The DIY automobile project

Guidelines for assembling the DIY automobile

Content

Chassis

Chassis is an important part of the automobile since it has to bear the load of the entire structure. Therefore, it needs to be made from a rather firm and robust material, such as a dense cardboard sheet of at least 2.5-3mm thickness, an MDF wood plate of at least 2mm thickness, or even a plastic bowl for preserving food. However, since this project is highly interrelated with engineering, it is strongly recommended to encourage your students on experimenting with more than one material.

The present guidelines are based on a specific pattern that was designed after several tests with various materials. The following diagram (Figure 1) indicates the location where each component should be placed. Bear in mind though that when working with students, different designs may lead to different arrangements). Experimentation should be encouraged and you should be in position to support your students' ideas and scaffold their learning process.

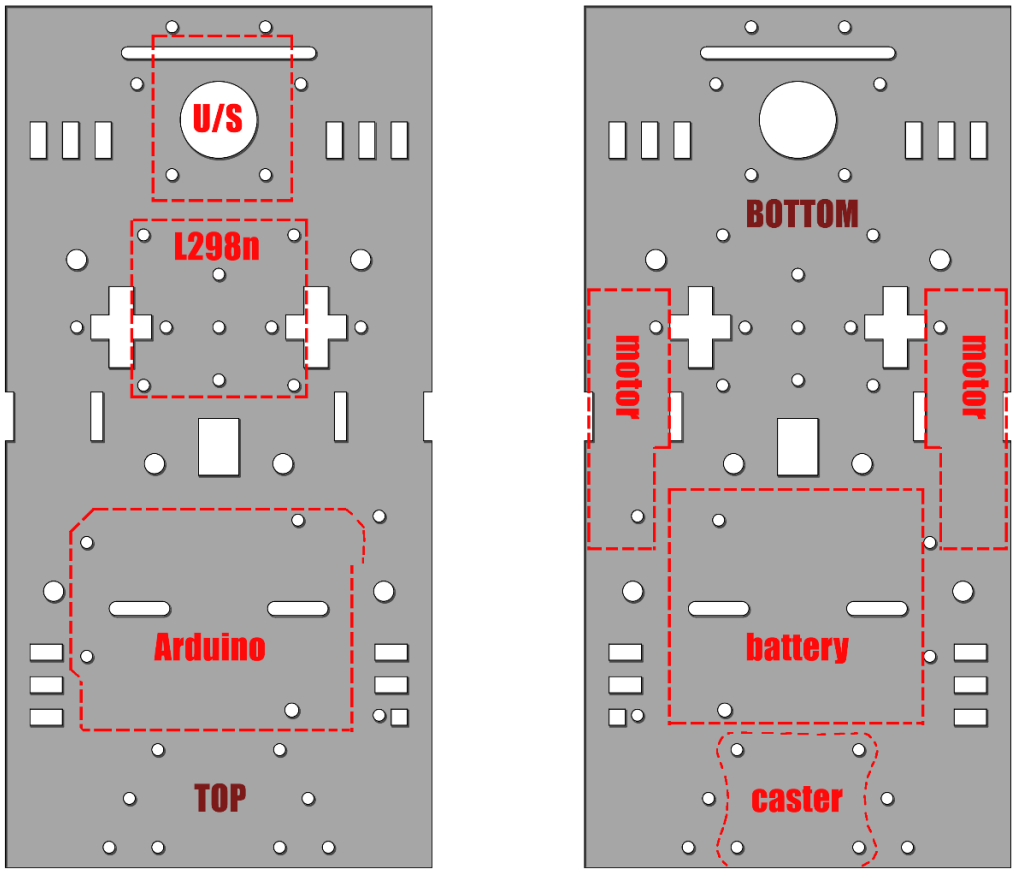


Figure 1 Indicating the location for each component. Left: the top side of the chassis; Right: the bottom side of the chassis

Assembling DC gear motors and wheels on the chassis

The following images suggest a method for placing the DC gear motors on the chassis. For each gear motor you will also need two fasteners, two M3 screws of 3cm (or 30mm) length and two M3 nuts (Figure 2).

The fasteners presented in the image are made from thick (2mm) grey cardboard. However, you are highly advised to encourage your students to experiment with different materials in order to explore what works better. This gives an excellent opportunity to raise issues regarding engineering and materiality in the class.

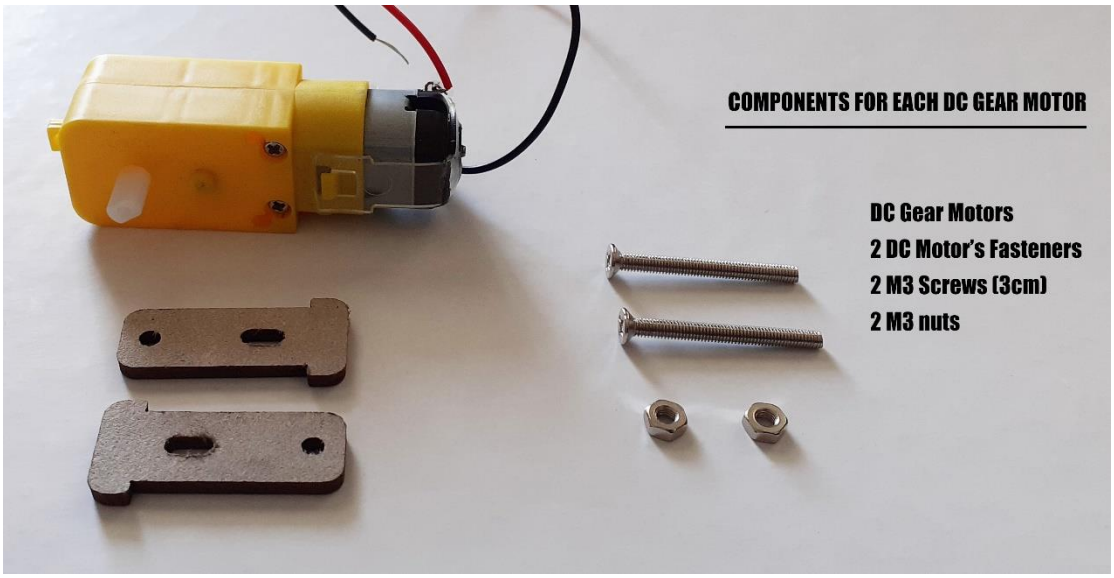


Figure 2: Components you will need for each gear motor

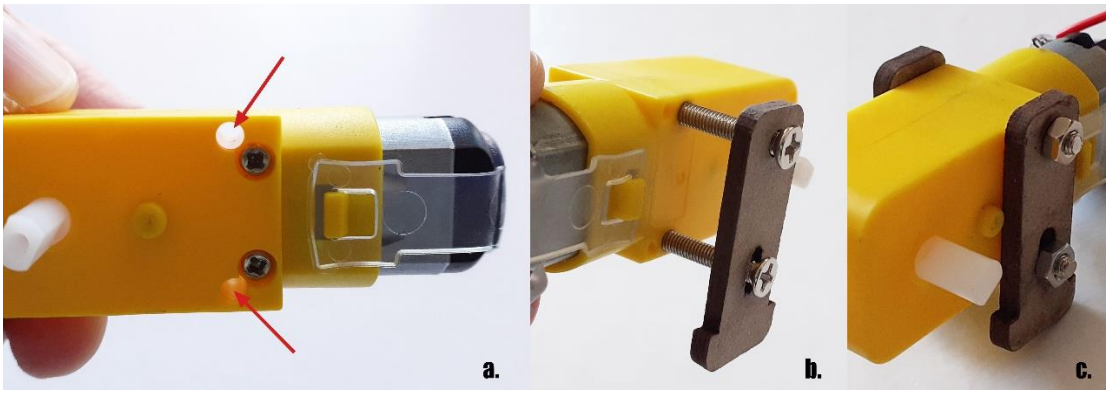


Figure 3: This image depicts the concept of how to assemble the gear on the chassis by using the fasteners. Each gear has two see-through holes (a.). You need to tie up both fasteners by using the two screws (b.) and the two nuts (c.).

