FIREMAN TO THE RESCUE

STEMJAM Teaching Guide

Developing make spaces to promote creativity around STEM in schools
Acronym: STEMJAM
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FIREMAN TO THE RESCUE

ABSTRACT

The idea is to make aware the students of the huge sensors´ utility.

For this purpose, we will design a robot which will be able to find fire. Once the fire is found, the robot will emit an alarm message and will run to a “safe area”.

While the robot is running a timer stars, in order to calculate the distance from the fire to the “safe area”. The distance value will be shown in the led matrix.

In the meantime, the line follower sensor corrects the direction of the robot’s way.

DIDACTIC OBJECTIVES

ENGINEERING & SCIENCE:

- Flame sensor. Line-follower sensor.
- Parameters that govern the running of the sensors.
- Utility of the sensors.
- Concepts of measurement units: obtaining linear speed (m/s) from angular speed (rad/s).
- Solving uniform linear motion equations: calculating distances.

TECHNOLOGY:

- 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☐

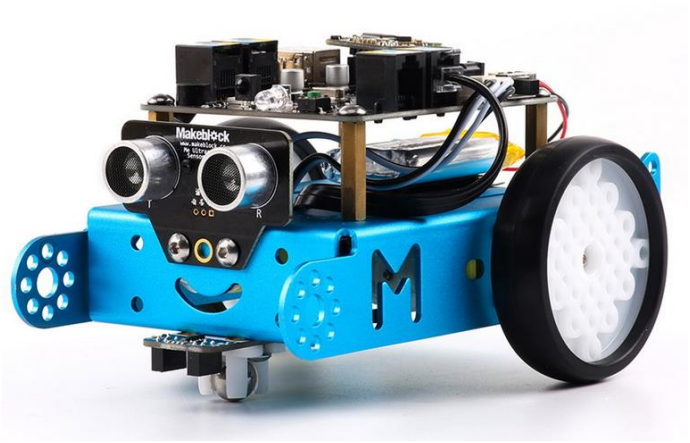
Education Level: 12-14 years☒ 14-16 years☐

PROBLEM STATEMENT

The mBot robot has to be programmed to detect fire. Later the robot will do some calculations and it will inform about the fire´s location.

BOM (Bill of Materials Needed)

- mBot => Ref. 90054

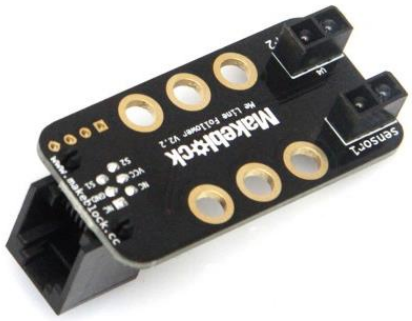


- Different beams and structures:

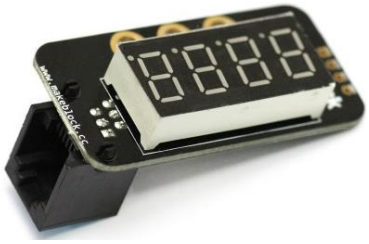
- Me **LED Matrix 8 × 16:**

- Me **Flame Sensor**:

❖ Me **Line Follower**:



❖ Me **7-Segment Serial Display - Red**:



❖ Black tape.

❖ Candles (several).

❖ Rest of Attrezzo (not essential).

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 7-Segment serial display	B	Yes	1												B				
Me Led Matrix 8x16	B	Yes	1		B														
Me Line Follower	B	Yes	1					B											
Me Flame sensor	Bl									Y	B	W	Bl						
RJ25 cables			Several																
Structures and beams																			
Laptops																			
Attrezzo (not essential)																			

