



**TITLE:** Introduction to hardware - microcontroller, camera and motor driver

### LEARNING SCENARIO

<b>School:</b>	<b>Duration (minutes):</b>	90
<b>Teacher:</b>	<b>Students' age:</b>	13-14

**Essential Idea:**

**Introduction to hardware**

**Topics:**

- Introduction to hardware - microcontroller, camera and motor driver

**Aims:**

- Students learn about the hardware to be used on our main project

**Outcomes:**

- Becoming familiar with the hardware used on main project

**Work forms:**

- work in pairs, group work

**Methods:**

- presentation, talk/discussion, interactive exercise

### ARTICULATION

**Course of action (duration in minutes)**

#### INTRODUCTION

A part of this curriculum is related to a real, physical devices with AI capabilities. For that purpose, Croatian Robotic Association developed a small mobile robot to implement programming knowledge from previous lessons. First, let's consider what our robot should consist of. It's clear that mechanical parts - case, wheels and DC motors - will be used as a drive. What about electronic parts? Pretty much like most of the living





beings, our robot will need the brain (microcontroller), the eyes (AI camera) and the nerves/impulses (DC motor driver). Let's take a look at those parts.

There are 2 options for building a robot:

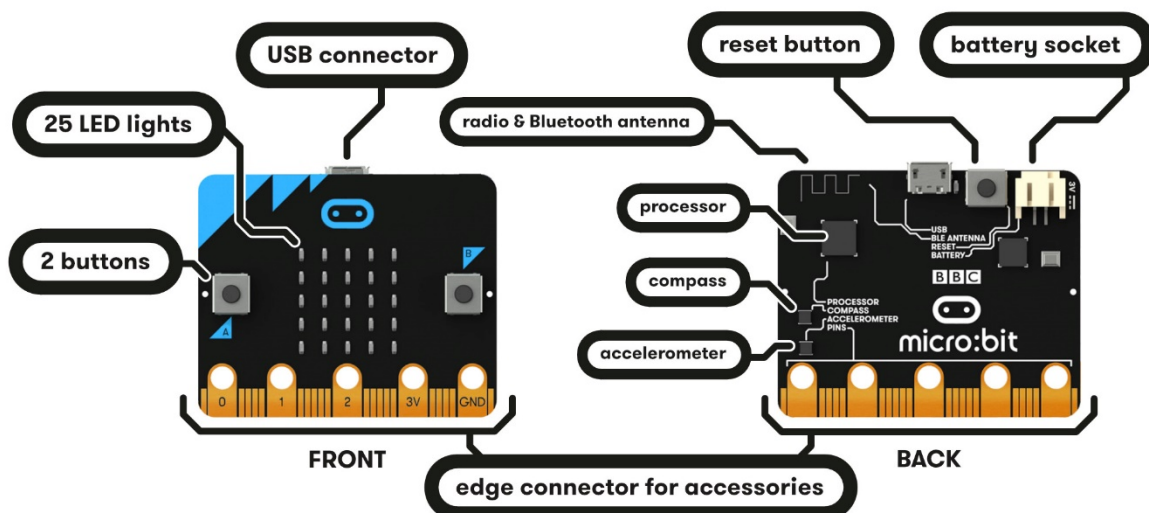
- 1) Maqueen Plus robot kit + HuskyLens AI camera (easy - suitable for beginners)  
micro: Maqueen Plus is an advanced STEM educational robot for Micro:bit. Powerful and smart, this micro:bit robot has optimized power management and a high-capacity power supply: it can be fully compatible with the AI HuskyLens vision sensor, making it an accessible teaching tool. Micro:Maqueen Plus features a large and stable chassis, built-in features and multiple expansion ports. It is not only suitable for classroom teaching, but can also be used for extended after-school training sessions and robot competitions.
- 2) Arduino UNO + Motor driver + HuskyLens AI camera (more complex - only for experienced users)

## MAIN PART

### Brain 1 - micro:bit

A "brain" in electronic world is called a processor or, in this specific case - microcontroller.

Micro:bit is an easy-to-use, powerful and cost-effective pocket-sized microcontroller designed for teaching kids and beginners how to program, allowing them to easily bring their ideas into DIY digital games, interactive projects and robotics.