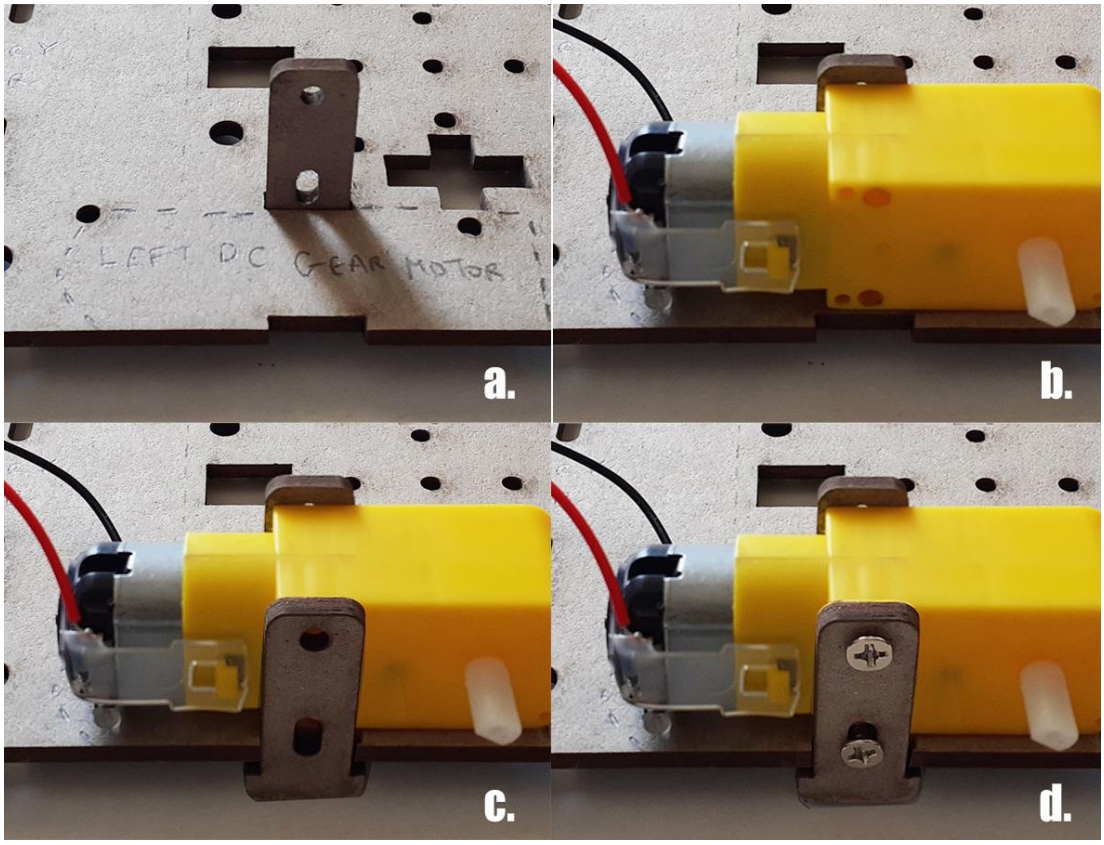


Figure 4: Assembling the DC gear motor by using fasteners, screws and nuts.

Figures 3,4 and 5 illustrate the way you can firmly bind the DC gear motors to the chassis by using the fasteners. Alternativelly, you can experiment by using hot glue (silicon glue gun) and/or tie wraps. Regarding the use of silicon glue guns from younger students (less than 15 years old) please follow your school safety rules.

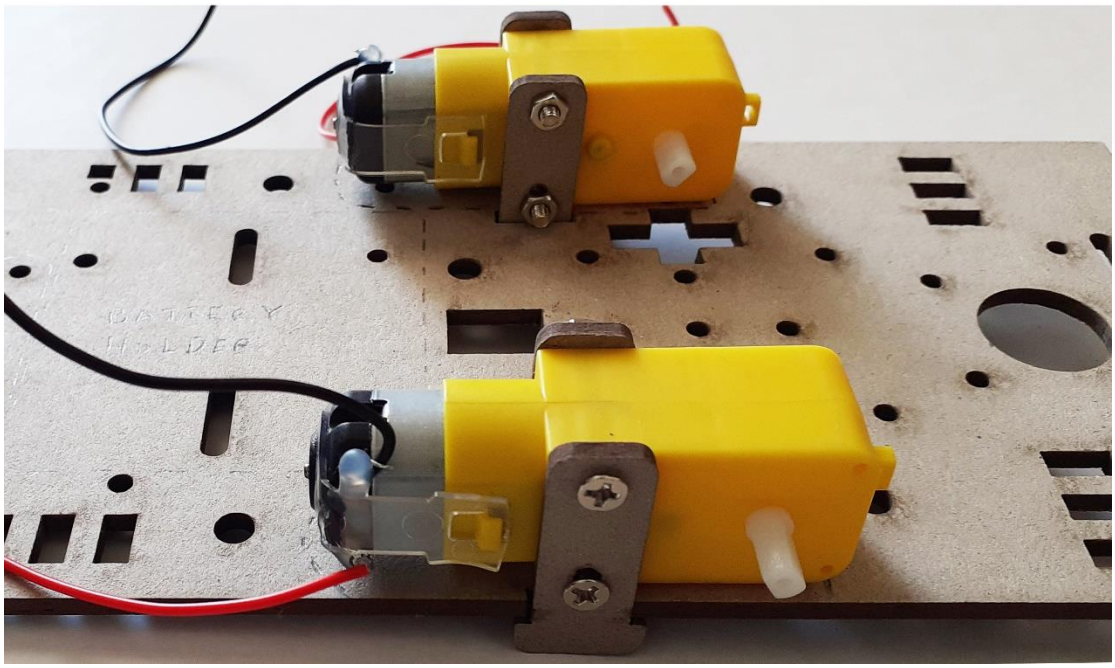


Figure 5: Placing the second DC gear motor.

After placing the DC gear motors, you can attach the wheels to the external axis of the DC gear motor (Figure 6).

