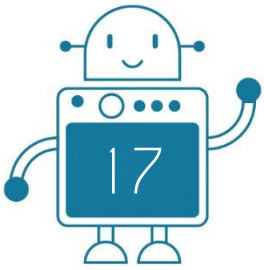


THERMOSTAT

STEMJAM Teaching Guide

Developing make spaces to promote creativity around STEM in schools

Acronym: STEMJAM
Project no. 2016-1-ES01-KA201-025470

www.stemjam.eu

Co-funded by the Erasmus+ Programme of the European Union

THERMOSTAT

ABSTRACT

The activity consists in the students learn the different temperature scales (celsius, kelvin and fahrenheit).

The mini fan pack of mBot will also be used to complement the activity

DIDACTIC OBJECTIVES

ENGINEERING and SCIENCE:

- Concept of temperature. Temperature scales. Celcius scale.
- Design of structures:
  - Stability: concepts of inertia and center of gravity.
  - Choice of the most suitable structure for the assembly of the chosen components and sensors.
  - Assembly of the structure.
- Reference systems: positioning in a reference system.

TECHNOLOGY:

- Temperature sensors. PTC sensors and NTC sensors. Variable resistance depending on the temperature Applications of sensors to automate processes.
- Introduction to computational thinking.
- Assimilation, creation and programming of algorithms, to decompose complex problems into ordered sequences of simple instructions, which solve it.

STEM Subject: Science☒ Technology ☒ Engineering☒ Mathematics☐

Education Level: 12-14 years☐ 14-16 years☒

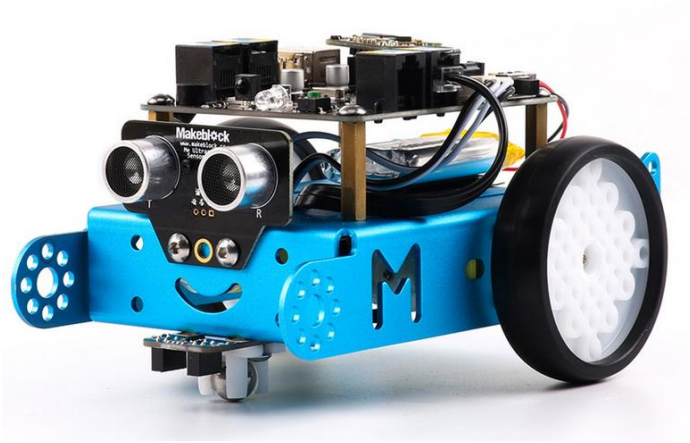
PROBLEM STATEMENT

Students need to know the different temperature scales, to compare them correctly.

Knowing the temperature of different elements, such as the temperature of the PC or a cup of coffee, students will implement a self-contained fan that will activate when it detects too high a temperature.

BOM (Bill of Materials Needed)

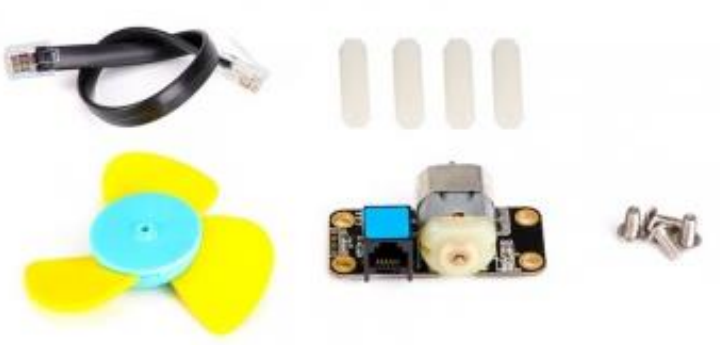
- mBot => Ref. 90054



- Me **LED Matrix 8 × 16:**

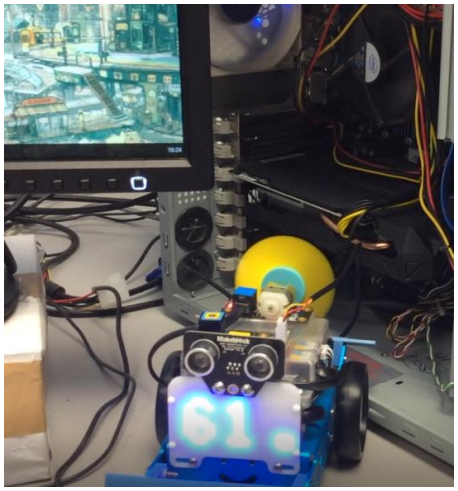
- Me **Temperature** Sensor:

- **Mini Fan** Pack:



❖ Hot Cup of Coffe:

❖ A PC:



First version

ELEMENT	ID	CABLE	AMOUNT	PORT 1			PORT 2			PORT 3				PORT 4				P.MOT1	P.MOT2
				Y	B	W	Y	B	W	Y	B	W	Bl	Y	B	W	Bl	W*	W*
Mbot Robot 2´4G			1																
Motor 1	W*																	W*	
Motor 2	W*																		W*
Me RJ 25 adapter	Y																		
	B																		
	Bl																		
Mini Pan-Tilt kit It has 2 servos. We have to connect the servo to a RJ25 adapter																			
Mini Gripper We have to connect the servo to a RJ25 adapter																			
Me 7-Segment serial display	B																		
Me Led Matrix 8x16	B	(1)	1												B				
Me Ultrasonic sensor	Y																		
Me Temperature Sensor - Waterproof	Y	(1)	1							Y									
Me Line Follower	B																		
Me Flame sensor	Bl																		
Me PIR Motion sensor	B																		
Me Sound sensor	Bl																		
Me Touch sensor	B																		
Mini Fan Pack	B	(1)	1					B											
Me Temperature and Humidity sensor	Y																		
Me 130 Motor Fan Pack	B																		
RJ25 cables			3																
Structures and beams																			
Laptops			1																
Attrezzo (not essential)																			

Second version

ELEMENT	ID	CABLE	AMOUNT	PORT 1			PORT 2			PORT 3				PORT 4				P.MOT1	P.MOT2
				Y	B	W	Y	B	W	Y	B	W	Bl	Y	B	W	Bl	W*	W*
Mbot Robot 2´4G			1																
Motor 1	W*																	W*	
Motor 2	W*																		W*
Me Temperature sensor Waterproof We have to connect the servo to a RJ25 adapter			1																
Me RJ 25 adapter	Y	1	1	Y	B														
	B																		
	Bl																		
Me 7-Segment serial display	B	1	1								B								
Me Led Matrix 8x16	B	1	1					B											
RJ25 cables			3																
Structures and beams																			
Laptops																			
Attrezzo (not essential)																			

ACTIVITY DESCRIPTION

First version

The first step, will be known the different temperature scales (Celsius, Fahrenheit and Kelvin):

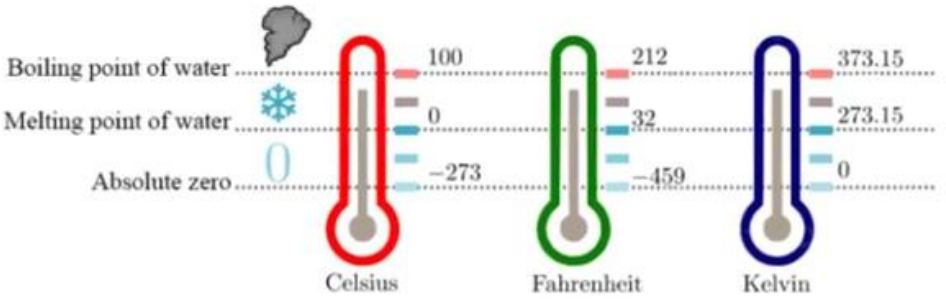
1. What is the temperature?
   - Temperature is a physical quantity that measures the amount of heat in a body, object or environment and is measured with a thermometer.

2. Temperature Scales:
   - The thermometer measures at different scales depending on the reference value it has for the freezing point and the boiling temperature of the water.

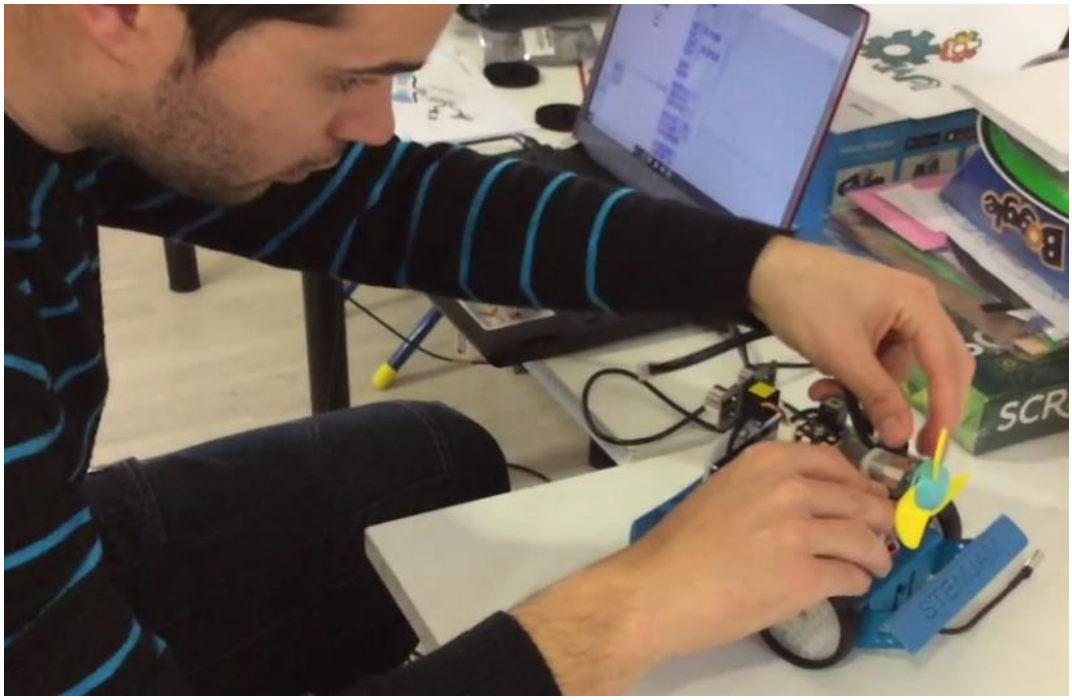
   - CELSIUS SCALE, the melting temperature of the ice is 0°C and the boiling temperature of the water is 100°C.

