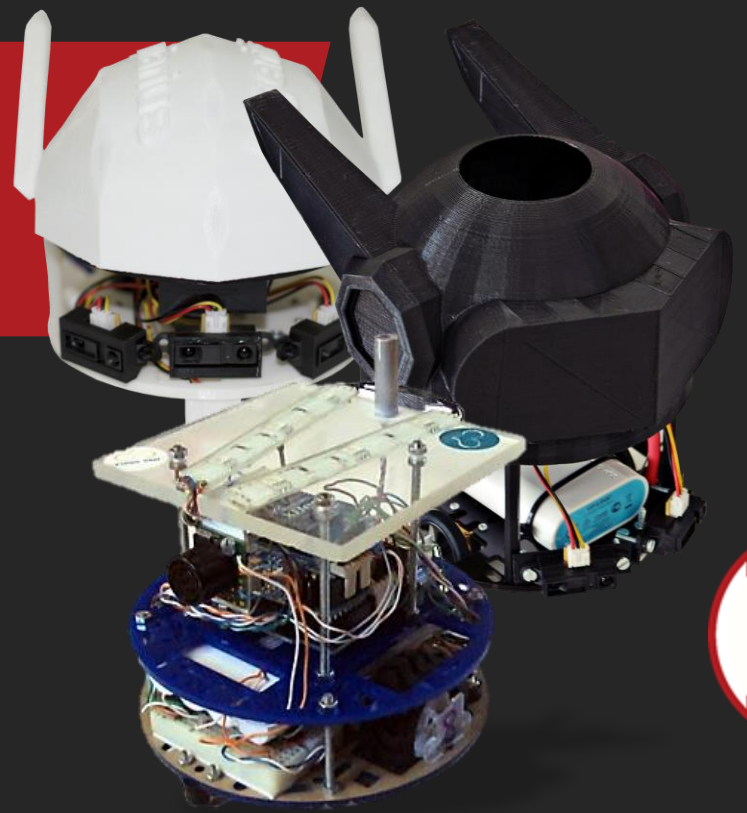
CRAFT #3

Mechatronics



Mobile Robotic Platform

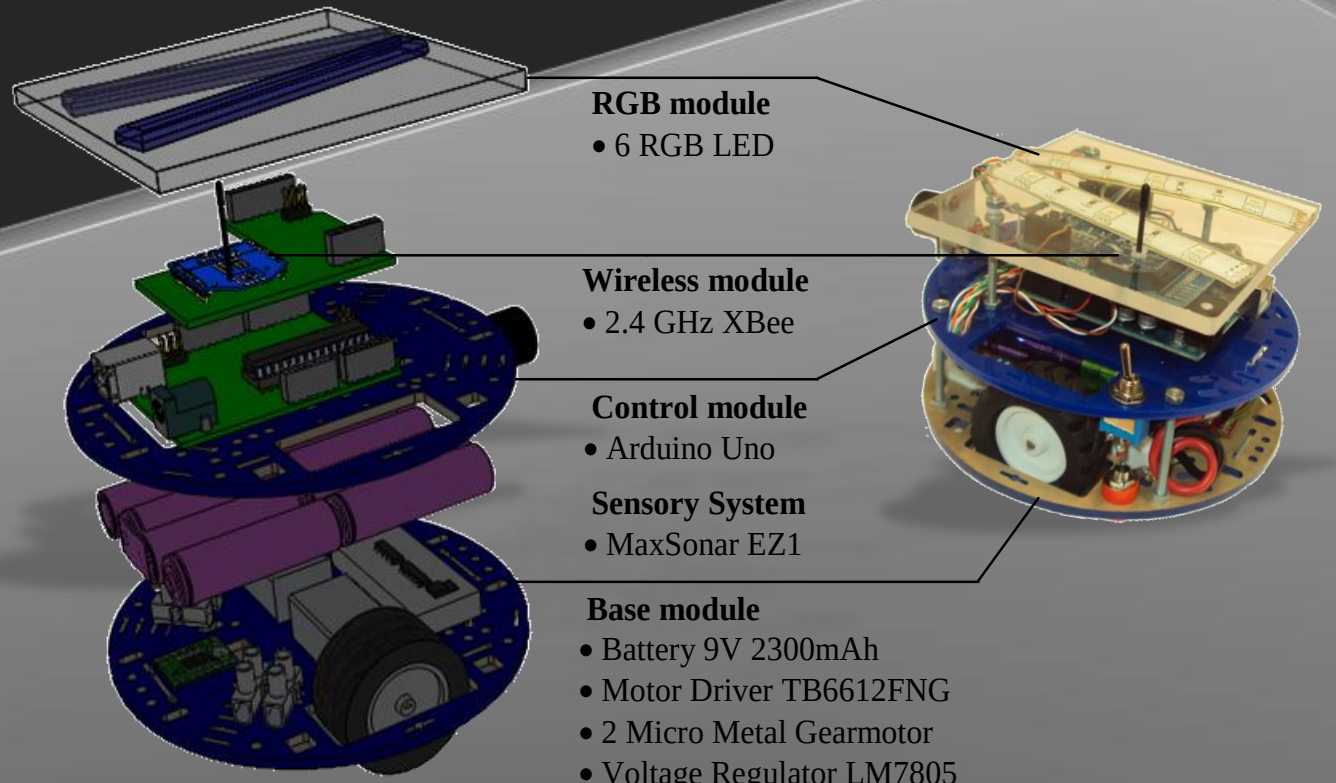
André Araújo, andre@ingeniarius.pt

07/07/2025

OBJECTIVES

- Present and describe the robotic configuration.
- Hardware work principles.
- Highlight the objectives to achieve during the following weeks

INSPIRATION: *eSwarBot*



RGB module
- 6 RGB LED

Wireless module
- 2.4 GHz XBee

Control module
- Arduino Uno

Sensory System
- MaxSonar EZ1

Base module
- Battery 9V 2300mAh
- Motor Driver TB6612FNG
- 2 Micro Metal Gearmotor
- Voltage Regulator LM7805
- Xor Logic IC – 7486
- LED Driver – L293D
- 2 encoders – 48 counts per revolution
- 2 white plastic wheel with rubber tire

Couceiro, M. S., Figueiredo, C. M., Luz, J. M. A., Ferreira, N. M., & Rocha, R. P. (2011). A low-cost educational platform for swarm robotics. *International Journal of Robots, Education and Art*, *2*(1), 1-15.

INSPIRATION: *eSwarBot*

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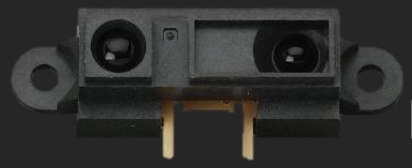
ROBOT LAYOUT

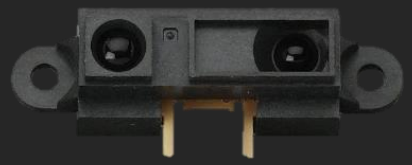
Right side

Front Side

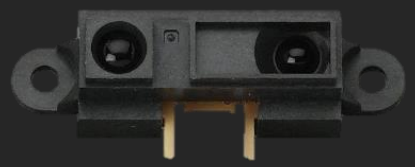


Sensor R

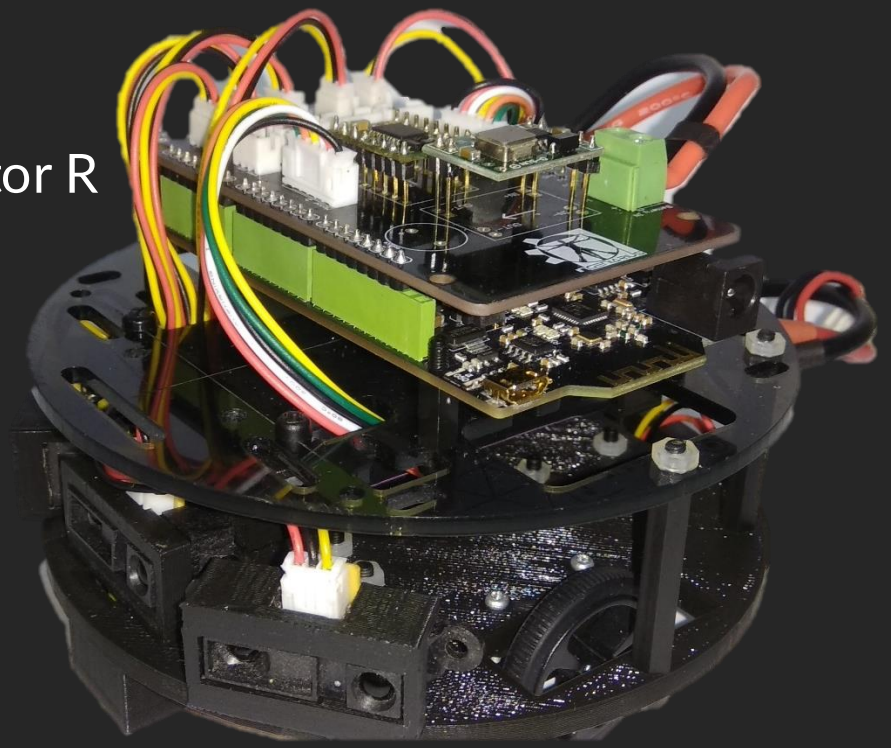
Motor R



Sensor F



Sensor L



Motor L

Left side

ROBOT COMPONENTS:

3rd level:

6x Nylon Screw M3
1x ZipTie

2nd level:

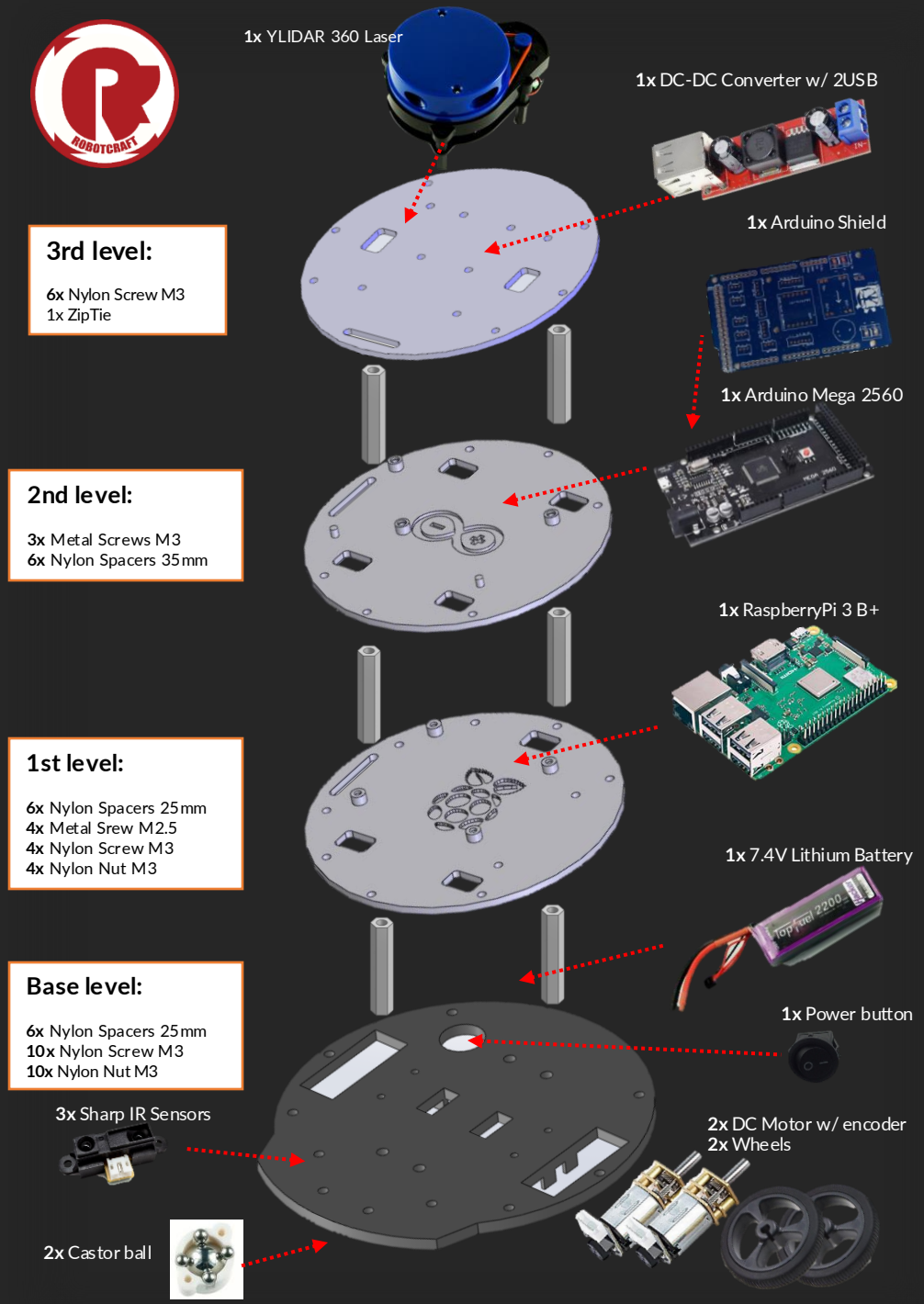
3x Metal Screws M3
6x Nylon Spacers 35mm

1st level:

6x Nylon Spacers 25mm
4x Metal Srew M2.5
4x Nylon Screw M3
4x Nylon Nut M3

Base level:

6x Nylon Spacers 25mm
10x Nylon Screw M3
10x Nylon Nut M3



ROBOT COMPONENTS:

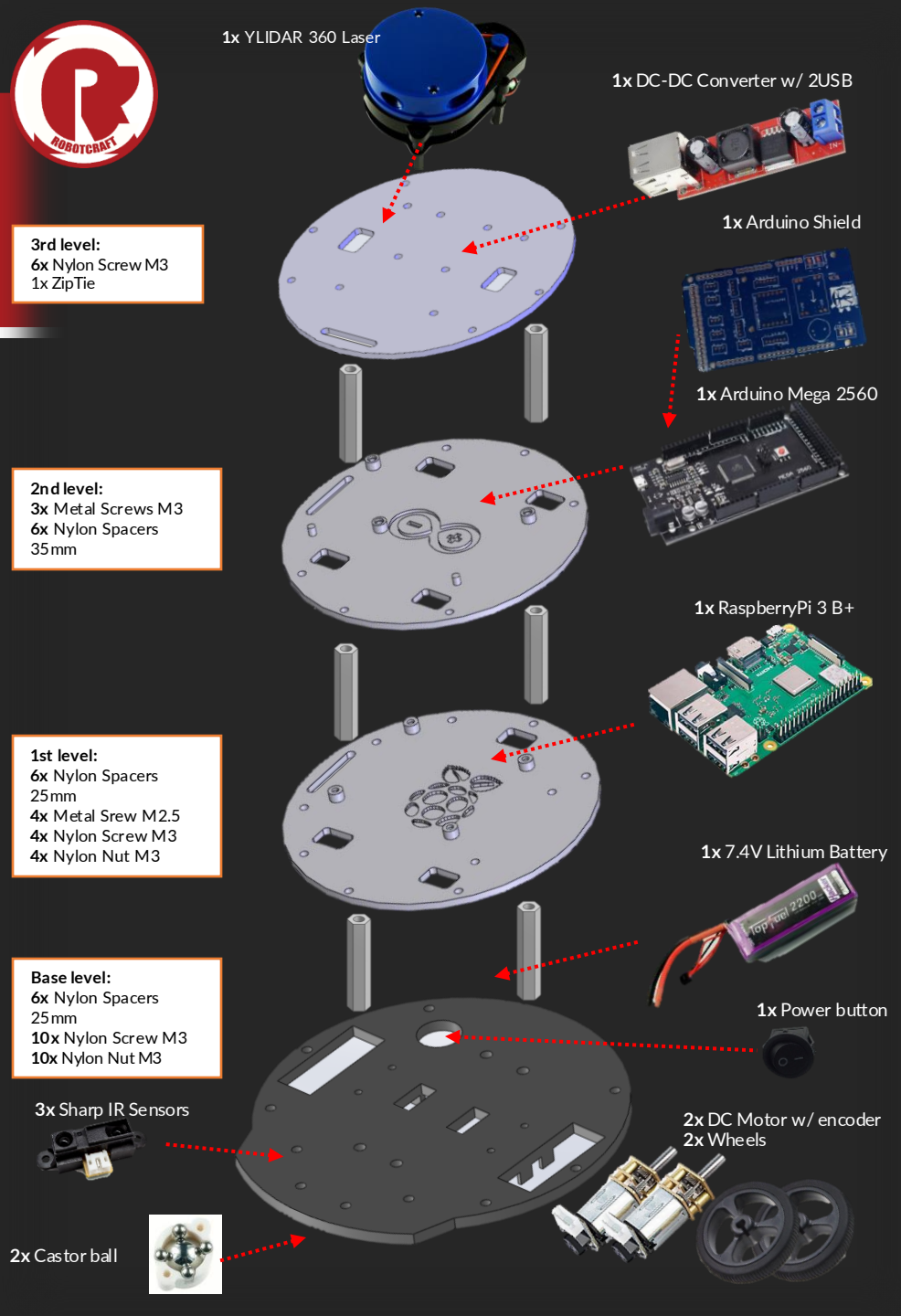
- Perception
- Action
- Decision-Making

3rd level:
6x Nylon Screw M3
1x ZipTie

2nd level:
3x Metal Screws M3
6x Nylon Spacers
35mm

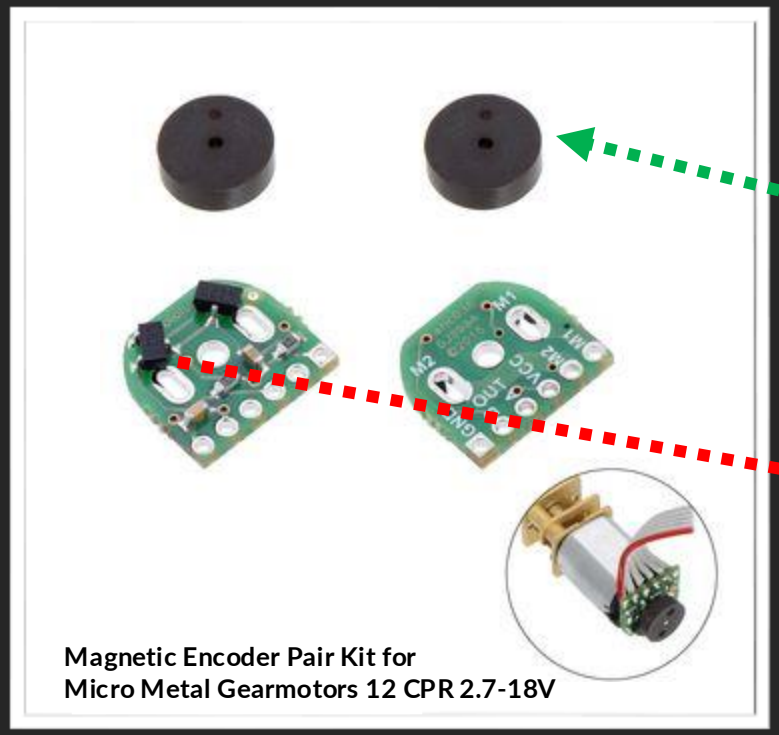
1st level:
6x Nylon Spacers
25mm
4x Metal Srew M2.5
4x Nylon Screw M3
4x Nylon Nut M3