Thanks to its external I/O ports and hardware support, Micro:bit is well suited for various robot-related learning and development.

### Micro:bit layout and tech specifications

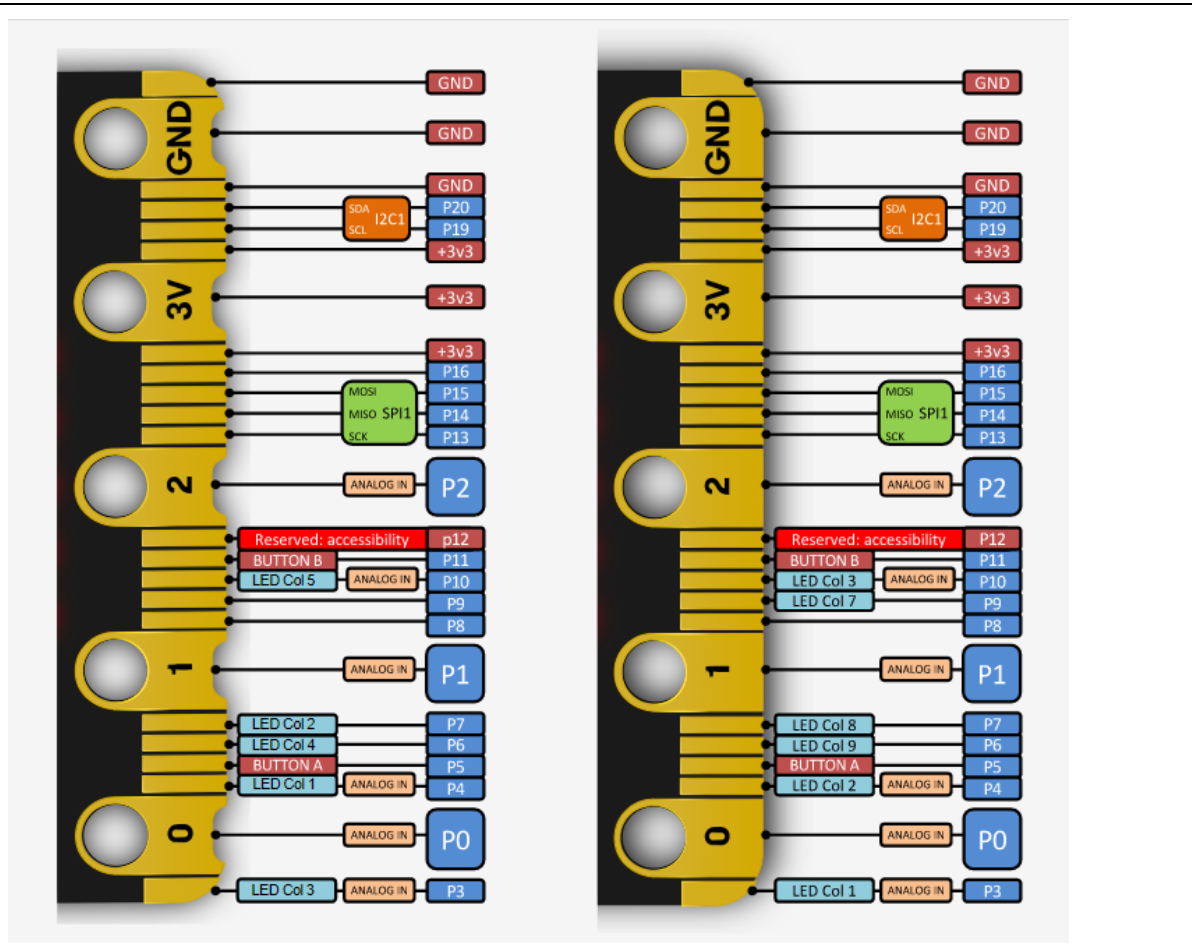
There are two versions of micro:bit available on market - check this article to find out which one you have:

<https://kitronik.co.uk/blogs/resources/explore-micro-bit-v1-microbit-v2-differences>





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**V2**

**V1**

- A small board similar in size to a credit card (4cm x 5cm)
- On-board modules, like accelerometer, Compass and Bluetooth® Smart module
- A pocket-sized microcontroller
- A 5x5 LED matrix (also supports light detection)
- Light and temperature sensors and other common sensing devices

Equipped with ARM's M0 processor, micro:bit can execute most of the fundamental functions of a robot.