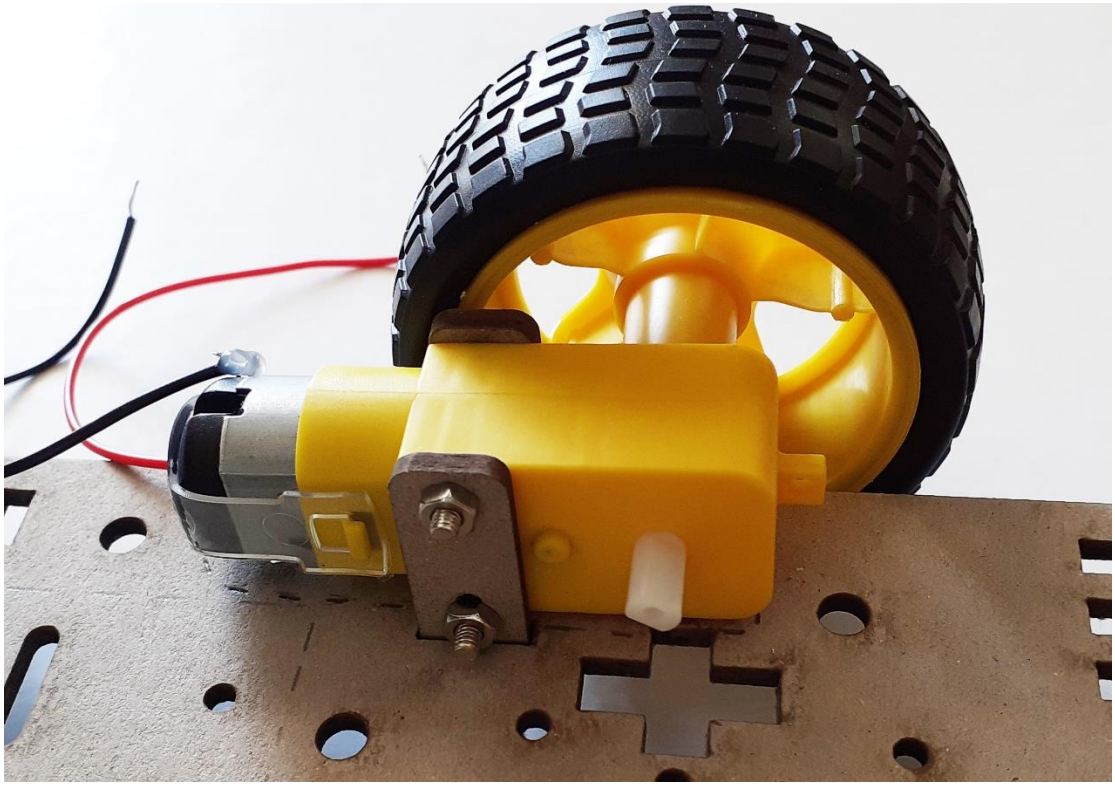


Figure 6 Attaching the wheel on the axes of DC gear motor.

Note: When you place the wheels, check whether or not you need to inverse the direction of the screws, since the nuts might slightly block and therefore prevent wheels from spinning smoothly, if they are **not** placed at the interior axis of the DC Gear Motors (Figure 7).

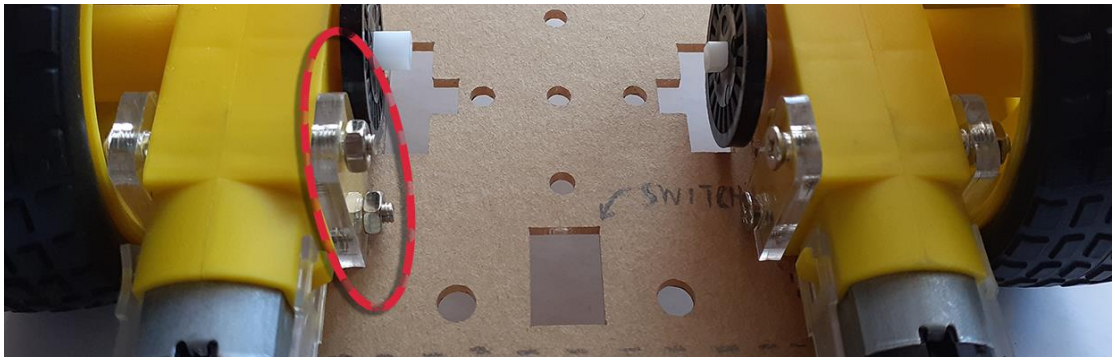


Figure 7: The red circle indicates the correct direction that screws should be placed/mounted.

Assembling and placing the caster

The following image illustrates the needed components for assembling and attaching the caster to the chassis. In details, you will need 4 M3 spacers of 10mm length and 8 M3 screws of 5-6mm length (Figure 8). Spacers are used in order to balance the height difference between the caster and the two wheels. Alternatively, you can experiment with other materials, such as wooden cubes for crafting, packed pieces of cardboard or anything else that can balance this height difference.

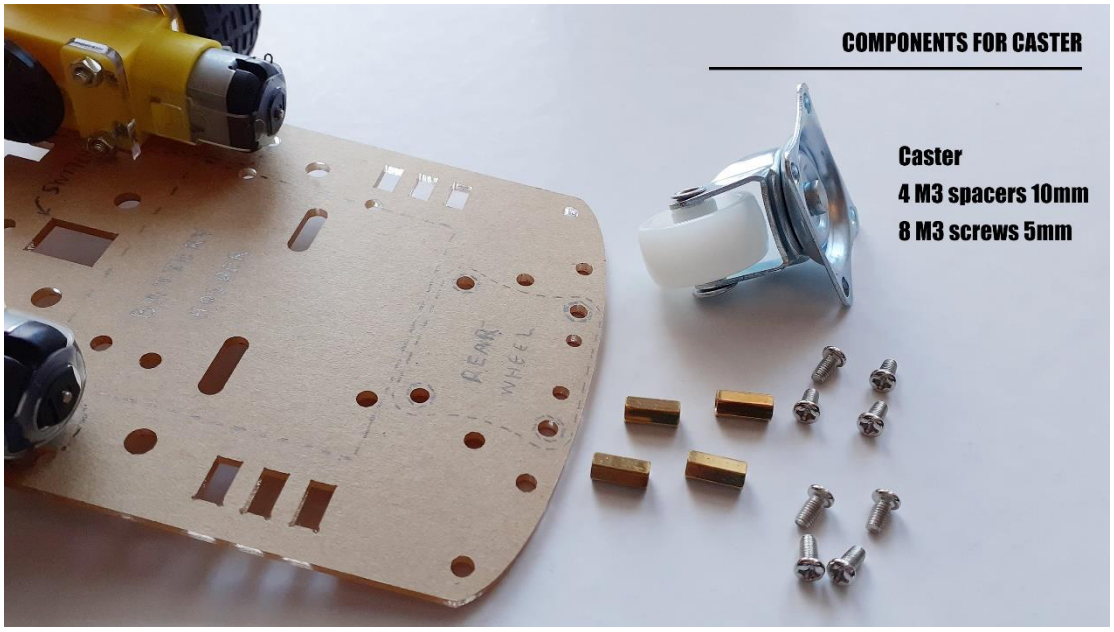


Figure 8: The component you need in order to assemble and attach the caster to the chassis.

First, in order to facilitate the process, you are advised to attach the spacers on the caster. To do that use four of the screws and follow the proposed steps that are illustrated in Figure 9.

Figure 9: Assembling the caster. Left: attaching a spacer on the caster; Middle: Binding the spacer with a screw; Right: Binding all the spacers on the caster

Next, you need to bind the caster on the chassis. To do that, place the caster on the chassis' bottom side, flip the entire structure, and use the four remaining screws to bind it (Figure 10).