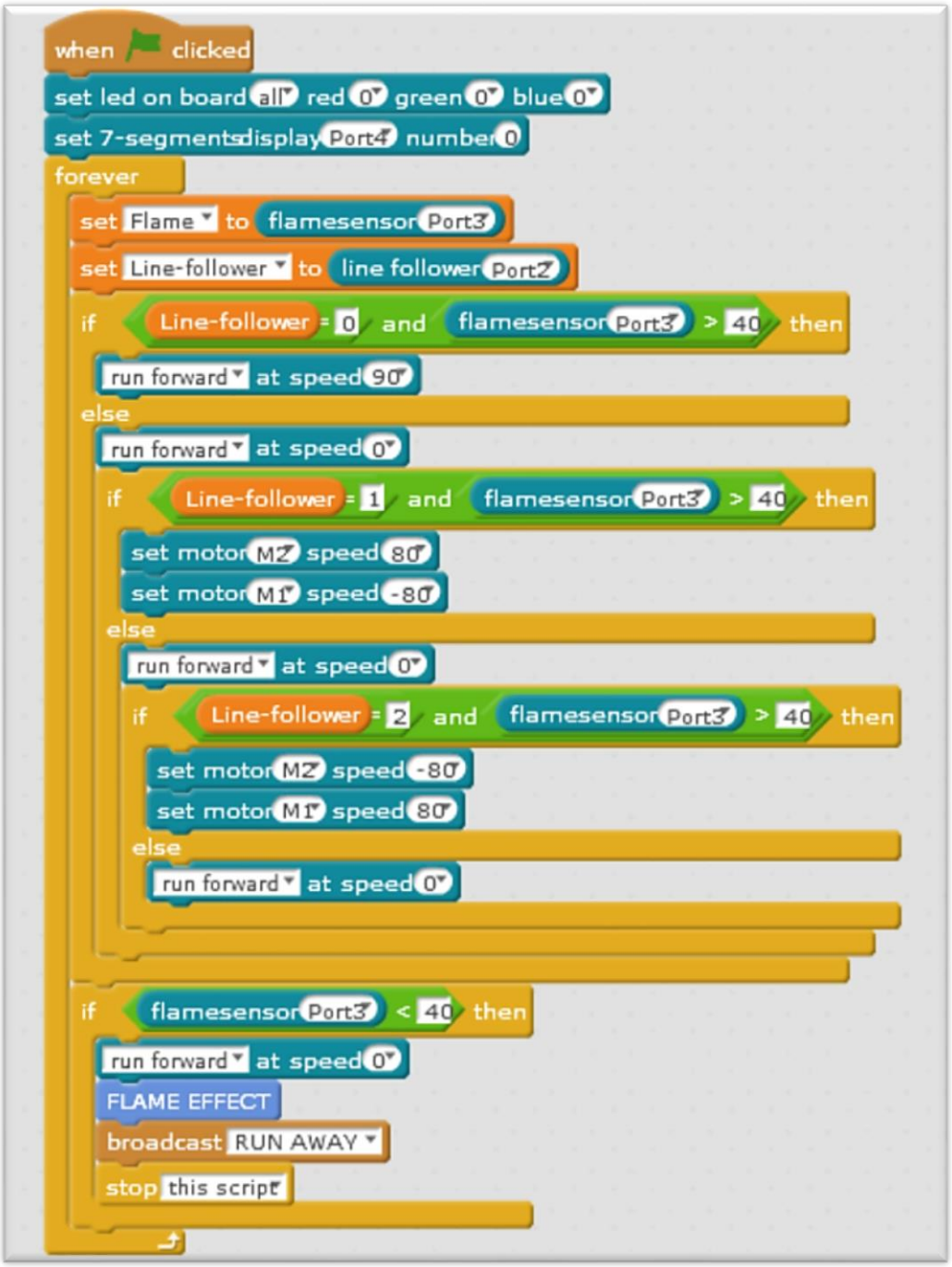
ACTIVITY DESCRIPTION

The activity consists on programming a mBot assisted by a laptop, whose function will be to detect fire. Later the robot will do some calculations and it will inform about the fire´s location.

