

LINE FOLLOWER



STEMJAM Teaching Guide

Developing make spaces to promote creativity
around STEM in schools

Acronym: STEMJAM

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LINE FOLLOWER

ABSTRACT

Different ways of tracking lines. Comparison of scratch and arduino mode.

DIDACTIC OBJECTIVES

Creating algorithm and programming the mbot:

- ❖ Use of line follower sensor.
- ❖ if – else statement.
- ❖ Infinite loop.

Compare scratch mode and Arduino mode – reaction time is different, the same program work on different way.

STEM Subject: Science Technology Engineering Mathematics

Education Level: 12-14 years 14-16 years

PROBLEM STATEMENT

First activity:

There are black lines of different thickness on the board. Write a program that allows the robot to run on lines 1.5 cm and 3 cm thick.

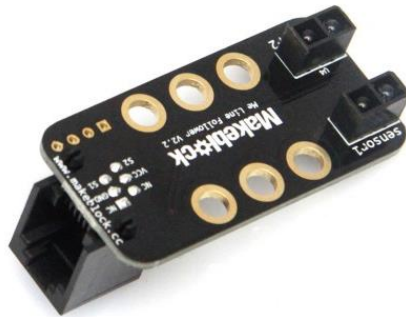
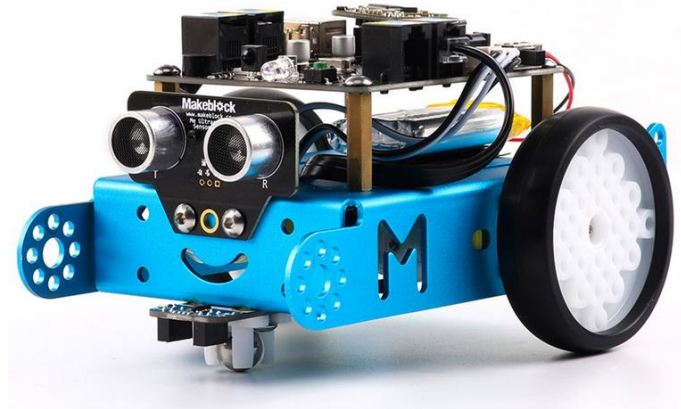
Second activity:

We observed that mBot could work with scratch codes by separating black and white. But, we wanted to see if the codes would work on a regular basis in a layer of black and white blocks.



BOM (Bill of Materials Needed)

- mBot equipped with **Line Follower**:



First activity:

- ❖ A board with black straight lines of 1.5cm and 3m wide.
- ❖ Boards with black curves of different shapes.

Second activity:

- ❖ White cardboard.
- ❖ Black cardboard.

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*		1													W*			
Motor 2	W*		1													W*			
Me Line Follower	B	(1)	1					B											
RJ25 cables			1																
Structures and beams																			
Laptops		1 USB	1																
Attrezzo (not essential)																			

ACTIVITY DESCRIPTION

First version:

1. Students observe what value returns the line sensor when it sees “two white colours”, “two black colours”, “left black, right white” or “left white, right black”.
2. Students observe the reaction time in the program where the robot goes on the black at the speed of 255 and when it enters the white it stops (firstly in the scratch mode and then in arduino mode)
3. Students program the robot so that it runs along the black lines.