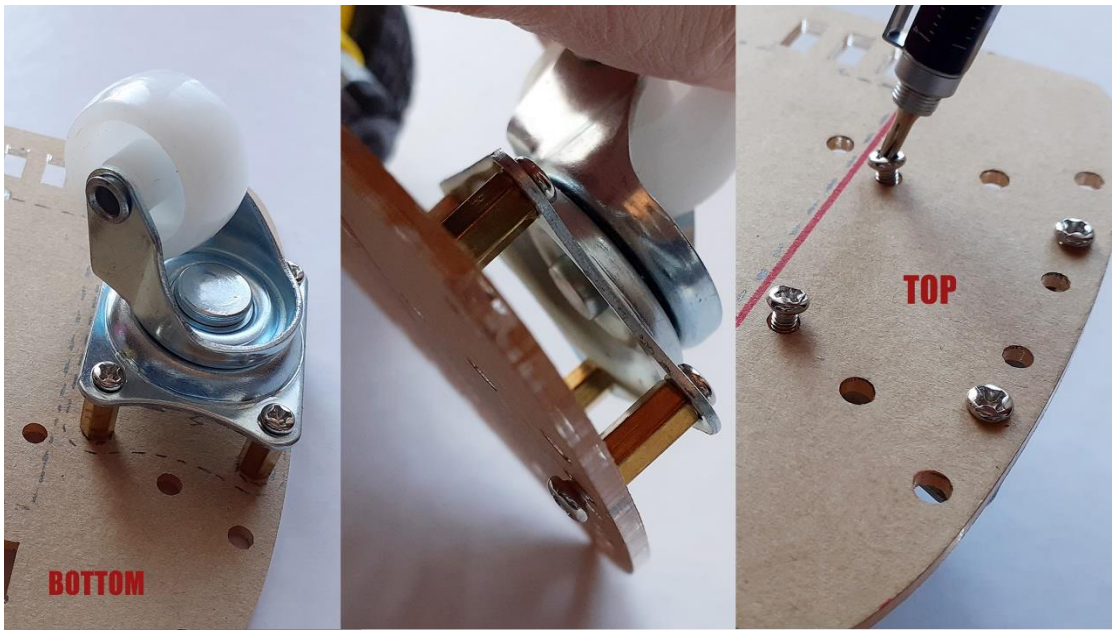


Figure 10: Left: Placing the caster on chassis' bottom side, Middle: Flipping the structure, Left: Binding the caster by using the four remaining screws

Think of alternative solutions. What if you had only some nuts and 4 long screws (i.e. 20mm). How could you firmly attach the caster on the chassis? Will some measurements and some marks on the screws be useful? How could you attach a caster with a ball, which has significant differences, as far as dimensions and geometry are concerned? (Figure 11)

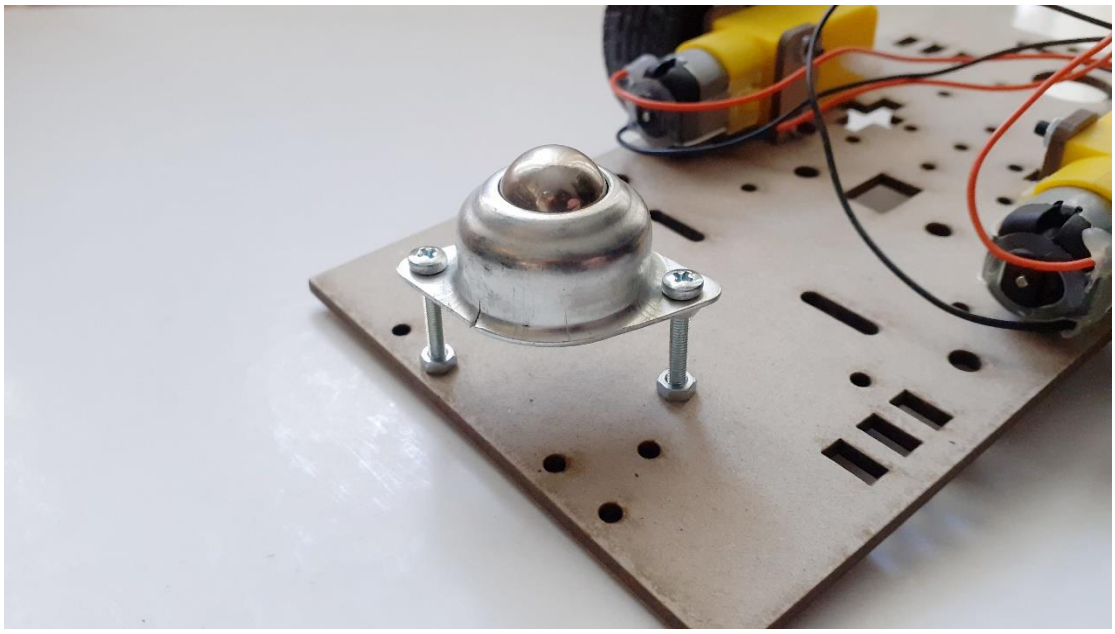


Figure 11: Placing a ball caster by using two screws and 6 nuts

Placing the power supply

There are alternative solutions as far as power supply is concerned. You can apply more or less ecological solutions, like solar banks, power banks, or even batteries. Two different solutions are presented in the following sections: a. the solar panel solution and b. the 4AA battery holder solution with a switch to control power supply.

Placing a solar panel

Solar panel is an ecological and rather easy solution as far as connectivity is concerned, since you just need to use a C type USB cable to directly connect it to Arduino. However, you need to find a way to place it on the chassis in a stable way and keeping in mind that the solar panel should be visible to the light (Figure 12).

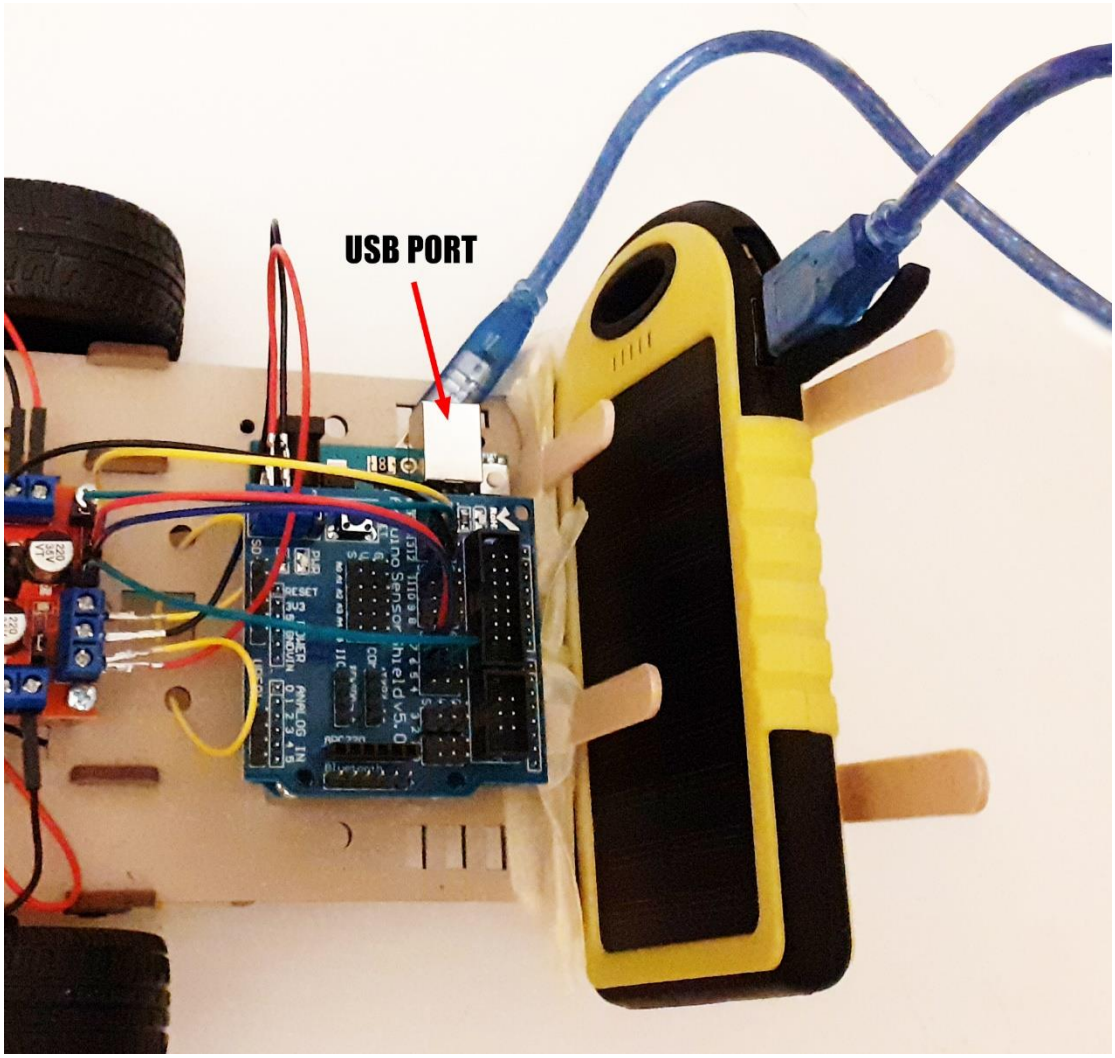


Figure 12 Placing the solar panel to the automobile by using popsicles.