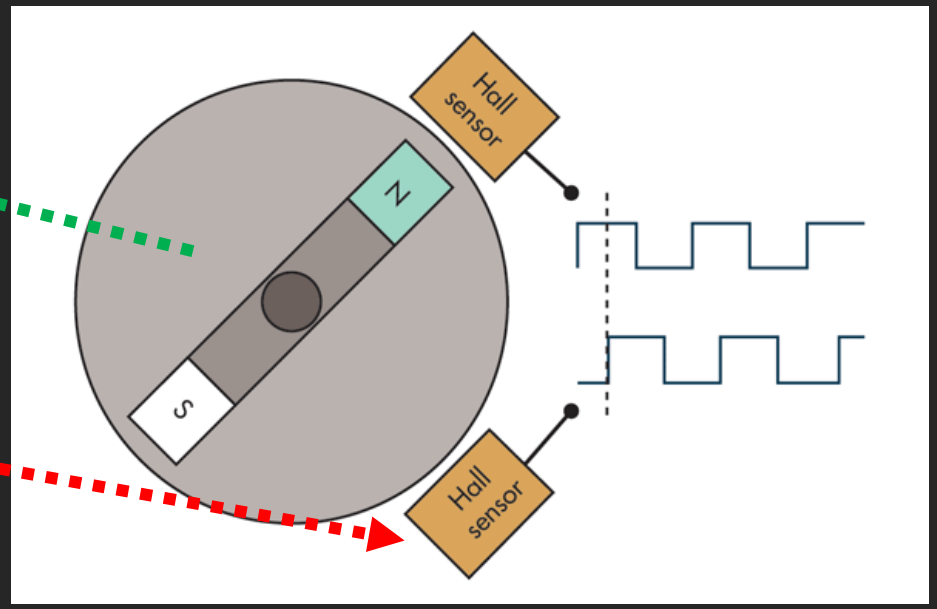
Base level:
6x Nylon Spacers
25mm
10x Nylon Screw M3
10x Nylon Nut M3



PERCEPTION - ENCONDERS

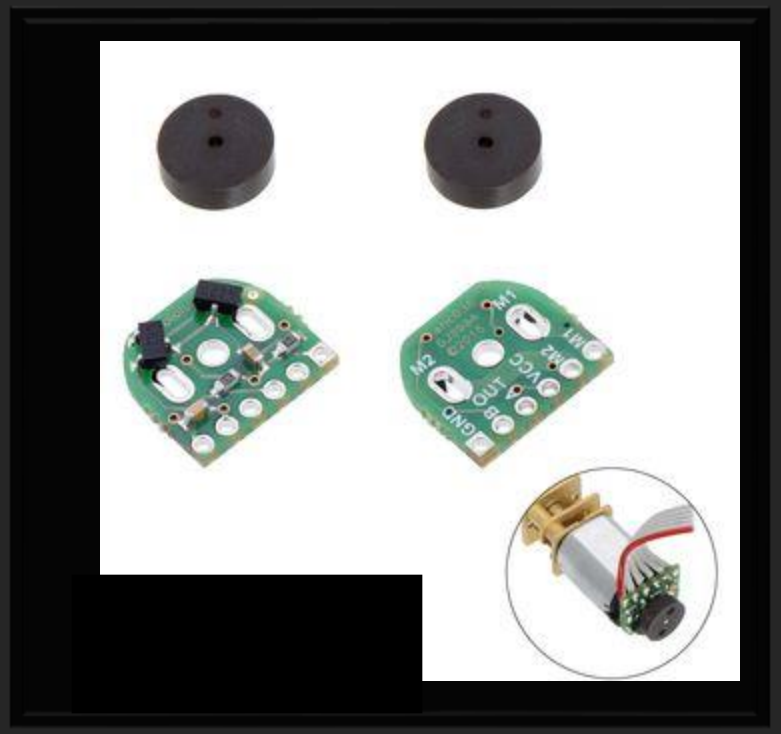
Internal Sensors (*a.k.a.* Proprioceptive)

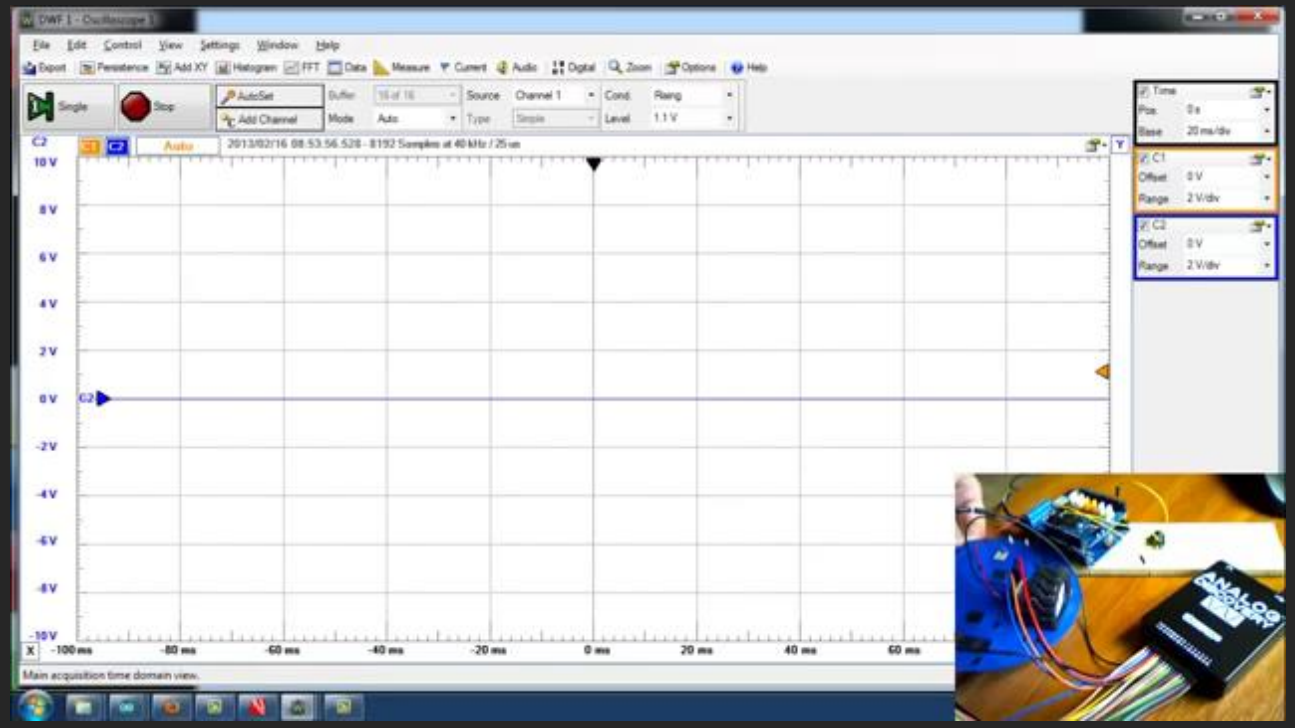




PERCEPTION - ENCONDERS

Internal Sensors (*a.k.a.* Proprioceptive)

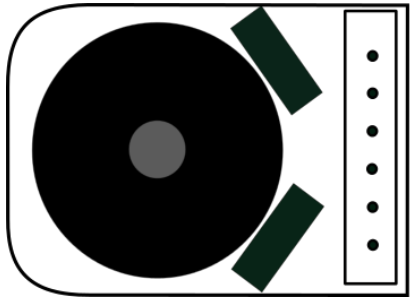




PERCEPTION - ENCONDERS

Internal Sensors (*a.k.a.* Proprioceptive)

Magnetic Encoder Pair Kit for
Micro Metal Gearmotors 12 CPR 2.7-18V



Micro Metal Gearmotor 298:1 w/Encoder

PERCEPTION – INFRARED DISTANCE SENSOR

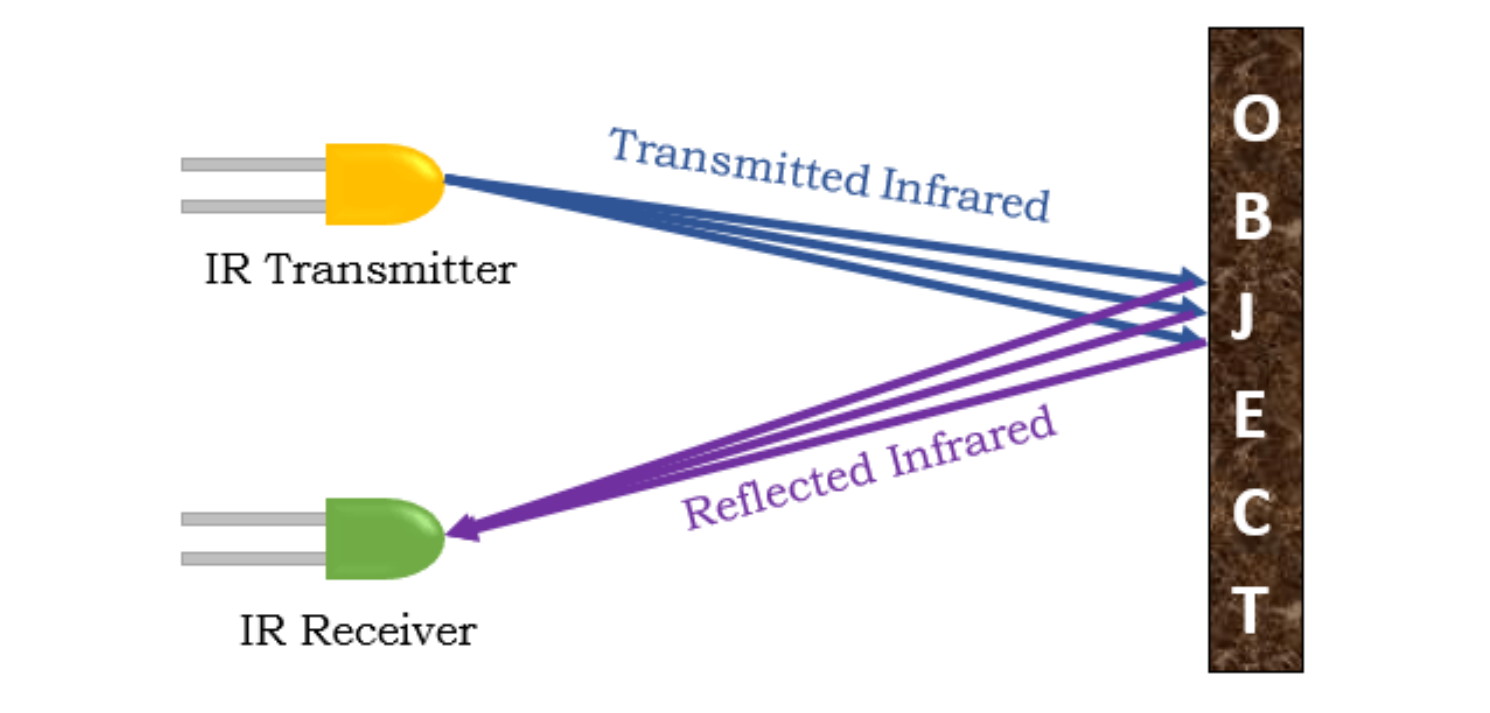
External Sensors (*a.k.a.* Exteroceptive)

```
void loop()

{

   int val = analogRead(POT);              //Read potentiometer
   int dist = map(val, 50, 400, 80, 10);     //Convert to centimeters
   Serial.print("Analog Readi    ");
   Serial.print(val);                      Print raw analog value
   Serial.print("  Centermet
   Serial.print(dist);                     Print distance
   Serial.println("cm");                   //Print centimeter abbrev
   delay(1000);

}
```

