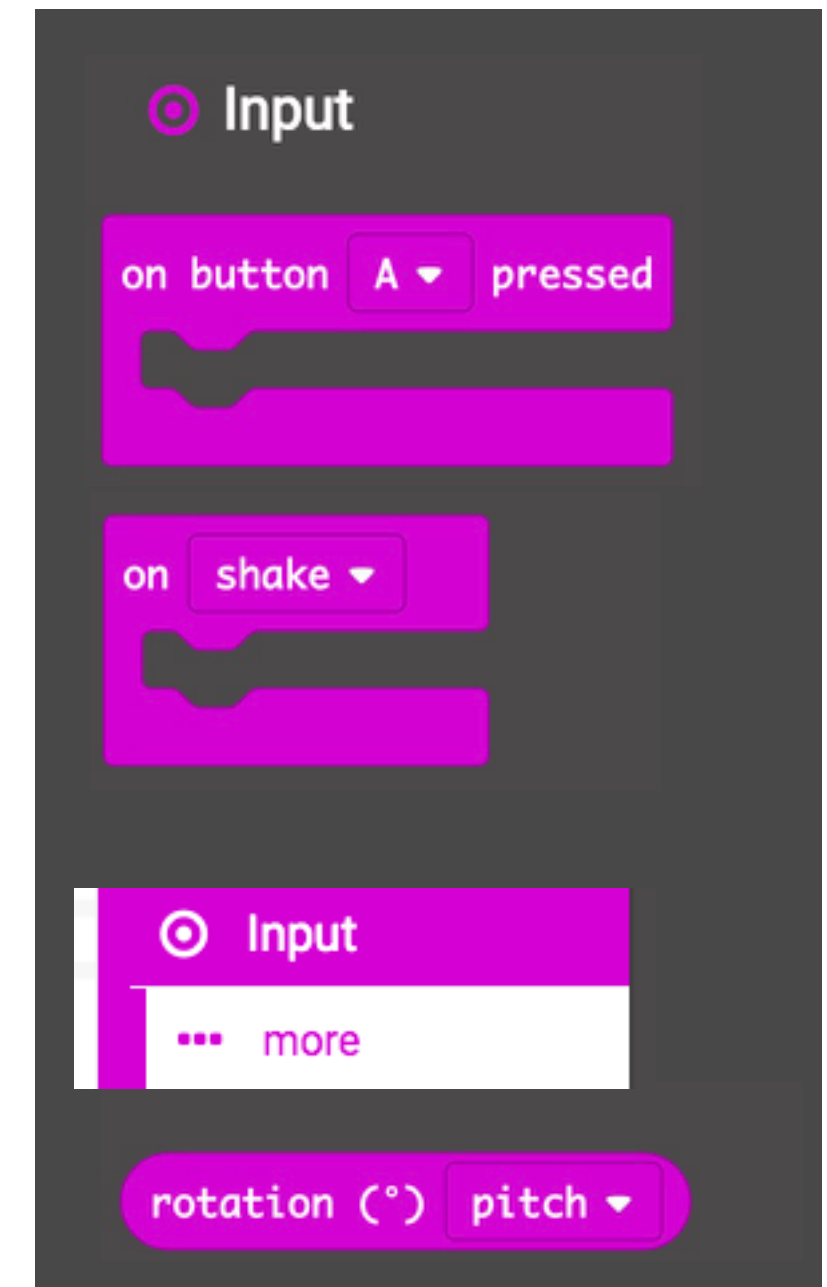
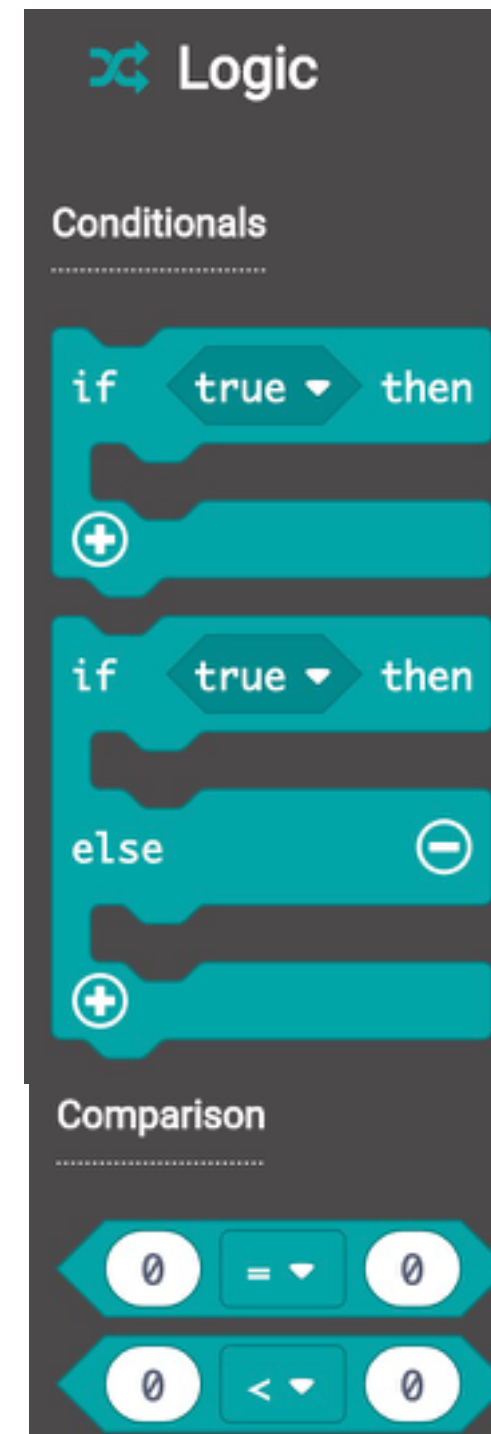
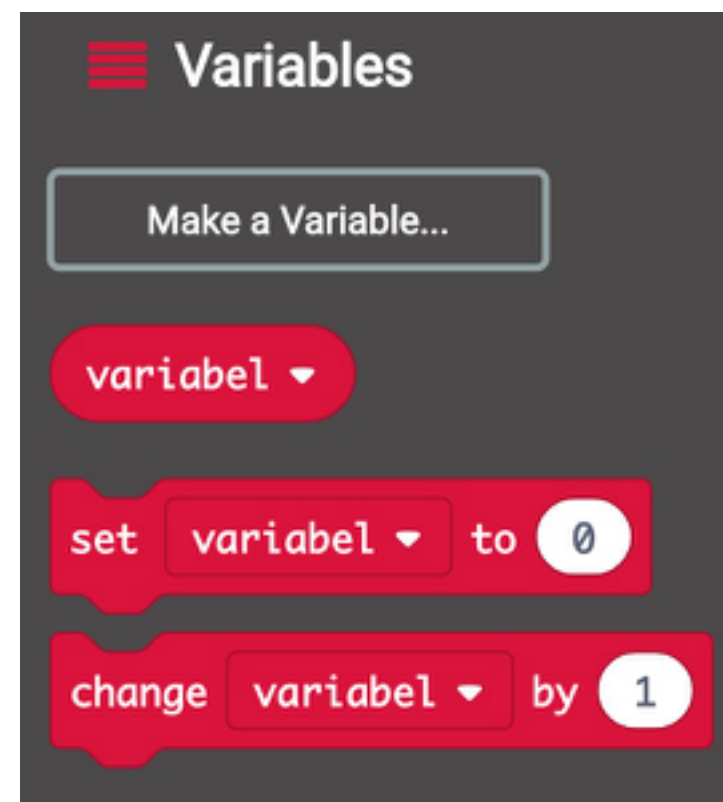
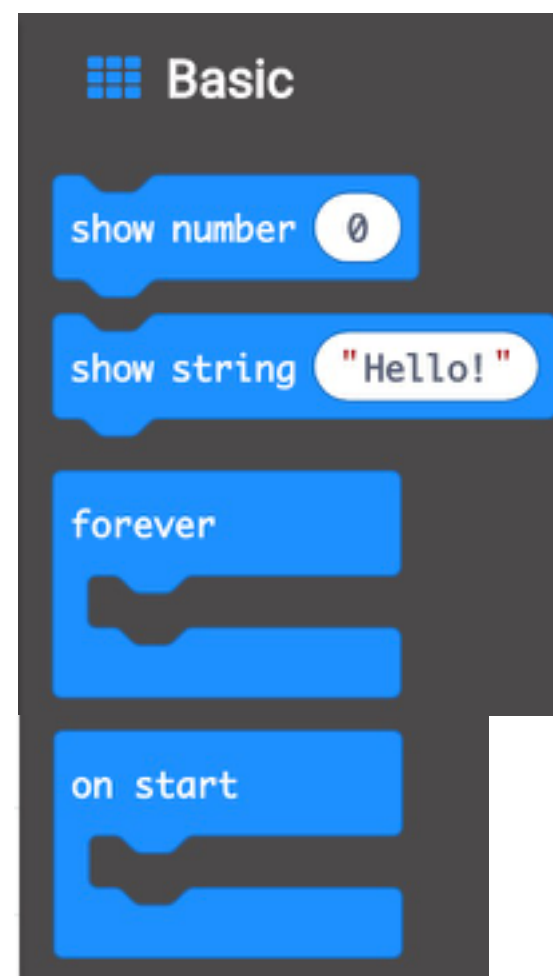


Start by giving your project a name like "Sender group x".
This is your unique radio channel. If you are flying alone you
can use channel 7

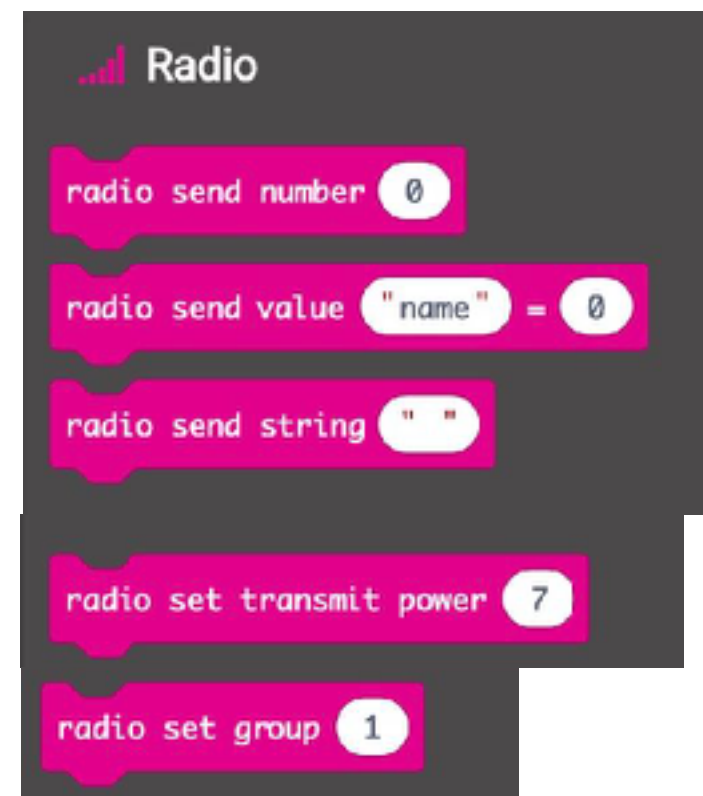
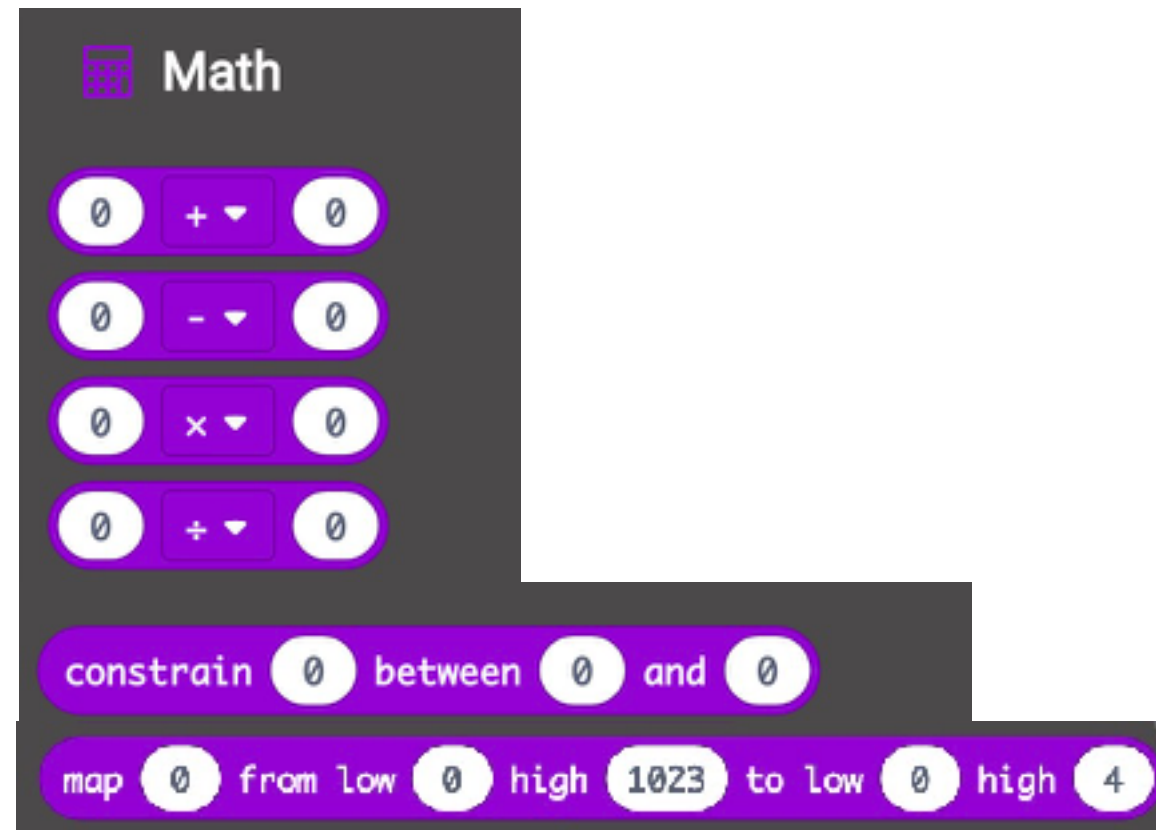


