



Lesson

# ON-OFF CONTROLLERS

CREATED BY

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## TOPICS

Robotics, Programming

## AGES

Grades 2-6

## METHOD

OzoBlockly

## DURATION

60-80 minutes

**Created by**  
Andrei I. Nasushnyi

**Ages**  
Grades 2-6

**Duration**  
60-80 minutes

**OzoBlockly programming topics**  
Movement, Logic, Loops, Variables

*What will they know?*

-What is a controller?

- In what way different on-off controllers work.

*They will learn.* How to program Ozobot the line following. How to use different on-off controllers.

### Procedure

You surely know that Ozobot can travel on black and colored lines. But what if we make our line white would it be able to travel on it. Let's check. Allow students to find out if it is possible or not.

1. A controller is a program which controls moving of a robot. It reads values from color sensors and supplies different force on motors.

2 step or on-off controller is a feedback controller that switches between two states.

The first controller we are going to use can be called a "zigzag" controller. The robot's course will be having the abrupt alternate right and left turns. To make it we need to choose colors our track is made of in our case they are black and white. Our robot needs to go away from the black color and at the same time away from white. To make Ozobot do so we just need to switch off one of the two motors in the first case and another one in the second. Try to employ the stated approach to make your program.

Figure 1 shows a small version of the map that can be used as an example.

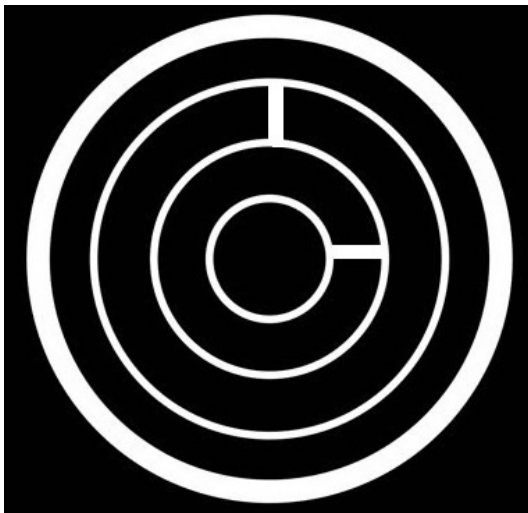
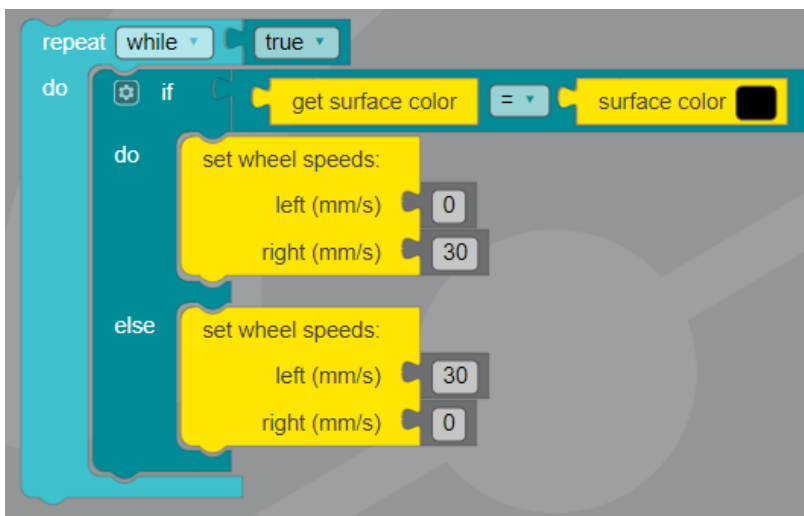
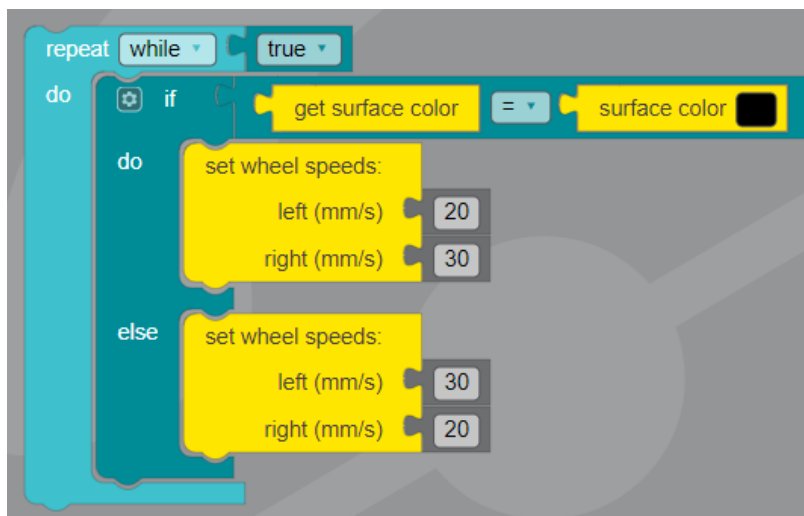


Figure 1



2. In our first example, a control was restricted to be between a lower and an upper bound. On the next one, we will try to make Ozobot movements smooth. And this one we can name as a “wave” controller. You do not need to switch off motors completely. What you have to do is to change motors’ speed. The task is to lower motors’ speed instead of switching them off. The next step is to make the robot move faster. Try to adjust the speed of motors the way Ozobot will be moving faster.



3. You can use these controllers not just for moving between black and white colors. You might want to make your own track using another colors and race on it.

Another method of using colors is to draw four differently colored lines next to each other. Or draw two but leave a white space between for following. It should be pointed out that a controller is similar to told above but there is an extra setpoint on which Ozobot switches.

Figure 2 shows a version of a track that can be drawn.



Figure 2

```
repeat while true
do
  if get surface color = surface color red
  do
    set wheel speeds:
      left (mm/s) 30
      right (mm/s) 20
  else if get surface color = surface color blue
  do
    set wheel speeds:
      left (mm/s) 20
      right (mm/s) 30
  else if get surface color = surface color green
  do
    set wheel speeds:
      left (mm/s) 30
      right (mm/s) 20
  else if get surface color = surface color black
  do
    set wheel speeds:
      left (mm/s) 20
      right (mm/s) 30
```



Figure 3

```
repeat while true
do
  if get surface color = surface color red
  do
    set wheel speeds:
      left (mm/s) 30
      right (mm/s) 0
  else if get surface color = surface color black
  do
    set wheel speeds:
      left (mm/s) 0
      right (mm/s) 30
  else
    set wheel speeds:
      left (mm/s) 50
      right (mm/s) 50
```

*Extensions*

- ◆ Students can play with robot's speed.
- ◆ Students can build different labyrinths and then make Ozobot move in them.

Figure 4 shows a version of a small labyrinth that can be drawn. There are many ways to travel in.



Figure 4

```
set Left to 30
set Right to 0
repeat while true
do
  repeat until get surface color = surface color green
  do
    if get surface color = surface color red
    do
      set wheel speeds:
        left (mm/s) Left
        right (mm/s) Right
    else if get surface color = surface color black
    do
      set wheel speeds:
        left (mm/s) Right
        right (mm/s) Left
    else
      set wheel speeds:
        left (mm/s) 50
        right (mm/s) 50
  rotate angle: 90 deg speed: 30 mm/s
  rotate angle: 90 deg speed: 30 mm/s
  if Left > Right
  do
    set Left to 0
    set Right to 30
  else
    set Left to 30
    set Right to 0
```