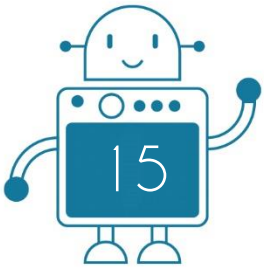


NOISE COP

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

NOISE COP

ABSTRACT

The idea is to make the students aware of the insalubrity the noise produces and also the amount of it they emit everyday at school.

In order to do that, the mBot robot will be programmed as a "*mobile soundmeter*", which will evaluate the sound level emitted by the students in every classroom, to find the noisiest one.

Also, the second part of the activity consisted in solving the problem the sound level meter and the sound sensor had. We have achieved the mBot will calculate the decibels that are being emitted at the moment the measurement is taken.

DIDACTIC OBJECTIVES

SCIENCE:

- Sound and noise physics concepts.
- Soundmeter. Concept and functions.
- Healthy noise levels.

TECHNOLOGY and MATHEMATICS:

- Introduction to computational thinking.
- Assimilation, creation and programming of algorithms, to decompose complex problems into ordered sequences of simple instructions, which solve it.
- Working with value lists on Scratch/mBlock.

Absolute maximum concept.The student will be able to calculate the sound decibels or the decibels of an environmental noise. From these calculations they will be able to know in what range of the scale of decibels is the sound emitted.

STEM Subject: Science☒ Technology ☒ Engineering☐ Mathematics☒

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

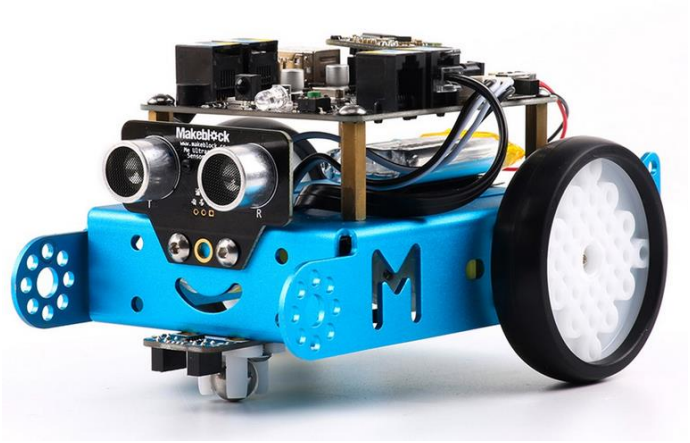
PROBLEM STATEMENT

The mBot robot has to be programmed to take measurements of noise in different classrooms. Later the robot will inform about the noise levels reached and about how unhealthy noise is.

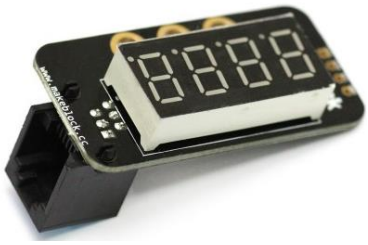
The sound sensor of the mBot measures the environment, no the decibels of sound. We need to create a program that can measure the decibels.

BOM (Bill of Materials Needed)

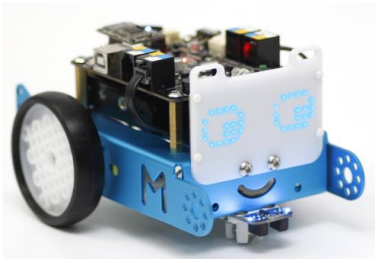
- mBot => Ref. 90054



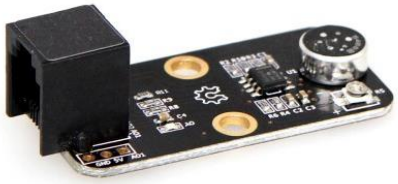
- Me **7-Segment Serial Display - Red**:



- Me **LED Matrix 8 × 16**:



- Me **Sound Sensor**:



❖ Different beams and structures:

❖ Sonometer.

❖ (x2) Cables RJ25.