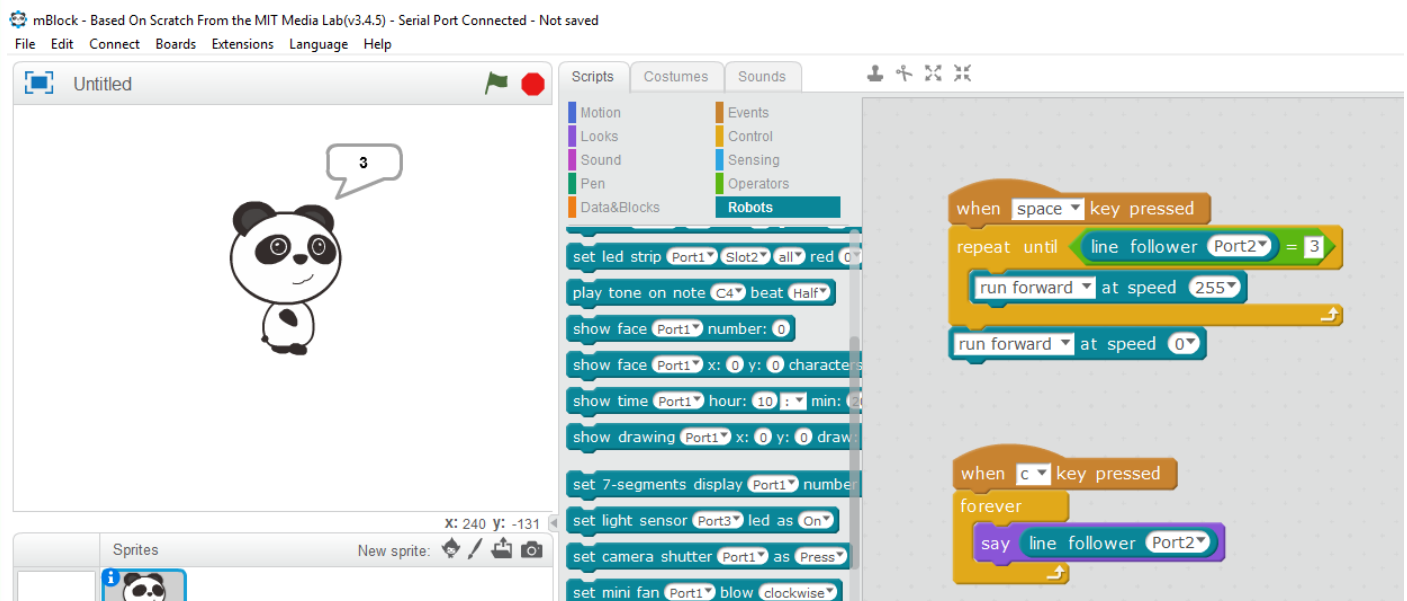
Step 1

The first step is to write a simple program that will show us the values that the line sensor returns for different colour combinations of white and black. Panda will show the values.



The sensor returns the following values:

two white colours	3
two black colours	0
left black, right white	1
left white, right black	2



mBlock - Based On Scratch From the MIT Media Lab(v3.4.5) - Serial Port Connected - Not saved
File Edit Connect Boards Extensions Language Help

Untitled

Scripts Costumes Sounds

when space key pressed

repeat until line follower Port2 = 3

run forward at speed 255

run forward at speed 0

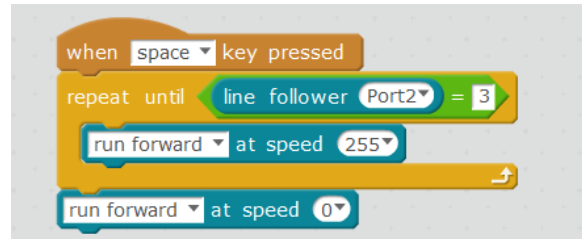
when c key pressed

forever

say line follower Port2

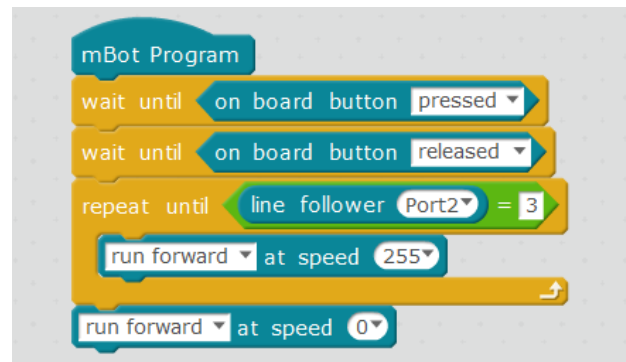
Step 2

In the next step we will compare the reaction time of the robot in the scratch mode and arduino. In the scratch mode the robot is connected to the computer using a 2,4 G communication module. The robot sends the readout from the sensor to the computer. The program is executed there and instructions are sent back to the robot.



```
when space key pressed
repeat until line follower Port2 = 3
run forward at speed 255
run forward at speed 0
```

In arduino mode we send the program to the mBot control board. The program is executed directly by the robot. Thanks to it, the response to readings is significantly faster. In this case, two blocks „wait until” have been added. They will start the right part of the program after pressing the button on the board.

