PhysicsKIT 4STEM

IO1A4 – PHYSICSKIT GUIDE

Assembly & Configuration

ECAM & AKNOW

Co-funded by the Erasmus+ Programme of the European Union

This project has been funded with support from the European Commission.

Project N°: 2020-1-FR01-KA201-080433

Revision History

Version	Date	Author	Description	Action	Pages
[..]	DD/MM/YYYY	PARTNER ORGANIZATION	[Creation/Insert/ Delete/Update of the document]	[C/I/D/U]	[No. of pages]
1.0	18/03/2021	AKNOW	Creation of document	C	22
1.0	05/04/2021	AKNOW	Update of document	U	50
1.0	08/04/2021	AKNOW	Update of documents	U	82

(*) Action: C = Creation, I = Insert, U = Update, R = Replace, D = Delete

Referenced Documents

ID	Reference		Title
1	2020-1-FR01-KA201-080433		PhysicsKIT4STEM Proposal
2			

Applicable Documents

ID	Reference	Title
1	[PARTNER ORGANIZATION]	[TITLE OF THE REFERENCED DOCUMENT]

1 Table of Contents

1. Introduction

The PhysicsKIT is designed to be possible to be assembled in the classroom by the students under the supervision of the teacher. It is expected that kids from the age of 8 will be able to assemble the PhysicsKIT themselves based on the assembly instructions.

The idea is to provide a full guide on how to build the PhysicsKIT, install and configure the software and then use it for all the envisaged project activities.

The PhysicsKIT elegant design imitates a suitcase with all necessary components included in their own individual space, offering ease of use in the classroom as it will not be necessary to add any external components. The PhysicsKIT is a fully fledged Raspberry Pi based computer as all the necessary components and peripherals are included in one package. The user just needs to connect the PhysicsKIT with a monitor via the HDMI port of the Raspberry Pi, as well as connect a keyboard and mouse via the USB ports.

FIGURE 1 THE PHYSICSKIT (WITH COVERS)

FIGURE 2 THE PHYSICSKIT (OPENED)

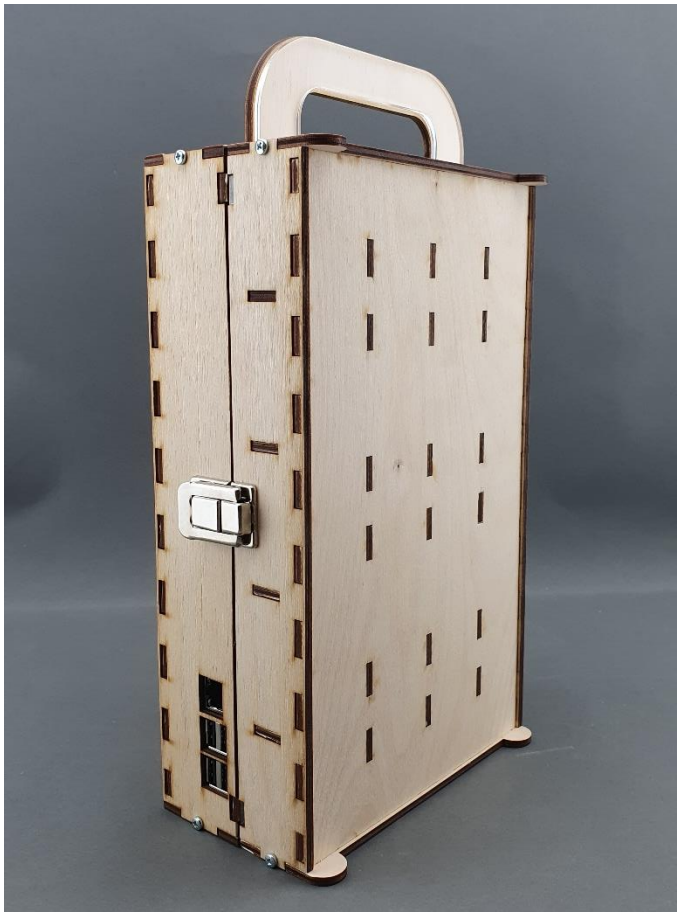


FIGURE 3 THE PHYSICSKIT (CLOSED)

2. The PhysicsKIT

Building the PhysicsKIT comprises of the following activities:

1. Construct the PhysicsKIT body.
2. Connect the Raspberry Pi.
3. Connect components and place electronics.
4. Install and configure the Raspberry Pi OS.

2.1 Inventory

The PhysicsKIT comprises of the following items:

- PhysicsKIT body (23 plywood) pieces
- 1 plywood cap with handle and 1 plexiglass cap with handle
- Raspberry Pi 3 Model B+
- Micro SD card (with pre-installed operating system)
- Power supply
- Mouse
- Breadboards
- Electronic components
- Sensors
- Cables

2.2 PhysicsKIT body

The STEMKIT body needs 23 plywood pieces to be assembled, which are included in the package. The package also includes all necessary bolts, screws, nuts and rubber bands. You just need to supply a Philips screwdriver which is not included in the package.

2.3 Raspberry Pi

A Raspberry Pi is a credit card-sized computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. Originally designed for education, inspired by the 1981 BBC Micro. Creator Eben Upton's goal was to create a low-cost device that would improve programming skills and hardware understanding at the pre-university level. But thanks to its small size and accessible price, it was quickly adopted by tinkerers, makers, and electronics enthusiasts for projects that require more than a basic microcontroller (such as Arduino devices).

The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-power consumption level. It is a capable small device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It is capable

of doing everything you would expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing and playing games.

FIGURE 4 RASPBERRY PI 3 MODEL B+

What's more, the Raspberry Pi has the ability to interact with the outside world and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras. The Raspberry Pi has the capability to be used by kids from around the world to learn to program and understand how computers work.

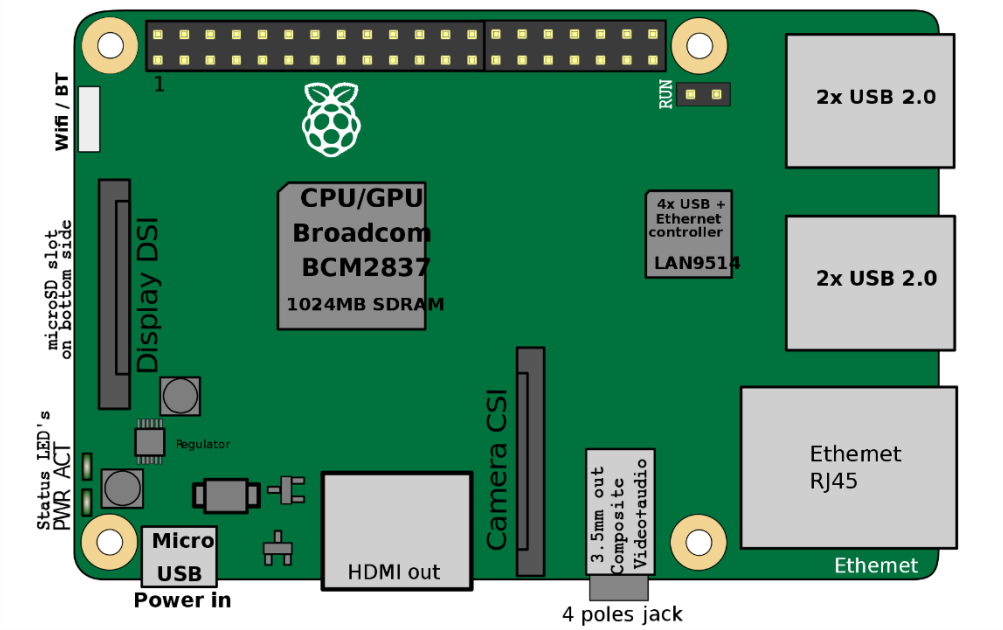


FIGURE 5 RASPBERRY PI 3 MODEL B+ SCHEMATIC

A powerful feature of the Raspberry Pi is the row of GPIO (general-purpose input/output) pins along the top edge of the board. A 40-pin GPIO header is found on all current Raspberry Pi boards (unpopulated on Pi Zero and Pi Zero W). The GPIO pins are integrated into the circuit board of the computer. Their behaviour can be controlled by the user to allow them to read data from sensors, and control components like LEDs, motors, and displays. Older models of the Pi had 26 GPIO pins, while the newer models all have 40. Using a bit of programming, like Python and C, GPIO pins are easy to be controlled.

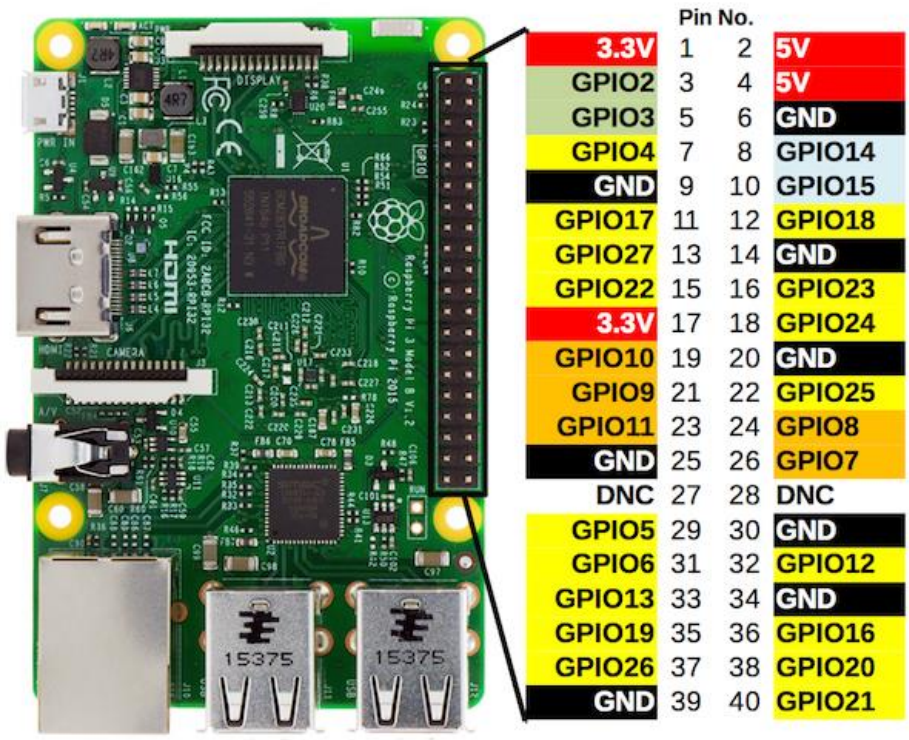


FIGURE 6 RASPBERRY PI GPIO AND PIN ASSIGNMENT

Please visit **https://www.raspberrypi.org/** for more information.

2.4 Micro SD card

The Raspberry Pi should work with any compatible micro-SD card, although there are some guidelines that should be followed:

- **Micro SD card size (capacity)**: the minimum recommended card size is 8GB. Above that, there is no limitation.
- **Micro SD card class**: the card class determines the sustained write speed for the card; a class 4 card will be able to write at 4MB/s, whereas a class 10 should be able to attain 10 MB/s. however, it should be noted that this does not mean a class 10 card will outperform a class 4 card for general usage, because often this write speed is achieved at the cost of read speed and increased seek times.

FIGURE 7 MICRO SD CARD

One 16GB micro-SD card is supplied with the PhysicsKIT

2.5 Power supply

For safety and portability reasons, a Power Bank is used to power the equipment. Portable Power Banks are comprised of a special battery in a special case with a special circuit to control power flow. They allow to store electrical energy (deposit it in the bank) and then later use it to charge up a mobile device (withdraw it from the bank). Power Banks battery life is outstripped by the amount of time we spend using them each day. By keeping a battery backup close by, you can top-up your device(s) while far from a wall outlet. They can be charged up using a USB charger when power is available.

FIGURE 8 POWER SUPPLY

Please note, that you can power up the Raspberry Pi by using any micro-USB charger and connect it to a power outlet. However, a Raspberry Pi does not have a power switch, so as soon as you connect it to a power outlet, it will automatically turn on. This is why a powerbank is supplied with the PhysicsKIT.

2.6 Cables

A USB to micro-USB cable is supplied, which is used to give power from the powerbank to the Raspberry Pi.

FIGURE 9 USB TO MICRO-USB CABLE

2.7 Mouse

A mini, wireless mouse with USB adapter is supplied with the PhysicsKIT.

2.8 Breadboards

Breadboards are one of the most fundamental pieces when learning how to build circuits. The breadboard is the bread-and-butter of DIY electronics. Breadboards allow beginners to get acquainted with circuits without the need for soldering, and even seasoned tinkerers use breadboards as starting points for large-scale projects. The first steps in the world of DIY or microcontrollers require just a breadboard.

FIGURE 10 BREADBOARD (200 PCS)

Two 200 pieces solderless breadboards are supplied with the PhysicsKIT.

2.9 Electronic components

Several electronic components are provided to help students creating their own experiments for testing. Electronic components comprise of:

- Jumper Cables (male-to-male, male-to-female, female-to-female)
- On-off switch
- LEDs
- Push-on button

- Button cap
- Buzzer
- Resistors (220 Ohm, 470 Ohm, 1K Ohm, 4.7K Ohm, 10K Ohm)

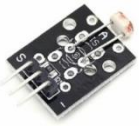
FIGURE 11 ELECTRONIC COMPONENTS

2.10 Sensors

Several sensors are provided with the PhysicsKIT to assist students during physics experimentation. Sensors comprise of:

FIGURE 12 SENSORS

Please, read below some additional information regarding the provided sensors:

SG90 Micro Servo Motor		Tiny and lightweight motor with high output power which can rotate approximately 180 degrees (90 in each direction).
3V-6V Small DC Motor		Small DC motor for Raspberry/Arduino. Easy connection with two pins. Ideal for experimentation.
HC-SR04 Ultrasonic Sensor		Ultrasonic measurement is one of the means used to determine the distance of an obstacle without contact.
PIR Motion Detector Sensor HC-SR501		This sensor can detect movement. Object detection is signaled by a digital - high state.
DHT11 Digital Temperature and Humidity Sensor		This sensor can measure humidity and temperature.
Photoresistor - Light Detection		This sensor can be used to measure light intensity.
SW-420 Vibration - Motion Sensor		This sensor can be used to measure or detect vibration waves.
Flame Sensor		The Flame sensor has a photodiode to detect light and a potentiometer to control sensitivity. It is used to detect fire and provide a HIGH signal upon the detection.
High Sensitivity Sound Detection Sensor		Sound detector with a potentiometer, changing the state when exceeding a certain level.

Linear Magnetic Hall Sensor		This sensor can be used to detect the magnetic field.
TMP36 Temperature Sensor		This is a digital temperature sensor based on an integrated thermistor.
4pin Magnetic Reed Switch Module		This is a magnetic sensor which can be used, for example, to determine the position of doors or windows.
Soil Hygrometer / Moisture Detection Sensor		This sensor can be used to determine moisture levels of soil.
MQ-135 Air Quality Sensor - Hazardous Gas Detection		This sensor is used to determine the concentration of CO.
KY-005 38KHz Infrared IR Transmitter Sensor		The KY-005 infrared transmitter module is designed to transmit coded infrared signals at a frequency of 38kHz and a wavelength of 940nm.
Infrared IR Receiver Sensor Module KY-022		Receives infrared signals. Light resistance, strong electromagnetic interference, built-in infrared dedicated IC, can work under 500 lux light intensity.
Rotary Encoder Module Brick Sensor KY-040		The KY-040 rotary encoder is a rotary input device (as in knob) that provides an indication of how much the knob has been rotated and what direction it is rotating in. It's a great device for stepper and servo motor control. You could also use it to control devices like digital potentiometers.
L293D Control IC Chip		The L293D IC chip is used to control DC motors.

3. Assembly

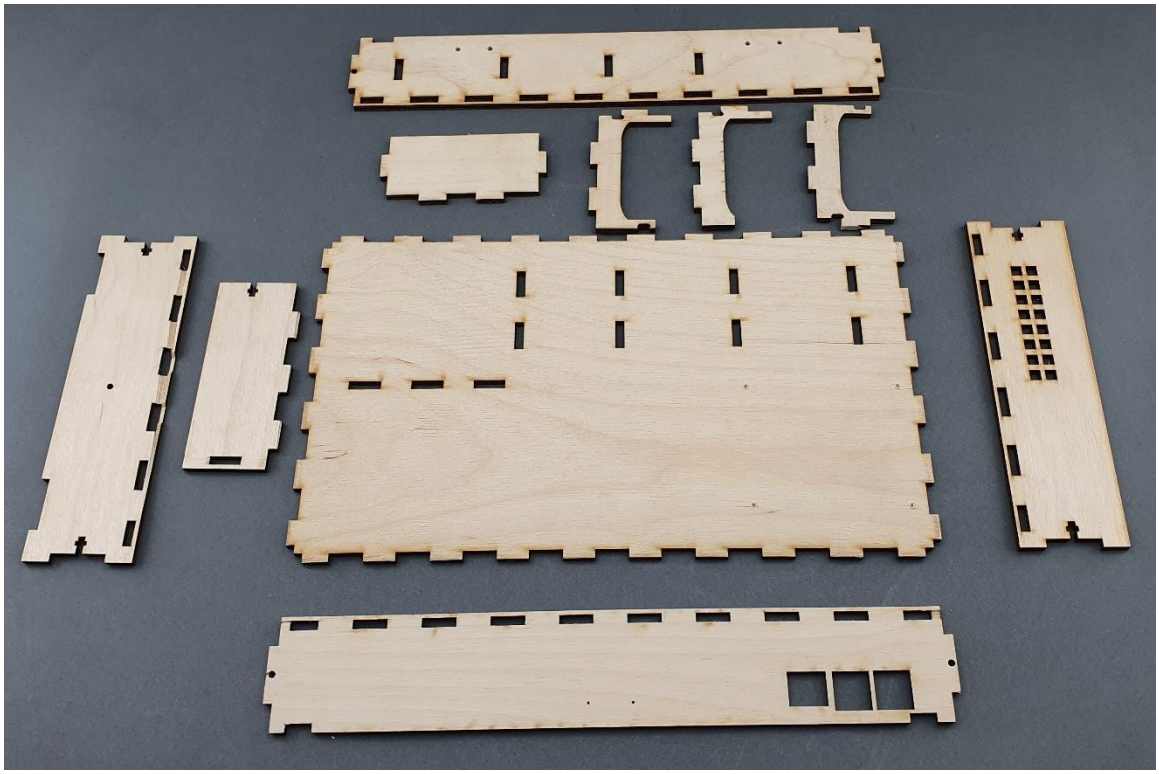
This section describes all necessary steps for assembling the PhysicsKIT. Please remember, the only tool you need is a Phillips screwdriver. Everything else is included in the package.

The assembly process is divided into six sections, each one including some simple assembly steps. These sections are the following:

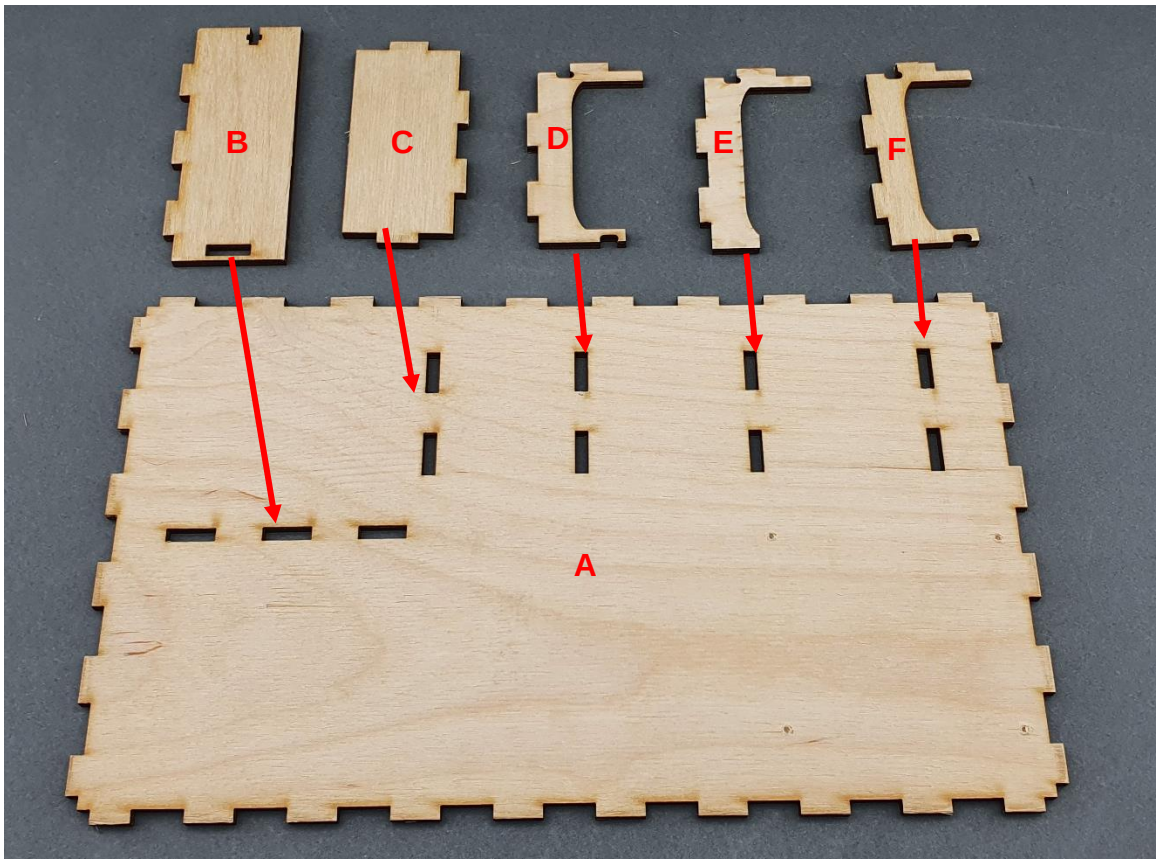
1. Lower-case assembly
2. Upper-case assembly
3. Raspberry Pi assembly
4. Hinges
5. Lock
6. Powerbank, breadboard and connectivity
7. Placing electronics and sensors
8. Placing lids with handles

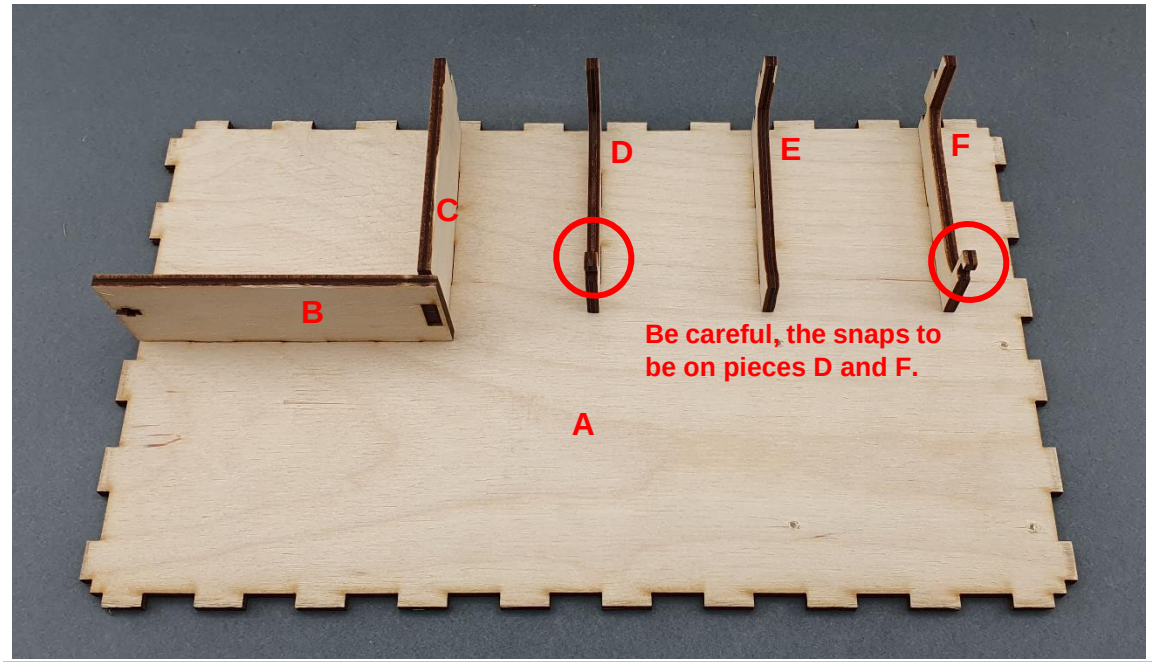
3.1 Lower-case assembly

Step 1 – What you will need:

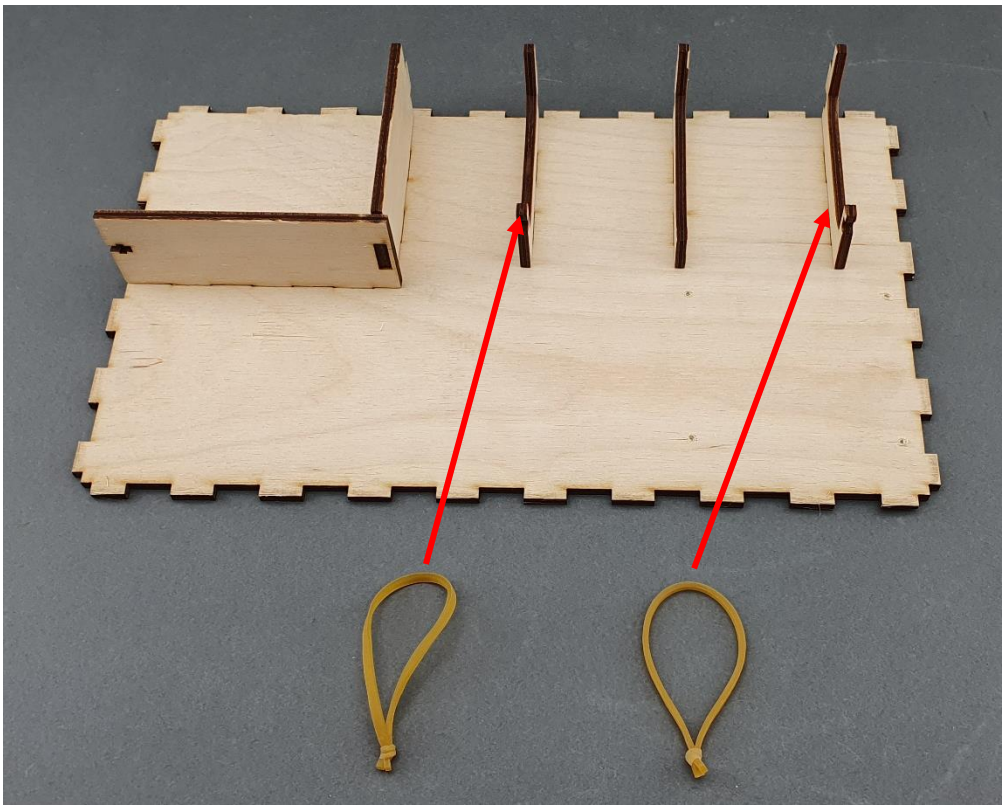


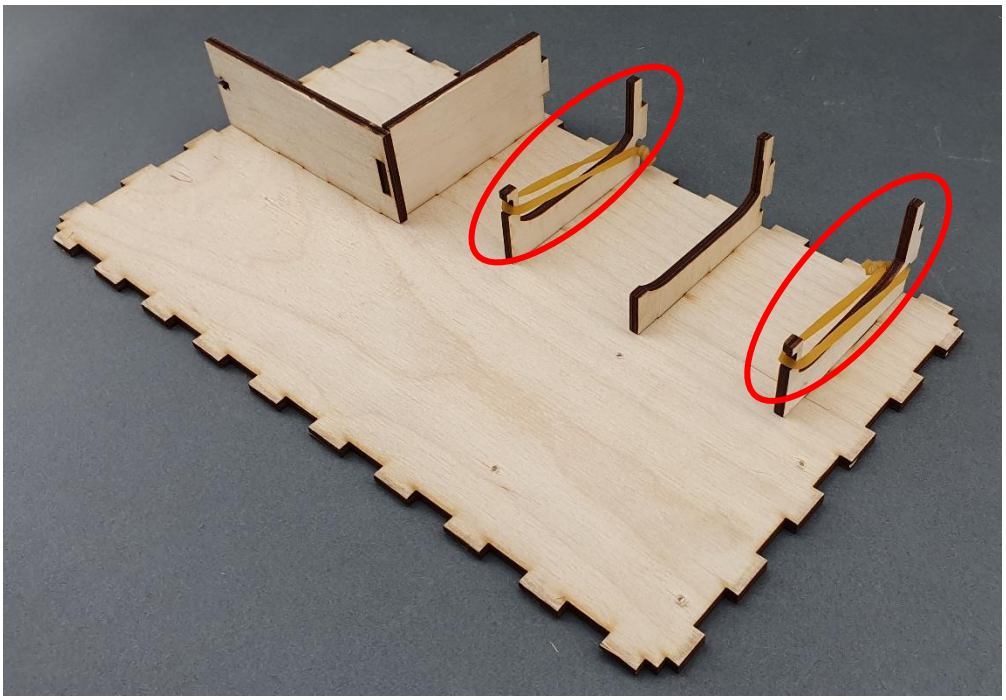
Step 2 – Assembly powerbank holders and cupboard shell:



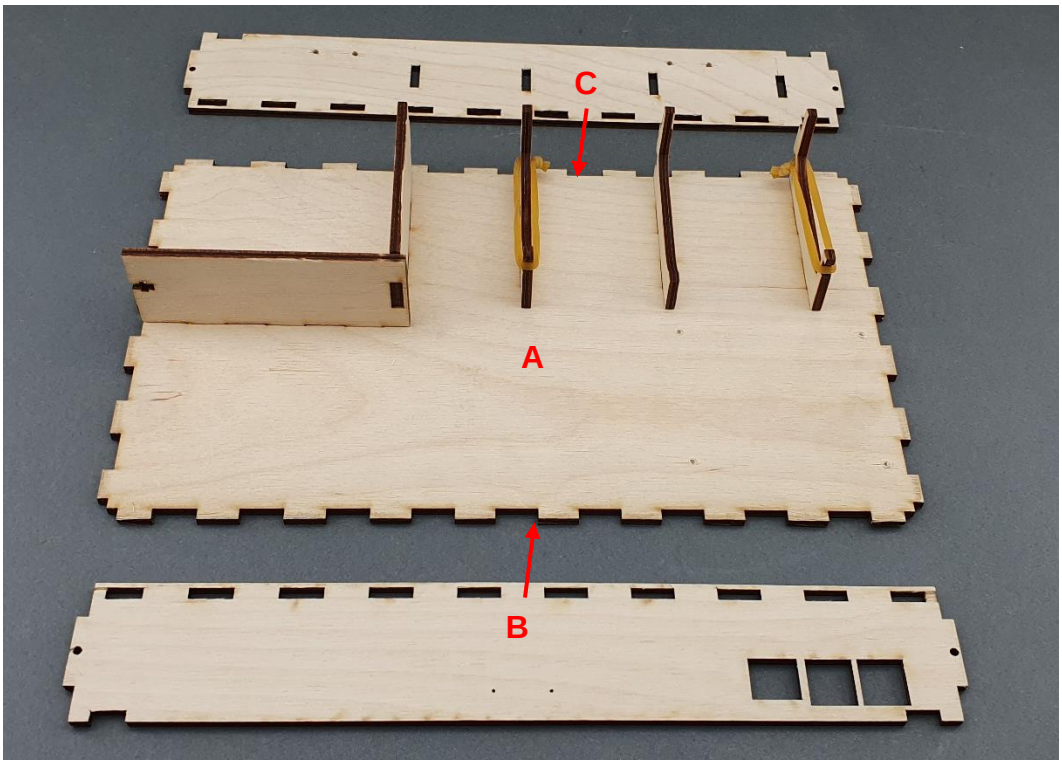


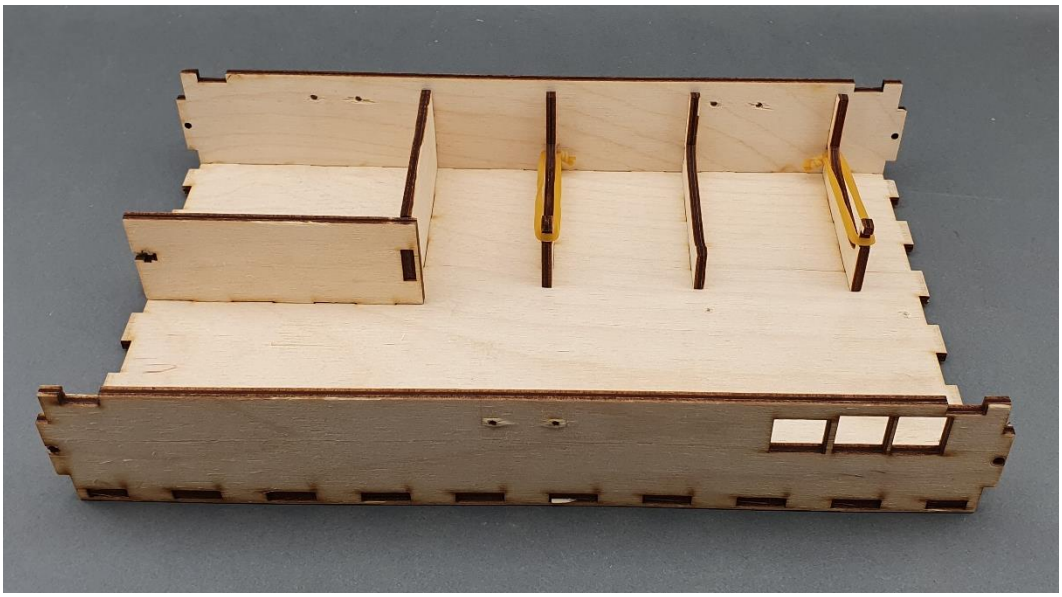
Step 3 – Place the rubber bands:



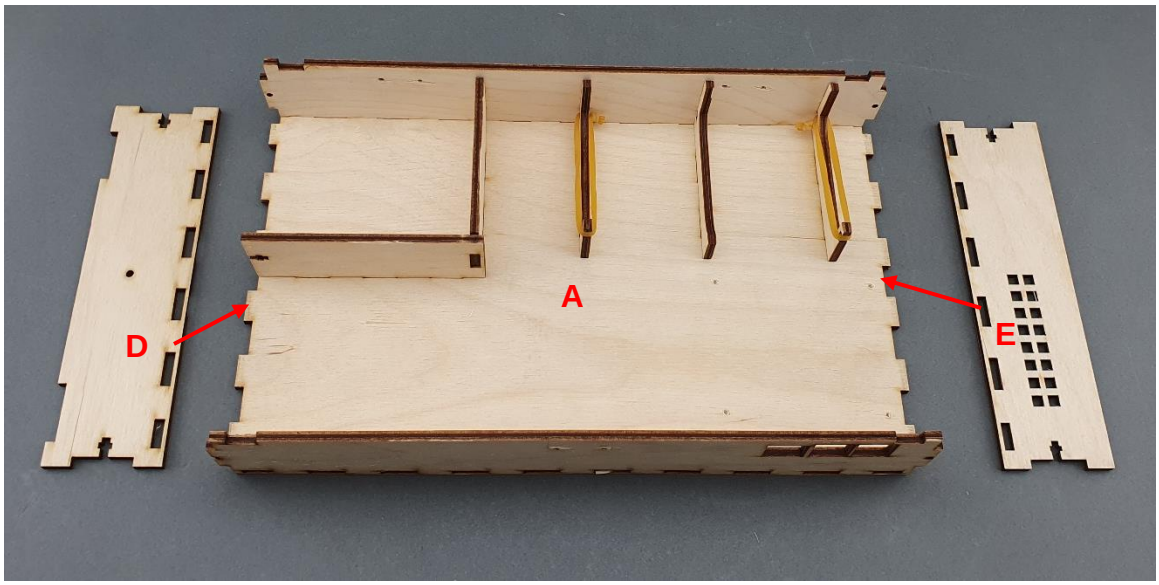


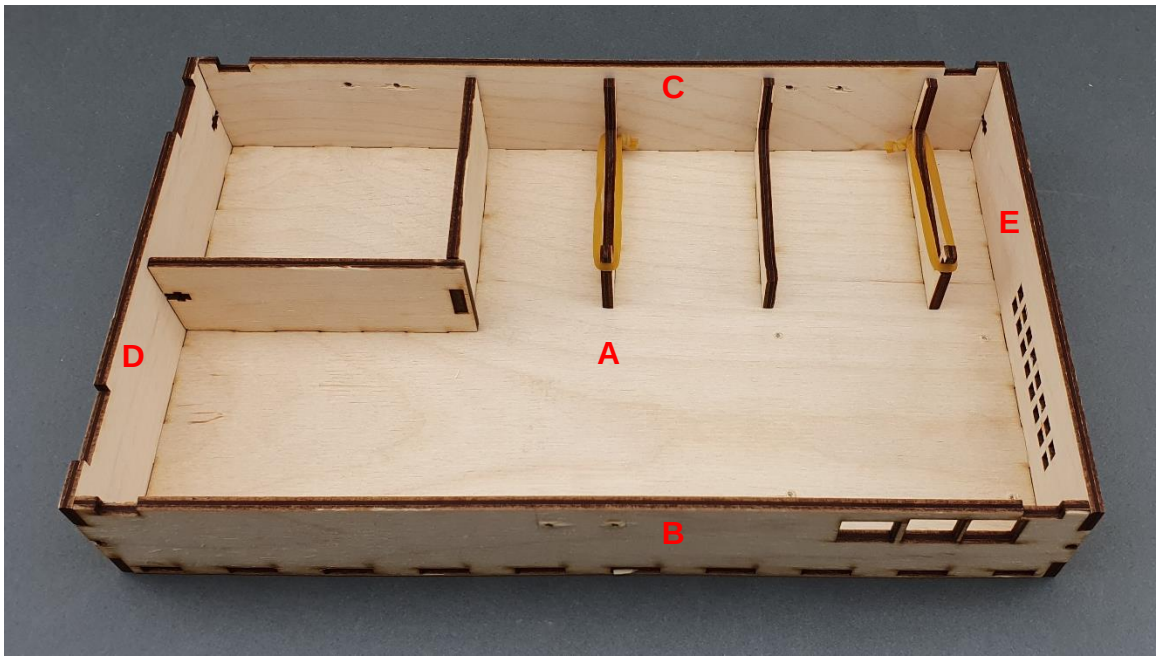
Step 4 – Assembly front and back covers (B→A & C→A):



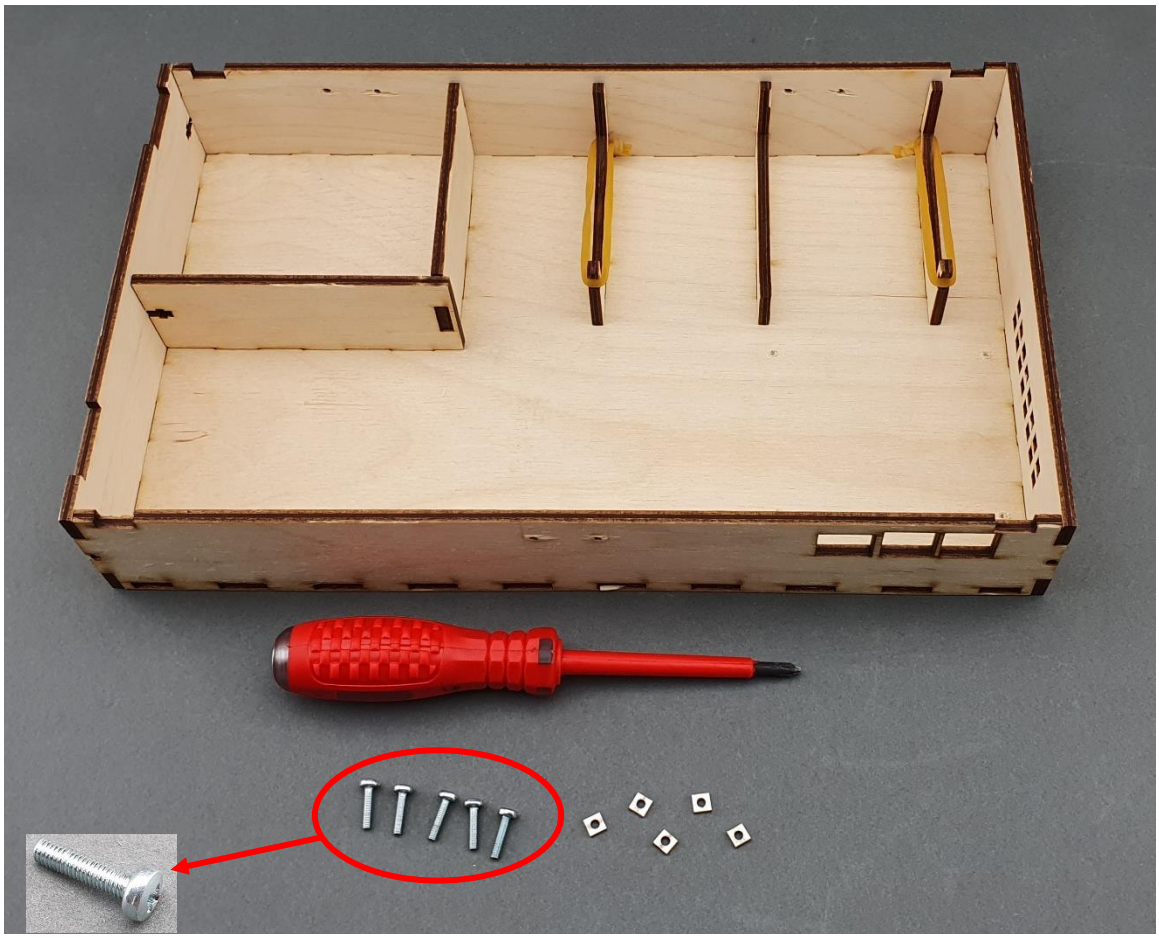


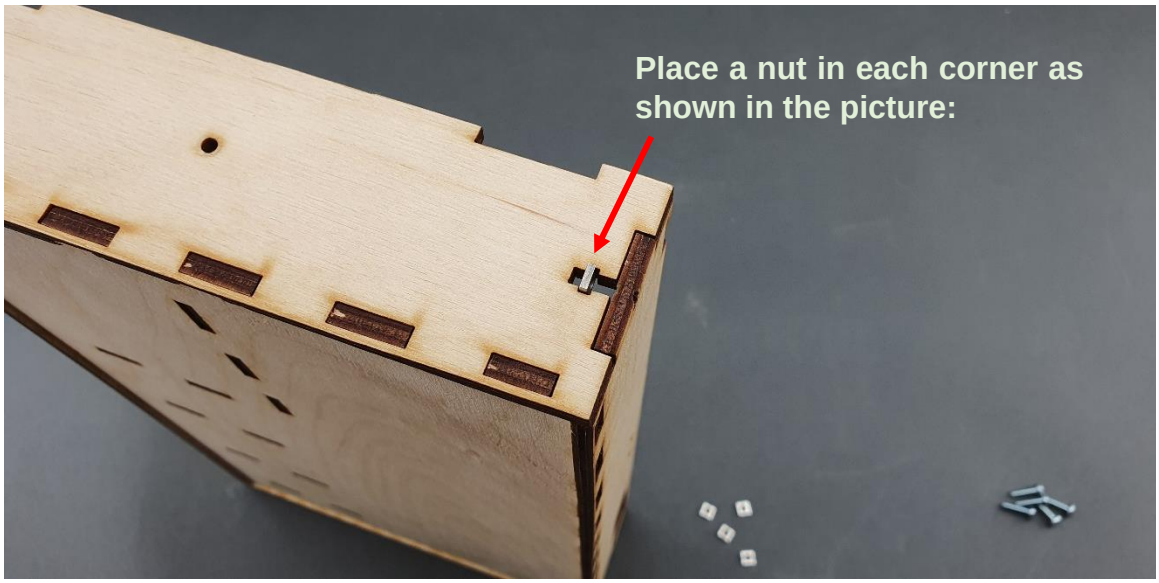
Step 5 – Assembly right and left covers (D→A & E→A):

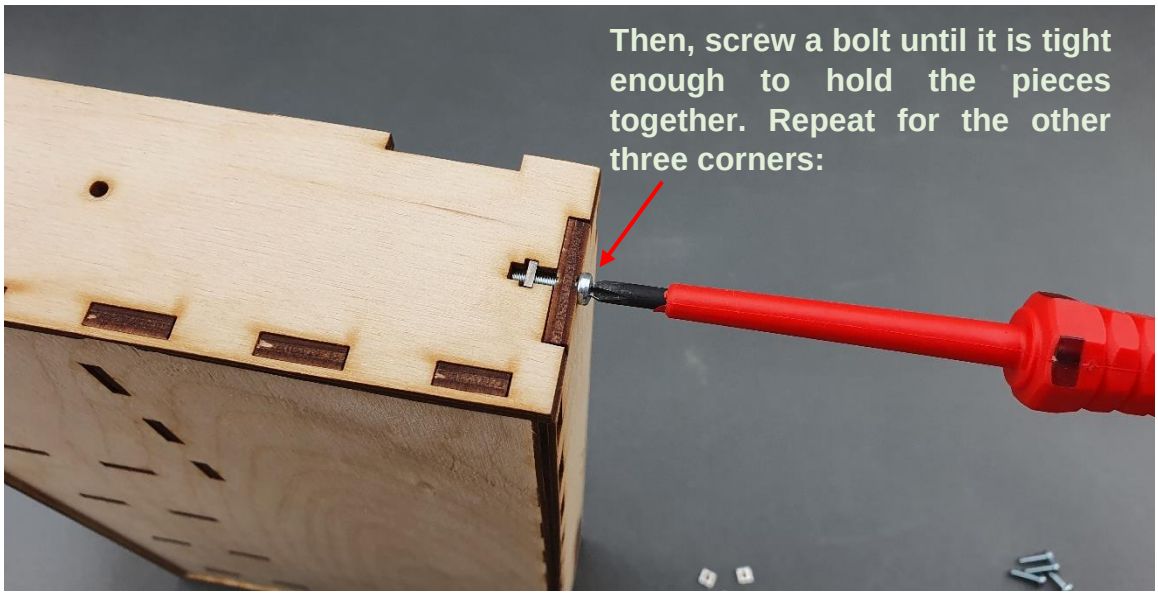


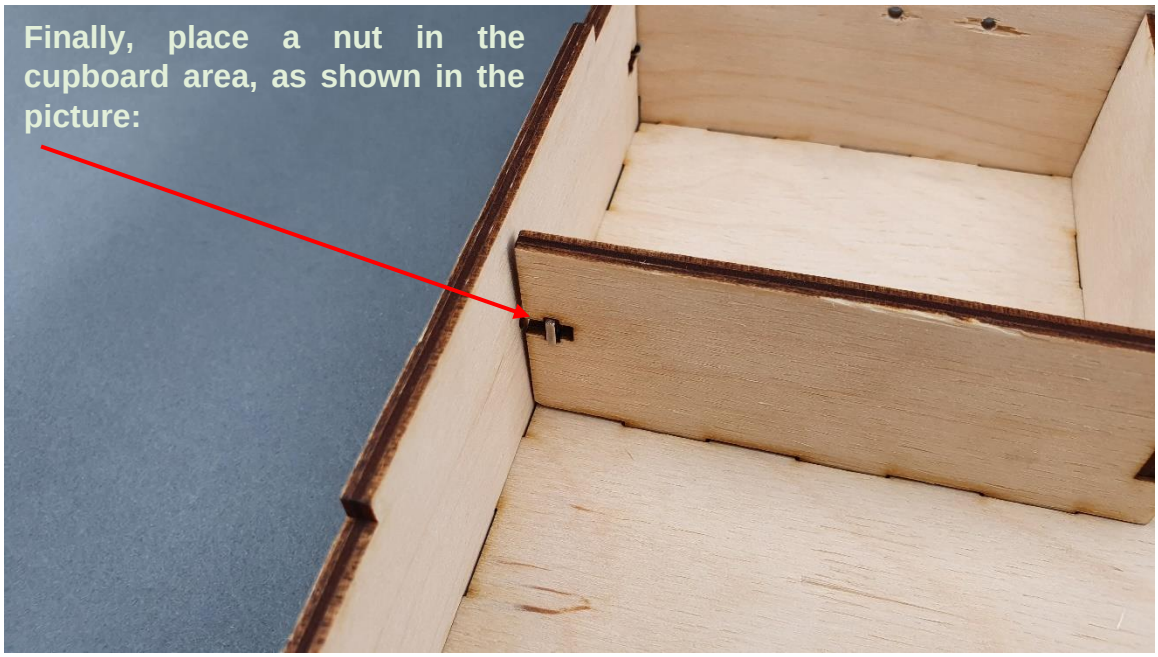


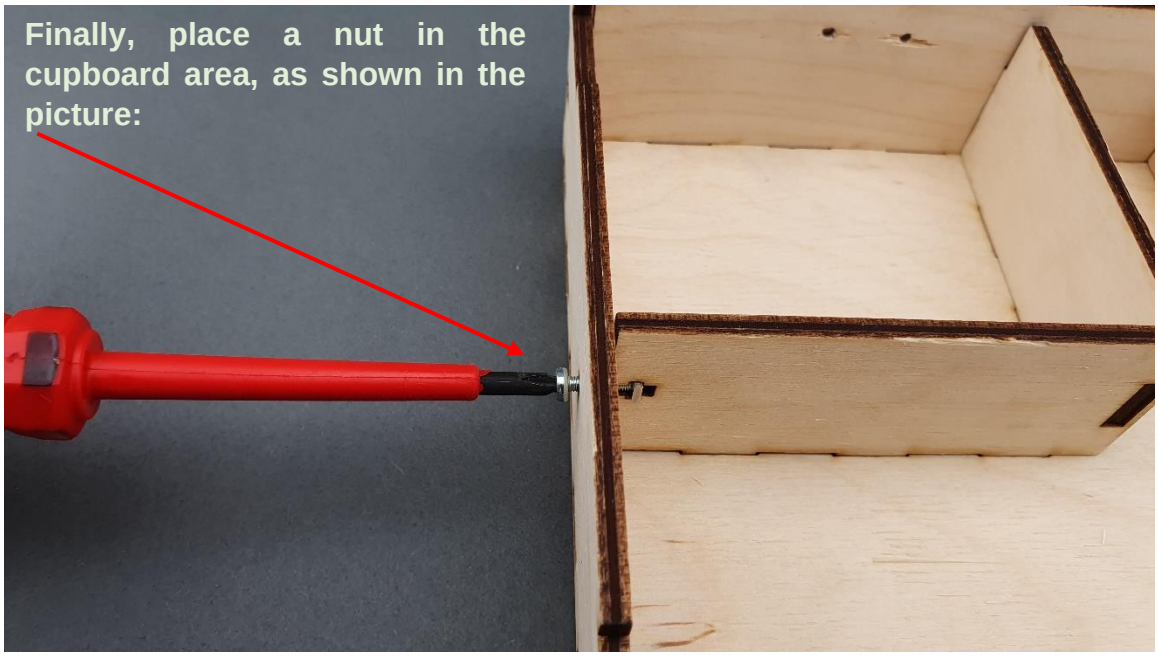
Step 6 – To keep the pieces together, 5 roundhead bolts with 5 nuts are needed:



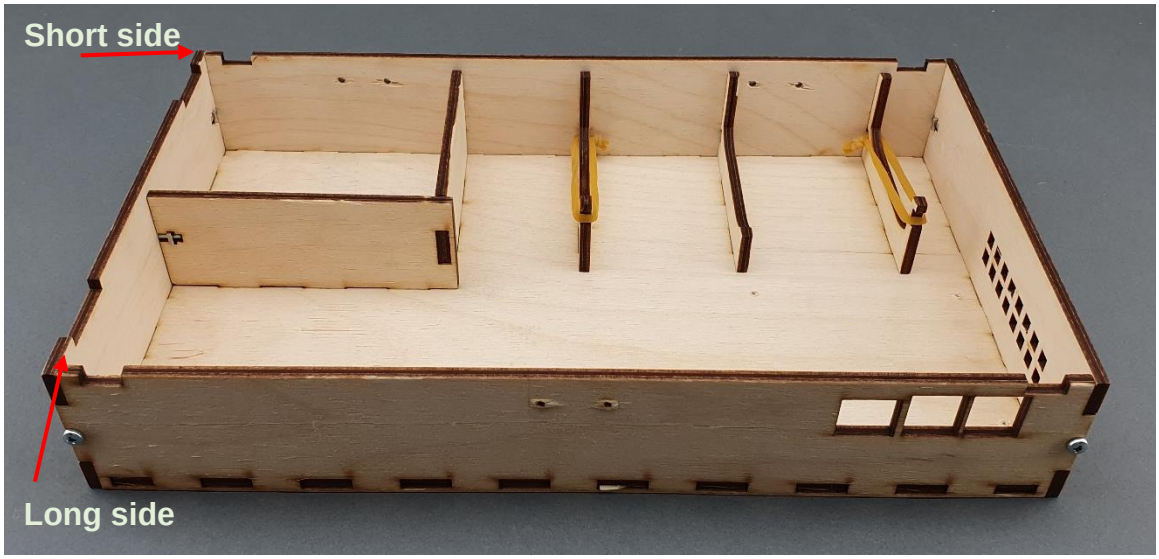



Then, screw a bolt until it is tight enough to hold the pieces together. Repeat for the other three corners:


Finally, place a nut in the cupboard area, as shown in the picture:

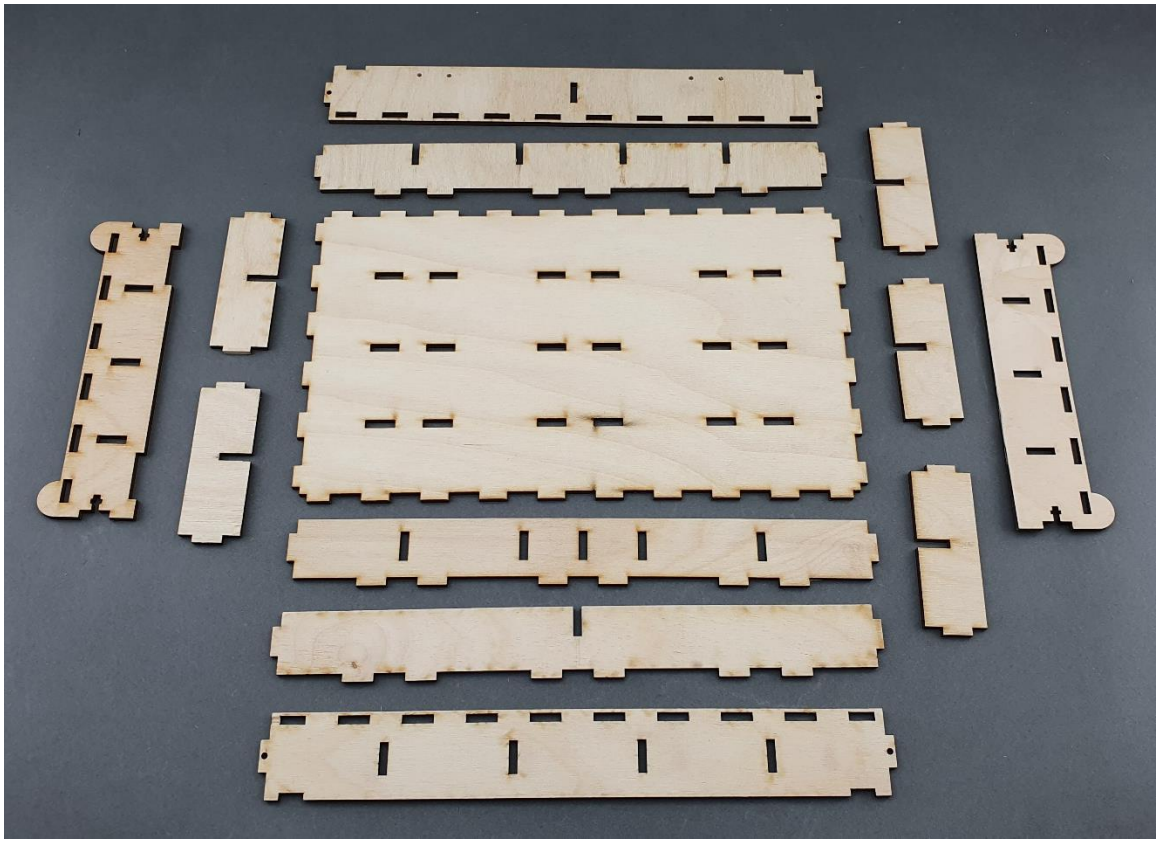


Step 7 – Make sure all five bolts are tight and all wooden pieces are in the correct place. The lower-case is ready:

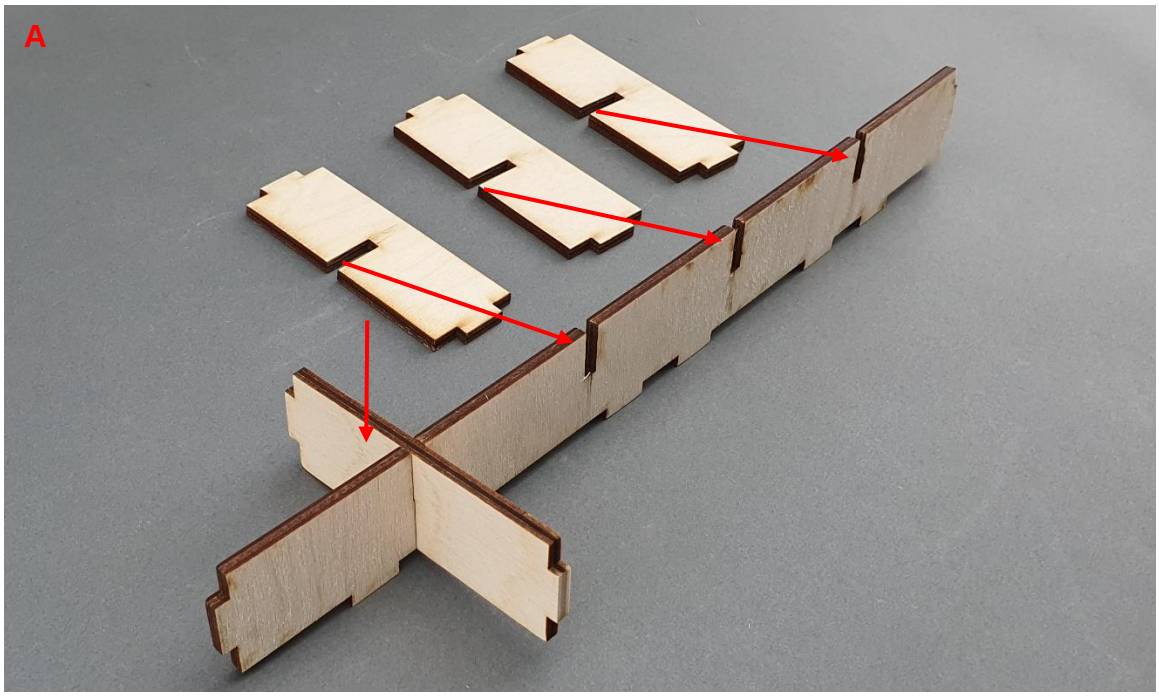


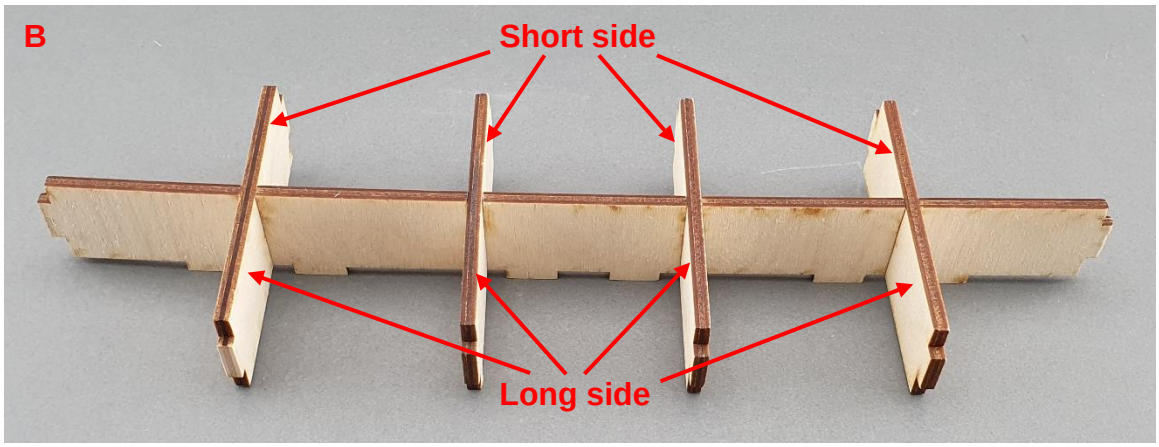
3.2 Upper-case assembly

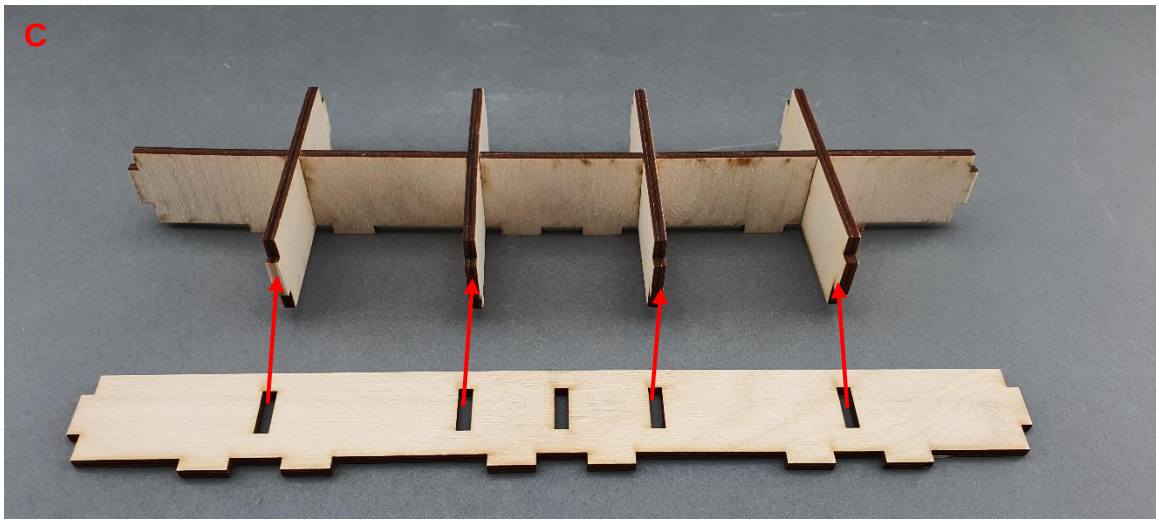
Step 1 – What you will need:

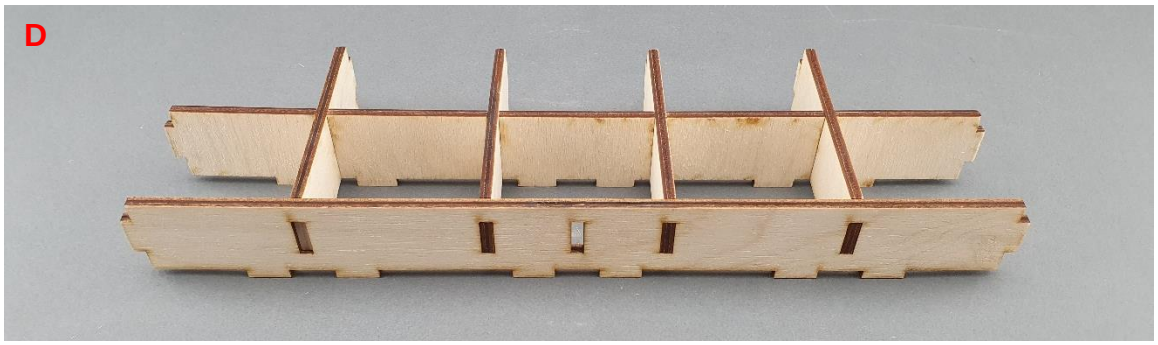


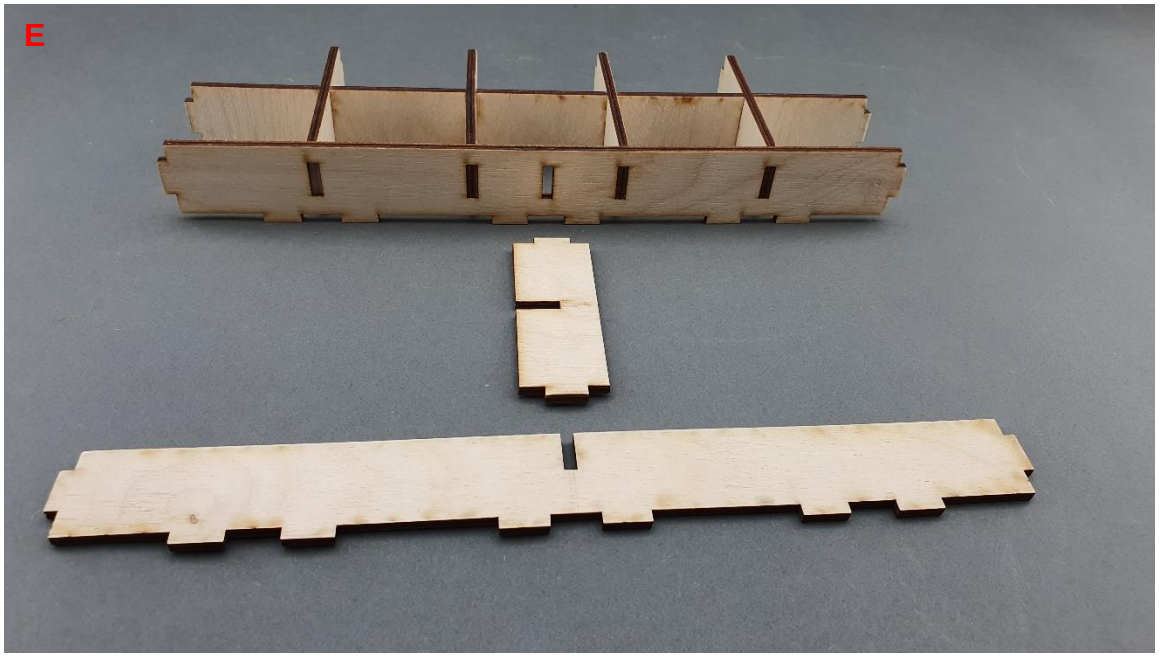
Step 2 – Assembly storage spaces following instructions from A to G:

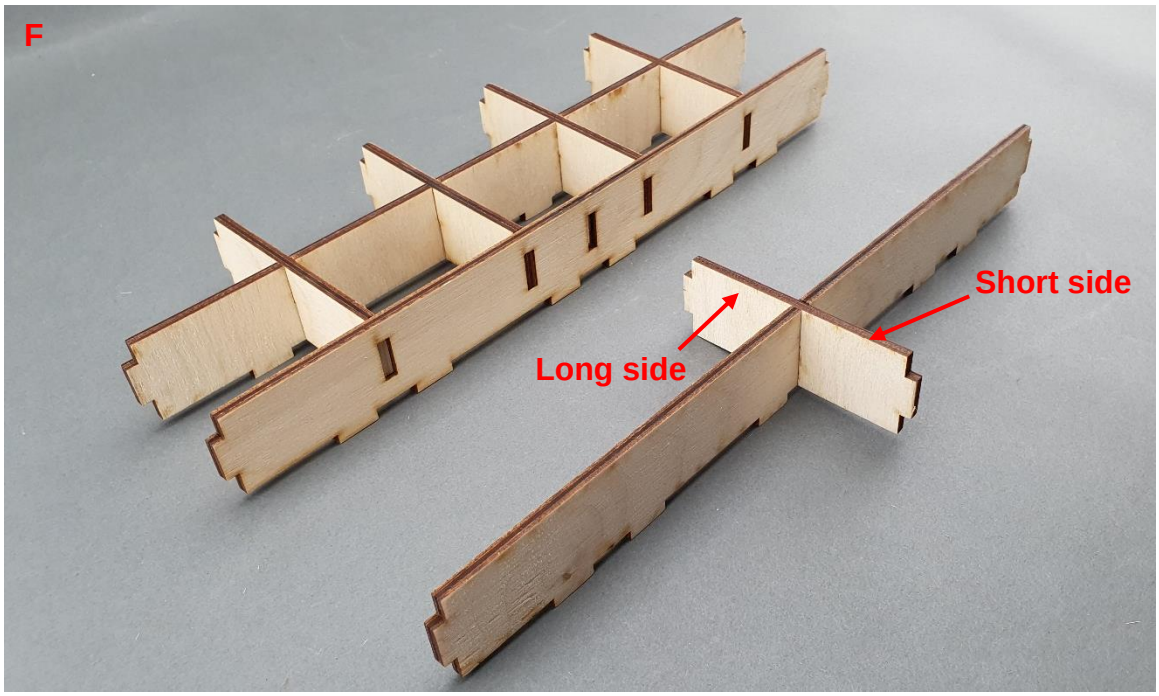


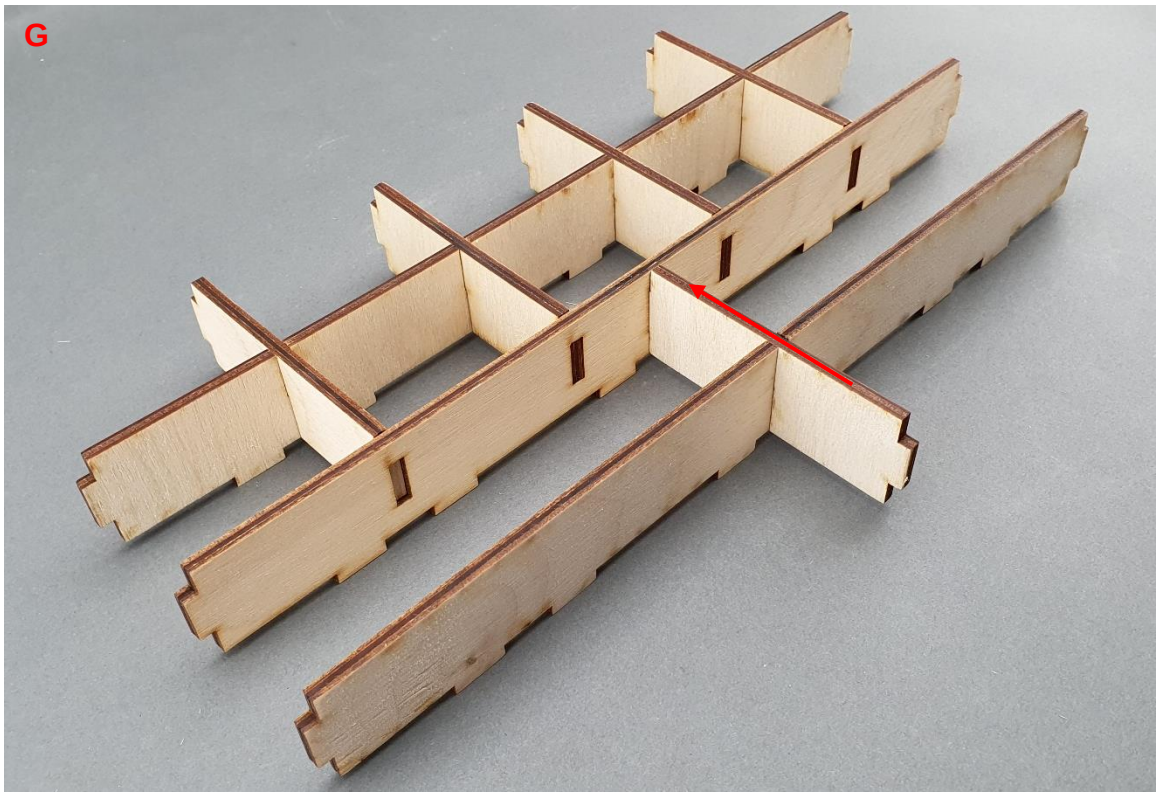



C

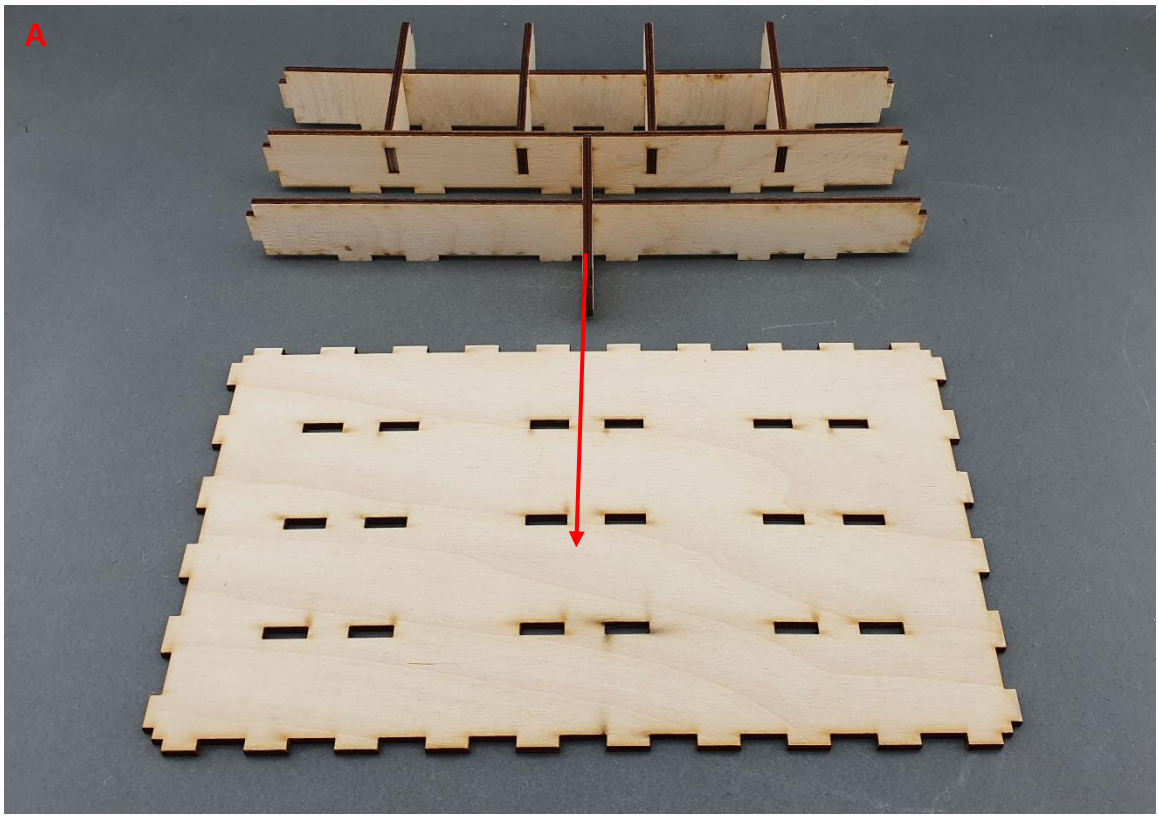

D

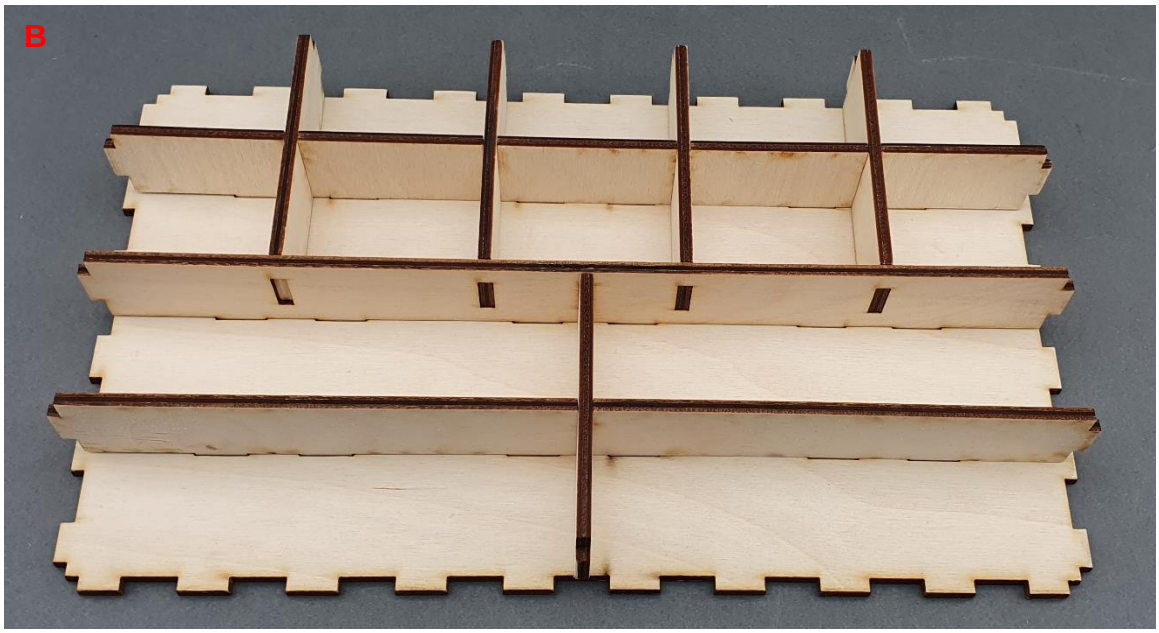

E


F
Short side
Long side

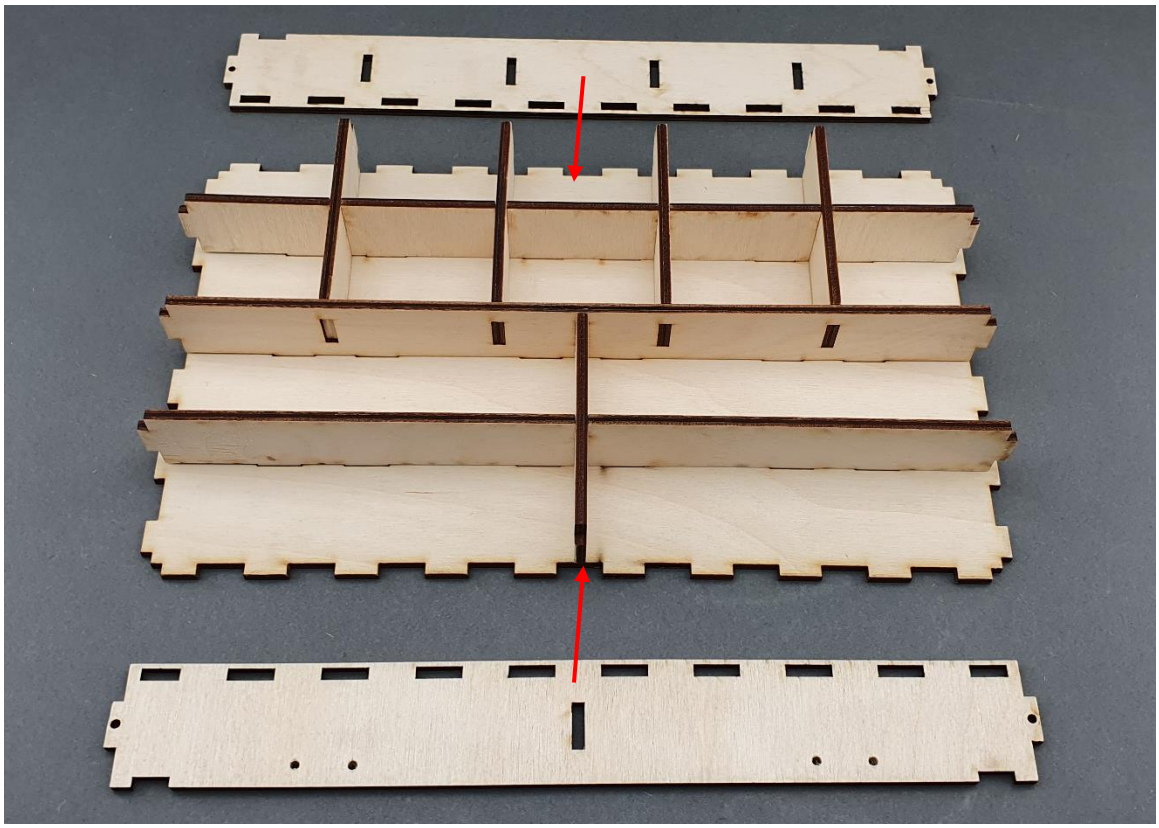

G

Step 3 – Place storage spaces on top cover:

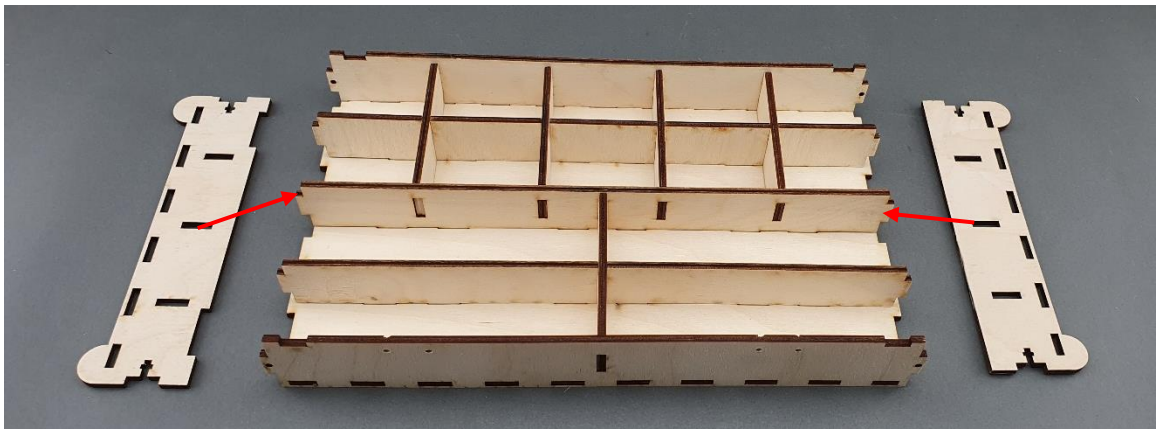




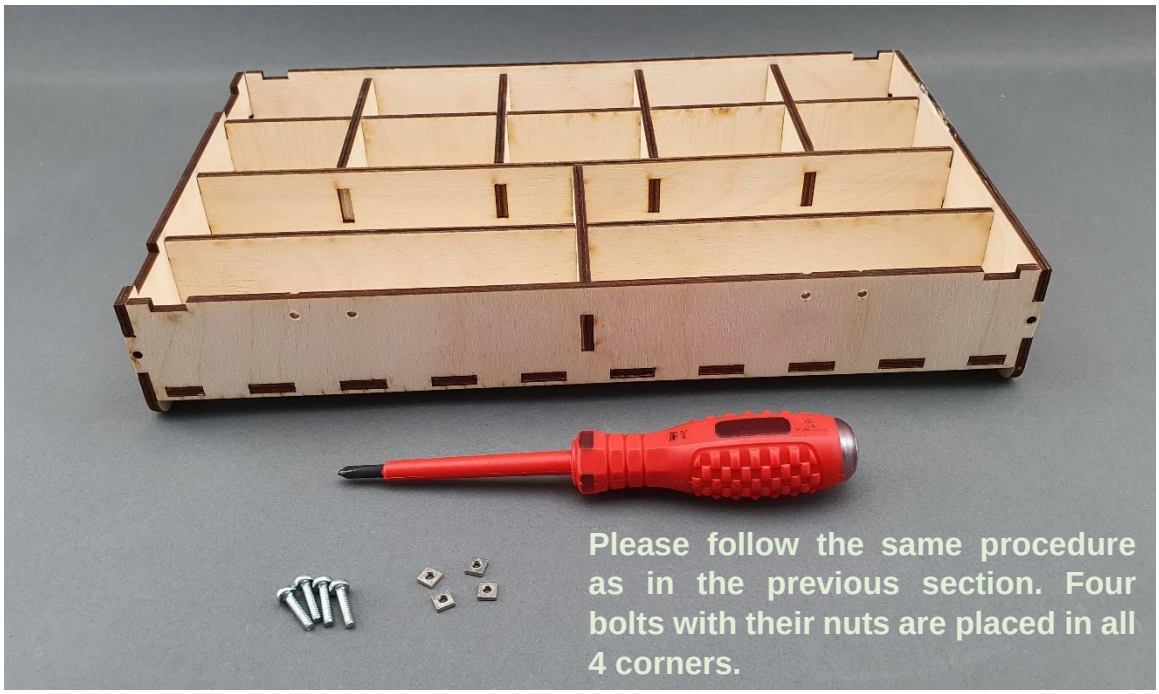
Step 4 – Assembly front and back cover:

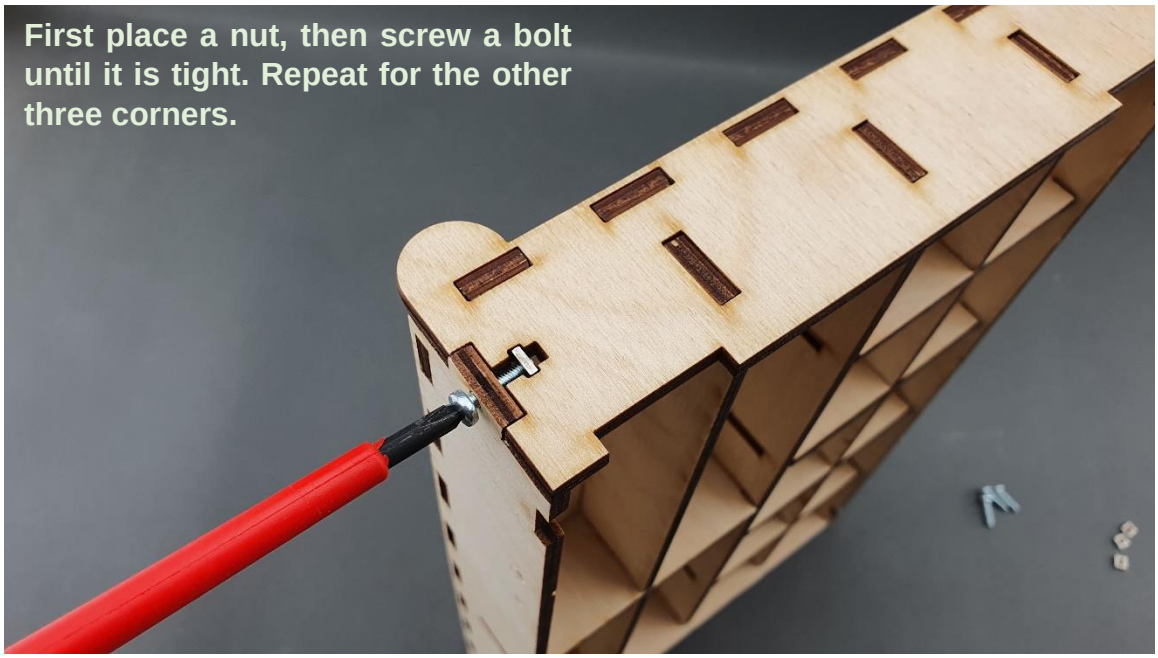


Step 5 – Assembly side covers:

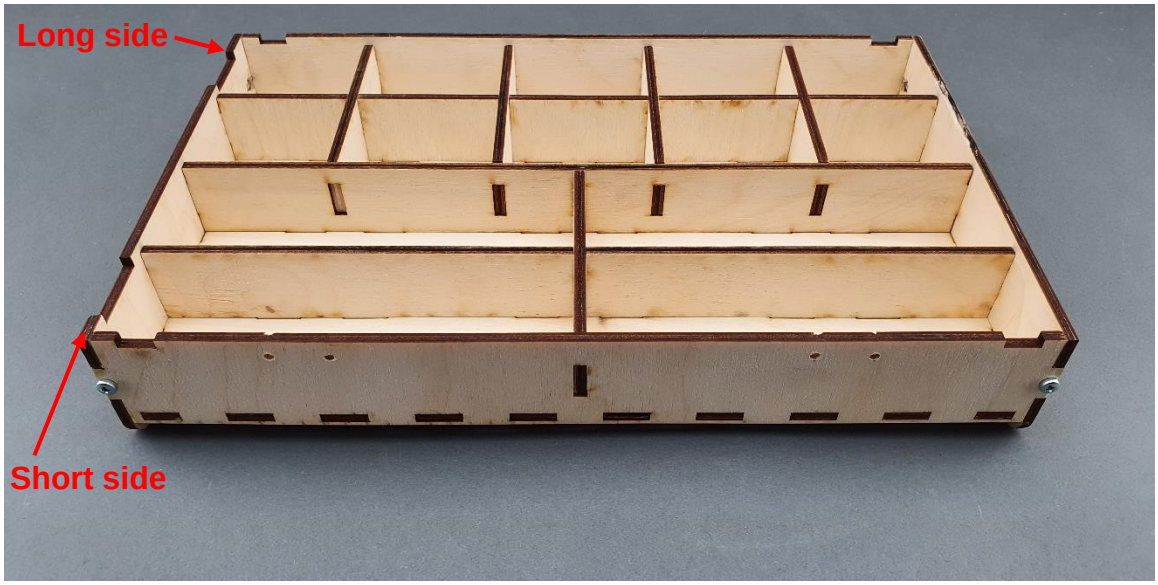


Step 6 – To keep the pieces together, 4 roundhead bolts and 4 nuts are needed:



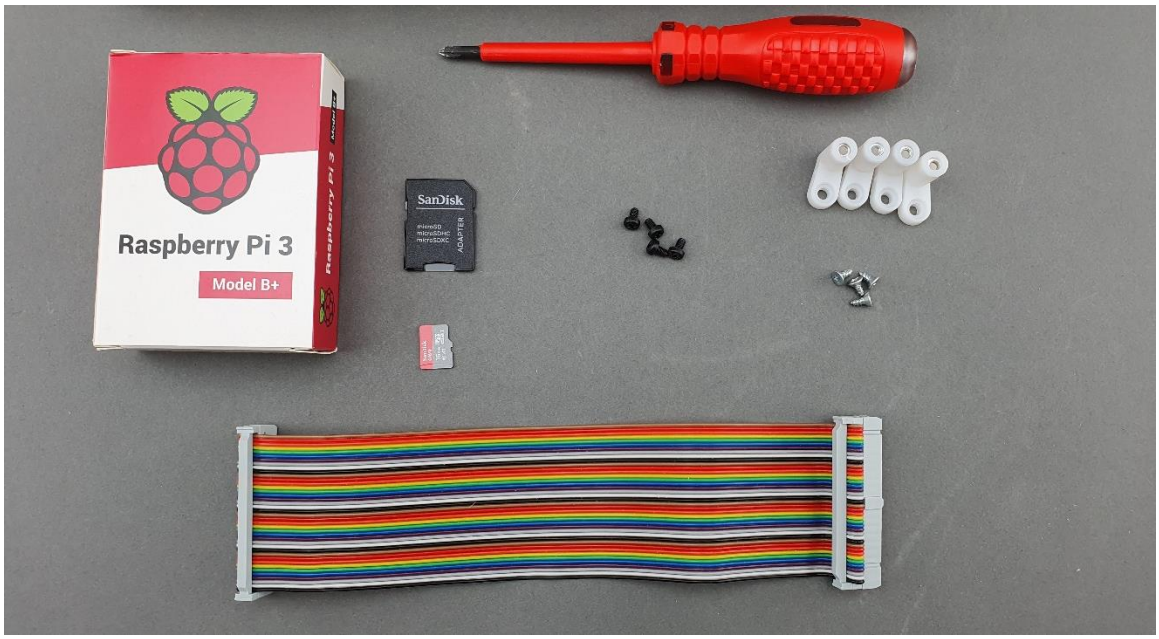


Step 7 – Make sure all four bolts are tight and all wooden pieces are in the correct place. The upper-case is ready:

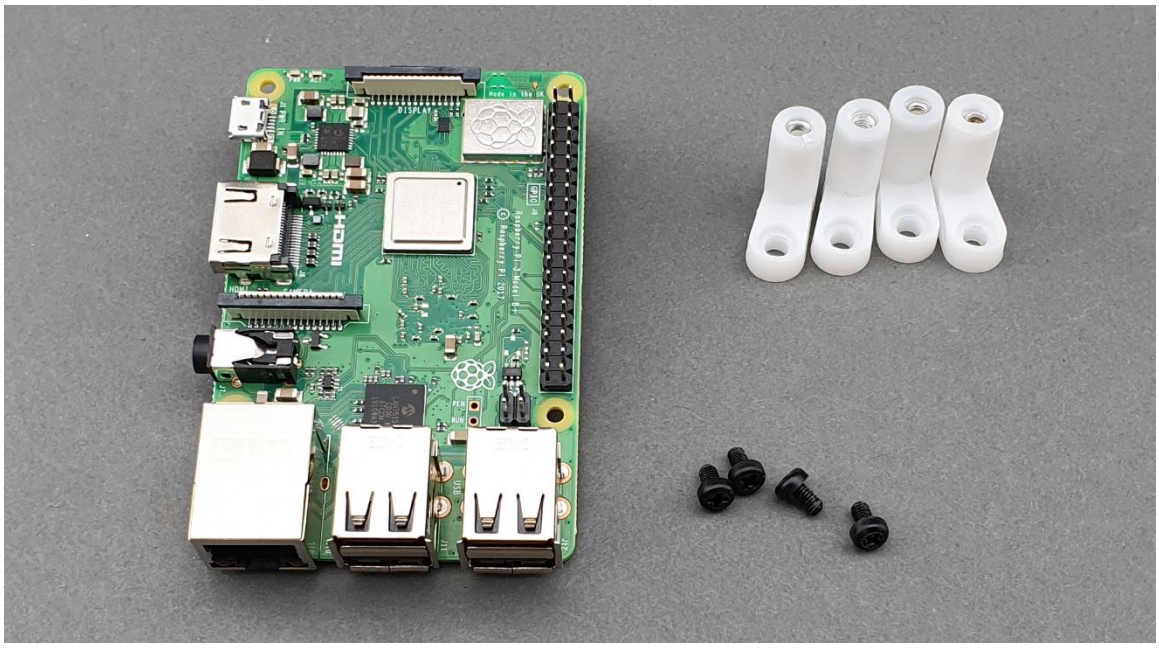


3.3 Raspberry Pi assembly

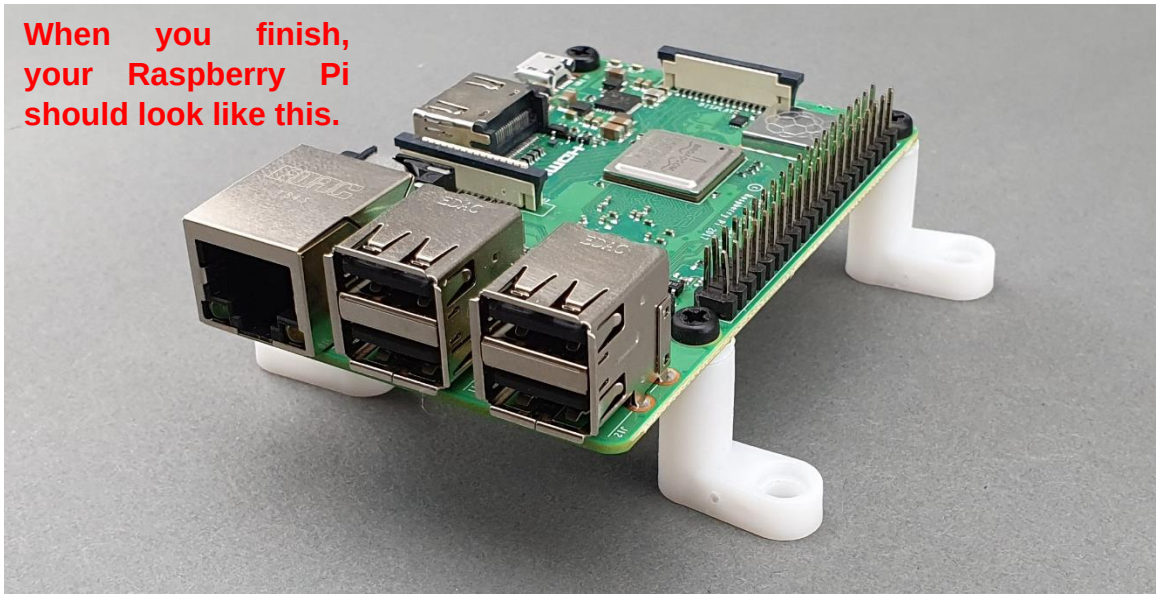
Step 1 – What you will need:



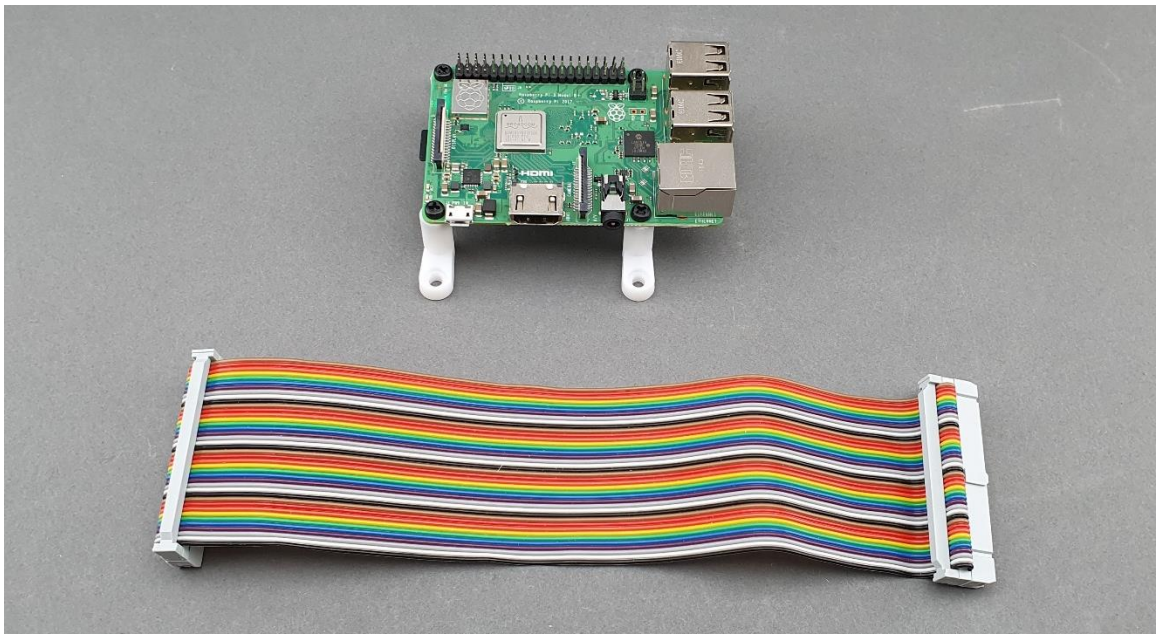
Step 2 – Mount the Raspberry Pi on plastic placeholders:

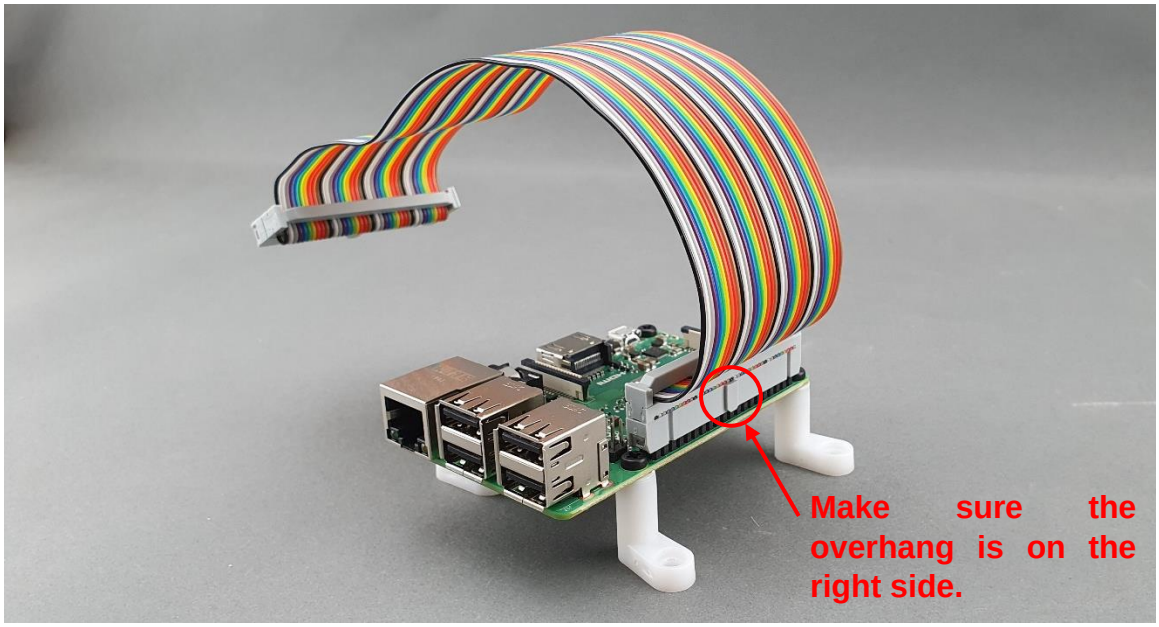


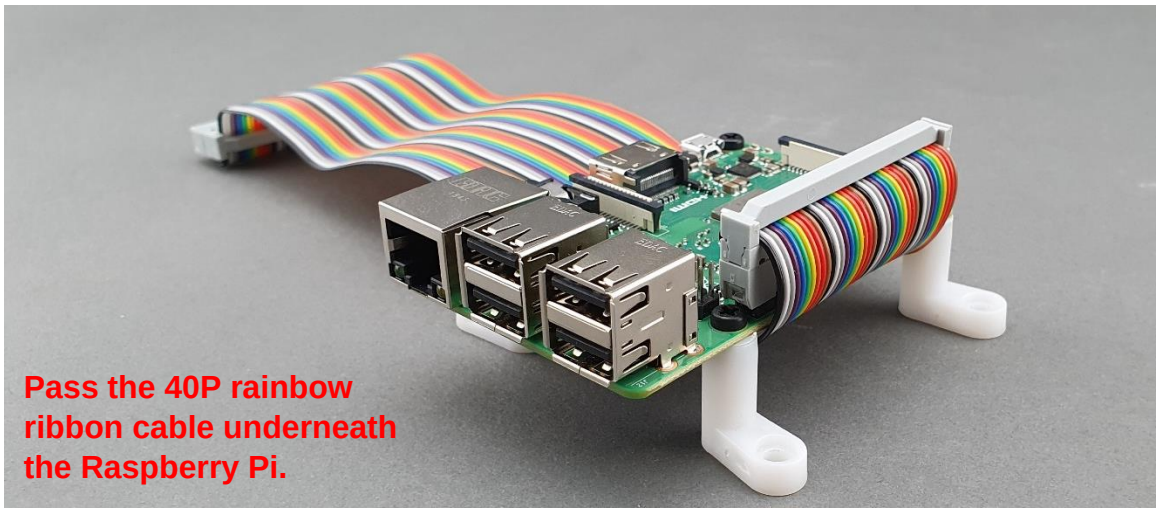

Use one plastic leg and one plastic screw. Repeat for all four legs. Do not screw too tight.


When you finish, your Raspberry Pi should look like this.

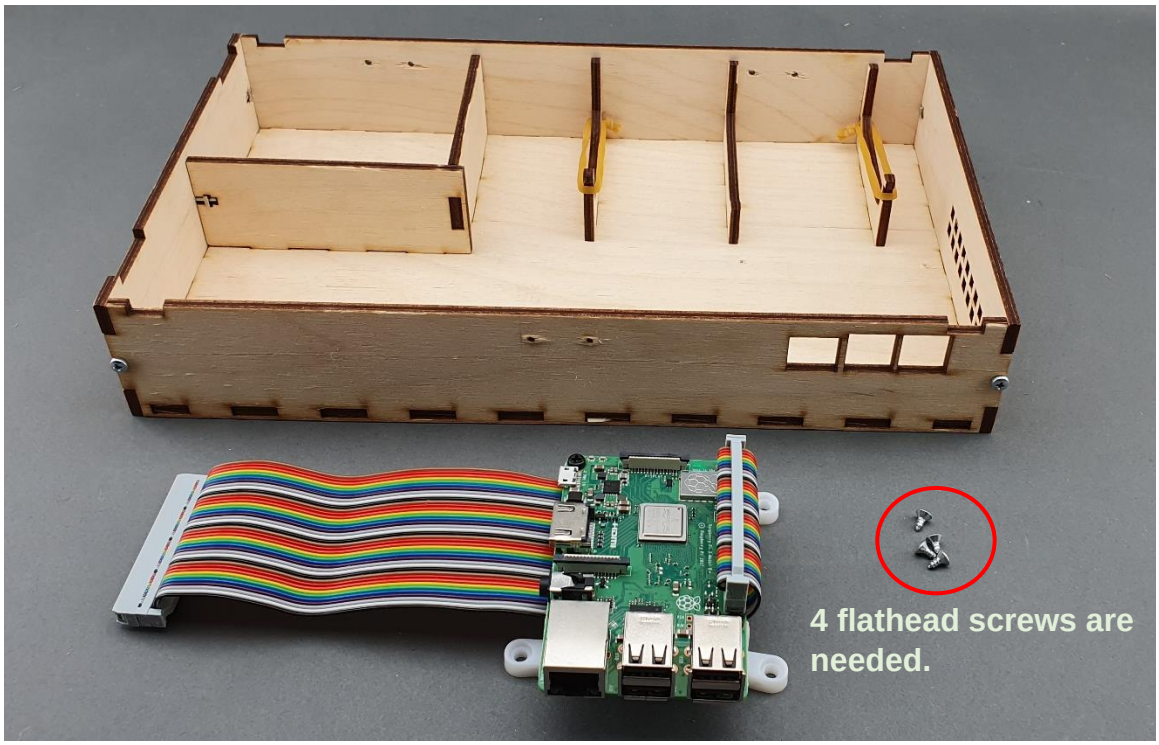
Step 3 – Attach the 40P rainbow ribbon cable to the Raspberry Pi:

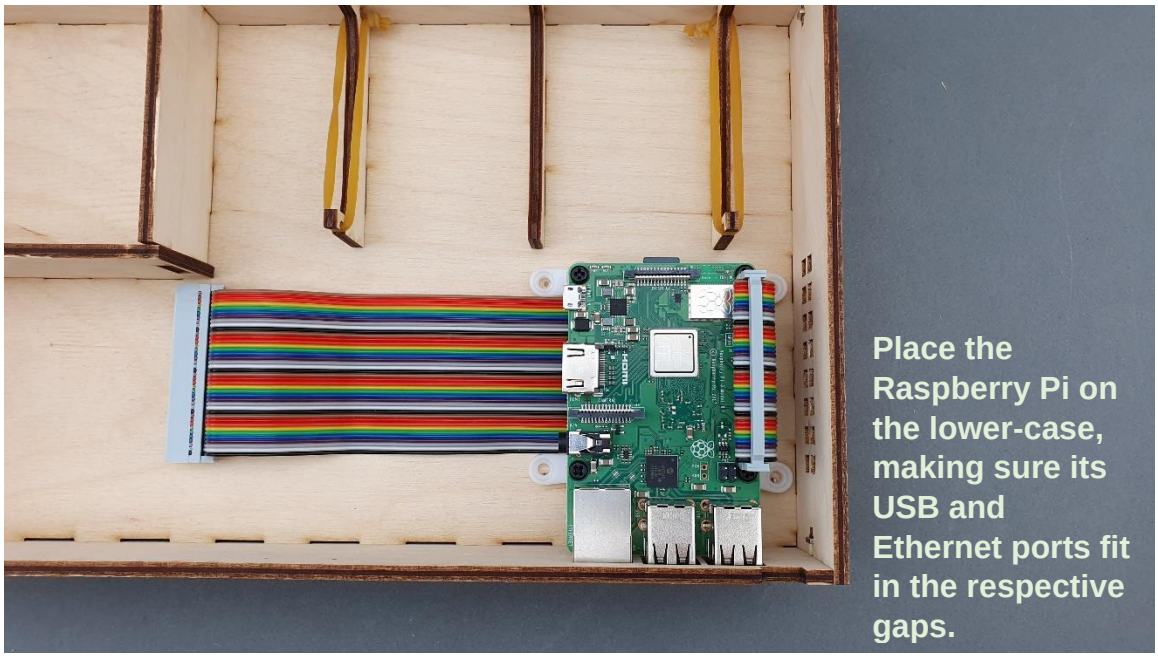


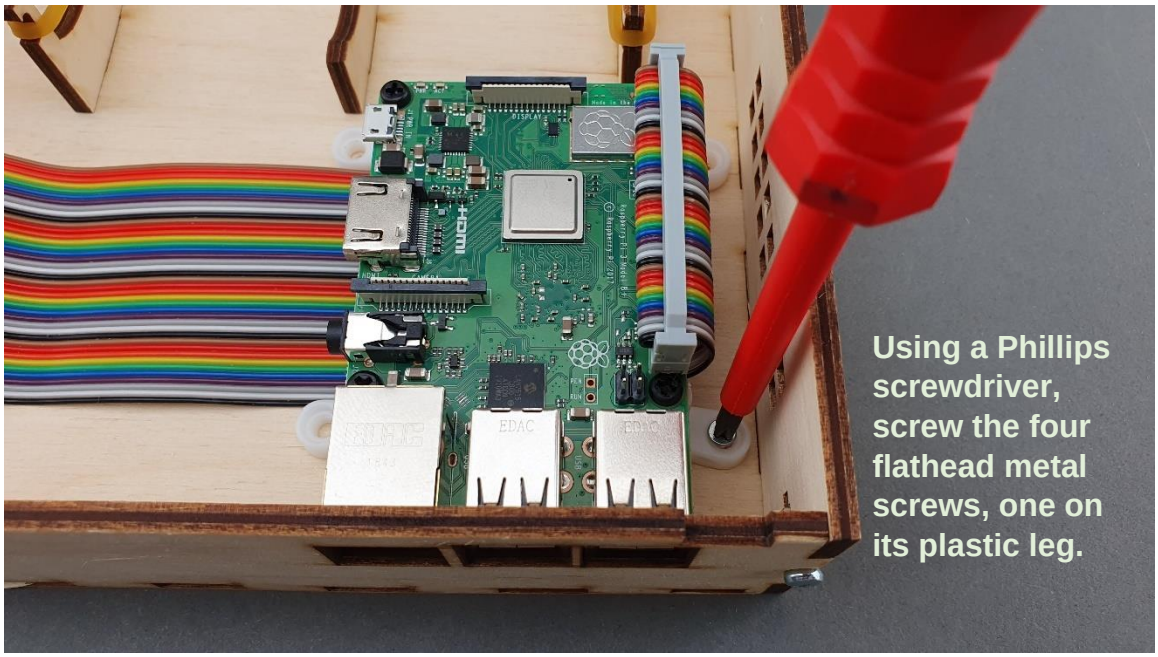




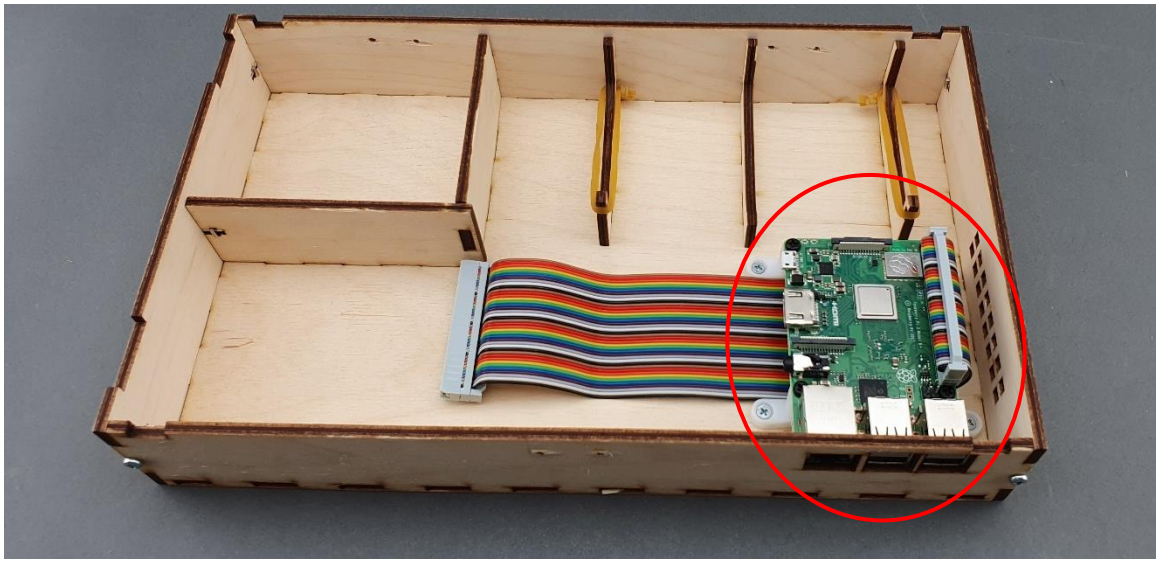
Step 4 – Mount the Raspberry Pi to the lower-case:




Place the Raspberry Pi on the lower-case, making sure its USB and Ethernet ports fit in the respective gaps.

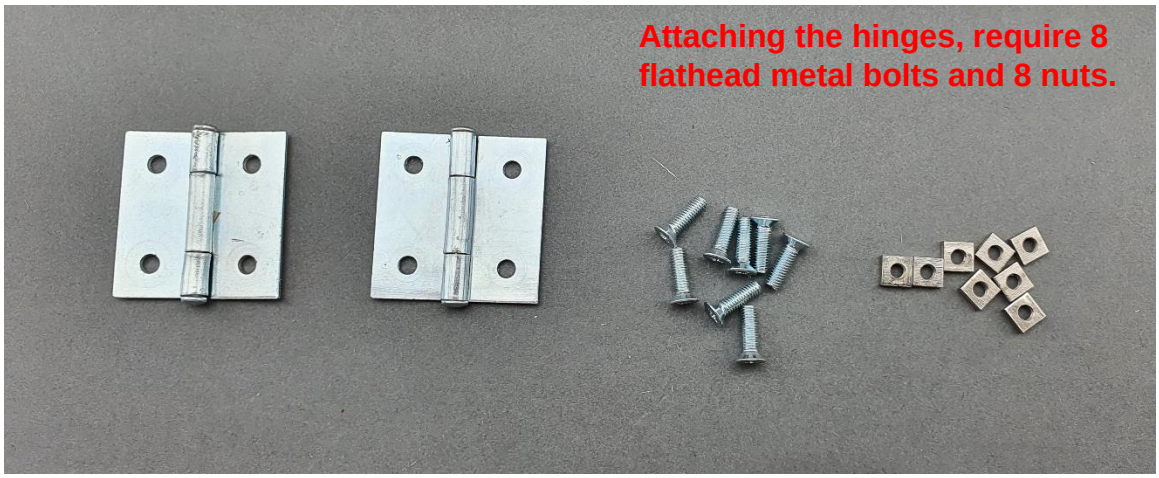

Using a Phillips screwdriver, screw the four flathead metal screws, one on its plastic leg.

Step 5 – Make sure the Raspberry Pi is stabilised on its placeholders and on the lower-case:

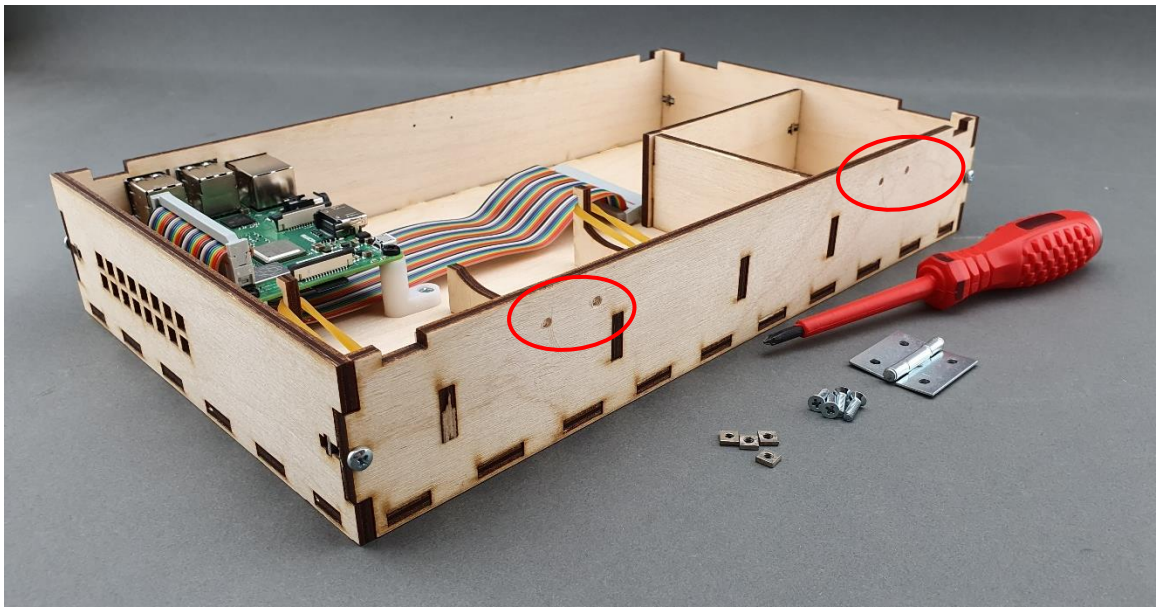


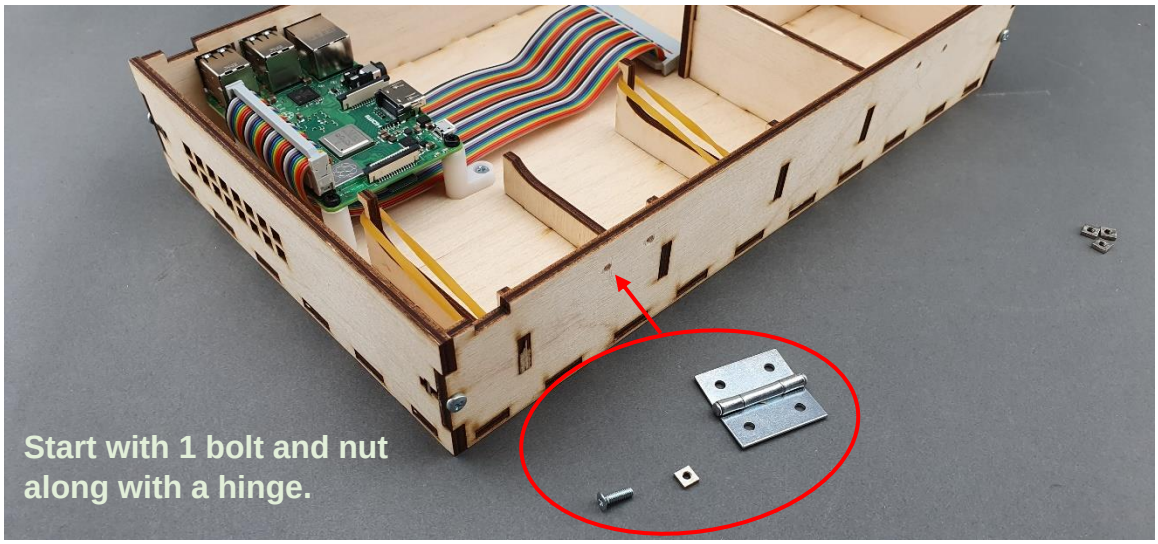
3.4 Hinges

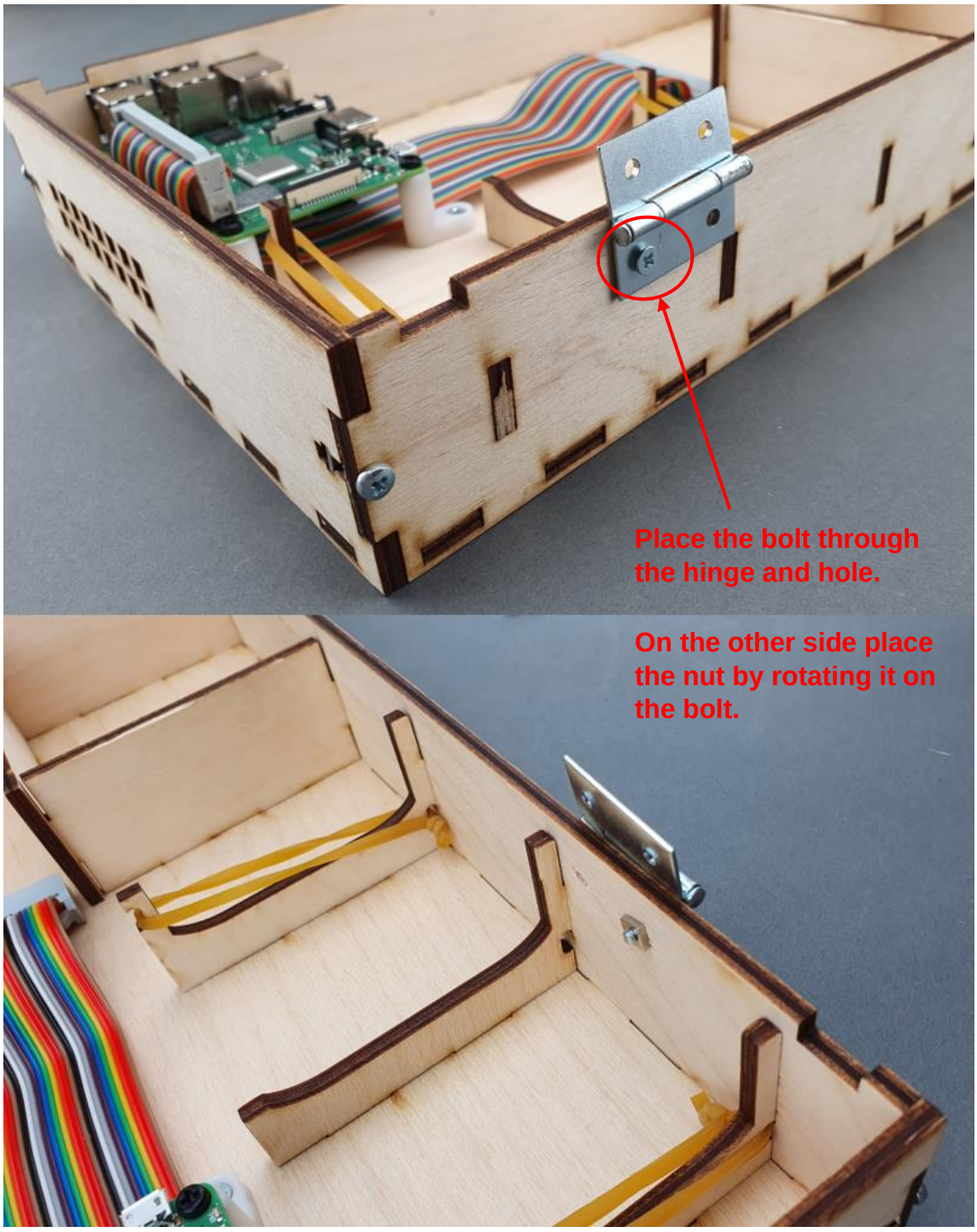
Step 1 – What you will need:

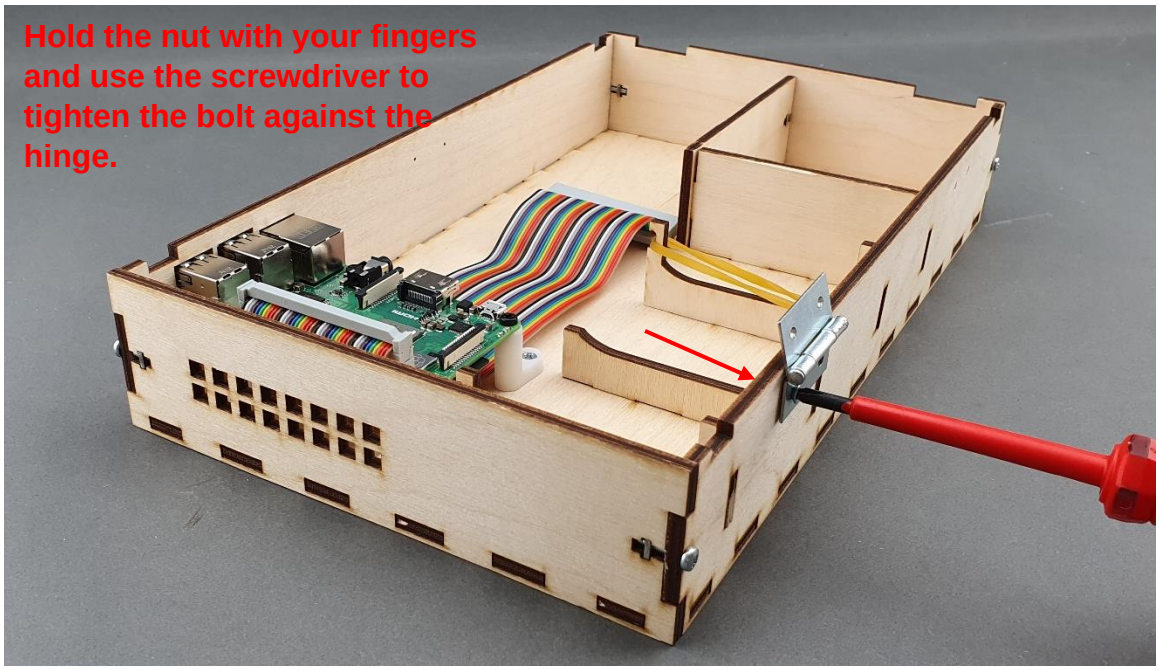


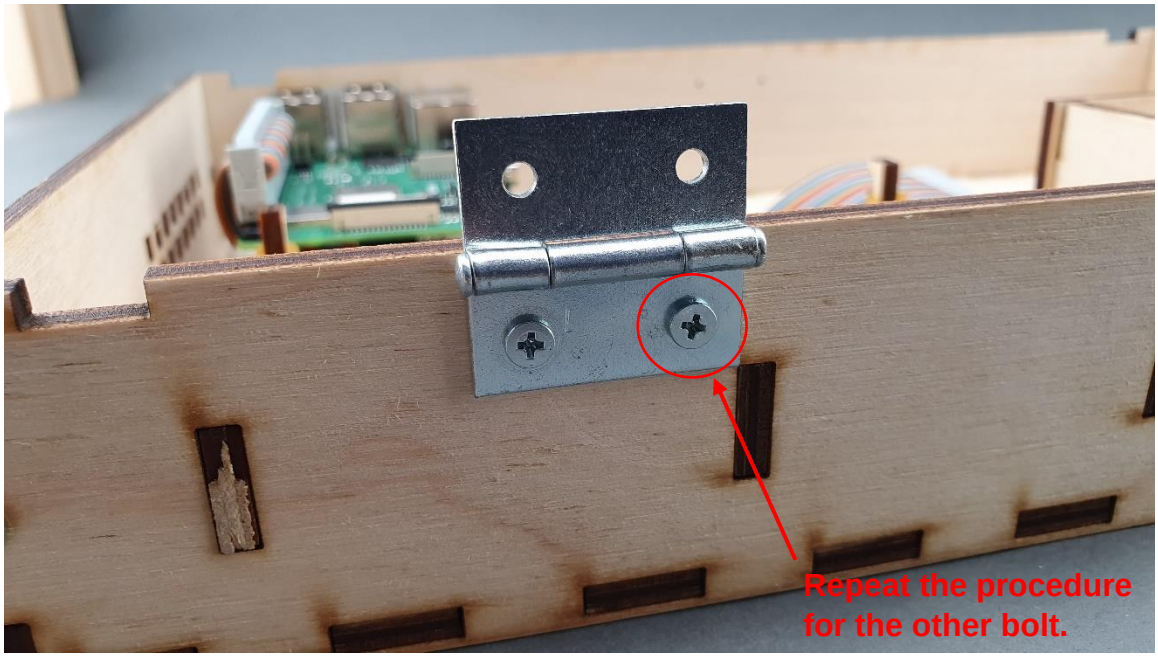
Step 2 – Mount one hinge to the lower-case:



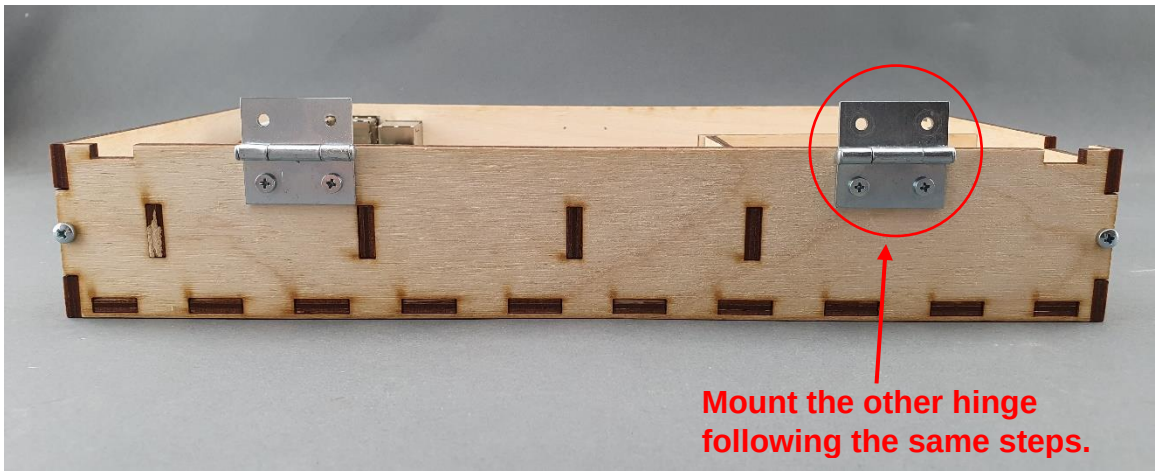



Place the bolt through the hinge and hole.
On the other side place the nut by rotating it on the bolt.

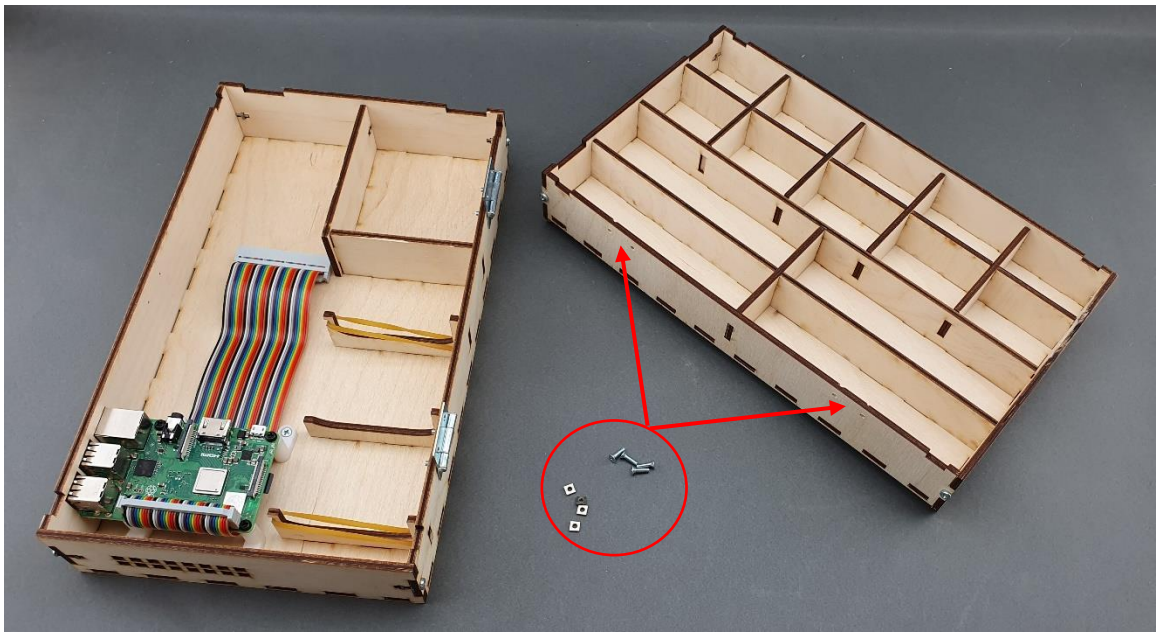

Hold the nut with your fingers and use the screwdriver to tighten the bolt against the hinge.

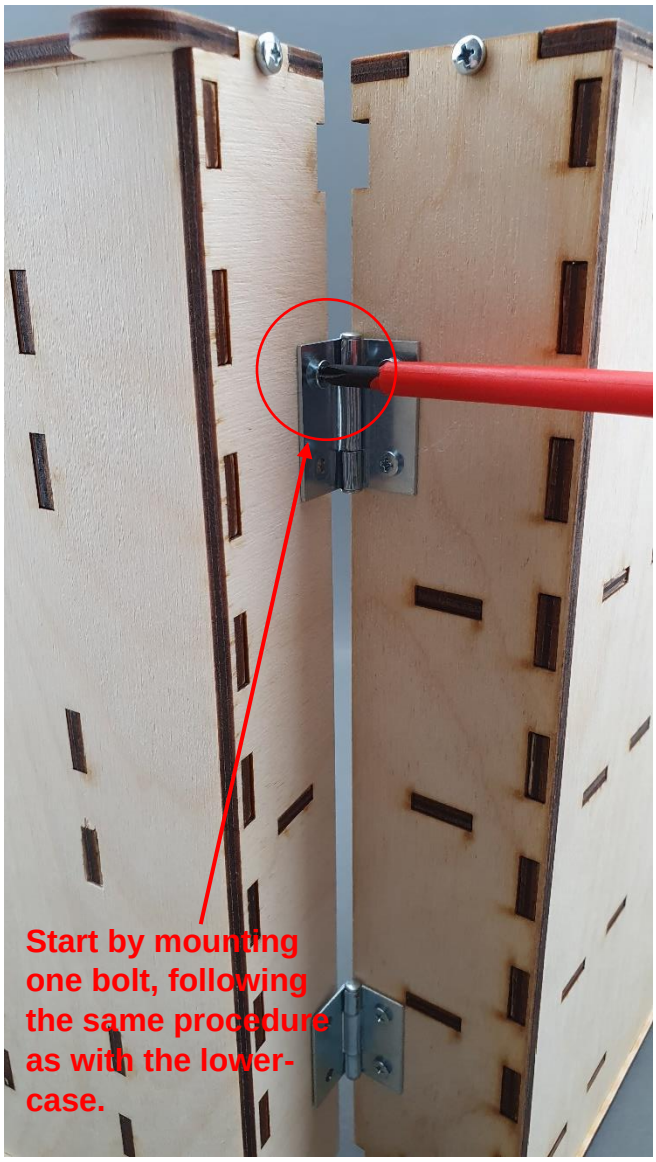

Repeat the procedure for the other bolt.

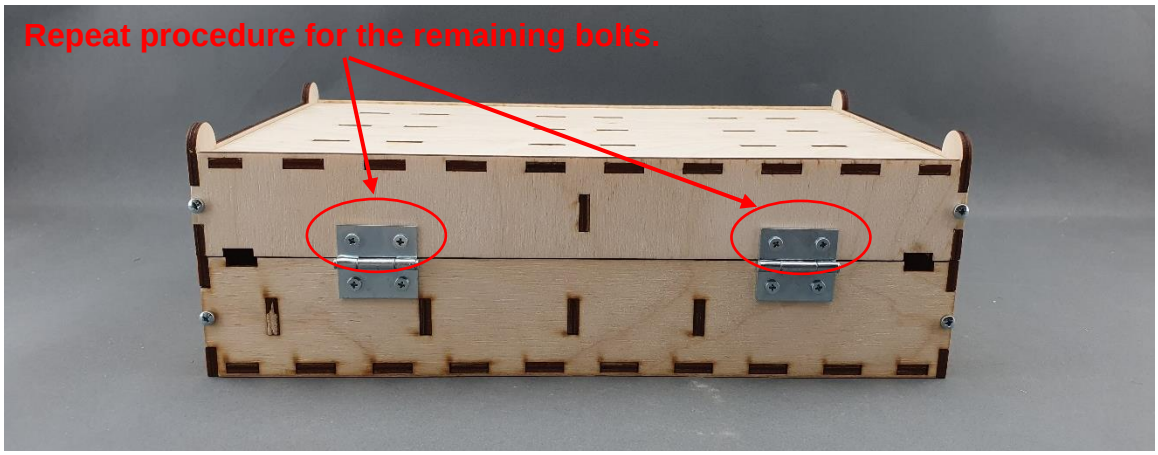
Step 2 – Mount the other hinge to the lower-case:



Step 3 – Mount the hinges to the upper-case:



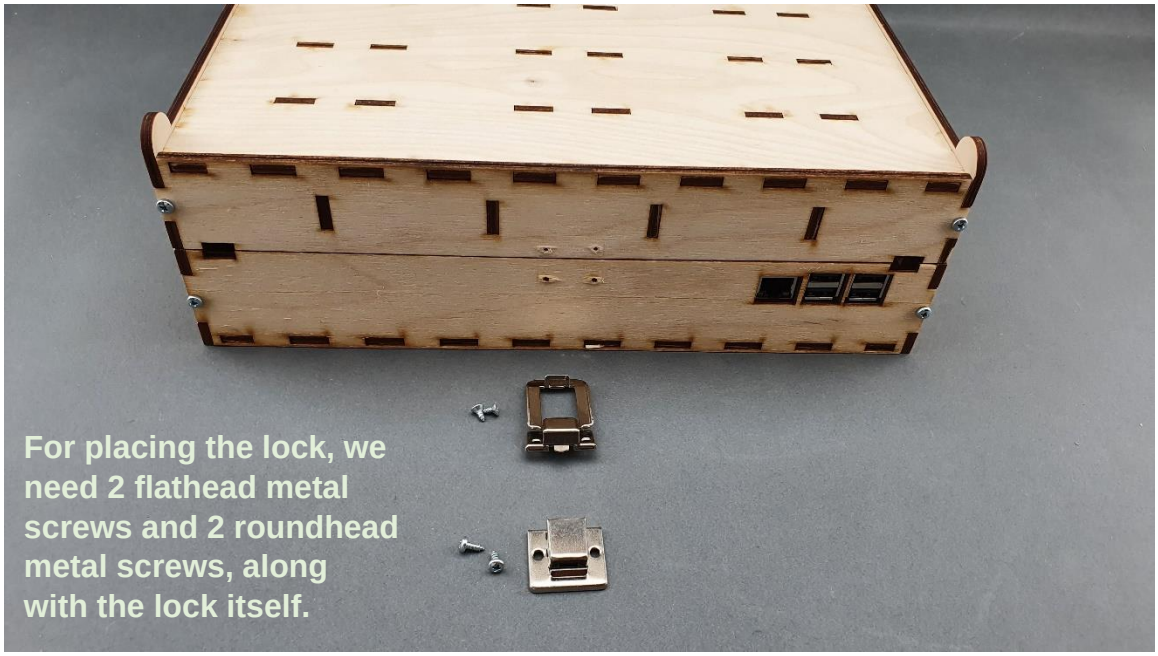

Start by mounting one bolt, following the same procedure as with the lower-case.



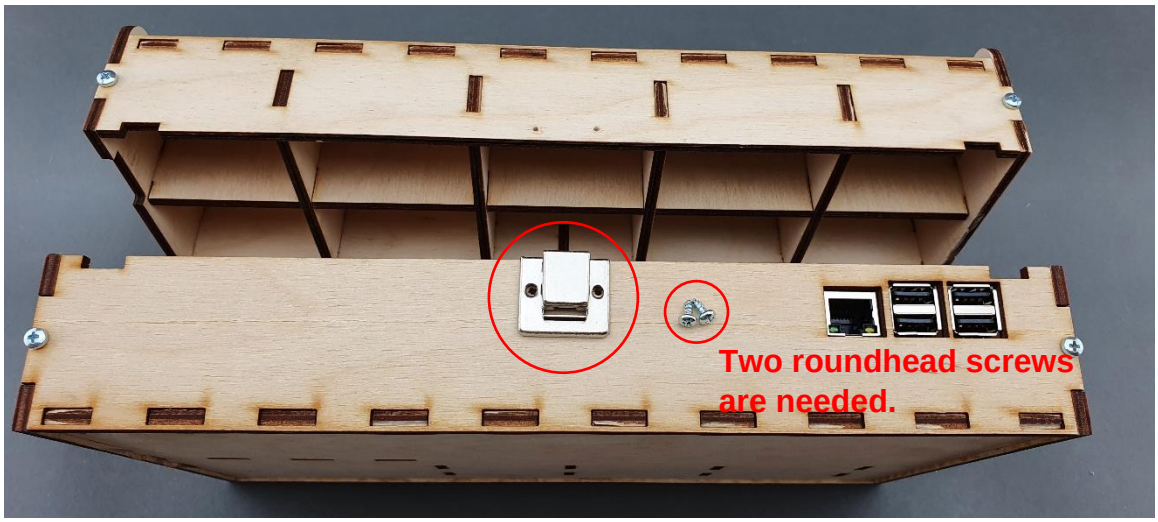
Step 4 – Make sure all bolts are tightened, and you are ready:

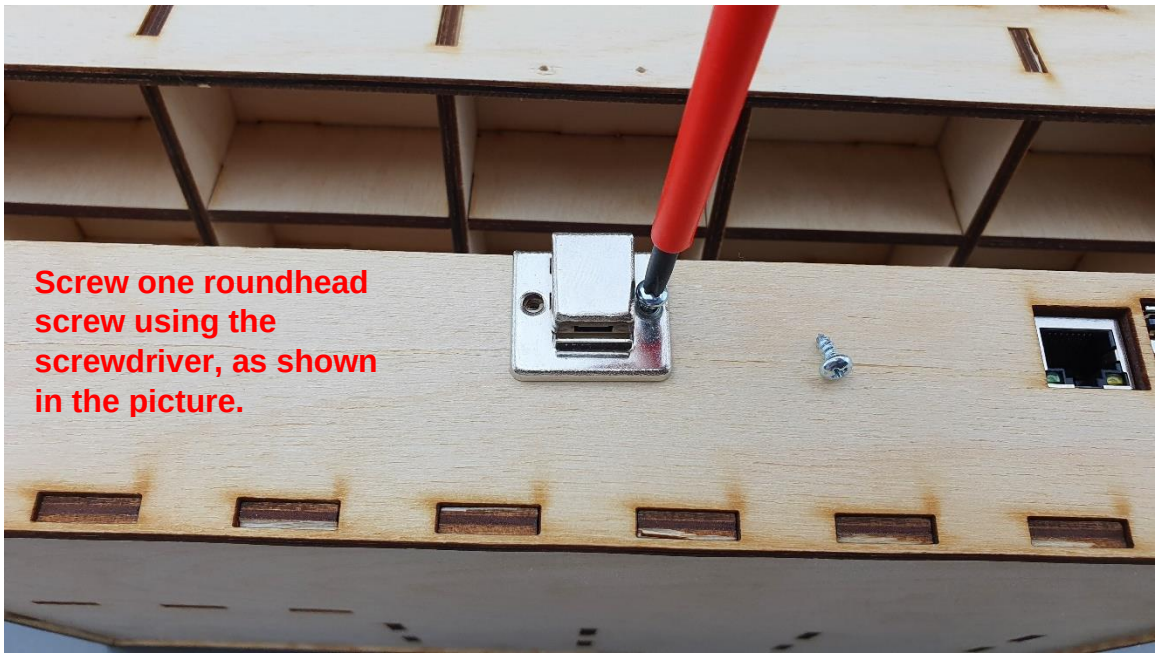
3.5 Lock

Step 1 – What you will need:



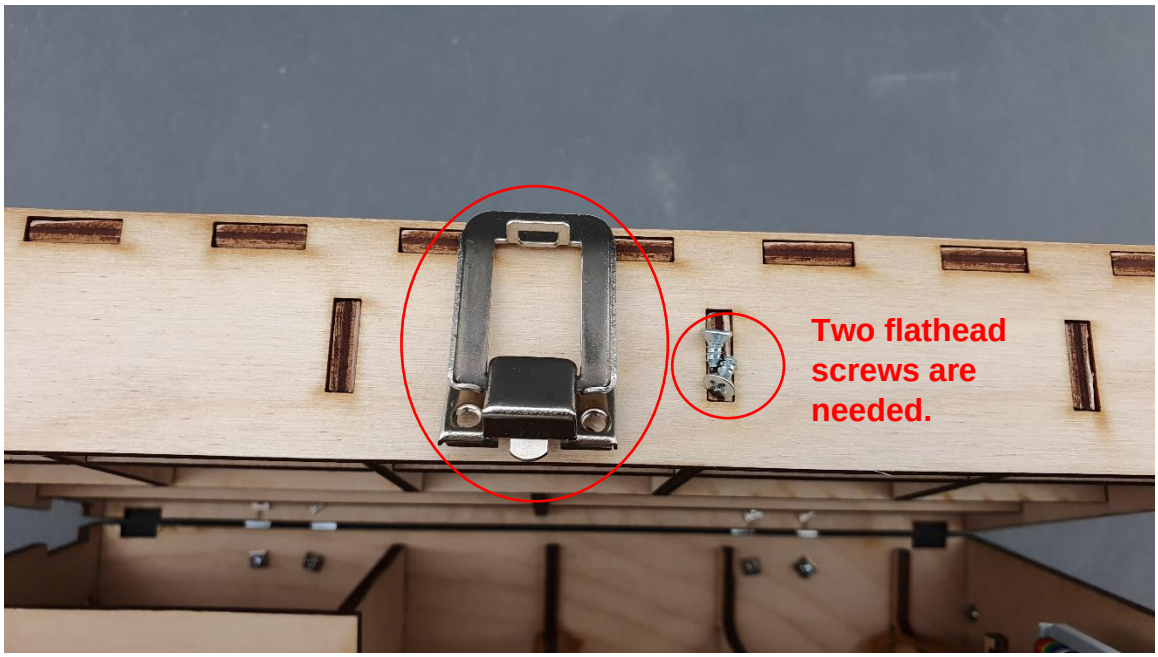
Step 2 – Mount the first part of the lock to the lower-case:

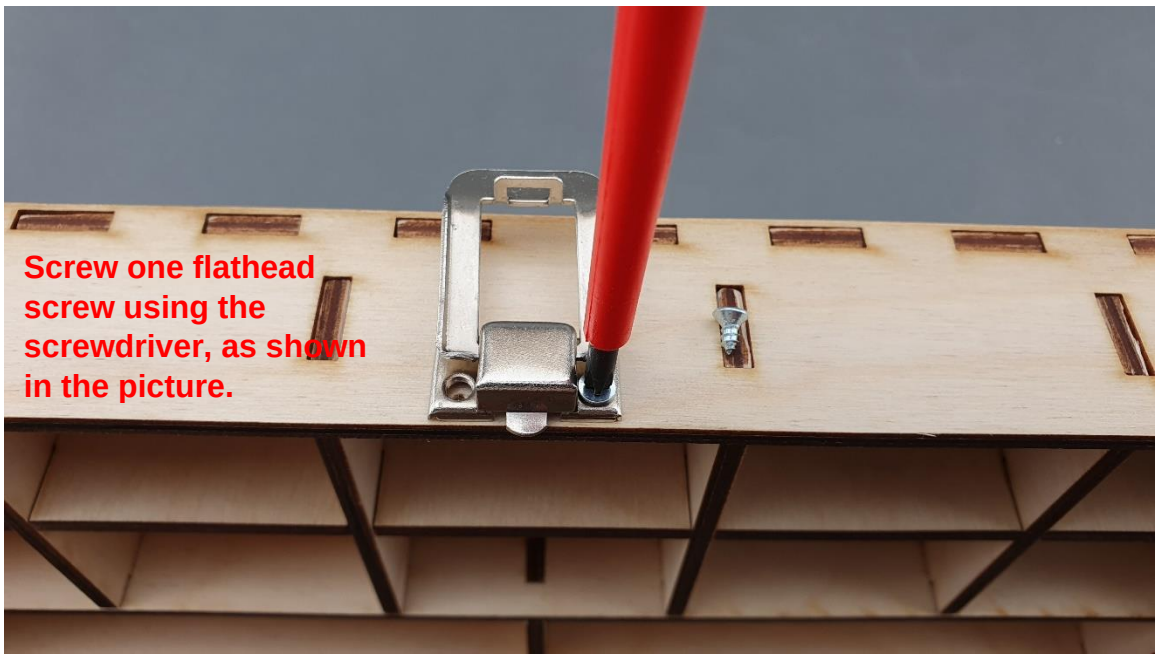


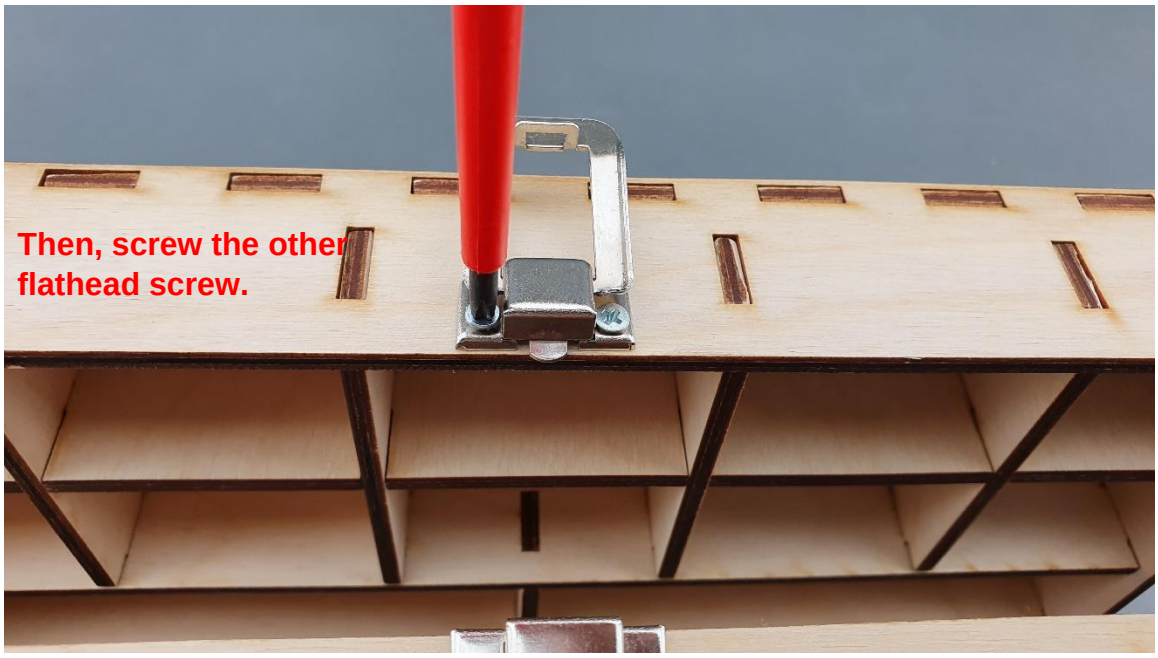

Screw one roundhead screw using the screwdriver, as shown in the picture.


Then, screw the other roundhead screw.