Placing an 4AA battery holder and a switch

Batteries might not be an ecological solution, but there are less restrictions on how and where you can place them, while they offer a better solution as far as control of power supply is concerned. The following figures present a solution where the battery holder is placed at chassis' bottom side.To attach the battery holder on the chassis you will need two M3 screws of 5mm length and two M3 nuts (Figure 13). Alternatively, you can use hot glue, or tie wraps.

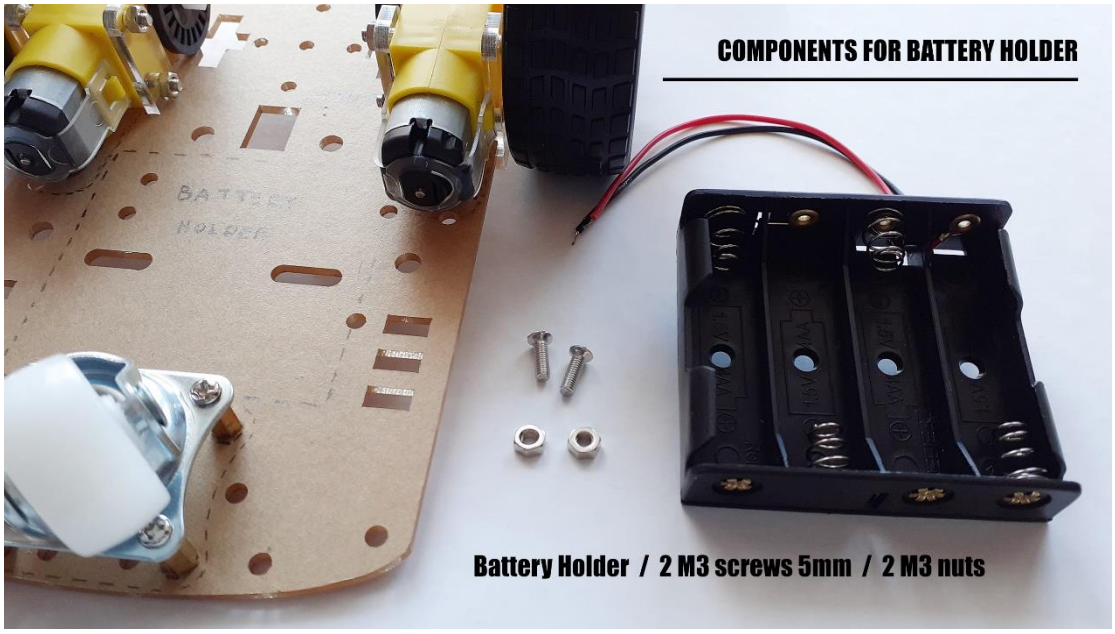


Figure 13: The needed components for attaching on the chassis the battery holder.

First, place the battery holder on chassis' bottom side, with the cables facing the dc gear motors (Figure 14). For your convenience, you are advised to pass the two cables through one of the existing circular holes. Then use the two screws to bind it on the chassis. Alternatively, you can either use hot glue or tie wraps.

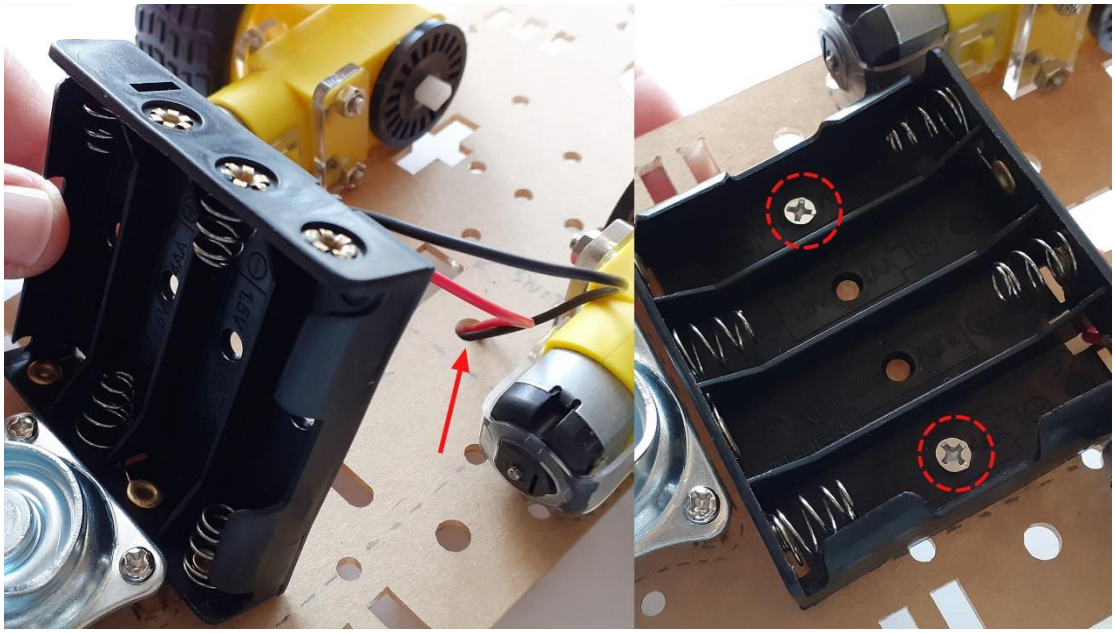


Figure 14: Placing the battery holder; Left: passing the cables through an existing hole; Right: binding the holder

Placing the switch

In the present example the switch can be easily embedded to the entire construction by placing it to the corresponding hole (Figure 15). Alternatively, you add it later on, during the wiring process.

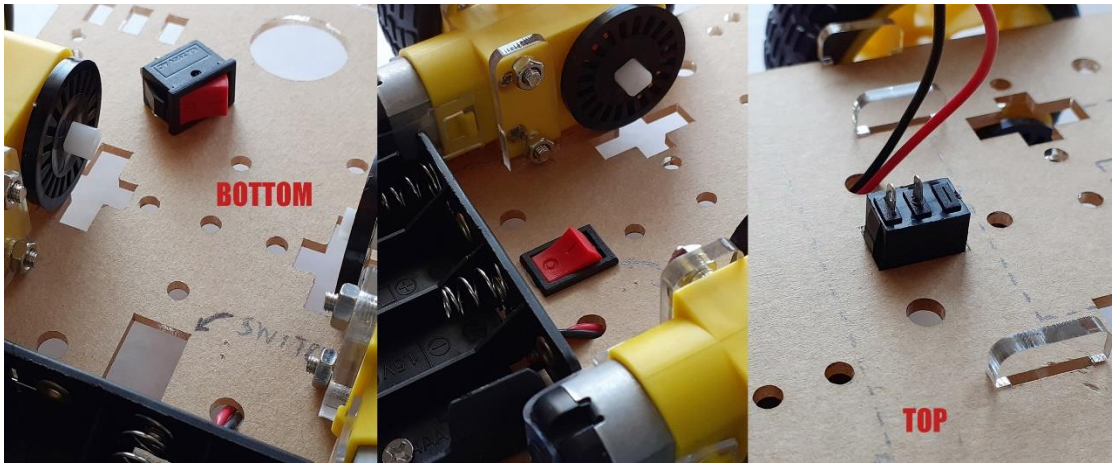


Figure 15: Embedding the switch to the chassis. Left: Indicating the place where the switch can be embedded; Middle: The switch is embedded to the chassis; Right: Chassis' top side after the switch has been embedded.