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 Sound sensor	Bl	Yes	1										Bl						
RJ25 cables			1																
Structures and beams																			
Laptops																			
Attrezzo (not essential)																			

ACTIVITY DESCRIPTION

First version

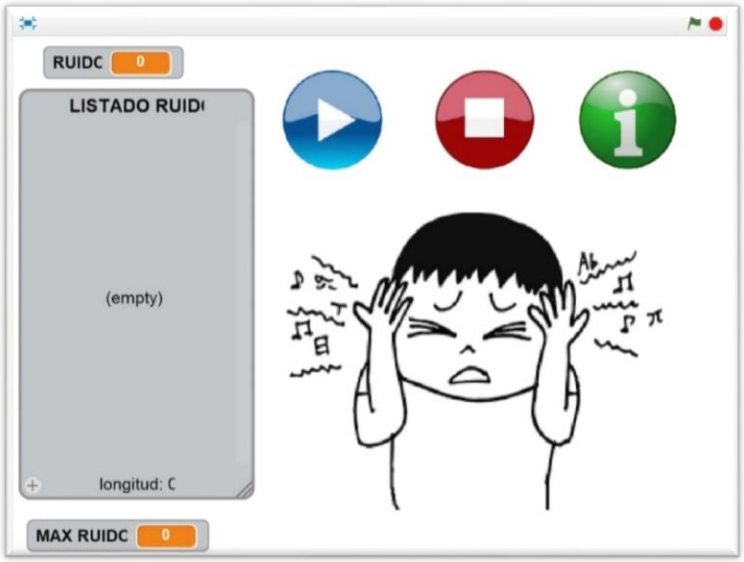
The activity consists on programming a mBot assisted by a laptop, whose function will be to move in between the different classrooms informing about how unhealthy noise is and taking acoustic measurements. Its reaction to silence will be positive; on the contrary, it will react in a negatively from a certain noise level on.

Once it has taken some measurements, the mBot will inform the students about the maximum sound quantity emitted. In this way a small competition between classrooms may be done, in order to check the most sound-efficient one.

First, you pair the software with mBot by using the 2.4G Wireless Serial Port.

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

1. PROGRAM'S INTERFACE:



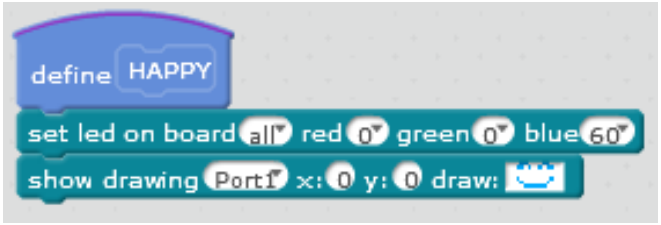
2. MOVEMENT CONTROL (Arrow keys):

3. PRESENTATION OF THE ACTIVITY AND MEASUREMENT SETTING:

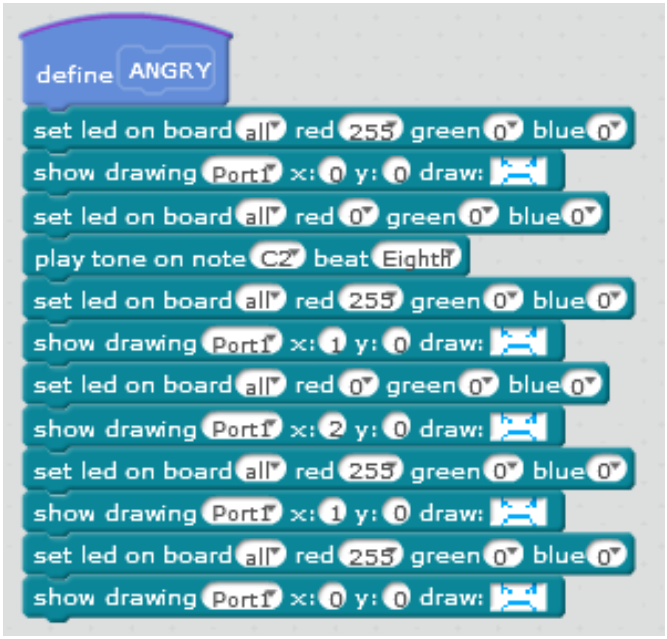
4. EFFECT'S PRESENTATION:

5. NOISE MEASUREMENT:

6. "HAPPY" ROUTINE. (It is shown either there is silence or little noise):

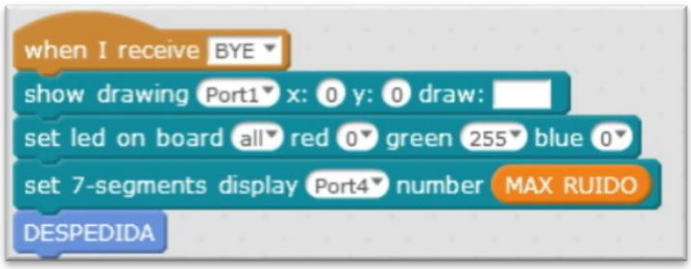


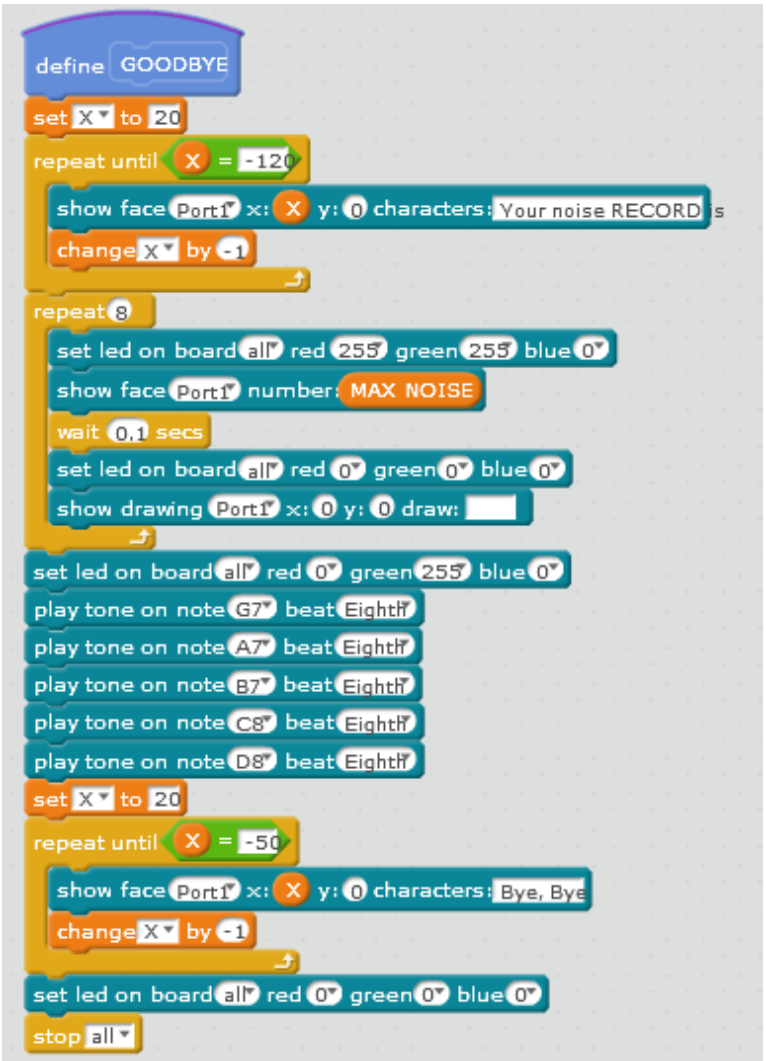
7. "ANGRY" ROUTINE. (It is shown when there is a considerable amount of noise):



