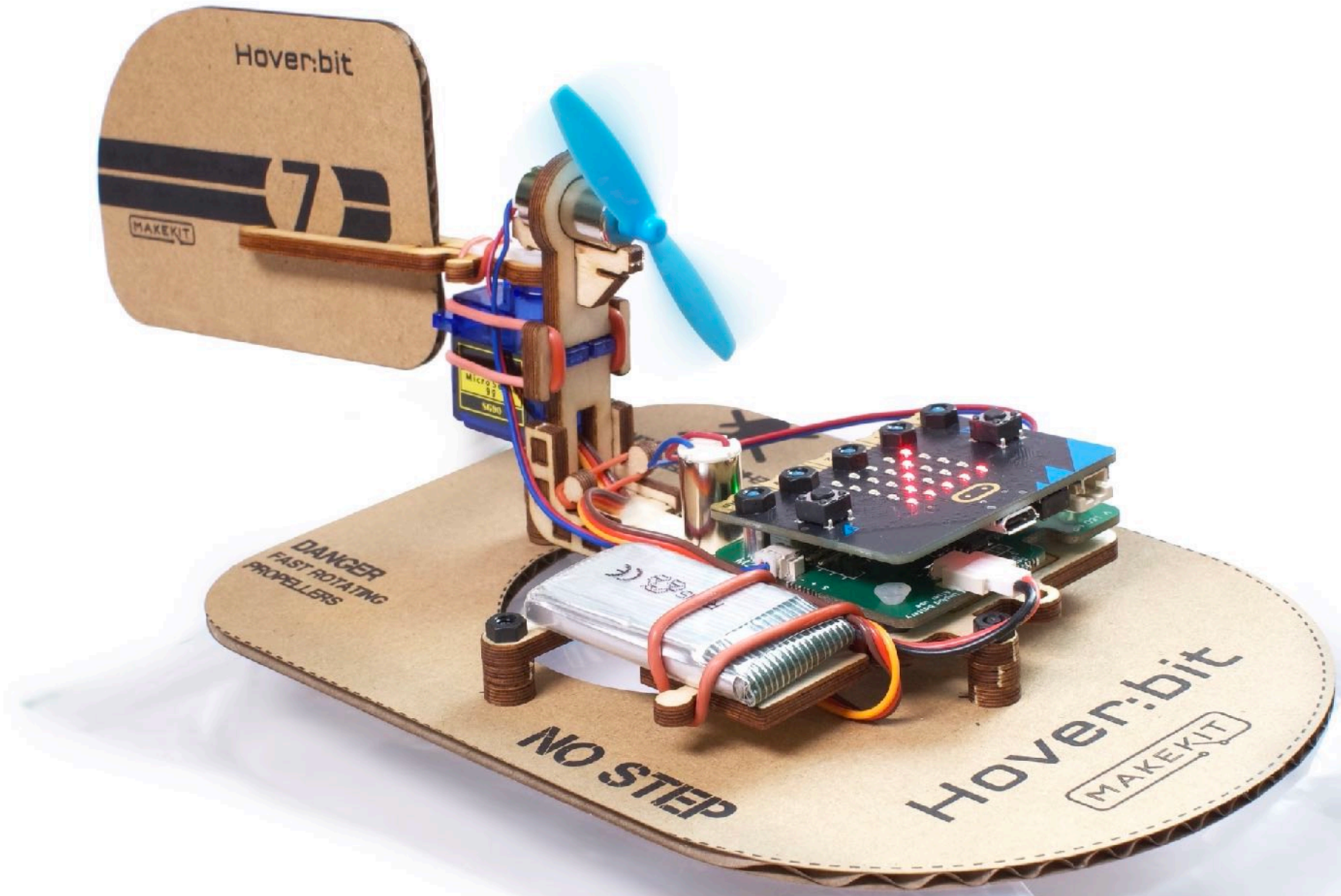
# Hover:bit V2




MAKEKIT

makekit.no

# Teachers!

Find the lesson plans and ideas in the end of this document!

# About the product

Hover:bit is designed and manufactured in the old premises of Tanbergs Radiofabrikk at Skullerud in Oslo, Norway
We welcome questions and feedback.
Do not hesitate to contact us!
Feel free to use our Facebook page as well

www.makekit.no

support@makekit.no

makekit

gomakekit (also Twitter)


*Henning and Steinar*
*At the Tandberg exhibition at Skullerud*

# Tools

## Must have:

Small philips screwdriver



Marker



Scissors



Utility knife


Glue gun
**or**
contact adhesive glue

## Recommended:

Piece of A4 paper

Ruler

Wrenches 5.5mm (Included)

# Tip!

Download and print the paper insert on A4 size paper.

It makes the assembly easier.

You find it at www.makekit.no/docs (Hover:bit section)

Dette klippes vekk

## Bottom side

Trace the rectangle on the plastic bag and cut it carefully.

The zip-line is this way

## Top side

1. Trace and cut the circle out of the bag
2. Glue the circle first
3. Then around the outer rim

Dette klippes vekk

**See hover:bit in action:**

https://youtu.be/0YS2lImtZ4o

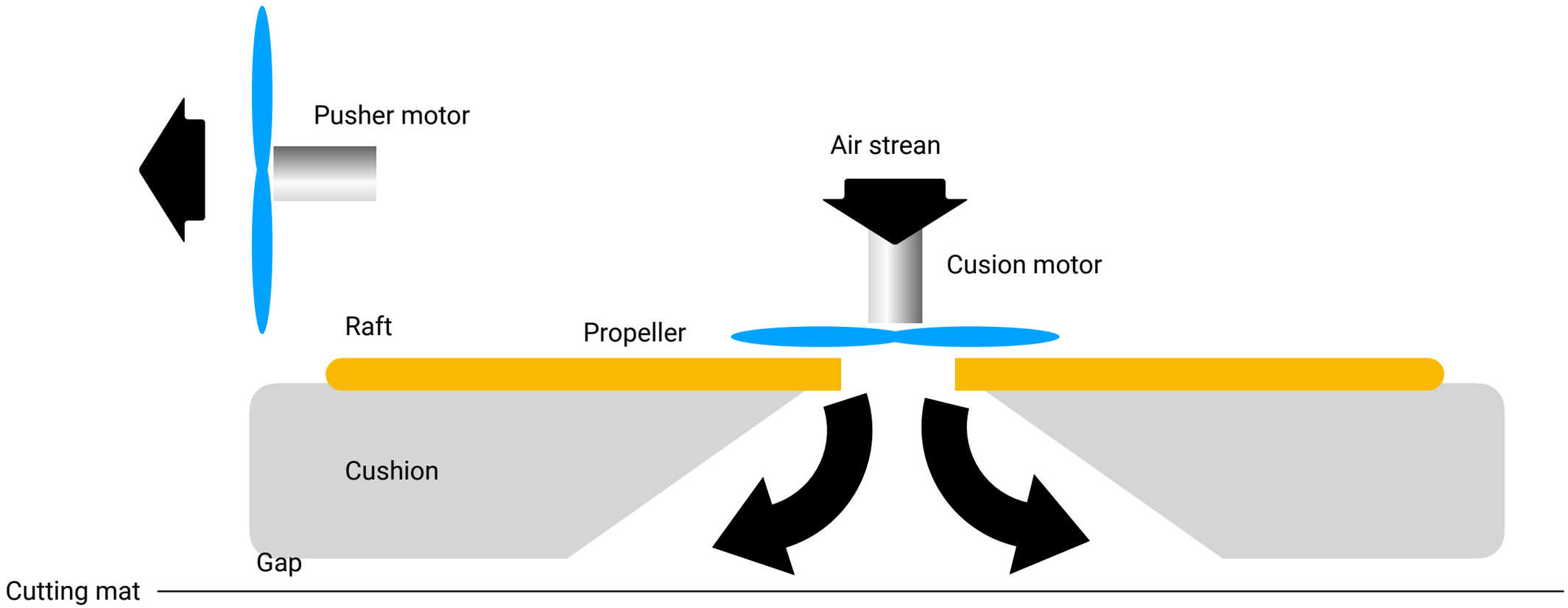
# ABOUT FRICTION AND ELECTRICAL ENERGY


"Hovercraft" by Phil_Parker is licensed under CC BY 2.0

A hovercraft uses a cushion of moving air to create a small space between the vehicle and the surface. This removes the friction. The craft can move forward by blowing air from one or more rear engines.


Air hockey tables use the same principle to remove friction. The air is pumped up with a fan so that a small air gap between the discs and the table removes friction. The pieces can float and bounce at great speed and it takes a long time before they stop.

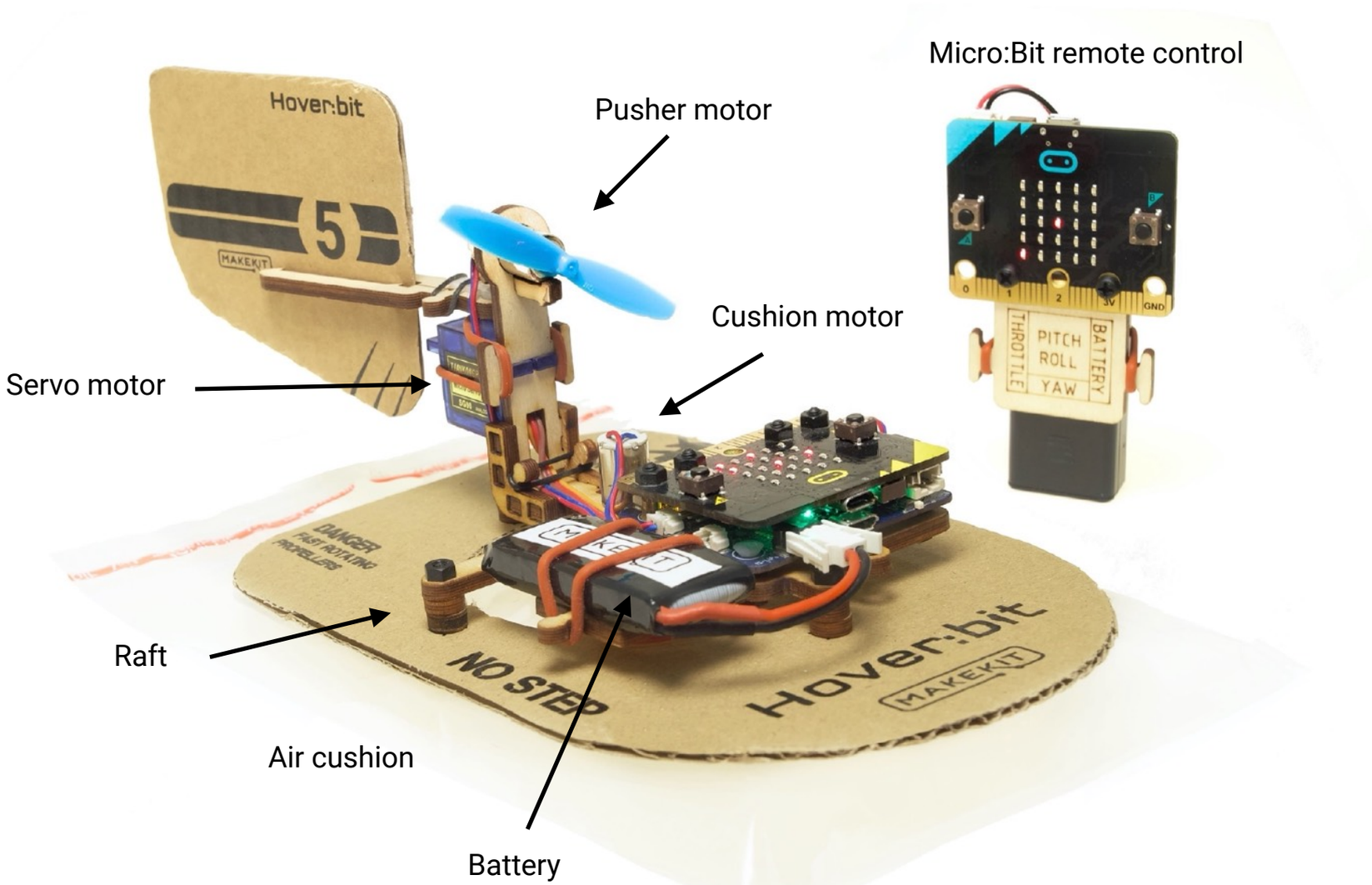
# Hover:bit Principle of action




When the air is blown into the bag, a small opening is created between the hovercraft and the ground. Then the friction is removed, and the craft slides easily and quickly with the help of the pusher motor.

? If we know that the air flow in the bag removes friction, how can we think the opposite and create an effective brake?

# Hover:bit: Energy system




**Quizzes:**

1. The motors convert electrical energy into another type of energy. Which?
2. Why are the motors magnetic?
3. What happens to the airflow if a CW (clock wise) propeller rotates counter-clockwise instead of clockwise

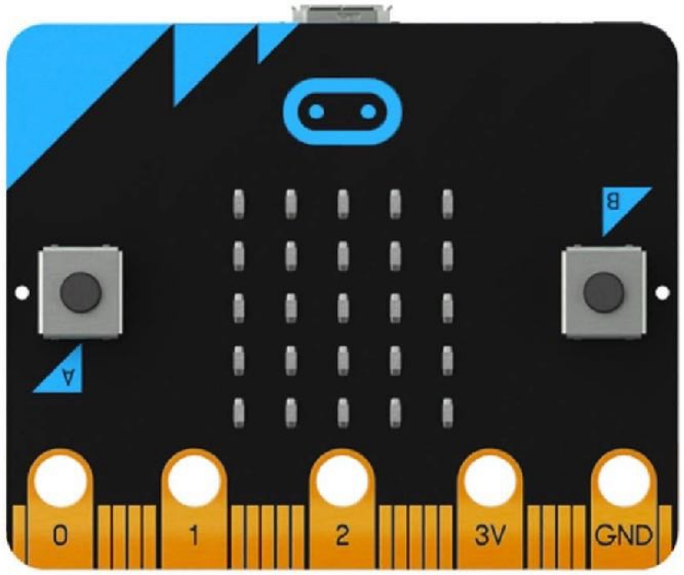
# Meet the micro:bit

Screen (5x5 pixels)

“Haircut”

Button A

“Gold teeth”




Front

Button B

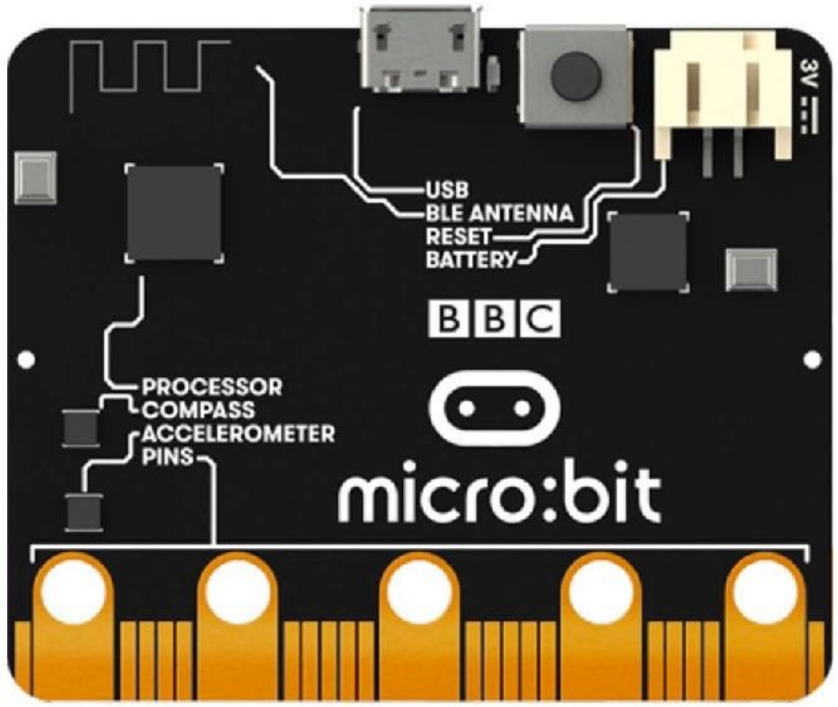
Sensors

Reset button

Antenna
2,4 gHz

USB

Battery (3V)

