2D AND 3D GEOMETRICAL SHAPES

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

2D AND 3D GEOMETRICAL SHAPES

ABSTRACT

To learn and to teach 2D and 3D shapes by helping and in competition environment and improving group activity and pleasure.

mBot detects the presence of 3D objects and acts differently depending on the 2D features of the path it is following. In particular we used the curvature of the path as a control variable: when mBot detects a 3D object and it is turning left, it bump into it and makes it fall down; when turning right, it turns back and go back along the path. In the experiment we played around in order to "hide" the effective control and mislead the user into believing that the mBot normally hit 3dim objects, but avoid dangerous situations.

DIDACTIC OBJECTIVES

- Maths:to identify2DIM and 3DIMgeometrical features (like curvature and height).
- Maths: the notion of curvature.
- Computer Science: Conditional actions and tasks. The *if*, *switch, while* instructions.

STEM Subject: Science☐ Technology ☒ Engineering☐ Mathematics☒

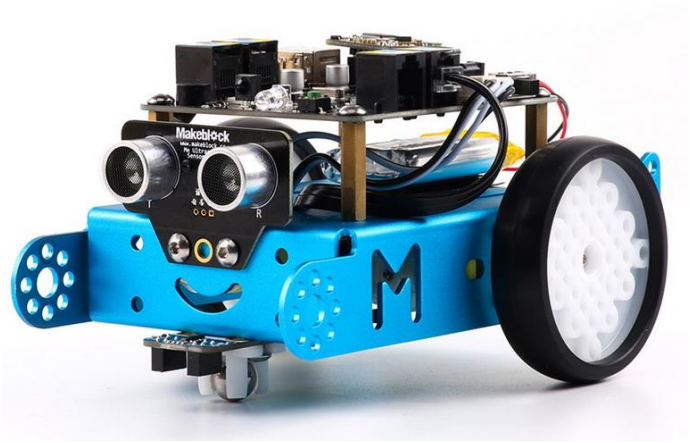
Education Level: 12-14 years☒ 14-16 years☐

PROBLEM STATEMENT

While following a line path, detect the presence of 3D objects and perform different tasks depending on the value of a 2D geometrical variable (like the curvature of the path).

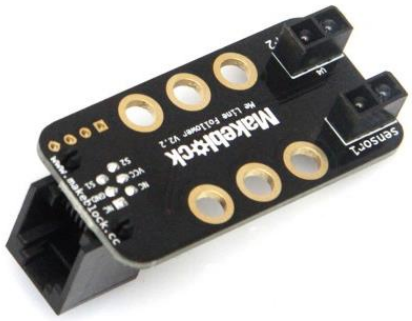
BOM (Bill of Materials Needed)

- mBot => Ref. 90054



- Me **Ultrasonic Sensor**:

- Me **Line Follower**:



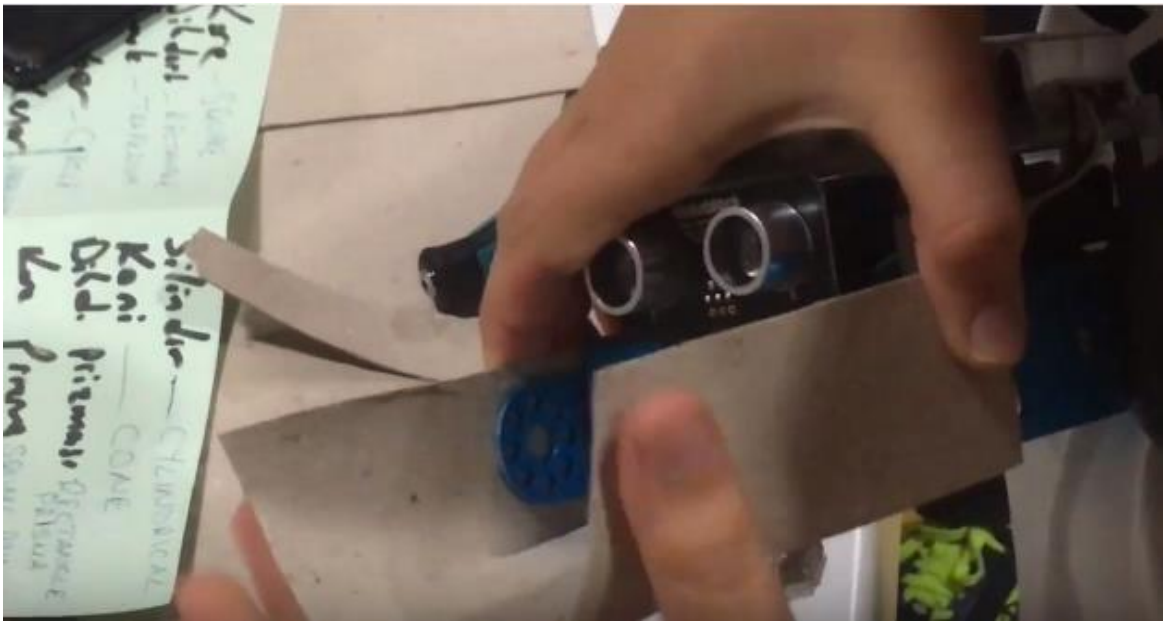
- A curved path (black on white).
- Small 3D objects, at least 10 cm high, like 3D shapes made out of cardboard or lightweight plastics.
- Cardboard, glue, tape, labyrinth, pen etc.