Note: The rest components (meaning Arduino, Shield, Motor driver as well as Ultrasonic sensor) will be added on chassis' top side. This is a highly recommended method since it will facilitate the circuit making process.

Placing Arduino board

The following images depict a suggested way on how to bind your Arduino board on the chassis, in the location that is indicated in the diagram in Figure 1. Apart from the Arduino board, you will need seven to eight M3 screws of 6mm length and four M3 spacers of 10mm length. Place the four spacers on chassis' top side, and bind them by using four of the screws (Figure 16b.). In case you are working on the solution with the battery holder, you will need four countersunk screws of 5mm length, while you need to keep in mind to place two of them before placing the battery holder, since the corresponding holes are overlapped with battery's holder place (Figure 16a.). Then bind the Arduino board on the spacers by using at least 3 more screws (Figure 16c.). For your convenience, remove the plastic cover of Arduino board.

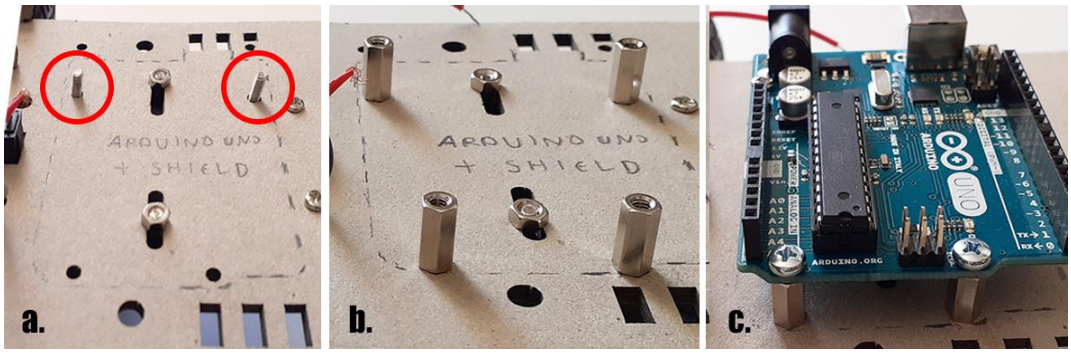


Figure 16: Placing Arduino board: a. Placing the countersunk M3 screws for binding; b. mounting the spacers; c. mounting Arduino board by using 3 M3 screws

Placing Arduino Sensor Shield V5.0

The Shield is an expansion that facilitates the circuit making process since it provides an easier way to connect sensors and servos. Specifically, it expands the digital and analog input pins of Arduino board with Power (V) and Ground (GND), and it also provides separate PWM pins. Moreover, it makes easier the connection of wireless and Bluetooth modules (Figure 17).

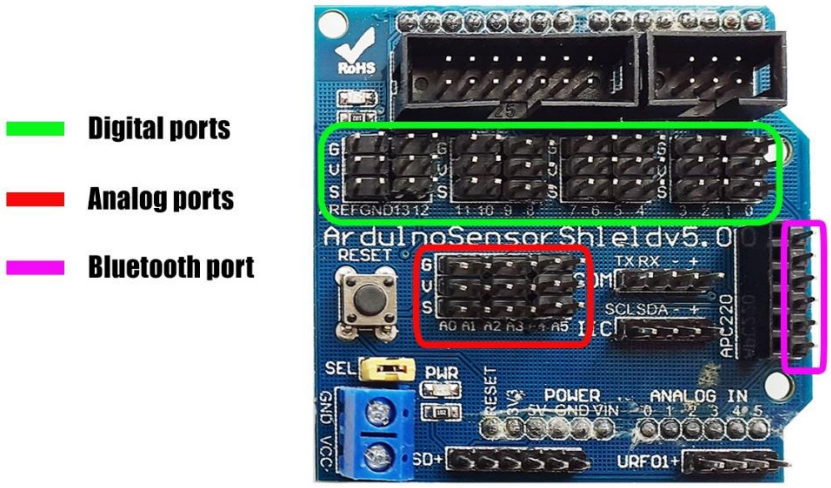


Figure 17: Diagram of the port

Connecting the Shield to the Arduino board is a straightforward process. The pins of the Shield should be properly attached to Arduino's board pins. Therefore, make sure that the Power and Analog in ports of Arduino are connecting to Shield's corresponding pins (Figure 18 and 19).

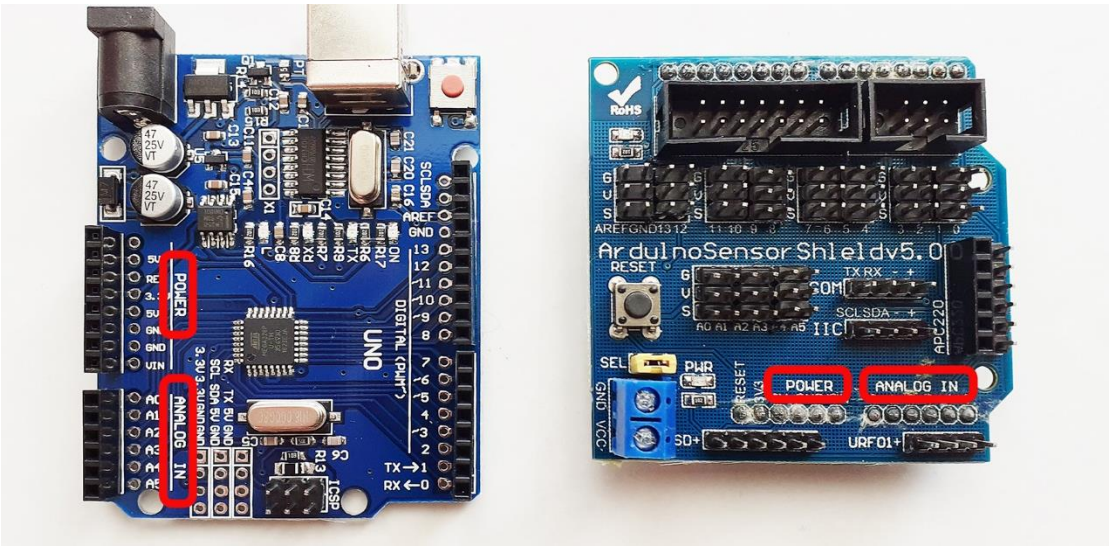


Figure 18: Highlighting the Power and Analog in ports in Arduino board and sensor Shield.