PERCEPTION – INFRARED DISTANCE SENSOR

External Sensors (*a.k.a.* Exteroceptive)

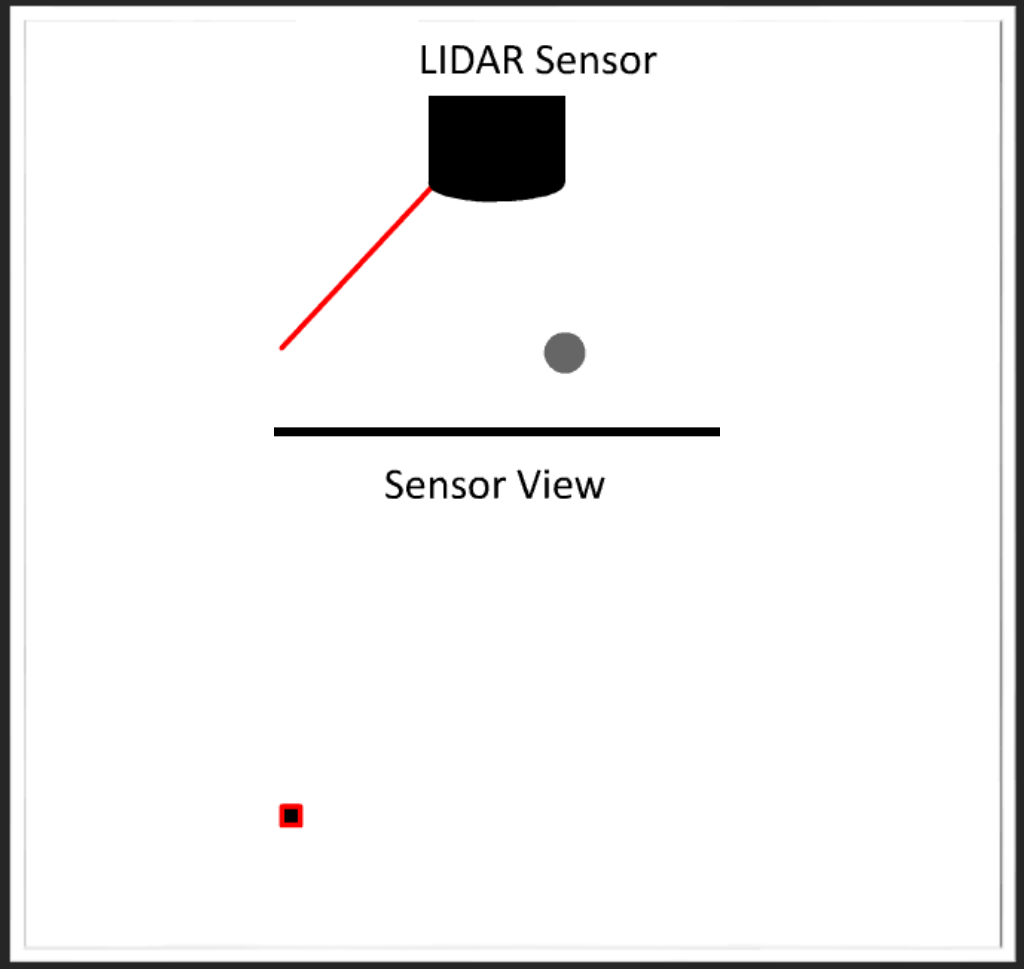
Sharp GP2Y0A21YK0F
Analog Distance Sensor 10-80cm



PERCEPTION – 360º LIDAR

Light Detection And Ranging

RPLIDAR

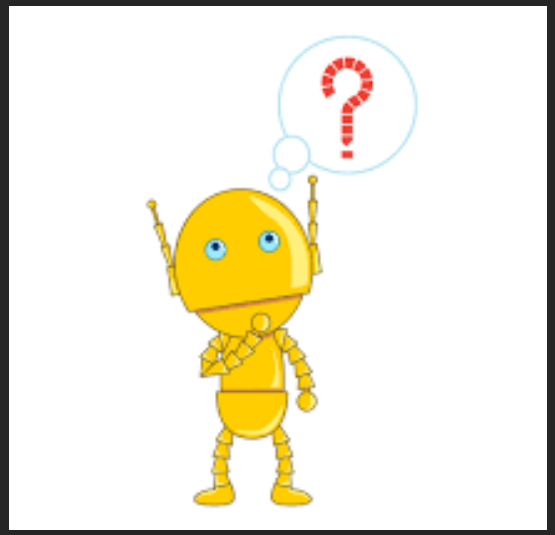


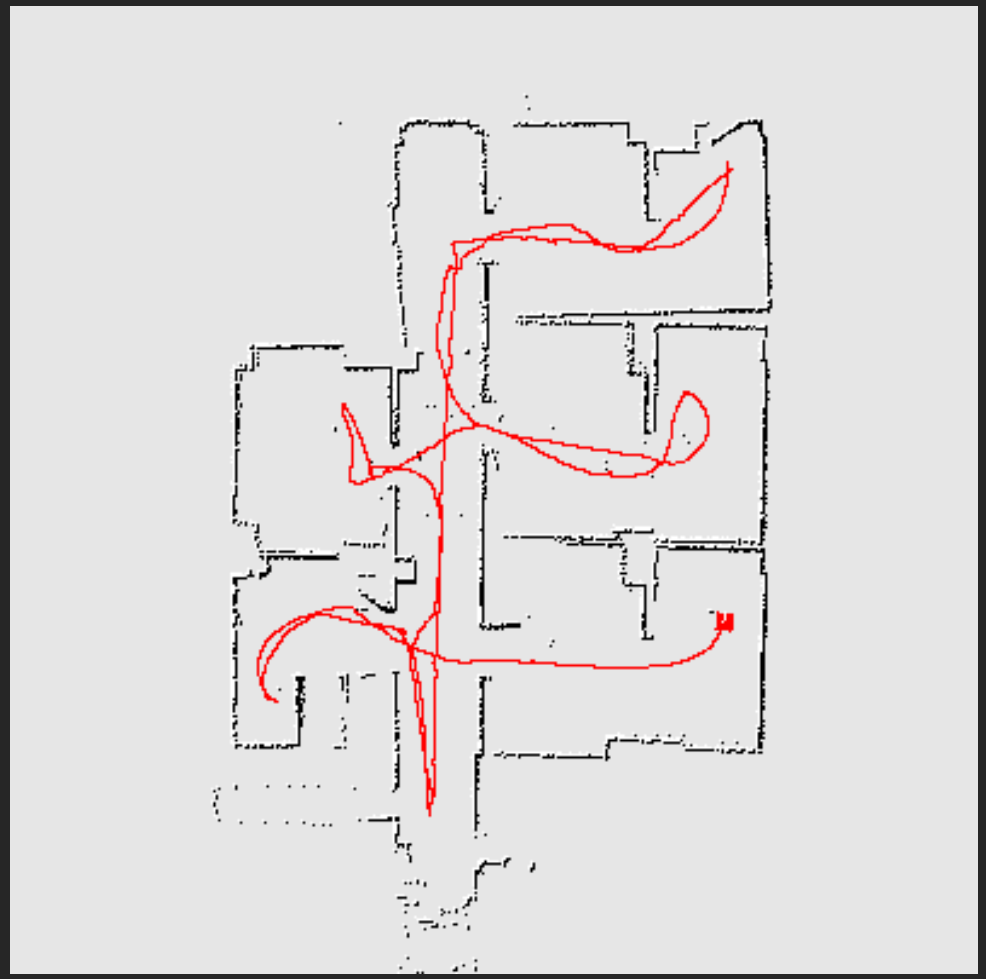
PERCEPTION – 360º LIDAR – 2D

Light Detection And Ranging

RPLIDAR

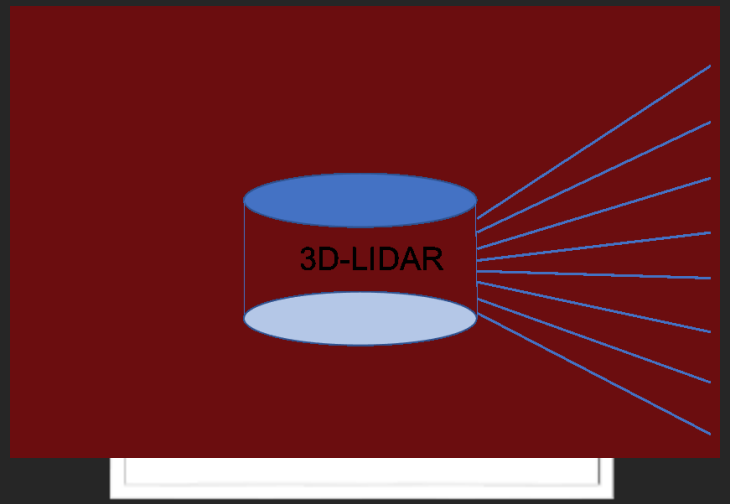
What can I use this sensor for…?