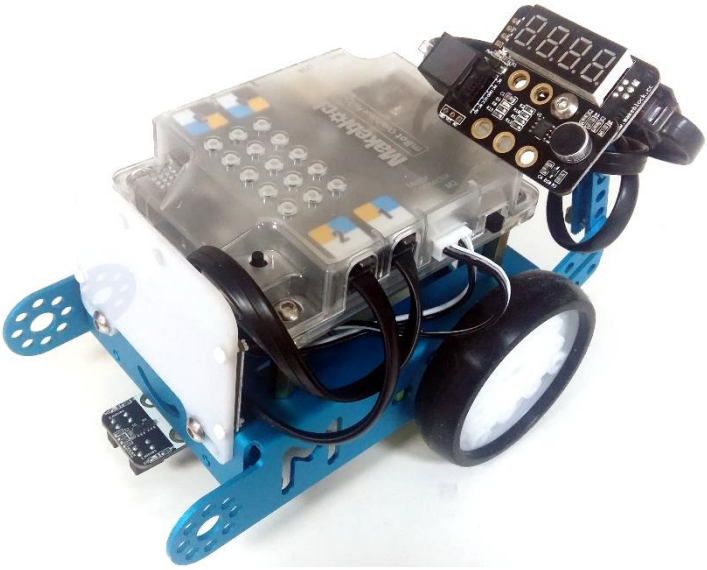
8. STOPPING THE NOISE MEASUREMENT. (When pressing the black button shown underneath):

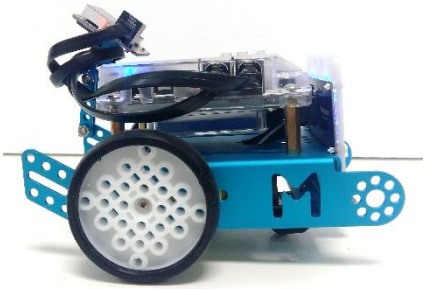
9. RESOULTS ANNOUNCEMENT. (When pressing the green "I" button shown underneath):

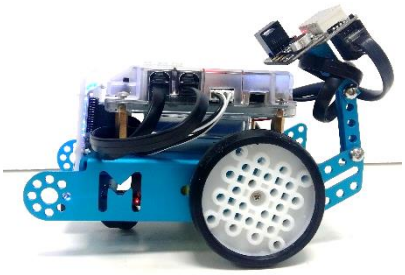


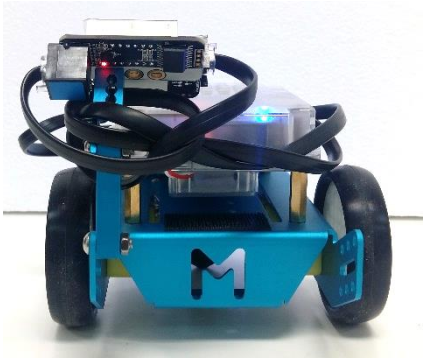


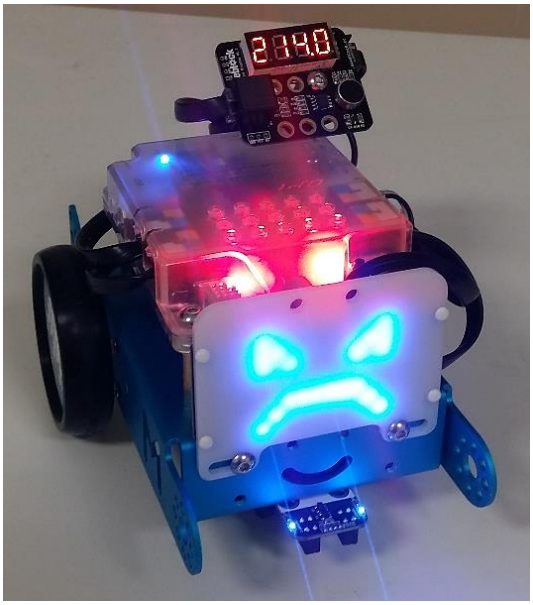
Once, the programming is finished, we start building up THE STRUCTURE, where all the mechanical elements will be set. Also the electronic elements.