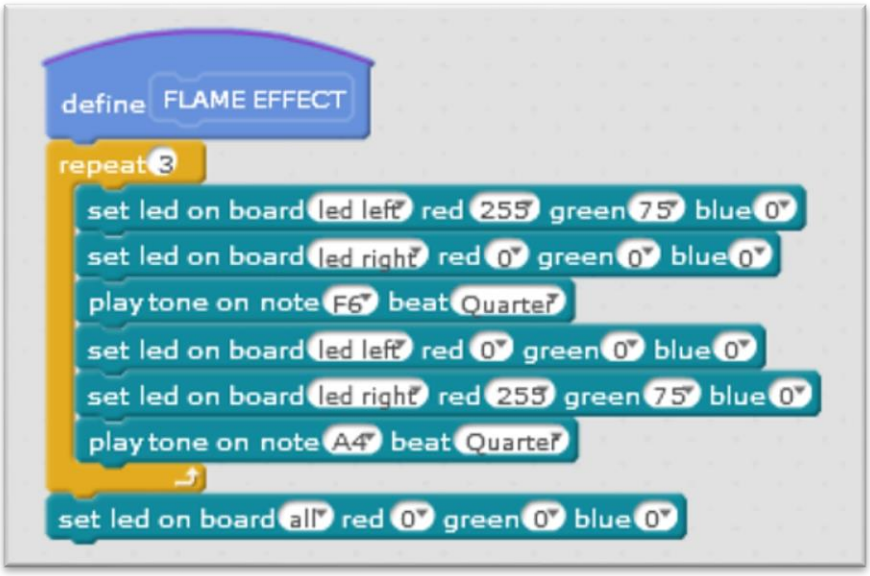
In order to achieve this goal, students will have to learn the proper functioning of both, the flame sensor and the line-follower sensor. The students will also design a part of the code related to sound and text effects for the activity.

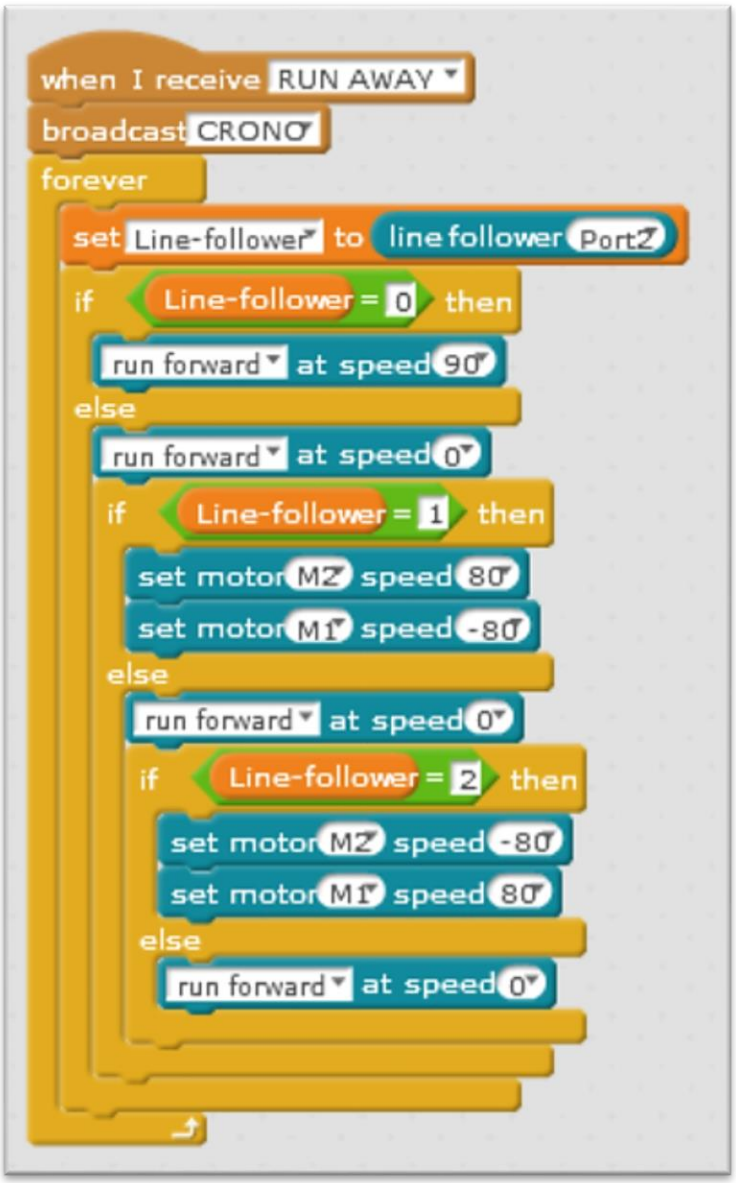
After all these technical tasks, we start with the PROGRAMMING.

