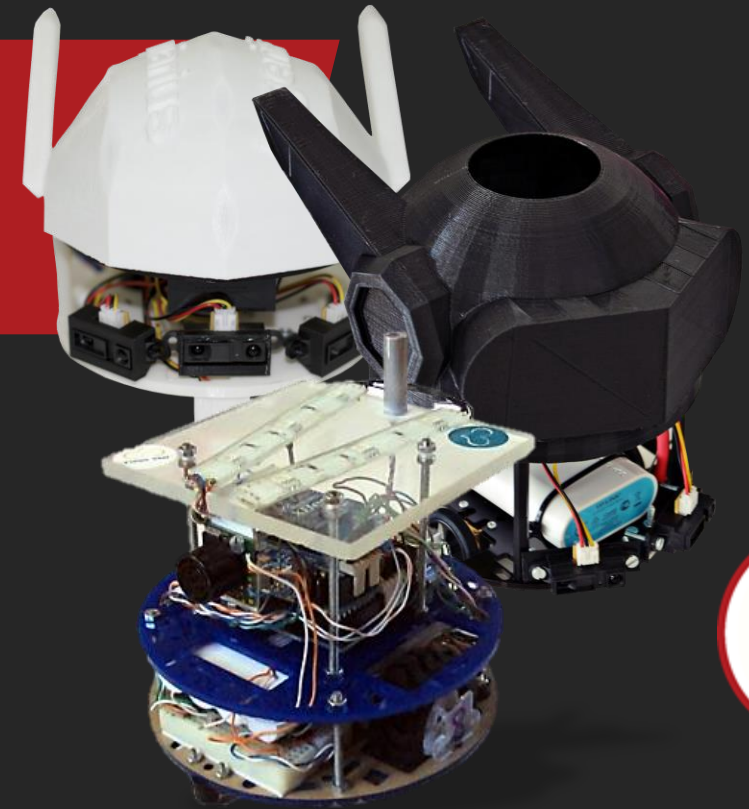


CRAFT #3

Mechatronics

Mobile Robotic Platform



André Araújo, andre@ingeniarius.pt
Miguel Araújo, miguel@ingeniarius.pt

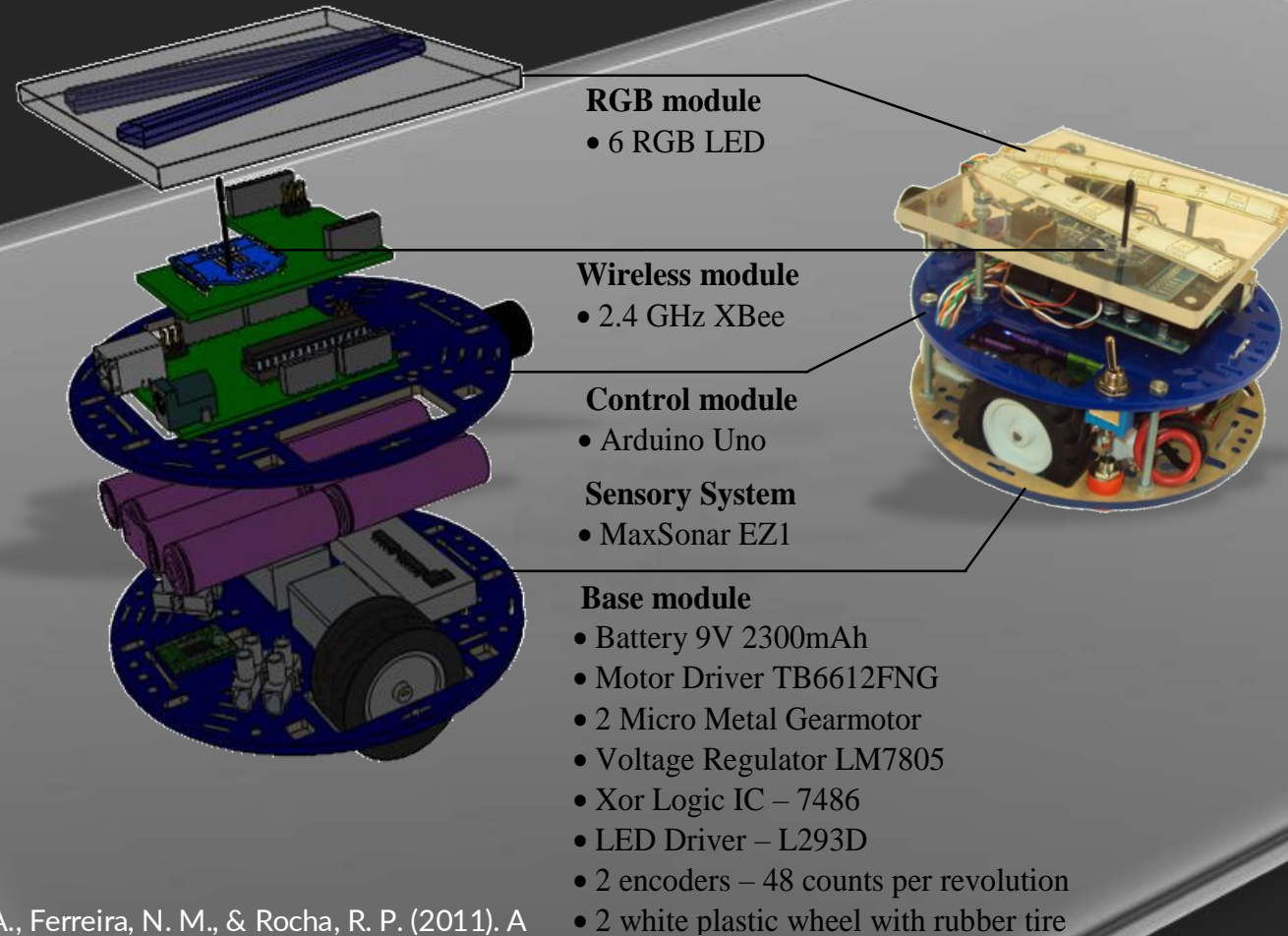
08/07/2024



OBJECTIVES

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

INSPIRATION: *eSwarBot*



INSPIRATION: *eSwarBot*



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.

