

## PRACTICE 4: DEFENDER



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## 1. Description

This document tries to introduce the user to the programming of Moway performing for this purpose diverse practices.

In this fourth practice called the “Defender” Moway shall drive out those objects that invade its territory, using for this purpose two sensors and the motors, with what is a complete practice that shall help to understand and program an application by optimizing the robot resources.

## 2. Strategy

The robot will have to make decisions according to the values provided by the line and obstacle sensors. For this purpose the robot must do the same as in the confined area practice (it must avoid trespassing the limits of the confined area) but at the same time controlling that there is no intruder inside this area. When it detects some object with the obstacle sensors, it must move it and drive it out of the area that it wants to defend.

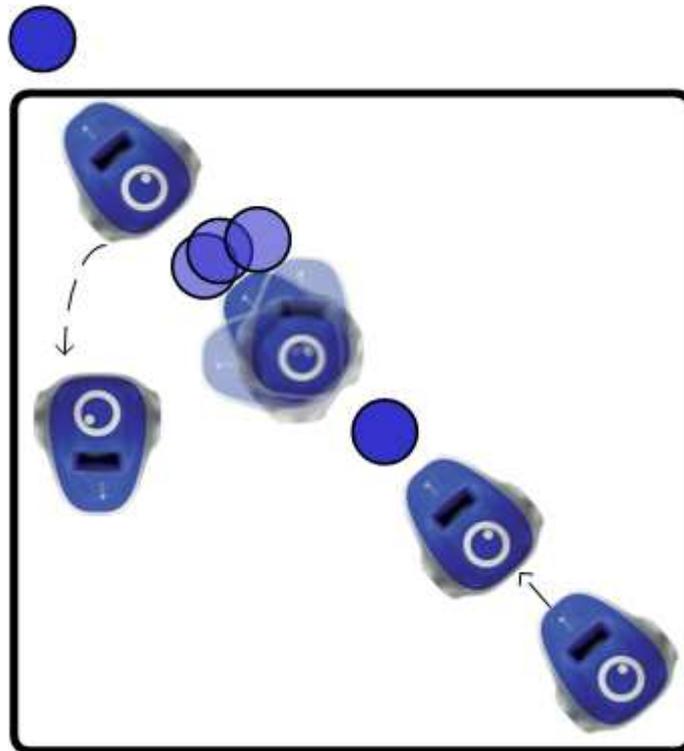


Image 1. Defender

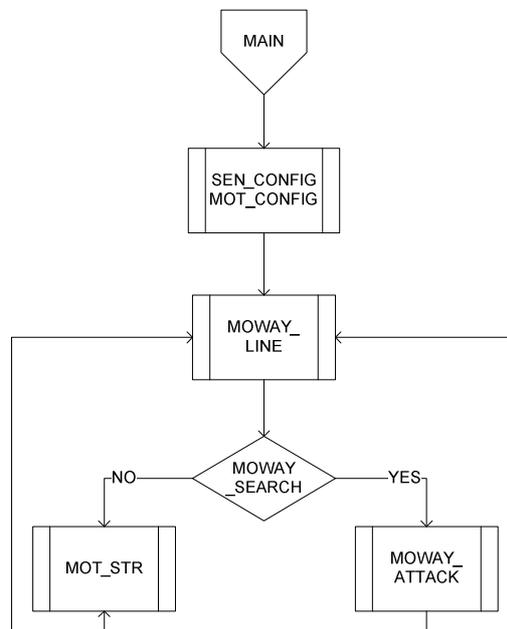
The main program must control both the line and the obstacle sensors. Each time the line is detected the robot will turn in order to avoid trespassing the limits and when

it detects any object it must push it away without forgetting to check the line sensors in order to not trespass the boundary limits of the confined area.

### 3. Solution

The complete practice code may be downloaded from Moway's Website: the assembly , the CCS and the MowayGUI versions. The image displays the program's flow diagram.

1. In the program Main window we must configure Moway's microcontroller to enable the use of the sensors and the motor unit.
2. It checks the existence of the boundary line of the area to be defended and turns if it finds it (MOWAY\_LINE function).
3. We call up the MOWAY\_SEARCH that indicates if there is an obstacle in front of the robot. If it finds any obstacle the robot attacks it (MOWAY\_ATTACK); otherwise it continues forward patrolling the area.