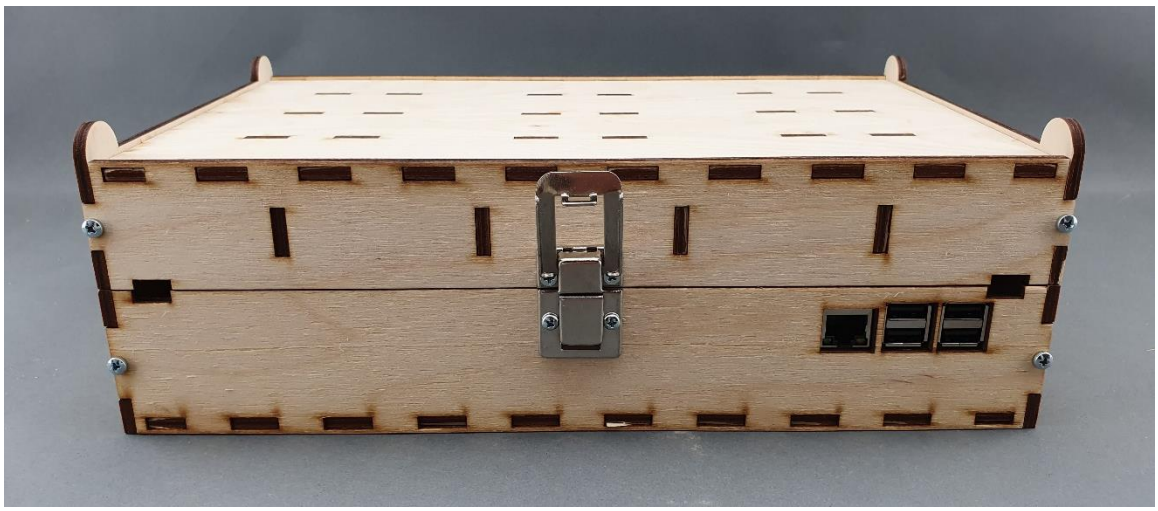
Step 3 – Mount the second part of the lock to the upper-case:

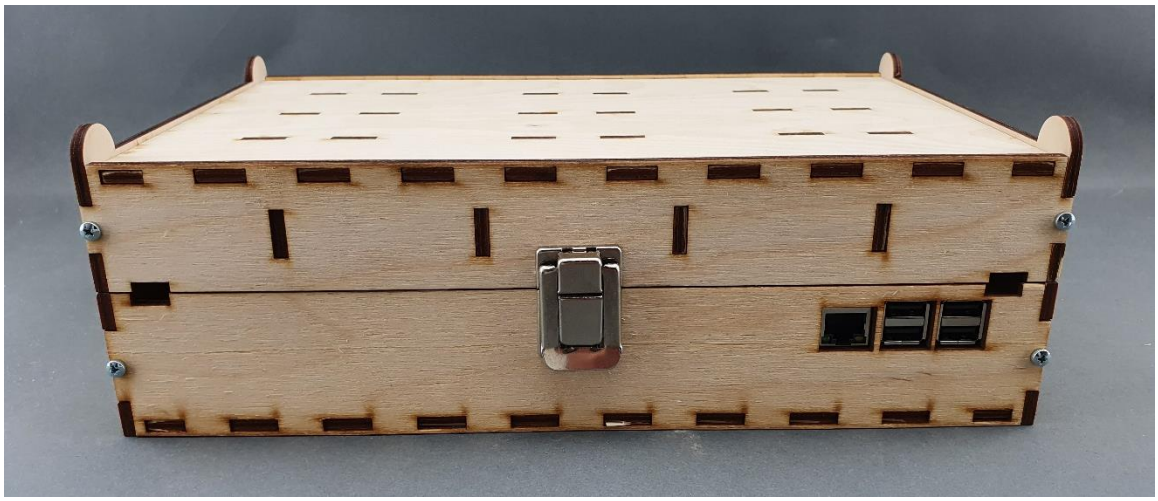






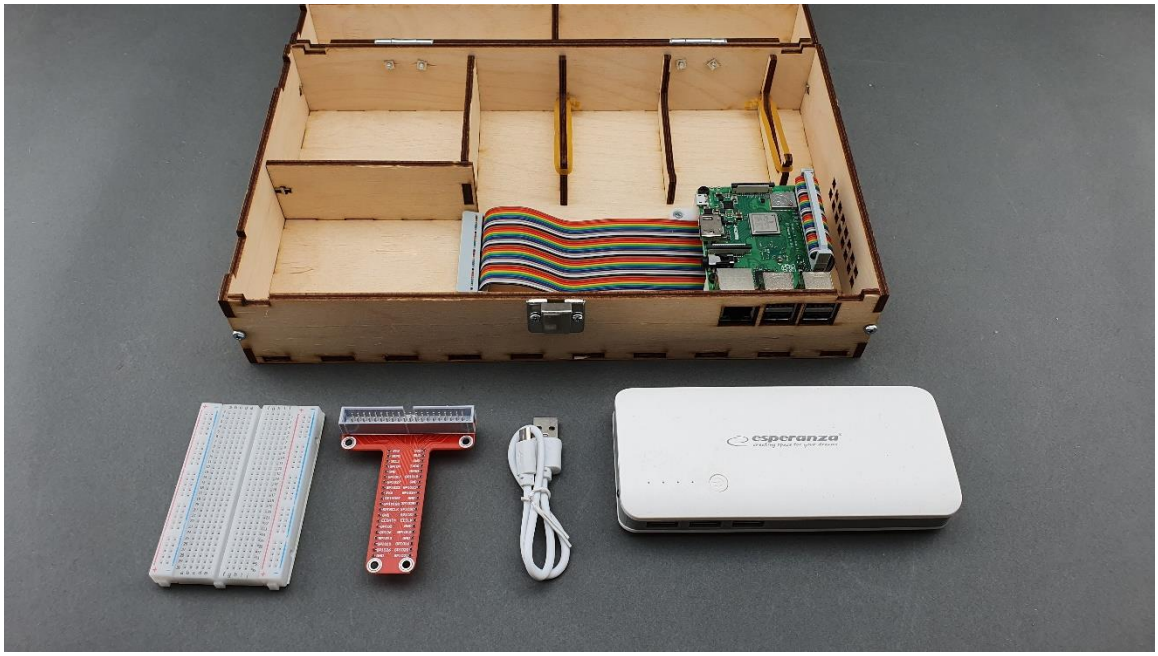
Step 4 – Make sure the two lock pieces are aligned and the lock is working:



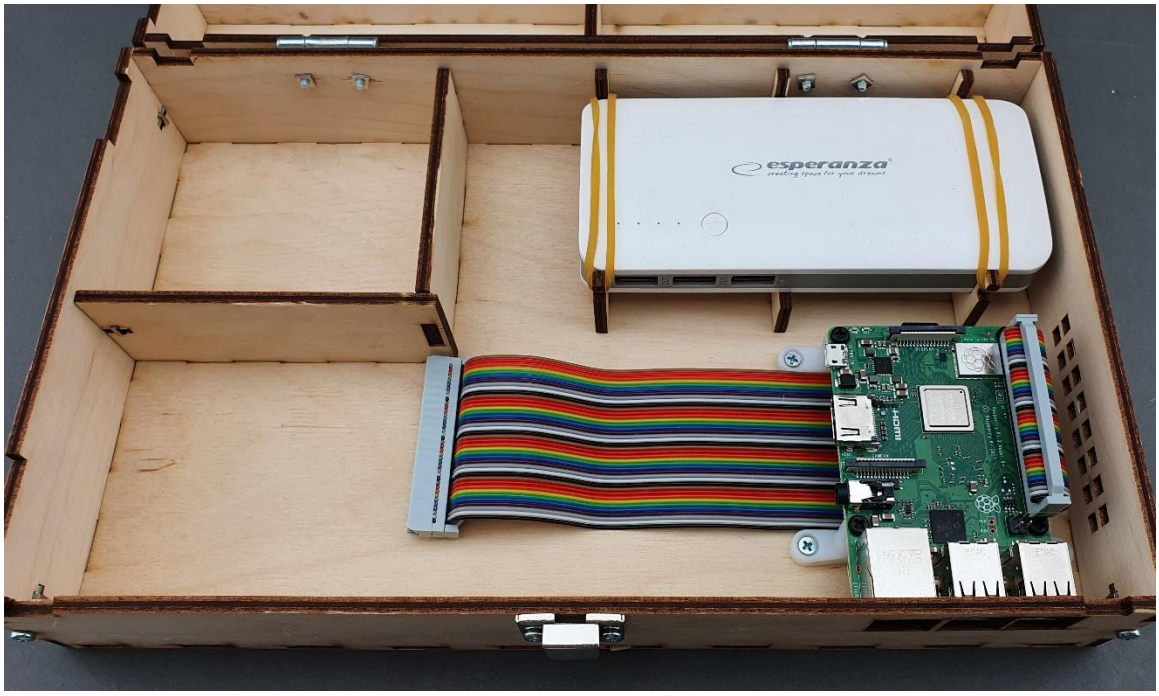


3.6 Powerbank, breadboard and connectivity

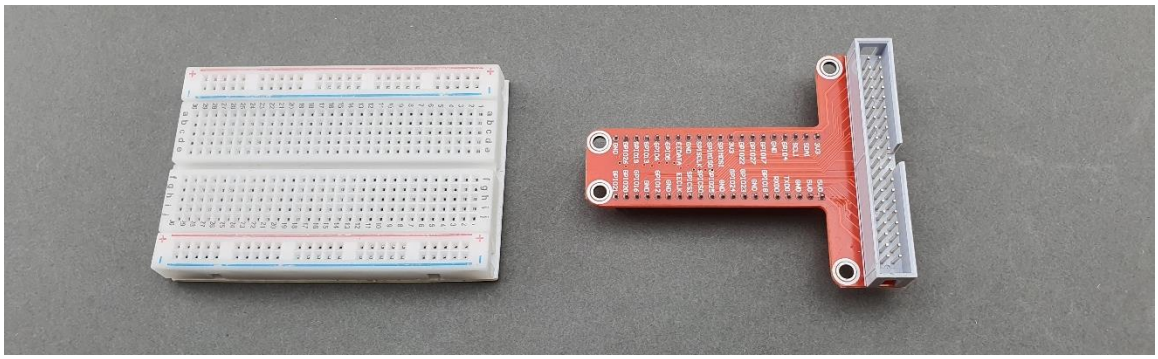
Step 1 – What you will need:

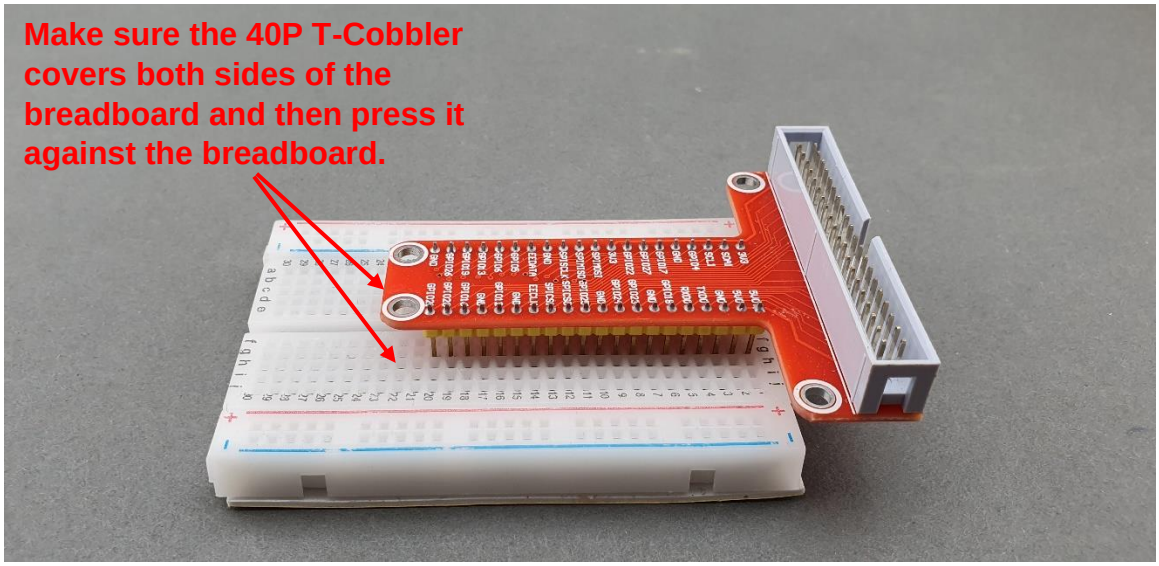


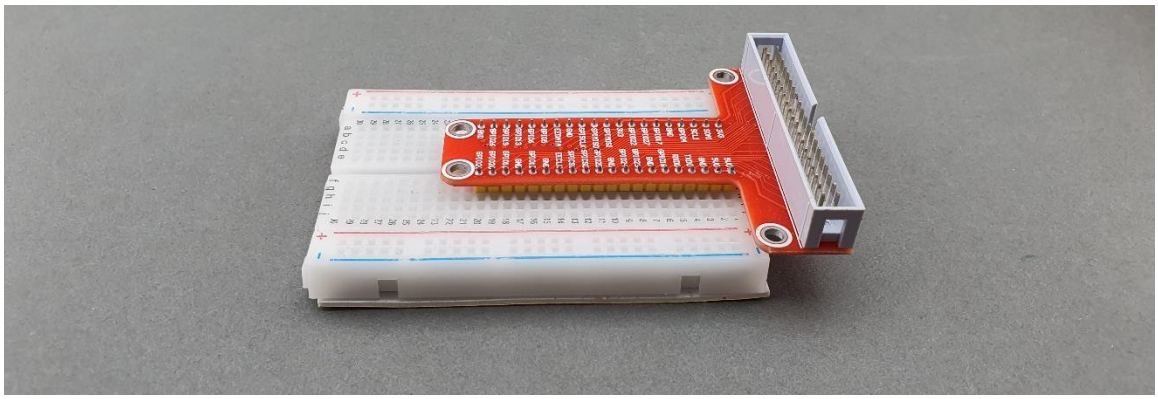
Step 2 – Start by placing the powerbank and secure it using the rubber bands:



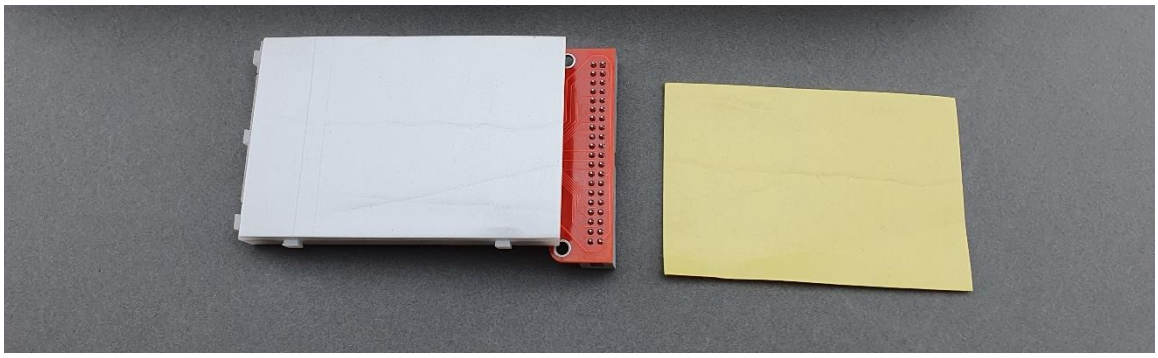
Step 3 – Place the 40P T-Cobbler on the breadboard:



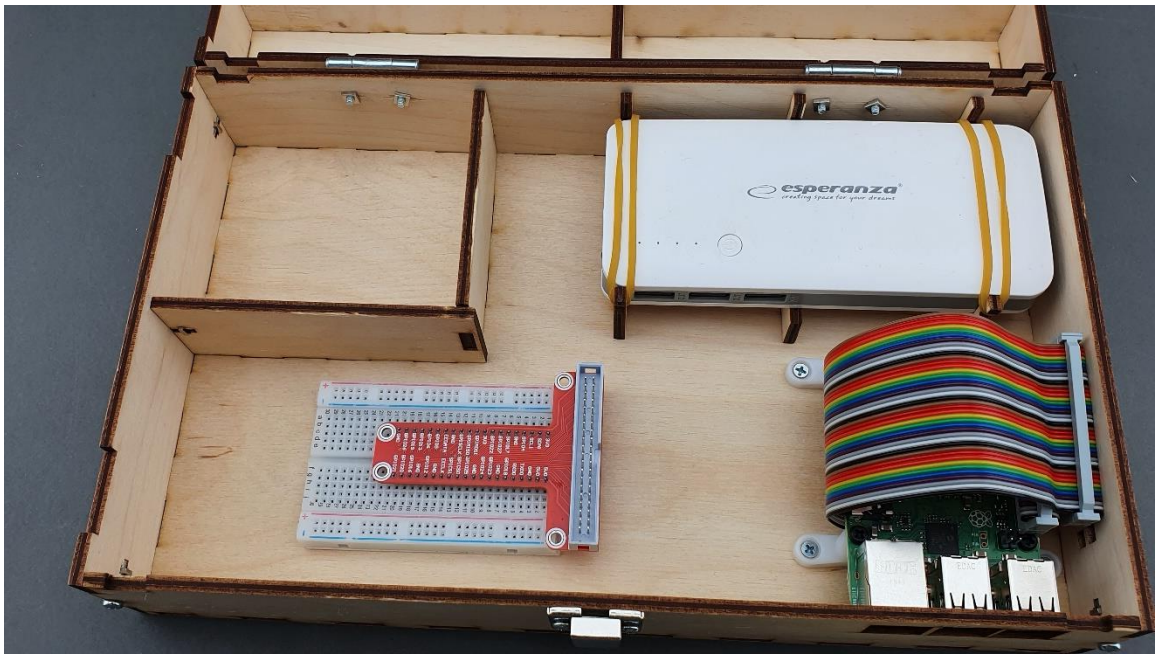




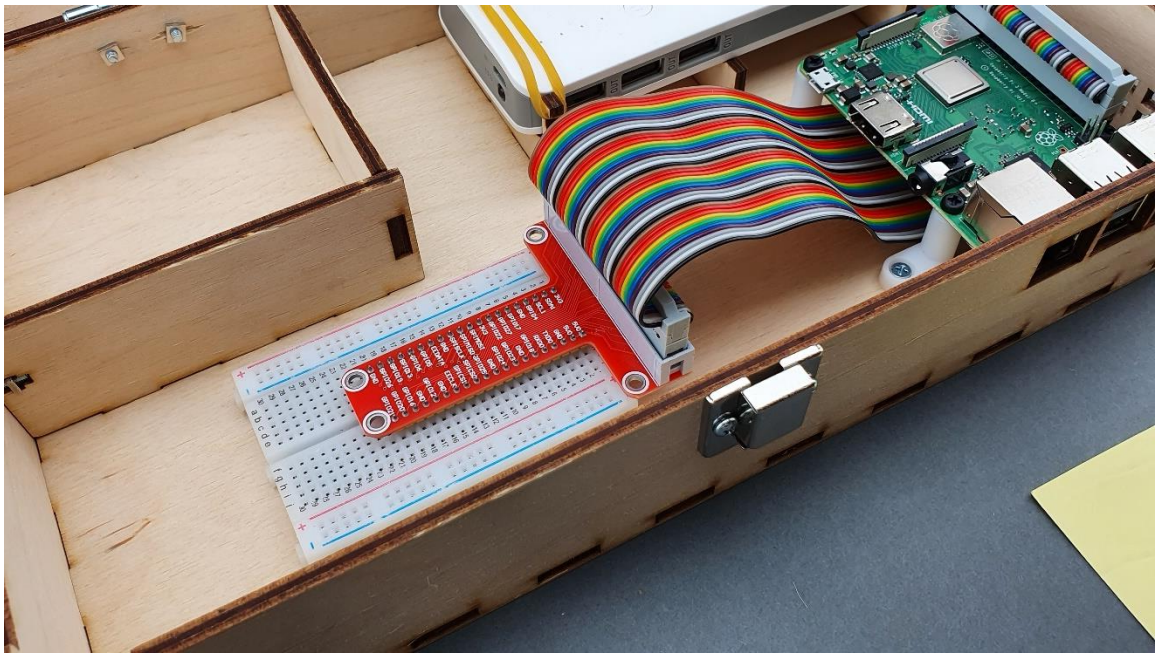
Step 4 – Remove the protective paper on the bottom side:



Step 5 – Place the breadboard inside the lower-case:

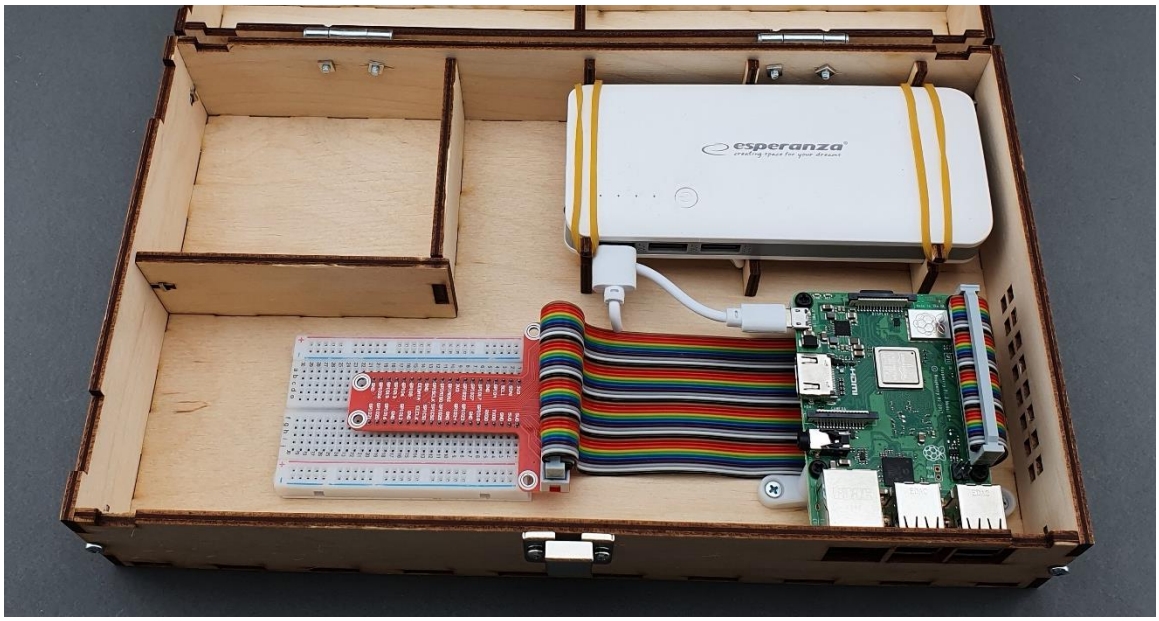


Step 6 – Connect the 40P rainbow ribbon cable with the 40P T-Cobbler:



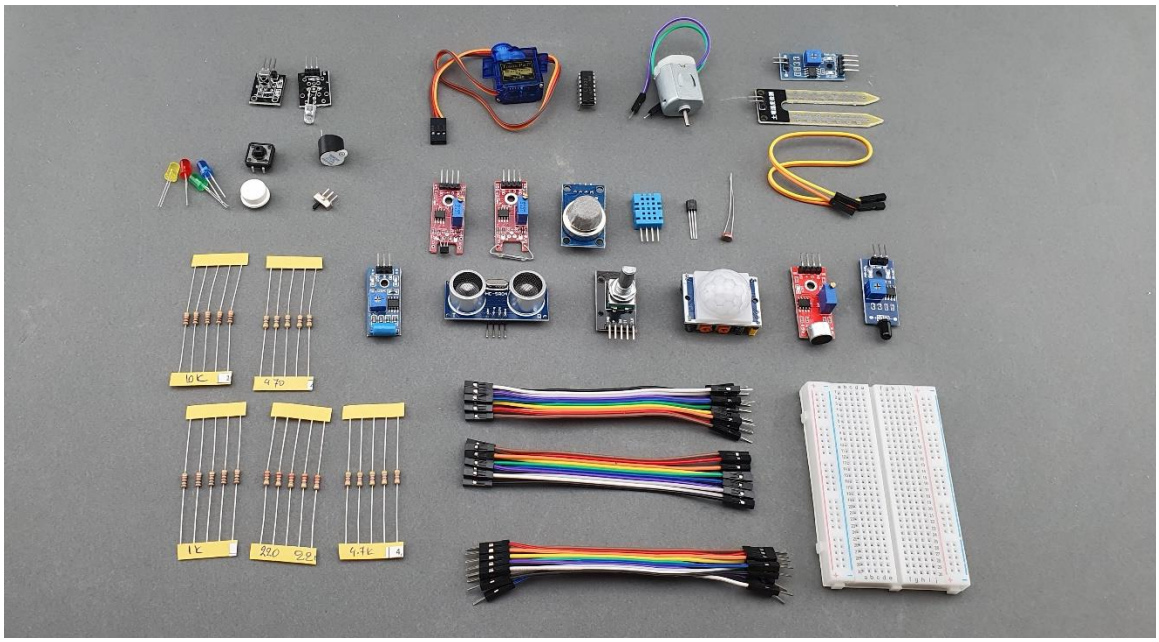
Step 7 – Connect the power cable from the powerbank to the Raspberry Pi:

Step 8 – Finally, make sure that everything is connected correctly:



3.7 Placing electronics and sensors

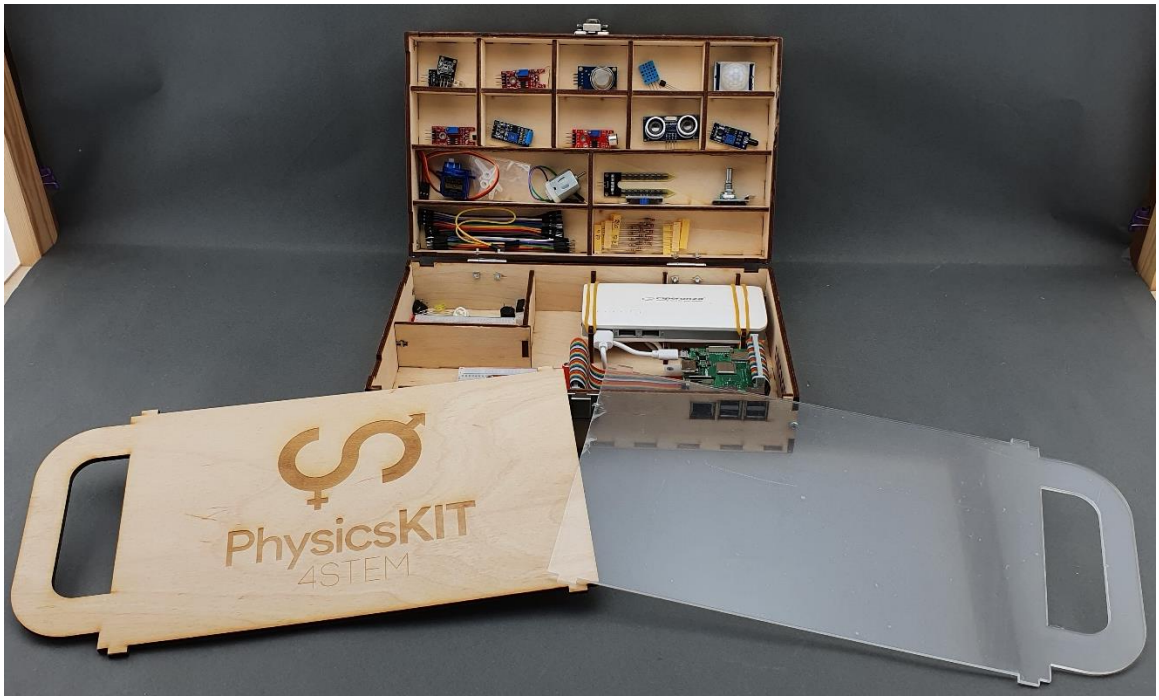
Step 1 – What you will need:



Step 2 – Place the electronics and sensors as shown in the image below:

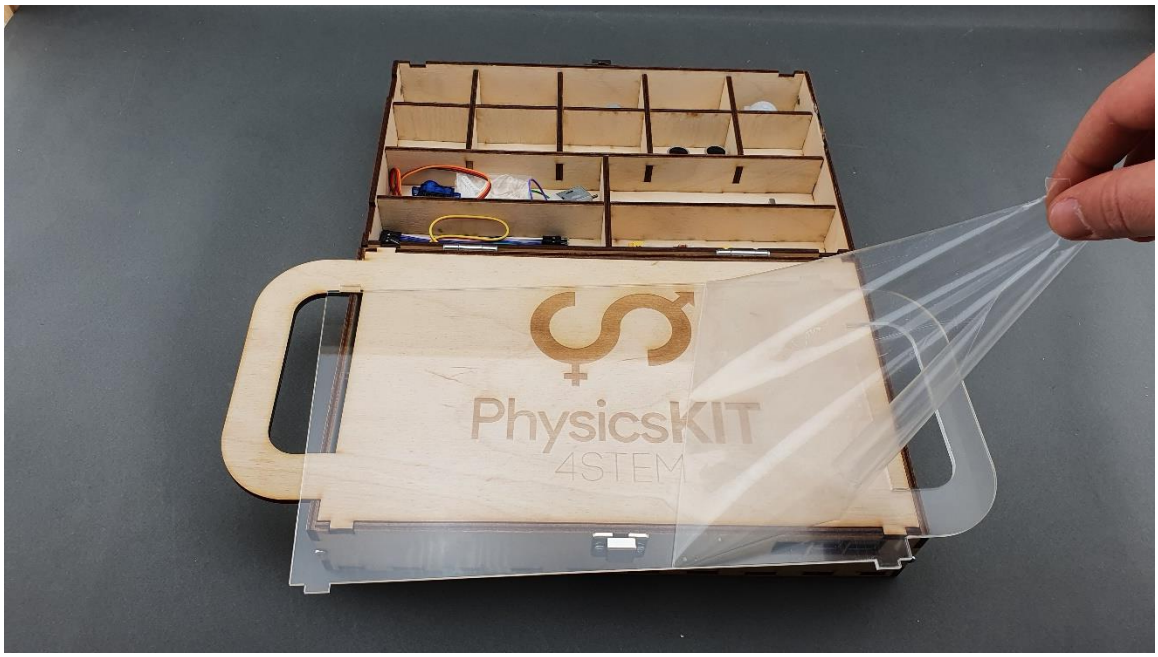
3.8 Placing lids with handles

Step 1 – What you will need:



Step 2 – Place the wooden lid on top of the lower-case:

Step 3 – Remove the protective cover from the plexiglass lid:



Step 4 – Place the plexiglass lid on top of the upper-case:

Step 5 – Congratulations! Your PhysicsKIT is ready:

4. Software

The Raspberry Pi on our PhysicsKIT runs on Raspberry Pi OS. Raspberry Pi OS (formerly known as Raspbian) is a Debian-based operating system for Raspberry Pi. Raspberry Pi OS provides more than a pure operating system: it comes with over 35 000 packages, pre-compiled and pre-installed with plenty of software for education, programming and general use bundled in a nice format for easy installation for the Raspberry Pi. It has Thonny Python, Scratch, Minecraft Pi, Java and more.