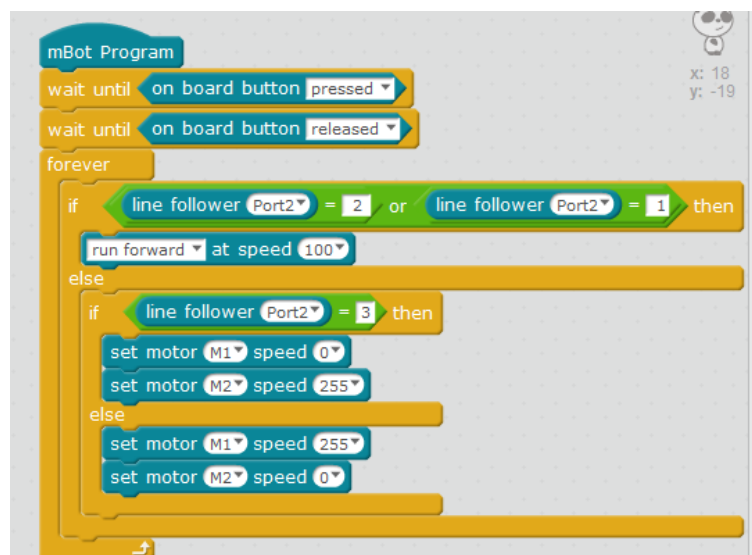


```
mBot Program
wait until on board button pressed
wait until on board button released
repeat until line follower Port2 = 3
run forward at speed 255
run forward at speed 0
```

Step 3

The 1.5 cm tracking line algorithm for mBot can work on the following principle:

- ❖ When you see one white and one black, go straight on.
- ❖ When you see two white, turn right.
- ❖ When you see two black, turn left.



```
mBot Program
wait until on board button pressed
wait until on board button released
forever
if line follower Port2 = 2 or line follower Port2 = 1 then
run forward at speed 100
else
if line follower Port2 = 3 then
set motor M1 speed 0
set motor M2 speed 255
else
set motor M1 speed 255
set motor M2 speed 0
```

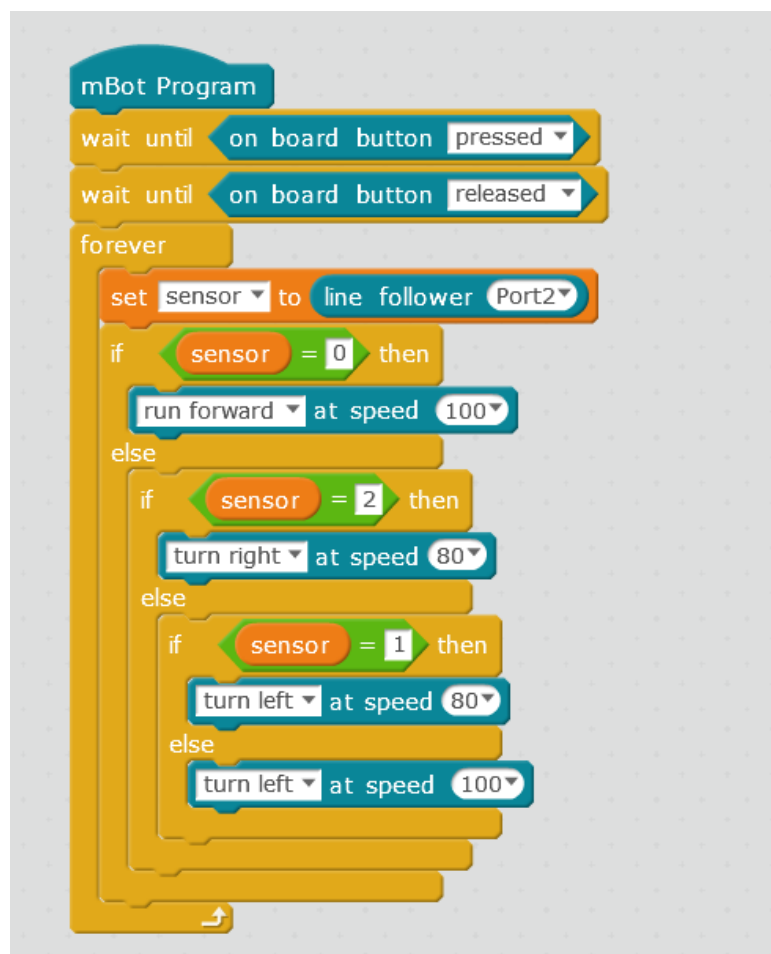
For larger lines, we can do as follows:

- ❖ When you see two black, go straight on.
- ❖ When you see black on the left side, turn right.
- ❖ When you see black on the right side, turn left.
- ❖ When you see two white, there is several option:
 - Go back to see black colour again (define the time of movement in mBlock).
 - Stop robot but, it doesn't work, when there is complicated shape of line (like 8). It happened that robot stops.
 - Turn left or right to find the black colour again.