Code blocks

We will be using these blocks



More blocks



PARTY

pitch, arm, **roll**, **throttle**, yaw

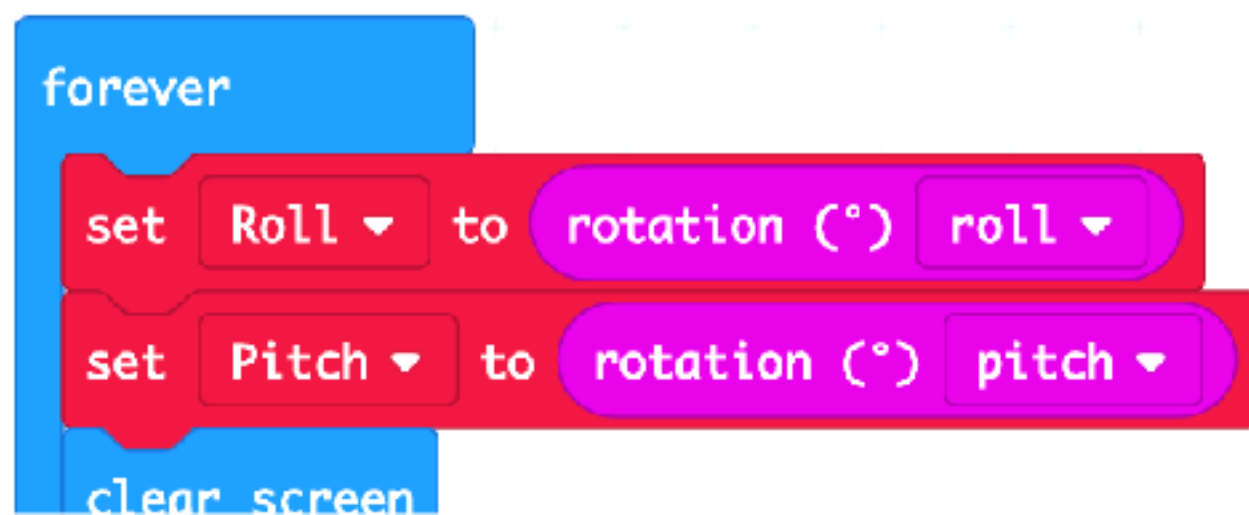
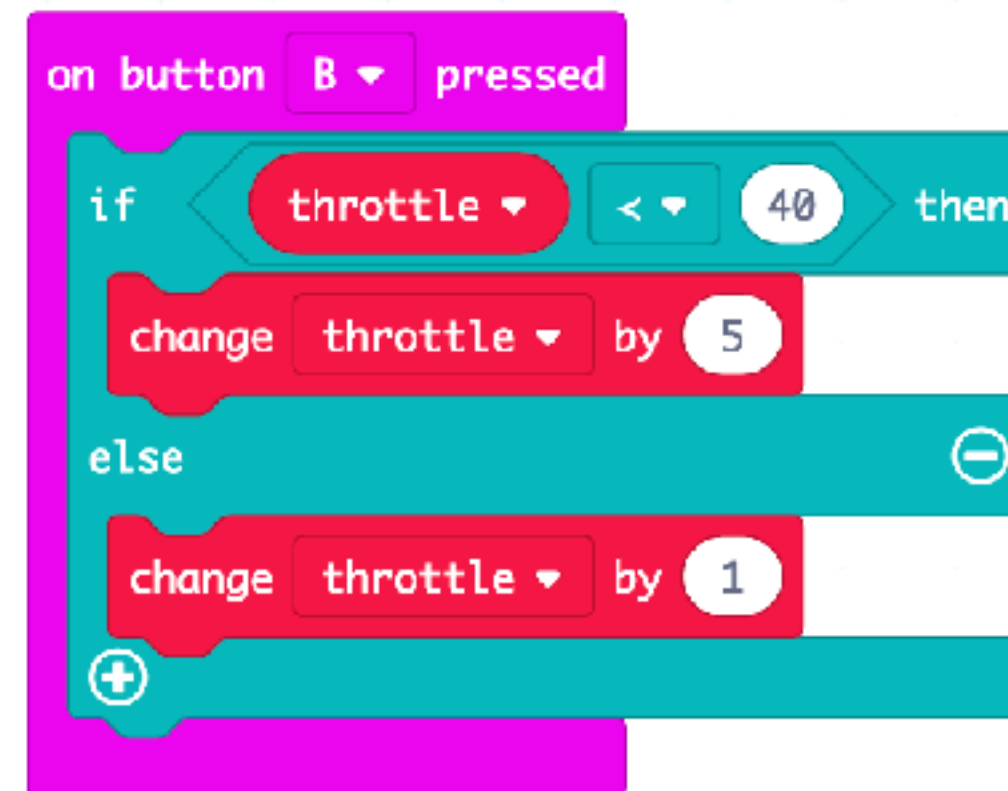
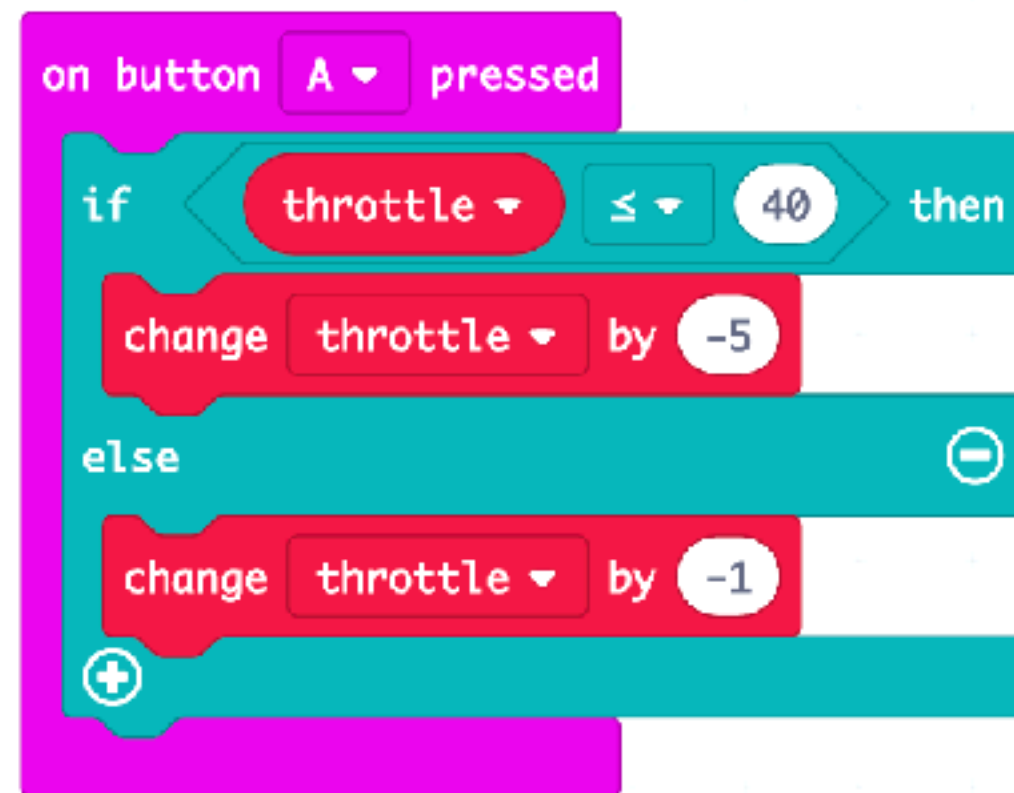
Throttle

- Make a variable called Throttle
- Use the buttons A and B to change the throttle. A should reduce it with 5, B should increase it with 5
- Use Show Number (in the forever loop) to verify that throttle is changing correctly
- When above 40, throttle should only change by 1 for better precision when drone is hovering.

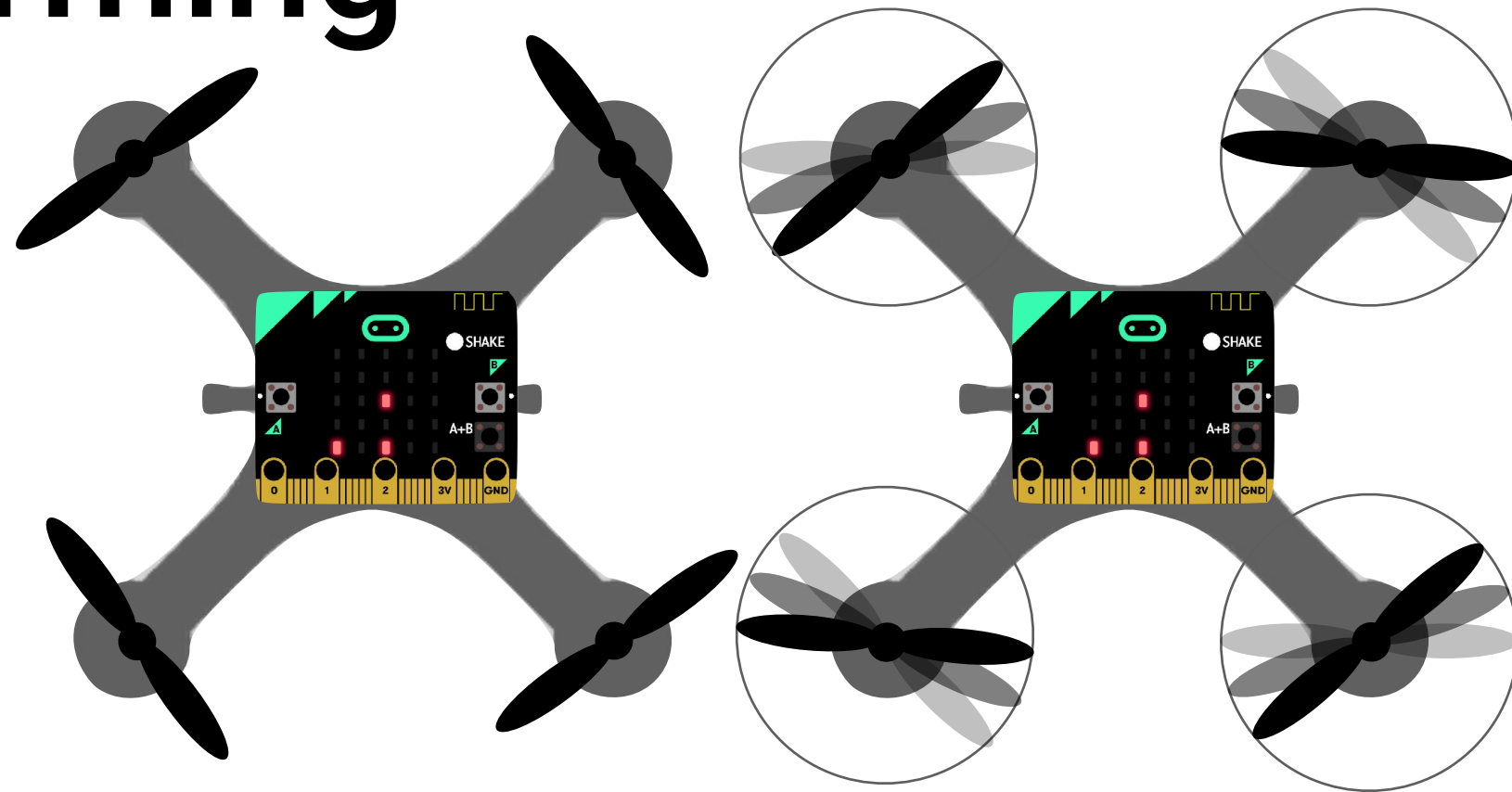
Roll og Pitch

- Make a variable called Roll and one called Pitch
- In the forever loop: Set the variables roll and pitch to the input -> more -> rotation.roll and rotation.pitch

Solution



Arming



Disarmed

Armert

Arming

- Arming is a safety switch and the propellers will only spin when arm is set to 1

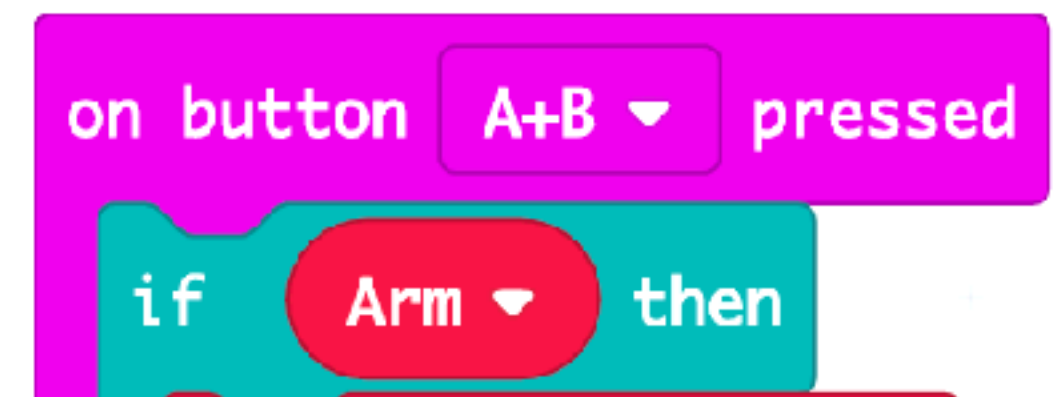
Task:

- Make a variable called Arm
- When pressing A+B, change the Arm between 0 and 1
- If Arm is 1 make it 0 and visa versa
- Use Show Number: Arm to verify
- When pressing A+B also reset throttle to 0

Bryteren setter Arm til 0 og 1 annenhver gang

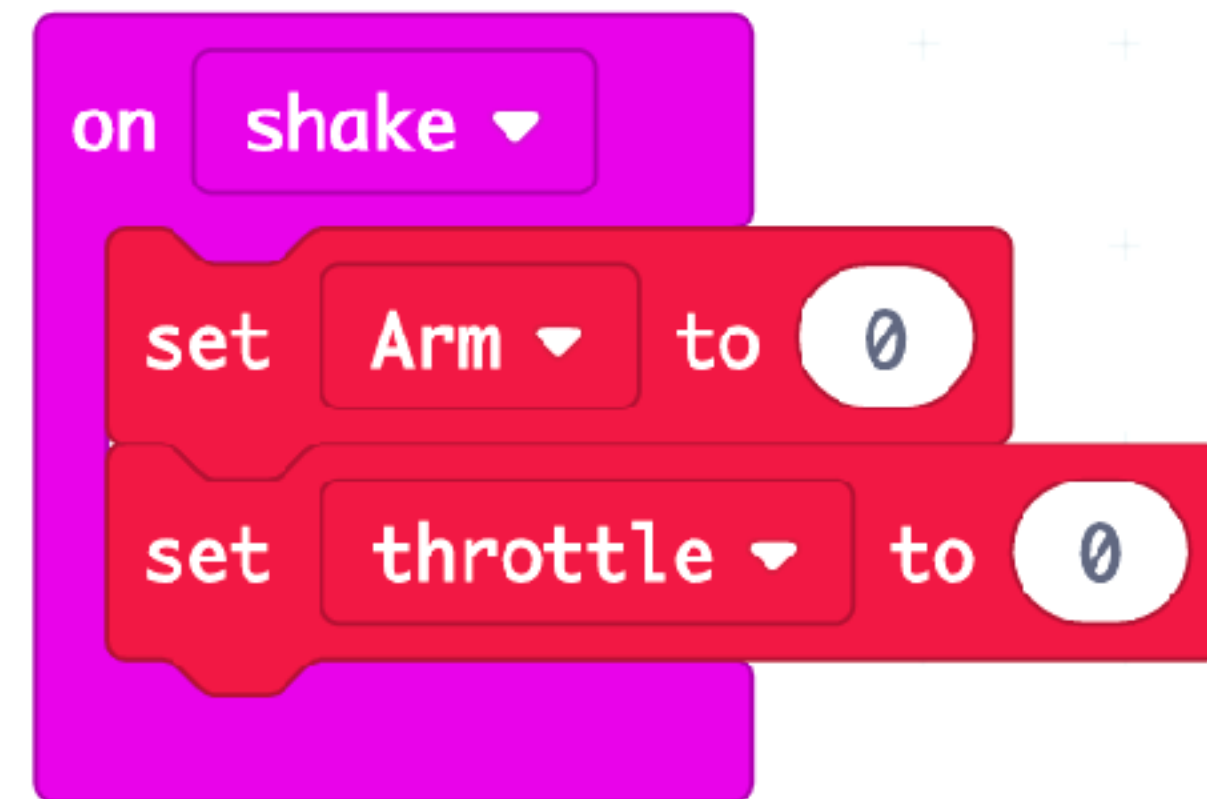
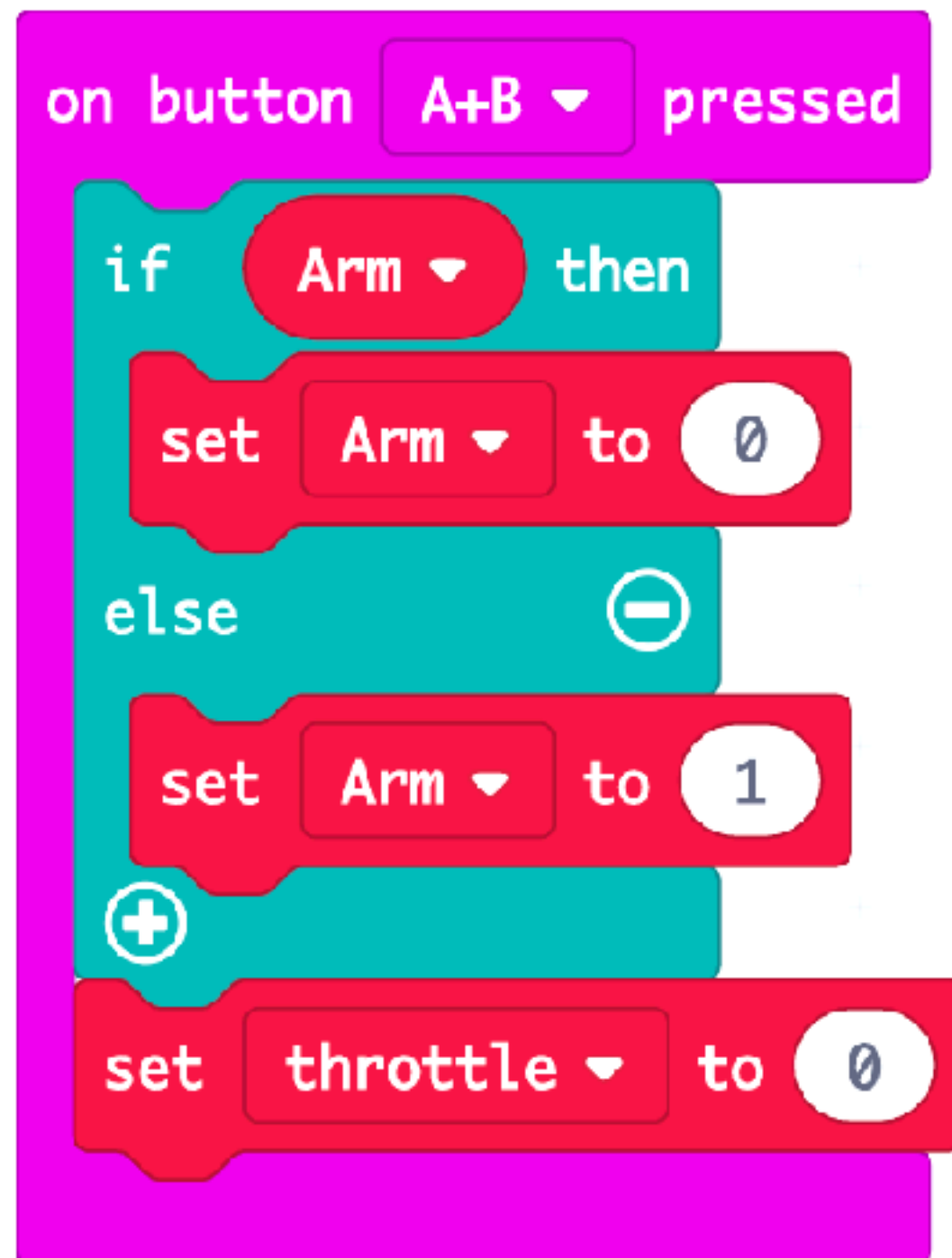