The initial build of over 35,000 Raspbian packages, optimized for best performance on the Raspberry Pi, was completed in June of 2012. However, Raspbian is still under active development with an emphasis on improving the stability and performance of as many Debian packages as possible. Since 2015, it has been officially provided by the Raspberry Pi Foundation as the main operating system for the Raspberry Pi family of compact single-board computers.

Raspberry Pi OS uses PIXEL, **P**i **I**mproved **X**-Window **E**nvironment, **L**ightweight as its main desktop environment as of the latest update. It is composed of a modified LXDE desktop environment and the Openbox stacking window manager with a new theme and a few other changes. The distribution is shipped with a copy of computer algebra program Mathematica and a version of Minecraft called Minecraft Pi as well as a lightweight version of Chromium, Thonny Python, Scratch and many more.

4.1 Installing Raspberry Pi OS to micro-SD card

All we need is to download the desired software version from https://www.raspberrypi.org/software/.

The easiest way to install Raspberry Pi OS to the microSD card is to download the Raspberry Pi imager. Depending on the operating system you use (Windows, macOS, Linux) click on the “Download” button.

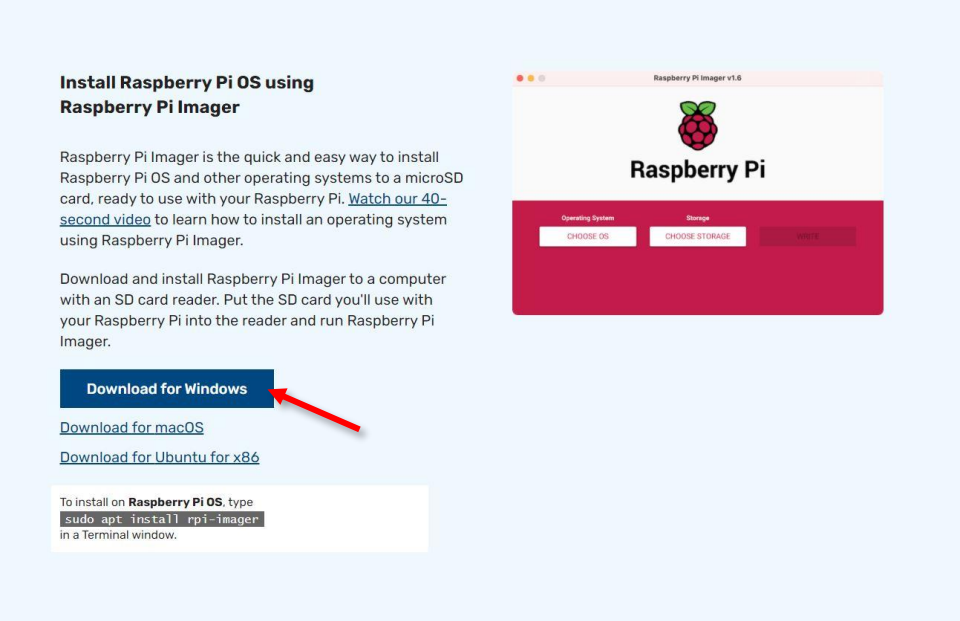


FIGURE 13 DOWNLOADING RASPBERRY PI IMAGER

Execute the /exe file you just downloaded and follow the instructions in order to install the Raspberry Pi imager to your computer.

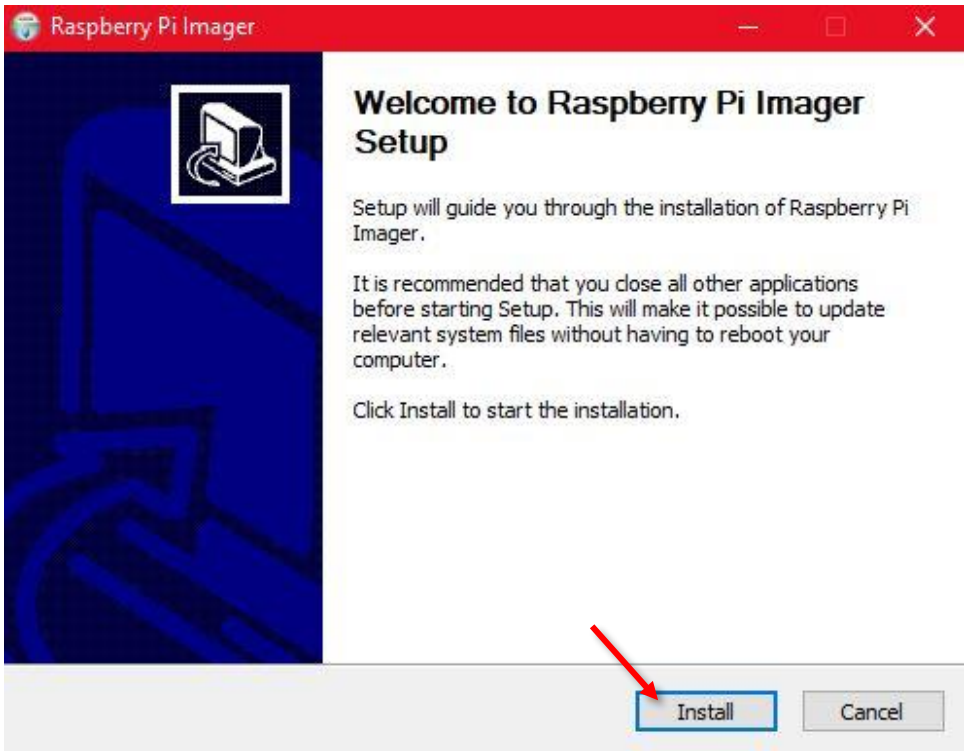


FIGURE 14 INSTALLING THE IMAGER

When installation is finished, make sure the “Run Raspberry Pi Imager” is selected.

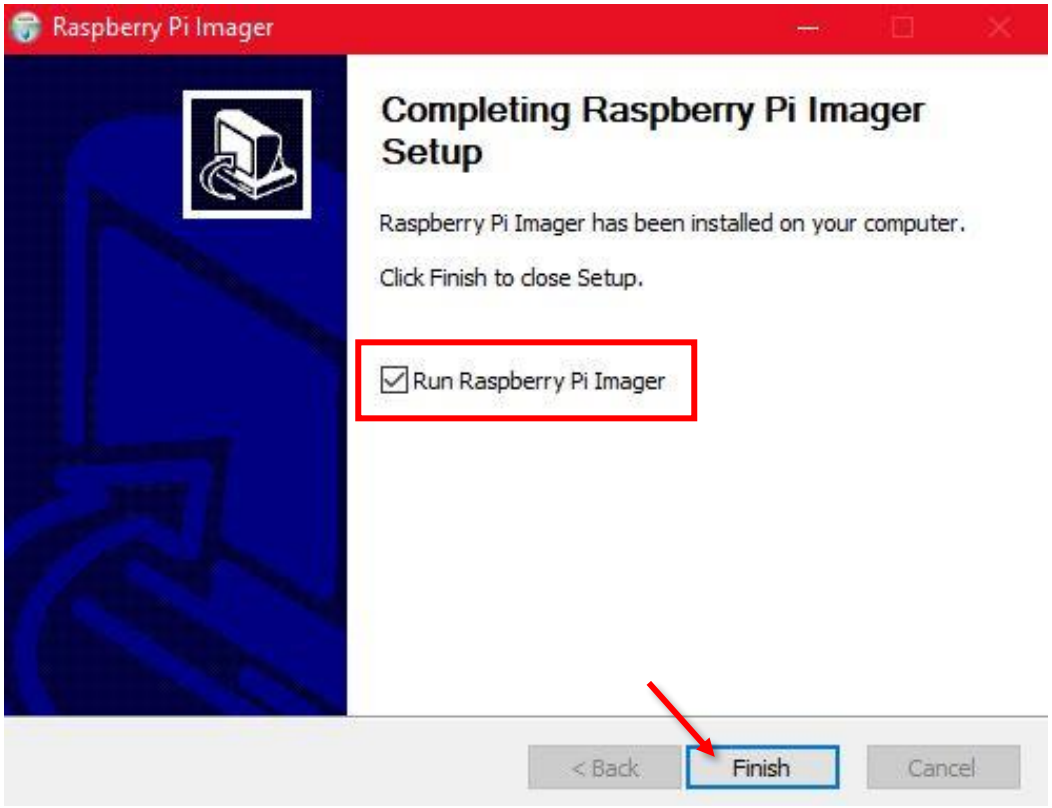


FIGURE 15 FINISHING WITH INSTALLATION

The Raspberry Pi Imager will run. Now it is time to insert the microSD card to the card reader of your computer. Then, click on “CHOOSE OS” button.

FIGURE 16 RASPBERRY PI IMAGER

On the list that appears, click the first item “Raspberry Pi OS (32-bit).

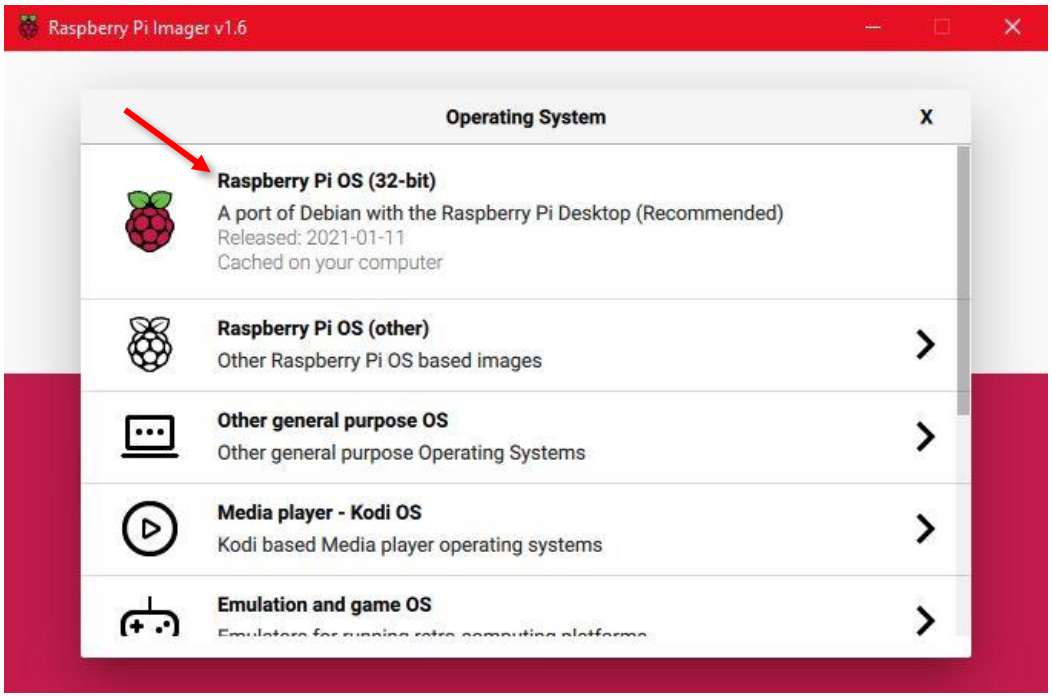


FIGURE 17 CHOOSING OS

In the next step, you need to choose the storage that the operating system will be flashed upon. Click on the “CHOOSE STORAGE” button.

FIGURE 18 CHOOSING STORAGE

Select the appropriate slot with the microSD card.

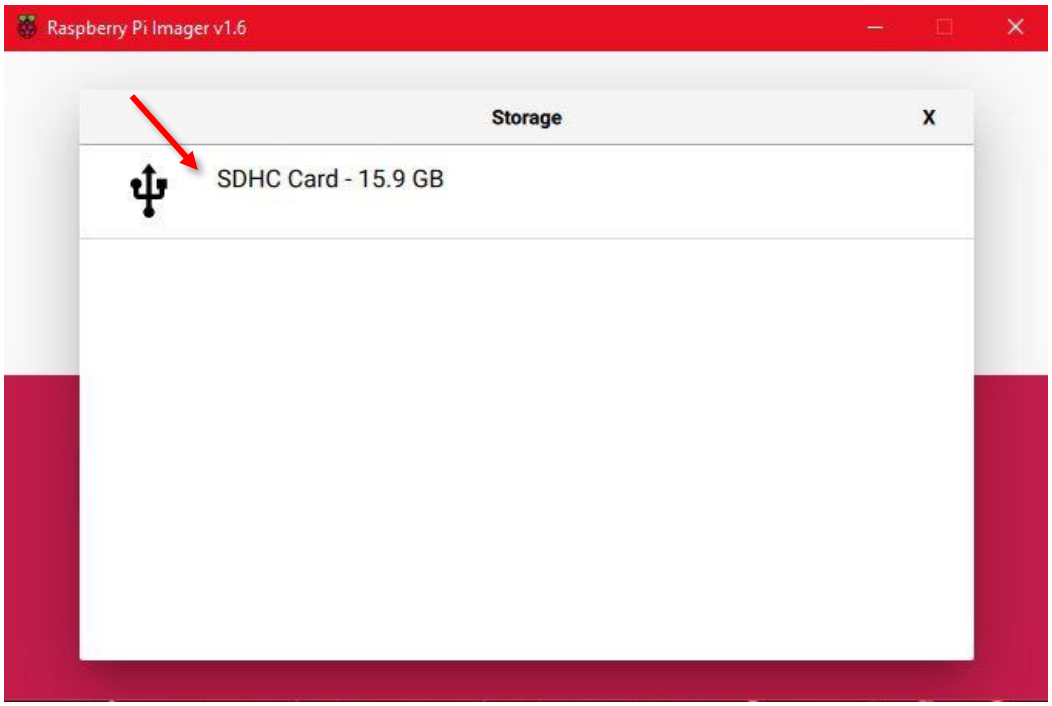


FIGURE 19 CHOOSING THE MICROSD CARD

After selecting the microSD card on your computer, the next step is to click “WRITE”.

FIGURE 20 CLICKING ON "WRITE"

If a pop-up window appears, asking you to overwrite existing data in the microSD card, click “YES”.

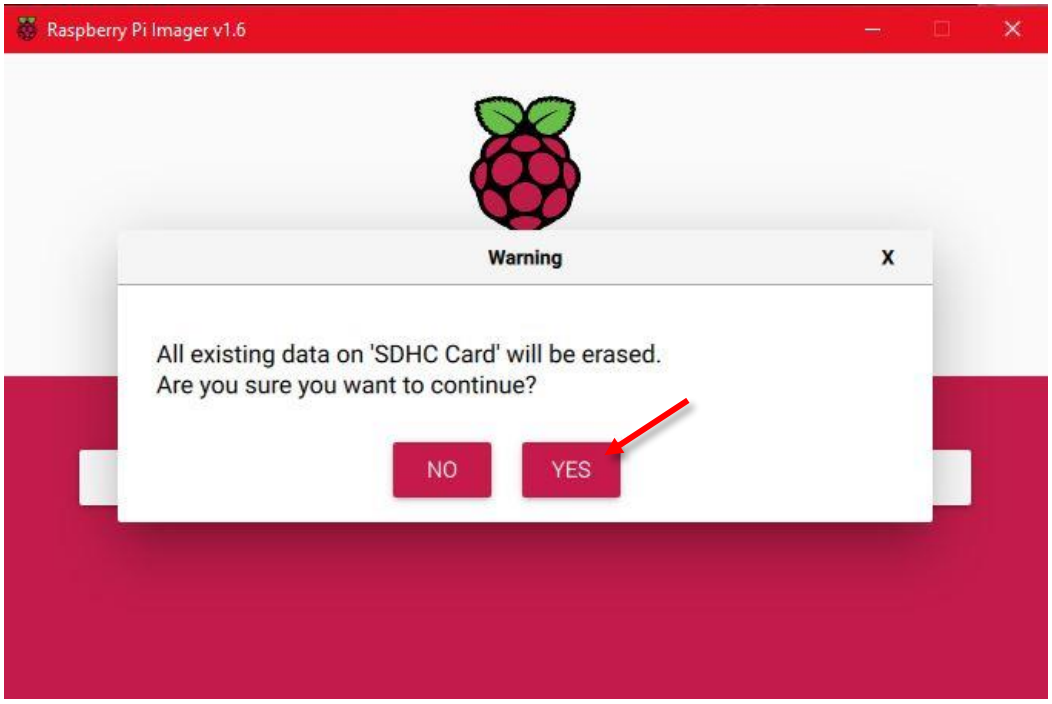


FIGURE 21 CLICK "YES" TO PROCEED WITH INSTALLATION

Wait until the imager finishes with the installation. This procedure may take several minutes. You can check the progress, by looking at the progress bar on the bottom of the imager’s window.

FIGURE 22 WRITING THE NEW OS TO THE MICROSD CARD

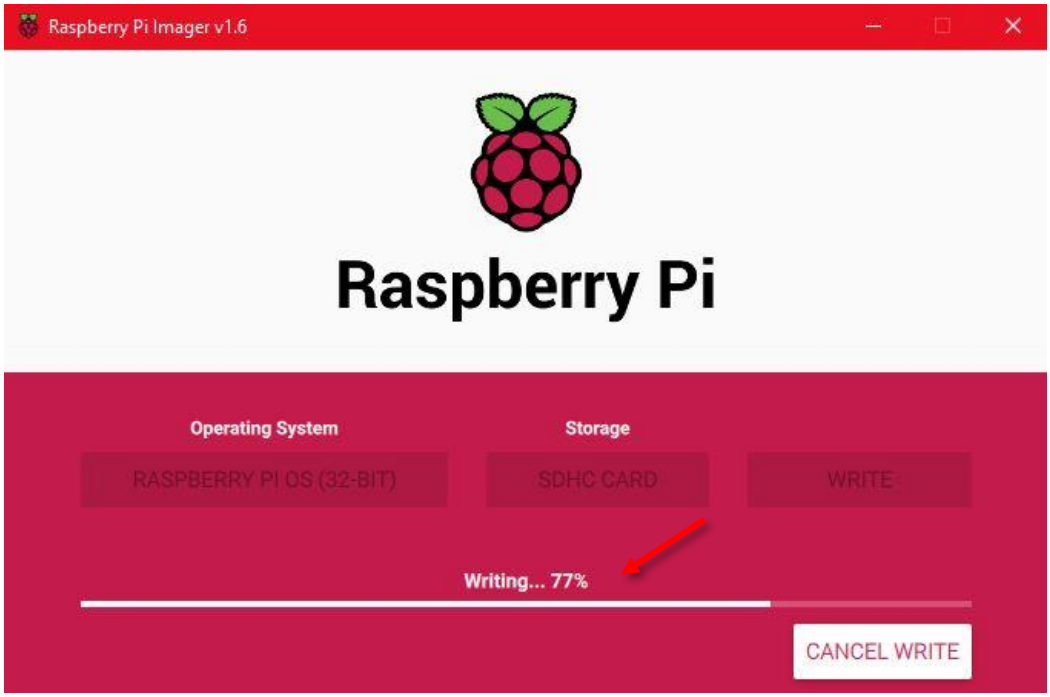


FIGURE 23 FINISHING-UP INSTALLATION

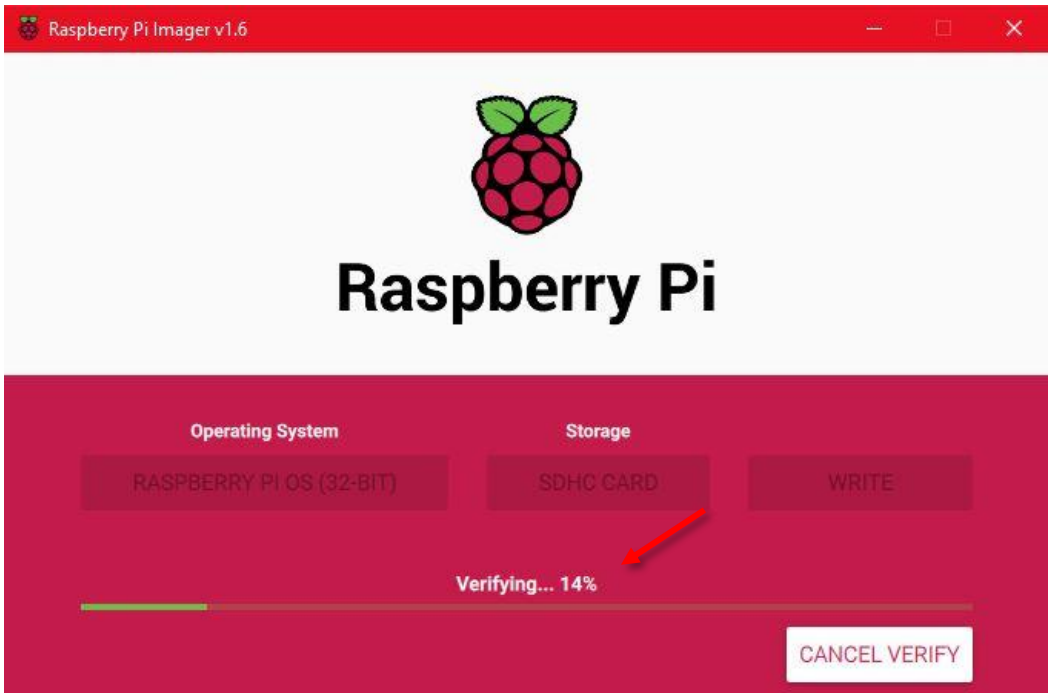


FIGURE 24 VERIFYING INSTALLATION

When the process is finished click on “CONTINUE” and remove the SD card from your card reader.

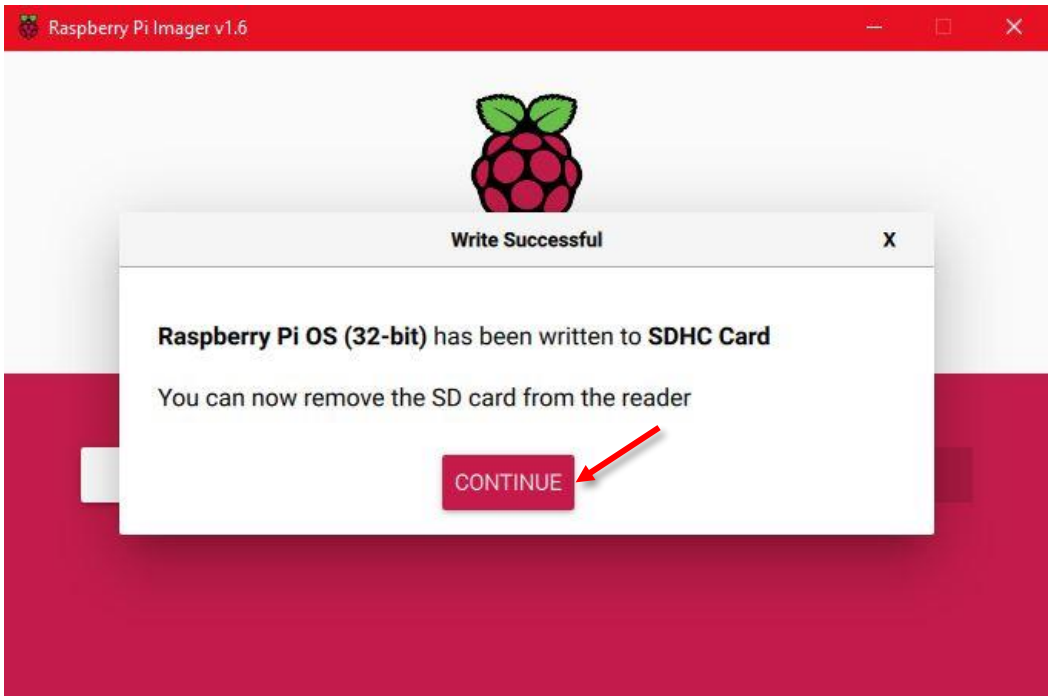


FIGURE 25 INSTALLATION OF RASPBERRY PI OS IS FINISHED

4.2 Inserting micro-SD card to Raspberry Pi

When the flashing operation is completed, remove the microSD card from your computer, insert it to the Raspberry Pi according to the following steps.

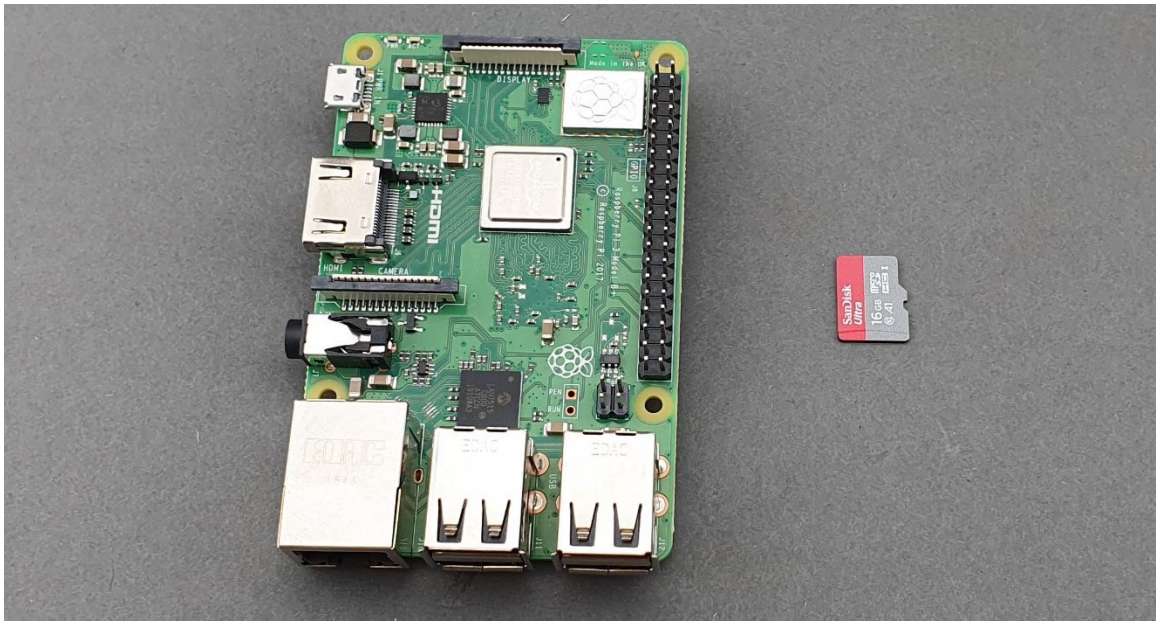


FIGURE 26 MICRO-SD CARD AND RASPBERRY PI

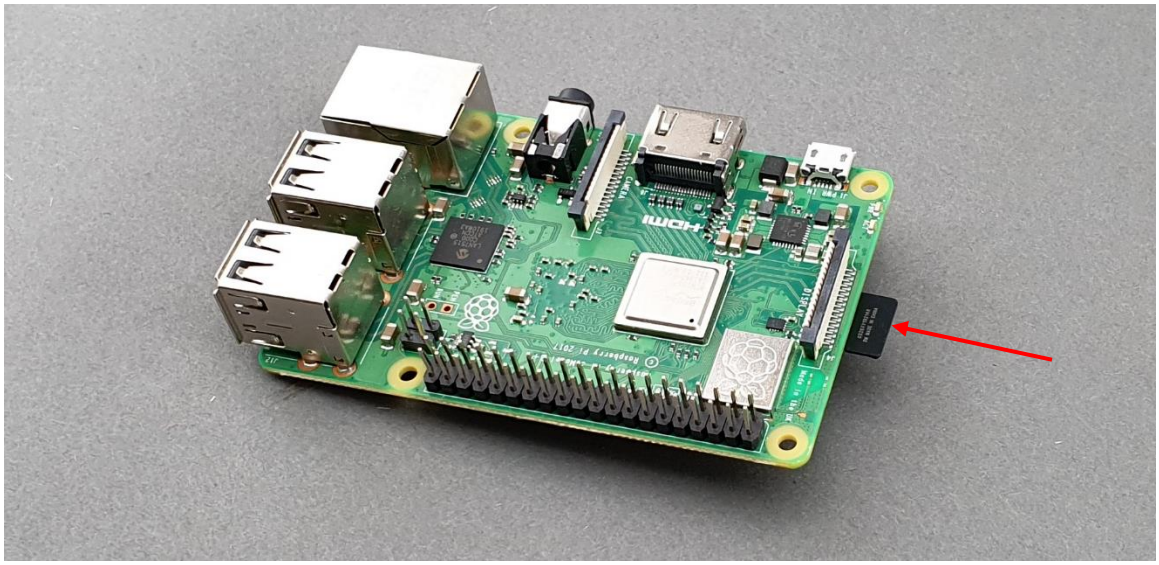


FIGURE 27 INSERT THE MICRO-SD CARD BY SLIDING IT UPSIDE DOWN INTO THE RASPBERRY PI

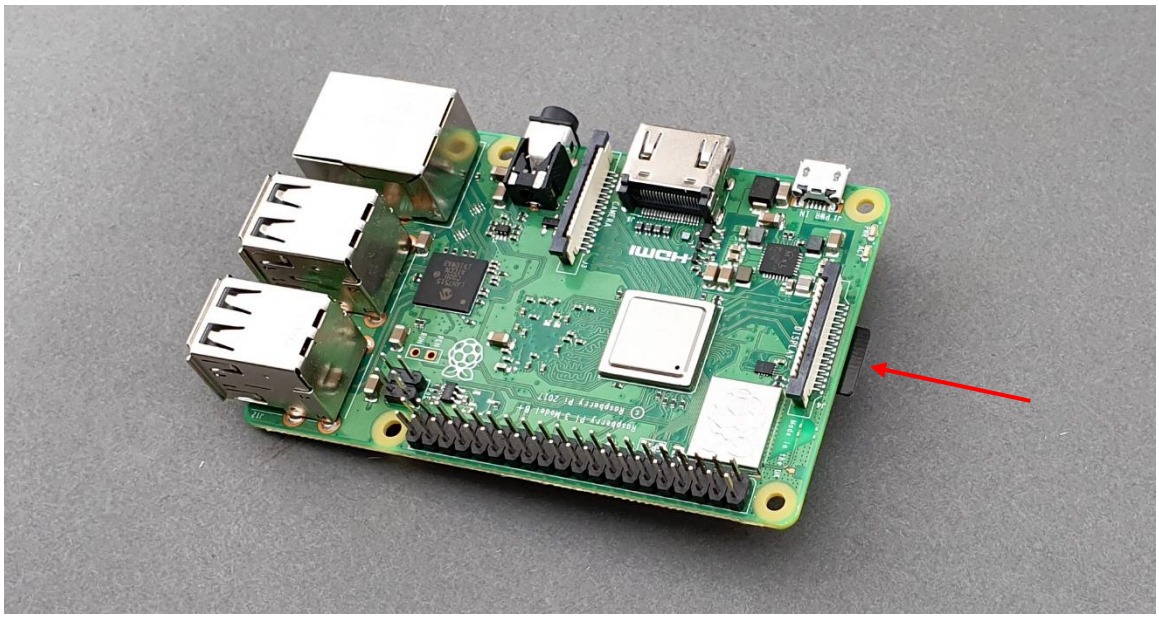


FIGURE 28 MAKE SURE THE MICRO-SD CARD IS SLIDE ALL THE WAY INTO THE RASPBERRY PI

4.3 Initial Configuration

After inserting the micro-SD card into the Raspberry Pi, all you need to do now is to connect it to an external monitor using an HDMI cable, connect a mouse and keyboard and power it on using the power button on the powerbank.