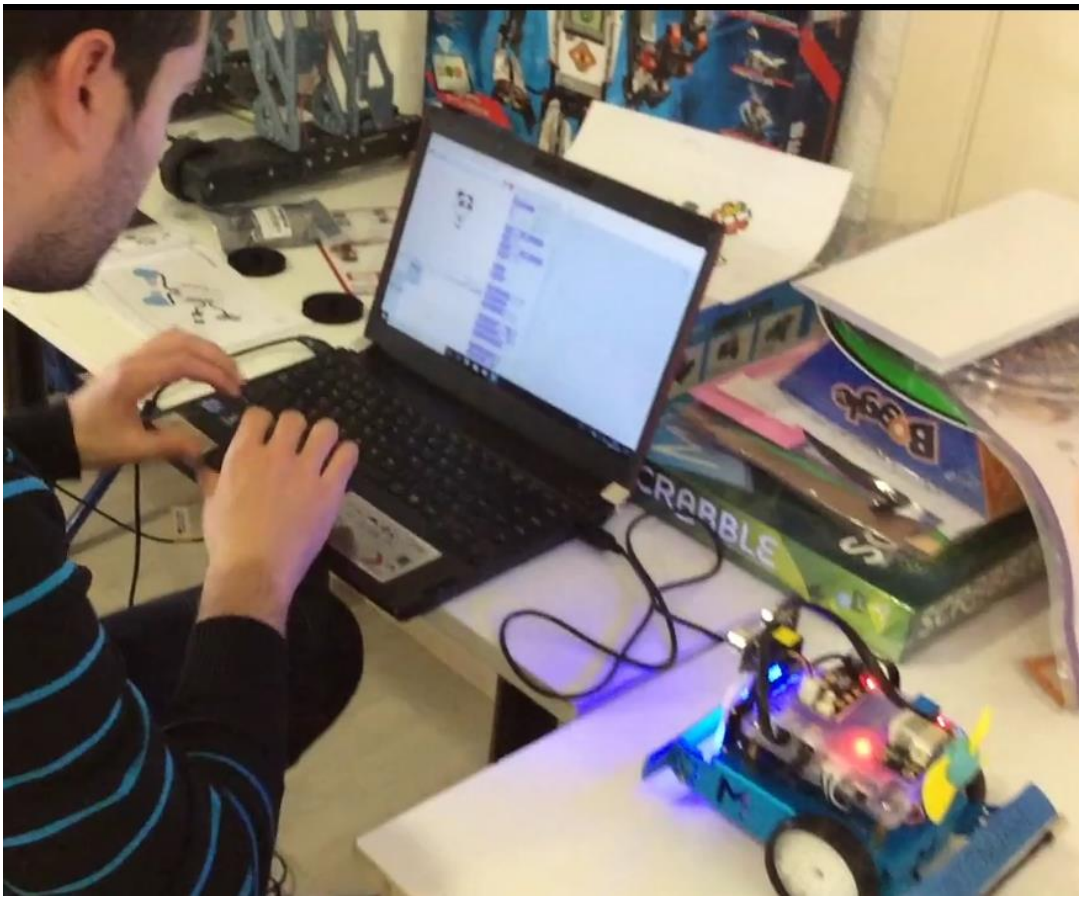
   - FAHRENHEIT SCALE, fusion takes place at 32°F and boiling at 212°F.

   - KELVIN SCALE starts at the lowest possible temperature and theoretically achievable, called absolute zero or 0°K (-273.15°C or -460°F), to which the particles stop moving.

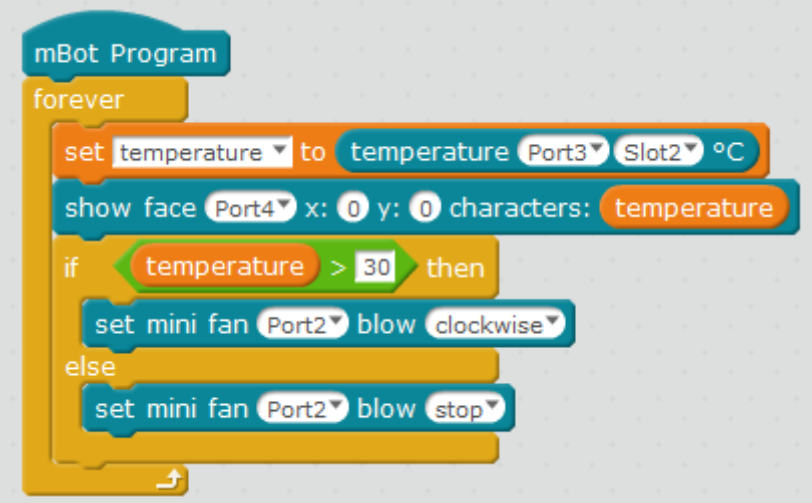


Once the scales are known, we now incorporate the mini fan pack to the mBot:



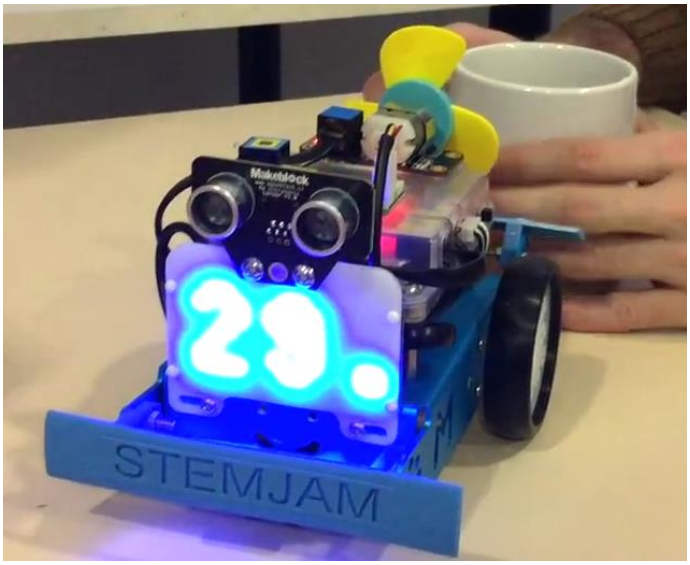


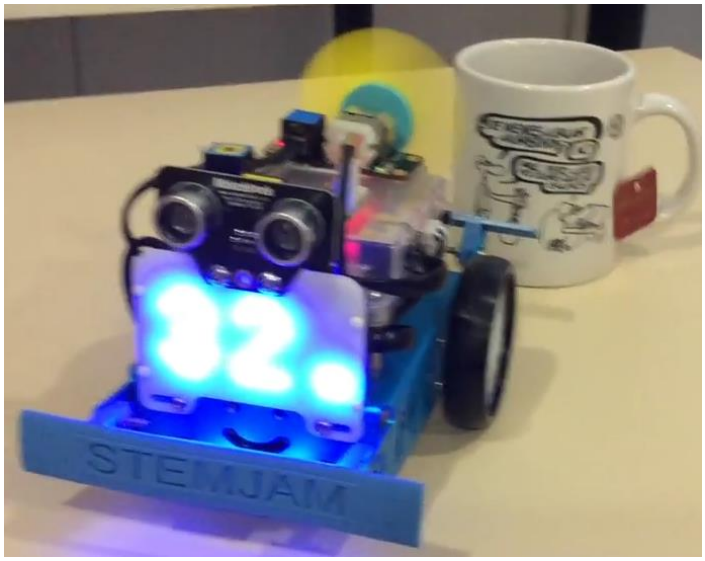
Now, we start to program the code:



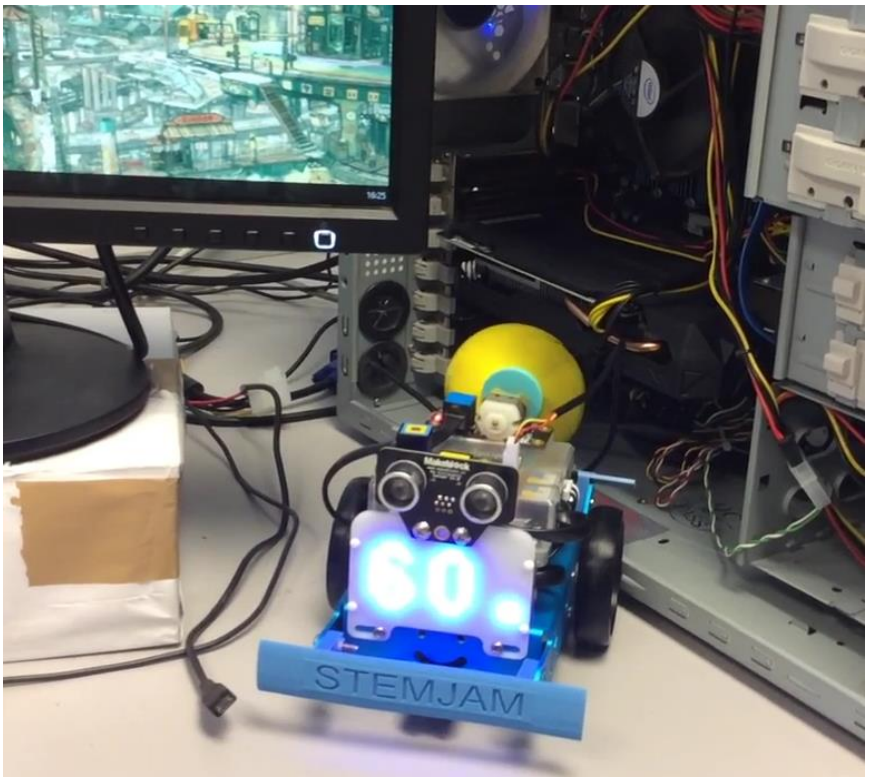
As you can see, it is a simple code, where the variable "temperature" will be determined by the sensor "Me Temperature Sensor".

