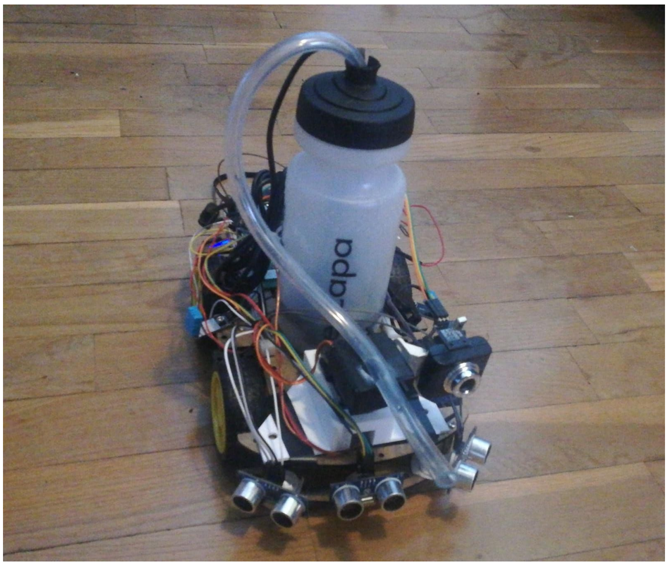
F.I.R.E

INSTRUCTABLE



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Step 1: Materials and costs.

The list of the material with their cost:

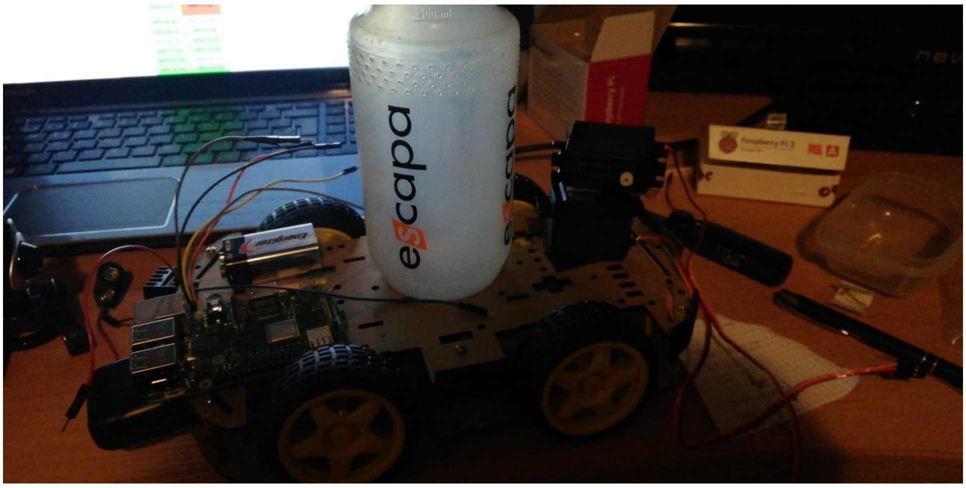
Raspberry Pi 3 B+	39,95 Eur
Ultrasound sensor HC-SR4 (x3)	7,2 Eur
Temperature and Humidity sensors DHT-11 (x2)	4,4 Eur
3V/6V Micro Electric Motor (x4)	6,40 Eur
Wheels (x4)	8 Eur
Servomotor (x2)	22 Eur
Webcam	6 Eur
IR Receiver KY-022	0,84 Eur
Motor controller L298N	6 Eur
PowerBank for Raspberry	21 Eur
Water pump	4,30 Eur
9V battery	2 Eur
Water bottle	5 Eur
Base for the robot	20 Eur
Transistor	0,27 Eur

All the products are able in online shops, and there are many of them like webcam, water bottle or 9V battery that it is possible that all people have in their house.
I have to say that there are many objects that I have reused from another projects that I did in the past.

Step 2: Build the base of the robot.

To build de base of the prototype it is important that the base with the motors and wheels let us to put the others electronic components on them. Like in the photo. There are many robot bases built that you can buy. In my case I reuse this one from another project.

The base of the robot must let you put all the components in the right place. In my case the distribution is: the ultrasound sensors, the webcam with the servomotors and the IR Receiver in the front, the water bottle (water pump is inside) in the middle and the Raspberry, temperature sensors one in each side of the robot, motor controller and the powerbany and batteries in the back.

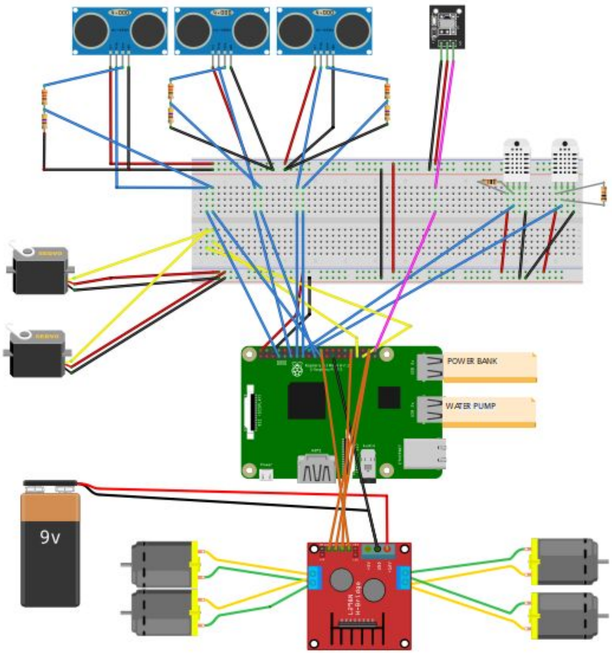


In the picture, there aren't all the components but it is an idea of the distribution that I used.