ROBOT LAYOUT



Right side

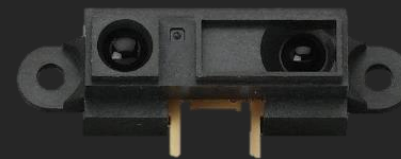


Motor R

Sensor R

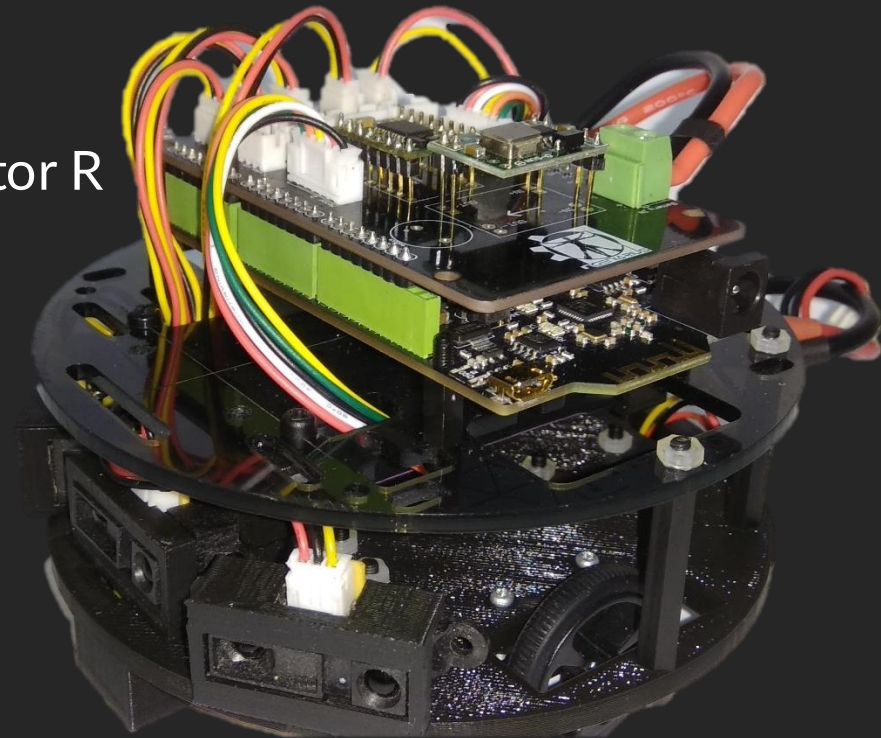


Sensor F



Sensor L

Left side



Motor L



Front 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

1x YLIDAR 360 Laser

1x DC-DC Converter w/ 2USB

1x Arduino Shield

1x Arduino Mega 2560

1x RaspberryPi 3 B+

1x 7.4V Lithium Battery

1x Power button

3x Sharp IR Sensors

2x DC Motor w/ encoder
2x Wheels

2x Castor ball



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 Screw M2.5
4x Nylon Screw M3
4x Nylon Nut M3

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

3x Sharp IR Sensors

2x Castor ball

1x YLIDAR 360 Laser

1x DC-DC Converter w/ 2USB

1x Arduino Shield

1x Arduino Mega 2560

1x RaspberryPi 3 B+

1x 7.4V Lithium Battery

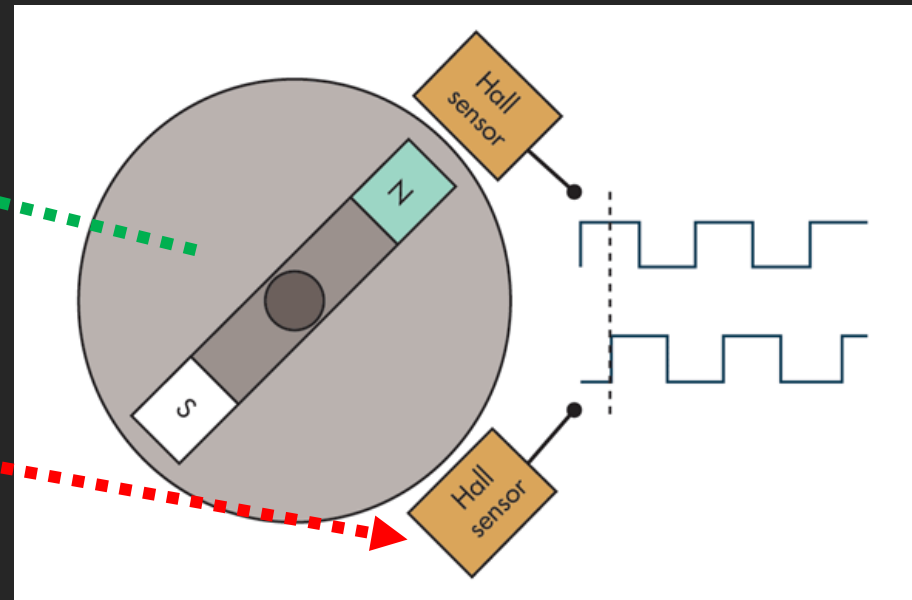
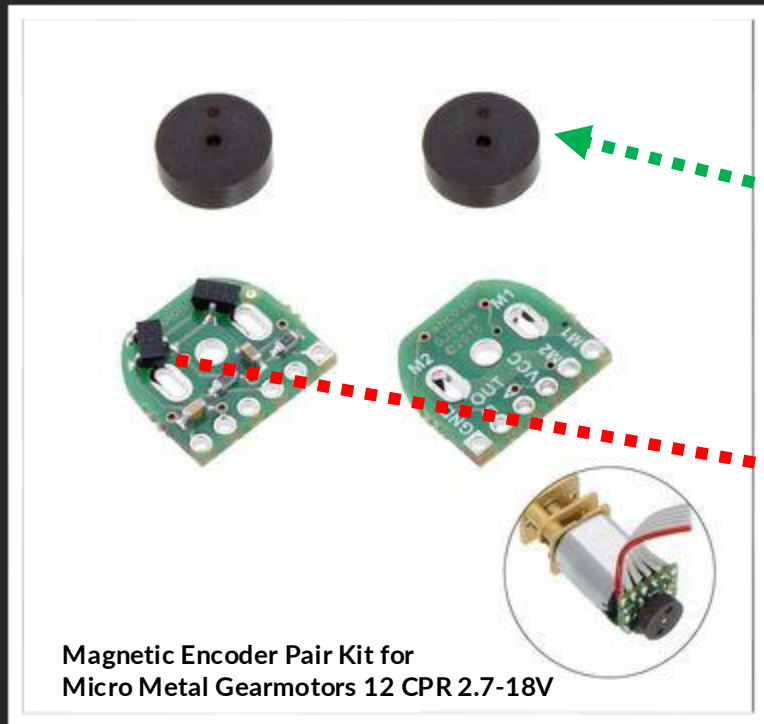
1x Power button