When the temperature is higher than the set value, in this case 30 degrees, which will serve for the example of the coffee cup, the fan will activate when the temperature is higher than 30, and when the temperature is lower it will descend.





Another example would be to measure the temperature of the PC, when the sensor detects an elevated temperature it will start working until the temperature descend.


60.
STEMJAM

Second version

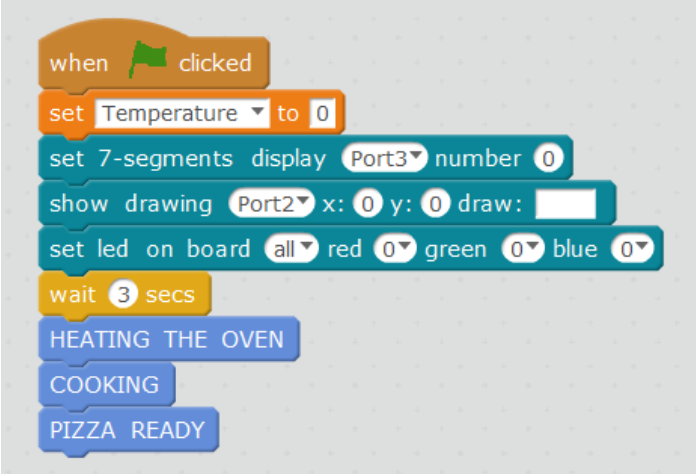
This activity consists of automating a process: the heating of an oven besides the cooking of a pizza.

To achieve this goal, students will have to design everything related to the programming of the temperature sensor (how it works, digital or analogical, adapters…). In addition, they will have to program different sounds and light effects for the activity.

After all these technical tasks, we start with the PROGRAMMING.

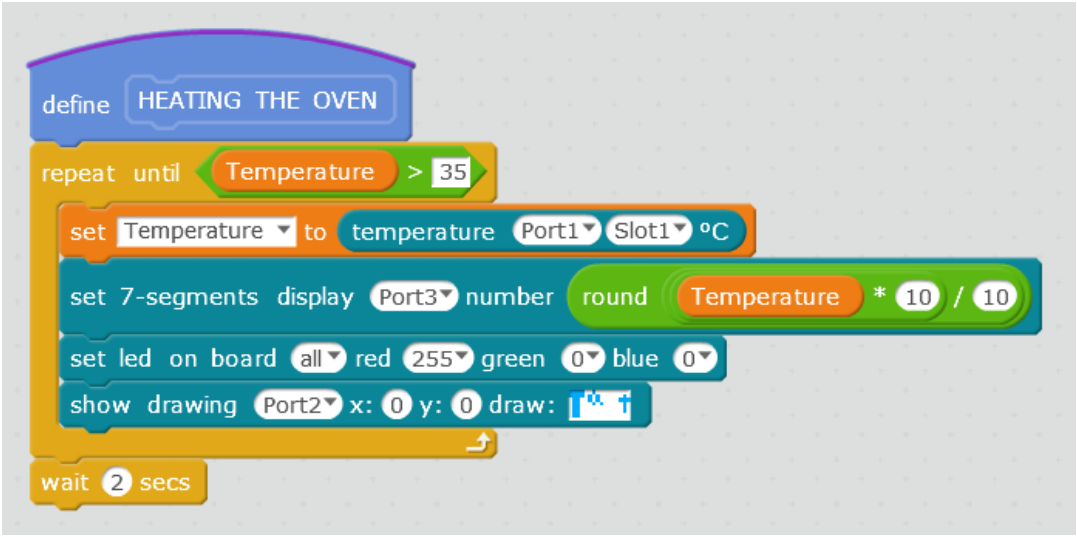
1. INTRODUCTION PART OF THE PROGRAM:

Right at the beginning, we will reset the temperature, the temperature display, the leds matriz and we will turn off the leds on board.



