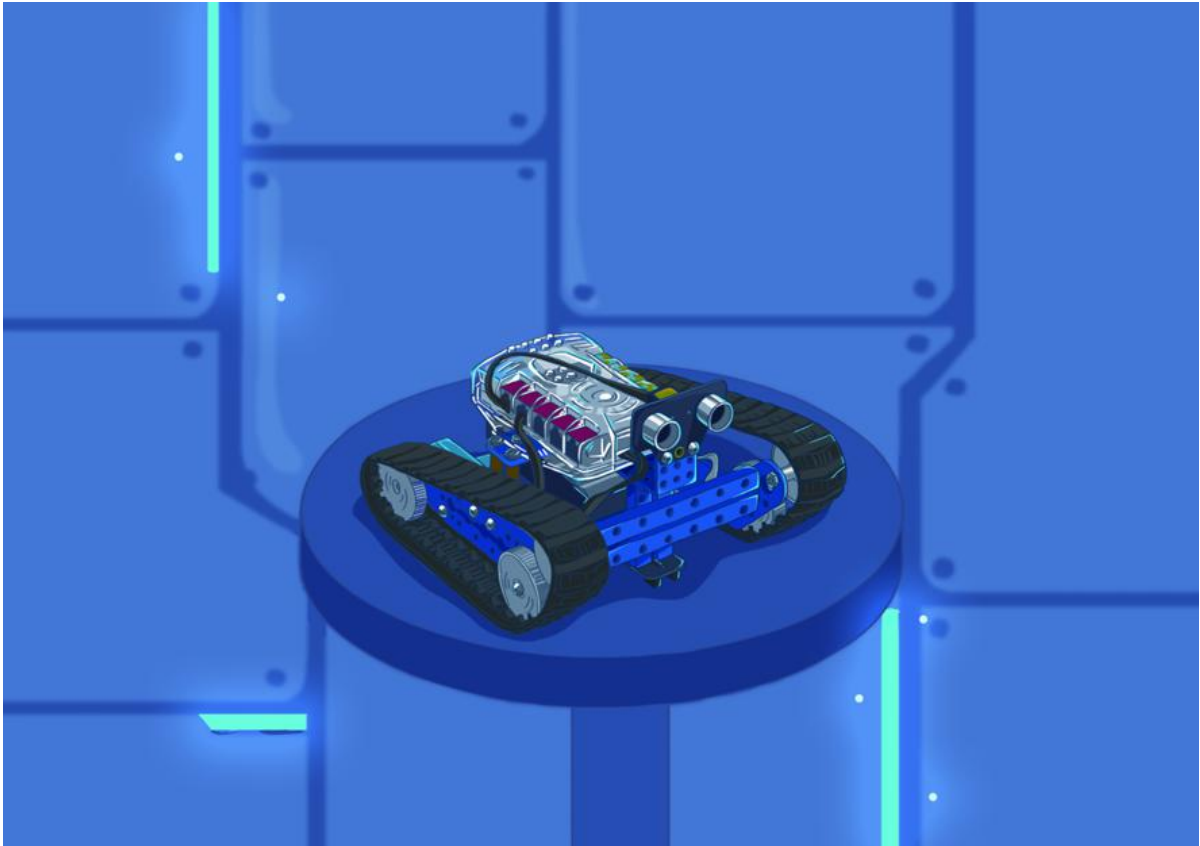


## Difficulty



Since it is in the pitch-darkness and the energy of ultrasonic wave detects is not enough to scan all the spaces and corners, which can only present the graphics of environment within 25 meters ahead on the screen, only some possible impacts can be functionally avoided at the most. In this reason, the whole advancing process still relies on weak infrared light trails on the ground until they find three long and narrow protrusions displayed on the upper part of the screen.

To keep away from the three long and narrow protrusions, Mark gives an order to stop Ranger Tank and gets ready to see what happens outside the capsule. In an instant, it seems that the tank starts ascending. Oh, no, it is supposed to be the whole ground that starts ascending...

“Don’t move the tank! According to the acceleration and ascending time, the ascending height is about 30 meters,” said Peter nervously. “It will be dangerous if we fall from this height!”

Keeping what Peter has warned in mind, Mark goes out of the capsule together with Rex after confirmation that the extravehicular environment is suitable for human activities...

“I confirm that there are or there were advanced smart lives in this place. The three long and narrow protrusions we saw on the screen are vertically retracted empty bridge walks, but I’m unable to confirm if I can still operate them. If Ranger Tank can be used to level these bridges, it seems that there is an entrance to another area at the other side. Also notice that it is a round platform that made us ascend just now. Please start all the ground sensors of Ranger Tank and avoid exceeding the range of the platform during operation,” Mark guides what needs to be done next over wireless walkie-talkie.

## Learning Objectives

In this chapter, we will learn how to use line following sensor to detect the boundary of the floor, allowing Ranger not to go beyond the boundary but to recede and make a turn when encountering the boundary. Meanwhile, we must utilize ultrasonic sensor to look for objects, impact them and complete the task.