PARTY



Tips! Bruk **If Arm** (betyr "hvis arm ikke er 0")
I praksis betyr dette "hvis dronen er armert"

Solution

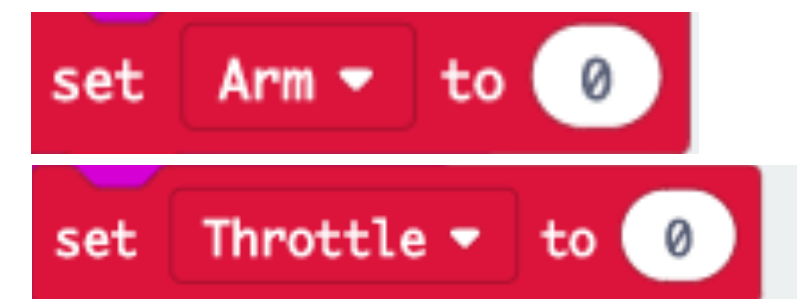
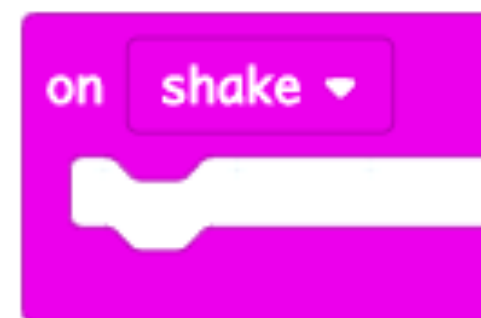
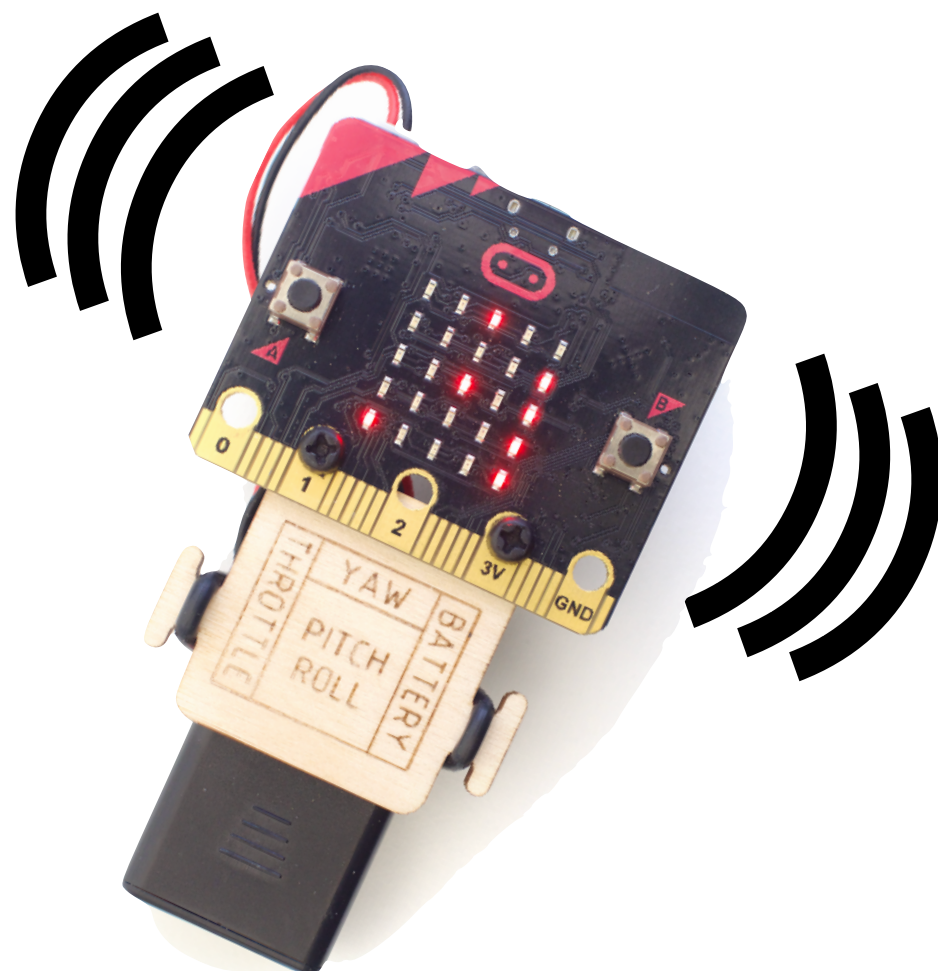


Panic feature

If we loose control of the drone or crash, a panic button will be handy. It will cut off the motors immediately.

Task:

- Use the On Shake feature to disarm the drone. It will detect a shake from the remote control.
- Think twice before using the feature from above 2 meters altitude or the drone can crash and be damaged.



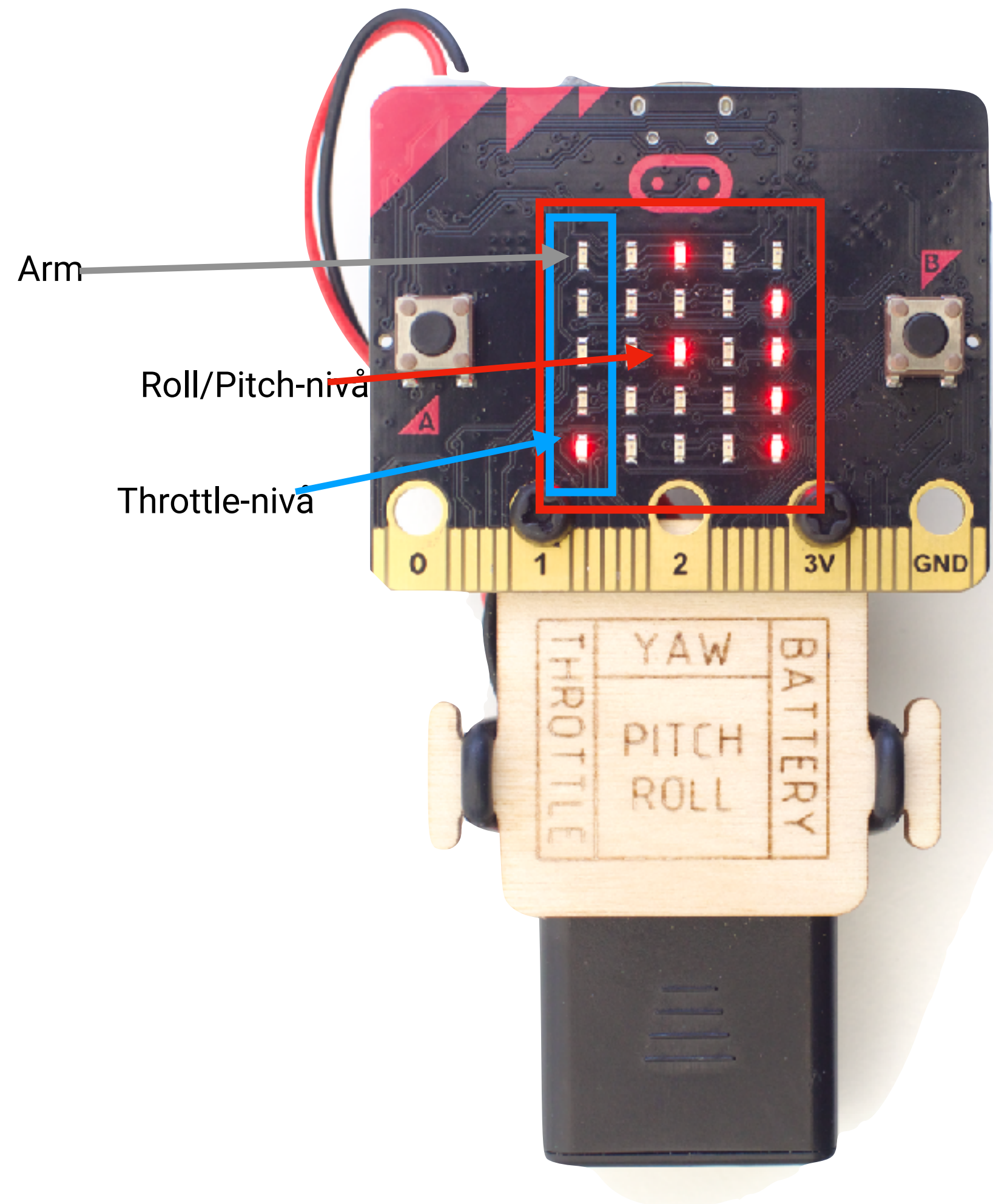
Solution



Visualise the variables

We can use the display to show basic information from our PARTY values.

- Arm-pixel lights when armed
- Throttle-pixel moves upwards when throttle increases (thrust)
- Roll and pitch is the X and Y position of the center dot



Visualise Arming

Arming

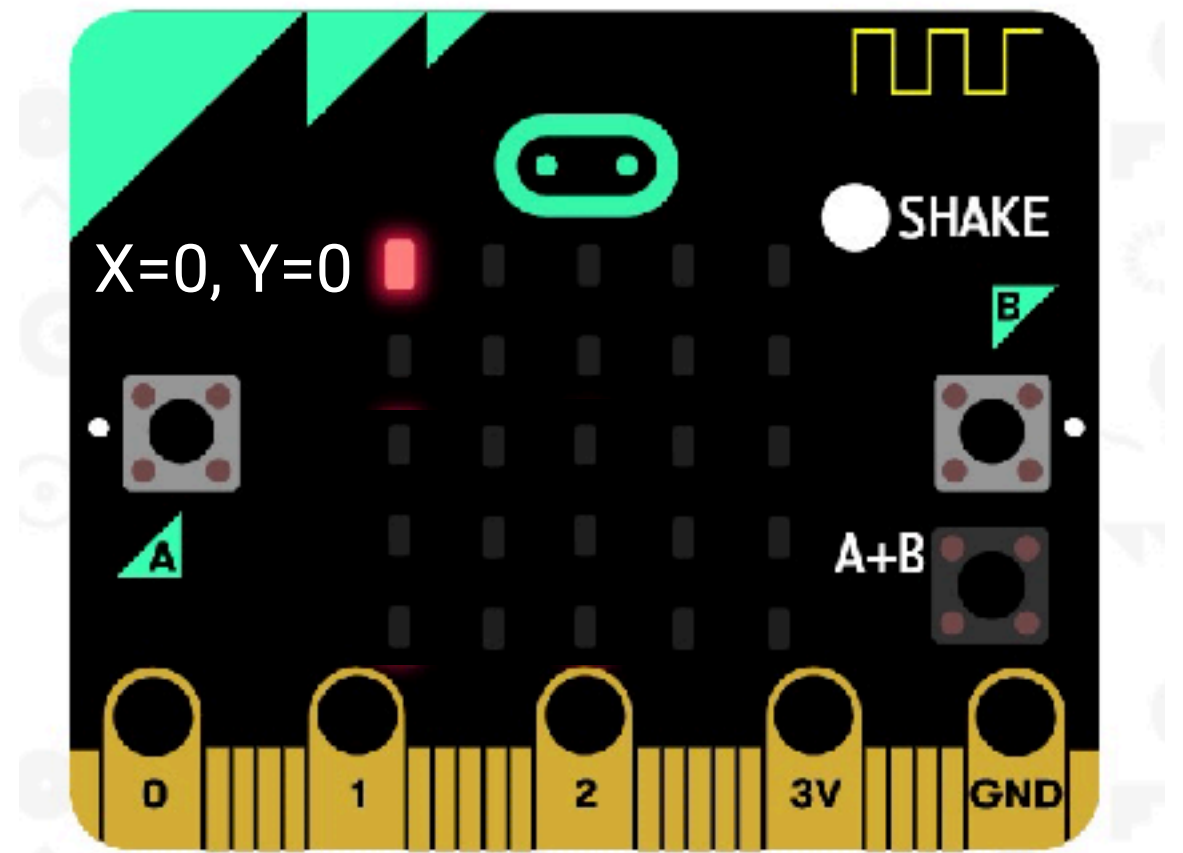
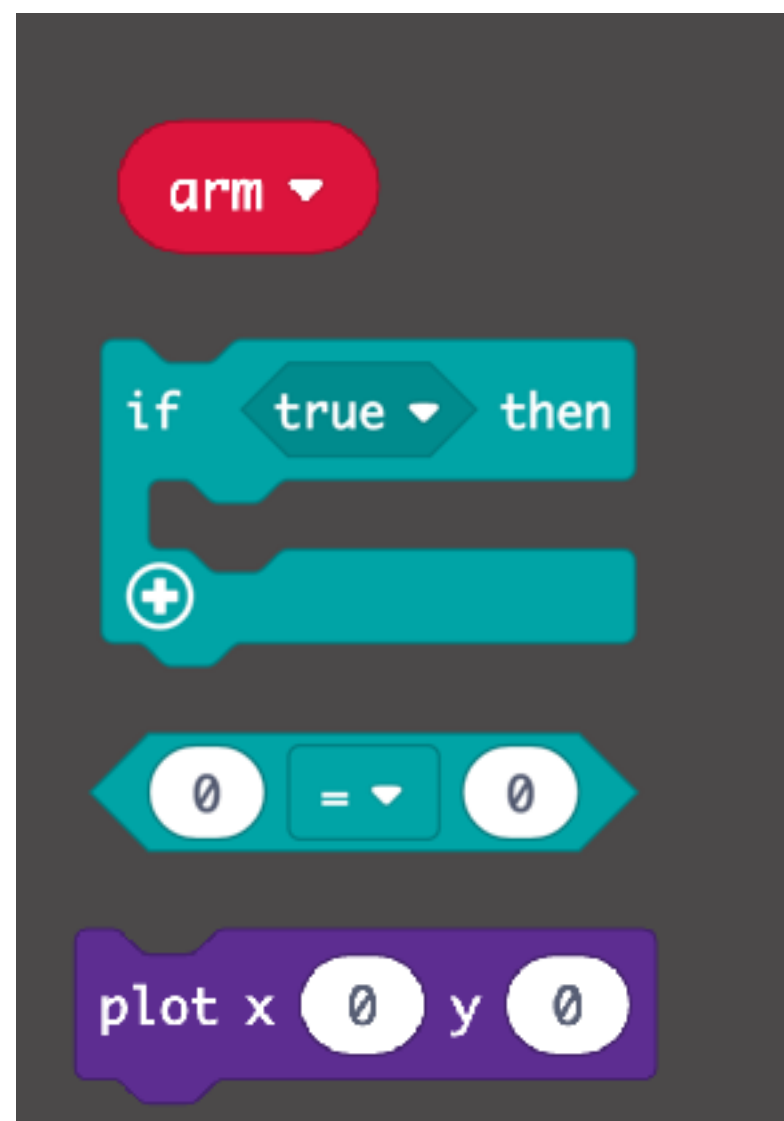
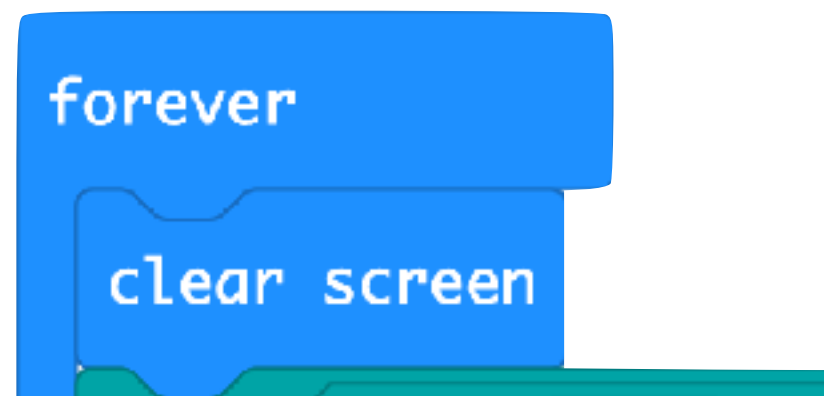
Use the screen to show if the drone is armed.

Find the forever-block.

Insert a clear screen block.