First version

Step 1: Coding for wifi connection

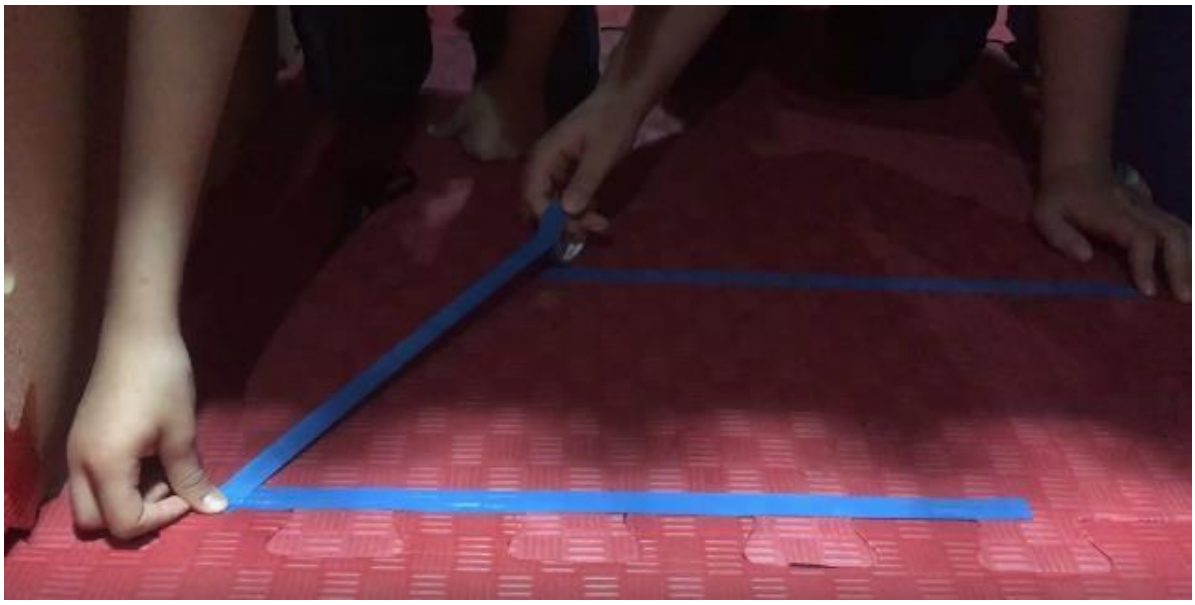
Step 2: Building Labyrinth

Step 3: mBot is prepared for the race



Step 4: Cardboard cuts are made ,the names of the objects, the directions are written on papers