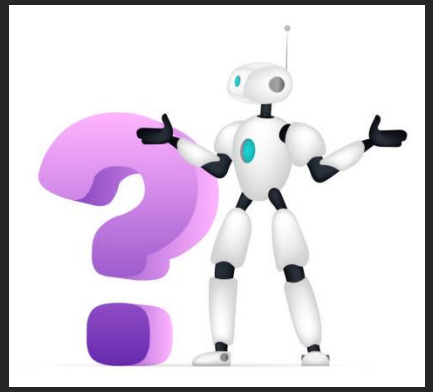


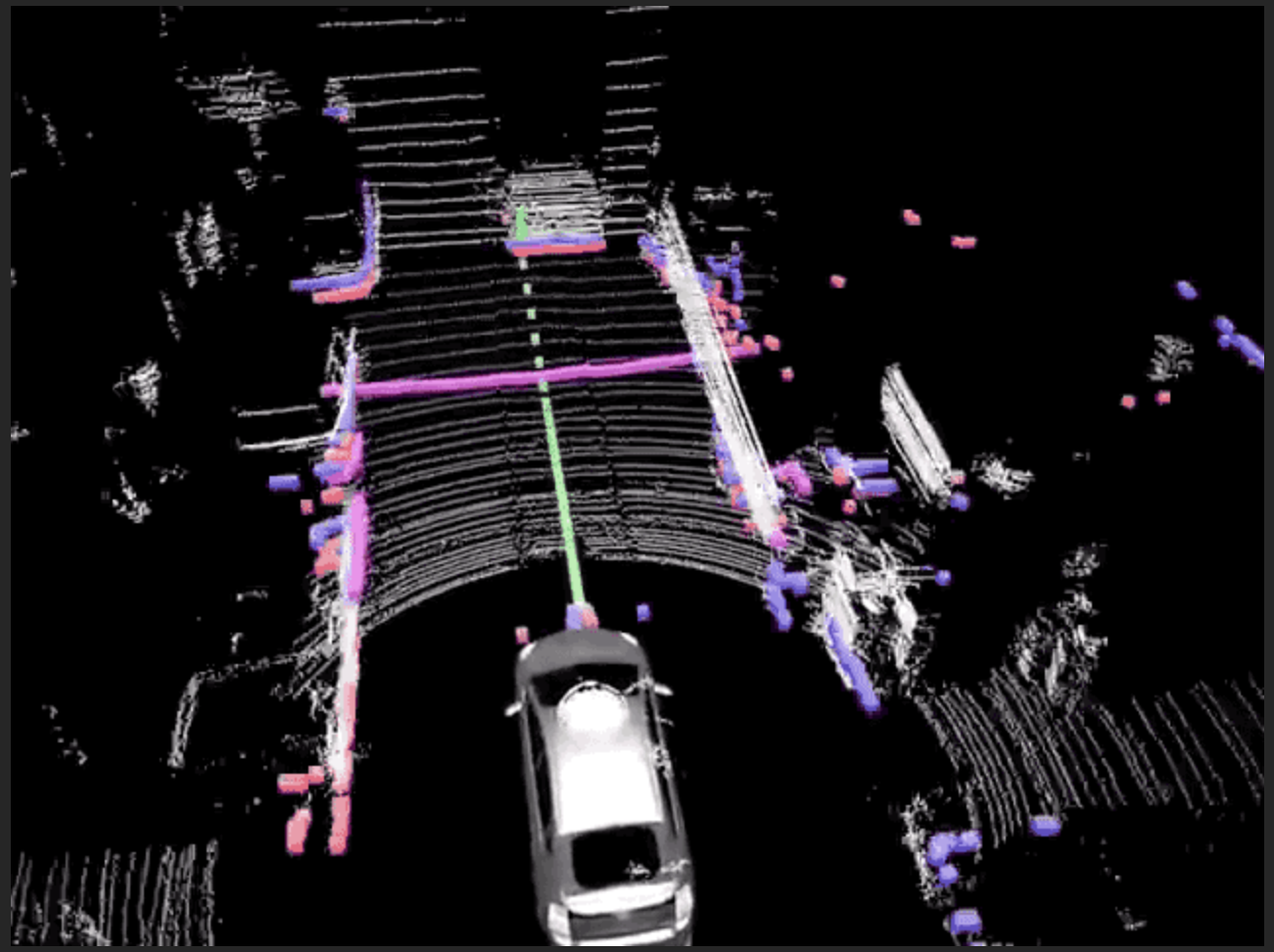
PERCEPTION – 360º LIDAR – 3D

Light Detection And Ranging



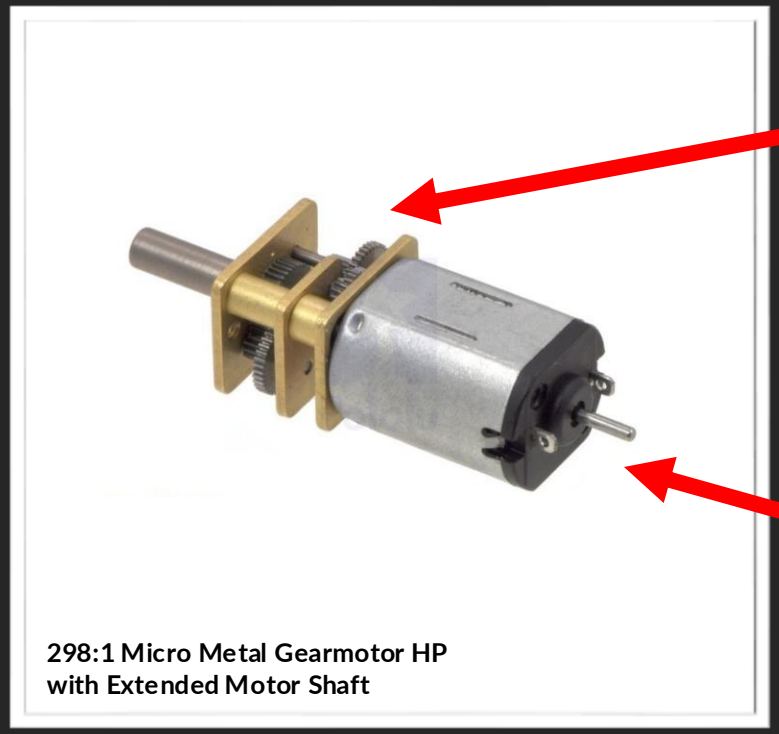
3D Scans for what??

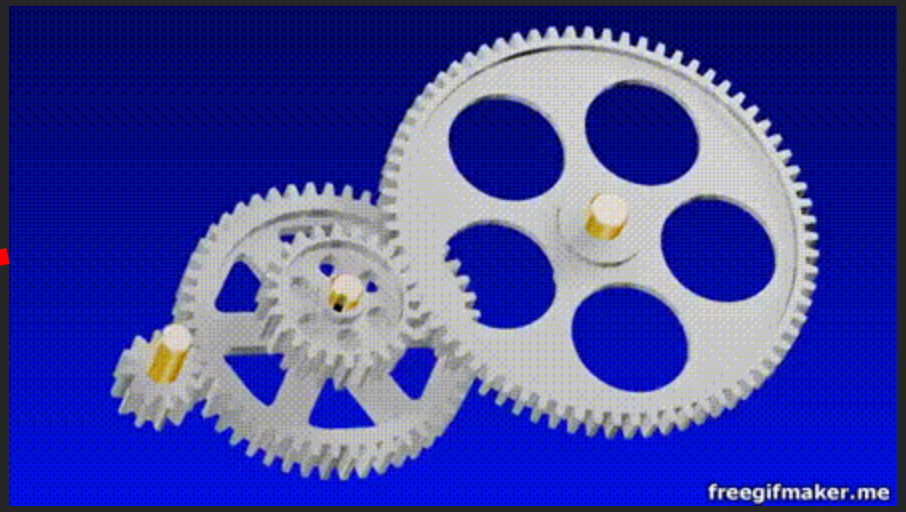


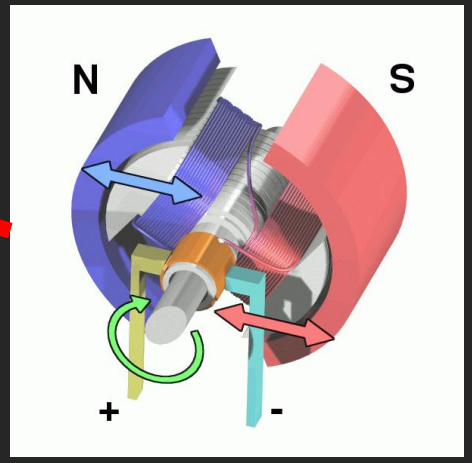


ACTION

Traction



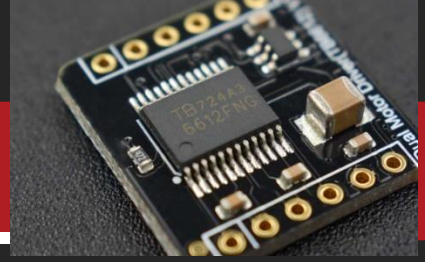




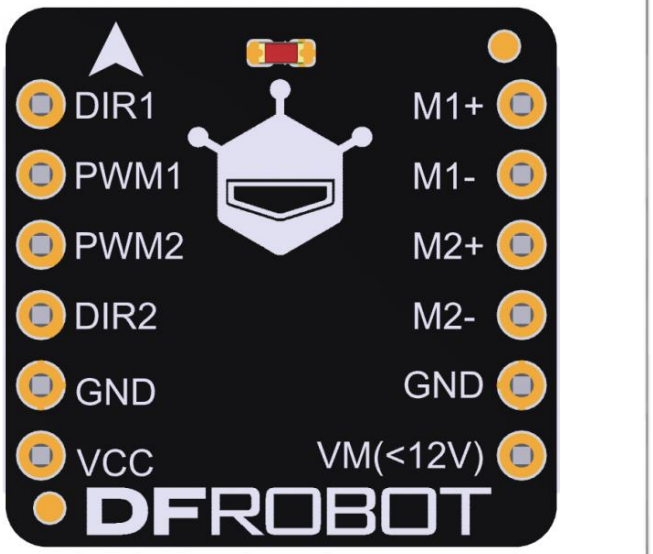
ACTION

Power and Control Traction

ACTION



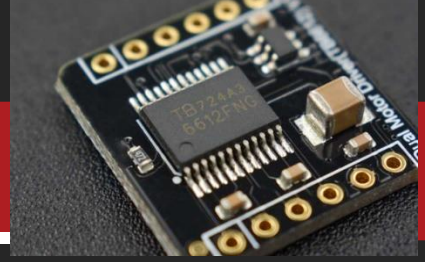
Power and Control Traction



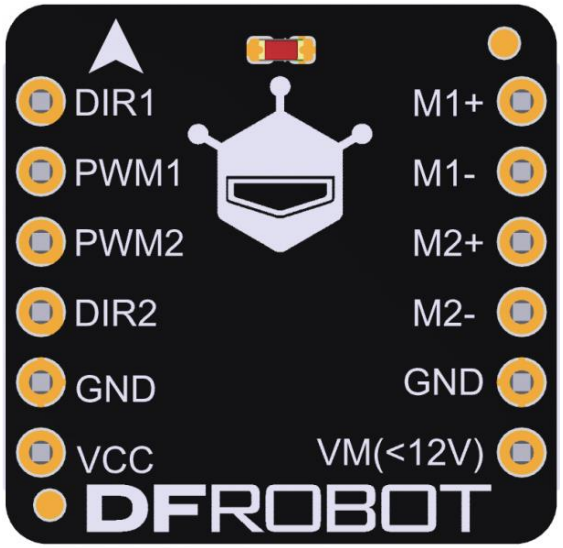
Dual DC Motor Driver (TB6612FNG)