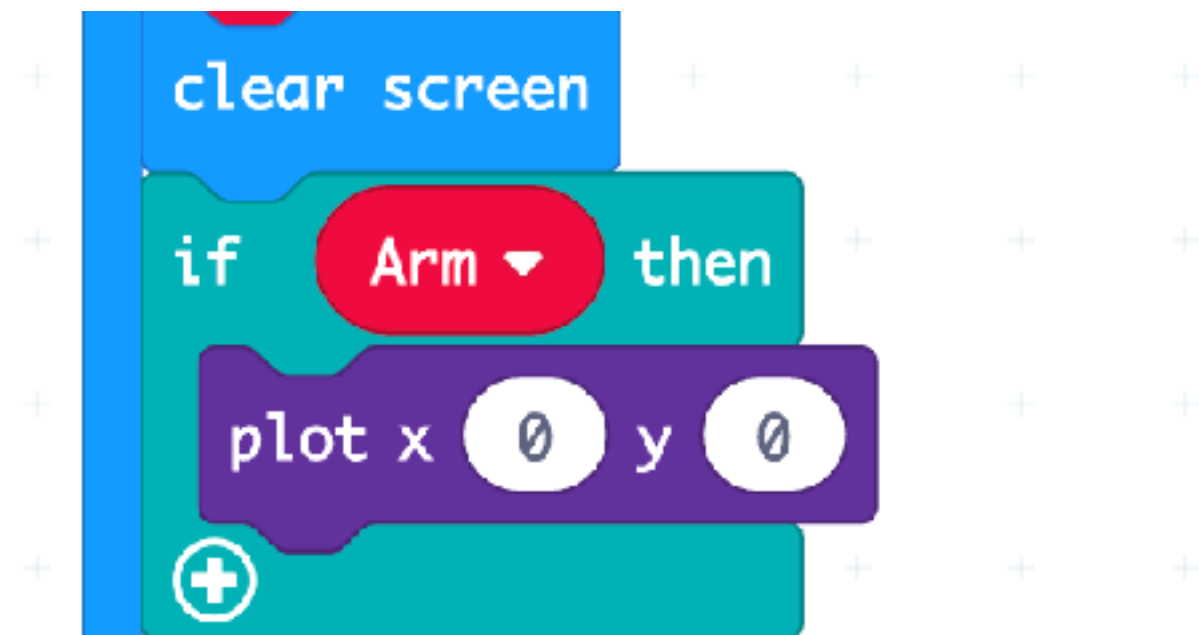
Use the if-block to check if arm is on (armed).

If armed plot at 0,0 (or another place off your choice)



- **Extra challenge:** Make the pixel blink

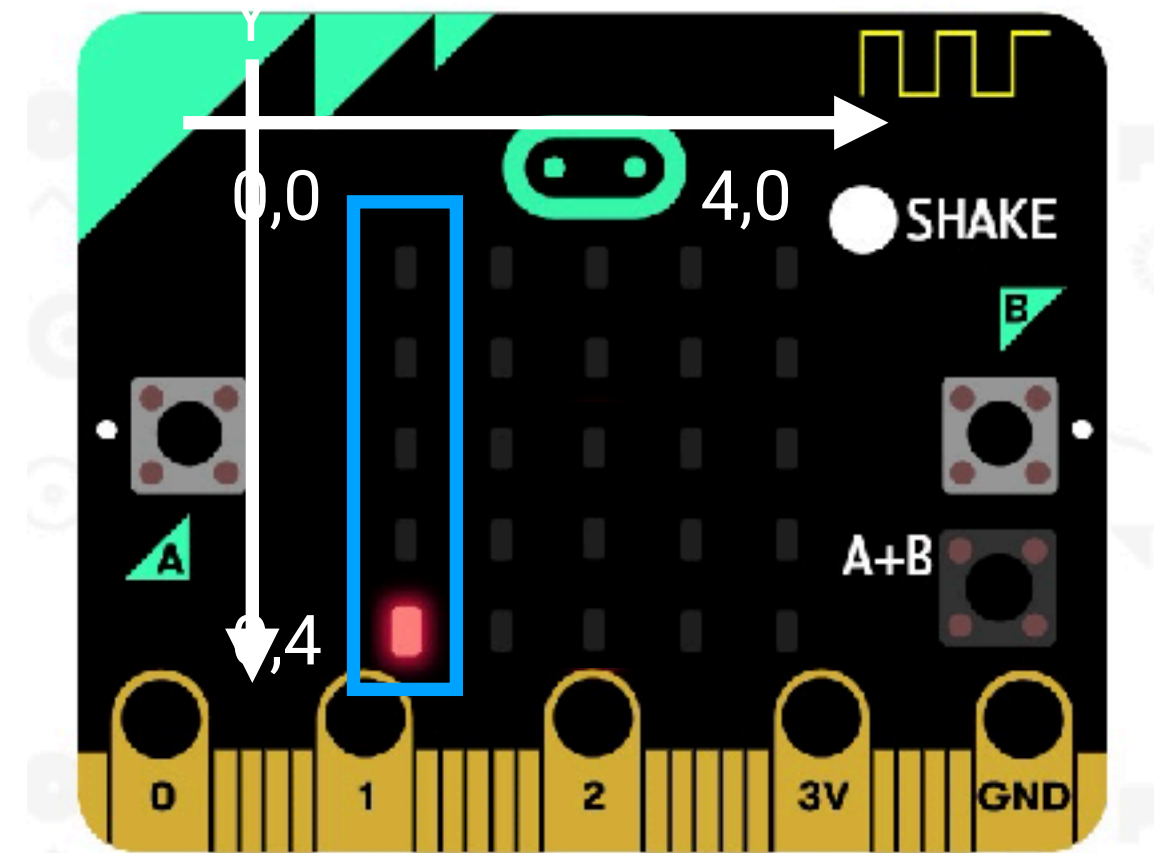
Solution



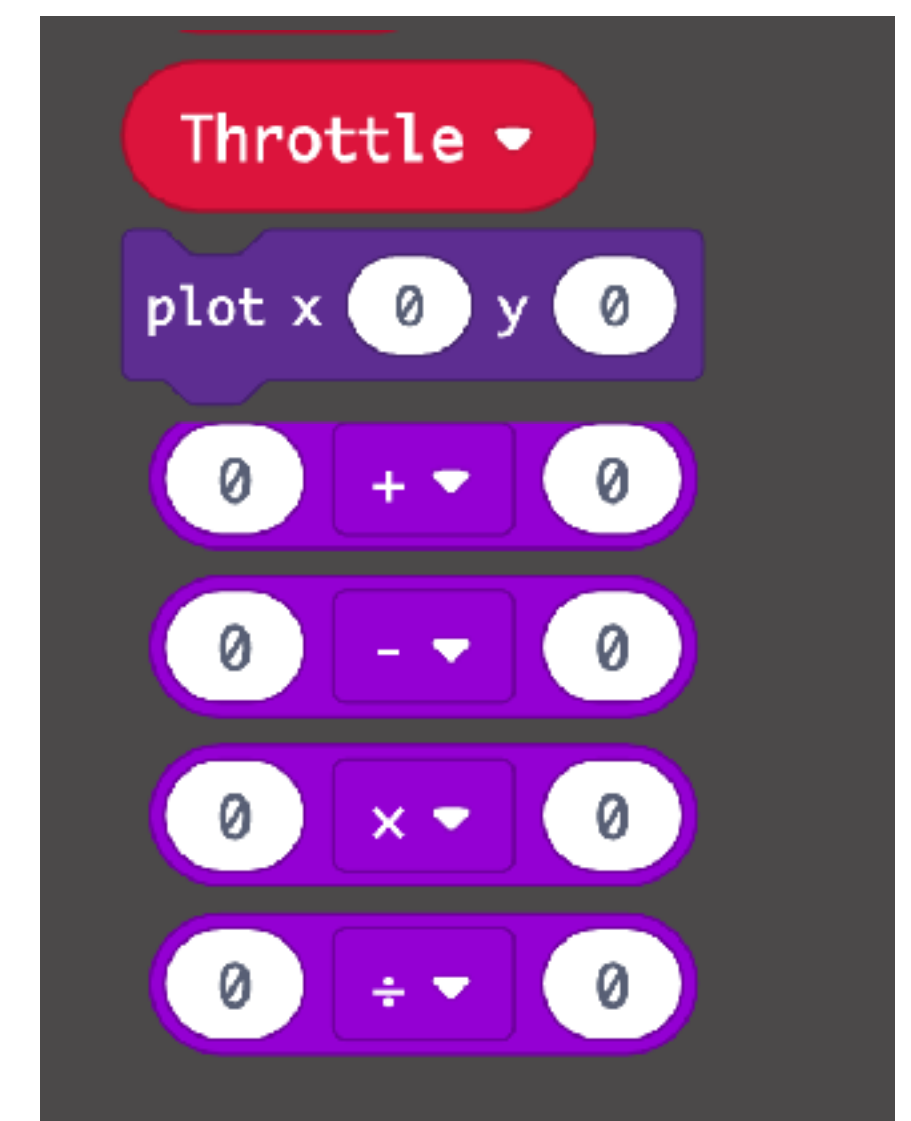
Visualise values: Throttle

Throttle

- We can indicate our throttle using the pixels on the left (blue frame)
- We need to translate our numbers according to the table below so that 0 gives 4, 50 gives 2 and 100 gives 0.
- Can you solve the equations?
- Hint:
 - We need to do a division in the first calculation
 - Then we need to do a subtraction in the second.