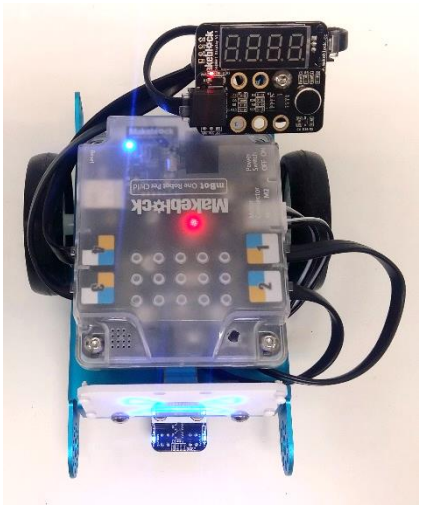












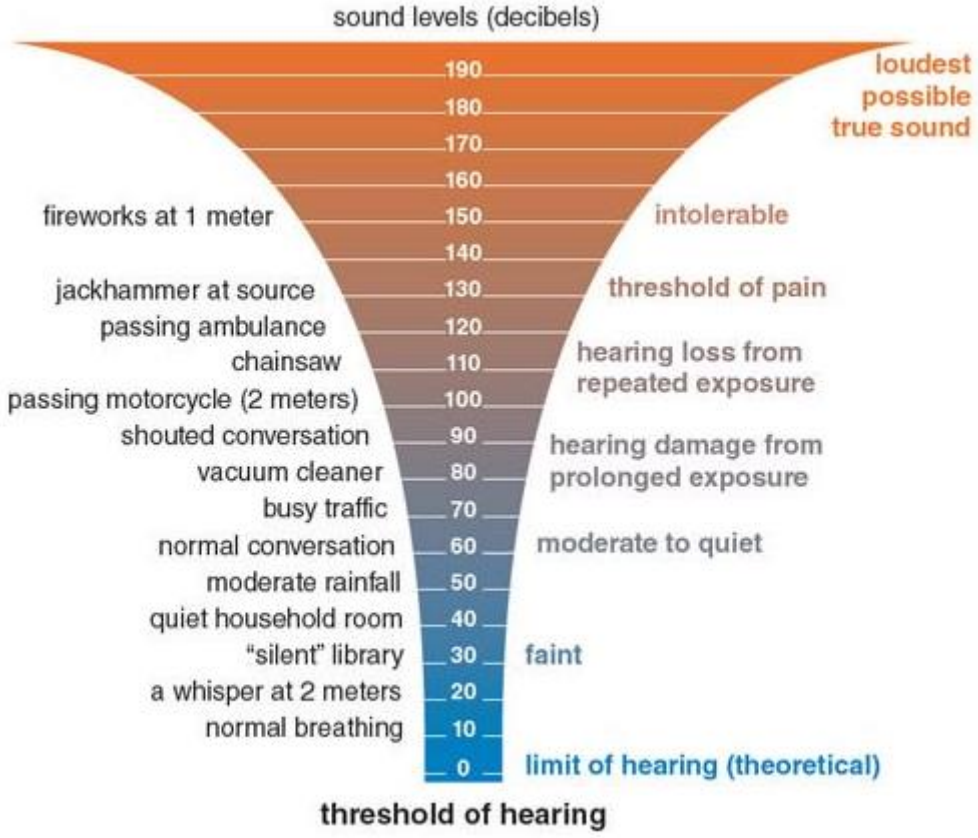
Second version

The decibel (dB) is the measure with which we quantify the intensity of the sound.

It is the relative unit used in acoustics, electricity, telecommunications and other specialties to express the relationship between two magnitudes: the magnitude being studied and a reference quantity.

Thanks to this measure, we can know which auditory thresholds can damage our hearing. On the other hand, we must bear in mind that it is not only the intensity that determines whether a noise is dangerous: it is necessary to control the time that we expose ourselves to it.