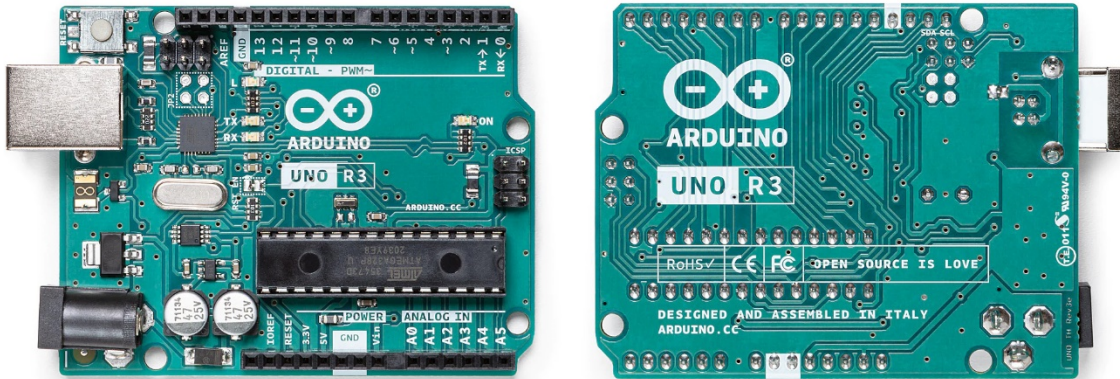
Introduction to micro:bit [https://www.youtube.com/watch?v=POkel\\_2NXMo](https://www.youtube.com/watch?v=POkel_2NXMo)

### Brain 2 - Arduino UNO

Arduino UNO is the most popular microcontroller in the world with huge online community and plenty of projects available on the internet. There are many UNO clones on the market. A clone means that core architecture, in terms of electronics, is similar to Arduino UNO, but some modifications are made to provide the additional features to the board. These modifications are designed and developed specially for students to learn coding and microcontroller architecture. Let's take a look at Arduino UNO.



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Each of the 14 digital pins on the Uno can be used as an input or output and they operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF pin. There are a couple of other pins on the board:

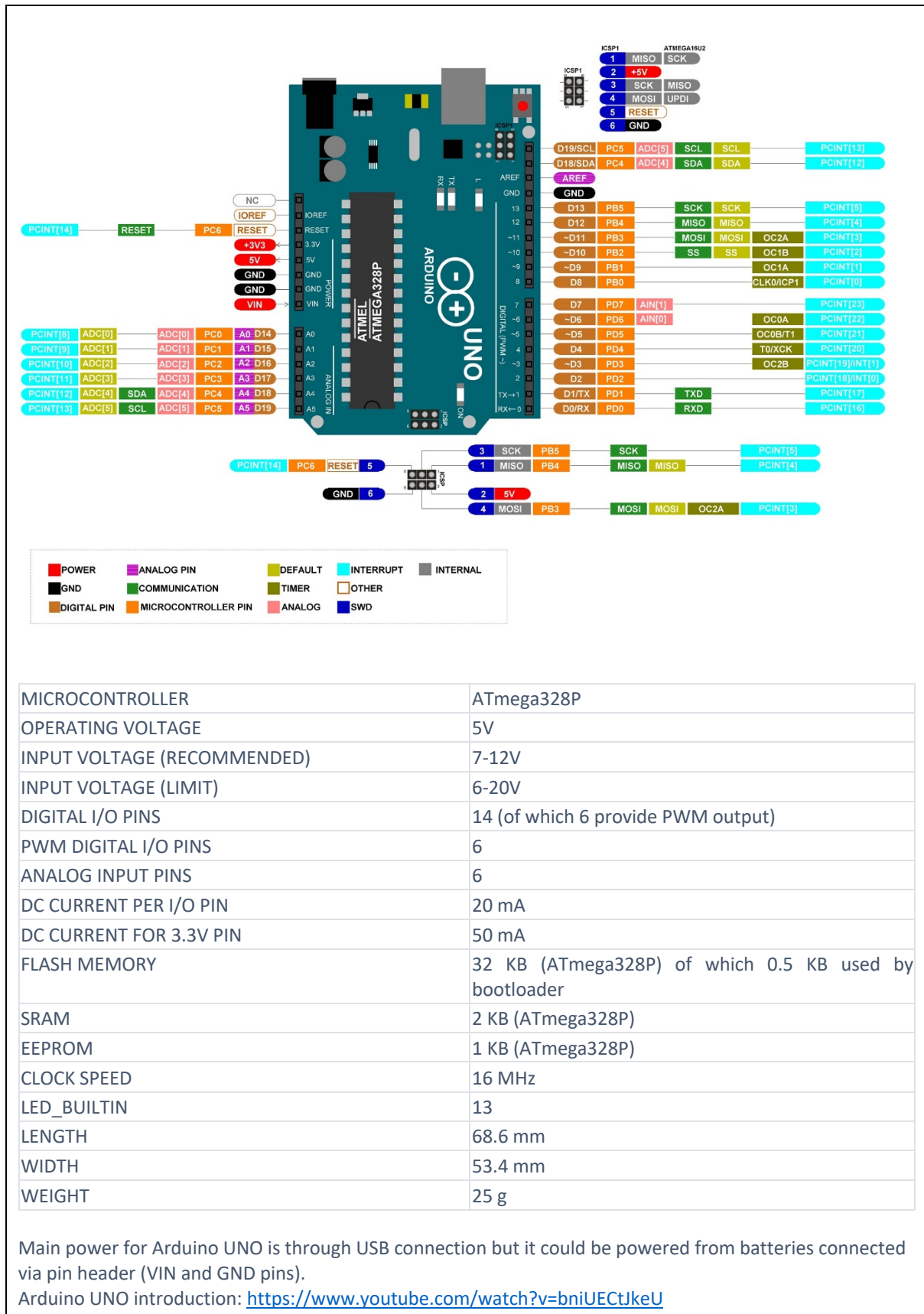
- AREF. Reference voltage for the analog inputs.
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board

### Arduino UNO layout and tech specifications

Arduino UNO board with pins explained:



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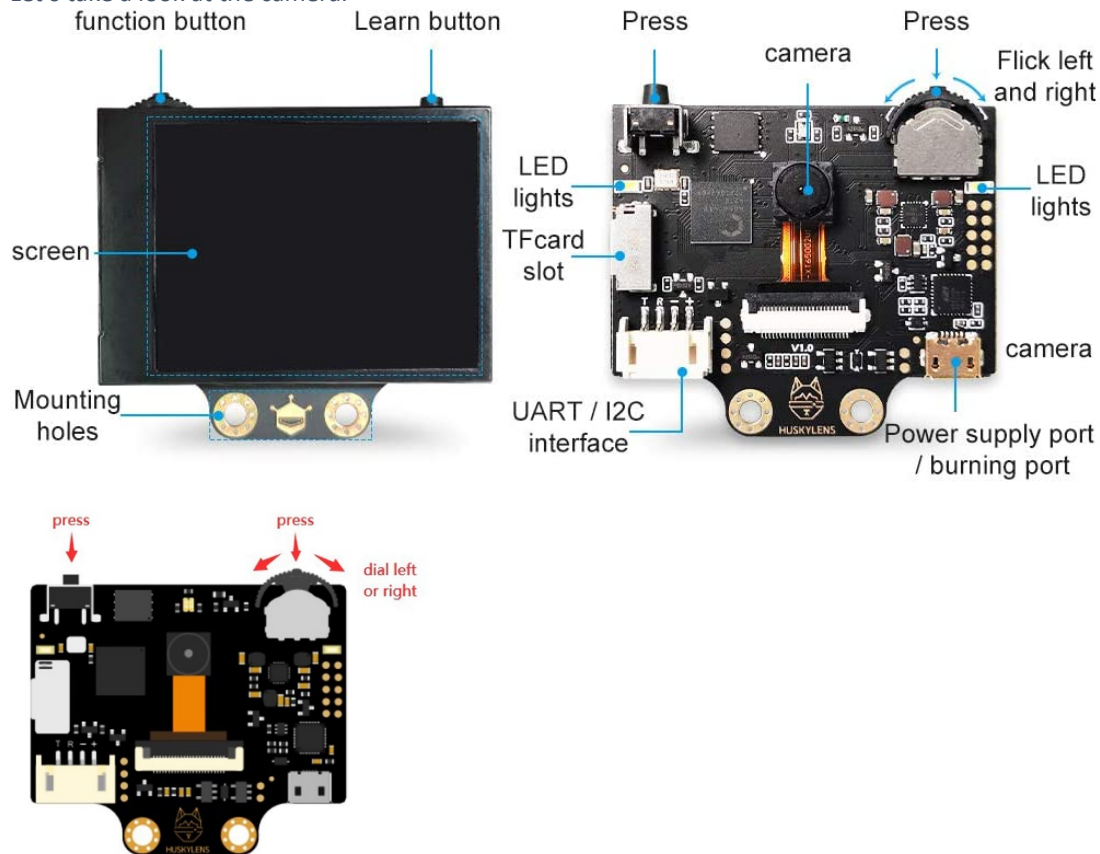