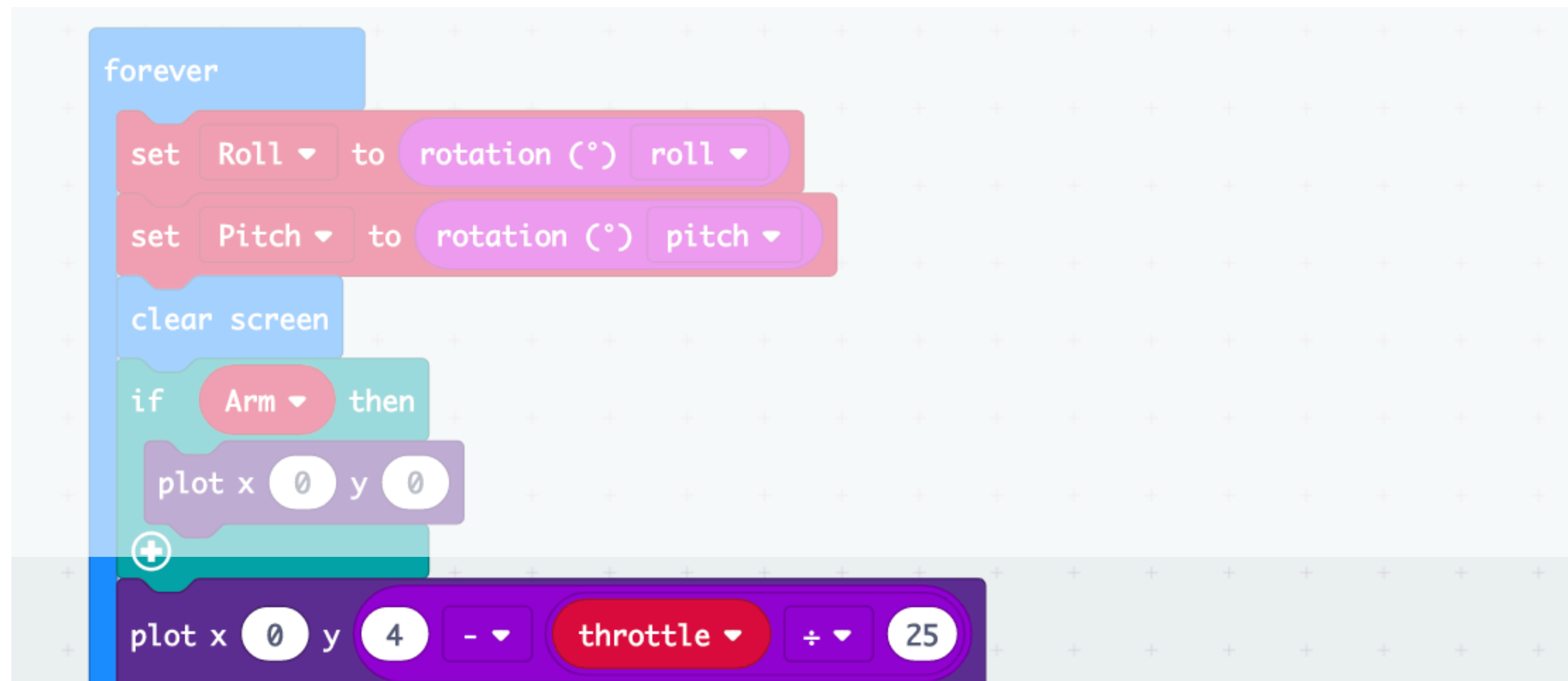


Throttle	0	50	100
First calculation	0	2	4
Second calculation	4	2	0



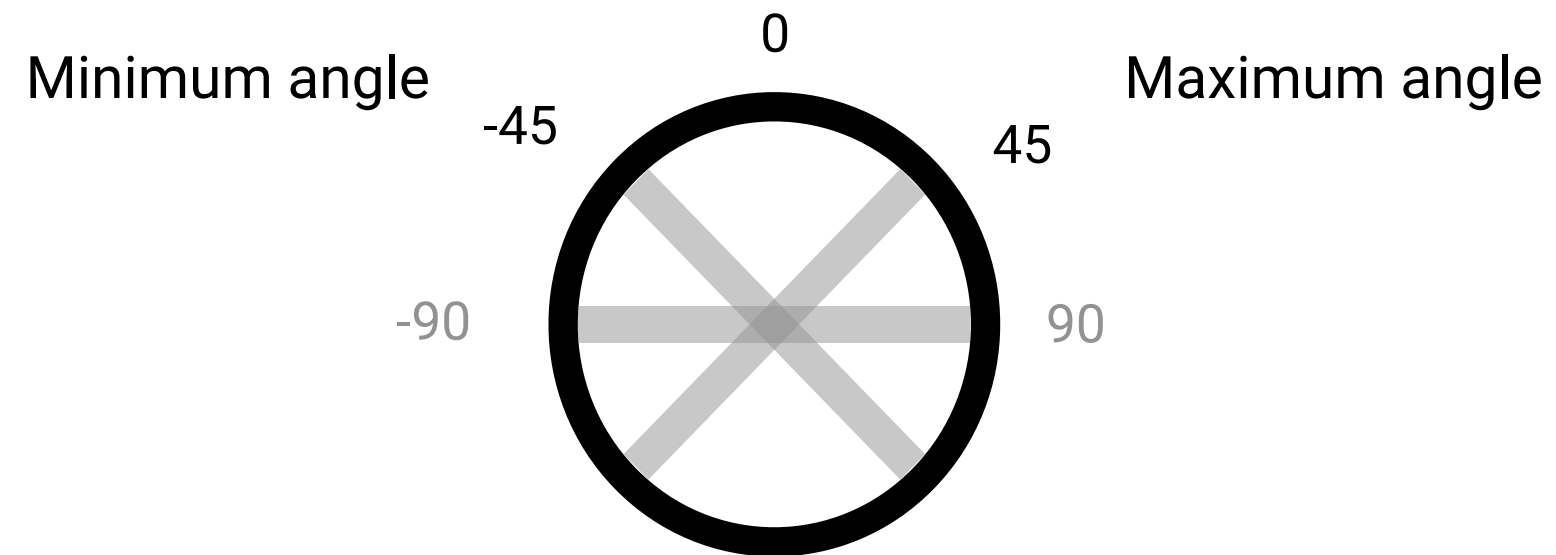
Solution

$$\text{Pixel Y} = 4 - \text{throttle} / 25$$



Throttle / 25 goes in the inner block

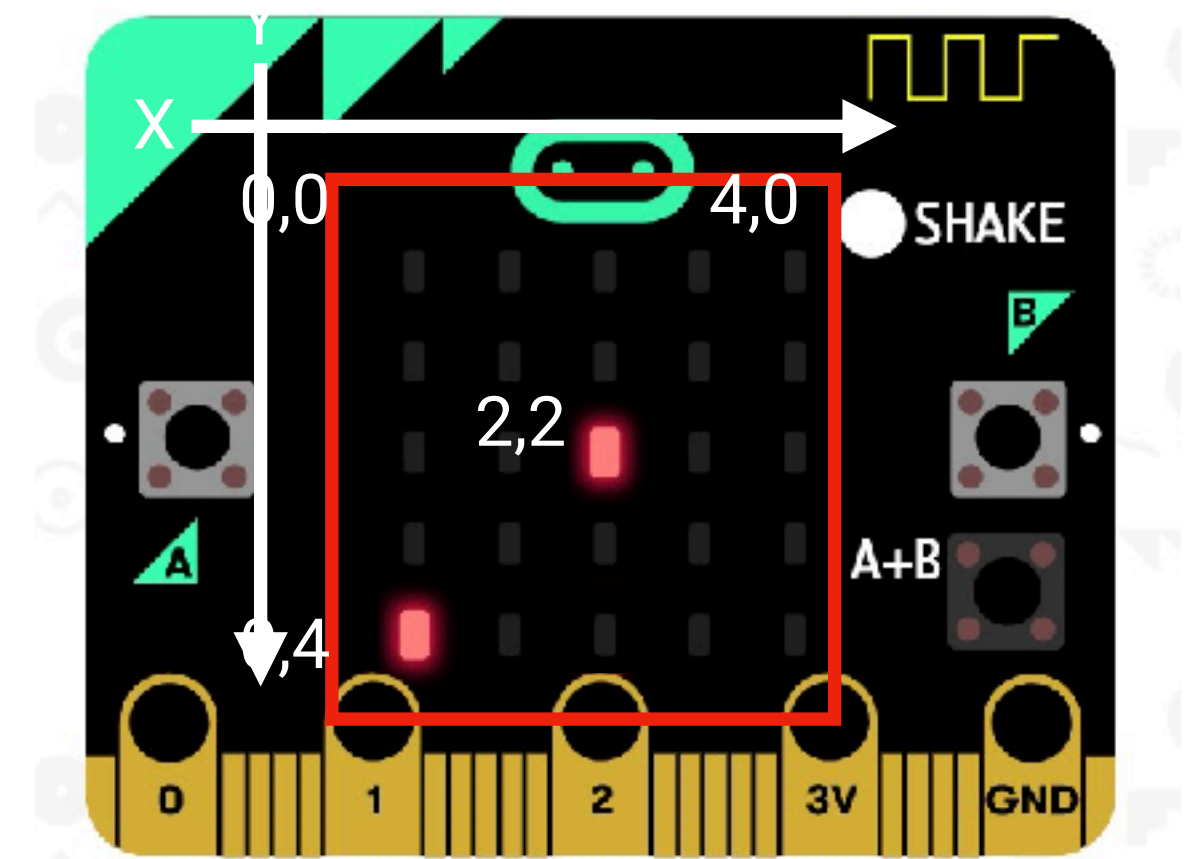
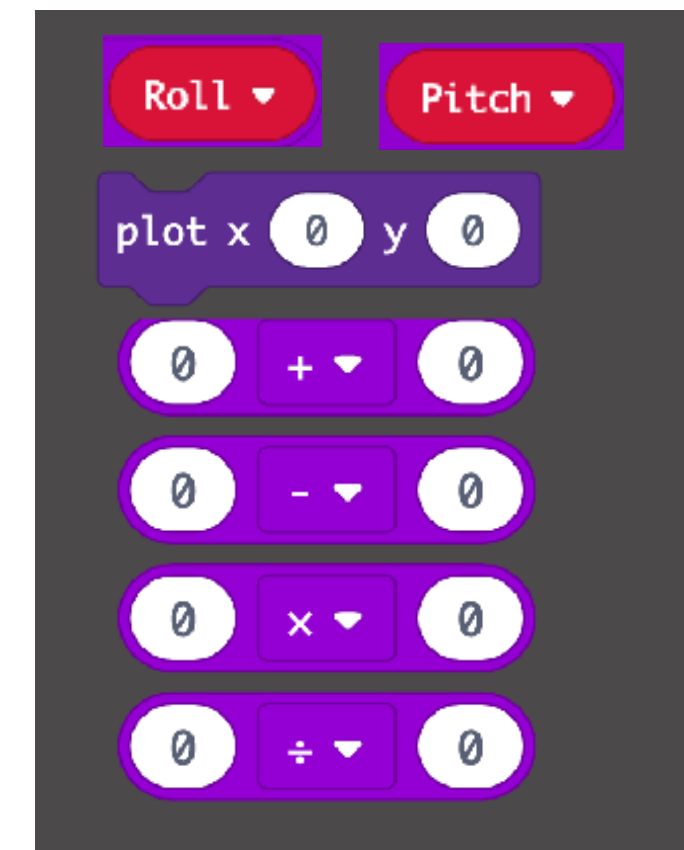
Visualise values: Roll/Pitch



Roll / Pitch

- We can indicate our Roll and Pitch angles using center pixel's X and Y position
- We need to translate our numbers according to the table below so that -45 gives 0, 0 gives 2, and 45 gives 4
- Can you solve the equations?
- Hint:
 - We need to do an addition in the first calculation
 - Then we need to do a division in the second.

Angle	-45	0	45
First calculation	0	45	90
Second calculation	0	2	4



Solution



Roll + 45 in the innermost block

Pitch + 45 i the innermost block



Tip! You can also use javascript. It can be easier to see the whole formula. In code, division and multiplication goes before subtraction and addition automatically. You will need parentheses if you want the + or - to be done first.

Be careful: There is not much room for typing errors in javascript.

```
led.plot(0, 4 - throttle / 25) (Division before subtraction)
```

```
led.plot((Roll + 45) / 22.5, (Pitch + 45) / 22.5) (Addition before division)
```

An easier alternative to functions

We can also map the values using this block



Original value

Lowest
expected
value

Highest
expected
value

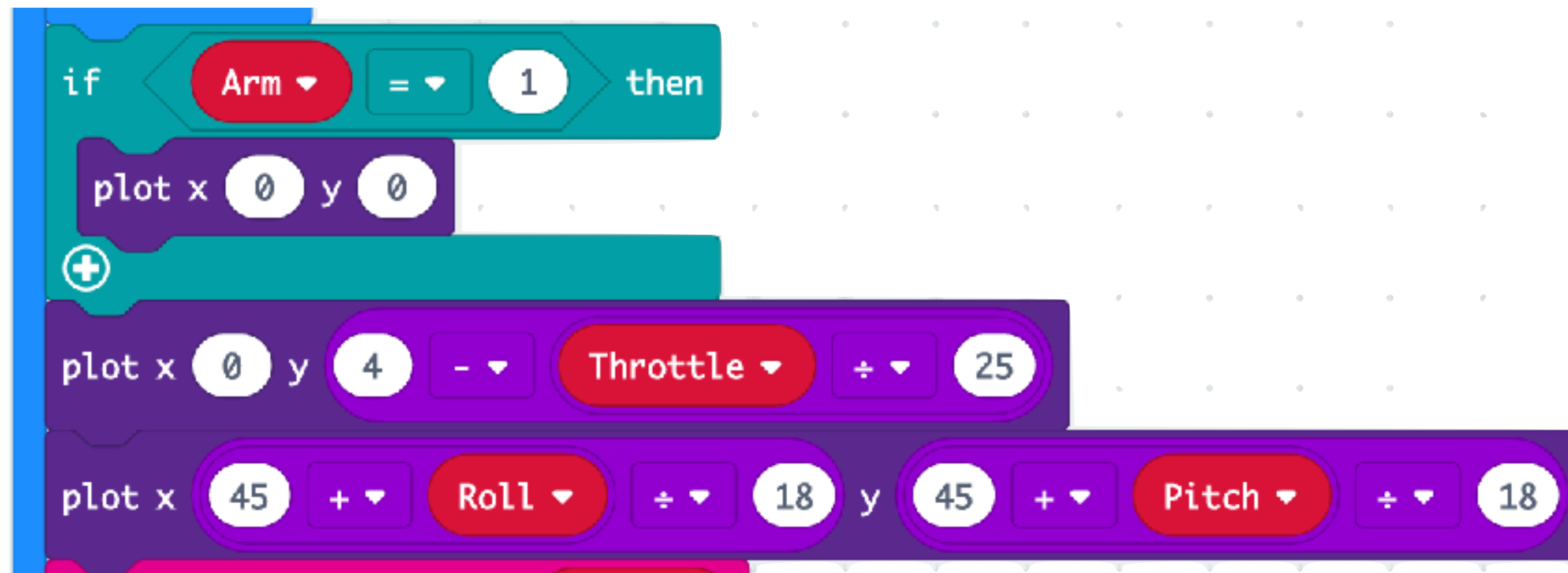
Lowest
output
value

Highest
output
value

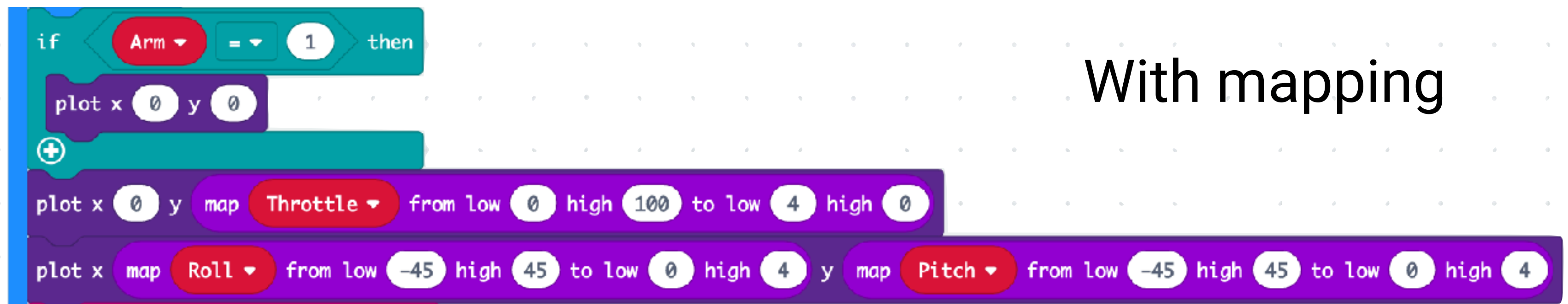
Example:



Two solutions

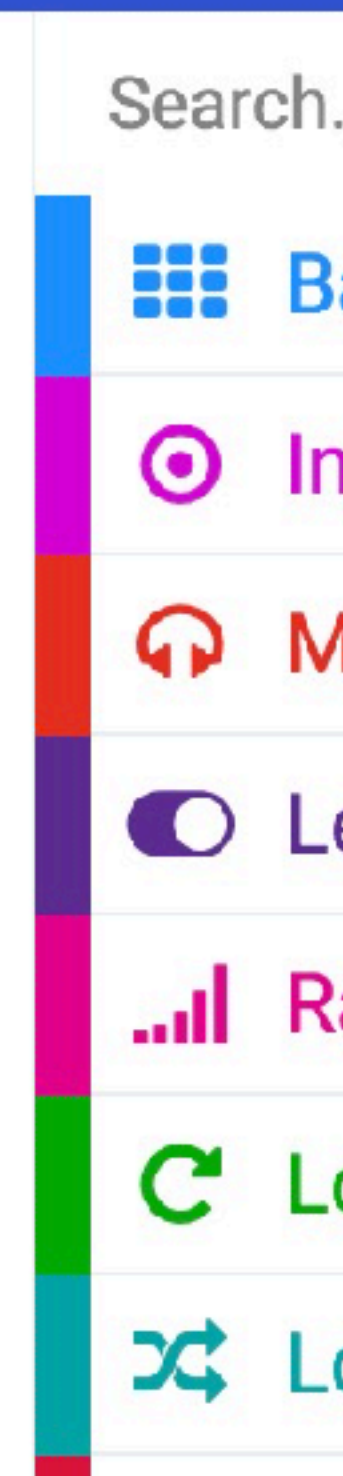
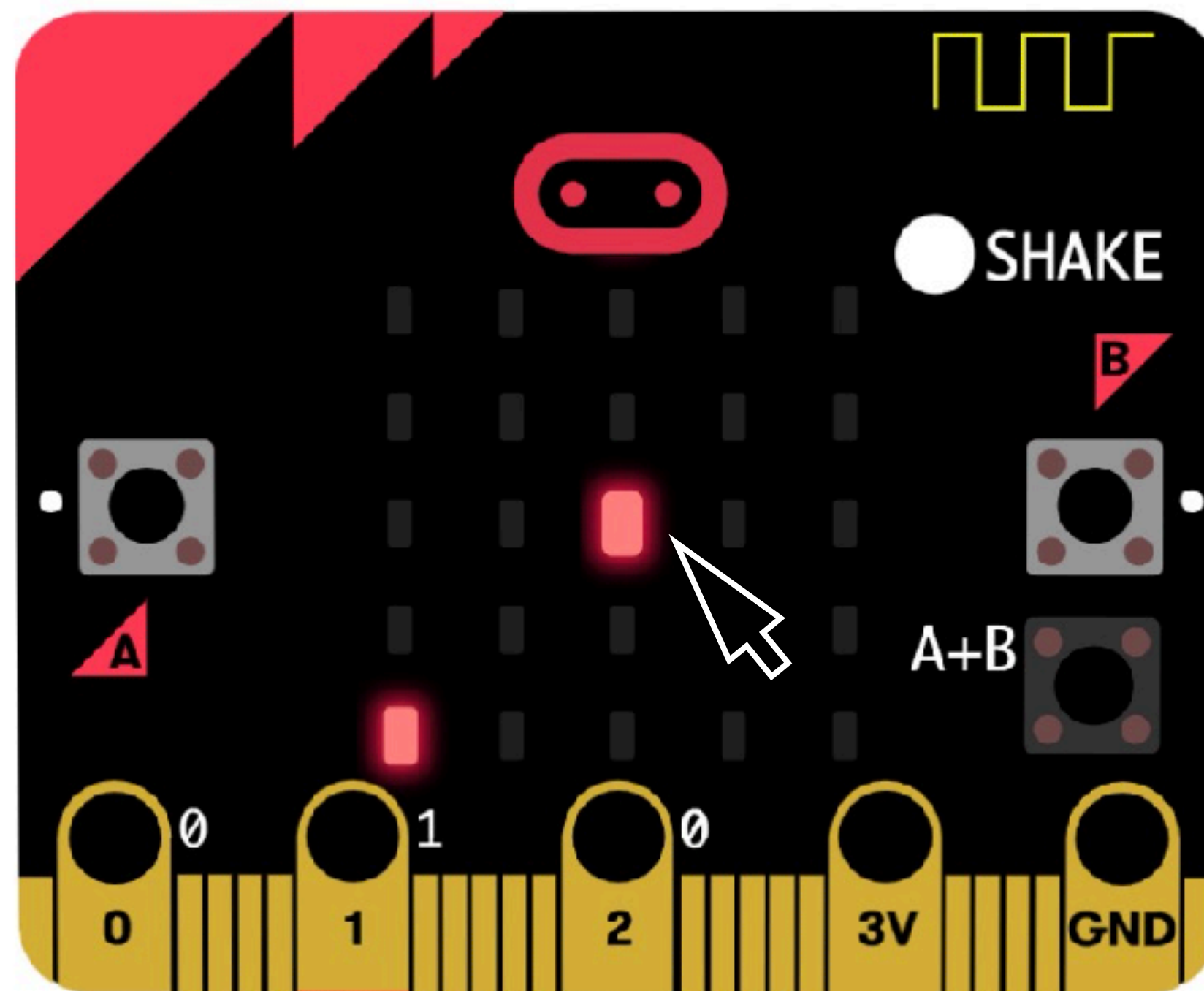


With functions



With mapping

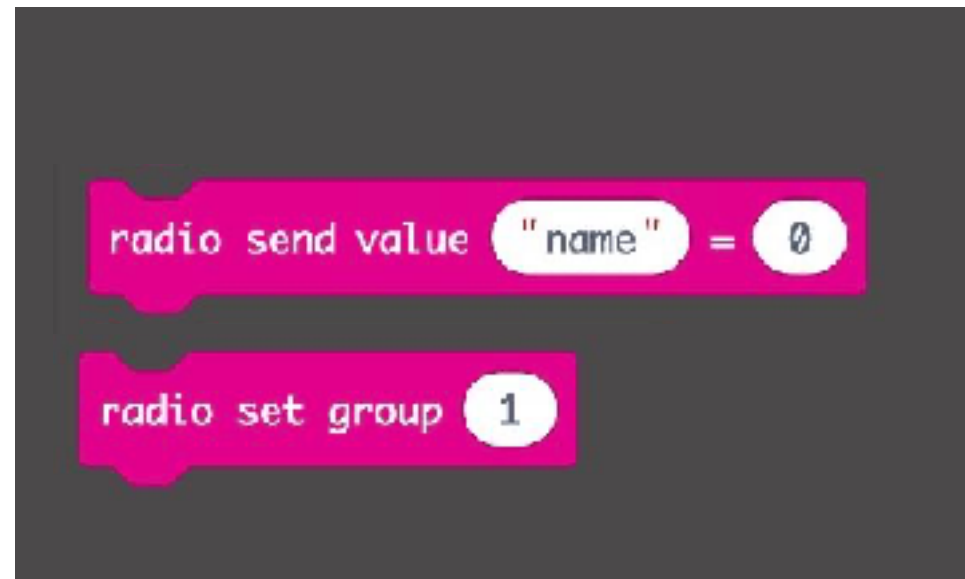
Does it work?