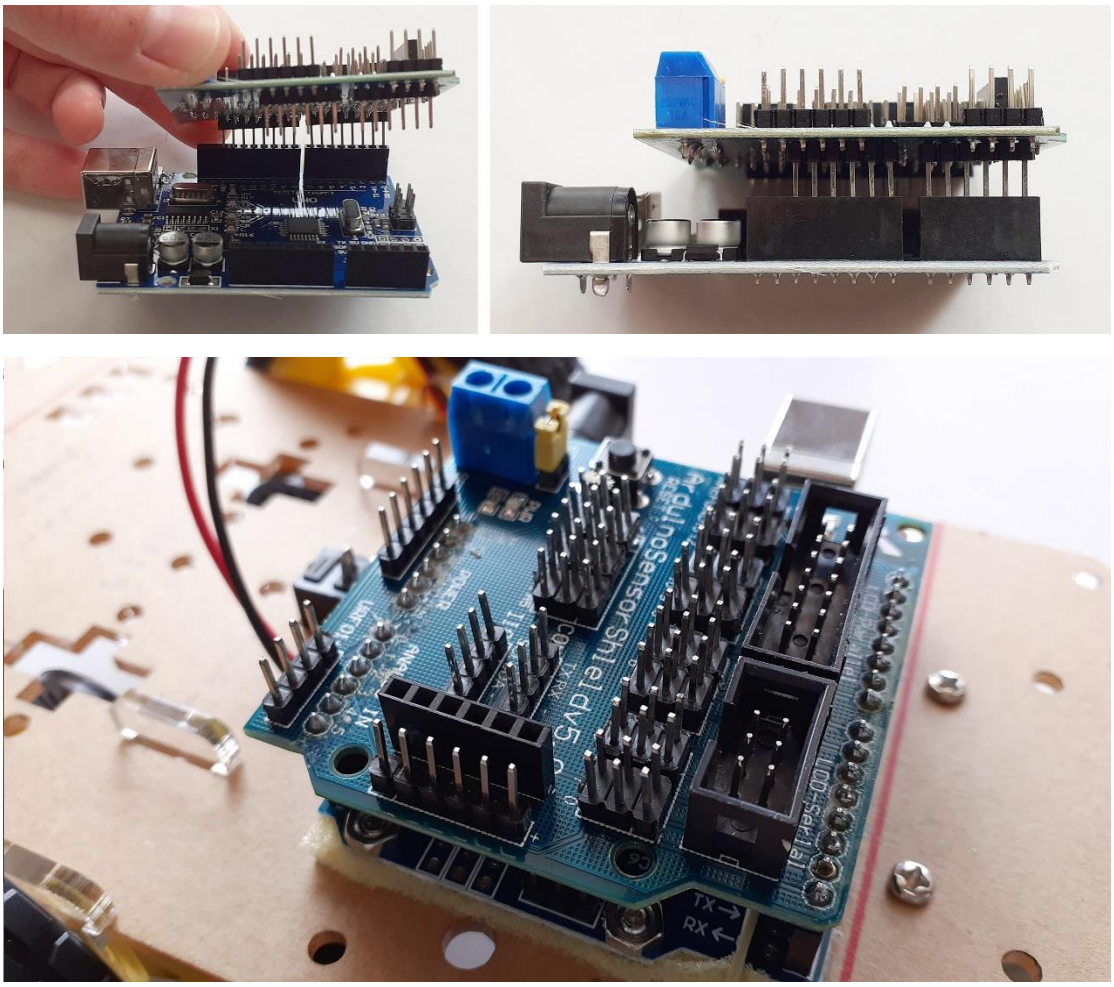


Figure 19: Connecting the sensor Shield to Arduino board.

Placing the driver for motors (L298n)

The driver for motors (L298n) is the last basic electronic component that you need to attach to your chassis (Figure 20).

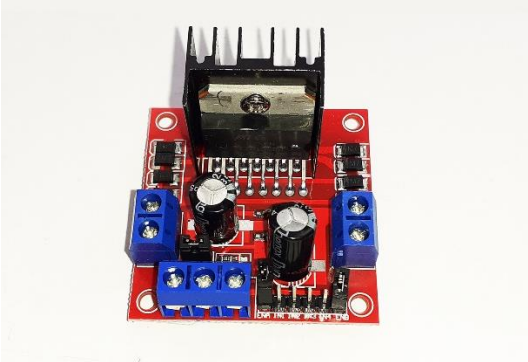


Figure 20: The L298n driver for motors

Likewise, there are many different ways for binding the driver. The suggested method is by using four M3 spacers of 10mm length and 8 M3 screws of 6mm length (Figure 21). However, you can try to experiment with different methods such as hot glue, tie wraps etc.

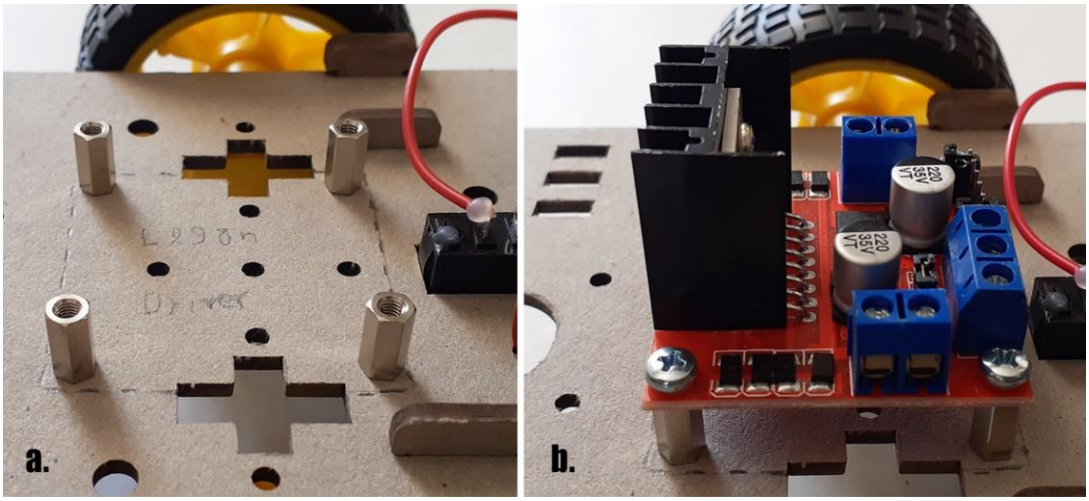


Figure 21: Placing the L298n: a. Binding the spacers on the chassis; b. Binding the L298n on the spacers

Placing Ultrasonic sensor

For the needs of level 2 (*see Guidelines for circuit making and programming file*), an Ultrasonic sensor should be included to the DIY model. There are many different ways for binding the Ultrasonic sensor to automobile's chassis, therefore feel free to experiment with different materials and crafting solutions.

Here are some indicative ideas:

a. Use some tie wraps to firmly attach the ultrasonic sensor on the chassis' front side.

b. Try to place ultrasonic sensor a little bit higher by using some spare screws, nuts and washers so as to create a bracket. Place a wooden popsicle between the washers and bind the ultrasonic sensor by using a tie wrap of hot glue (Figure 22).

c. Try to create a firm basis by using wooden popsicles and glue

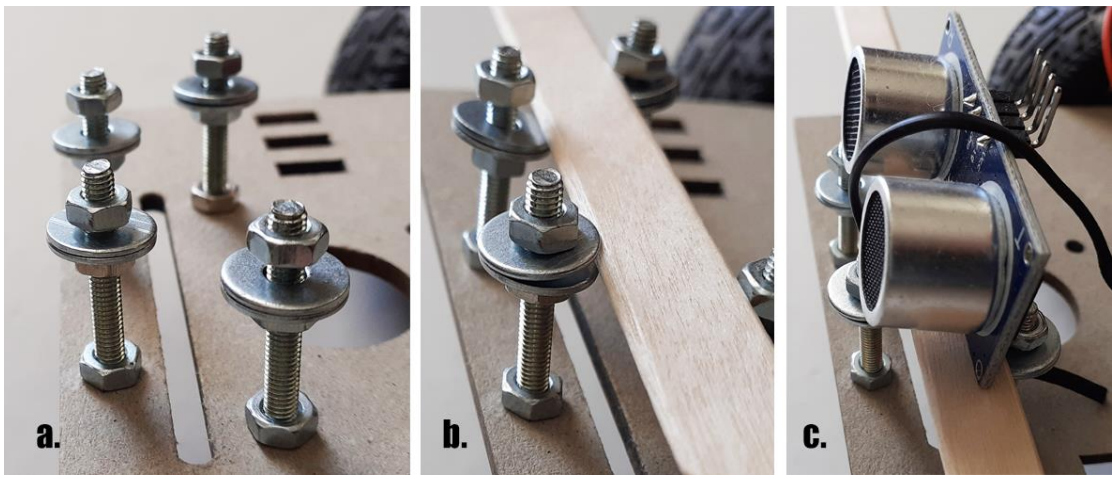


Figure 22: a. Bracket made from screws, nuts and washers; b. Placing a wooden popsicle between the washers and stabilizing it with the nuts; c. Binding the Ultrasonic sensor on the wooden popsicle base