### Eyes - HuskyLens Kendryte K210 (all scenarios)

Our mobile robot will be able to sense the environment with this camera. HuskyLens is an easy-to-use AI computer vision sensor with 7 built-in functions: face recognition, object tracking, object recognition, line tracking, colour recognition, tag recognition and object classification.

It can be easily connected to any Arduino/Arduino compatible device and micro:bit. Now, you can do very creative projects even without the knowledge of complex machine learning algorithms.

Let's take a look at the camera.



### Buttons

There are two buttons on the HuskyLens, the function button and the learning button. The basic operations of these two buttons are shown as follows:

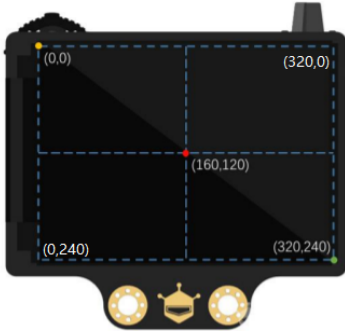
- Dial the "function button" to the left or right to switch different functions.
- Short press the "Learning button" to learn the specified object; long press the "Learning button" to continuously learn the specified object from different angles and distances; if HuskyLens has learned the object before, short press the "Learn button" to make it forget.
- Long press the "function button" to enter the second-level menu (parameter setting) in the current function. Dial left, right or short press the "function button" to set related parameters.

### Coordinate system

When HuskyLens detects an object, the target will be automatically selected by a colour frame on the screen. The coordinates of the color frame position x and y are assigned according to the following coordinate system. After getting the coordinates from the UART / I2C port, you can know the position of the object.



Format:x,y)



Functions:

- 1) Face recognition
- 2) Object tracking
- 3) Object recognition
- 4) Line tracking
- 5) Colour recognition
- 6) Tag recognition
- 7) Object classification

#### Colour Instructions

In each function, the colour definitions of the frame and the symbol "+" in the centre of the screen are all the same, which helps you know the current status of HuskyLens.

Colour	Status
From orange to yellow, then from yellow to orange	Have not learned the object yet but ready to learn
Yellow	Learning the new object
Blue	Have learned the object and recognized it

The RGB LED indicator is used to indicate the status of the face recognition function. Its colours are defined as follows.

Colour	Status
Blue	Have not learned the face yet, but detected the face
Yellow	Learning the new face
Green	Have learned the face and recognized it

Complete manual: [https://wiki.dfrobot.com/HUSKYLENS\\_V1.0\\_SKU\\_SEN0305\\_SEN0336](https://wiki.dfrobot.com/HUSKYLENS_V1.0_SKU_SEN0305_SEN0336)