2x DC Motor w/ encoder
2x Wheels



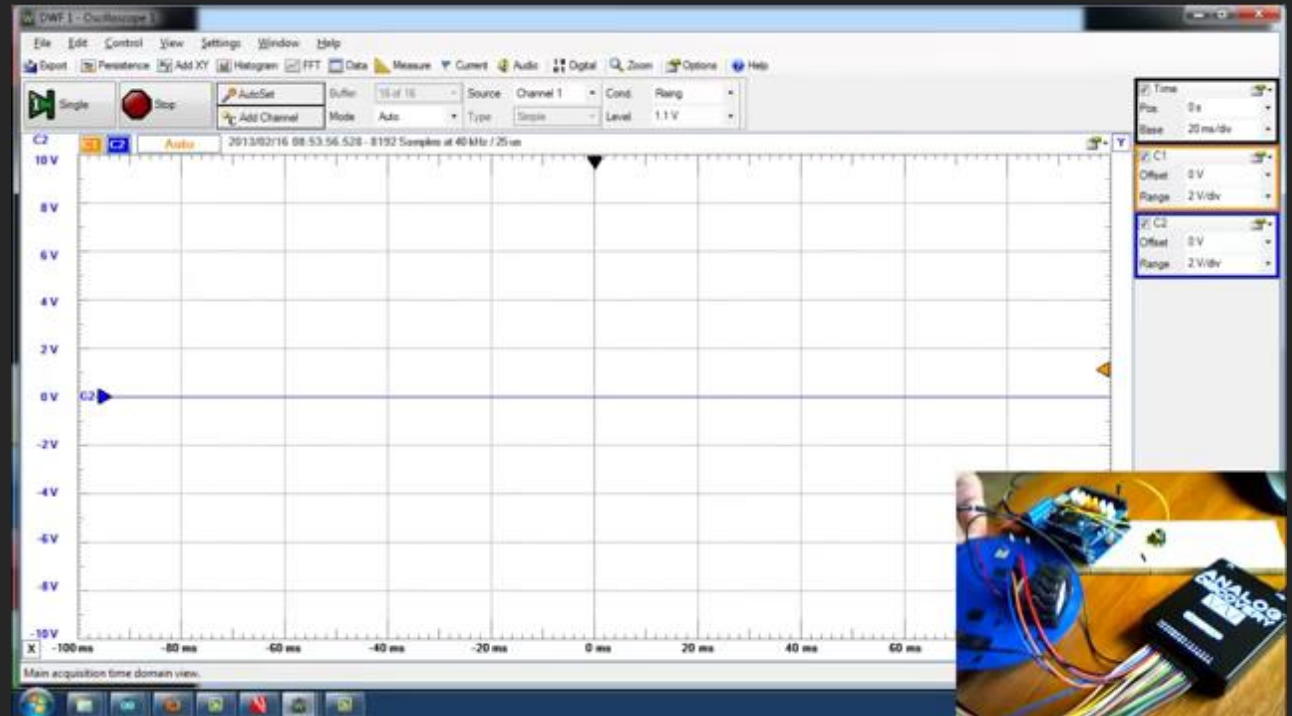
PERCEPTION - ENCONDERS

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



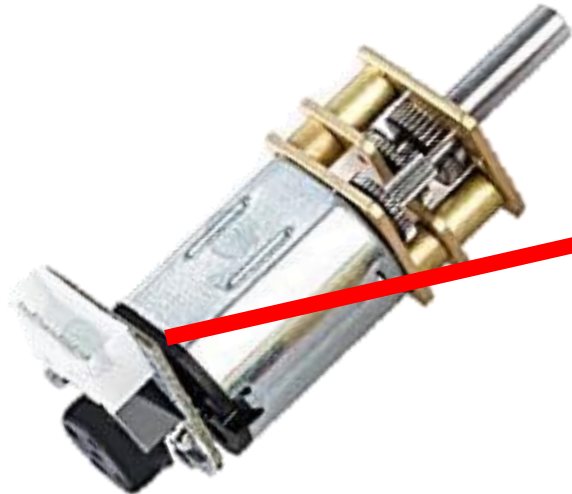
PERCEPTION - ENCONDERS

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

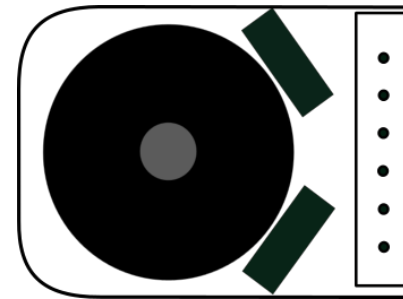


PERCEPTION - ENCONDERS

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



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



- 1.Motor +
- 2.Encoder + (3.3V/5V)
- 3.Encoder A Phase
- 4.Encoder B Phase
- 5.Encoder GND
- 6.Motor -

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 Reading: ");
    Serial.print(val);                  //Print raw analog value
    Serial.print("  Centimeter ");
    Serial.print(dist);                 //Print distance
    Serial.println("cm");               //Print centimeter abbrev
    delay(1000);