1. DEFINITION OF THE MAIN PROGRAM: the mBot follows a straight black line until it finds fire

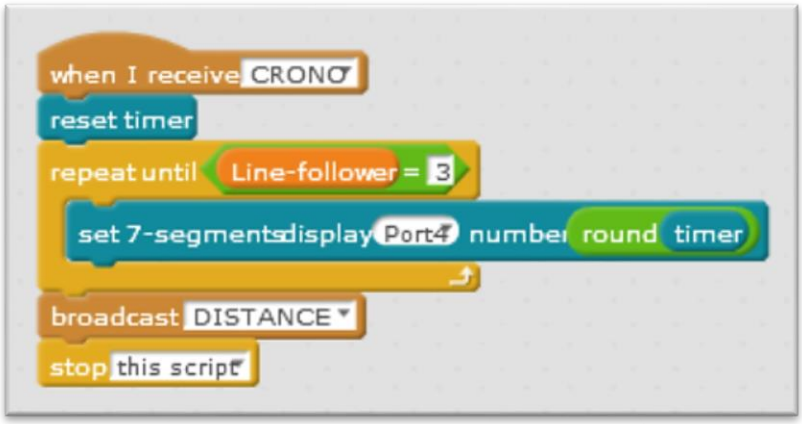


2. FIRE DETECTION: as soon as fire is detected, the “FLAME EFFECT” starts and the “RUN AWAY” message is sent.

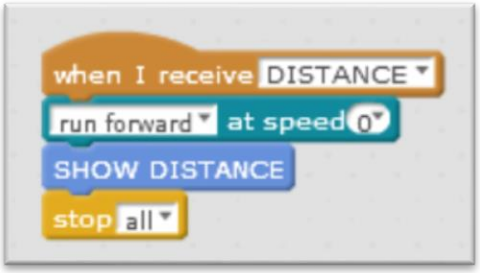




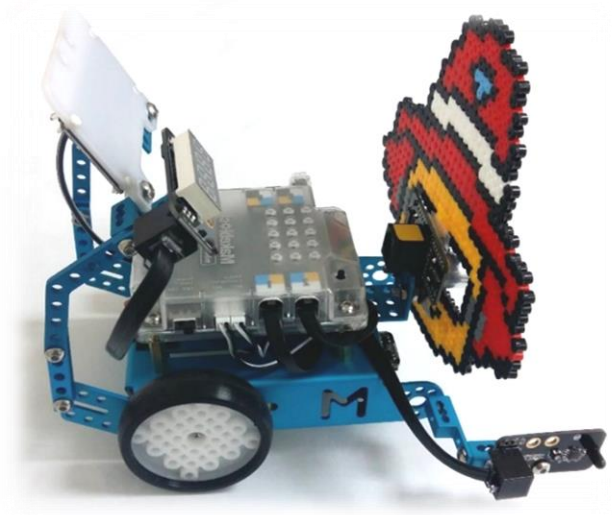
3. **“**CRONO MESSAGE”: this message is sent and the CRONOMETER starts up.