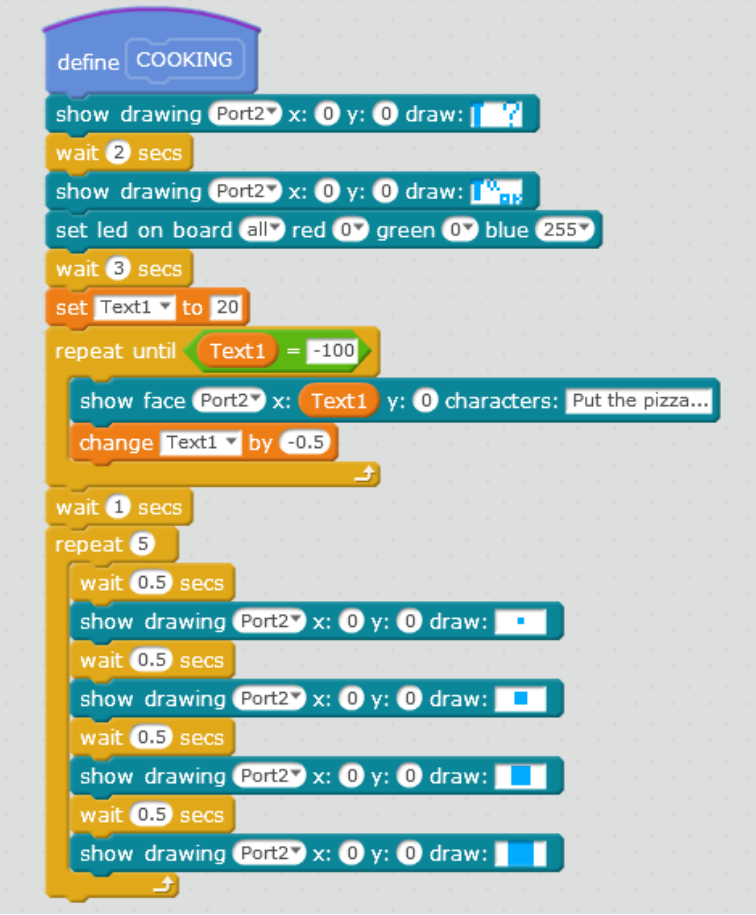
2. HEATING THE OVEN Routine:

In this routine we start by heating the temperature sensor with a lighter. The mBot shows red leds and a "symbol of temperature rising" in the led matrix. It will keep on doing it, until the temperature is higher than 35º C.



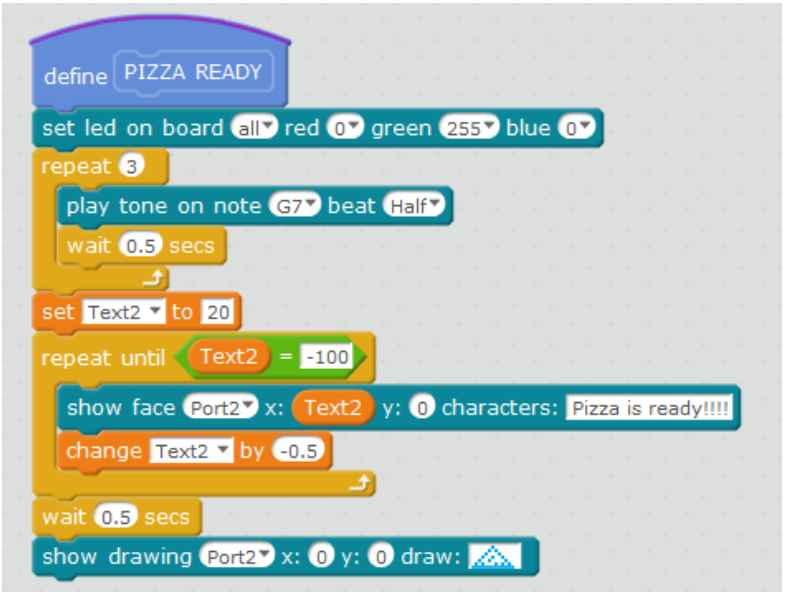
3. COOKING Routine:

Now, in this routine, the temperature for cooking has already been reached. The mBot simulates the "cooking process" starting by showing in the matrix the message "put the pizza...". During the process the leds are blue, and some light effects are shown in the matrix.

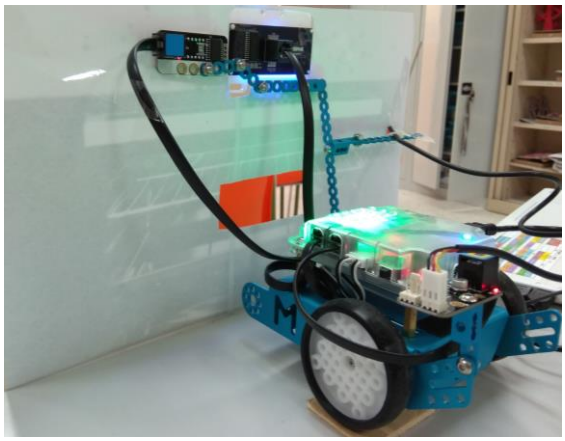


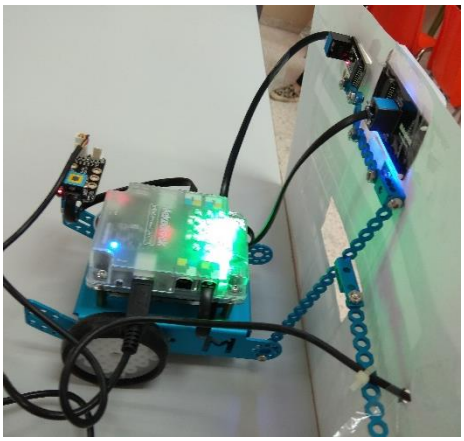
4. PIZZA READY Routine:

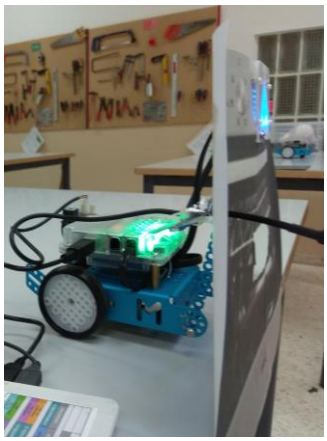
Once the pizza is cooked, the leds turn green and an alarm sounds. The mbot shows the message "Pizza is ready!!!", and the program is finished.



Once, the programming is finished, we start building up THE STRUCTURE, where all the mechanical elements will be set. Also the electronic elements.

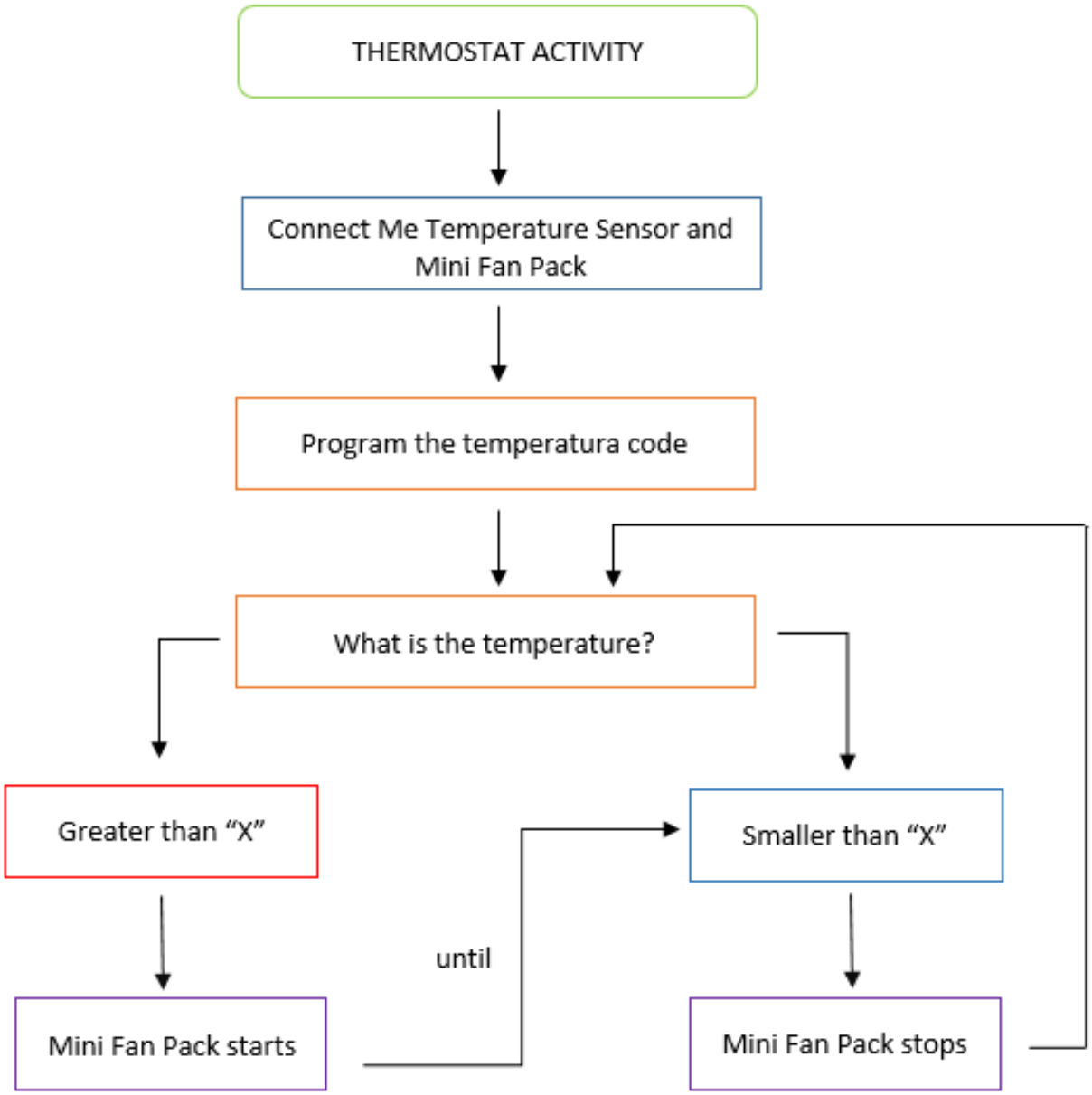




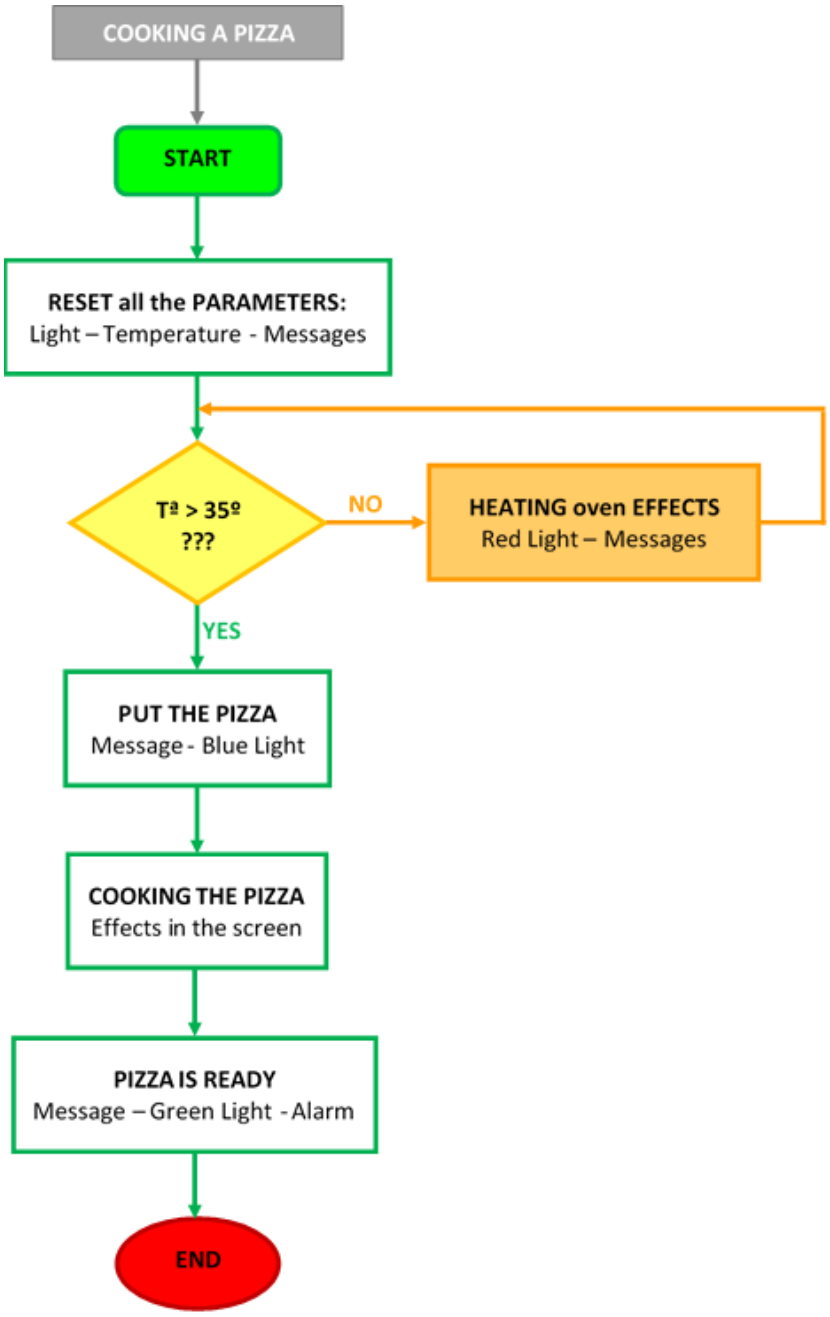


FLOW CHART

First version



Second version



STUDENT'S EVALUATION

For evaluate the student's competence, first, the teacher explain the different temperatures scales, then the pupils will assemble de different components to mBot and then they program the code.

Also, for the evaluation of the students in this activity, use the Evaluation Rubric designed for this project.

BIBLIOGRAPHY

"Guía de Scratch". CEIP de Cella, (Teruel). Pdf.

"Scratch. Guía didáctica para profesores". (Pdf). (www.isuriarte.com).

"Jugando con MBlock". Makeblock España.

"Divirtiéndome con MBot". Susana Oubiña.

Comunidad de Makeblock en español. (http://www.makeblock.es/foro/).

"Curso de Scratch + Arduino". J. Javier Esquiva Mira.

MORE INFORMATION

DIFFICULTIES:

- TEMPERATURE SENSOR & DISPLAY: sometimes, although the program resets all the parameters and the values, the program starts showing a not real temperature, higher and therefore, going to the last routine directly. We have solve this by clicking twice the *green flag* of mBlock.