**Image 2. Main Program**

Below is an explanation of the functions of MOWAY\_LINE, MOWAY\_SEARCH and MOWAY\_ATTACK

#### 3.1. MOWAY\_LINE

The MOWAY\_LINE function prevents the Moway from leaving the area to be defended.

1. The function calls up the SEN\_LINE\_DIG function of sensors library lib\_sen\_moway that returns the digital values of the line sensors (1: There is a black line, 0: There is no line).
2. When any of these variables is 1 (line detected), we send a command to the drive system to turn a set number of degrees and wait until it is completed.

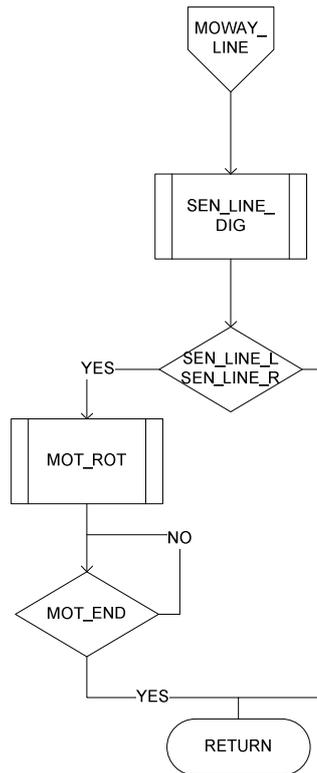
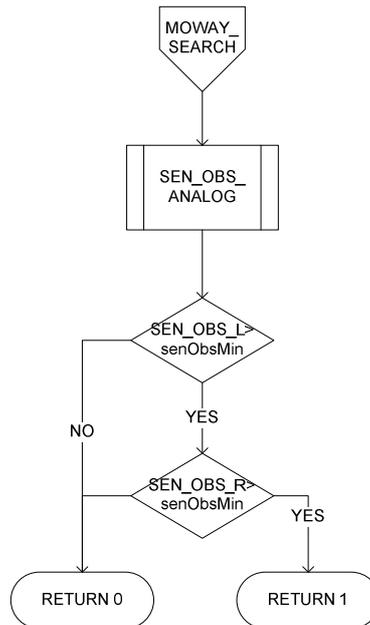


Image 3. MOWAY\_LINE

### 3.2. MOWAY\_SEARCH

The MOWAY\_SEARCH function indicates the existence of an obstacle in front of the robot.

1. First call up the sensors' lib\_sen\_moway library function SEN\_OBS\_ANALOG that returns the analog values of the obstacle sensors.
2. These values gathered are compared with the senObsMin set at the beginning of the program, returning a 1 if the value of the sensor is higher than the constant. This constant depends on the sensitivity of the sensors and can vary from one robot to another, depending on their manufacturer. The user must adjust the sensitivity according to his robot.