On film there is program that realize coming back on two whites colour and can follow 8-shape.

This time students should change the reaction of robot, when it can see two white colours.

This program realize turning left on two white colours



```
mBot Program
wait until on board button pressed
wait until on board button released
forever
  set sensor to line follower Port2
  if sensor = 0 then
    run forward at speed 100
  else
    if sensor = 2 then
      turn right at speed 80
    else
      if sensor = 1 then
        turn left at speed 80
      else
        turn left at speed 100
```

Second version:

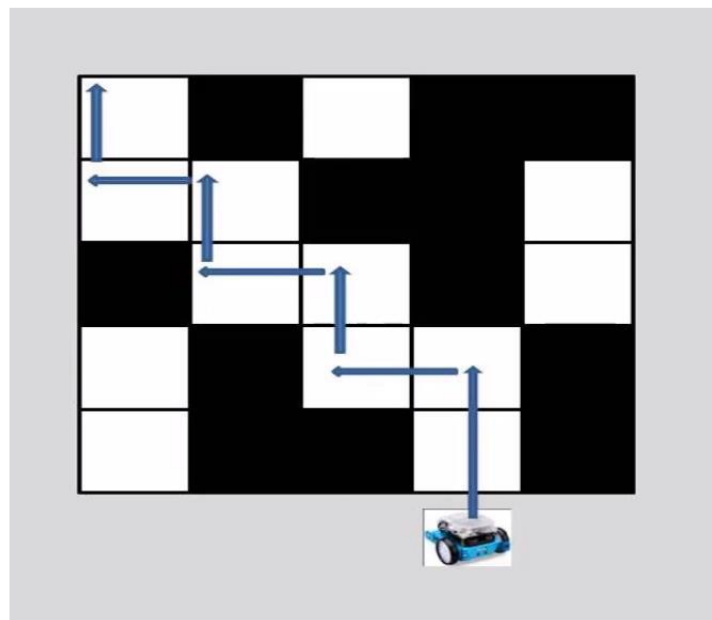
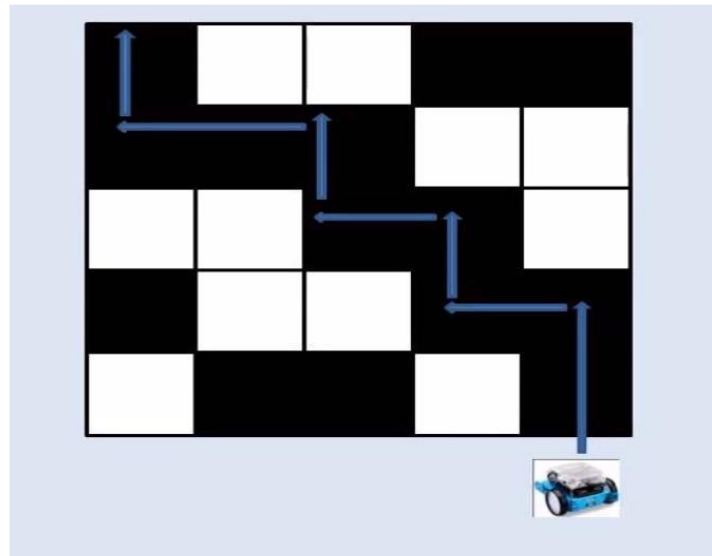
Step 1: We will use the white line tracking codes when controlling the mBot.

Step 2: We will use black line tracking codes when controlling mBot.

Step 3: the number of squares is determined on floor.

Step 4: Black and white blocks are cut from the cartons by the number determined by the same measure.

Step 5: The blocks are pasted to the black or white floor.