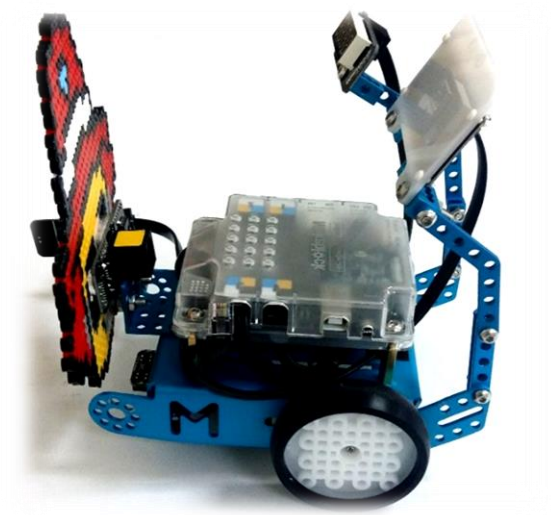


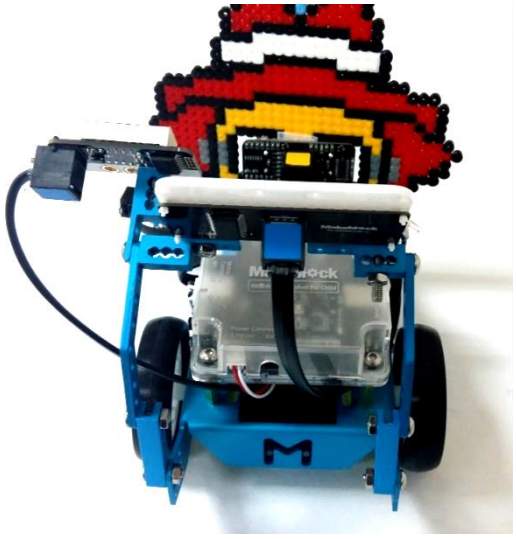
4. “DISTANCE MESSAGE”: once this message is sent, the distance calculations begin. Once the robot arrives to the end of the black line, fire’s distance will be shown, (“SHOW DISTANCE”).

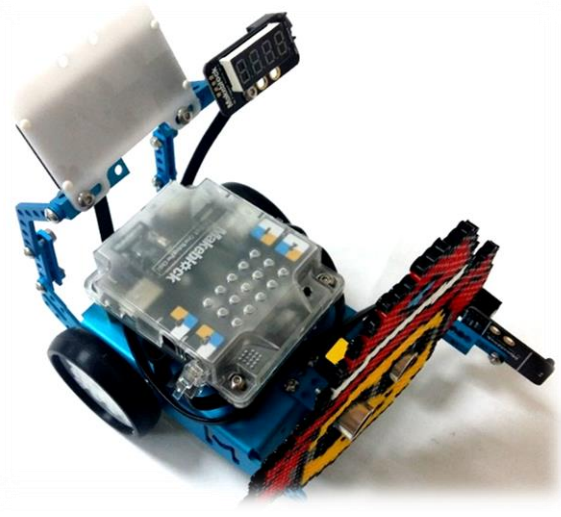


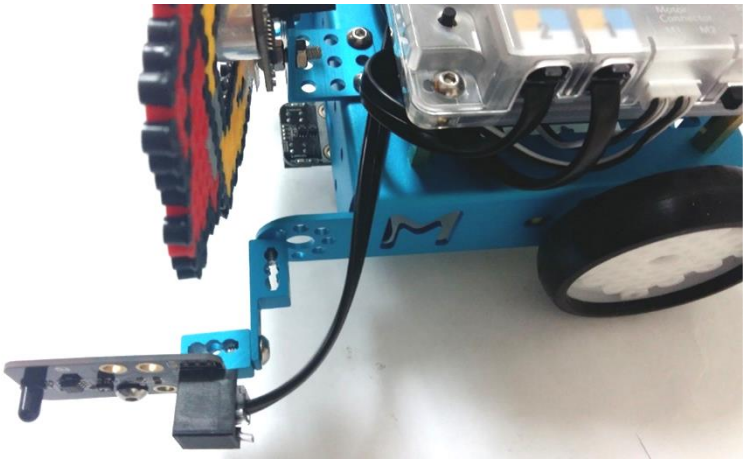
Once, the programming is finished, we start building up THE STRUCTURE, where all the mechanical elements will be set. Also the electronic elements.