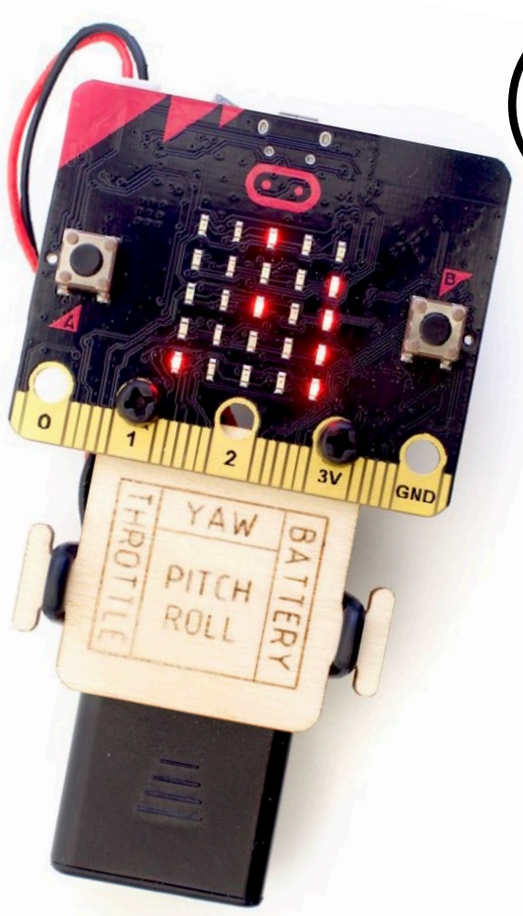


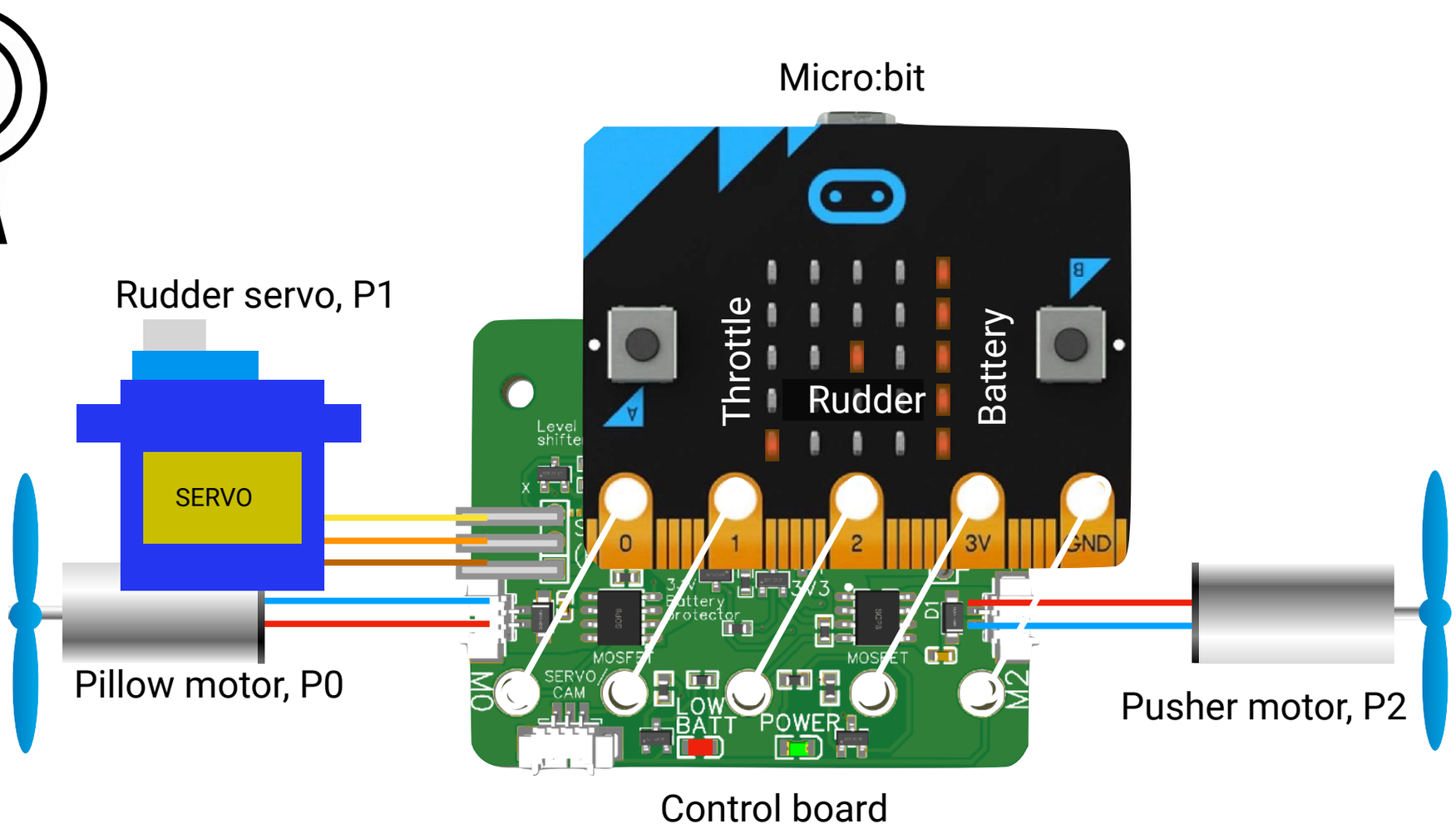

Back

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/

# Connections




The microbit on the left transmits the three parameters Arm (start and stop), Roll (angle of rudder) and Throttle (speed) over radio.

The second micro: bit receives the signal, and then controls the servo on pin P1, the pillow fan on P0 and the pusher motor on P2. The signals are amplified with the control board and sent to the motors and servo.

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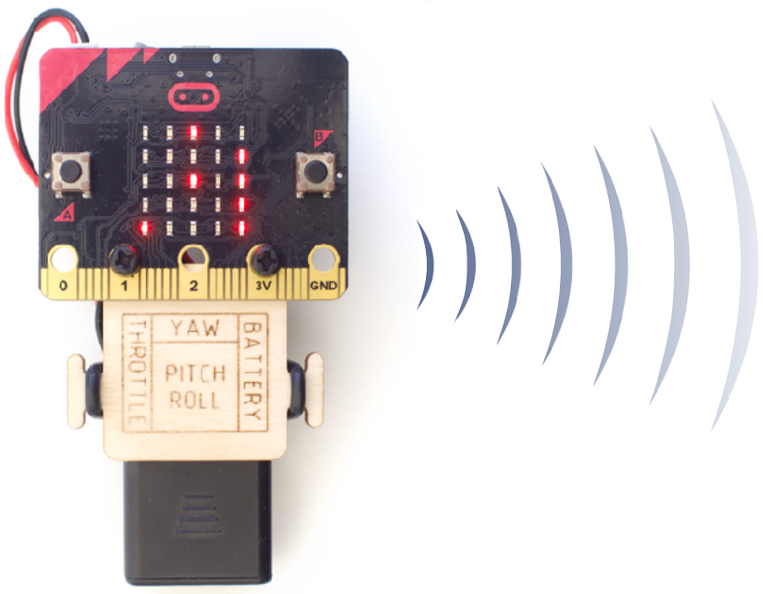
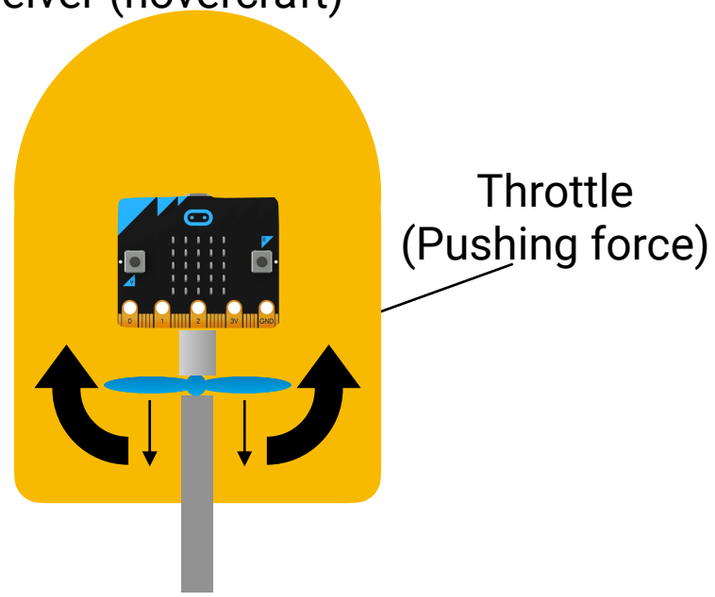
# Controls

We need to name some values we can use to control the hovercraft.
Arm starts and stops motors.
Roll controls the rudder and stearing.
Throttle control the speed.
The values are being transmitter from remote control to the receiver (hovercraft)




**ART**

arm, roll, throttle



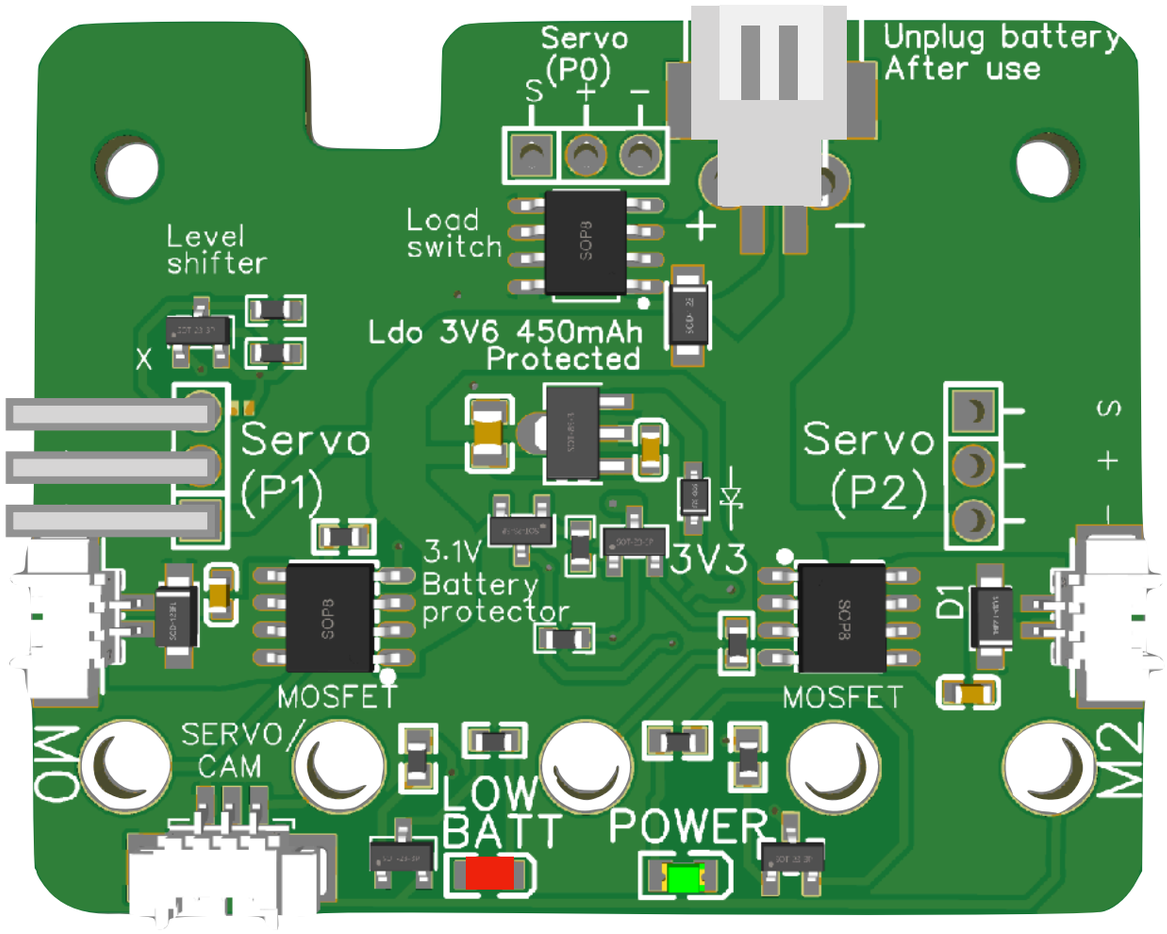

These 3 values control the hovercraft:

| Variable: | Type | Minimum | Neutral | Maximum |
|---|---|---|---|---|
| Arm (start/stop) | Binary | 0 | | 1 |
| Throttle (speed) | Percent | 0 | 50 | 100 |
| Roll (steering) | Degrees | -45 | 0 | 45 |

# Control board (green version)

Battery connection

Servo Connector




Pillow motor

Pusher motor

Battery warning light

The control board amplifies the current from the micro: bit to the motors. It also ensures that the micro: bit gets the right amount of voltage from the battery.

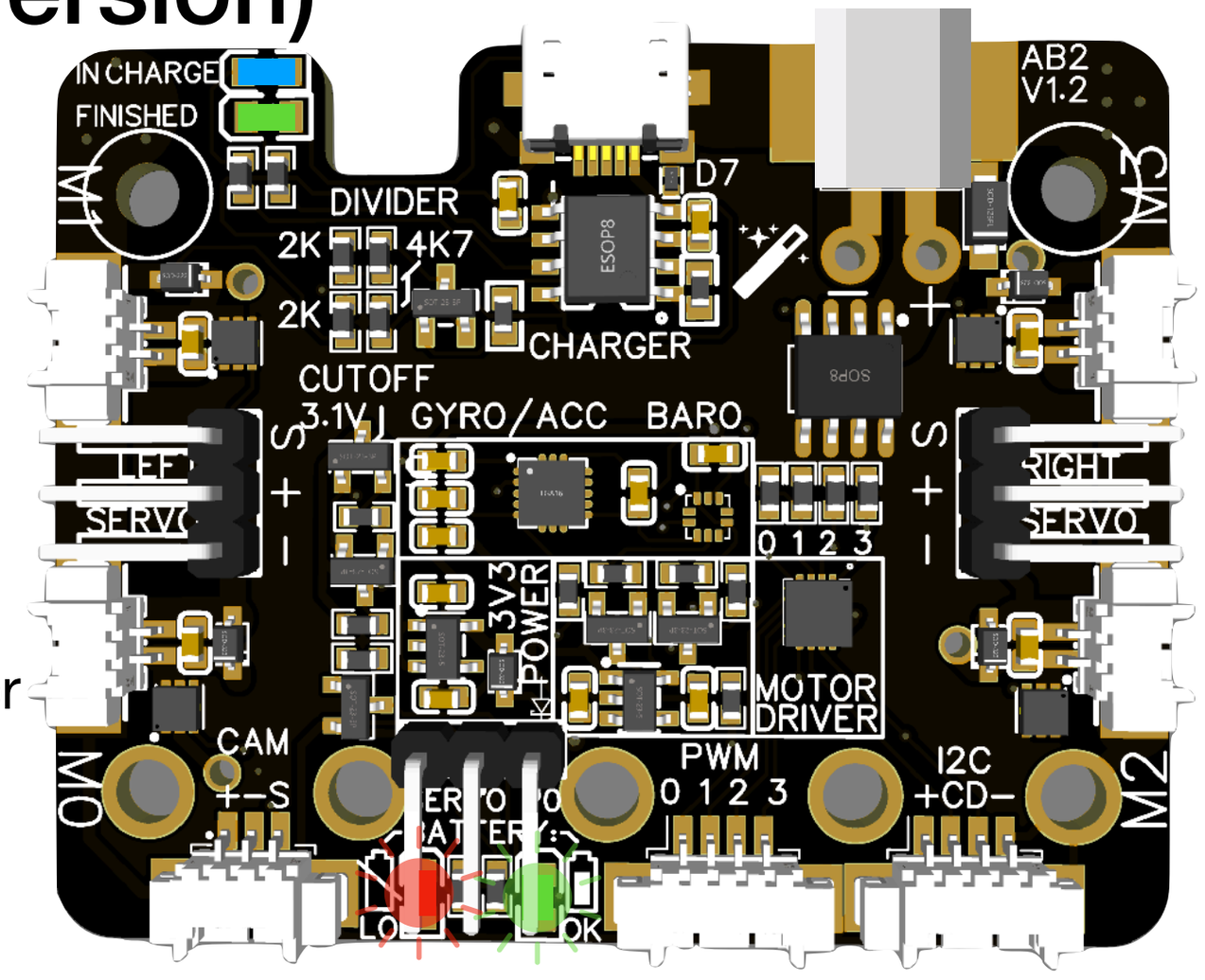
If the battery approaches empty, turn off the power to protect the battery. This is to not damage the rechargeable battery.

**Note that if the red light is flashing, the battery must be charged.**

# Control board (black version)

Micro usb
for charging

Battery connector




Servo

Pillow motor

Pusher motor

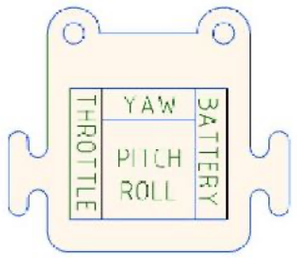
Battery warning light

The blue or black card also has a built-in USB charger and gyro. It will glow blue while charging and green when charging is complete.