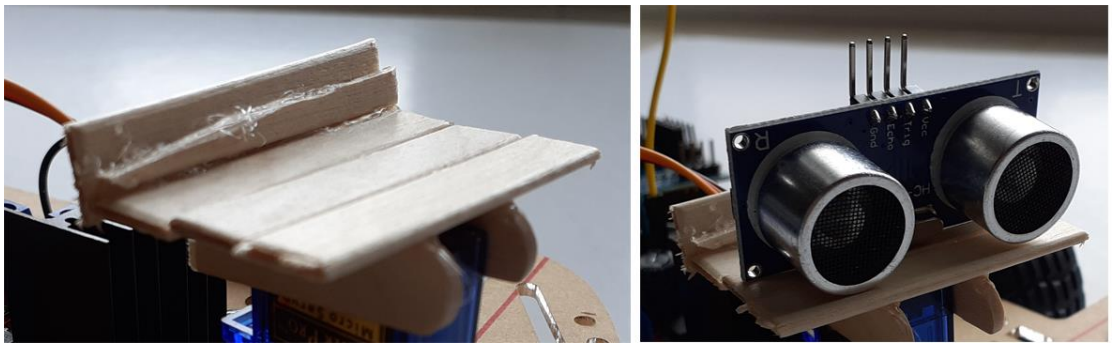


Figure 23: Basis made from wooden popsicles

Index with images of various materials

1. Cardboard:

A sheet of stiff cardboard is needed for the creation of the chassis as well as for DC Motor's fasteners.

You can either use grey (2mm) (*Figure 1, left*), or 3-ply sheet (3mm) cardboard (*Figure 1, right*), or any other stiff cardboard, suitable for robust structures.

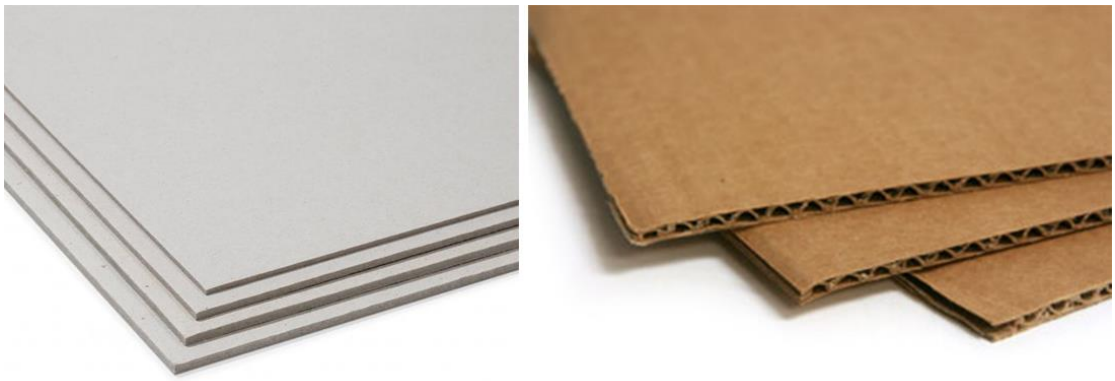


Figure 24: left: Grey cardboard; right: 3-ply sheet cardboard

2. Cutter:

For your convenience, you are advised to use a cutter (*Figure 2*) for cutting the chassis. Alternatively, you can use a rather professional scissor.

Figure 25: Indicative image of a cutter

3. Screws, nuts and Spacers:

- **Countersunk** (Figure 4) M3 screws of 30mm length (*Figure 3a*)

- Spacers (*Figure 3b*)

- M3 screws of 6mm length (*Figure 3c*)

- M3 nuts (*Figure 3d*)

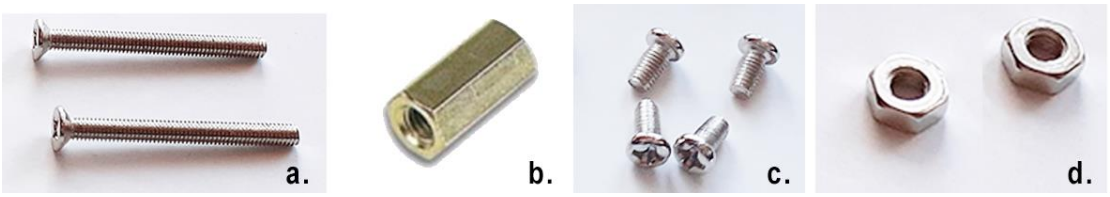


Figure 26: a. M3 screws of 30mm; b. M3 Spacers of 10mm; c. M3 screws of 5mm; d. M3 nuts

Figure 27: Indicative image of a countersunk screw. Countersunk screws are those with a rather flat head.

4. Tie wraps

Tie wraps (*Figure 5*) can be an alternative solution for stabilizing the DC motor gears on the chassis

Figure 5: Indicative image of a tie wrap

5. Wooden Sticks (popsicle sticks)

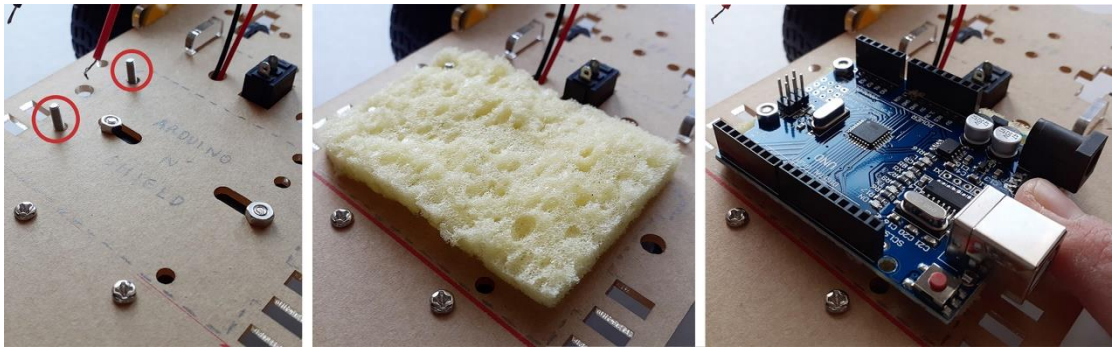
Suitable for stabilizing some electronic components (e.g. ultrasound sensor) as well as for decoration

6. Silicon glue gun and silicon sticks

7. Screwdriver and small plier

8. Any other thinner cardboard (monochrome or colorful) [for decoration]

9. Soft materials (such as sponge) for stabilizing Arduino board and L298n DC motor driver (in case you are not using spacers)



ROBOSCIENTISTS PROJECT

Motivating secondary school students towards STEM careers through robotic artefact making

Erasmus+ KA2 2018-1PL01-KA201-051129

Creators

Rene Alimisi, Chrysanthi Papasarantou, Konstantinos Salpasaranis (EDUMOTIVA)

Declaration

This report has been prepared in the context of the ROBOSCIENTISTS project. Where other published and unpublished source materials have been used, these have been acknowledged.

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