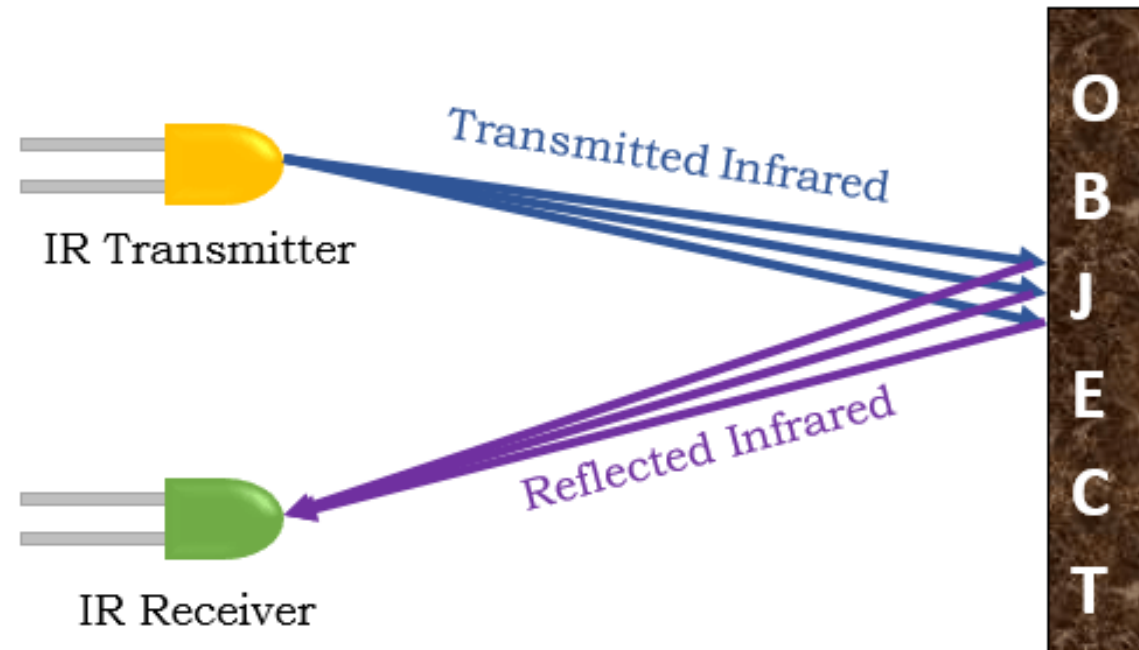
}
```

PERCEPTION – INFRARED DISTANCE SENSOR

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



Sharp GP2Y0A21YK0F
Analog Distance Sensor 10-80cm

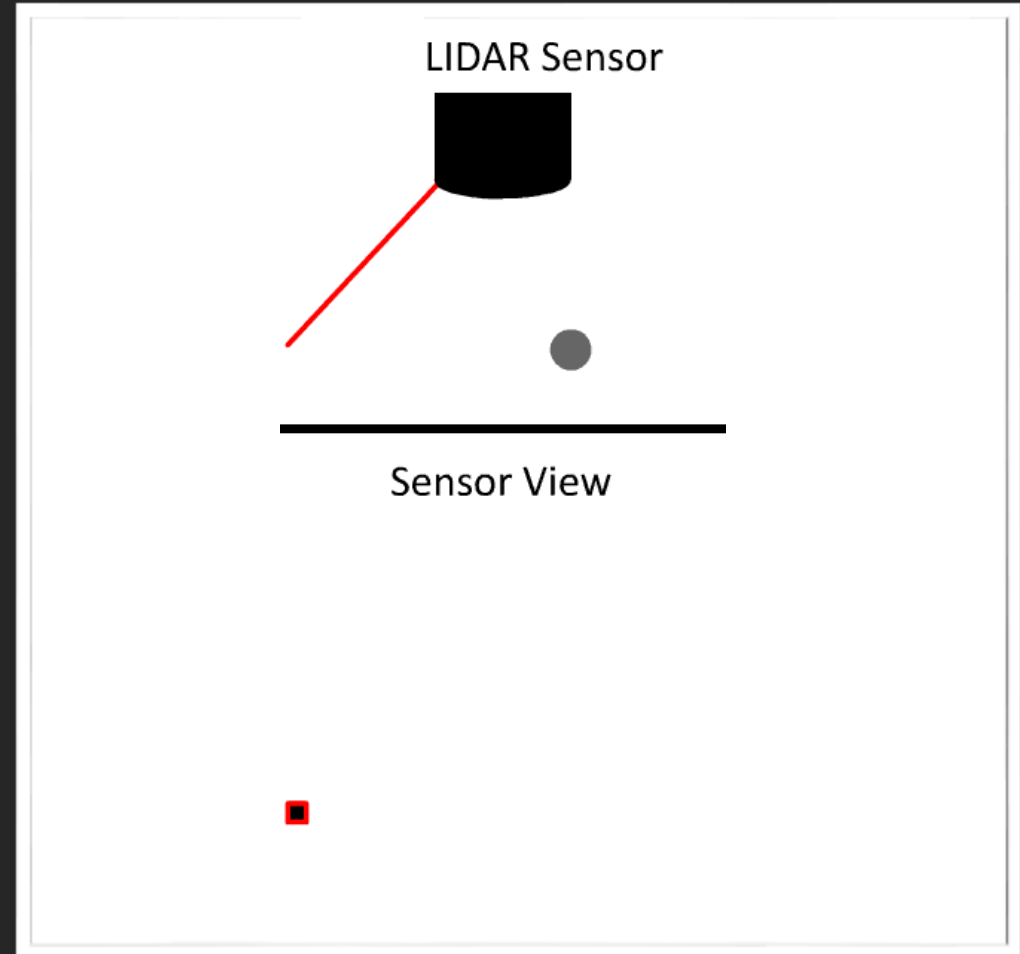


PERCEPTION – 360° LIDAR

Light Detection And Ranging



RPLIDAR

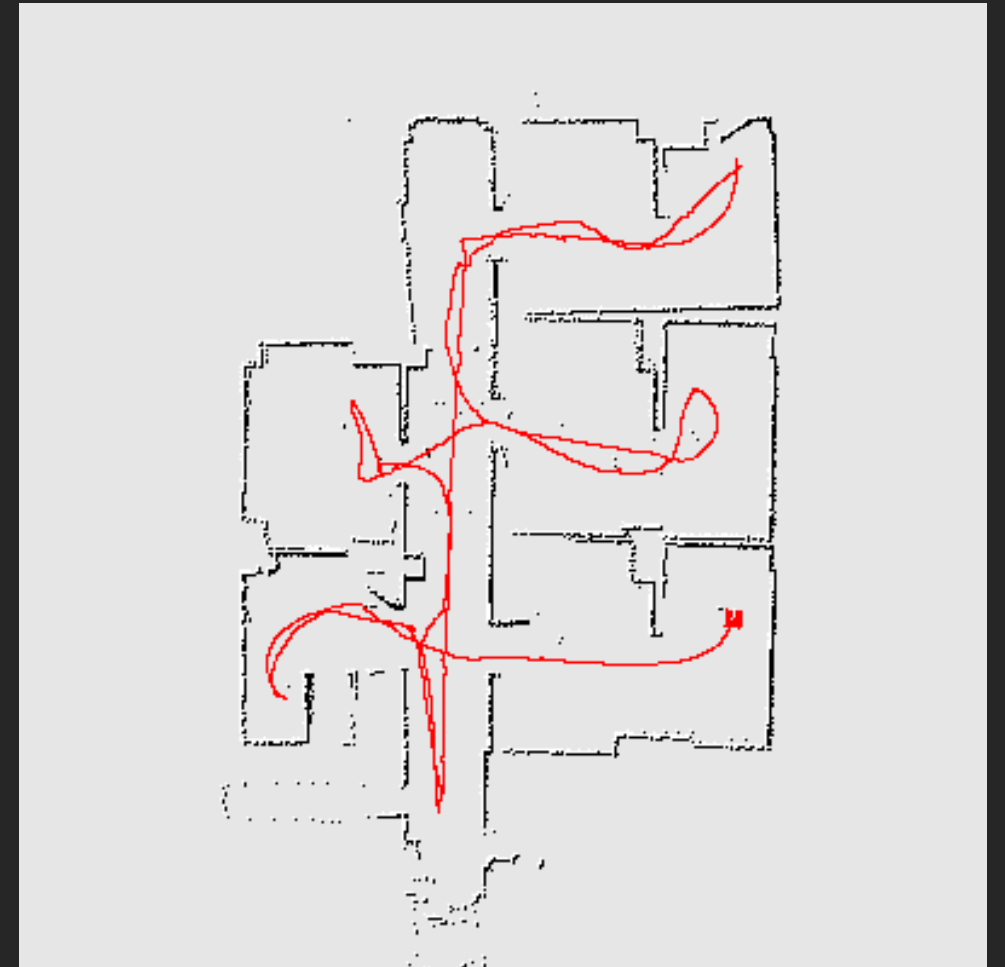
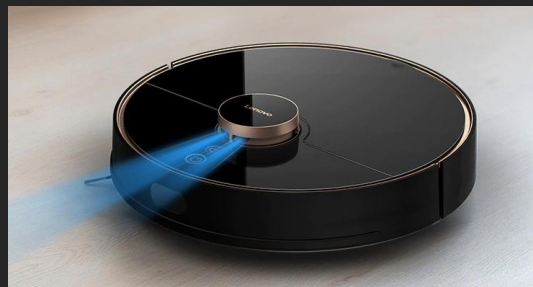


PERCEPTION – 360° LIDAR – 2D

Light Detection And Ranging

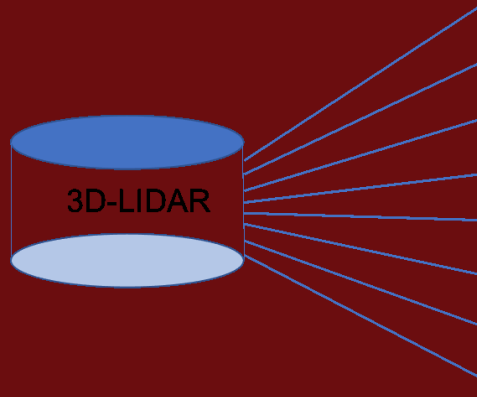


What can I use
this sensor for...?

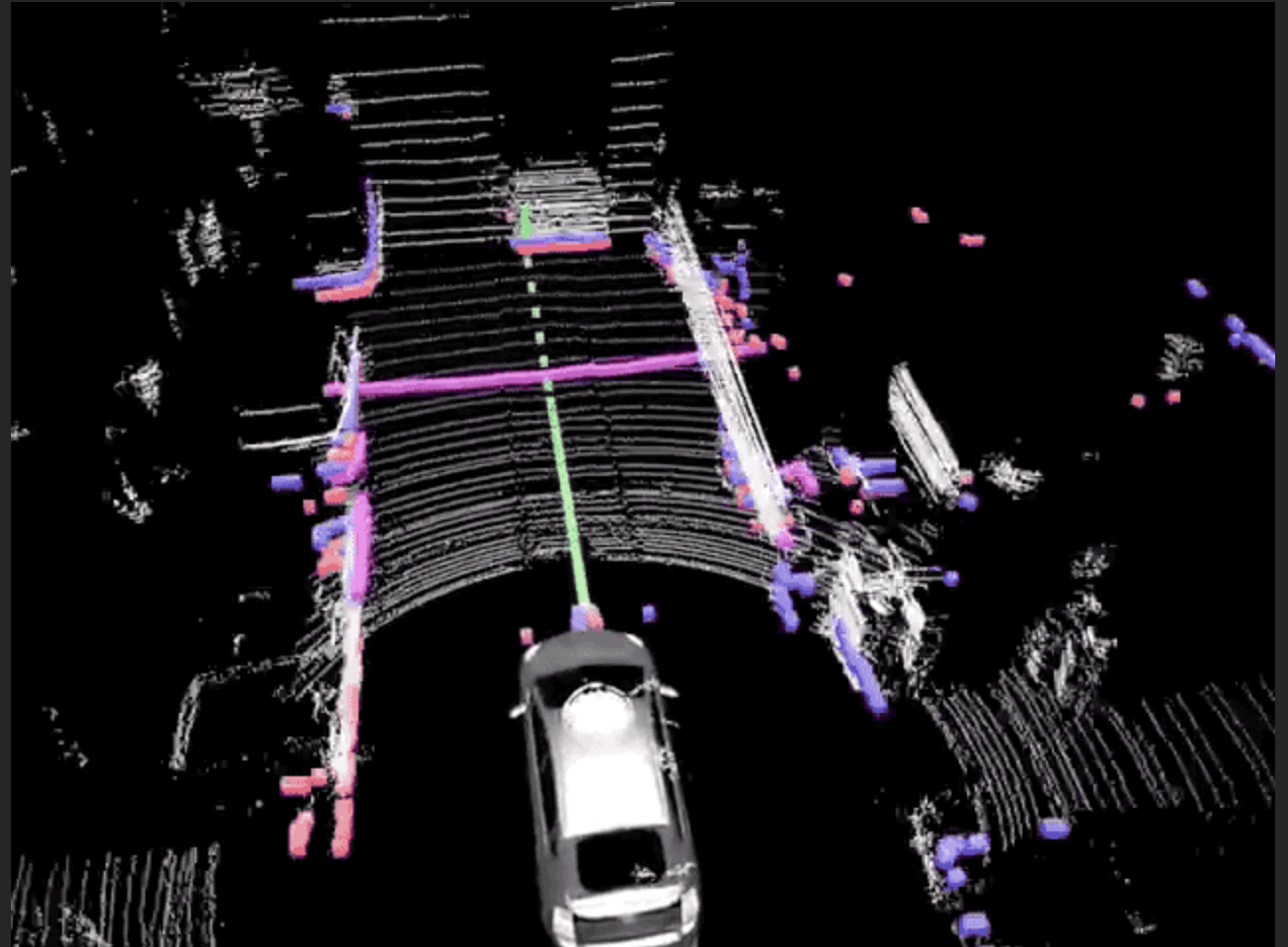
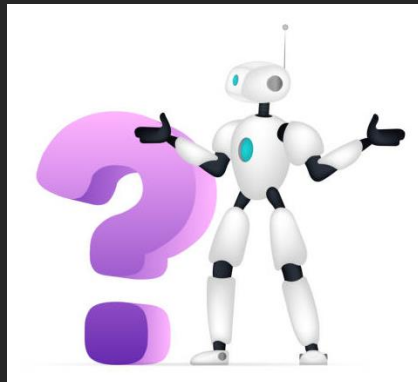


PERCEPTION – 360° LIDAR – 3D

Light Detection And Ranging