Test it in the simulator:

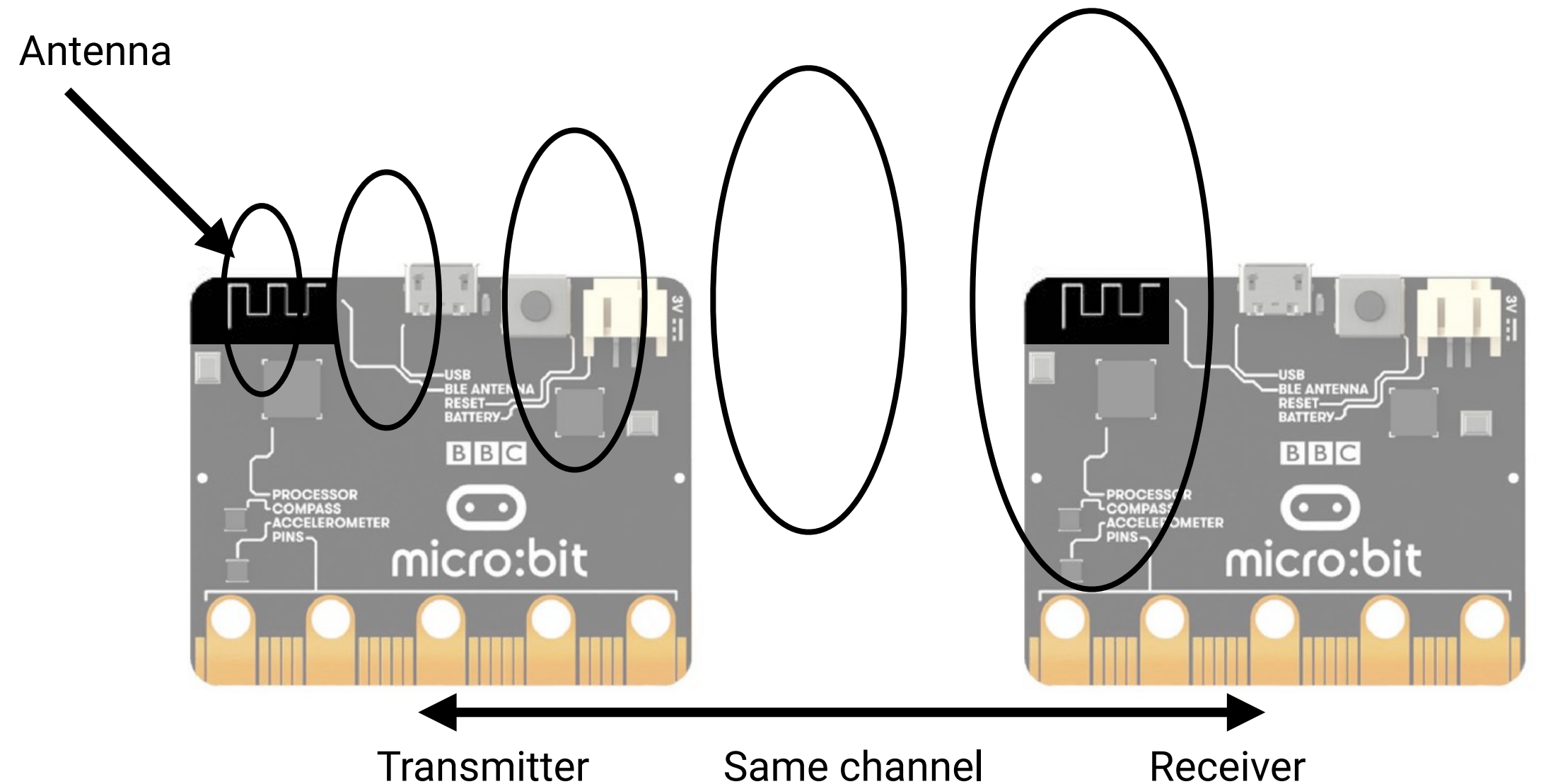
- The center dot follows the mouse arrow's movement
- The throttle-pixel on the left is rising when pressing B multiple times
- $A + B$ results in a lit ARM-pixel and throttle will go down to lowest position.

Radio

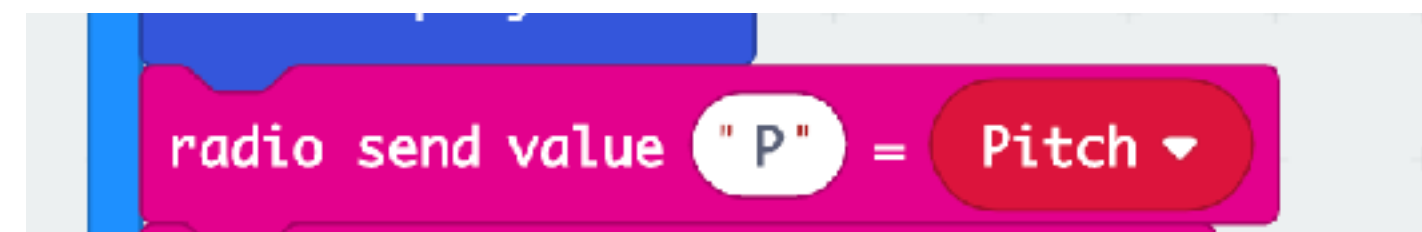


Task:

- In the On Start block:
 - Make a value called radioGroup or similar and set it to your radio channel
 - Show the number
 - Use radio set group to make the channel take effect
- We need to transmit a letter "string" in pair with the number for the receiver to know the number.
- Use a capital letter for each of the 5 PARTY-values.
- Yaw can be skipped

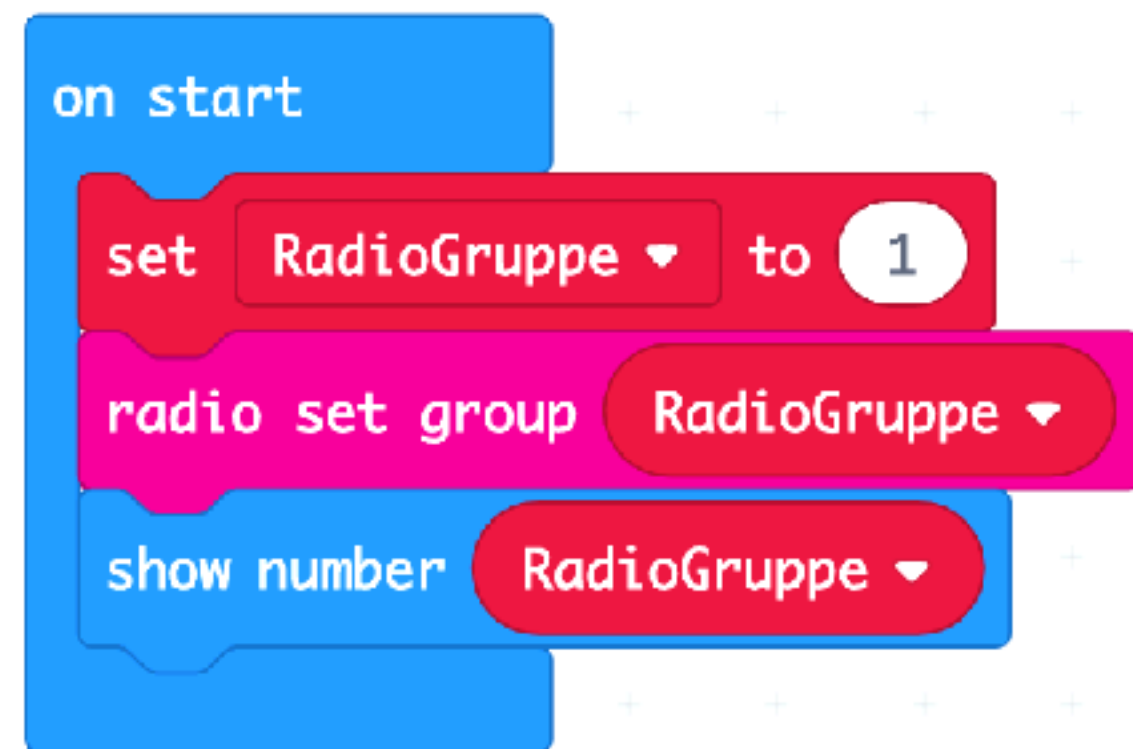


Example:



Solution

Your unique radio group



Bottom of forever block

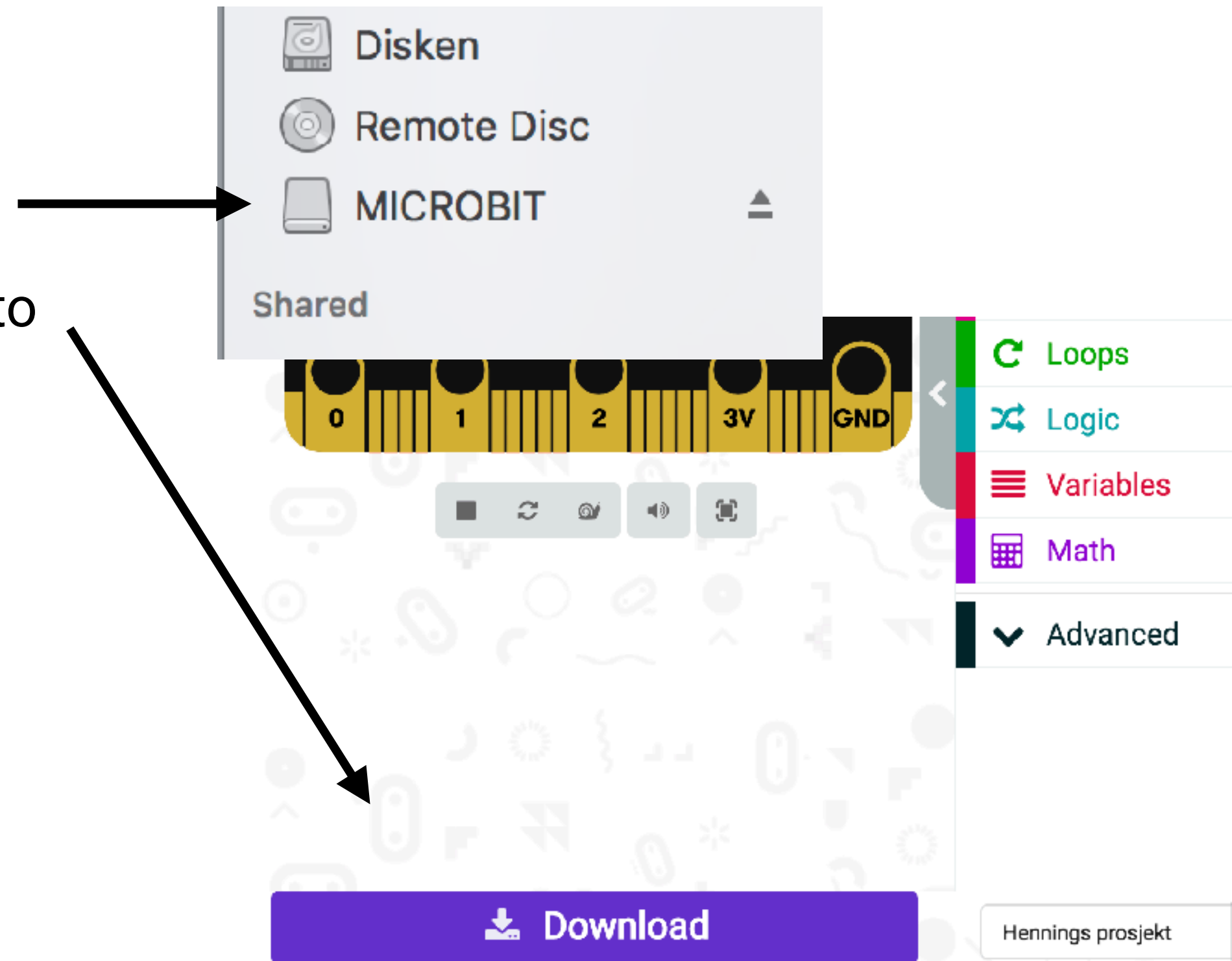


Remember: capital letters

Yaw can be skipped

Download the code

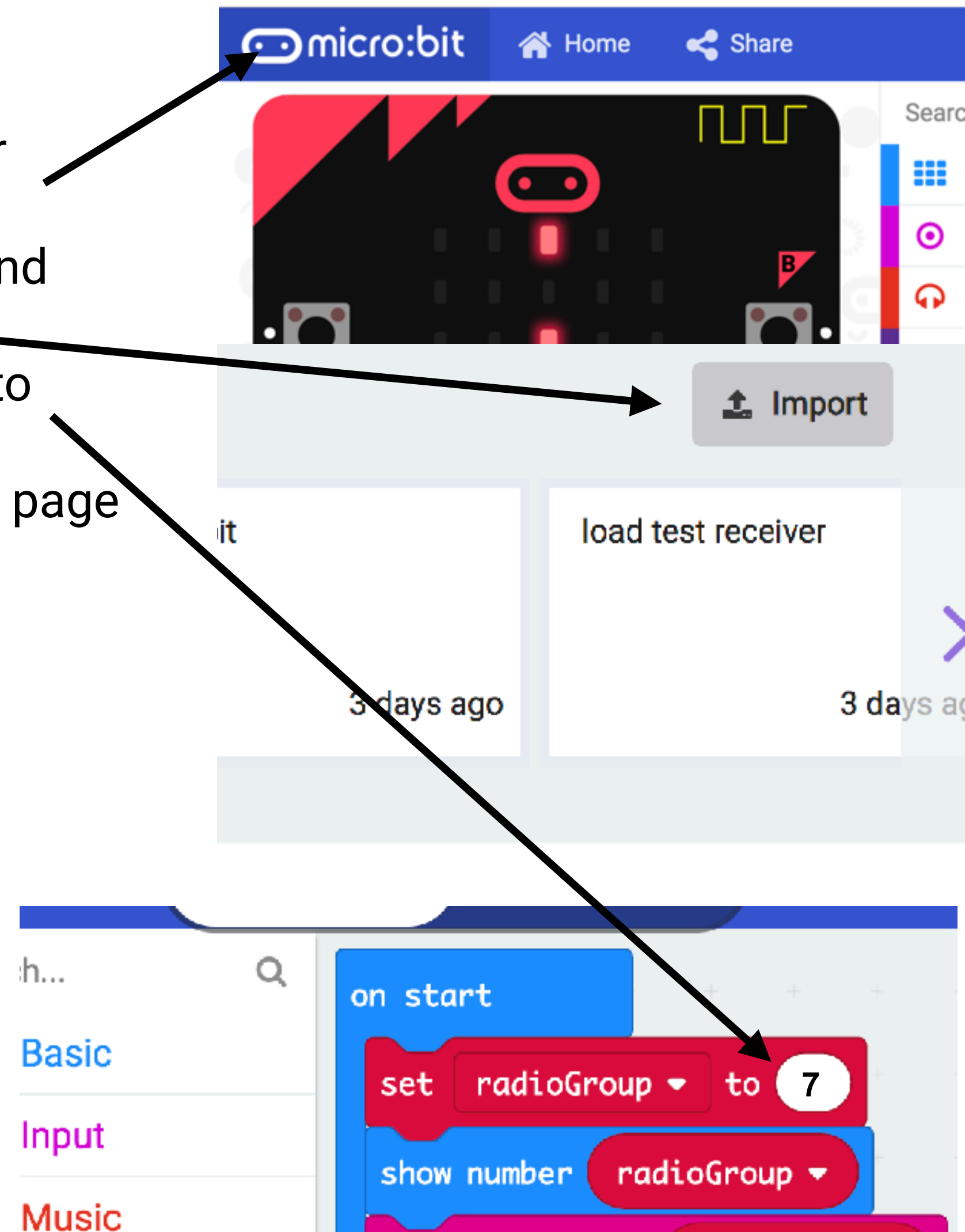
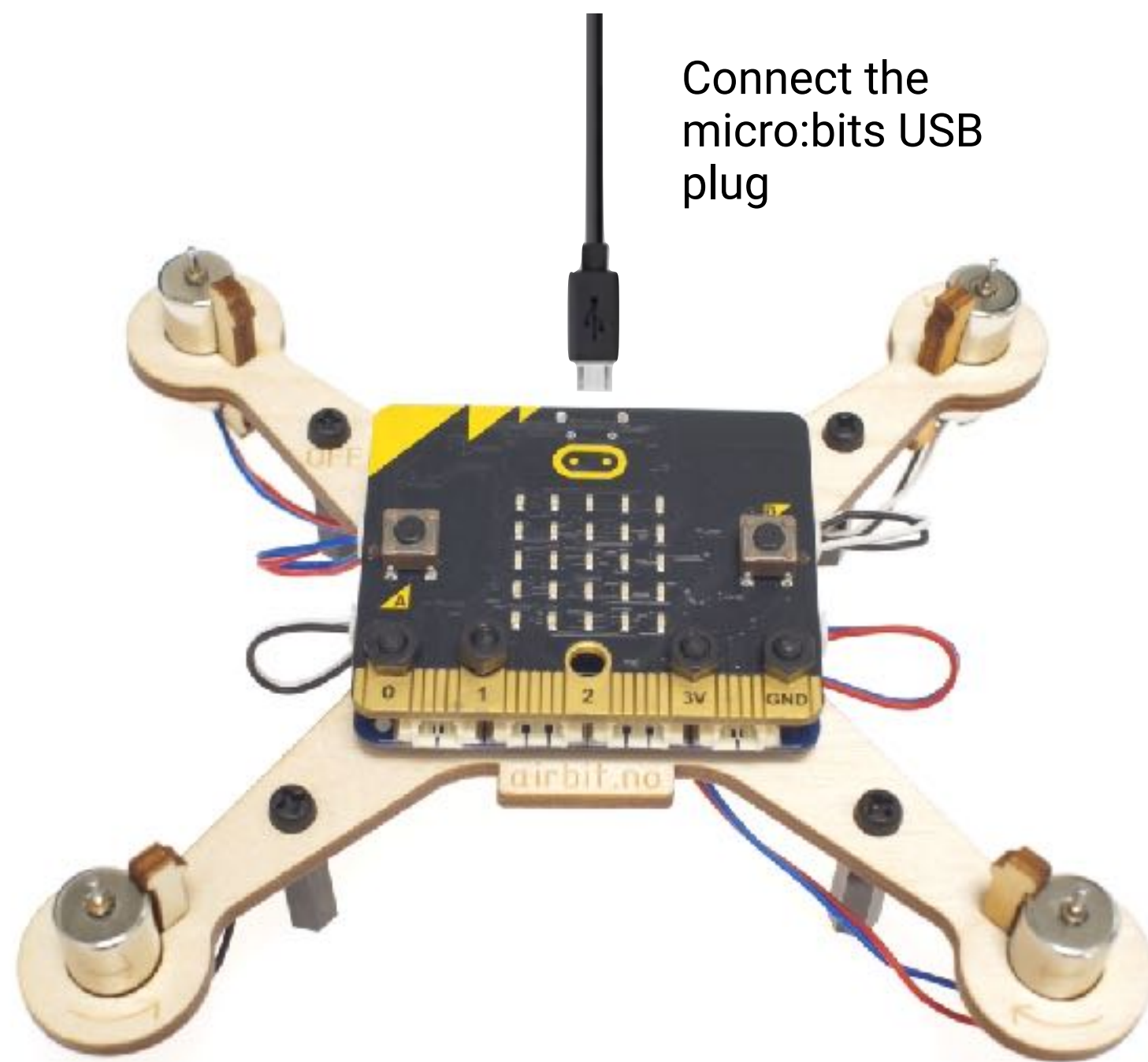
1. Connect your micro:bit to the micro usb
2. Microbit appears as a drive
3. Press "Download" and copy the file to the MICROBIT drive.
4. Watch the orange light on the back and make sure it flashes when code is downloaded