Label	Number	Description
1	DIR1	??
2	PWM1	
3	PWM2	
4	DIR2	
5	GND	
6	VCC	
7	M1	
8	M1-	
9	M2	
10	M2-	
11	GND	
12	VM(<12V)	

ACTION



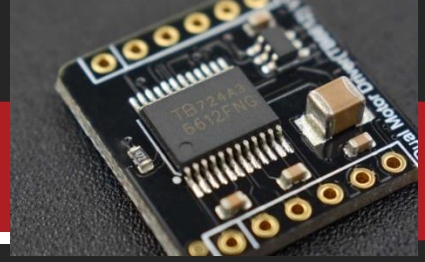
Power and Control Traction



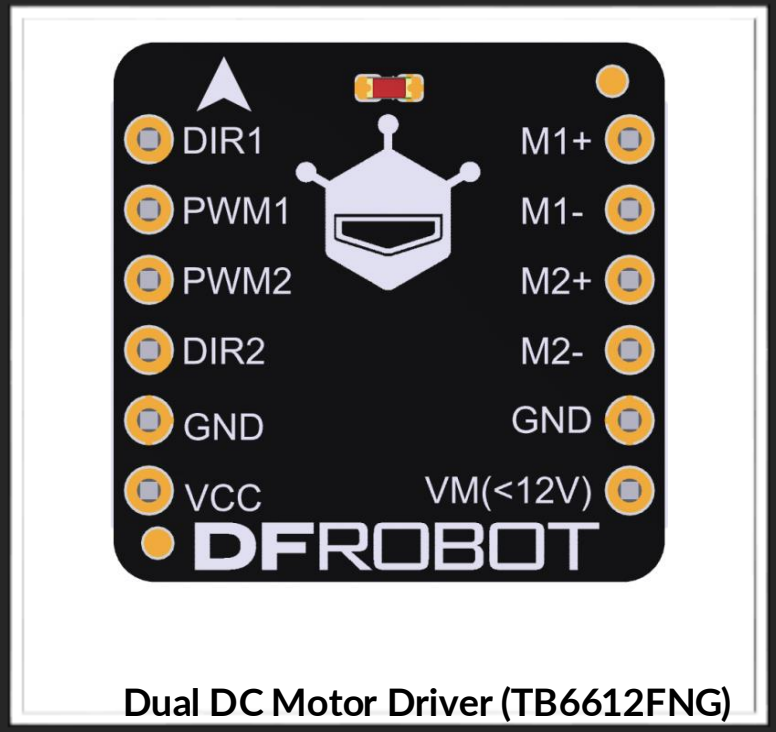
Dual DC Motor Driver (TB6612FNG)

Label	Number	Description
1	DIR1	M1 Direction Control
2	PWM1	M1 Speed control(PWM)
3	PWM2	M2 Speed control(PWM)
4	DIR2	M2 Direction Control
5	GND	Negative power supply
6	VCC	Power 3.3V-5V or IO port output high
7	M1	A Output 1
8	M1-	A Output 2
9	M2	B Output 1
10	M2-	B Output 2
11	GND	Negative power supply
12	VM(<12V)	Motor drive power 3.3V-12V

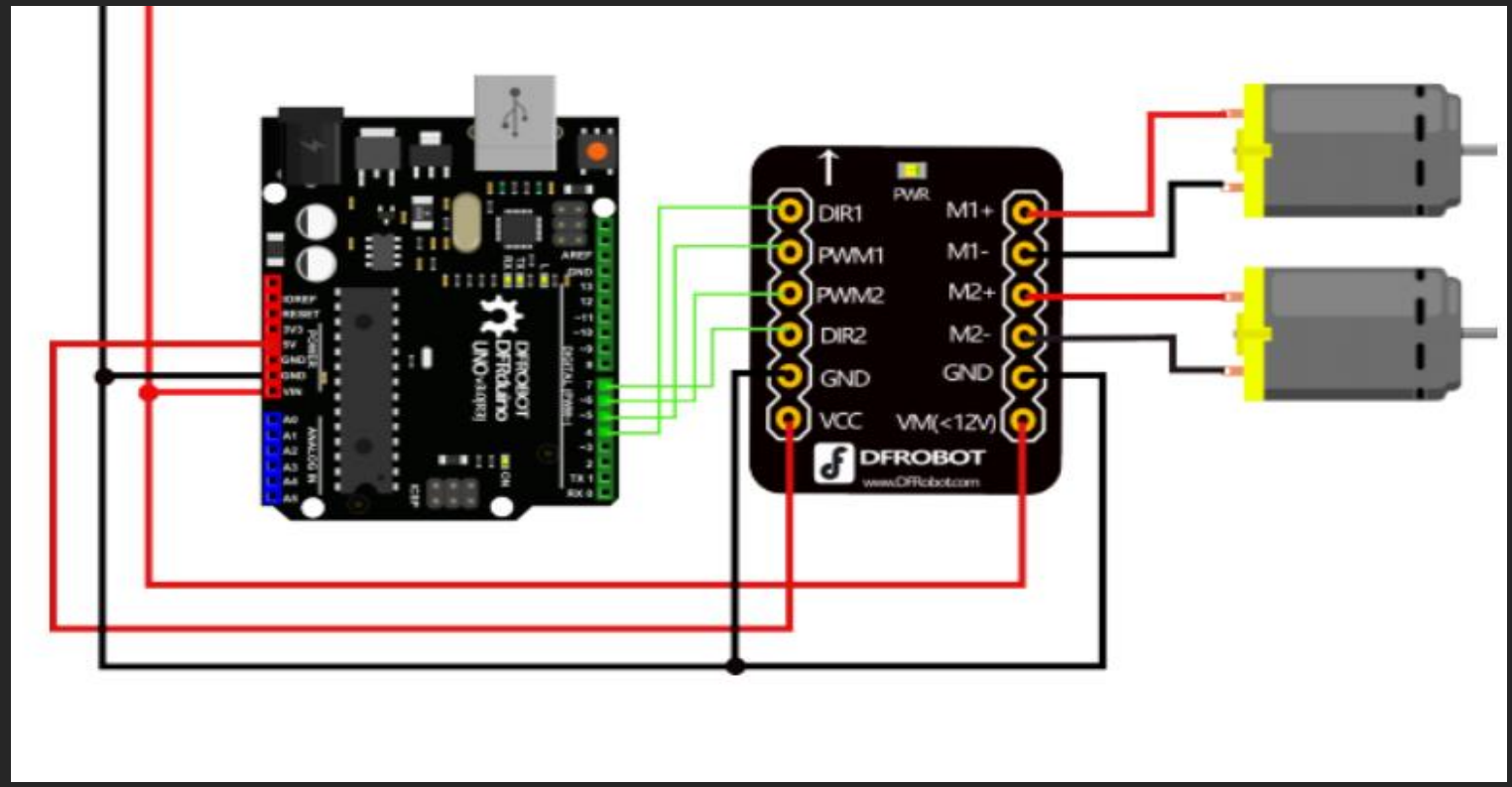
ACTION



Power and Control Traction

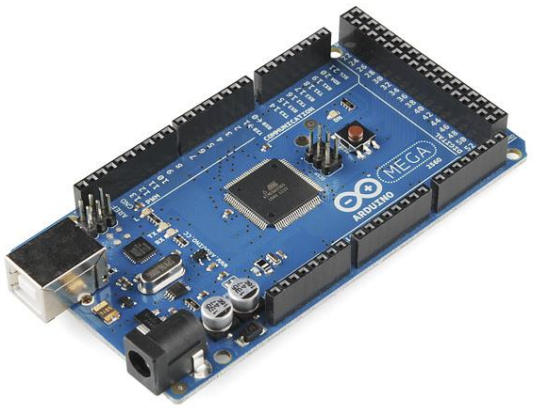


Dual DC Motor Driver (TB6612FNG)



DECISION MAKING - LOWLEVEL

Low-level Programming



Arduino Mega 2560 R3

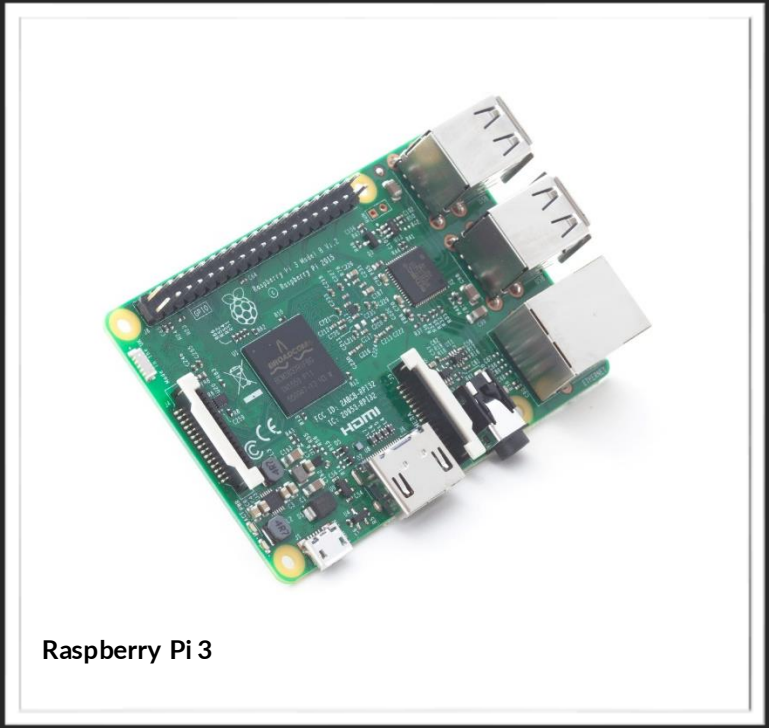
Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
Length	101.52 mm
Width	53.3 mm
Weight	37 g