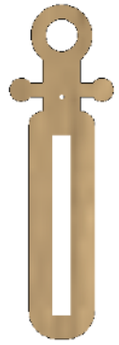
**Note that if the red light is flashing, the battery needs to be charged.**

# ASSEMBLY INSTRUCTIONS

# Parts



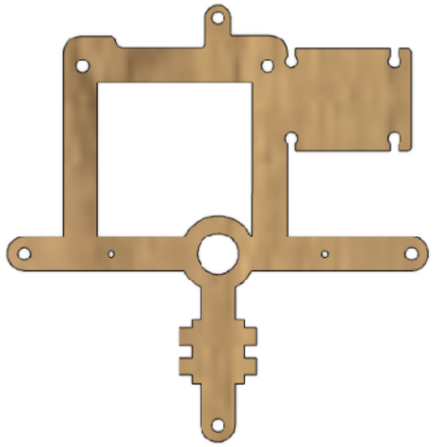

Remote holder



Tail fin holder

Motor holder

2x angle connectors

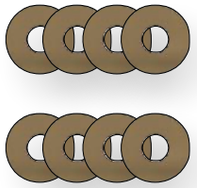


Base frame



Ziplock bag, 15x20 cm

Wedges



8x spacers

2x small O-rings

3 Large o-rings

1 CW propeller

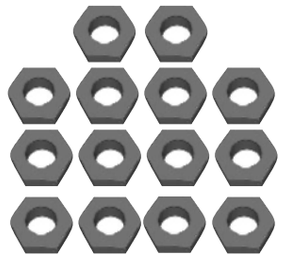
1 CCW propeller

2x m3x8 nylon screws

5x m3x12 nylon screws

4x m3x15 nylon screws

2x m3x12 countersunk



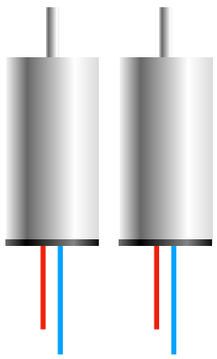
15x nylon nuts

5x spacere, aluminium

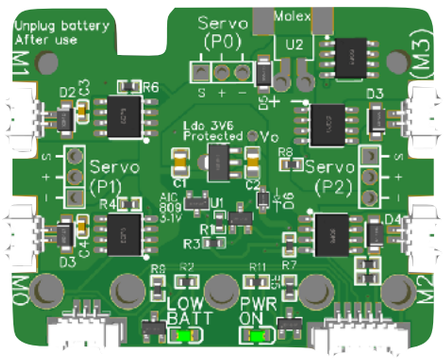
# Parts - Electronics

Servo motor

Servo horn

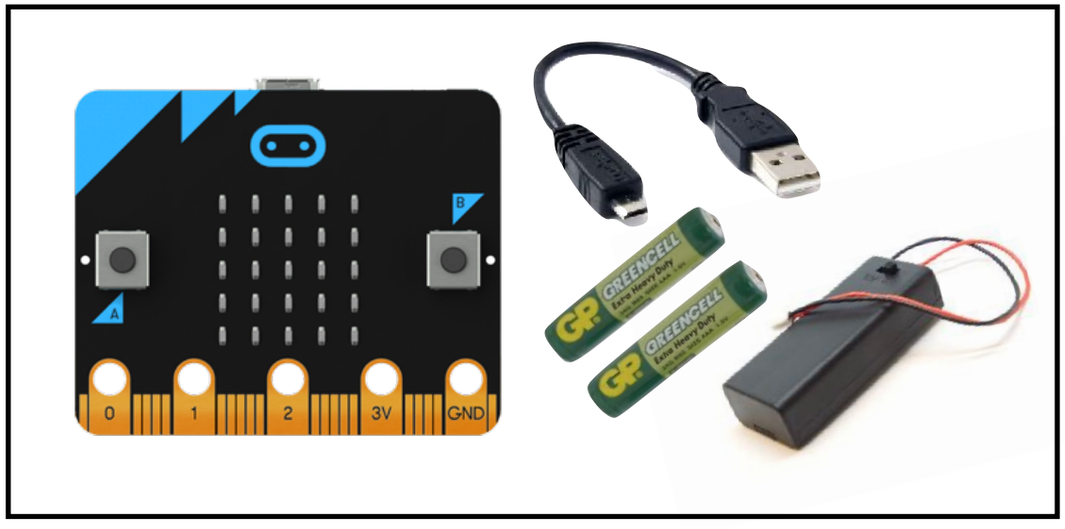


2x Motors




Control board
(Can be black)


Rechargeable
Battery (LiPo)




Micro:bit start kit

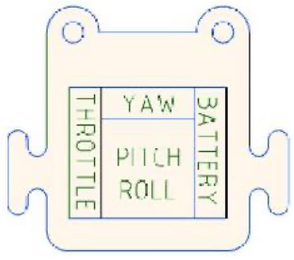
# Assemble the remote

**Tools:** Philips Screwdriver

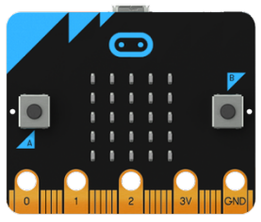
**Parts:**

2 nylon screw m3x8

2 nylon nuts m3

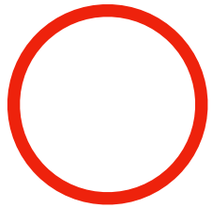



Remote holder

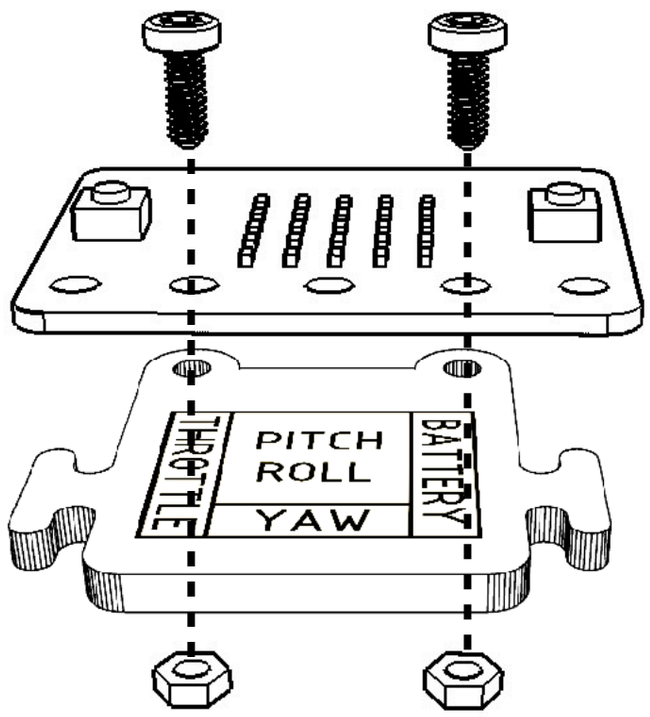


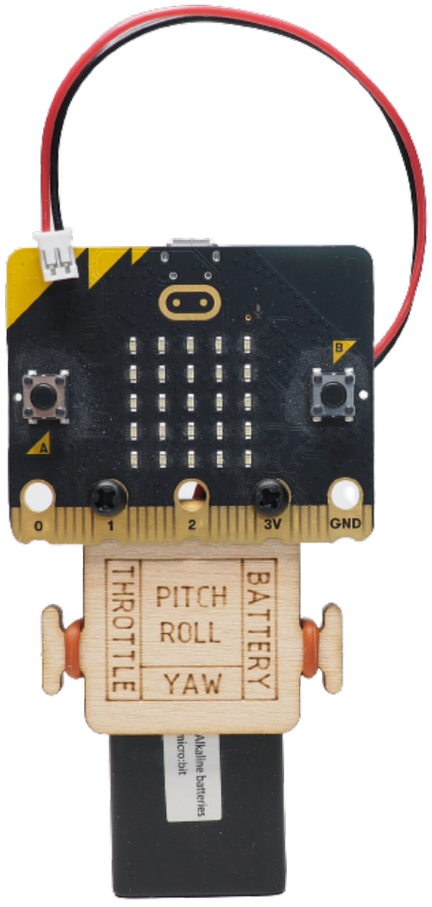

Micro:bit

Battery box AAA



Large silicone ring




- Place the micro:bit with **screen facing up** on top of the holder (1)
- Make sure the remote holder also is **facing up**
- Mount battery box with the silicone ring (2)

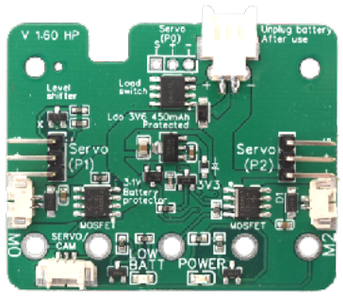
# Countersunk screws

**Tools:** Medium philips screwdriver, wrench

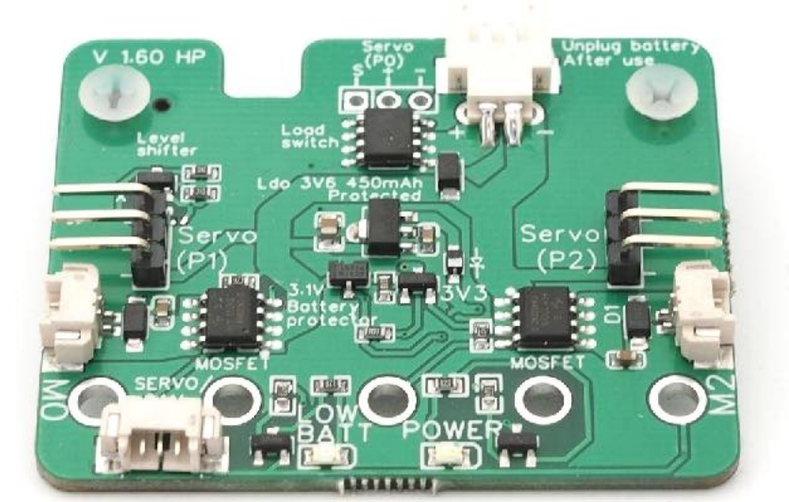
**Parts:**

2x
Nylon screws
(Countersunk)

2x
Nylon nuts m3




Control board



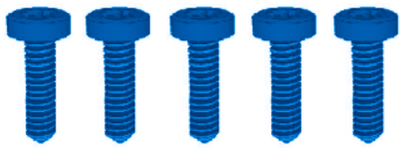


Insert the screws from top.
Attatch the nuts on the backside of the board (where the “MakeKit” logo is).

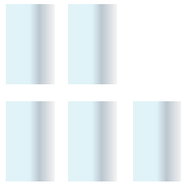
# Spacers

**Tools:**

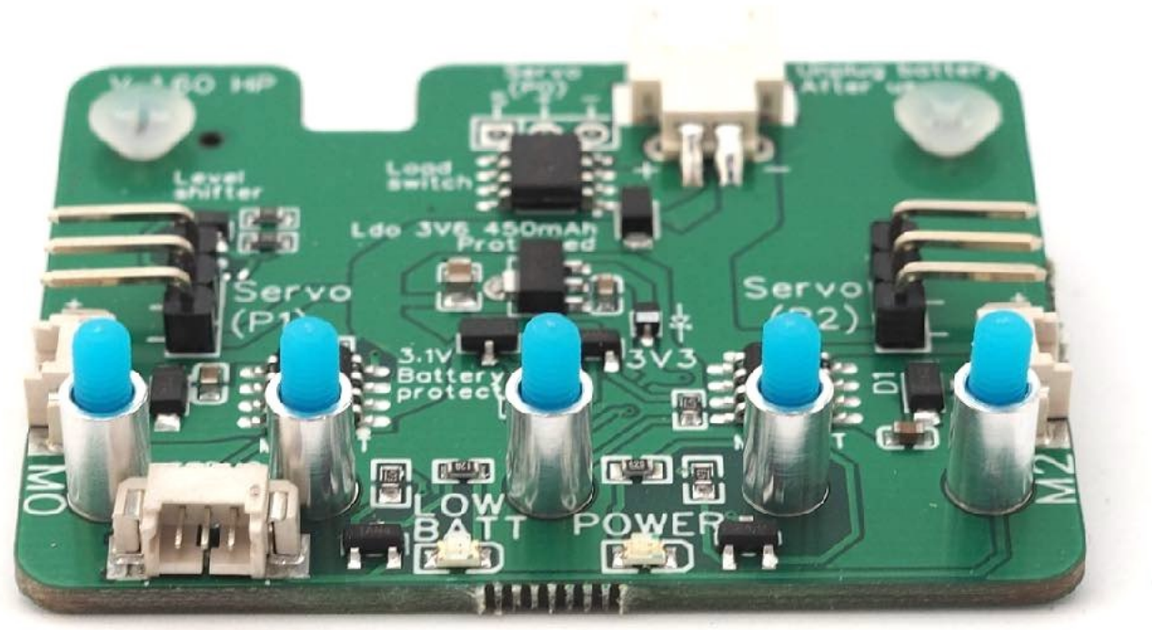
**Parts:**



5x m3x12
nylon screws, blue



5x
Electrical conducting aluminium spacers

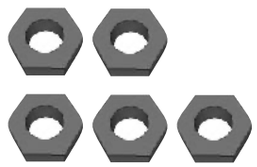



Insert five screws, pointing upwards.
Thread an aluminum ring onto each screw

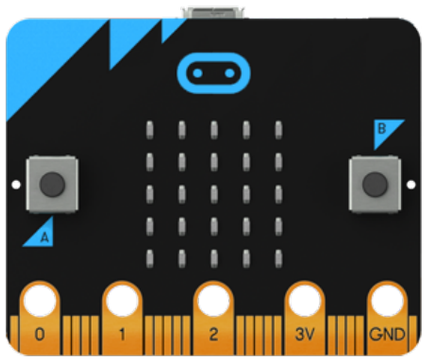
# Micro:bit

**Tools:** Medium philips screwdriver, wrench

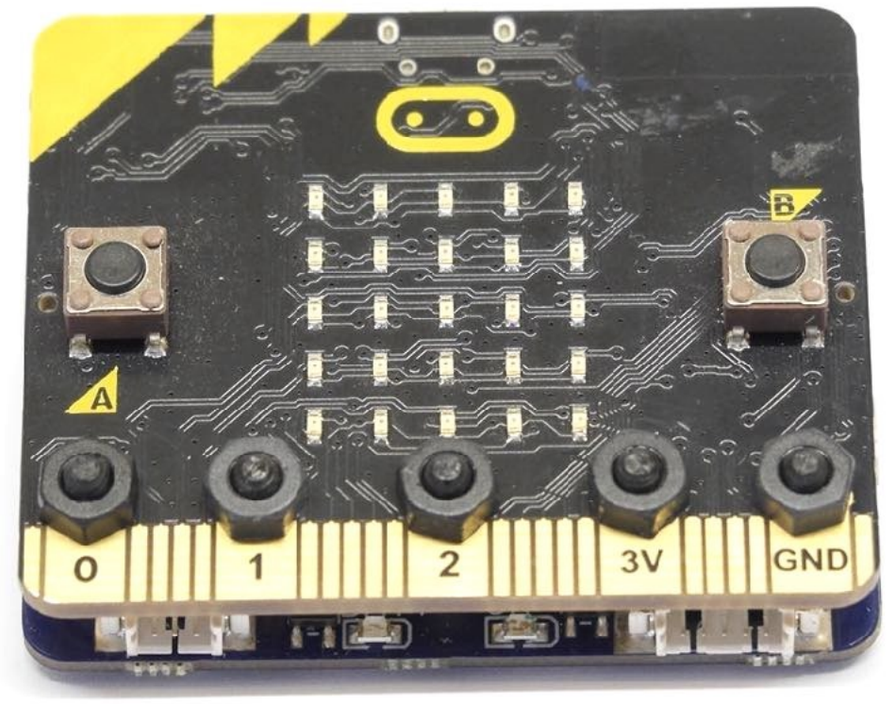
**Parts:**



5x nuts




micro:bit

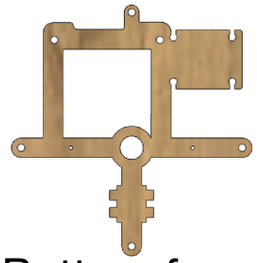



Place the micro:bit over and screw on the five nuts on top. Tighten the screws on the underside so that there is a tight and good contact.