#### Nerves/impulses/muscles 1 - Maqueen Plus robot board

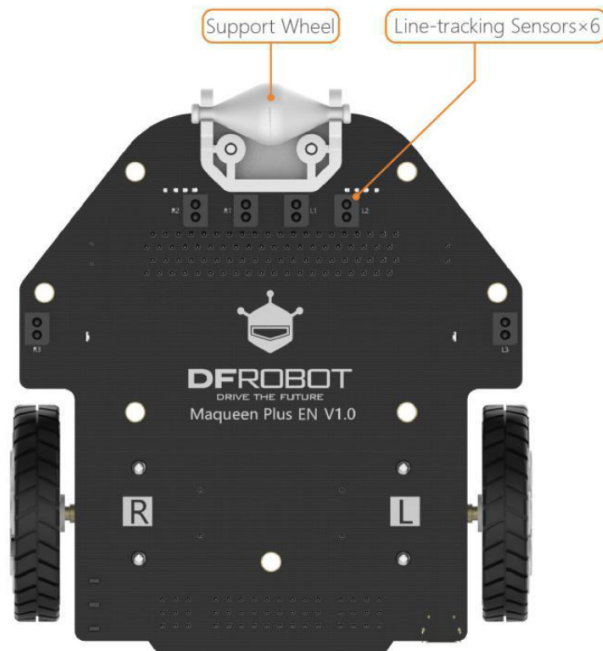
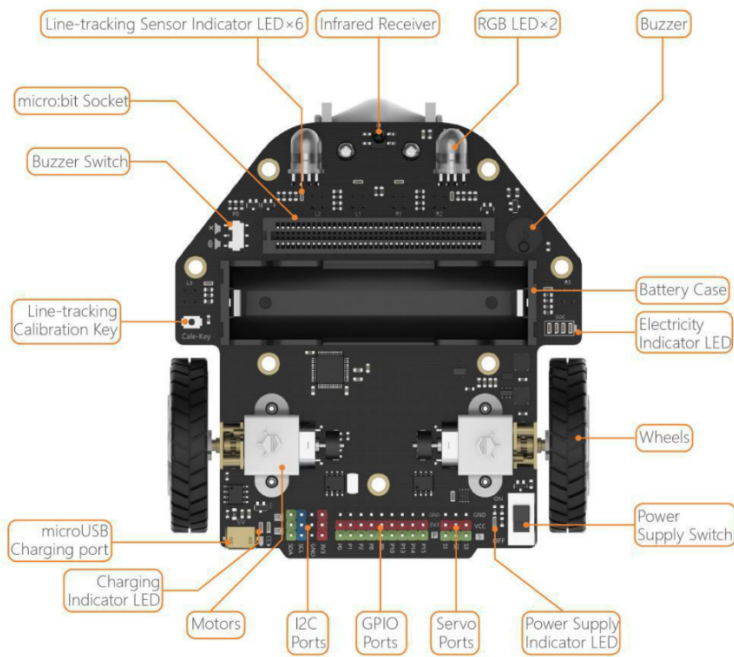
Maqueen Plus is a smart programmable educational robot designed for beginners. It can be programmed with Mind+ and MakeCode programming platforms. It is optimized with better power management and a larger capacity power supply. It's ideal for use with the HuskyLens AI Vision Sensor and comes with a larger



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and more stable chassis. It also features more built-in functions and more expansion ports. It's suitable for classroom teaching, and for after-school extended exercises and robot competitions.

Here are the main parts on the Maqueen Plus board:







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### Maqueen plus tech specifications