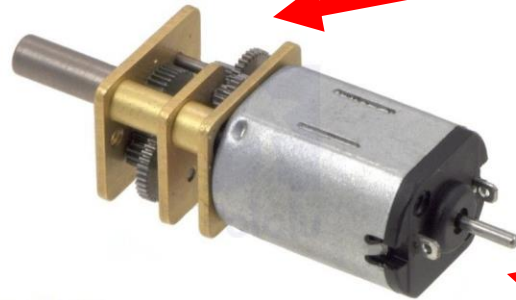


3D Scans for what??

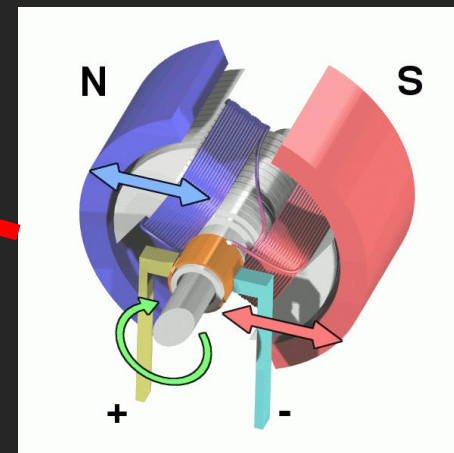
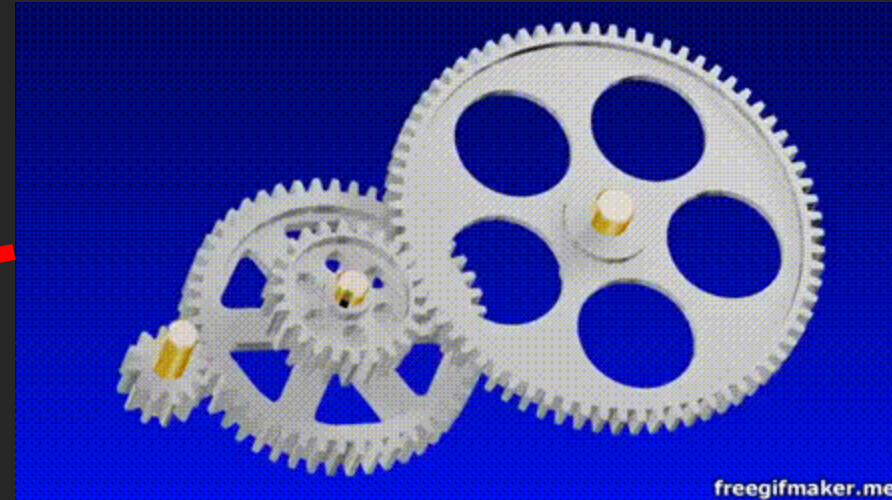


ACTION

Traction



298:1 Micro Metal Gearmotor HP
with Extended Motor Shaft

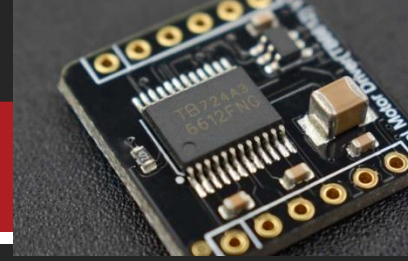


ACTION

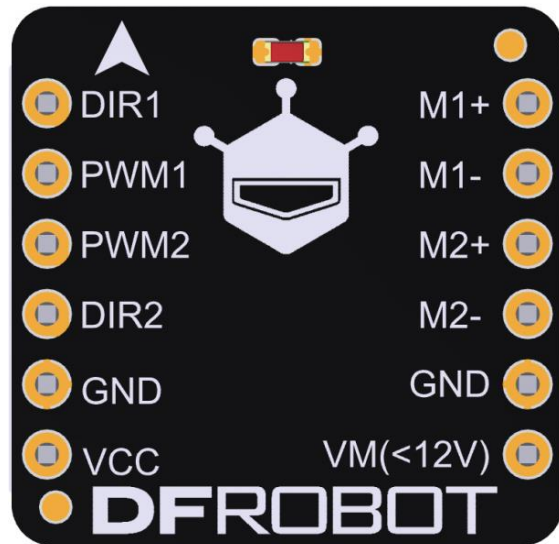
Power and Control Traction




ACTION



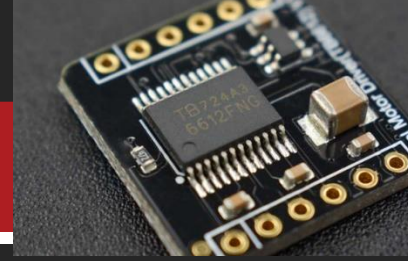
Power and Control Traction



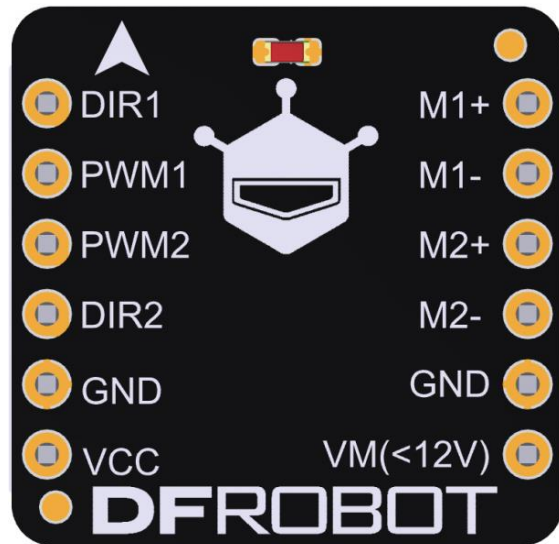
Dual DC Motor Driver (TB6612FNG)

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



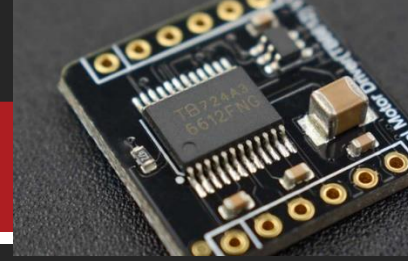
Power and Control Traction