DECISION MAKING - HIGHLEVEL

High-level Programming

DECISION MAKING - HIGHLEVEL

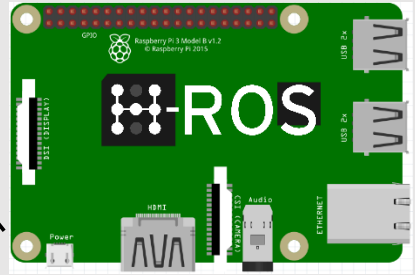
High-level Programming



Raspberry Pi 3

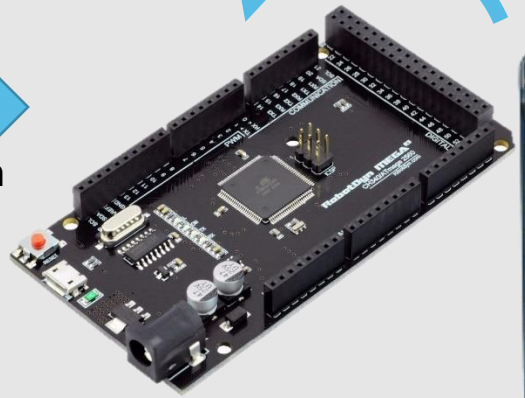
SoC	Broadcom BCM2837
CPU	4× ARM Cortex-A53, 1.2GHz
GPU	Broadcom VideoCore IV
RAM	1GB LPDDR2 (900 MHz)
Networking	10/100 Ethernet, 2.4GHz 802.11n wireless
Bluetooth	Bluetooth 4.1 Classic, Bluetooth Low Energy
Storage	microSD
GPIO	40-pin header, populated
Ports	HDMI, 3.5mm analogue audio-video jack, 4× USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

Raspberry Pi 3B+



rosserial

USB Conn

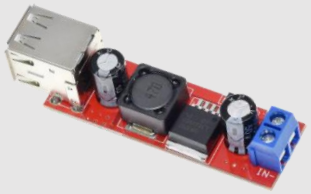


Arduino Mega 2560

USB Conn

USB Power

USB Power



5V DC Voltage Regulator

Bat OUT

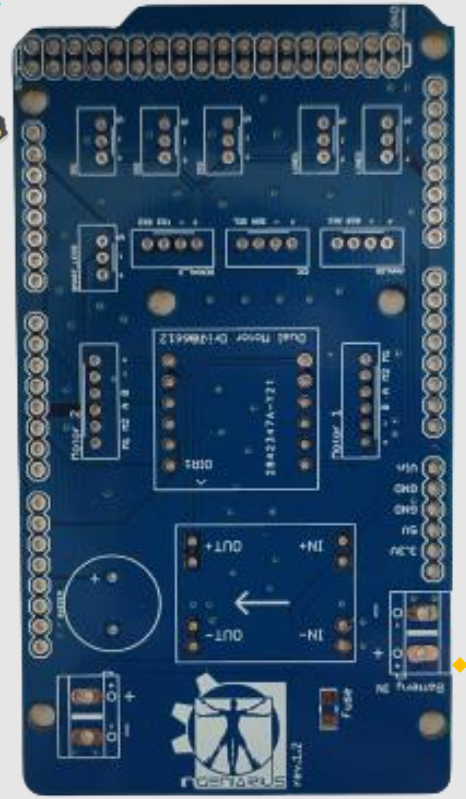
Shield 5V DC Voltage Regulator

7.4V Battery

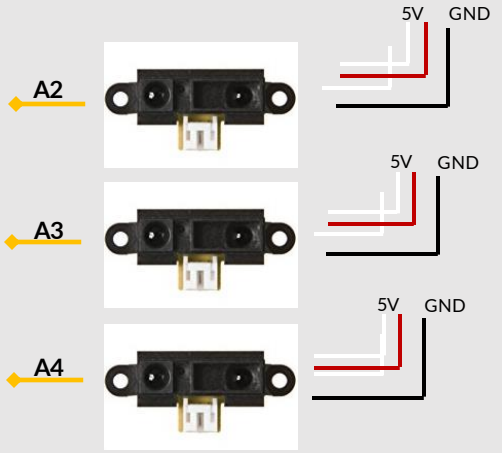
ON-OFF Power Switch

Bat IN

RobotCraftBot Shield



IR Sensor Sharp GP2Y0A21



Smart RGB Led WS2812B

D4 D5 D6 D9

DFRobot TB6612FNG Dual Motor Driver

Enc1 D2 D3

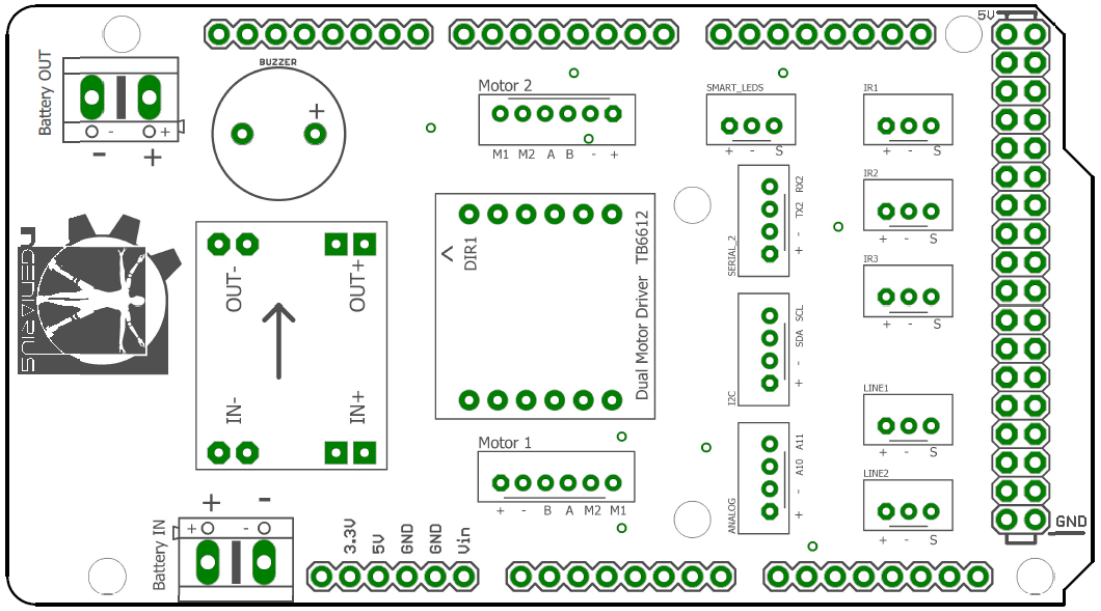
Enc2 D18 D19

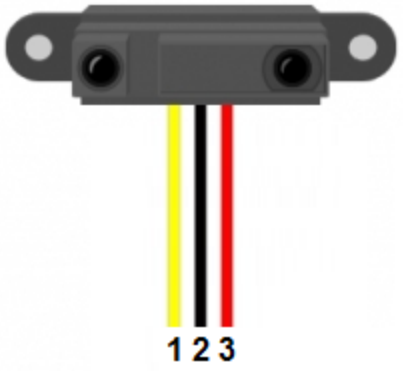
5V GND

Motor 2

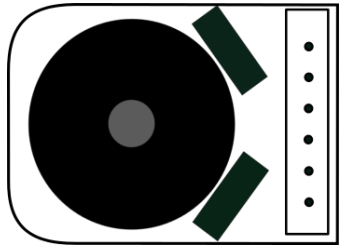
Motor 1

DC Motors 298:1 with encoders



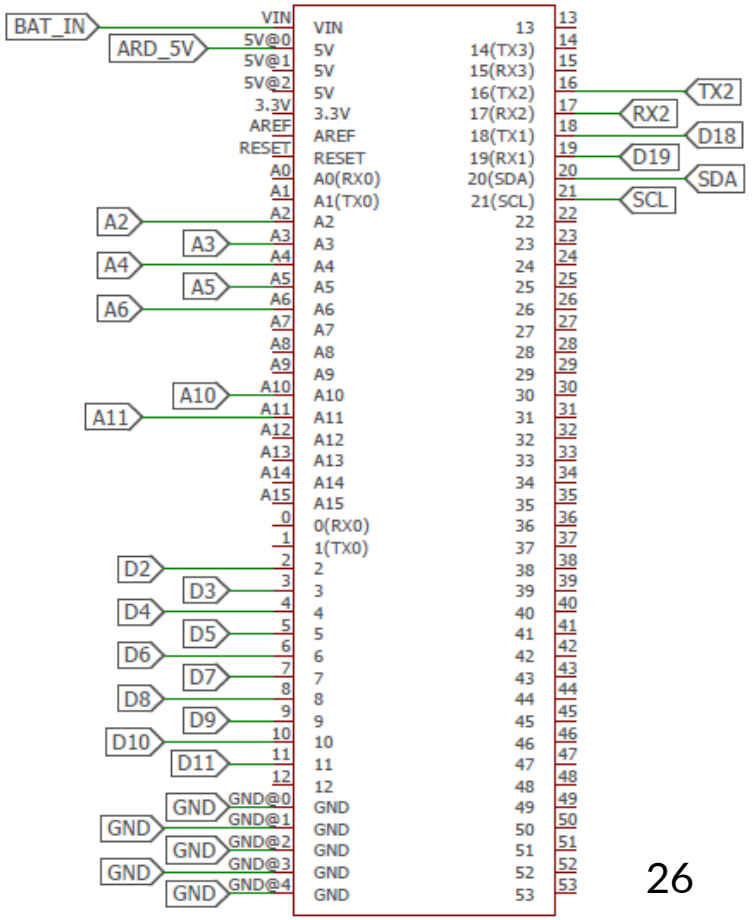


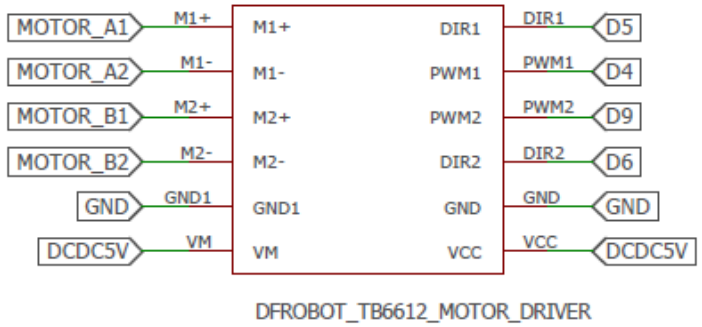
1- Signal
2- GND
3- Vcc (+5V)