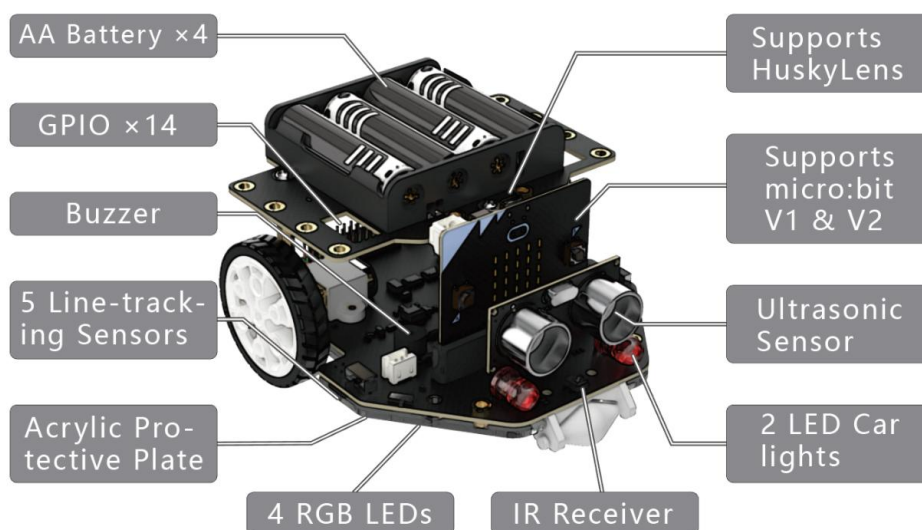
- Power Supply: 3.7V-18650 lithium battery
- Charging Voltage: 5V
- Charging Current: 900mA, Charging Time: 4h
- Battery Indicator: 4 LEDs
- Drive Motor: N20 motor 260 rpm
- Buzzer \* 1
- RGB-LED \* 2
- GPIO Expansion Ports : P0 P1 P2 P8 P12 P13 P14 P15 P16
- I2C Expansion Ports \* 3
- Servo Expansion Ports \*3
- Line Tracking Sensors \*6
- Line Tracking Sensor Output Data: analog + digital
- Line Sensor Calibration: support
- Infrared Receiving Sensor \*1
- Ultrasonic Sensor: URM10
- Top Metal Plate \* 1
- M3 threaded connections \*12
- Map Size: 50cm\*50cm
- Dimension: 107x100mm (4.21 x3.94")

Maqueen Plus is accessible through Mind+ Programming platform now. Mind+ is a Scratch3.0-based graphical programming platform from DFRobot, supporting python, Arduino and other programming platforms. At present, Mind+ has been applied to all kinds of sensors, modules and related educational products.

Find out more about Maqueen Plus:

[https://github.com/DFRobot/Maqueen\\_Plus\\_Basic\\_Tutorial/blob/master/MBT0021-EN-Maqueen%20Plus%20Basic%20Tutorial.pdf](https://github.com/DFRobot/Maqueen_Plus_Basic_Tutorial/blob/master/MBT0021-EN-Maqueen%20Plus%20Basic%20Tutorial.pdf)

As this scenario is being completed, the V2 version of this robot is available on the market.



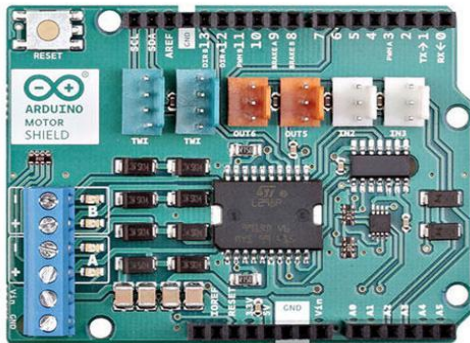


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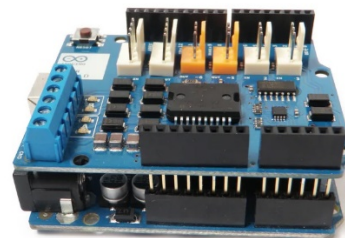
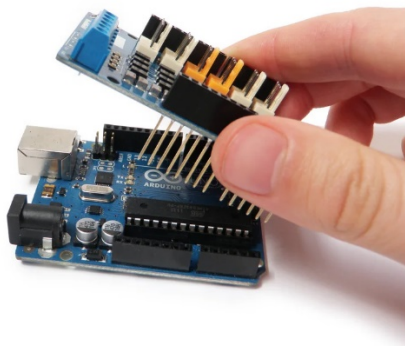
### Nerves/impulses/muscles 2 - Arduino Motor Shield Rev 3

There are several ways we can control a DC motor; perhaps the easiest one is just by applying power to it. Very early inventions using the DC motor worked like that: add a power source and the motor will start rotating, switch the polarity and you switch the direction.

But if we want to do a bit more than just making a motor spin full speed in two directions, we need a motor control circuit. More specifically, the dual full-bridge driver L298P (chip), which we can find on the Motor Shield Rev3.