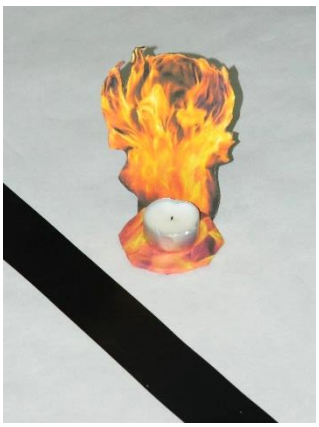









THE FIREFIGHTER
TO THE RESCUE

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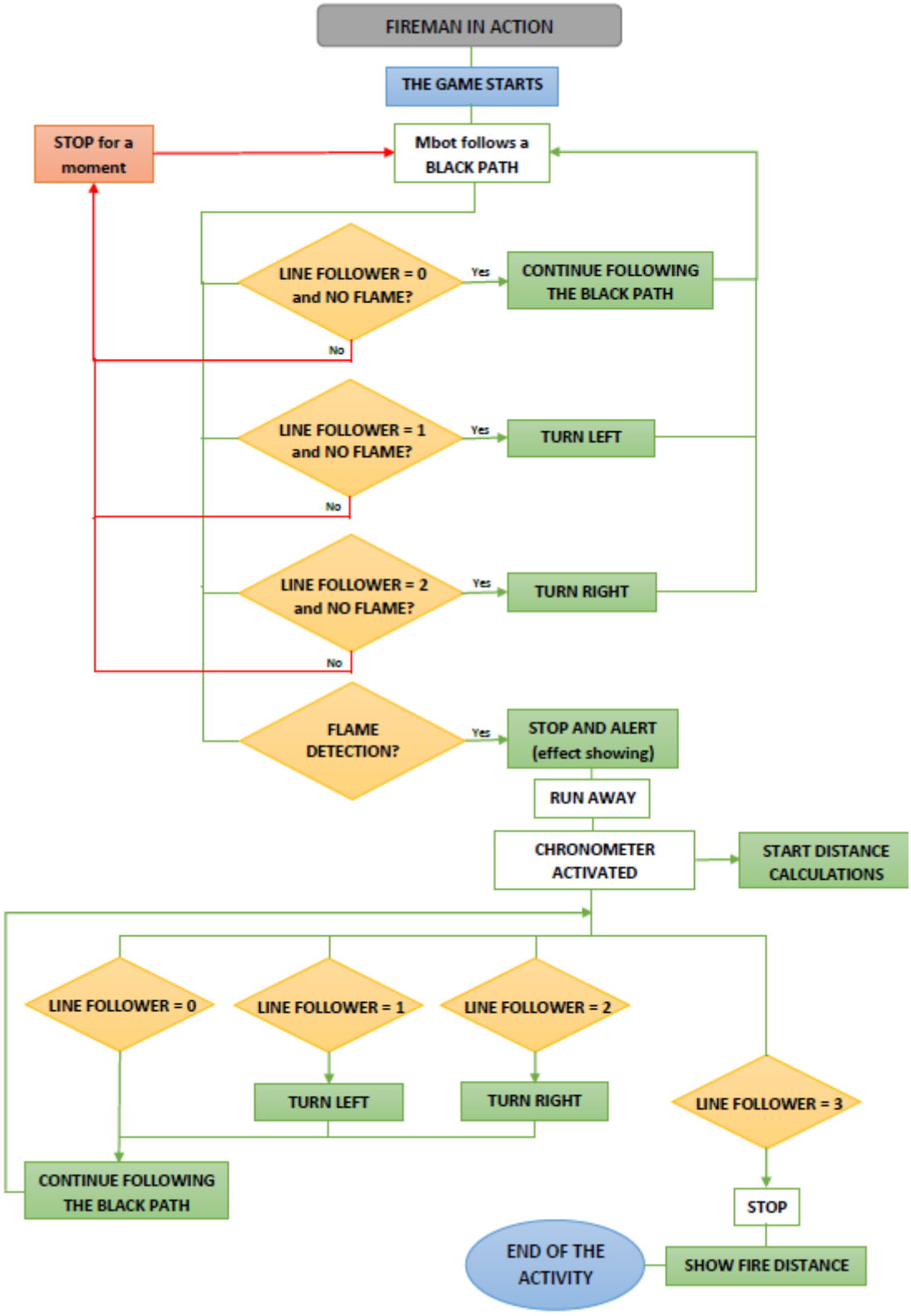
SOS

FLOW CHART



STUDENT'S EVALUATION

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

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"Jugando con MBlock". Makeblock España.

"Divirtiéndome con MBot". Susana Oubiña.

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MORE INFORMATION

DIFFICULTIES:

- FLAME SENSOR: flame sensor is highly sensitive to solar radiation. If we want it to work correctly, it has to be used indoors.

- ULTRASONIC SENSOR: it was supposed to be used to avoid obstacles, but it also does not work properly when the obstacles are right in front of the mBot. If the obstacle is placed at an angle with the mBot, the ultrasound does not work and the robot can not avoid it.

- MBOT'S UNUSUAL BEHAVIOUR: sometimes the mBot has an unusual behaviour. To avoid this, it is recommended to erase the cache memory (found in the "Extensions" section).

- MOTORS' SPEED: the speed of the motors depends on the state of the battery, as well as the angular velocity. This behaviour affects the program when calculating the distance to which the flame is. That is why, we must take the result of the calculations, as an approximate value.