In this image, we can see the decibels scale and how we can be affected by the decibel level:



A person can hear up to a maximum of 150 decibels: If the sound goes beyond this limit, it could cause irreversible auditive loss in the person.

There are several decibel scales, but we will use the dbA, which is the one that measures the ambient sound.

For the activity, we want that the mBot calculates the decibels of the site where we are. The Sound Sensor calculates an environmental value, so we need to convert that value to decibels.

For do this, we applicate a formula:

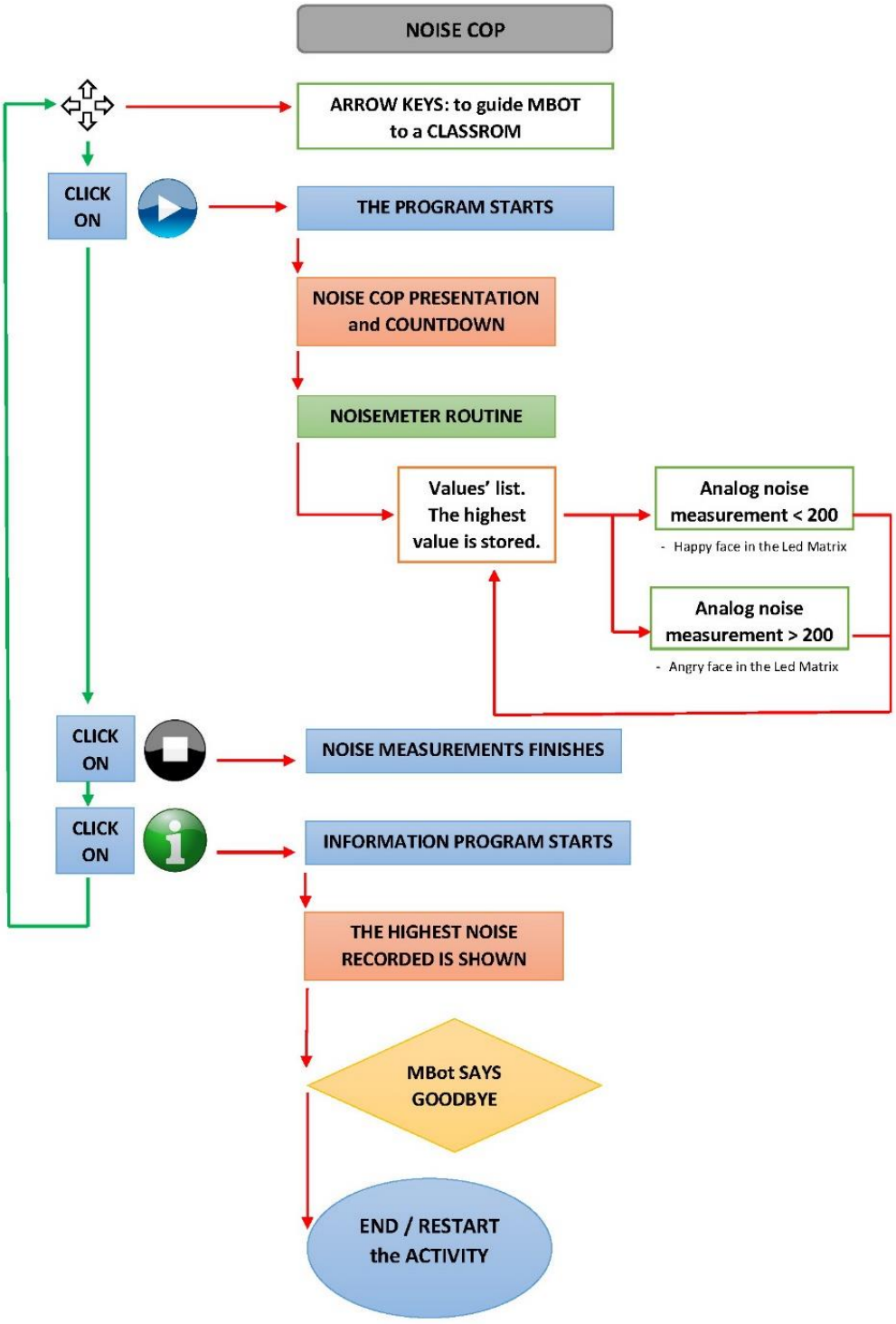
What we are doing in the code is that in the Leds Matrix we see the result of dividing the value obtained by the Sound Sensor by 3.3 .