Micro Metal Gearmotor 298:1
w/Encoder

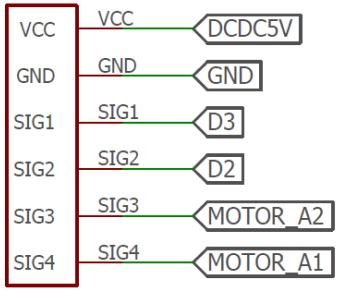
Arduino Mega 2560



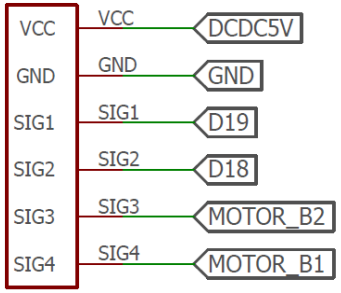


DFROBOT_TB6612_MOTOR_DRIVER

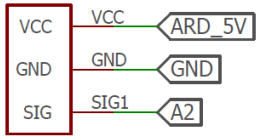
Motor_1



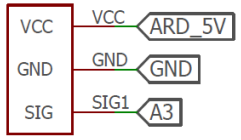
Motor_2



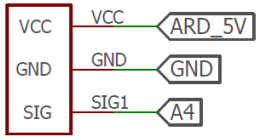
IR_1



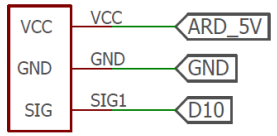
IR_2



IR_3



Smart RGB



THREE LAWS OF ROBOTICS (@ROBOTCRAFT)

1.

2.

3.

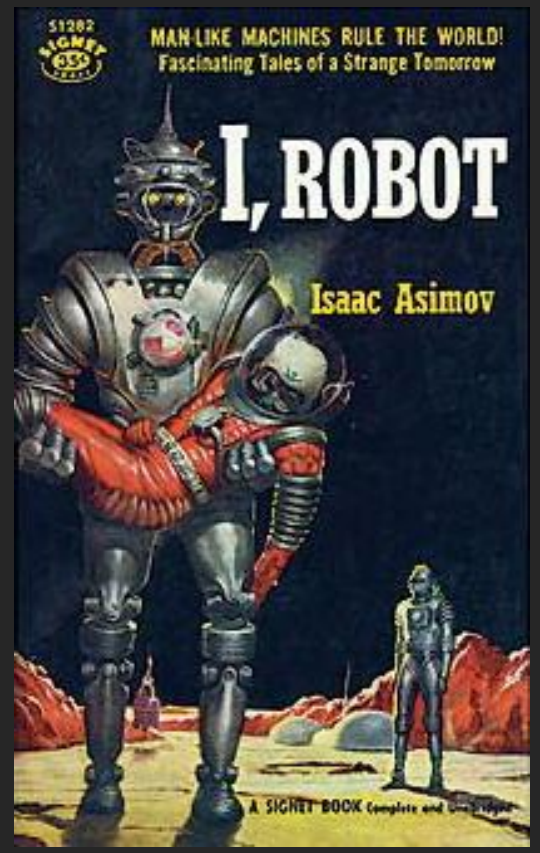
THREE LAWS OF ROBOTICS

(by Isaac Asimov)

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.

2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.



THREE LAWS OF ROBOTICS (@ROBOTCRAFT)

1. Do not connect the battery power without the mentor approval.

2. Follow the datasheets and assembly guides, except where such orders would conflict with the First Law.

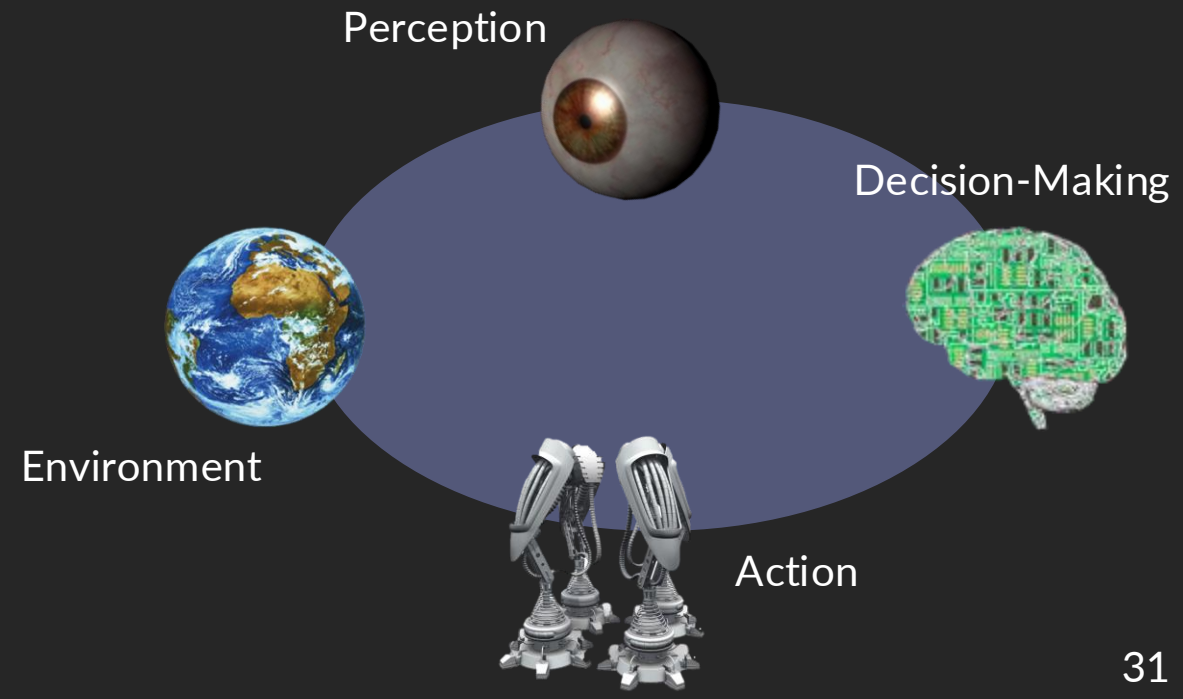
3. Leave your workspace clean and tools organized, as long as such task does not conflict with the First or Second Laws.

CONCLUSIONS

- Although simplistic, the platform which will be assembled during the course comprises all relevant components inherent to mobile robots
- Students will start with the mechatronics development of the platform, assembling it, connecting and testing all electronics
- Afterwards, the low-level programming using Arduino Mega will be used mainly for navigation
- This will be followed by the high-level programming using ROS and simple AI routines
- At last, the platforms will be evaluated and compared with each other in competitive tasks

Task – Report 1st Part

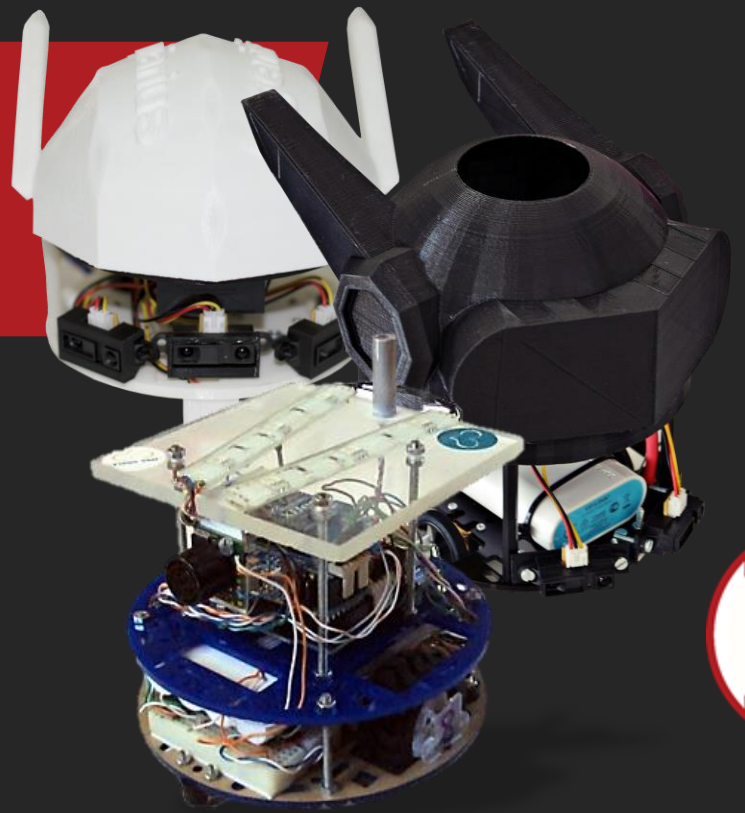
Prepare a report, **that you should maintain and deliver when fully completed by the 18th August 23h59**, starting with a description of the team, the hardware to be integrated (considering this presentation), and how you believe that it will all interconnect as an architecture to solve the maze at the final competition.



- **This first part of the report should be delivered by the 12th July, 23h59**

CRAFT #3

Thank you



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07/07/2025