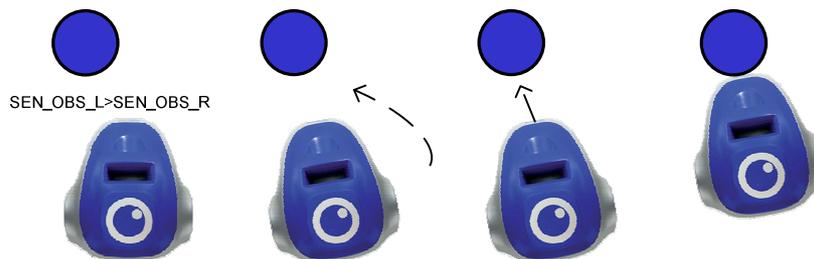


**Image 4. MOWAY\_SEARCH**

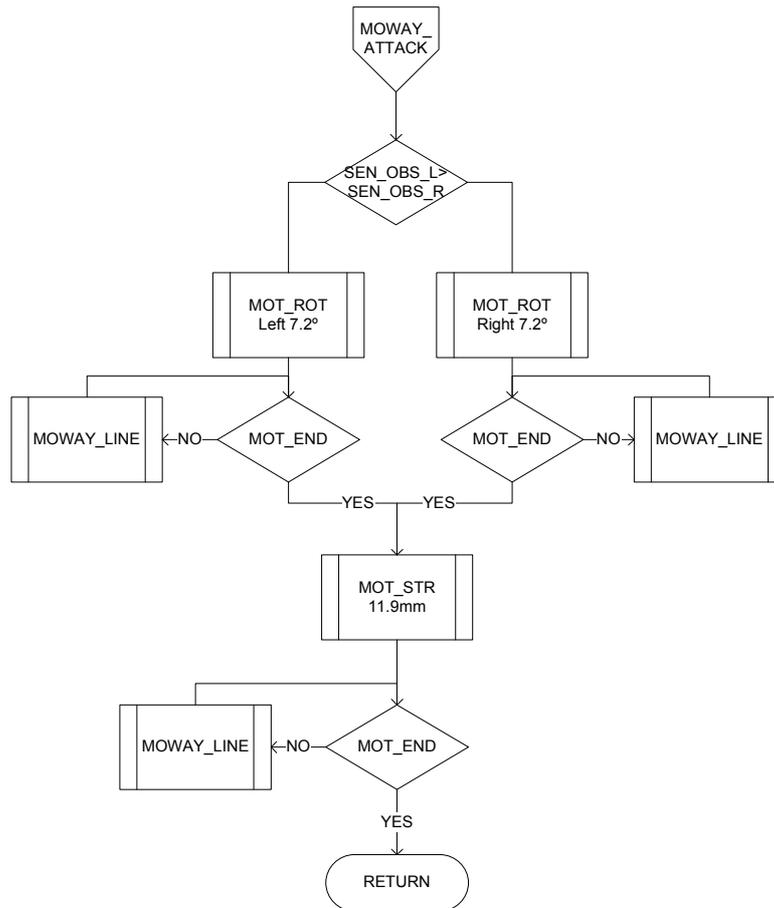
### 3.3. MOWAY\_ATTACK

The MOWAY\_ATTACK function is the attack routine that Moway uses to push the intruder until it expels it from its territory.

1. Both obstacle sensors are compared and Moway turns towards the side where the sensor value is higher. It is important to check if it is near the border of the area when it is turning.
2. Once the rotation ends, Moway goes in a straight line towards the object pushing it, also verifying the existence of the line.

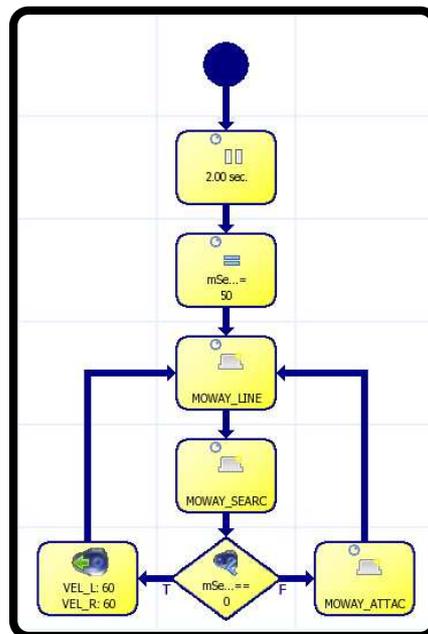


**Image 5. MOWAY\_ATTACK Strategy**



**Image 6. MOWAY\_ATTACK**

In MowayGUI the main program diagram can be simplified by using routines.



**Image 7. Diagram MowayGUI**

## 4. Improvements

Improvements may be introduced on the project in order to become acquainted with the robot programming:

- Change the speed of the movements.
- Modify the sensitivity of the detection changing senObsMin.
- Modify the attack algorithm.
- Notify the PC if Moway detects any intruder.
- Confront various Moways within the same territory.

## 5. Documentation

All the required documentation is available in Moway's website [www.moway-robot.com](http://www.moway-robot.com).

### Moway Manual

Moway User Manual.pdf

### Source Code

mOway\_defender\_ASM

mOway\_defender\_CCS

mOway\_defender\_GUI

### User Manual for module RF BZI-RF2GH4

Manual RF.pdf