# Control board mount

**Parts:**

2x nuts

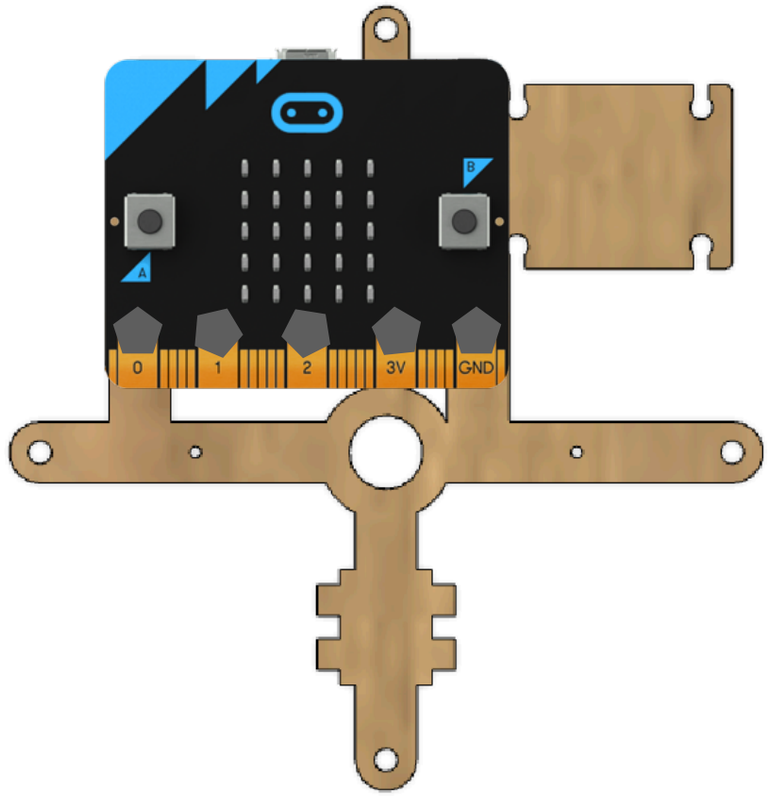


Bottom frame

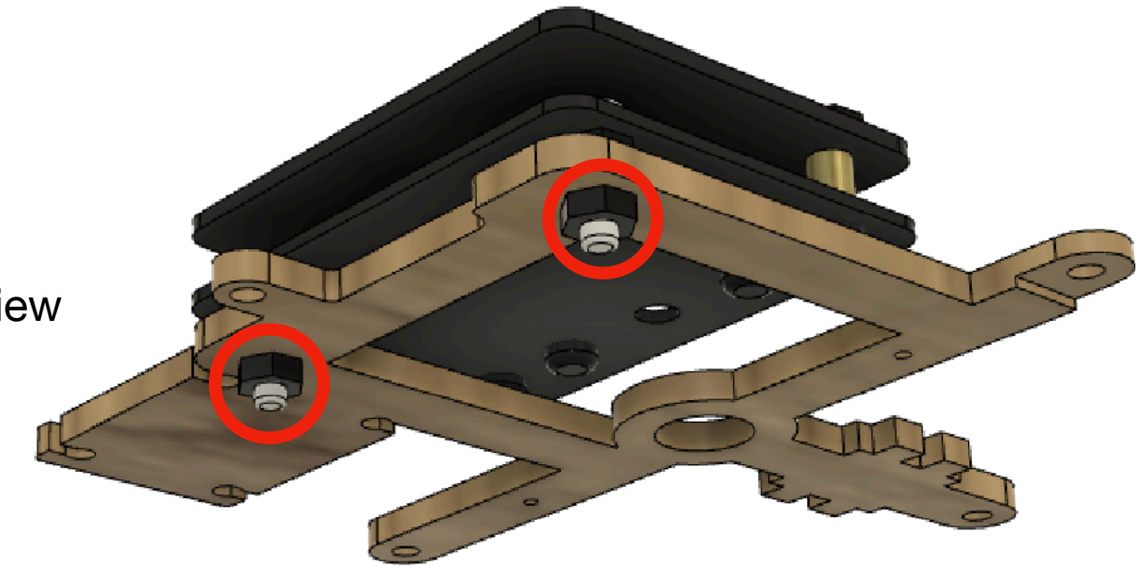



Control unit (micro:bit + control board

Top view



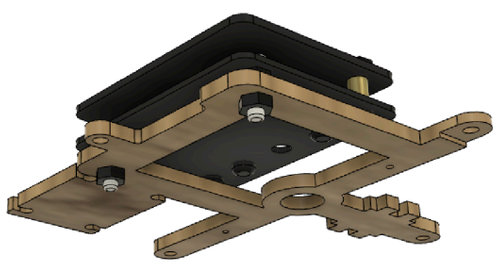

Bottom view



Screw the control board to the base plate. Do not remove the original nuts, they leave a little distance between the control board and the bottom frame.

# Motor holder

**Parts:**

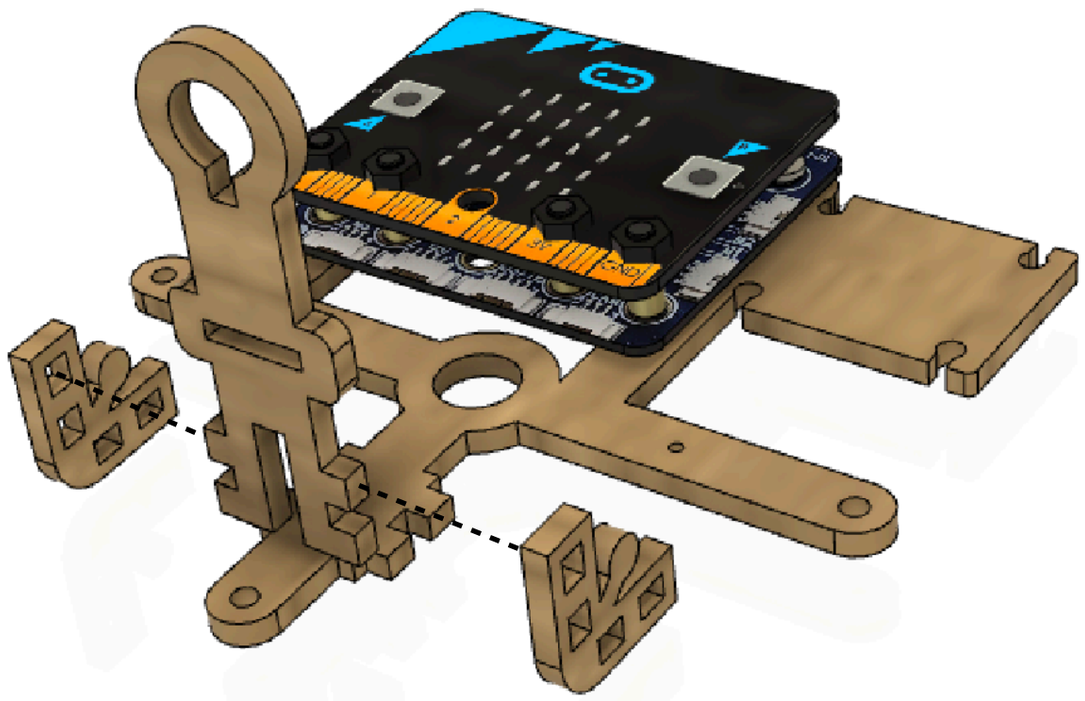


Base

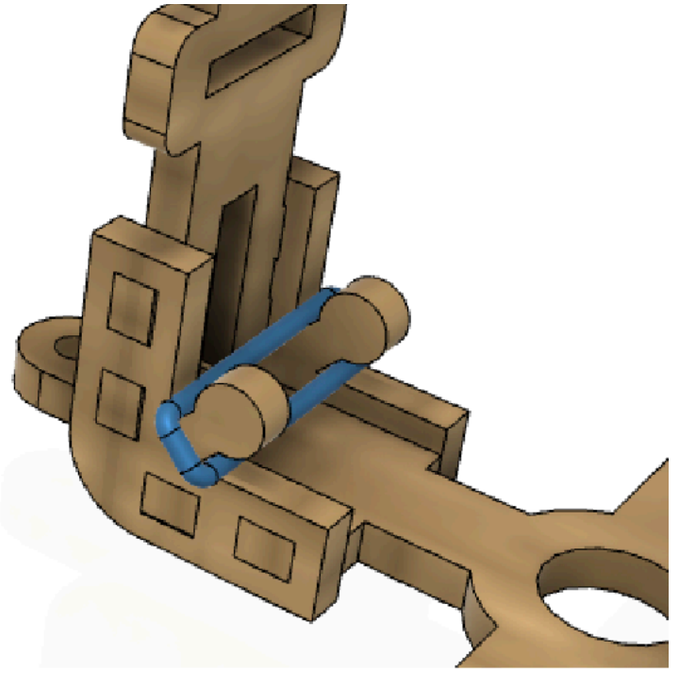
Ghost

Bananas

Small rubber ring

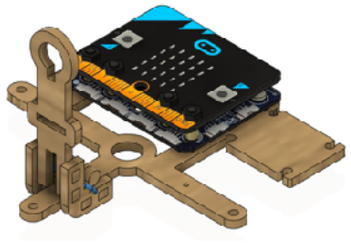


Attach the motor holder (ghost) to the base with the “bananas”



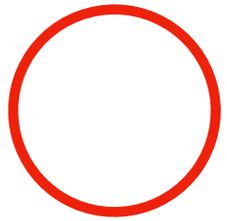
Lock with a rubber ring

# Fasten the servo motor



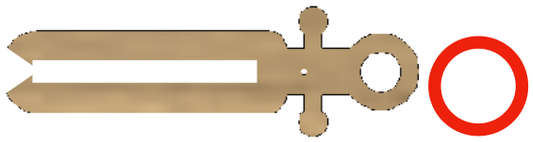
Base

Servomotor



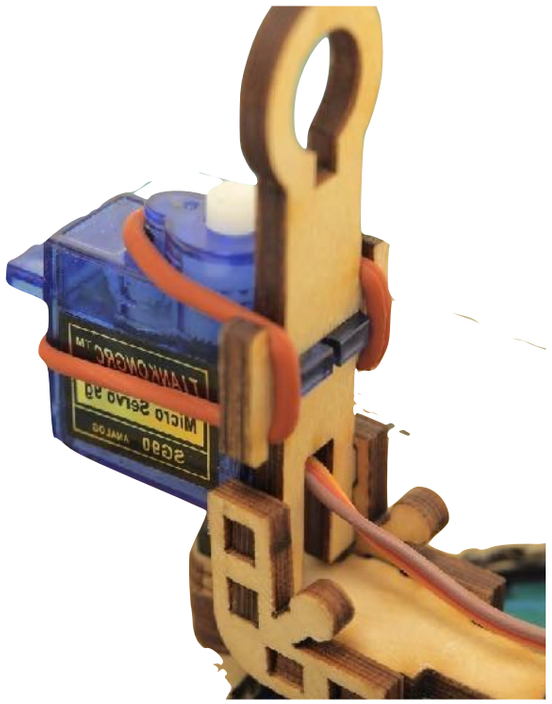
Large
Rubber ring

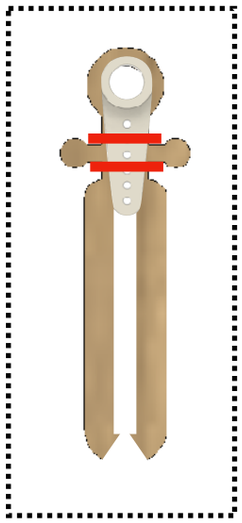
Servo horn

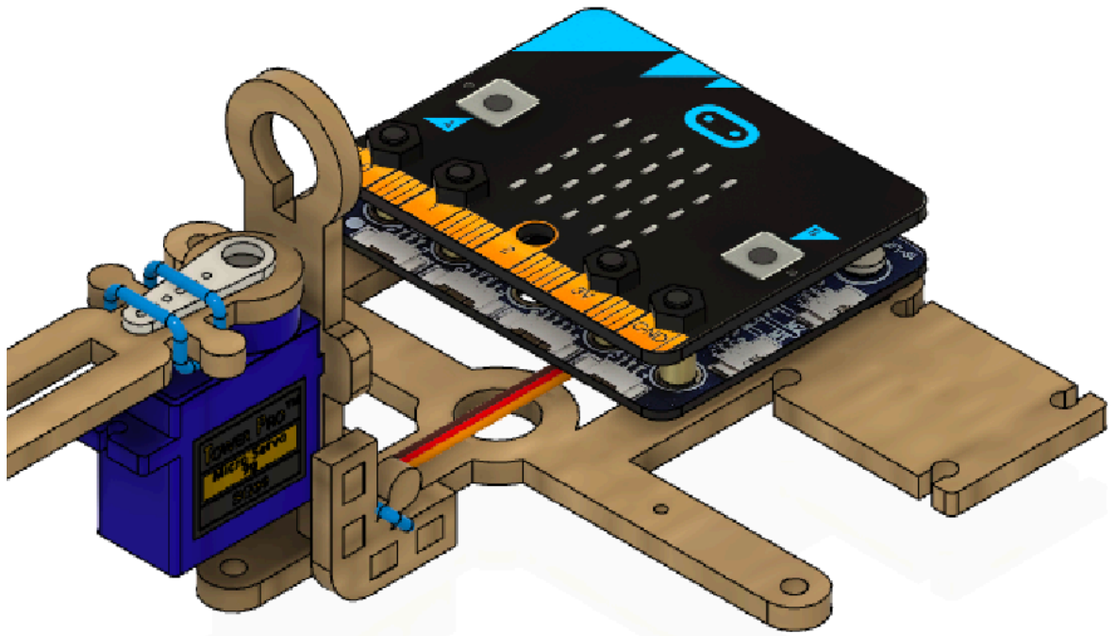


Sword

Small rubber
ring



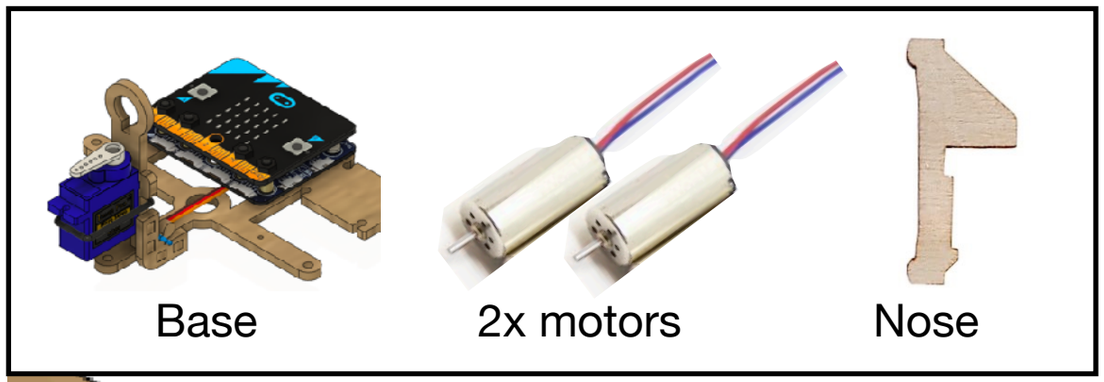


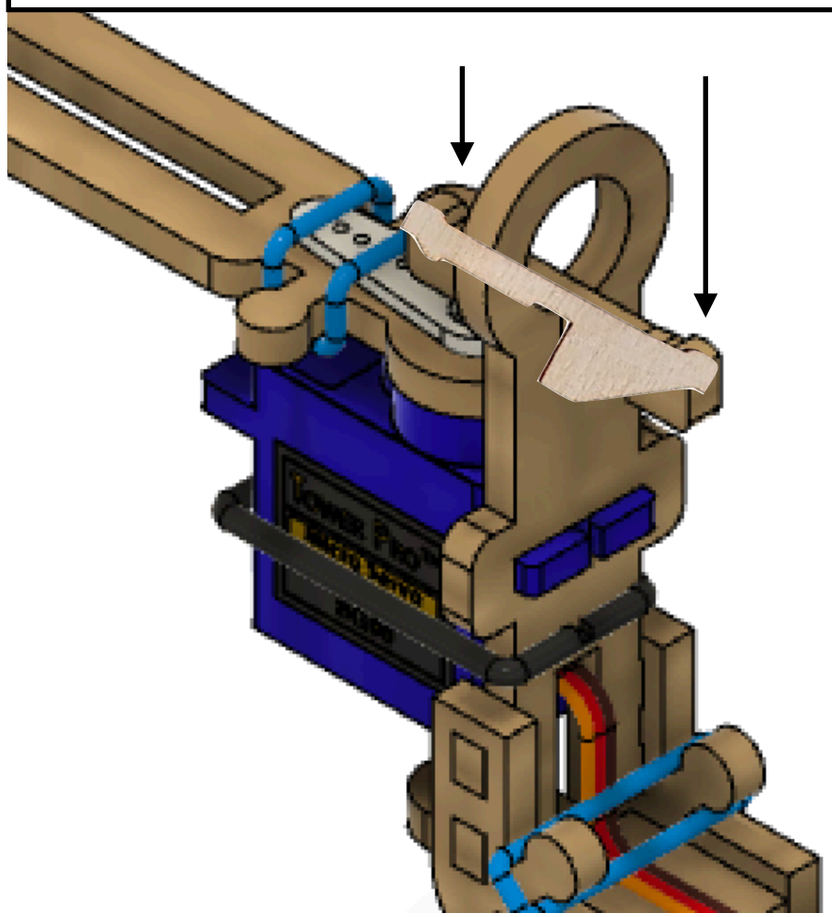


Mount the servo motor in the motor holder (ghost). The wire must go through the ghost. The large rubber ring is threaded over and holds the servo firmly to the motor holder.