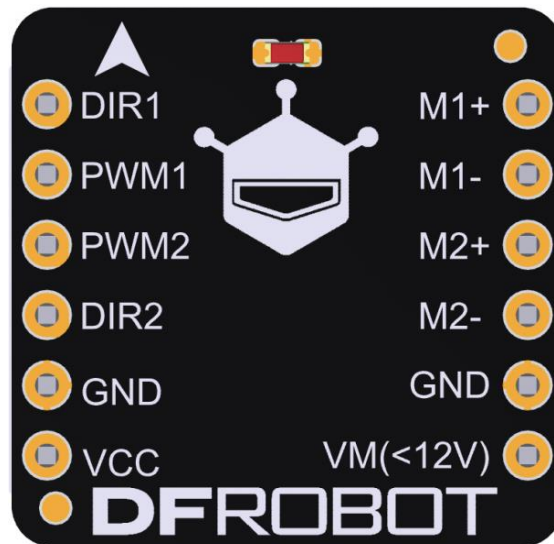
Dual DC Motor Driver (TB6612FNG)

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

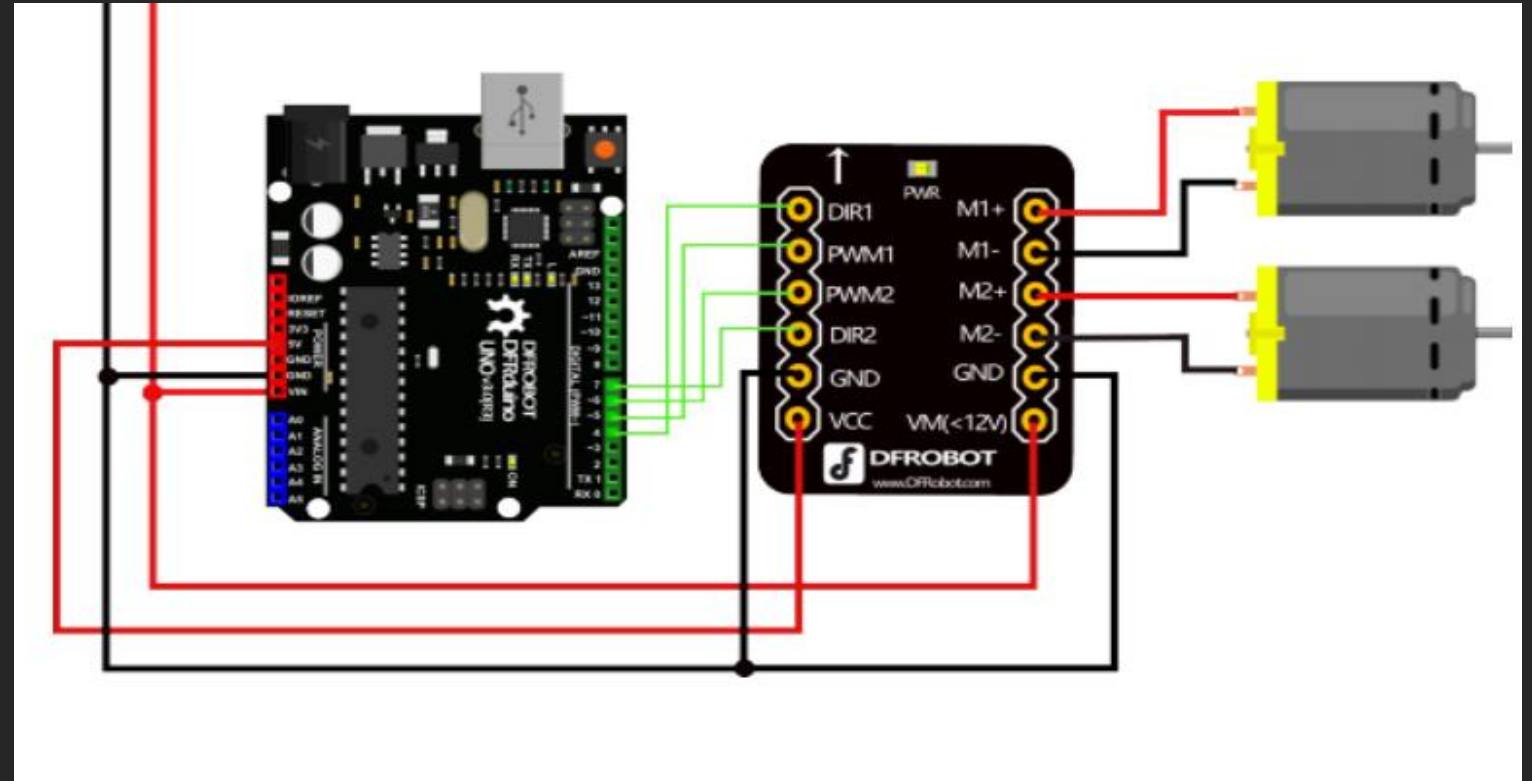
ACTION



Power and Control Traction

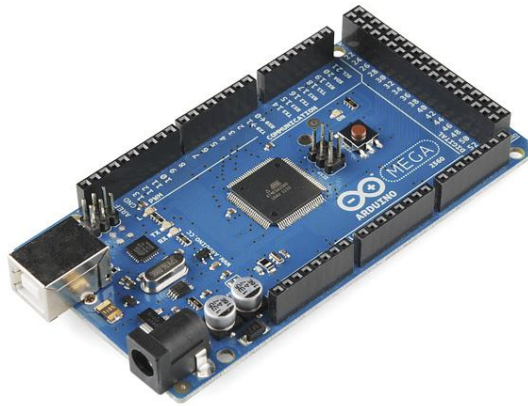


Dual DC Motor Driver (TB6612FNG)



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
DCCurrent per I/O Pin	20 mA
DCCurrent 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



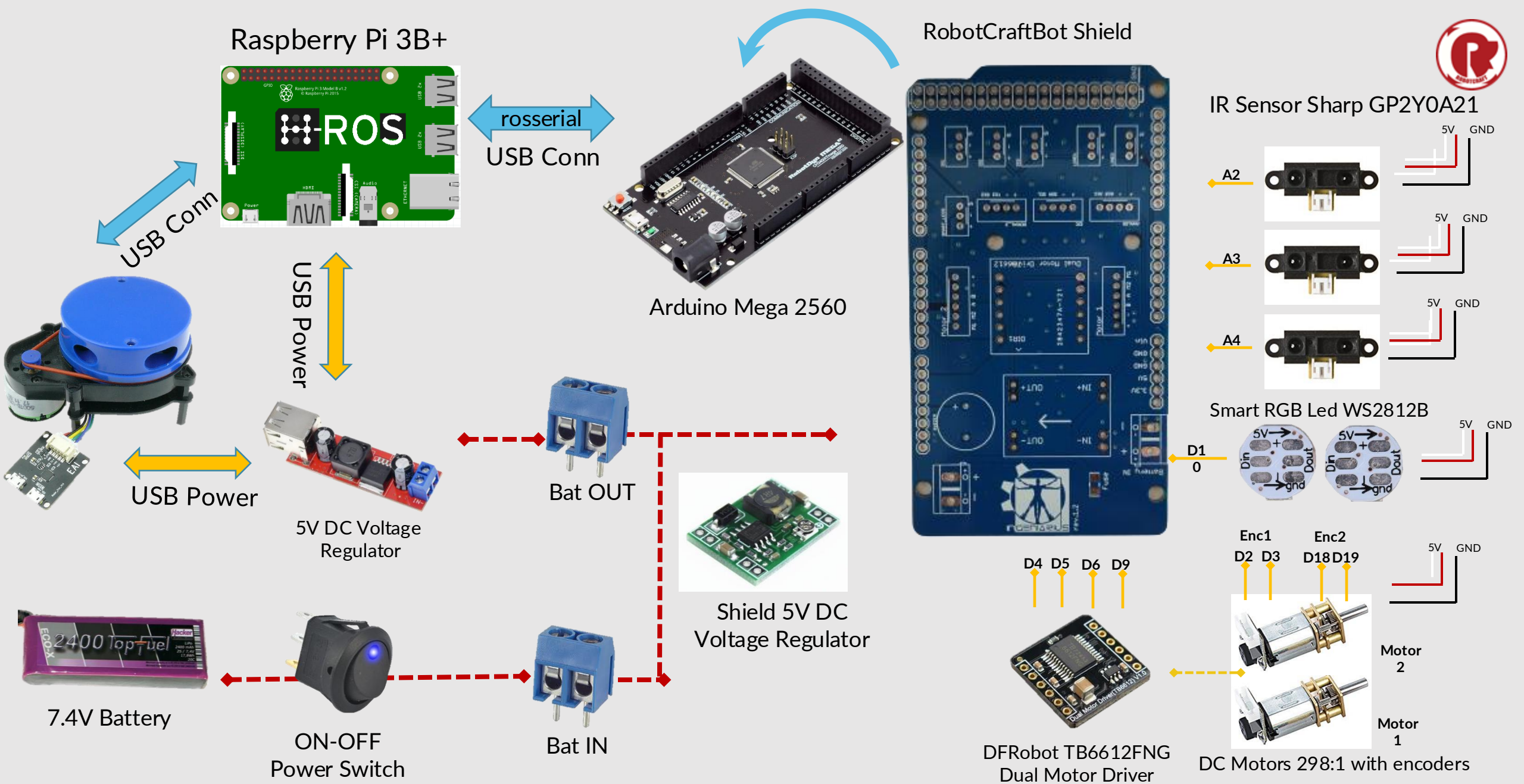
DECISION MAKING - HIGHLEVEL

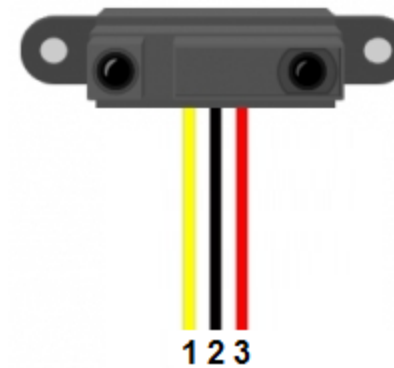
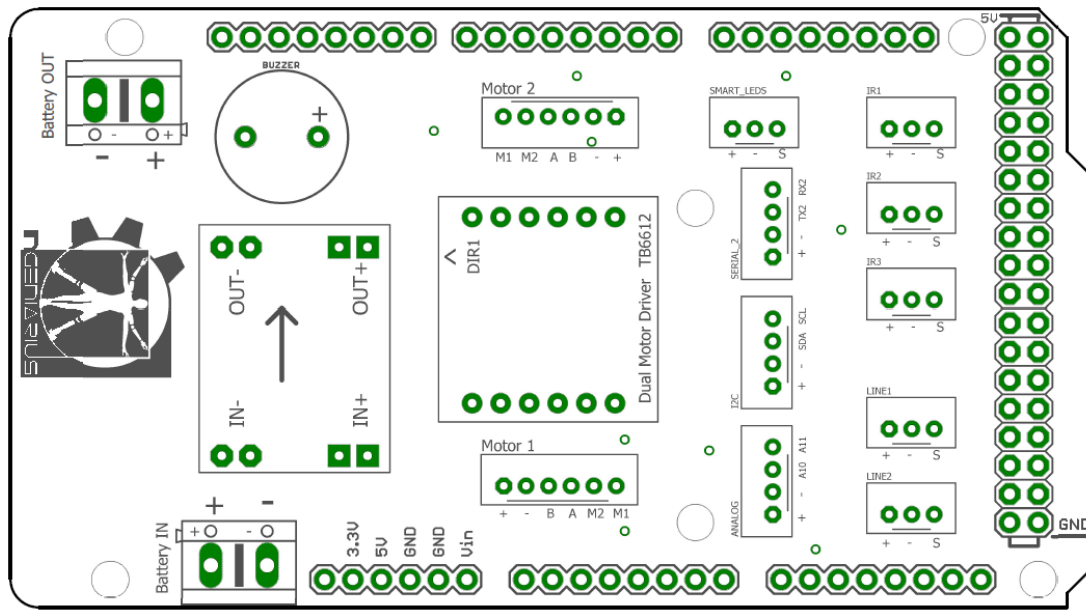
High-level Programming



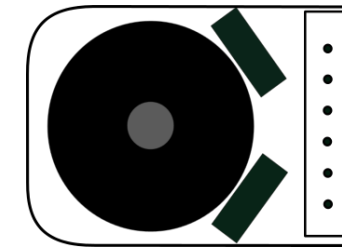