Step 5: Plastic colored bands and 2D objects are created



Step 6: 3D objects are placed in the labyrinth

Step 7: mBots compete to get 3D objects

Second version

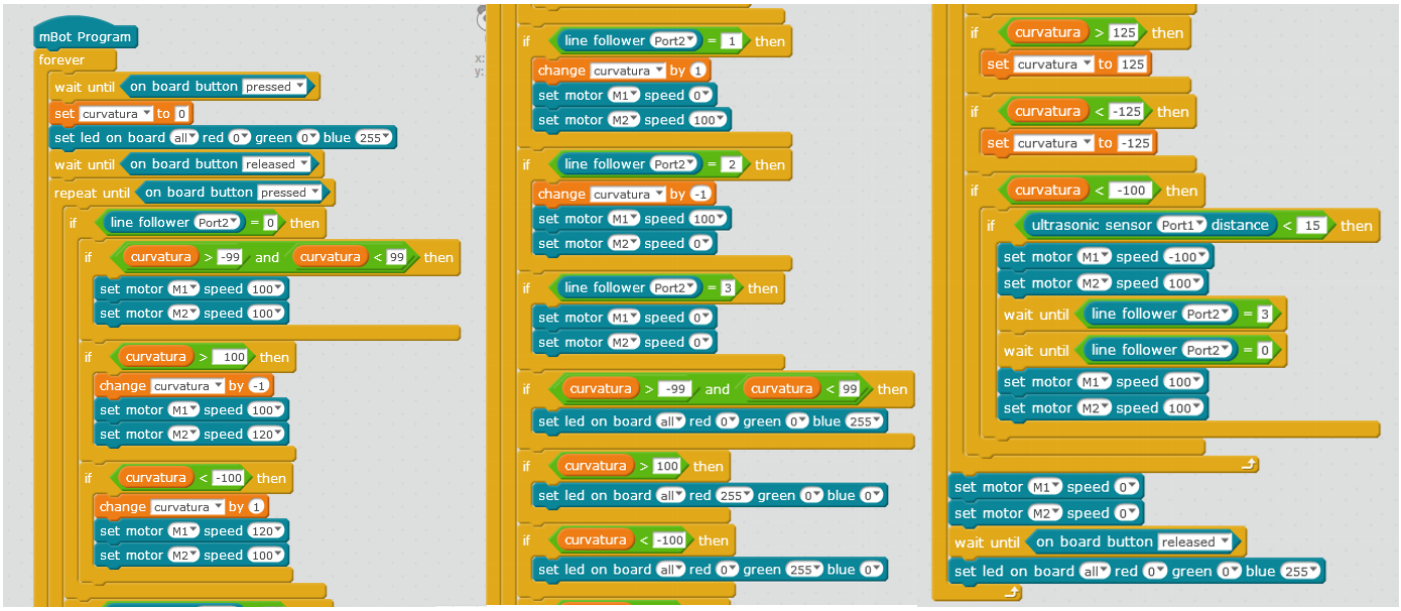
1. Short introduction. Definition of the curvature as a variable ***c***:
    - Each time the mBot exit on the right side of the path (line follower sensor 1), motors are set to turn left and curvature is increased by 1. Similarly, when turning right it is decreased by 1.

    - In its final configuration after program development and testing, The curvature is bound below 125 $|c|<125$ and when it overcomes 100 ($|c|>100$) the on board leds change colours accordingly to the curvature (red when turning left, green when turning right, blue while traveling forward)

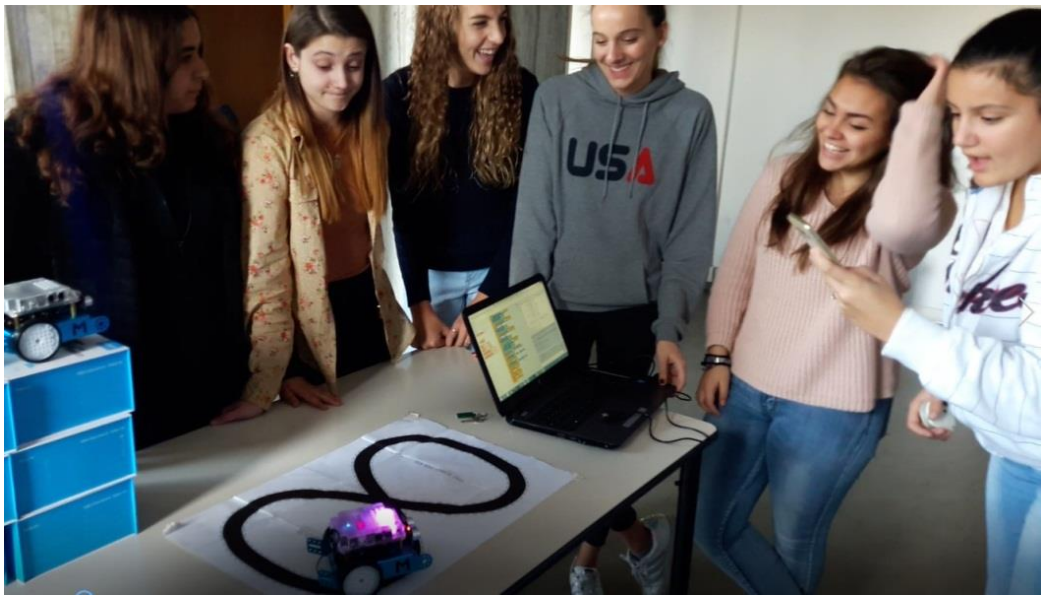
2. The students developed the code in steps of increasing difficulty:
    a. Line follower code.
    b. Line follower + Calculation of curvature.
    c. Line follower + Curvature + Detection of 3D objects (anything high enough to reach the ultrasonic position sensor is considered 3D).
    d. Line follower + Curvature + Detection of 3D objects + Actions.
    e. Testing and corrections.

3. The program was tested on different 3D object and along different paths.

he code:



Photos from the activity:



STUDENT'S EVALUATION

- Development of algorithm.
- Ability to discriminate between 2DIM and 3DIM geometrical features.

SCALABILITY

Suitable for students at beginning of high school or last year of intermediate secondary school (13 - 15 years).