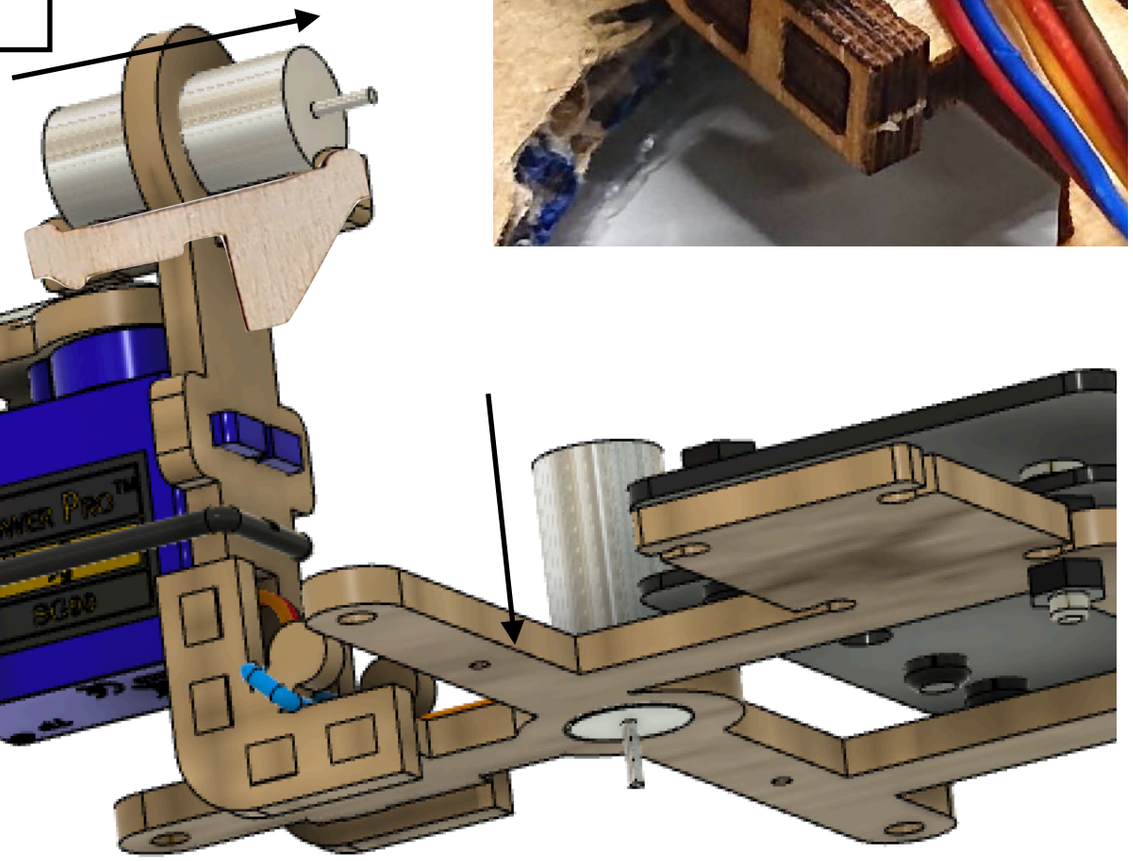
A small rubber ring secures the servo horn and sword together.
This is clicked down into the mount on the servo motor so that it points backwards.

# Fasten motors

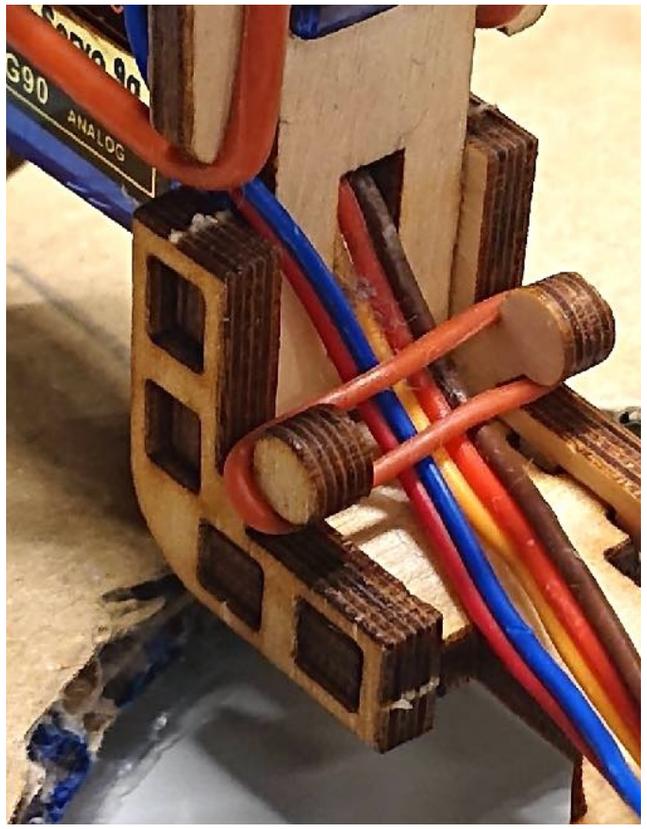


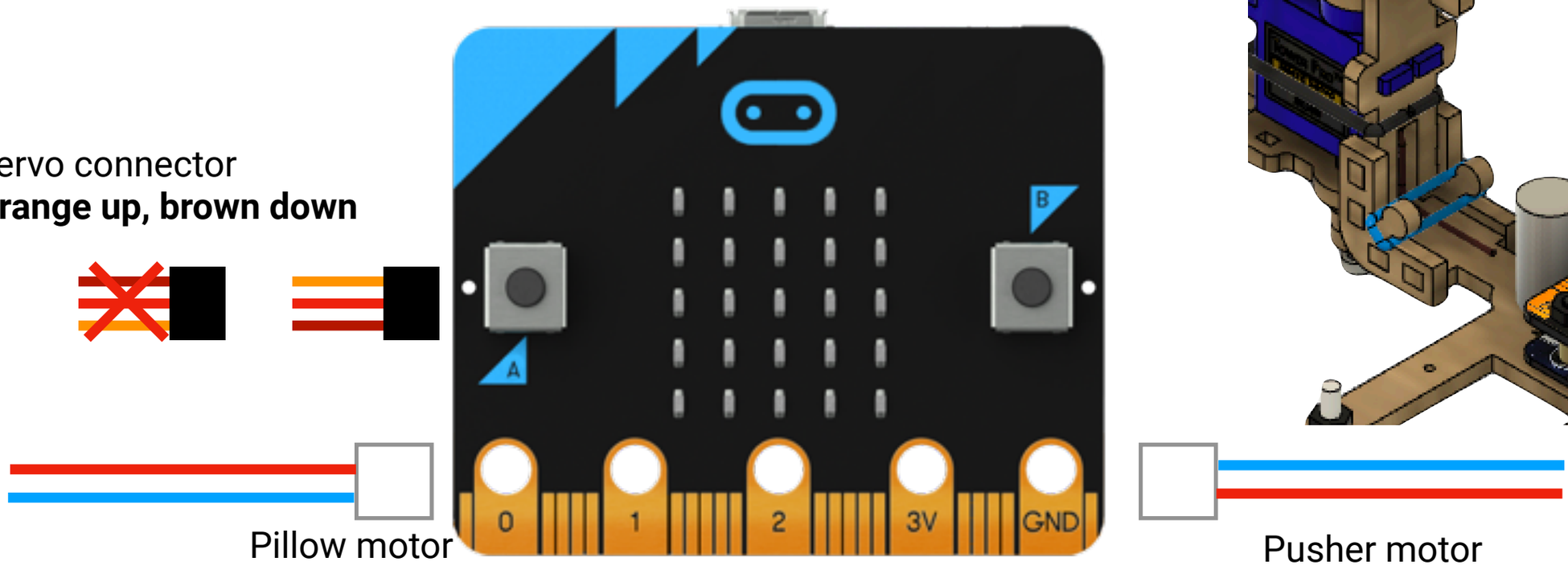
Press into place a wedge (nose) in the motor holder




Place the motors in the directions shown by the arrow. The bottom motor should run flush with the base.

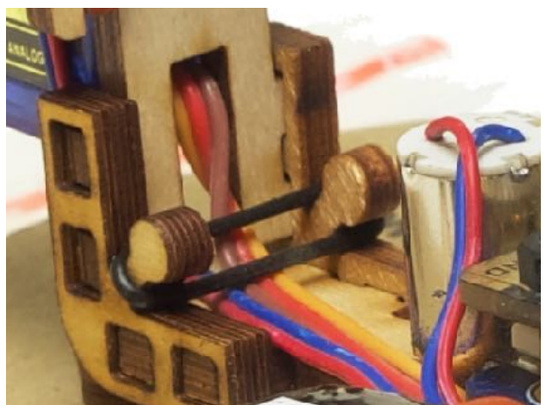


# Connections





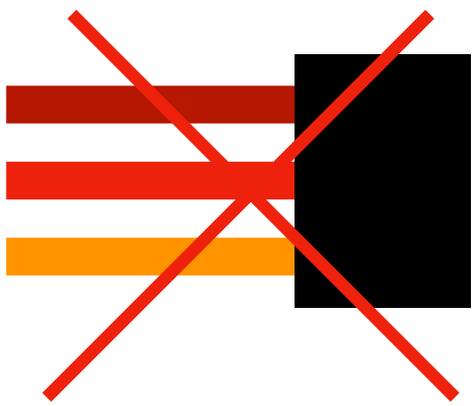


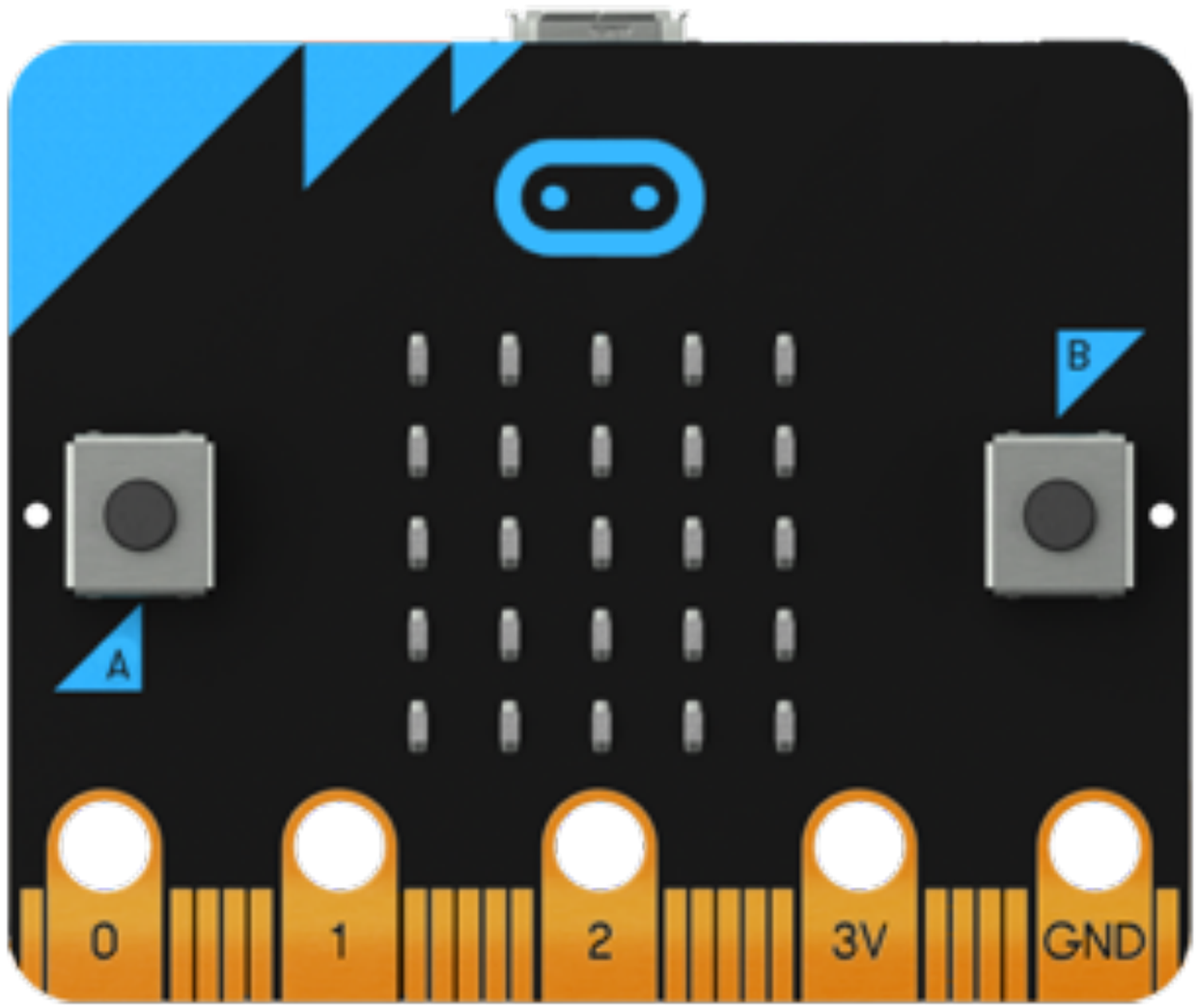


Pull the rubber ring over the thrust motor and servo cable.

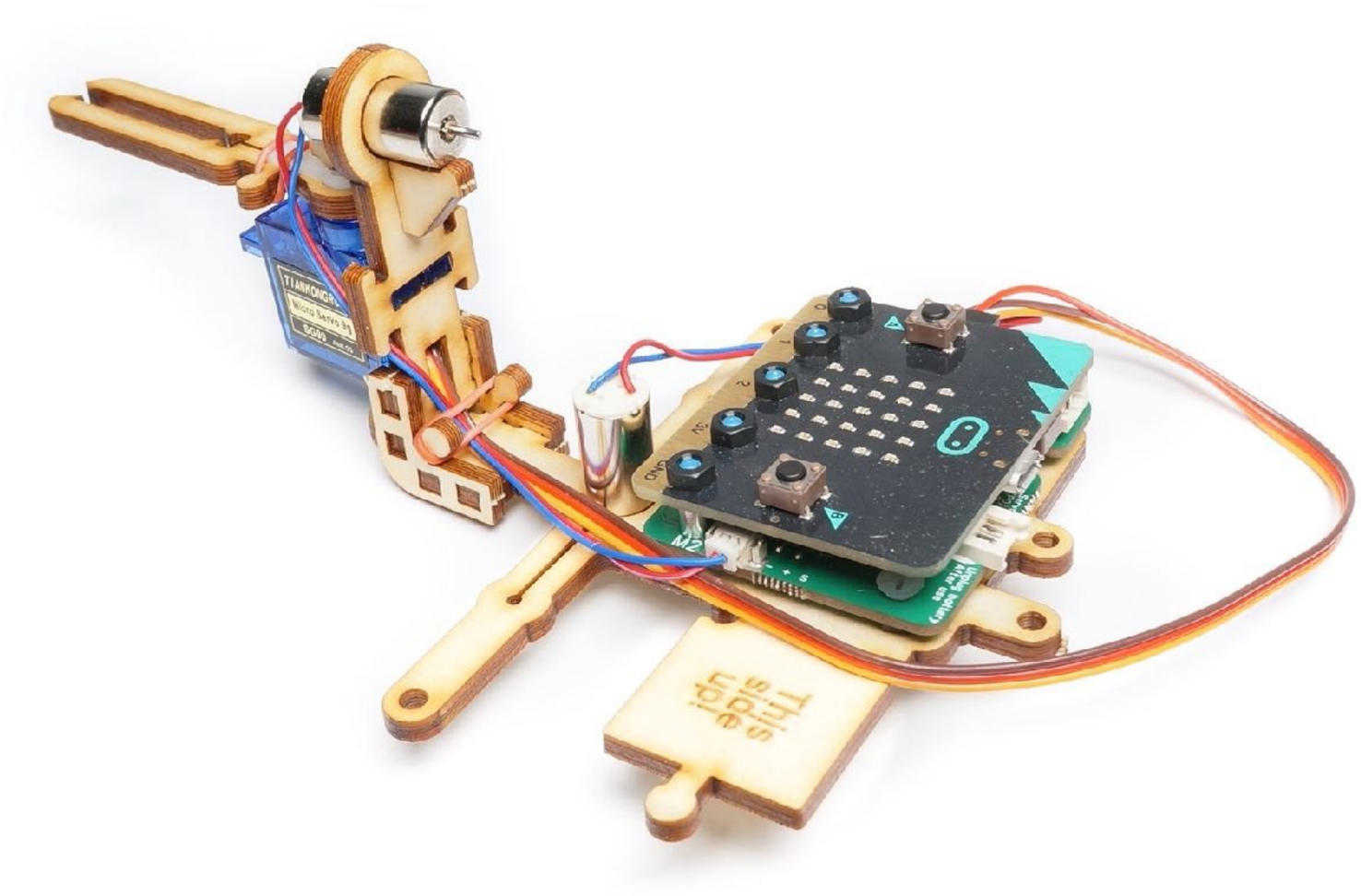
# Servo connections

A reminder!
The servo plug must be connected with orange up and brown down.