Raspberry Pi 3

SoC	Broadcom BCM2837
CPU	4× ARM Cortex-A53, 1.2 GHz
GPU	Broadcom VideoCore IV
RAM	1GB LPDDR2 (900 MHz)
Networking	10/100 Ethernet, 2.4 GHz 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)





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

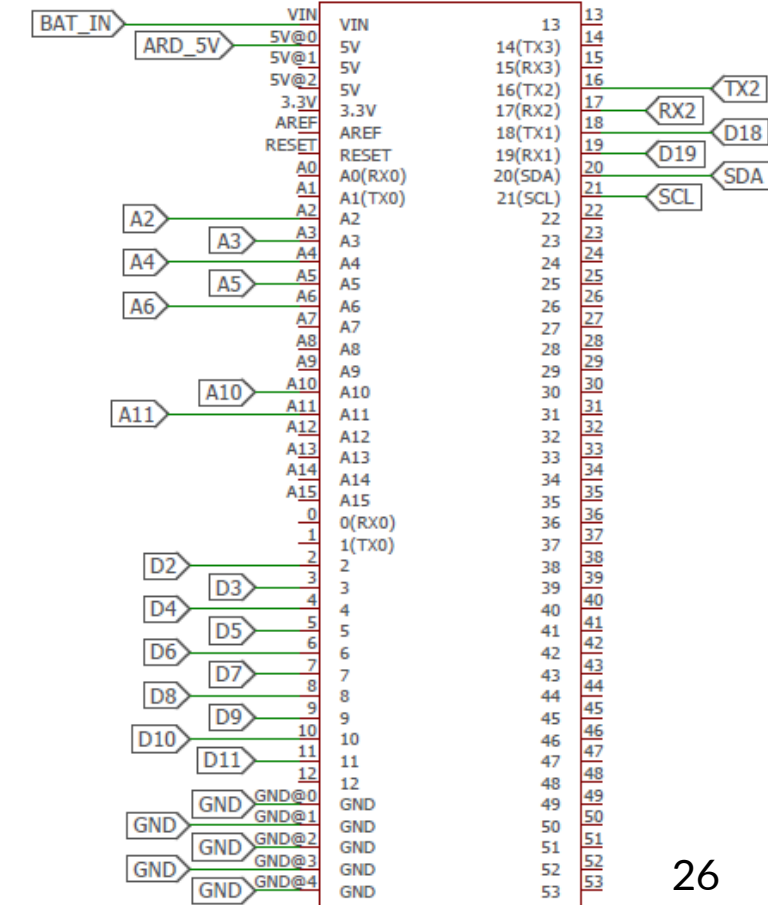


Micro Metal Gearmotor 298:1
w/Encoder

- 1.Motor M2
- 2.Encoder + (3.3V/5V)
- 3.Encoder A Phase
- 4.Encoder B Phase
- 5.Encoder GND
- 6.Motor M1



Arduino Mega 2560



THREE LAWS OF ROBOTICS

(@ROBOTCRAFT)

1.



2.

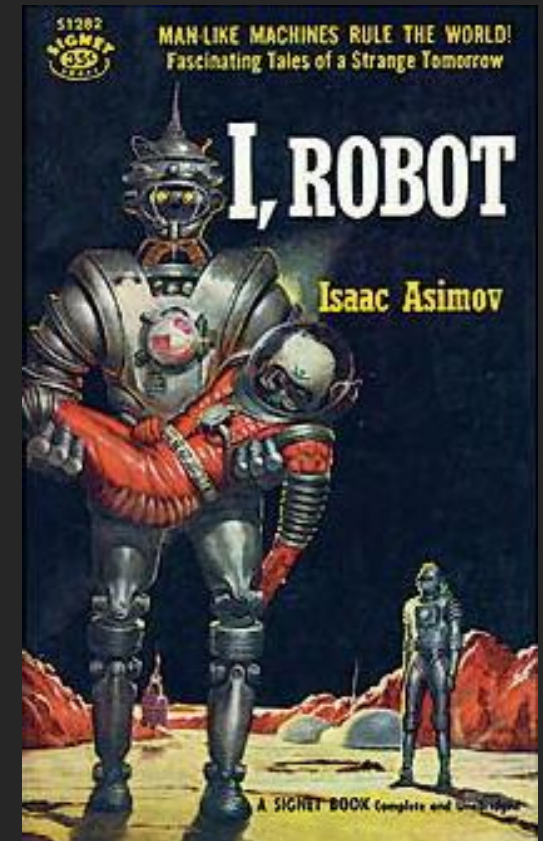


3.

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.



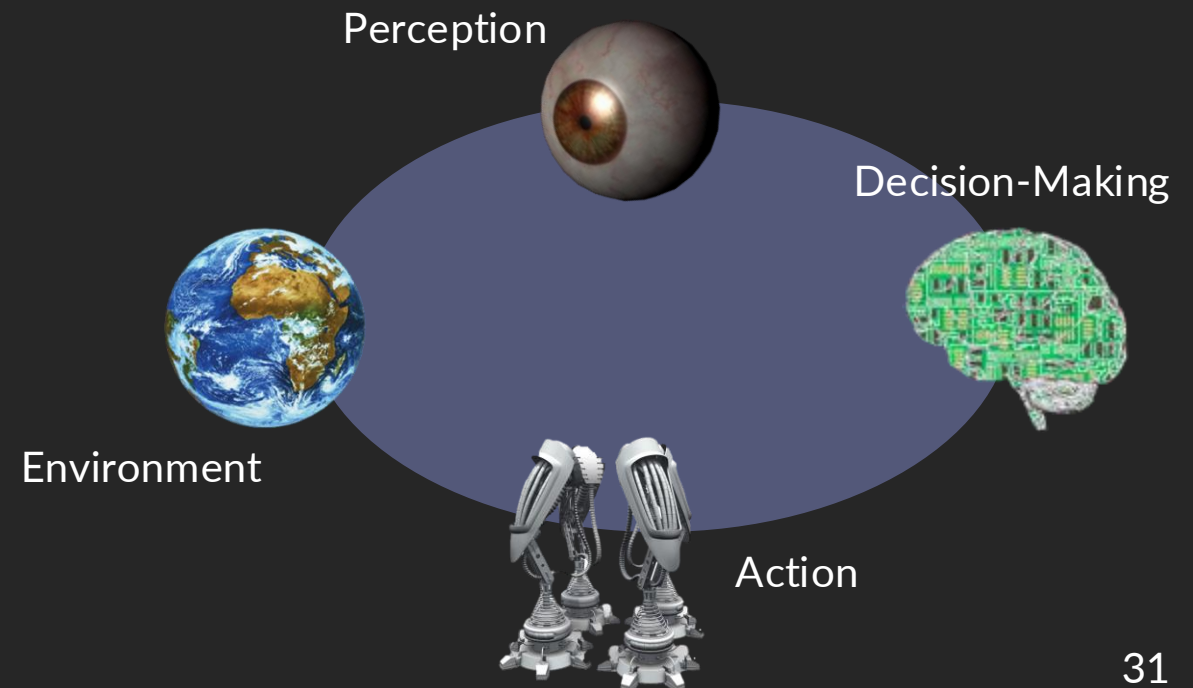