Read more about connecting the micro:bit See the micro:bit introduction at makekit.no/

The drone code

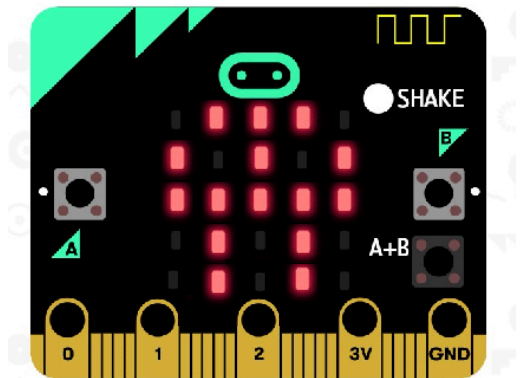
1. Download the drone code called "Airbit" or "Wonderbit Airbit"
2. Open the file in the editor. Click "import" and select the file
3. Make sure you have the right radio group to match your transmitter
4. Download the code as seen on the former page



Flying

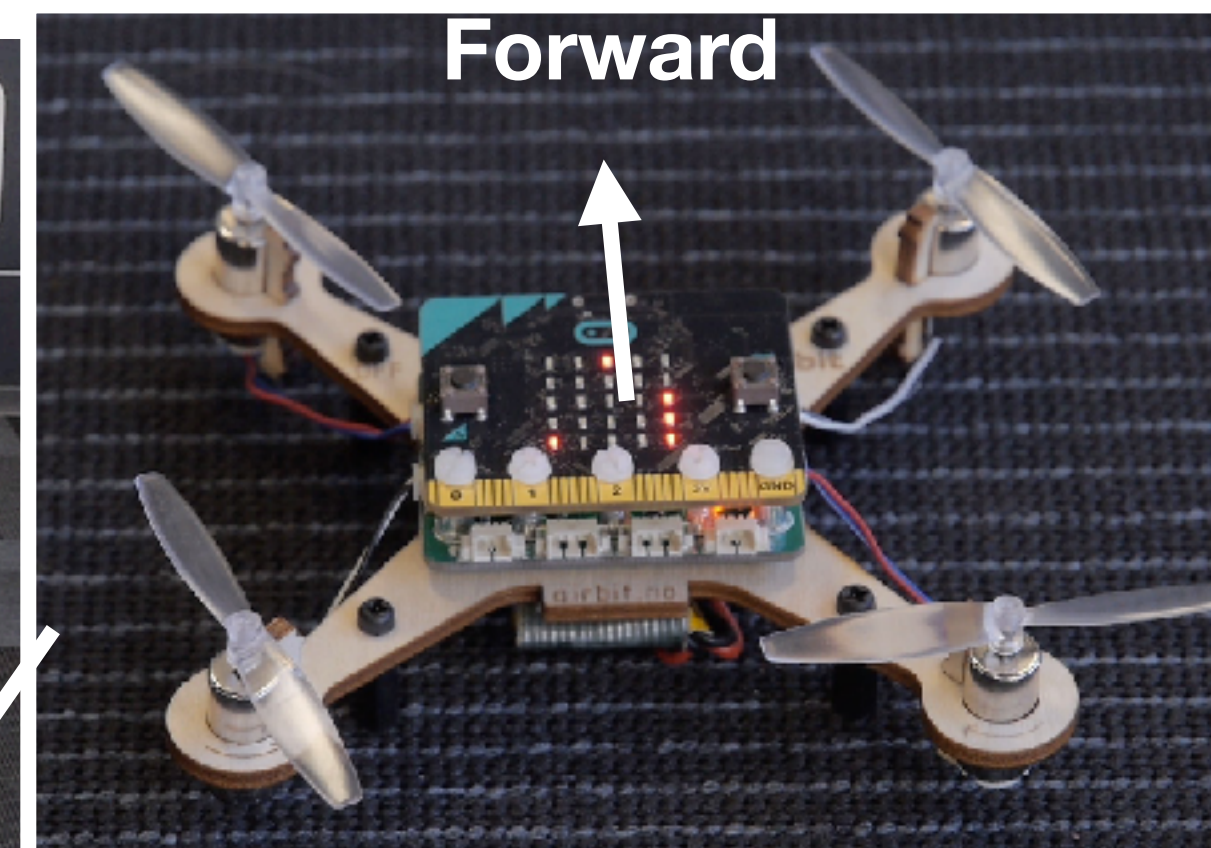
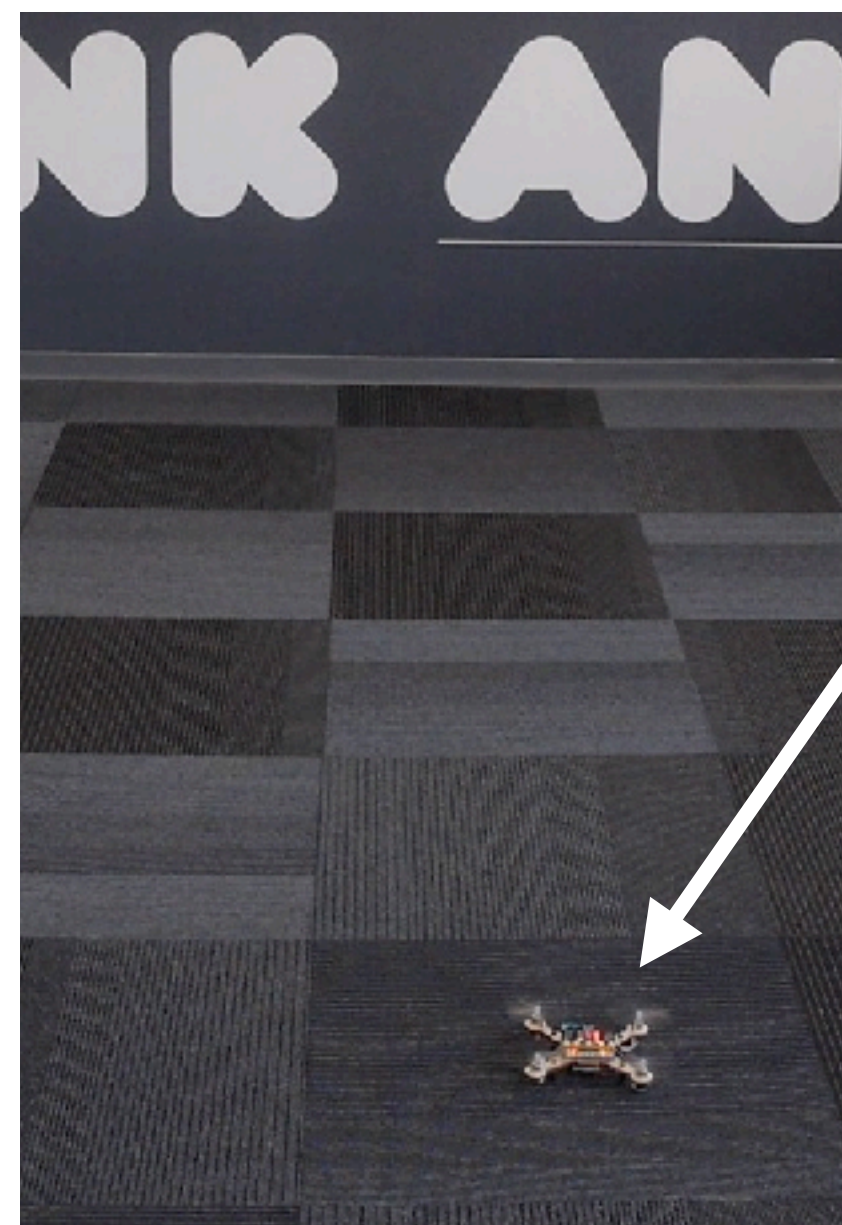
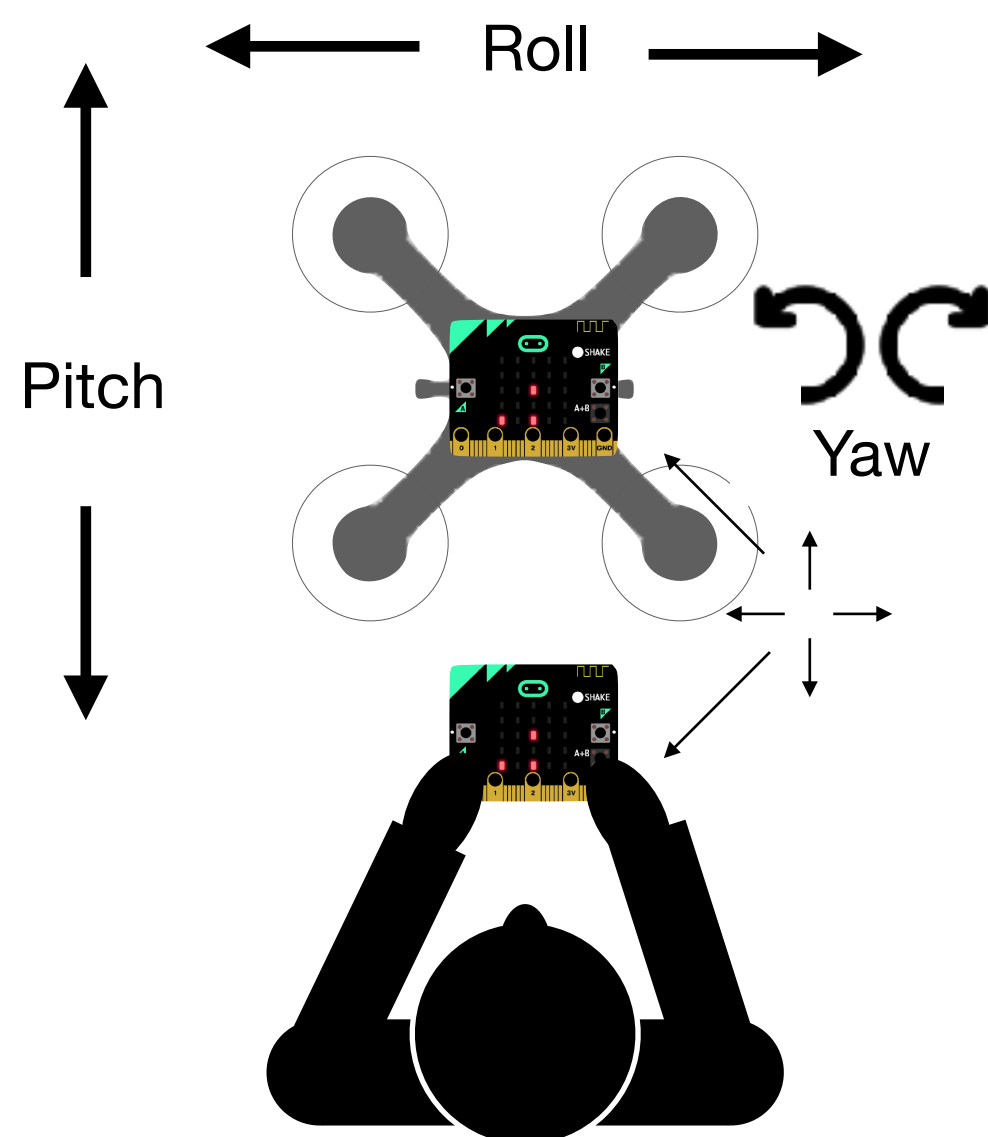


Video: <https://youtu.be/VMF9uehLfg8>

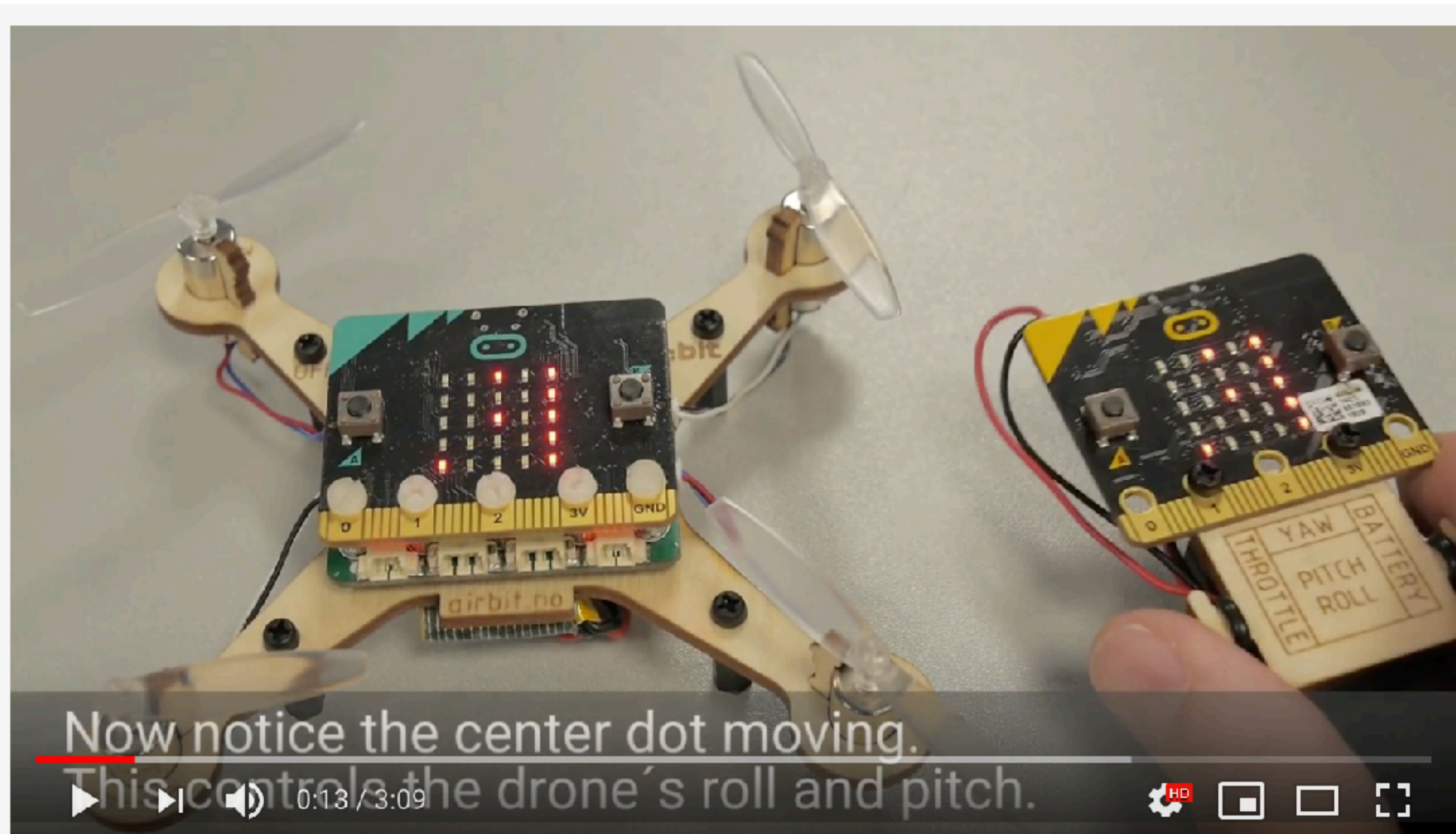


Battery empty

- ☐ Find an open room without obstacles, indoor or outside at a grass field or similar
- ☐ Carpets and low ceiling lowers the risk of damaging the drone. Fly low and over soft surfaces.
- ☐ Keep children under 8 and animals at a safe distance
- ☐ Place the drone in the middle of the space, with the microbit's "face" towards you
- ☐ Start the propellers by pressing A + B simultaneously
- ☐ Increase throttle step by step until the drone is hovering 10-30 cm above the ground
- ☐ Move the micro:bit transmitter to steer the drones roll and pitch
- ☐ As soon as drone starts to climb, lower throttle a bit to maintain altitude
- ☐ If you need to emergency stop: shake the remote
- ☐ When the battery is empty, the battery icon will blink, then drone will land and a skull appears
- ☐ Follow local drone regulations



See the video: <https://youtu.be/VMF9uehLfg8>

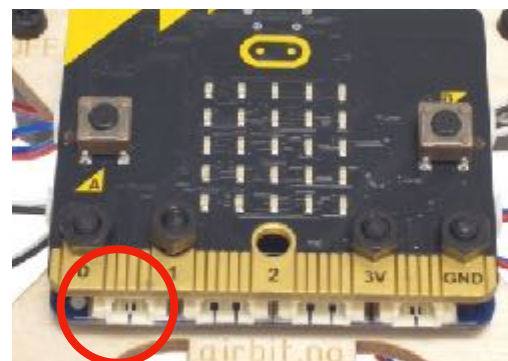


Problems?