Motor shield is stackable to Cytron Maker UNO and that means you don't have to wire the connection to the microcontroller. Just plug the shield pins (male) to microcontroller pins (female).



The motor shield has 2 channels, which allows for the control of two DC motors, or 1 stepper motor.

It also has 6 headers for the attachment of Tinkerkit inputs, outputs, and communication lines. The use of these pins is somewhat limited, and therefore not covered in this tutorial.

With an external power supply, the motor shield can safely supply up to 12V and 2A per motor channel (or 4A to a single channel).

There are pins on the Arduino that are always in use by the shield. By addressing these pins you can select a motor channel to initiate, specify the motor direction (polarity), set motor speed (PWM), stop and start the motor, and monitor the current absorption of each channel.

The pin breakdown is as follows:

Function	Channel A	Channel B
Direction	Digital 12	Digital 13
Speed (PWM)	Digital 3	Digital 11
Brake	Digital 9	Digital 8

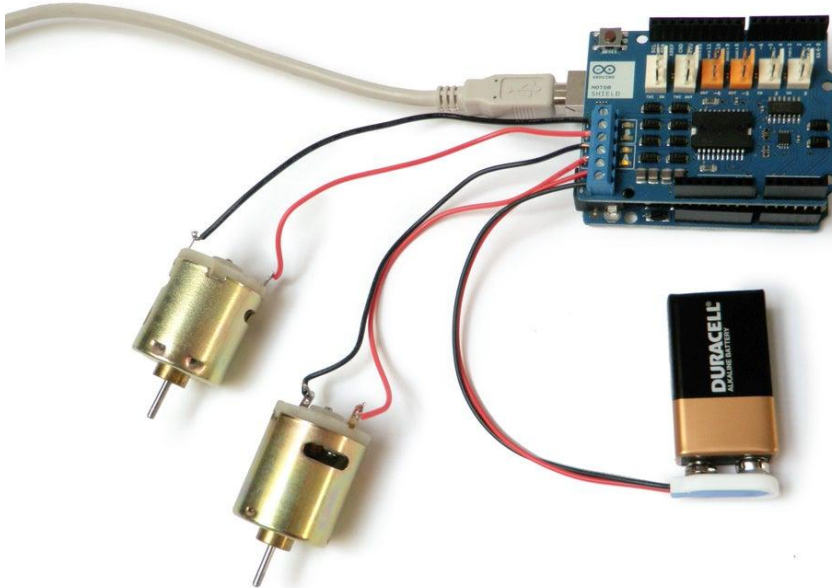




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Current Sensing	Analog 0	Analog 1
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And finally, this is how it should look like when connected:



Find out more in this Instructables page:  
<https://www.instructables.com/Arduino-Motor-Shield-Tutorial/>

### CONCLUSION

Now we are ready to make our robot. Choose the option suitable for your level of DIY experience.  
Good luck!

Do the K.W.L. (**K**now, **W**ant, **L**earned) chart with your students.

What I Know	What I Want to Know	What I Learned

**Methods**

**Work forms**



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*presentation*  
*talk/discussion*  
*work on the text*

*interview*  
*demonstration*

*work in pairs*  
*group work*  
*frontal work*

**Material:**

- <https://www.youtube.com/watch?v=bniUEctJkeU>
- [https://www.youtube.com/watch?v=POkeI\\_2NXMo](https://www.youtube.com/watch?v=POkeI_2NXMo)
- [https://wiki.dfrobot.com/HUSKYLENS\\_V1.0\\_SKU\\_SEN0305\\_SEN0336](https://wiki.dfrobot.com/HUSKYLENS_V1.0_SKU_SEN0305_SEN0336)
- [https://github.com/DFRobot/Maqueen\\_Plus\\_Basic\\_Tutorial/blob/master/MBT0021-EN-Maqueen%20Plus%20Basic%20Tutorial.pdf](https://github.com/DFRobot/Maqueen_Plus_Basic_Tutorial/blob/master/MBT0021-EN-Maqueen%20Plus%20Basic%20Tutorial.pdf)
- <https://www.instructables.com/Arduino-Motor-Shield-Tutorial/>

**Literature**

PERSONAL OBSERVATIONS, COMMENTS AND NOTES