# Finished frame assembly

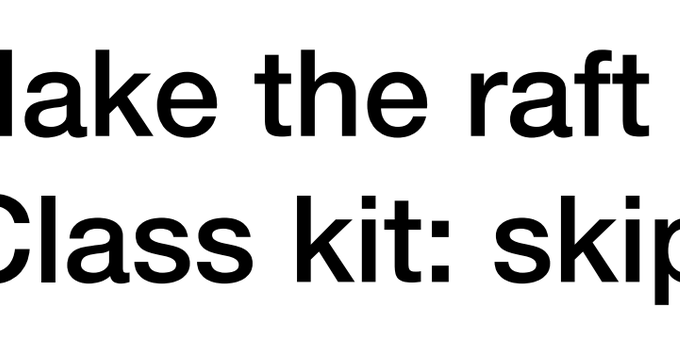


Reference with motors and servo connected

# Make the raft
# (Class kit: skip to next page)

**Tools:**
Utility knife or scissors

**Parts:**



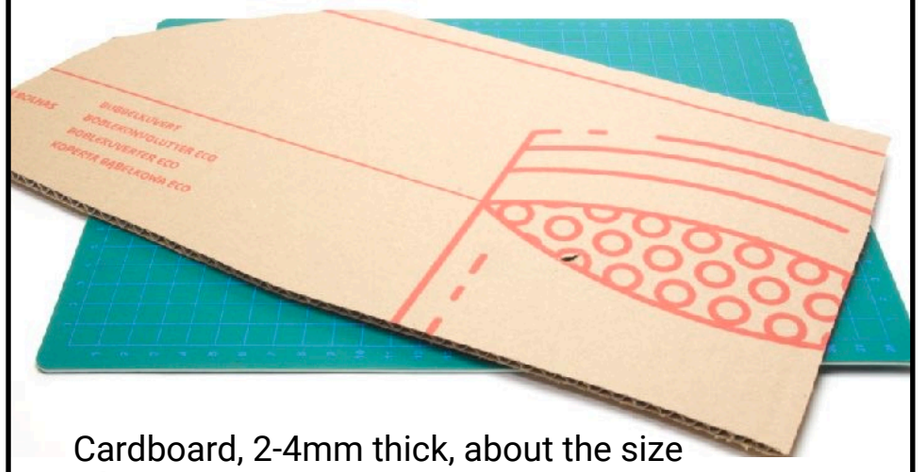

Cardboard box from kit


- Carefully cut along the dotted lines
- Cut out one of the tail fins

# Make the raft (Class kit variant)

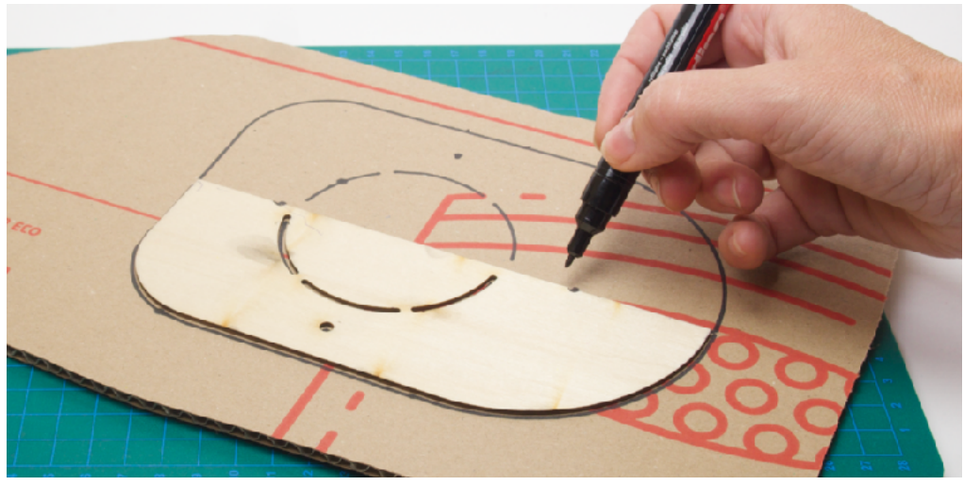
**Tools:**
Template, marker, pen or pencil

**Parts:**



Cardboard, 2-4mm thick, about the size of an A4 paper


- Place the template on the cardboard, the ruler should lie approximately in the middle of the cardboard
- Draw around the entire template, except along the ruler. Get all three holes/ notches that are marked with a pencil

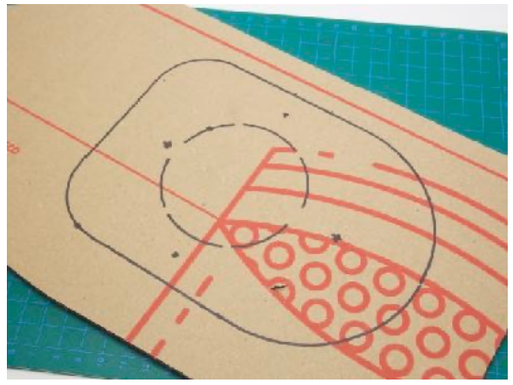


- Flip the template and complete the outlines

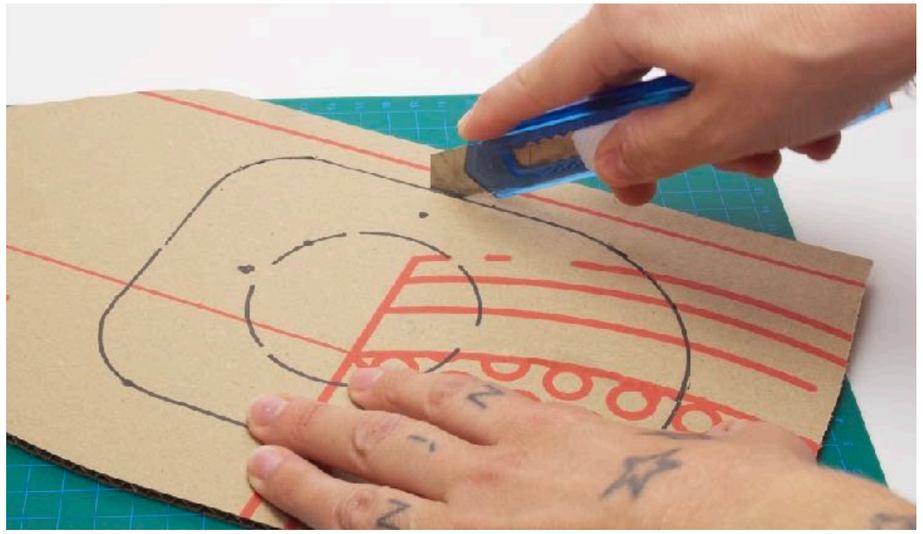
# Cut the raft

**Tools:**
Wallpaper knife or good scissors,
cutting mat or wooden board.

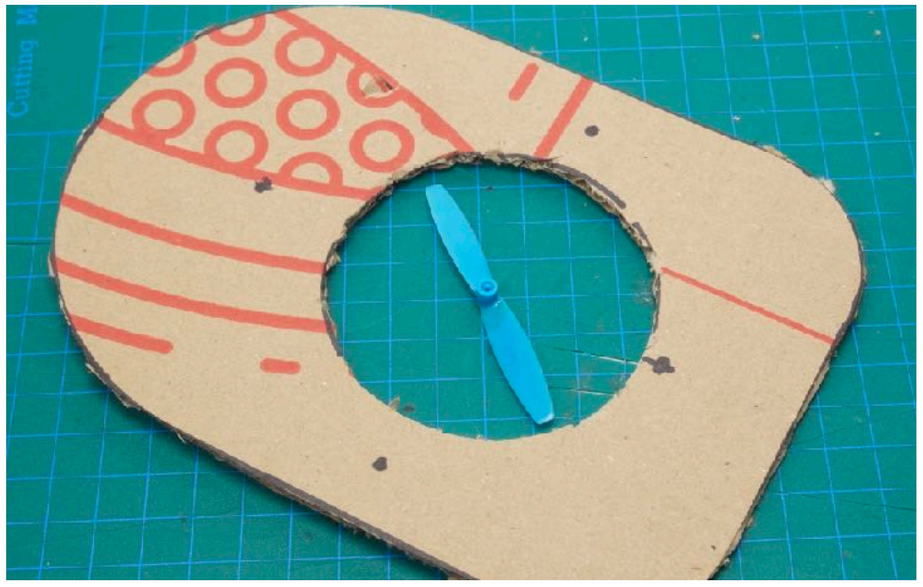
**Parts:**



Cardboard



- Cut along the lines with a wallpaper knife or scissors (the outside of the raft and the inside/circle)



- Have enough room for the propeller to spin freely in the middle. This can be tested by placing a propeller in the center of the hole.

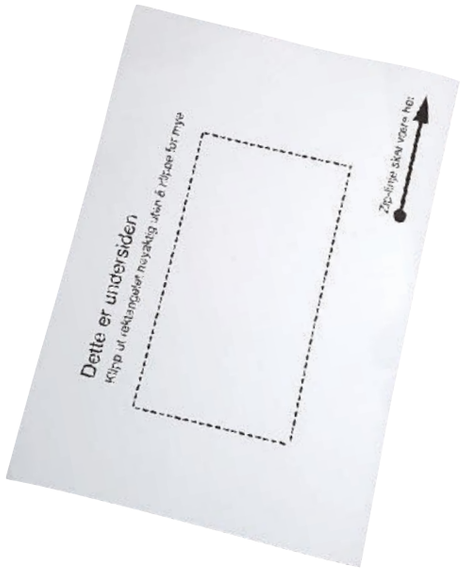
# Prepare the cushion

**Tools:**
Wallpaper knife or good scissors,
cutting mat or wooden board

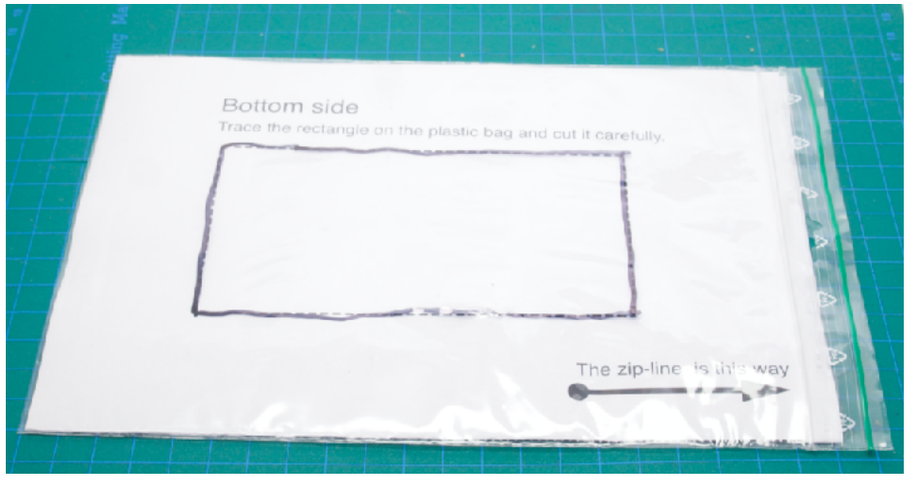
**Parts:**



Zip-bag




A4-Template




- Fold the A4 sheet in half and place it in the bag. You can fold a small extra part of the edge of the sheet so that it fits more easily. Note that there is a separate arrow pointing towards the zip line.

- Draw the oblong square


- Cut out the square with scissors.
- Do not cut through the paper and do not cut past the lines.

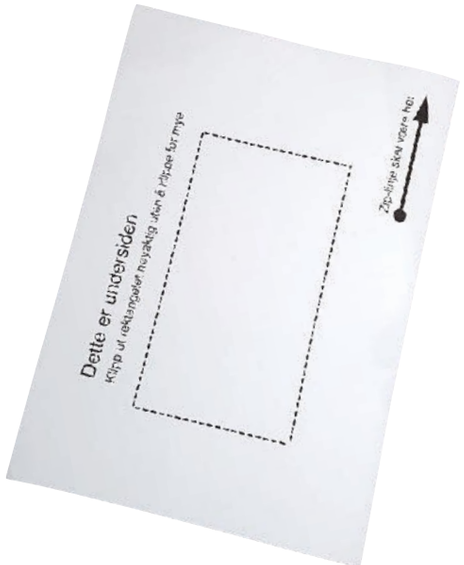
# Prepare the cushion (2)

**Tools:**
Scissors

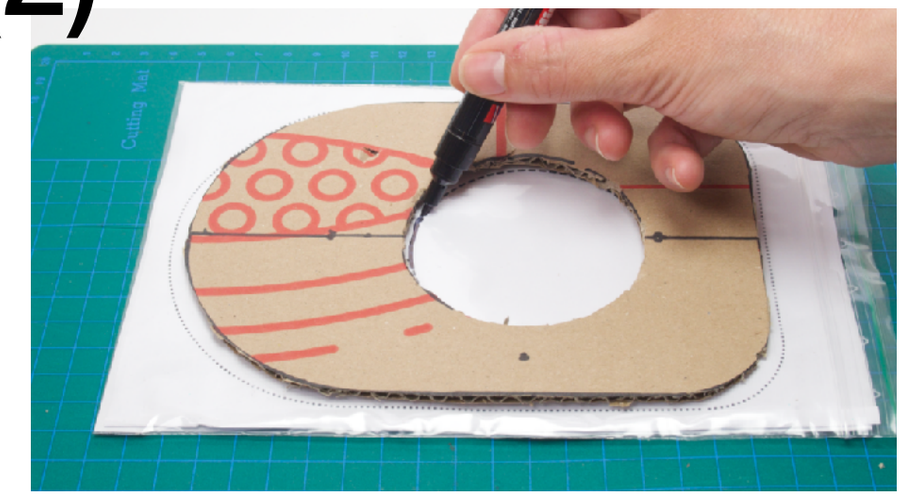
**Parts:**



Zip-bag




Printed A4-template




- Turn the bag over and draw the hole in the middle. You can use the raft as an additional template.

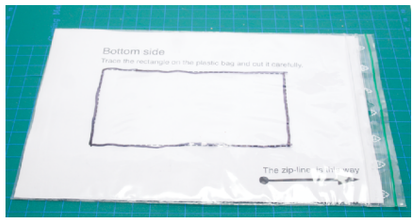

- Cut out the hole with scissors. Do not cut through the paper!