Place drone on ground, wait at least 5 seconds. Press A+B on remote and release quickly. Press a couple of times and watch the propellers closely to see if they start and stop to spin.

Can't start the motors/propellers

- Is the micro:bit on the drone receiving the radio signal? The dots on the screen should move when you move the remote. Check and re-upload code for transmitter and receiver. Make sure they are on the same radio channel. You can try with ready made code for both transmitter and receiver.
- Are the barrel nuts tightened? On the drone, remove the micro:bit, tighten the barrel nuts, add the micro:bit, tighten the nuts again. Disconnect usb and switch power off and on again.
- If this orange light keeps blinking for a long time, the blue card it doesn't have signal on Pin 1



Motor starts, but can't lift off

Do you have the motors correctly placed and connected correctly? (Page 18)

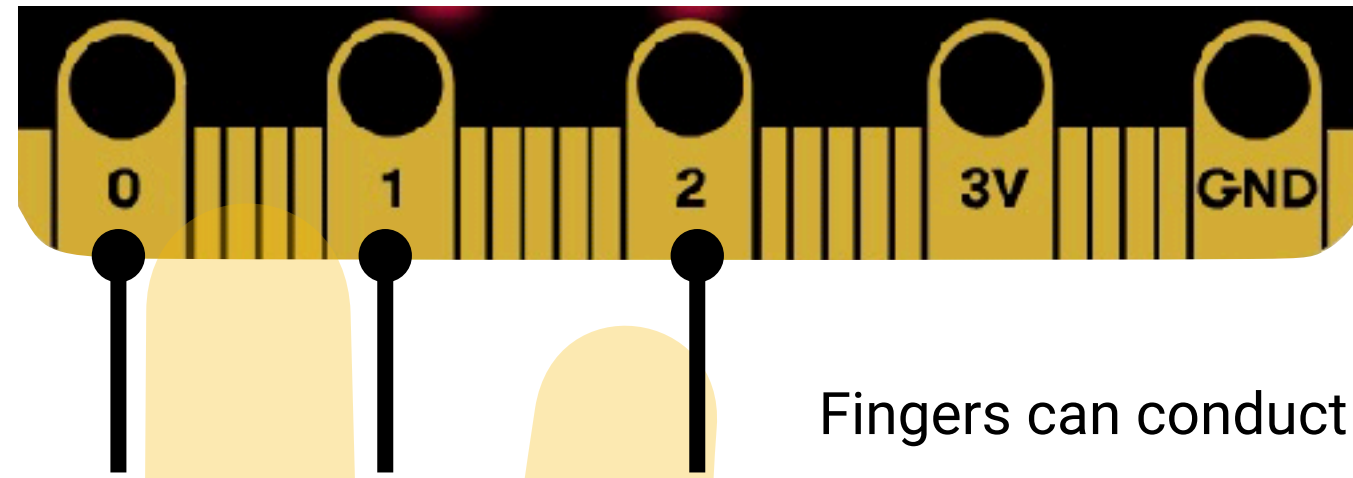
Have you placed the proper propeller on the right motor? (Page 21)

Are all the motors working and spinning? Can there be a damaged motor?

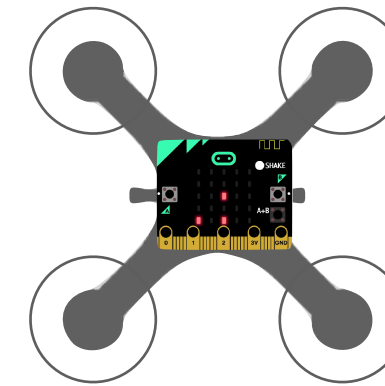
Have you placed the drone the proper way and given enough throttle? Need about 50-60% to lift off. See page 52.

Is the battery charged?

Extra task: Yaw



Fingers can conduct electric current



Yaw is a sideways rotation

Yaw

Yaw makes the drone rotate sideways around its center. You can make artificial button and control the yaw.

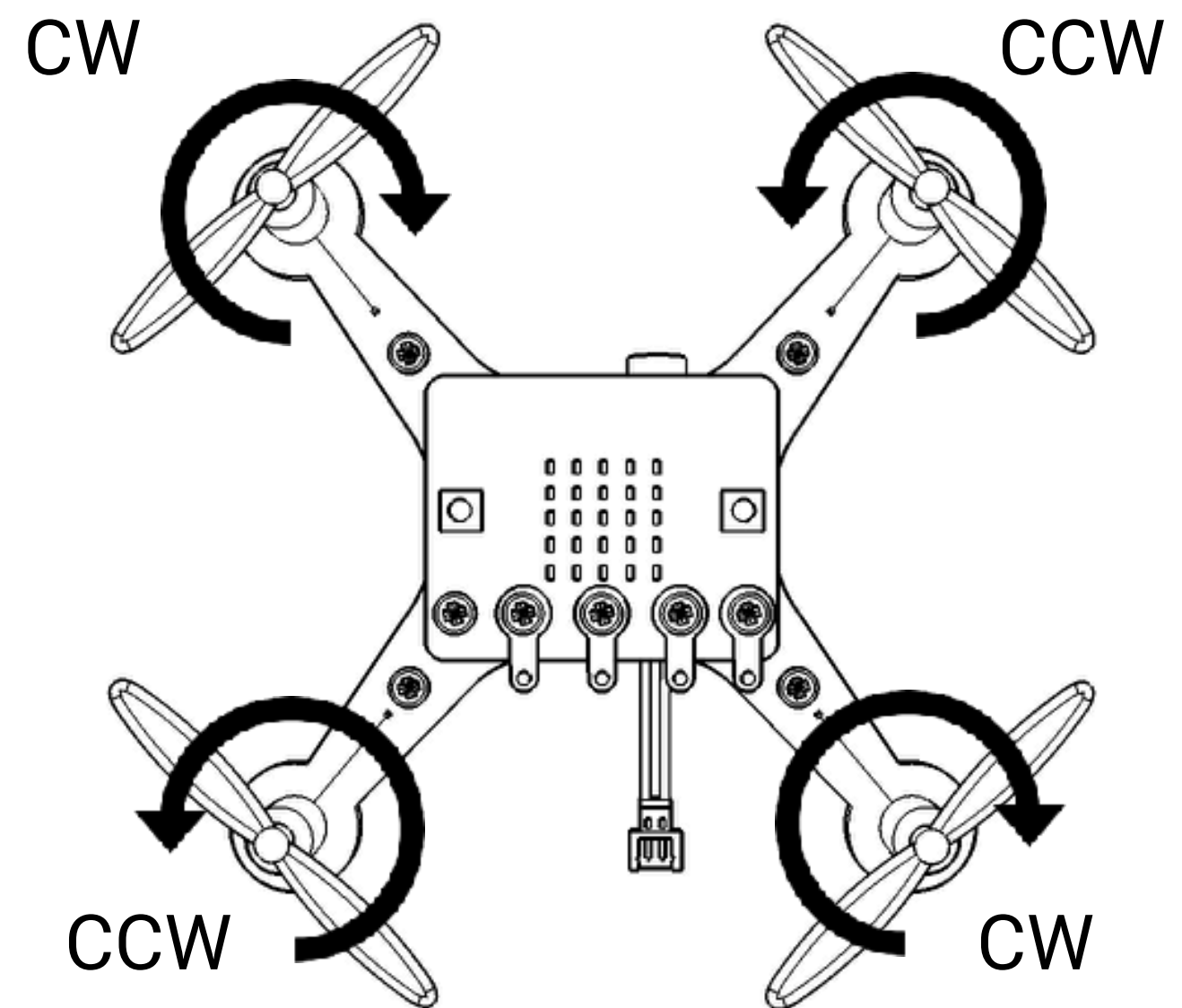
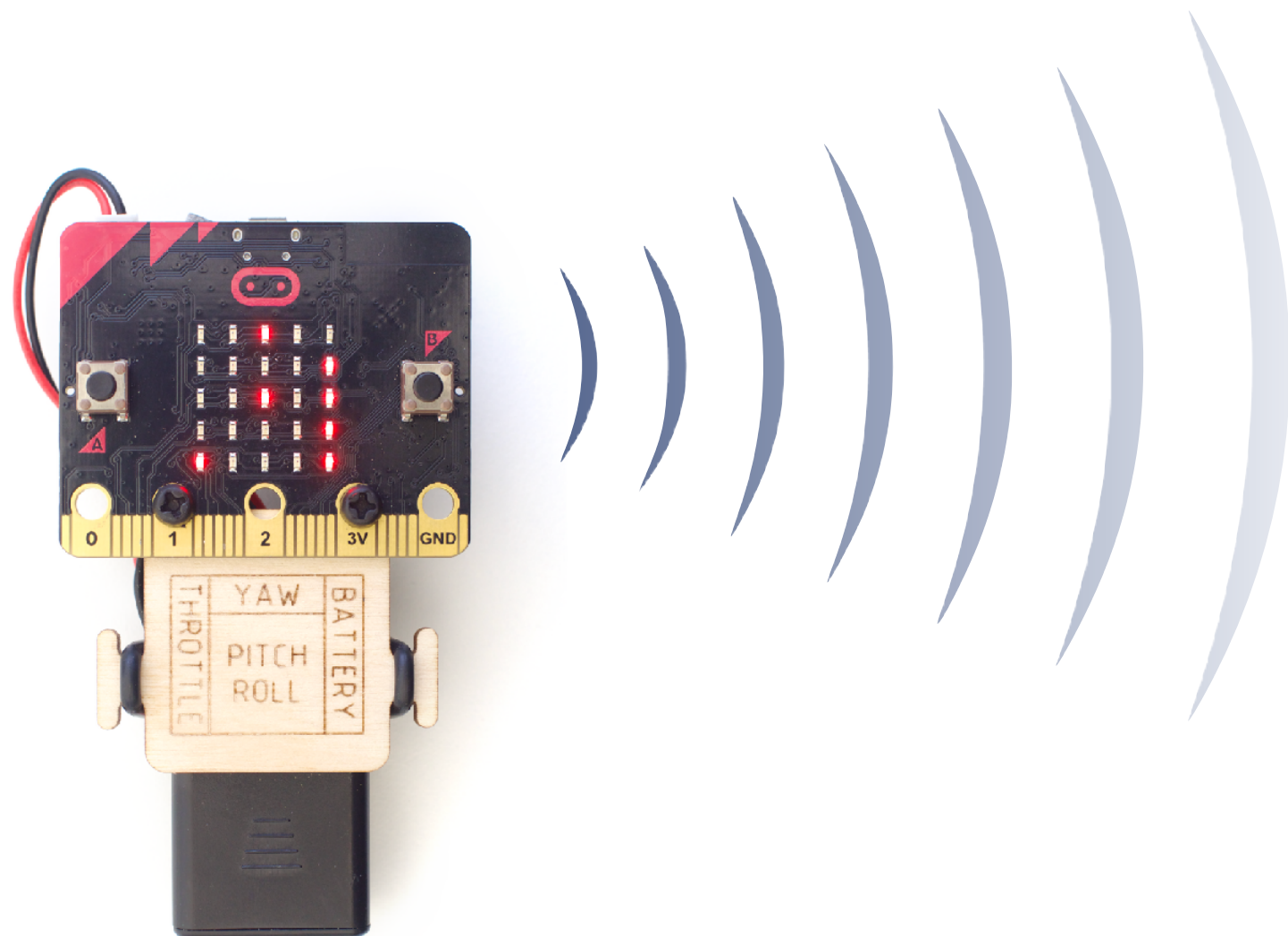
- Use analog write to make P1 send out power
- Use analog read to make P0 and P2 read power that is lead trough your fingers
- When nothing is touching P0 and P2, the analog read will be low (around 200)
- When conducting electricity from your fingers, the analog read can be about 800
- Using a treshhold on about 500, you can detect a finger press.
- When a press is detected, change the yaw to a negative number for left rotation, and a positive number for right rotation
- If no button is pressed, the yaw should be 0. The easiest way is to set it to zero before checking if a button is pressed.



Yaw: Solution



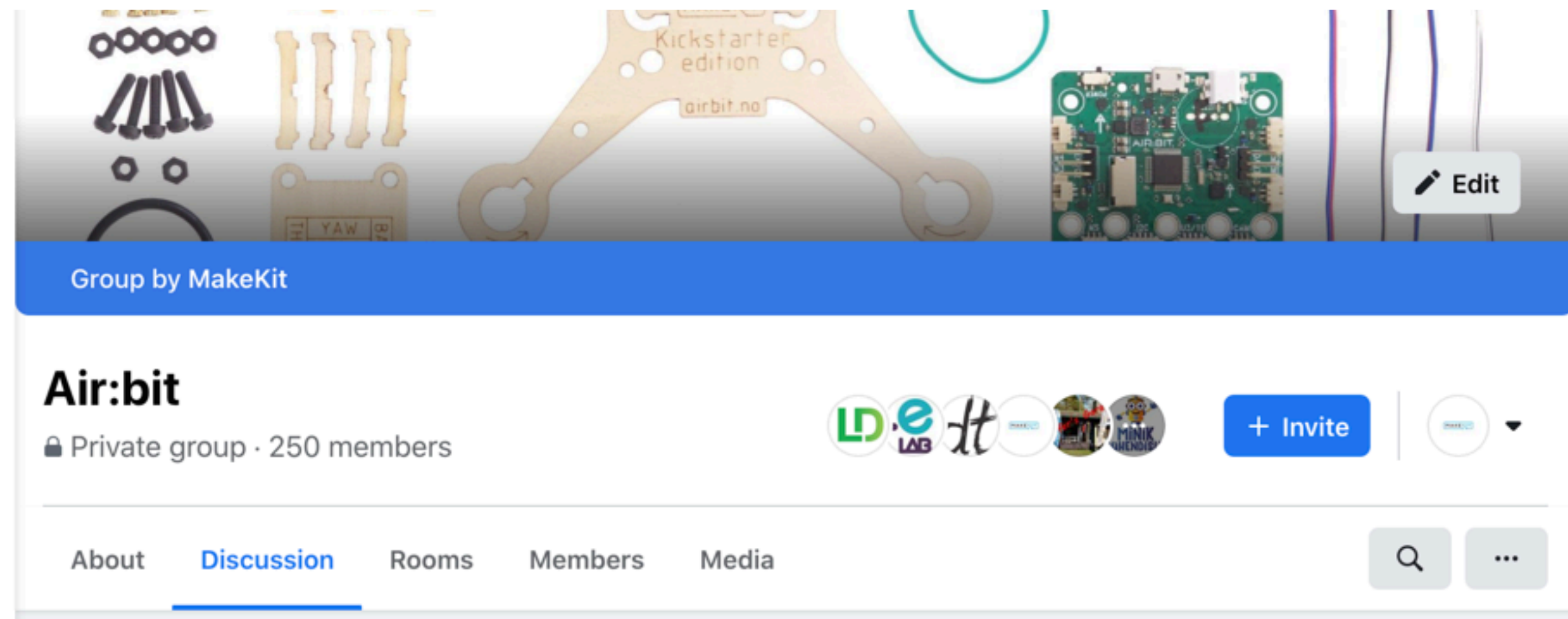
How the drone controls its path



- Two motors rotates with the clock (CW) and two rotates against the clock (CCW)
- The counter rotating setup prevents the drone from spinning around the yaw-axis.
- The drone ascends (**Throttle**) by making all the motors go equally faster
- The drone moves forwards (**Pitch**) by increasing power at the two back motors, while decreasing power to the front motors. This tilts the drone forward.
- Sideways movement is done by speeding up two motors at one side (eg. left) then slowing down two motors at the opposite side (eg. right)
- Drone can rotate around the **Yaw**-aksen by speeding up every other motor (eg. every CW motor) while slowing down every CCW motor.
- The flight control board takes all the flight directions (PARTY) and mixes the info onto the four motors.

Contact:

Get tips and help in our Facebook community:
www.facebook.com/groups/goairbit/



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