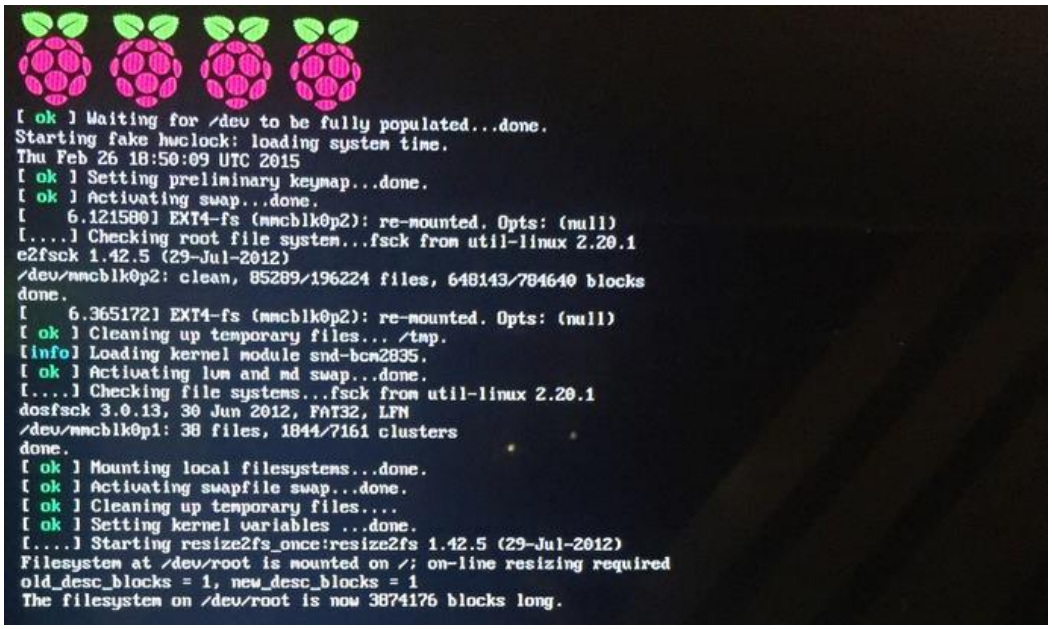


FIGURE 29 RASPBERRY PI BOOTING SCREEN

Next, follow the simple installation steps for the initial configuration of your Raspberry Pi, (Country, Language, time zone etc.).

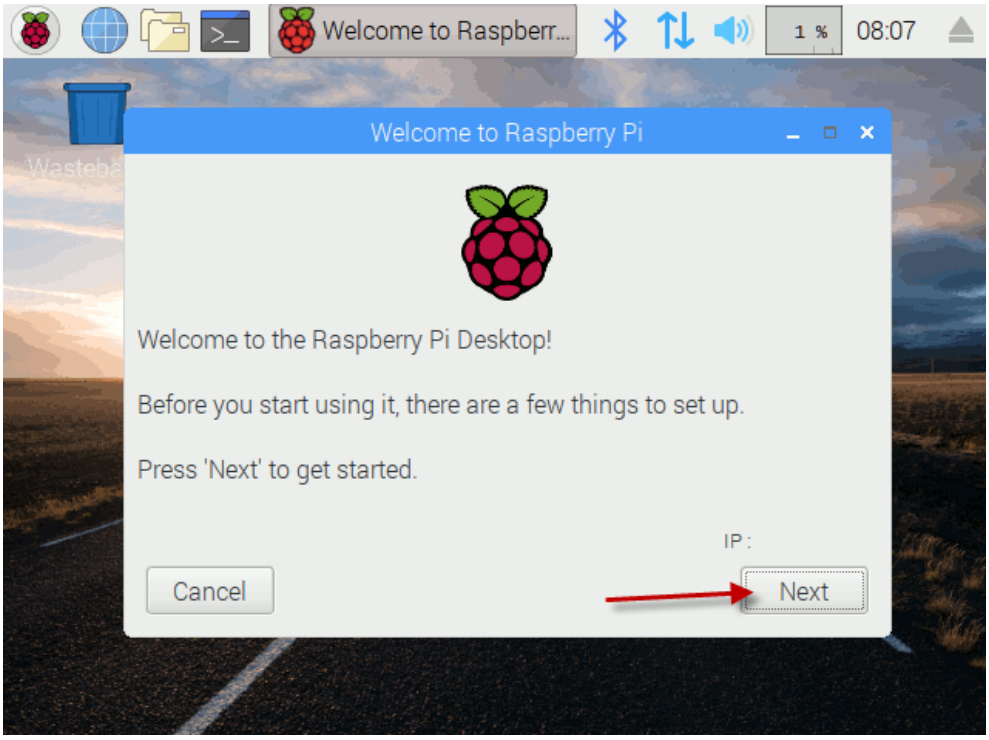


FIGURE 30 RASPBERRY PI CONFIGURATION PROCEDURE

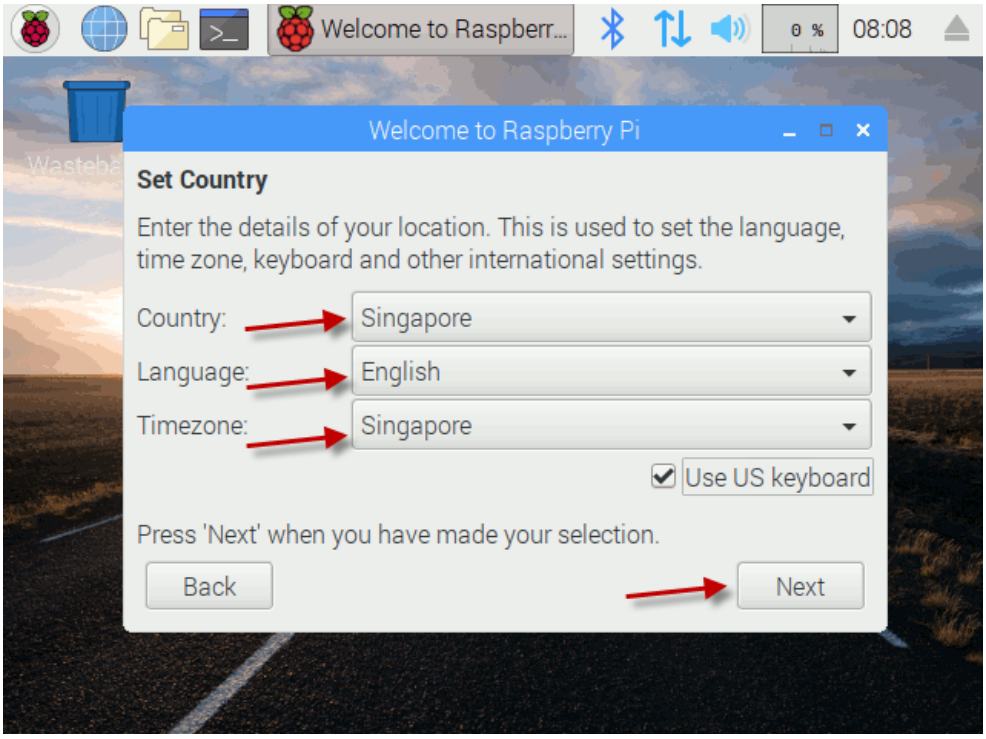


FIGURE 31 SETTING-UP LOCATION DETAILS

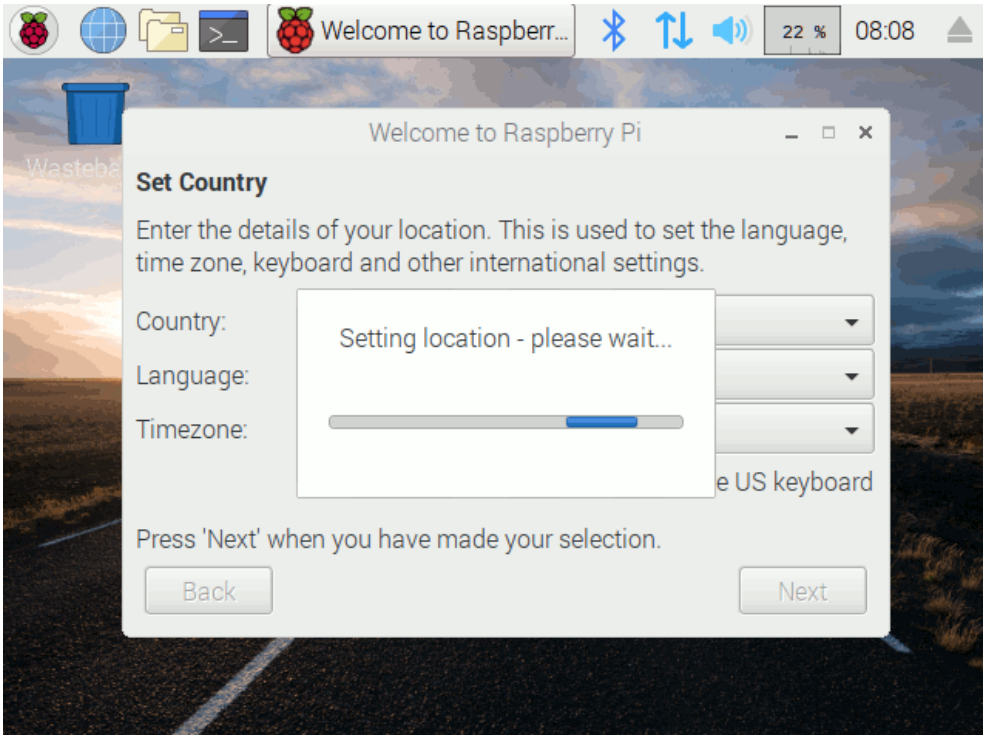


FIGURE 32 SETTING LOCATION

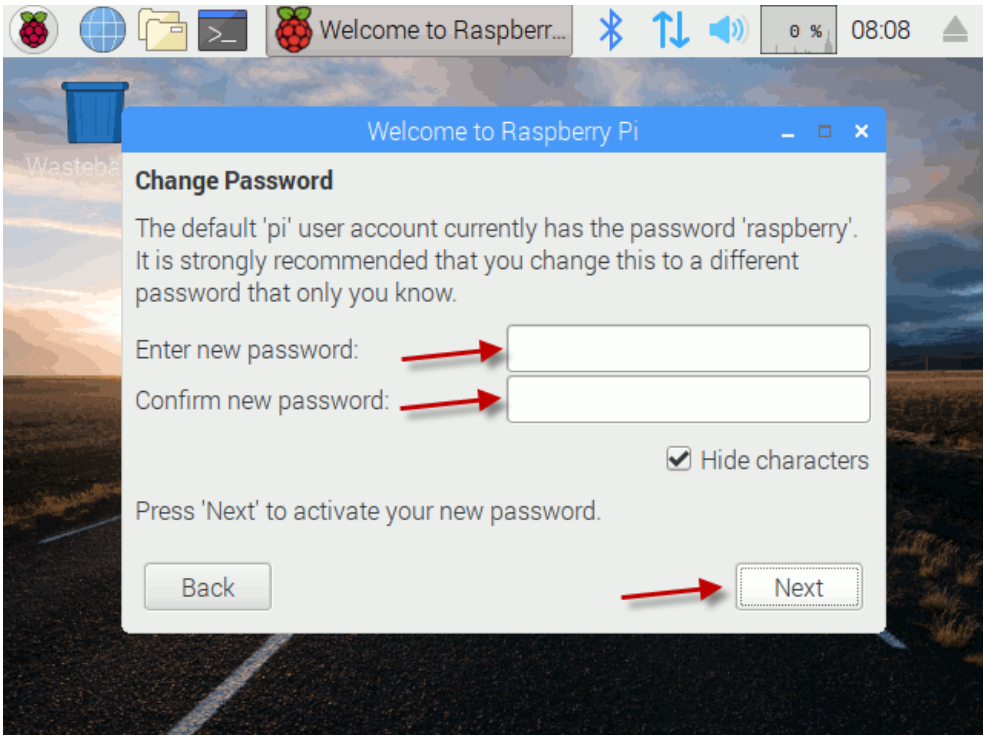


FIGURE 33 CREATING A PASSWORD

Choose your Wi-Fi Network or connect the Raspberry Pi to the Internet via Ethernet cable. The Raspberry Pi needs to be connected to the Internet in order to check for OS updates.

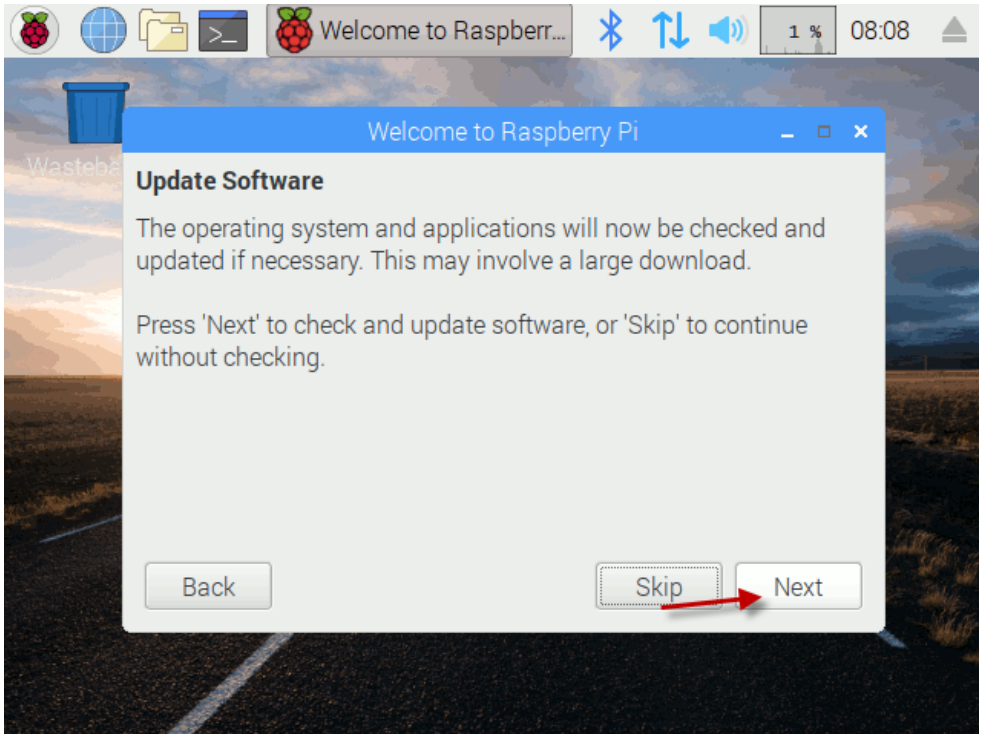


FIGURE 34 CHECKING FOR UPDATES

When all available updates are successfully installed, click on “OK”.

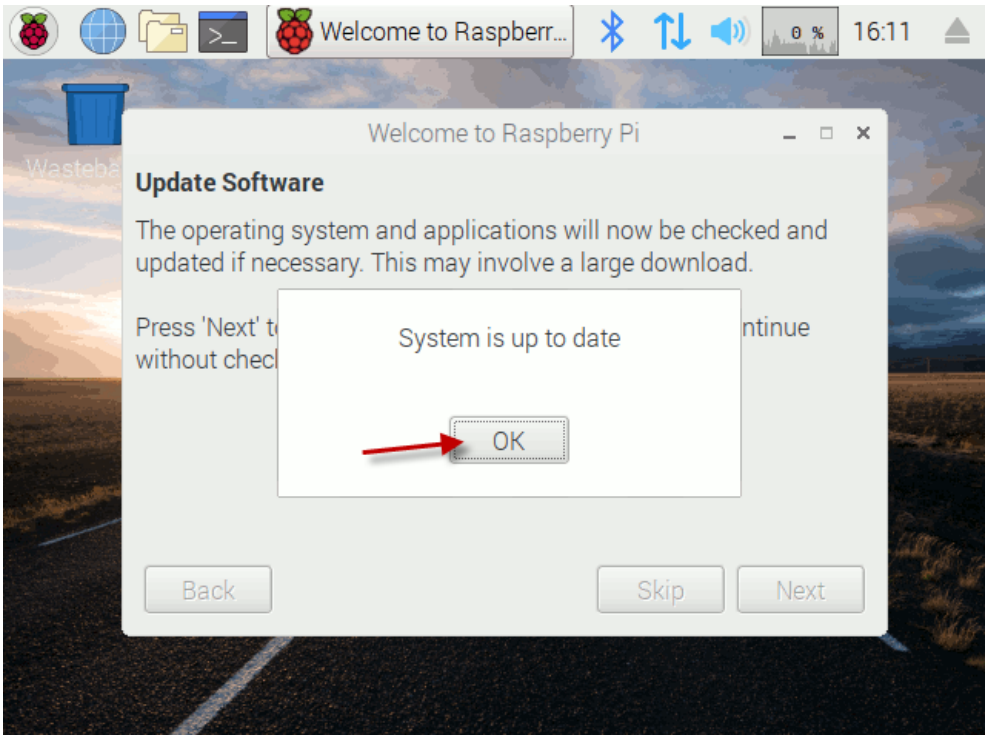


FIGURE 35 OS UPDATES HAVE BEEN SUCCESSFULLY INSTALLED

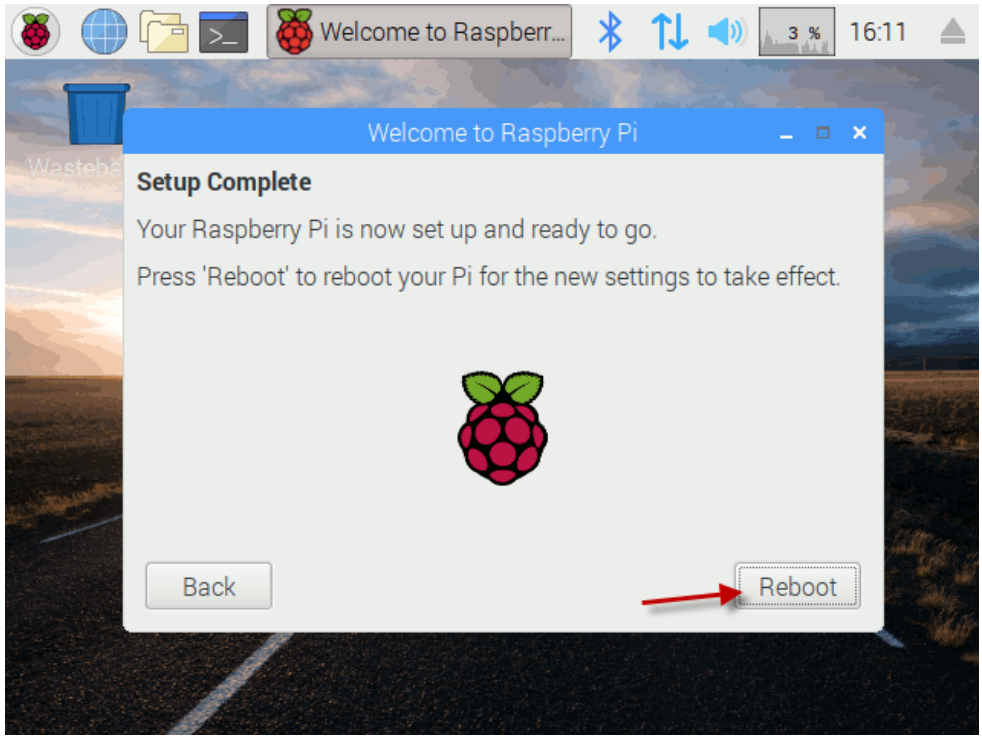


FIGURE 36 FINISHING-UP CONFIGURATION

Click on “Reboot” for updates to take effect. When your Raspberry Pi turns on, the configuration procedure is completed, and you can now start using your PhysicsKIT.

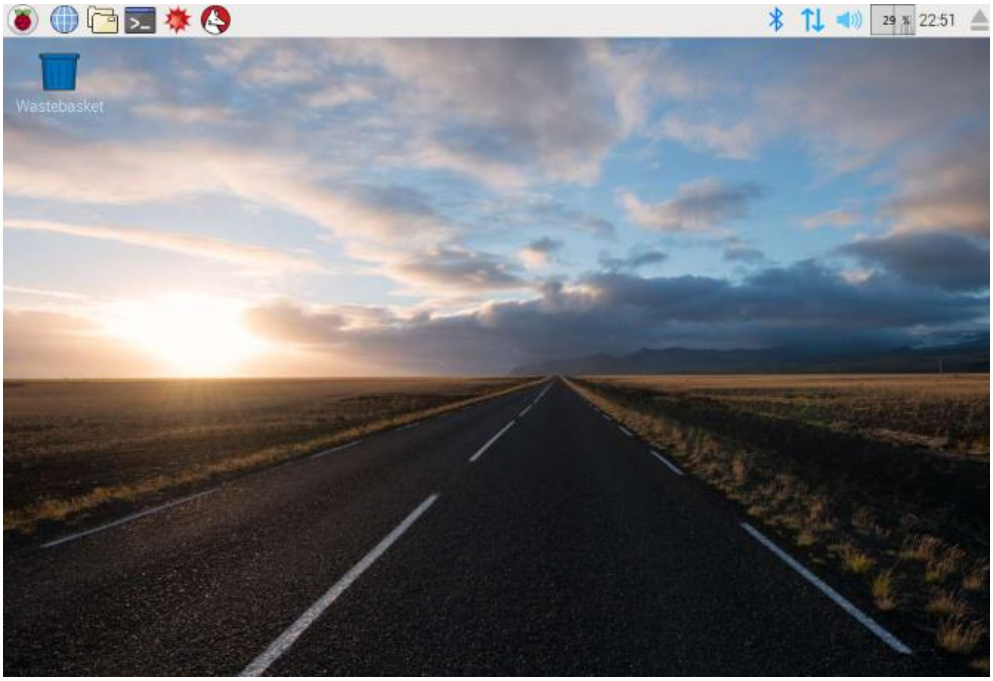


FIGURE 37 RASPBERRY PI OS USER DESKTOP

4.4 Introduction to Thonny Python

You will use Python to create simple programs that control the different electronics and sensors that are provided with the PhysicsKIT.

Python is an interpreter, object-oriented, high-level programming language with dynamic semantics. Its high-level, built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together.

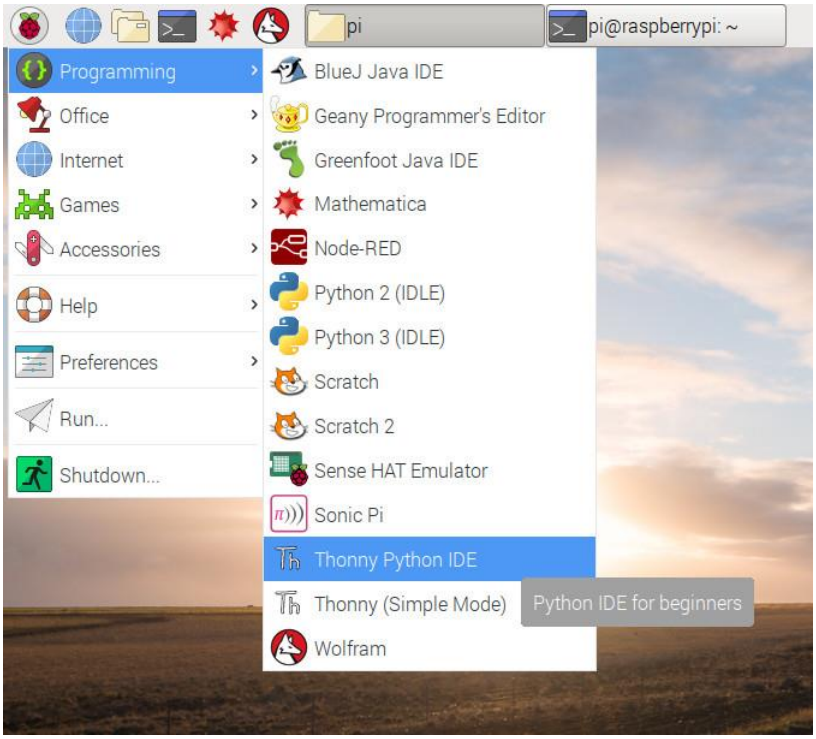


FIGURE 38 LOCATING THONNY PYTHON

Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms and can be freely distributed.

```
# Python 3: Fibonacci series up to n
>>> def fib(n):
>>>     a, b = 0, 1
>>>     while a < n:
>>>         print(a, end=' ')
>>>         a, b = b, a+b
>>>     print()
>>> fib(1000)
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987
```

FIGURE 39 FIBONACCI SERIES IN PYTHON

Python 3.0 is pre-installed on Raspberry Pi OS and automatic updates run through the operating system. In case a manual update is needed, use a terminal window, and run the following command: `sudo apt-get install python3`

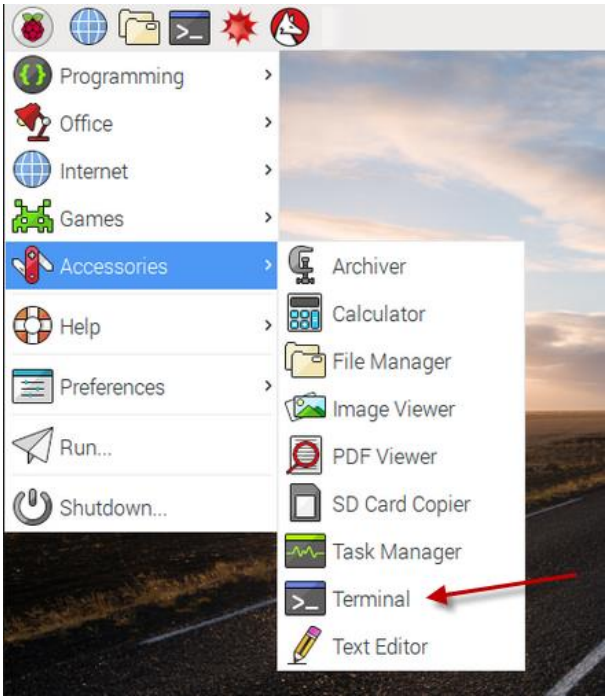


FIGURE 40 LOCATING THE TERMINAL WINDOW

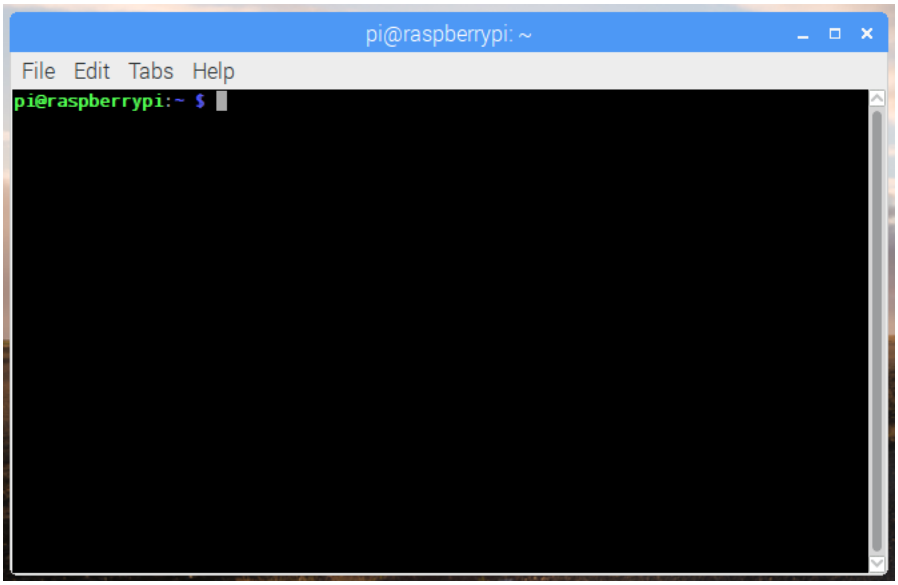


FIGURE 41 TERMINAL WINDOW IN RASPBERRY PI OS

5. Annex

PhysicsKIT – Inventory List		
ID	**Item**	**Quantity**
1	Plywood pieces	23
2	Plywood lid with handle	1
3	Plexiglass lid with handle	1
4	Bolts – roundhead (metal)	9
5	Bolts – flathead (metal)	8
6	Screws – roundhead (metal)	2
7	Screws – flathead (metal)	6
8	Screws – black roundhead (plastic)	4
8	Nuts (square)	17
9	Plastic base legs	4
10	Rubber bands	2
11	Raspberry Pi 3 Model B+	1
12	SD Card 16 GB	1
13	USB to micro-USB cable	1
14	Powerbank	1
15	Mouse	1
16	40P T-Cobbler Plus GPIO Breakout Board	1
17	GPIO 40P Rainbow Ribbon Cable	1
18	White breadboard	2
19	Jumper cables (Male-to-Female)	10
20	Jumper cables (Male-to-Male)	10
21	Jumper cables (Female-to-Female)	10
22	Push button	1
23	Button cap	1
24	Buzzer	1
25	LEDs	4
26	On/Off slide switch	1
27	Resistors pack (220, 470, 1K, 4.7K, 10k)	25

PhysicsKIT – Sensors List		
ID	**Item**	**Quantity**
1	SG90 Micro Servo Motor	1
2	3V-6V Small DC Motor	1
3	HC-SR04 Ultrasonic Sensor	1
4	PIR Motion Detector Sensor HC-SR501	1
5	DHT11 Digital Temperature and Humidity Sensor	1
6	Photoresistor - Light Detection	1
7	SW-420 Vibration - Motion Sensor	1
8	Flame Sensor	1
9	High Sensitivity Sound Detection Sensor	1

10	Linear Magnetic Hall Sensor	1
11	TMP36 Temperature Sensor	1
12	4pin Magnetic Reed Switch Module	1
13	Soil Hygrometer / Moisture Detection Sensor	1
14	MQ-135 Air Quality Sensor - Hazardous Gas Detection	1
15	KY-005 38KHz Infrared IR Transmitter Sensor	1
16	Infrared IR Receiver Sensor Module KY-022	1
17	Rotary Encoder Module Brick Sensor KY-040	1
18	L293D Control IC Chip	1