# Glueing

**Tools:**
Glue gun, cutting mat

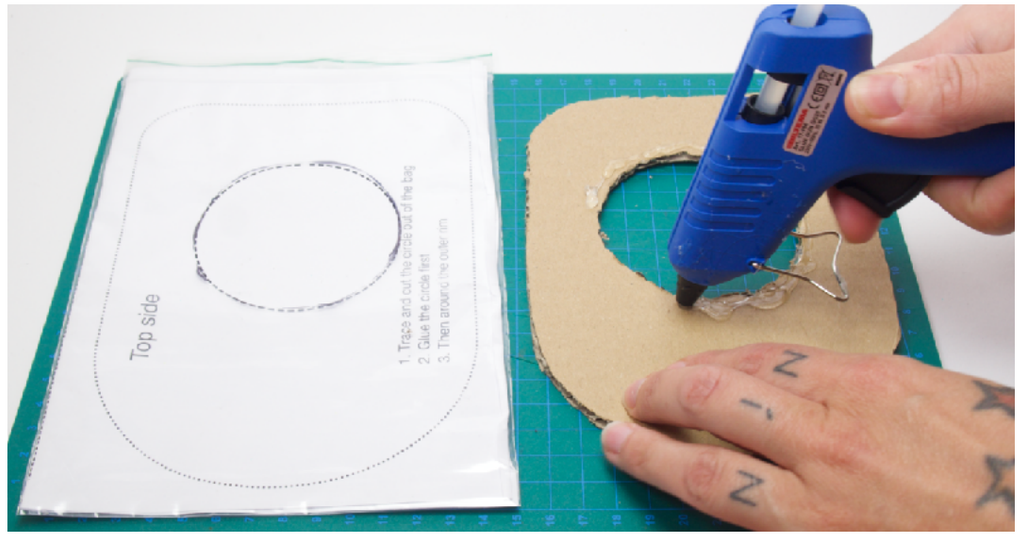
**Parts:**

Fleet

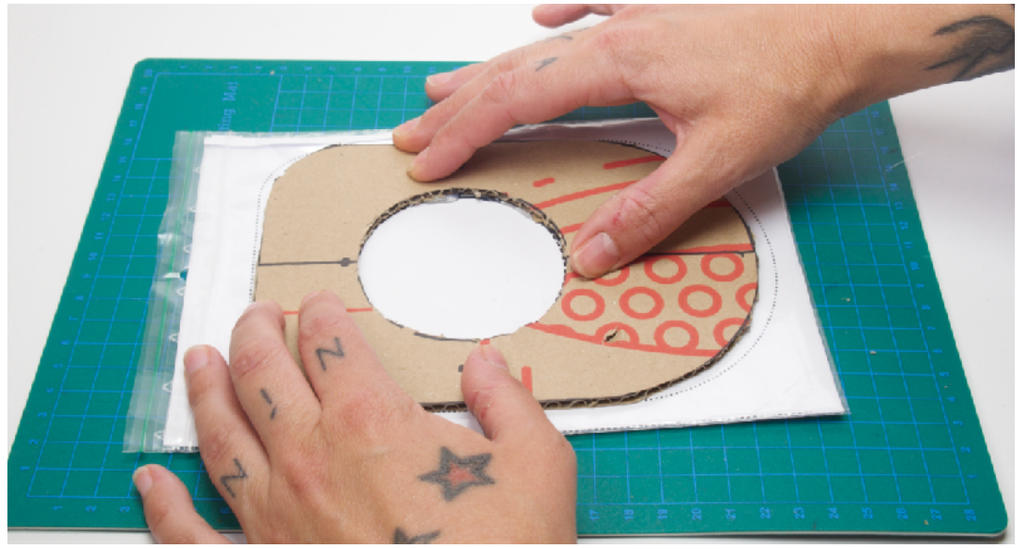



Bag/Paper

**Tip!**
It is best to glue the hole in a round. Therefore, leave the glue gun nice and warm, and practice what you are going to do first. You have to be quick to place the raft, and hit the right spot right away.



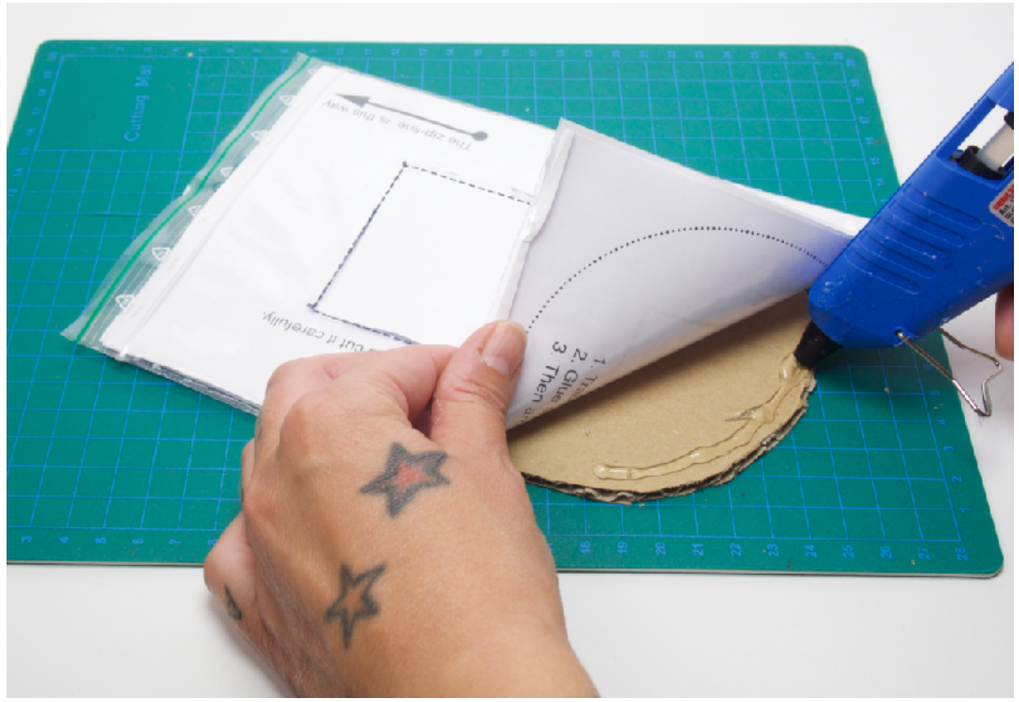

- Prepare the bag so you can see the top side
- Heat up the glue gun and have enough glue on hand. Place a strip around the entire hole.



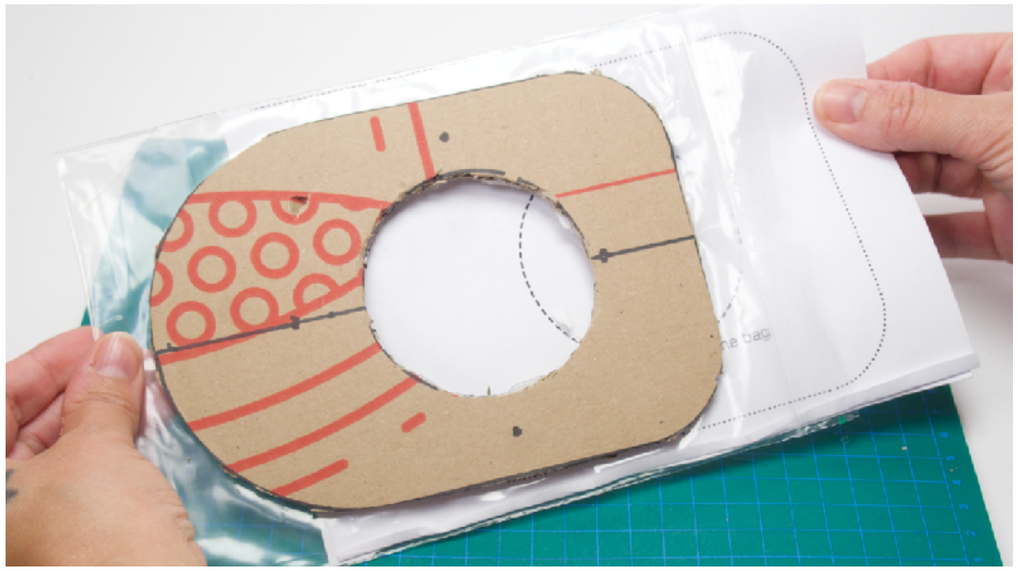
- Quickly place the raft on the bag before the glue hardens. Hit as precisely in the middle as you can
- Press together for a few seconds

# Glueing (2)

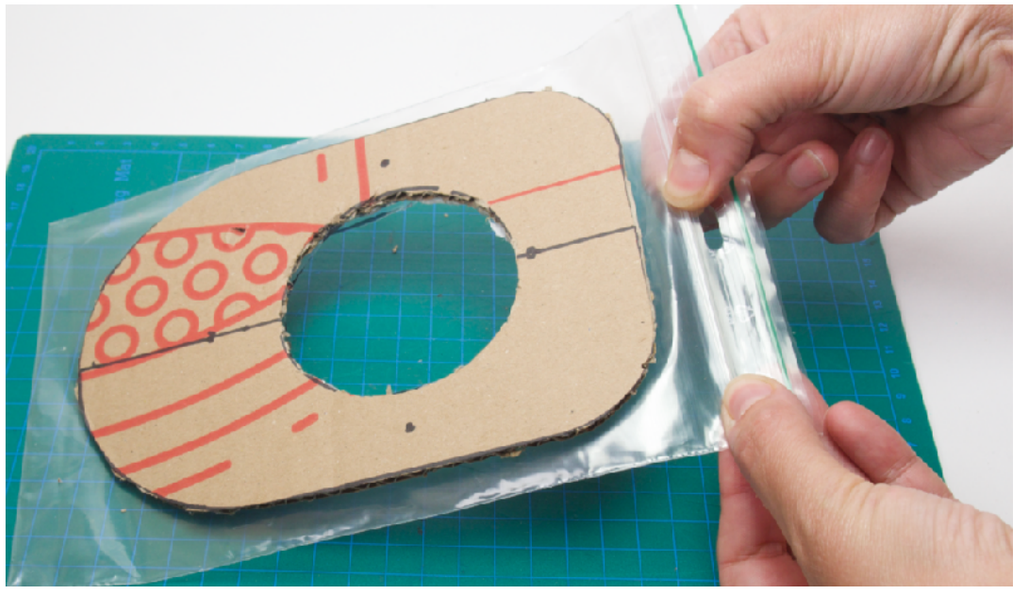
**Tools:**
Glue gun, cutting mat




We also have to glue along the edge around the entire raft. You can do this in several rounds. Apply a strip of glue and press down.



Once you have glued around the entire edge, pull out the paper.



Close the zip bag, so that air does not leak when the air is pumped in.

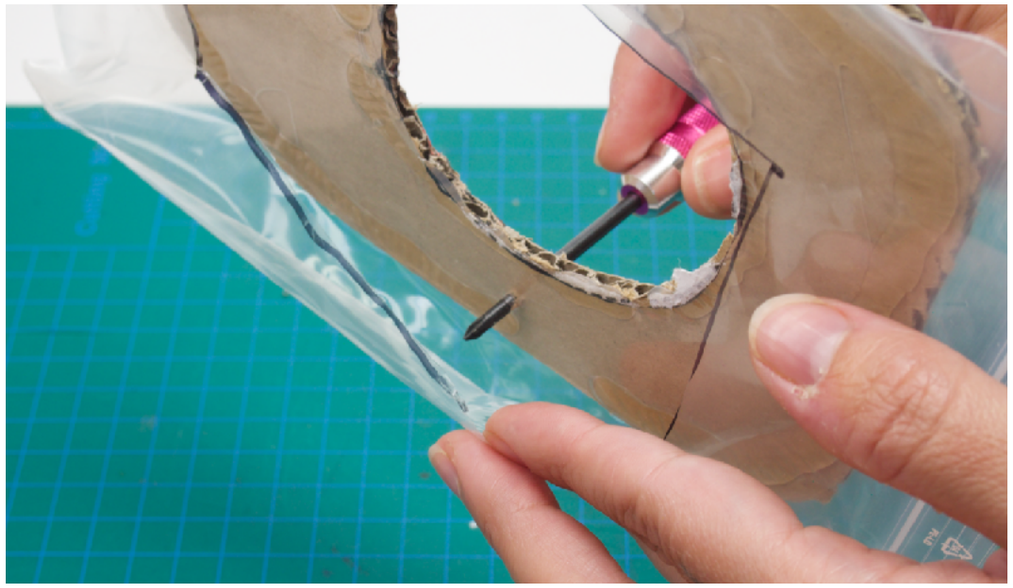
# Prepare fleet

**Tools:**
Small philips screwdriver

**Parts:**

Glued fleet/bag

4x nylon screws
m3x15



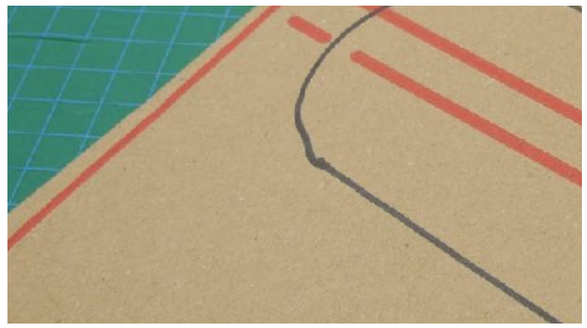
Punch holes through the raft and one layer of bagn in all four holes

Put a screw through each hole, but only through the side of the bag that is glued.

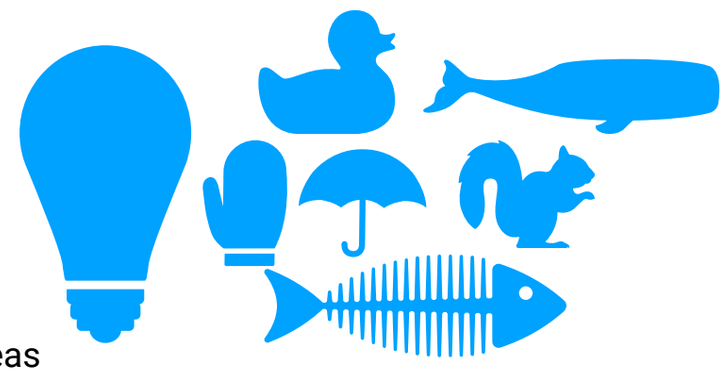
# Prepare sail

**Tools:**
Scissors/knife, cutting mat

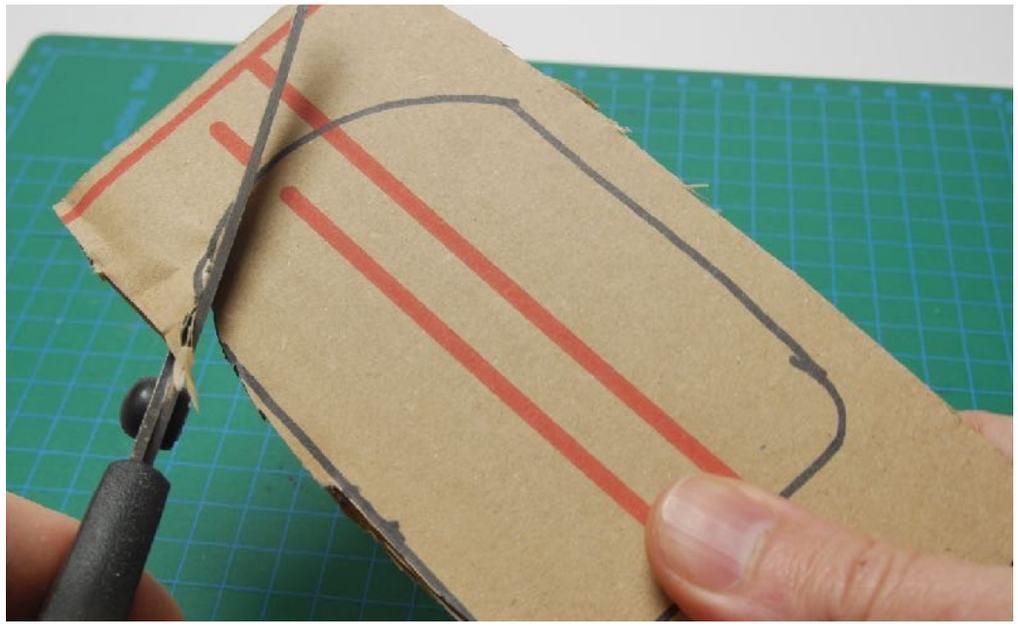
**Parts:**



Some cardboard, 2-4 mm thick



Ideas



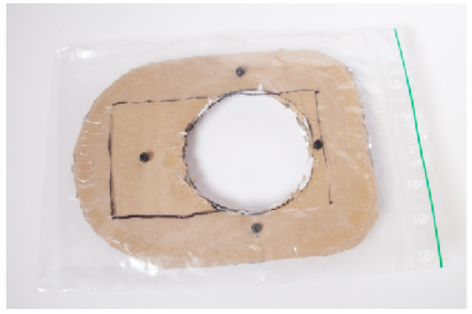
Design your own tail rudder. You can be inspired by, for example, fish, plants, airplanes, or something else. Soft, round shapes can have a beneficial effect on air resistance.

The rudder should normally be between 5 and 10 cm high, and between 5 and 12 cm long.