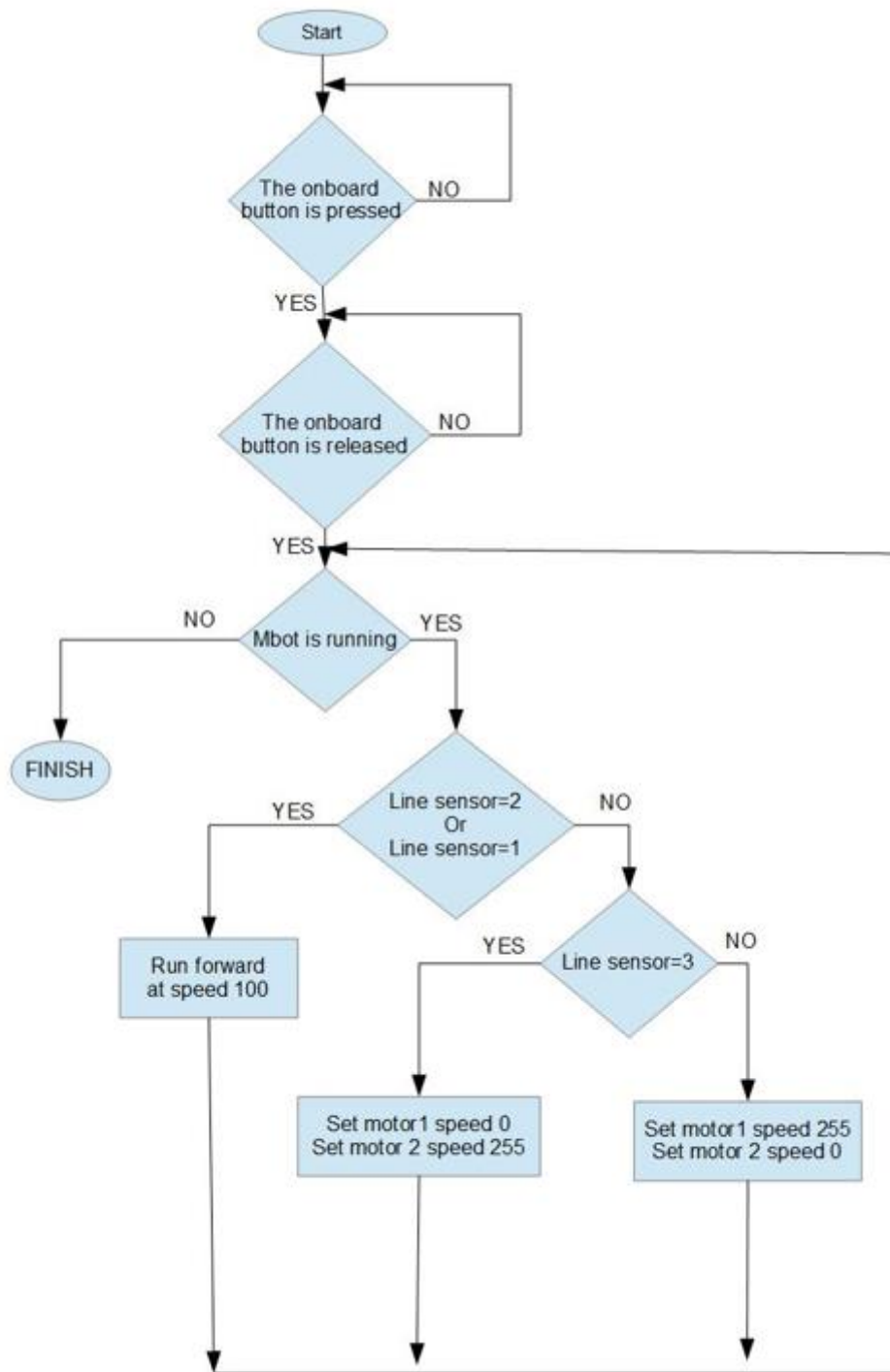


Finally, mbot went sometimes just white paper, sometimes just black paper depends on scratch codes.



FLOW CHART

First version (line 1.5 cm)



STUDENT'S EVALUATION

Student can write a line tracking program tailored to varying line thickness and activity conditions.



BIBLIOGRAPHY

<http://www.makeblock.com/>

<https://www.youtube.com/watch?v=LE-SOKW1xQM>

SCALABILITY

The design is based on students with "zero" preconditions.