To determine this correction value, with the help of our AIJU toy lab experts, we calibrated the sound level meter correctly. Since there are many different decibel scales, in order to calculate the ambient sound of our place, for developing the activity, we needed to calibrate it correctly.

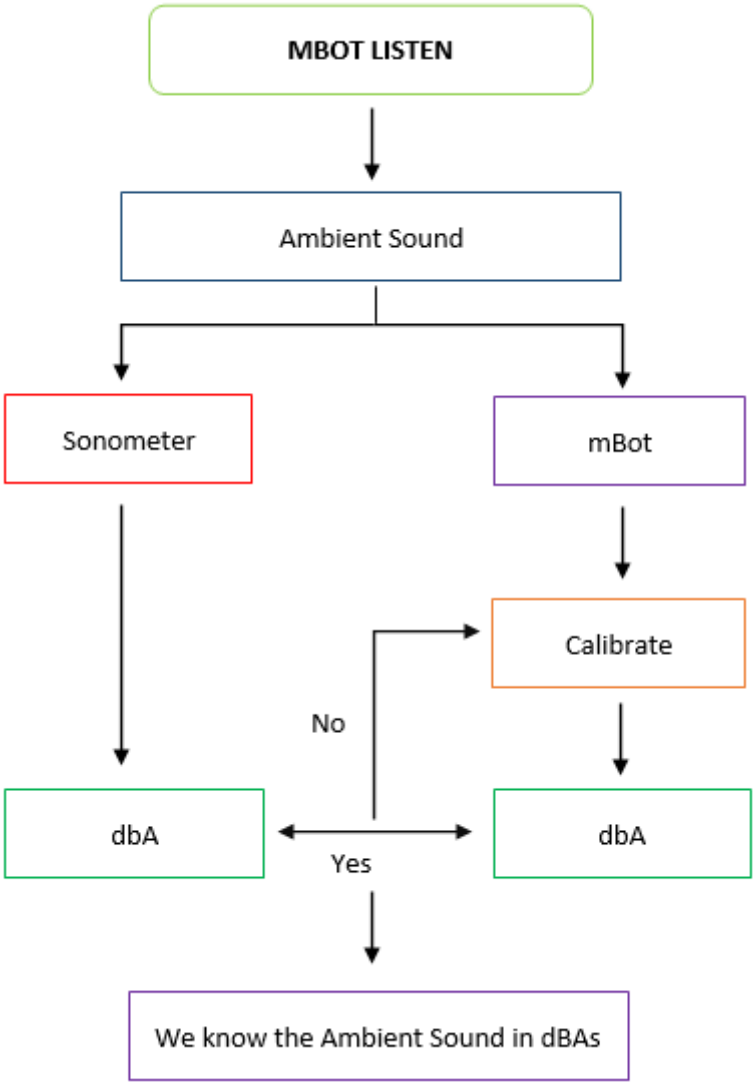
Once the sound level meter was calibrated, we had to find the formula for our mBot to calculate the decibels. After many tests/errors, we determined that if we divided the value obtained (by the Sound Sensor) by 3.3, we obtained the same result as in the sound level meter, so we managed to solve the problem of decibel detection.

FLOW CHART

First version



Second version



STUDENT'S EVALUATION

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

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MORE INFORMATION

DIFFICULTIES:

THE SOUND SENSOR DOES NOT OFFER AN ACCURATED SOUND MEASUREMENT → there is no chance of turning the values taken into decibels.