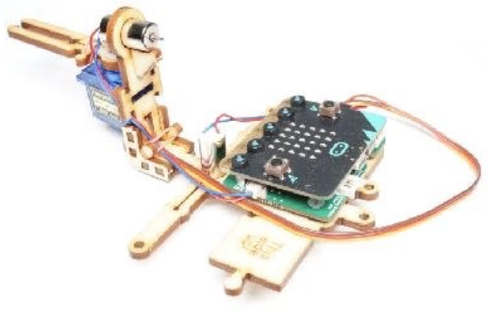
# Assembly

**Tools:**
Small philips screwdriver, wrench

**Parts:**



Raft

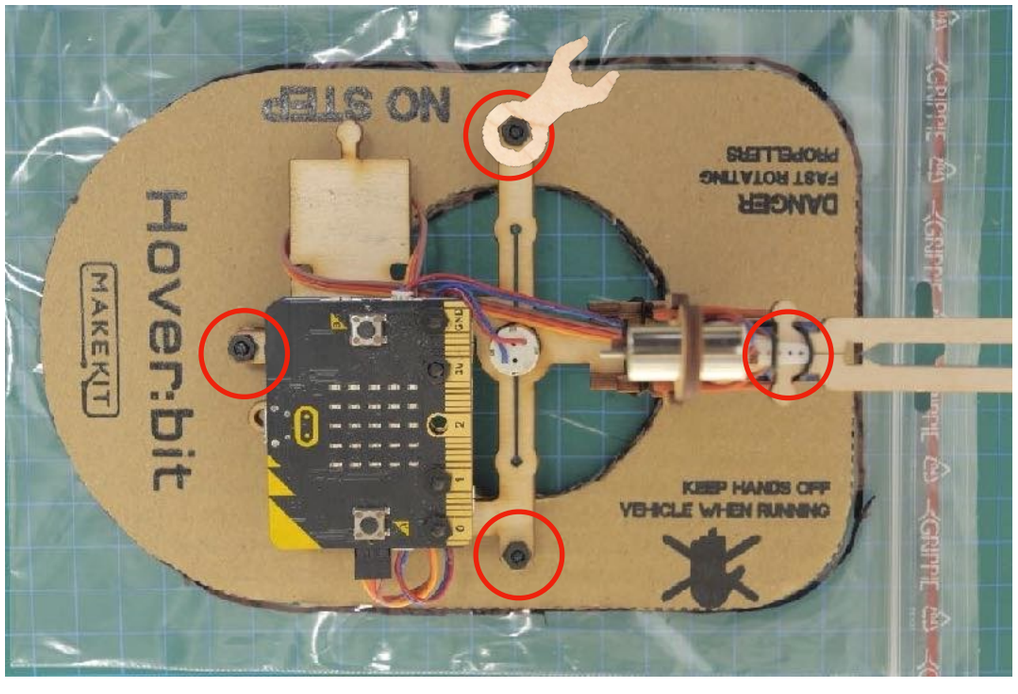


Frame

8 spacer rings (plywood)

4 nylonnuts


Place the raft with the plastic bag down. Place two spacer rings on each screw.




Place the frame on the screws/spacers.
Tighten all four bolts. Feel free to use the nut tool on one side and the screwdriver on the other side.

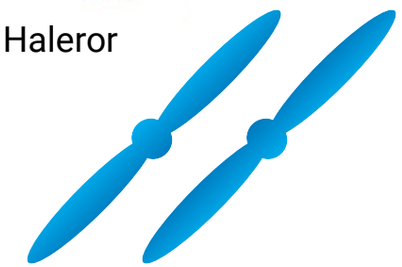
# Tail rudder and propeller

**Tools:**

Small philips screwdriver

**Parts:**

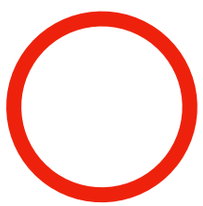

Haleror



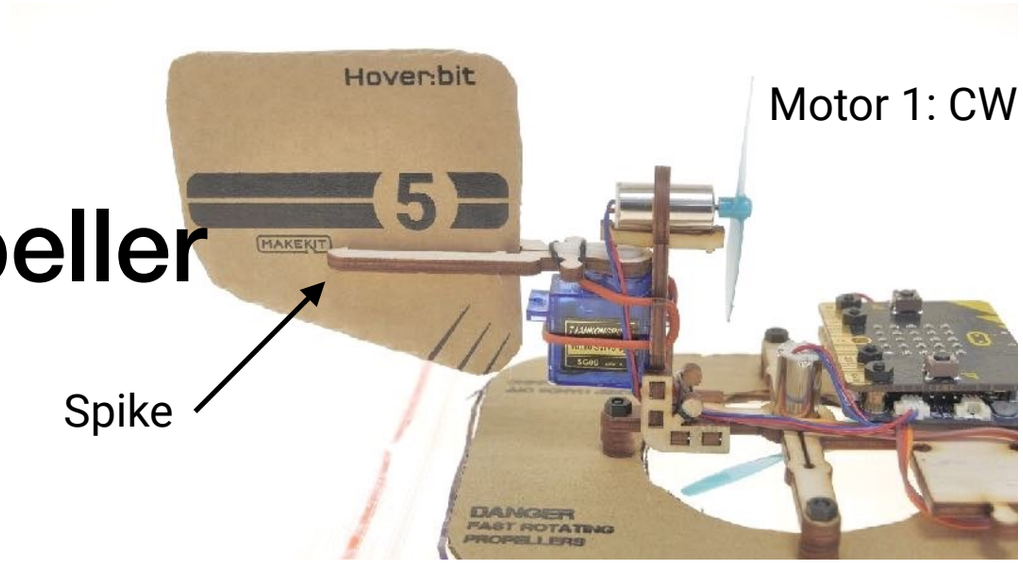
1 CW propell

1 CCW propell


LiPo-battery



Stor o-ring

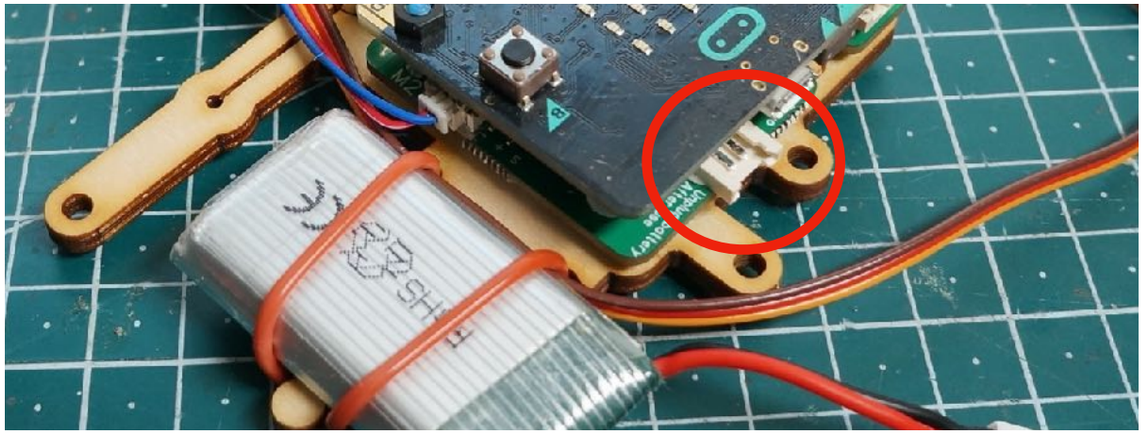



Motor 1: CW

Spike

Motor 2: CCW

- Push the tail rudder into place. Squeeze the "spike" intro cardboard for better grip.
- Attach the propellers. CW / CCW is written in small print on the top of the propeller, near the center.

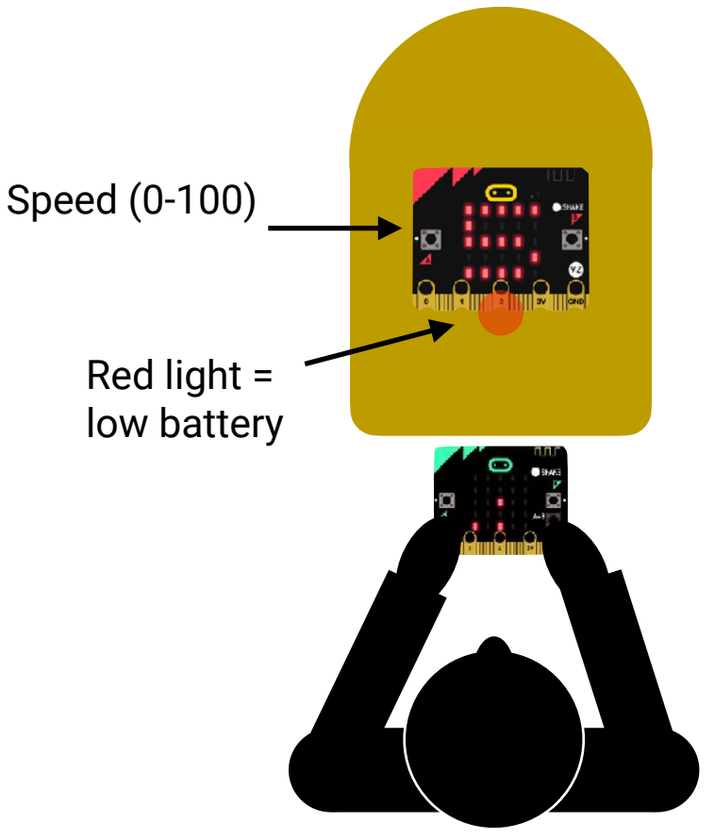


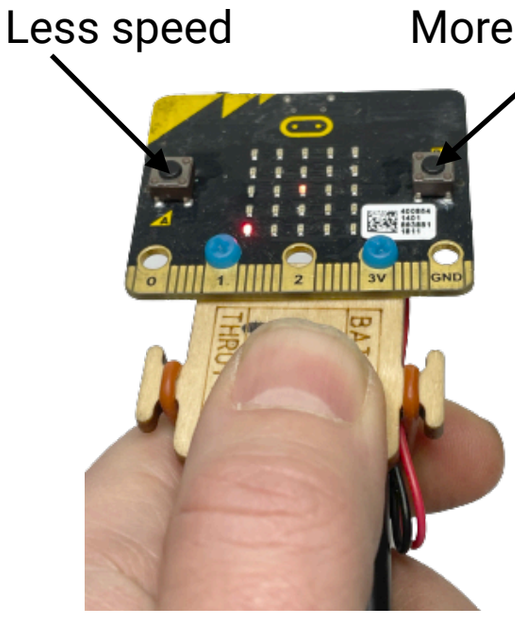
Secure the battery with a rubber ring. If necessary, use a screwdriver.
When the code has been uploaded, you can plug the battery cable into the connector in the red ring as shown in the picture.

**The battery cable must be disconnected again when you are not using the hovercraft. Never allow the battery to discharge completely.**

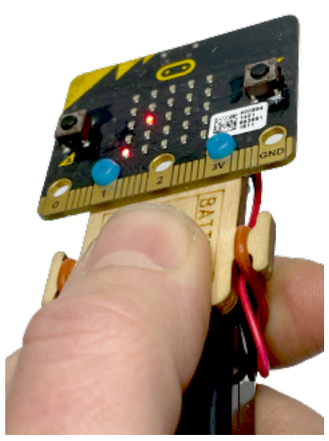
# How to run hover:bit

- [ ] Children under the age of 9 must operate with an adult supervision
- [ ] Turn the tail rudder by turning the remote control like a key
- [ ] Start the engines with A+B
- [ ] Increase the gas with B (press several times, speed increases per press)
- [ ] Lower the throttle with A (press several times)
- [ ] The engine speed (0-100) is shown on the screen
- [ ] Emergency stop: Shake the hand control
- [ ] Disconnect the battery after use.

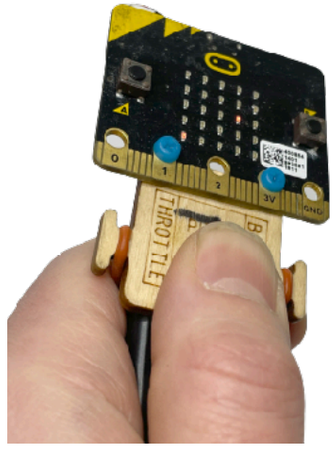




**((Shake to stop!))**



Turn left



Turn right

MAKEKIT

# Contact us:

Get help at our Facebook group:
**www.facebook.com/groups/goairbit/**

Do you have suggestions for improvements to the product or the guide?
Then I would like to hear from you!

You can contact me directly at henning@makekit.no

Henning Pedersen,
Chief product developer

www.makekit.no  support@makekit.no  makekit  gomakekit (also twitter)

# STEAM subjects

Hover:bit is an interdisciplinary and practical program that includes programming, science, crafts and mathematics. The scheme is suitable from 5th grade and is intended for classes that have some previous experience with micro:bit. Hover:bit reuses cardboard and other materials and can be taken apart and repaired.

The most important learning elements in hover:bit are:

**Science**
Friction and absence of friction as a phenomenon
Propeller and engine: electrical forces and energy
Technological systems with transmitter and receiver

**Mathematics**
Functions and arithmetic with angles, algebra and negative numbers
Exploring mathematical properties and relationships using programming

**Arts and crafts**
Design, build and experiment with stable structures
Express feelings and opinions in your own works
Using programming to create interactivity and visual expression
Assess the materials' durability and possibilities for repair and reuse

# About the project

**The project can be divided into three parts:**
Programming of the remote control and possibly the receiver side (2-6 school hours)
Assembling and connecting the hull (1-2 school hours)
Design and construction of rafts and sails (2-4 school hours)

If you want to create a faster scheme, you can first assemble the hovercars, then only run programming or only assembly of the hull.

**Equipment:**
For the programming: A micro:bit for each student, PC or tablet to code, usb cable or battery pack
For mounting and connecting the hull: Hover:bit the parts, small star screwdriver, small spanner (supplied)
For design and construction of fleet:
Decorative material, cardboard, glue, "eyes", pipe cleaners, glitter, stickers, paint and other decorative elements you may have to hand.

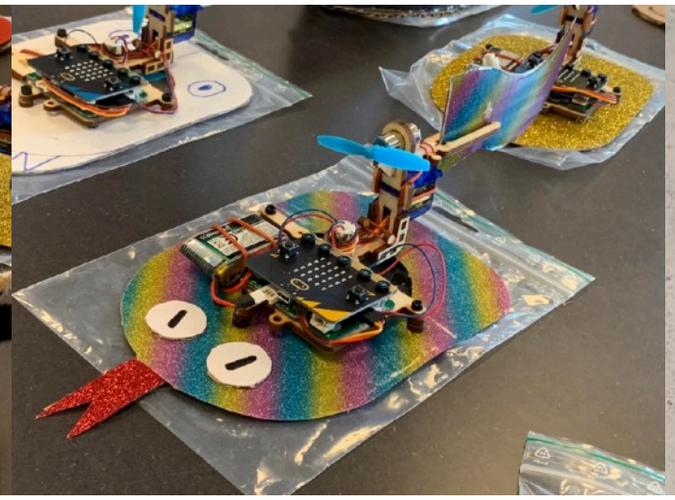
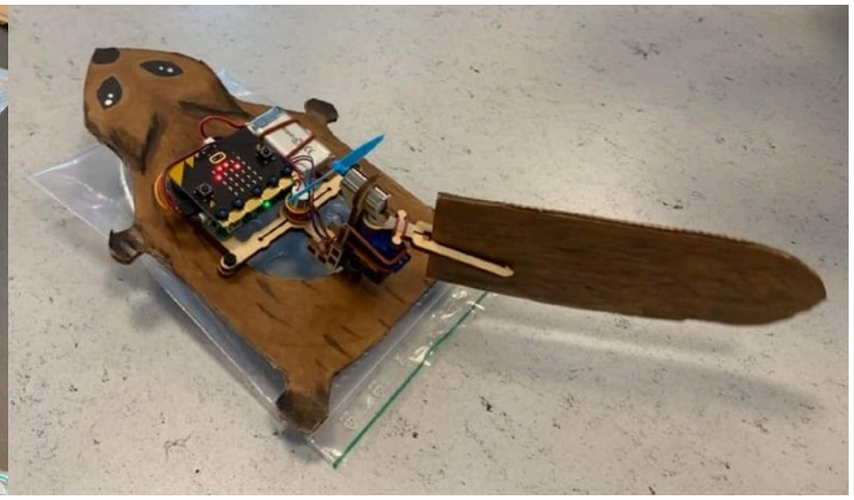
See list on page 6

# Design challenge

**Design of raft and sails**
Raft and sail design is a creative design task that is based on construction with ruler and marker, as well as creative design. Here, students can let their imagination run wild.

First you draw and build the raft according to the recipe, then you add your own design.

Mission → Find ideas → Test ideas and prototypes → Building → Presentation

Tip! Make sure that the students do not use the glue gun on parts of wood or electronics, as this will be reused.

# Mission specification: Hover:bit

**The assignment**
It is the holiday of the hovercars. You will design and decorate completely unique hover cars that say something about yourself or your background. The hover cars must work and be steerable, as they must be able to drive in trains!

**Fleet**
The raft must be able to be filled with air
The basic shape should be symmetrical laterally so that the weight is distributed evenly on both sides
The fleet must wholly or partly use recycled materials such as cardboard from cardboard boxes etc.
The construction should not be so heavy that the cushion motor cannot lift itself off the ground.
Tip! The speed of the cushion motor can be increased in the receiver code ("cushion speed")

**Sail**
The sail will help to control the air so that the hovercar turns
It must not be so heavy that the car becomes unstable
The sail must be able to be attached to the rudder holder (the “sword”)
The sail normally works best when it is between 5 and 10 cm high, and between 5 and 12 cm long, but if someone wants to try other sizes, it is just a matter of testing.

**Equipment**
Use recycled cardboard or other materials that you find, as well as tools and decorative materials that you have to hand.