Step 3: Electronics.

In this step we have to connect all the components in the Raspberry Pi 3 B+, so to make it easier we did a table with all the pins of the raspberry and where are connected the components. It is important that the pin's distribution are as equal as this distribution because if not is the same then the code of the project will not work well. If you have to change a pin, then you have to change it in the code too.

TempSensor + IR Sensor	PWR 3.3 V (1)	PWR 5 V (2)	ROJO ServoMotor UD+US
Echo (UltrasoundSensorLeft)	GPIO 02 (3)	PWR 5 V (4)	ServoMotorLR ++SensorHumTemp
Trig (UltrasoundSensorLeft)	GPIO 03 (5)	GROUND (6)	
Echo (UltrasoundSensorCenter)	GPIO 04 (7)	GPIO 14 (8)	Data (SensorHumTempLeft)
	GROUND (9)	GPIO 15 (10)	Data (SensorHumTempRight)
Trig(UltrasoundSensorCentr)	GPIO 17 (11)	GPIO 18 (12)	ENA (MotorController)
Echo(UltrasoundSensorRight)	GPIO 27 (13)	GROUND (14)	
Trig(UltrasoundSensorRight)	GPIO 22 (15)	GPIO 23 (16)	
	PWR 3.3 V	GPIO 24 (18)	
Data IR Sensor	GPIO 10 (19)	GROUND (20)	
Pin ServoMotorUpDown	GPIO 09 (21)	GPIO 25 (22)	
Pin ServoMotorLeftRight	GPIO 11 (23)	GPIO 08 (24)	
	GROUND (25)	GPIO 07 (26)	ENB (MotorController)
	ID SD (27)	ID SC (28)	
IN1 (MotorController)	GPIO 05 (29)	GROUND (30)	
IN2 (MotorController)	GPIO 06 (31)	GPIO 12 (32)	
IN3 (MotorController)	GPIO 13 (33)	GROUND (34)	
IN4 (MotorController)	GPIO 19 (35)	GPIO 16 (36)	
ON/OFF transistor WaterPump	GPIO 26 (37)	GPIO 20 (38)	
	GROUND (39)	GPIO 21 (40)	



Step 4: Wiring and building.

With all the electronic components connected in the Raspberry Pi 3 B+ we have to put the voltage and ground wires. We recommend joining all the grounds on the same ground pin using a protoboard maybe and do the same for the voltage pins that goes to the voltage's pins of the raspberry (always paying attention and connecting in the pin that we indicate in step 3). Then we have to connect the micro electric motors to a 9V battery.

It is important to know that our water pump were connected with usb but this has a problem, that we cannot control when the water pump starts to shoot water. So to solve this problem you have to cut usb wire and catch only the voltage and ground wire of the water pump and connect the voltage wire to the 9V battery, and the ground to a transistor to make us able to control de water pump. And in the transistor are connected a ground wire to raspberry and a pin wire to a raspberry like in the step 3.

When this is did it, we can start building and fixing all the components with loctite, bluetack, screws or using 3D pieces. We used a 3D pieces to fix the servomotors, we put the stl file with the source code.

Step 5: Remote control.

To make the robot “wireless” we have to control the Raspberry in a remote way, so I did it using VNC.

The VNC Server is a program that in Raspberry Pi 3 B+ is installed and let us to control the Raspberry remotely and in a graphical way.

The first thing that we have to do is install VNC Viewer in our laptop. When this is finished we only have to put the IP of our Raspberry in the VNC Viewer, if you do not know the IP use the command ifconfig, and then put the user and the password and the connection is established and we can control the raspberry from our laptop remotely.

Here there is a link where explains how to do the remote control:
https://www.raspberrypi.org/documentation/remote-access/vnc/

Step 6: Testing components.

Having done all the previous steps, we can do test for all the components to make us sure that individually they are working well before test all the project with all the components working together.

To test the components you have to run the files of our source that are named like *“main_*name of the component*TEST.py”* and watch and analize the results to know if the components is working well.

If one or many components are not working in the correct way, I recommend you that check the step three and the step four because it would be for two of these reasons: the component is not connected with the correct pins or the wires of pin, voltage or ground are not well connected.

To have access to all the code of this project you can download it from:
https://github.com/creusvictor/F.I.R.E

Step 7: Conclusion.

In this step all the components are working well and we have to do that the components work together to have a firefighting robot, so we have two modes for the robot:

- Manual: In this mode you can control all the functions of the robot with the keyboard of your laptop. If you press W, S, D, A, Q keys, the robot starts moving forward, backward, right, left and stop respectively. If you press T, Y keys the robot measure the temperature and the distance respectively. To run the webcam you have to press V key and the arrows keys to control the differents views and press O key to take a picture and apply DARKNET to recognize objects. And to shoot water you have to press the space key. To run this mode *"main_Main.py"*.

- Automatic: in this mode the robot collect all the information of the distance of the obstacles, the temperature of the two side to search where the fire is and shoot water to put out the fire. To run this mode *"main_Auto.py"*. Maybe for this mode you have to install OpenCV and numpy in python.

To include in this project the Darknet and Yolo functions you have to follow this steps and install darknet in the folder where the project is.
The steps are here: https://pjreddie.com/darknet/install/