CONCLUSIONS

- 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

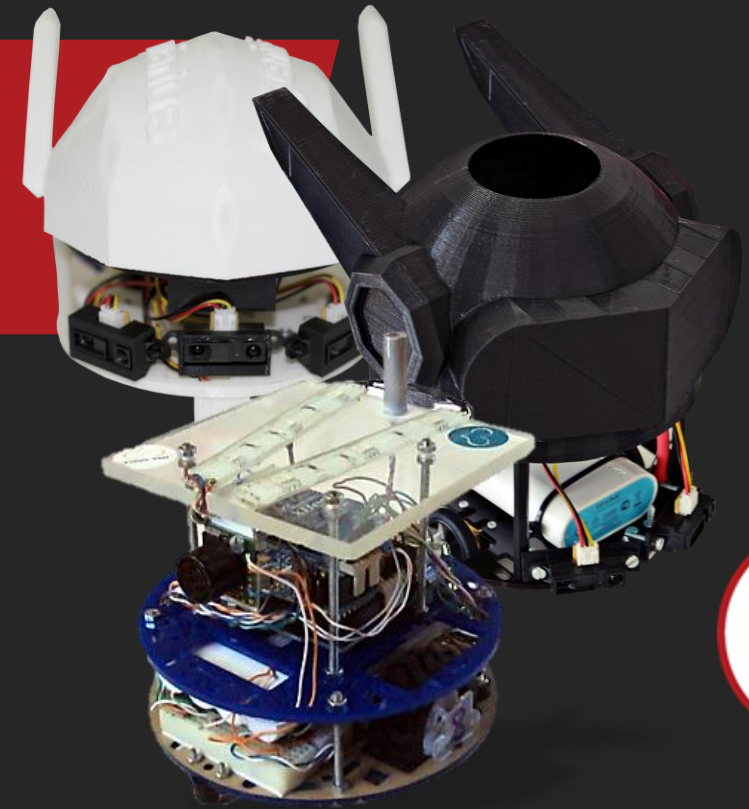
Prepare a report, **that you should maintain and deliver when fully completed by the 18th August 23h59**, starting with a description of the team, the hardware to be integrated (considering this presentation), and how you believe that it will all interconnect as an architecture to solve the maze at the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

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



CRAFT #3

Thank you



André Araújo, andre@ingeniarius.pt
Miguel Araújo, miguel@ingeniarius.pt

08/07/2024