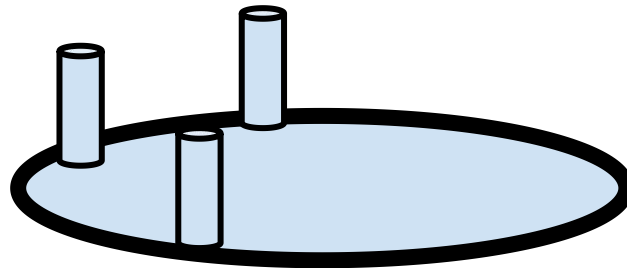
## Scientific Knowledge

Gravity refers to the force exerted on a body by the Earth's gravitational pull. We who live on the Earth have been accustomed to the Earth's Surface Gravity, but the Mars' Surface Gravity is just about 38% of that of the Earth, so a 75kg person will only have 28.4 kilograms in weight on the Mars. A body with the mass of 1,000g will lose its mass to 380g on the Mars, so any one can be a man of unusual strength on the Mars, easily lifting things that are very heavy on the Earth.

## Assembly Preparation

In this chapter we use off-road robot. Site layout:

Use electrician adhesive tape to create a round ground where three PET bottles (which can contain a third of a bottle of water) are randomly placed.

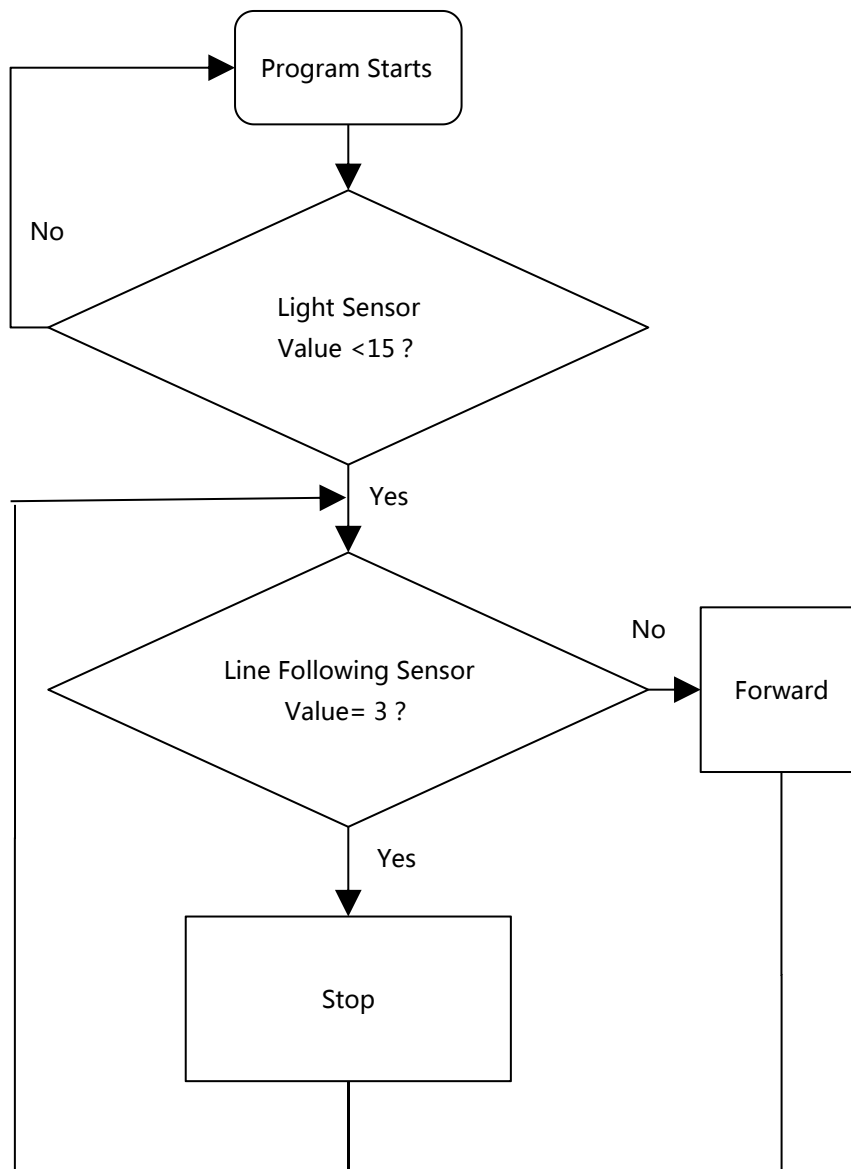


## Learning Tasks

### Learning Task 1 – Stop in Front of Black Line

Review the use of line following sensor and detect its state. Let Ranger move forward and stop as soon as it encounters black line

```
Auriga Program
wait until light sensor on board 1 < 15
forever
  if line follower Port9 = 3 then
    run forward at speed 0
  else
    run forward at speed 100
```

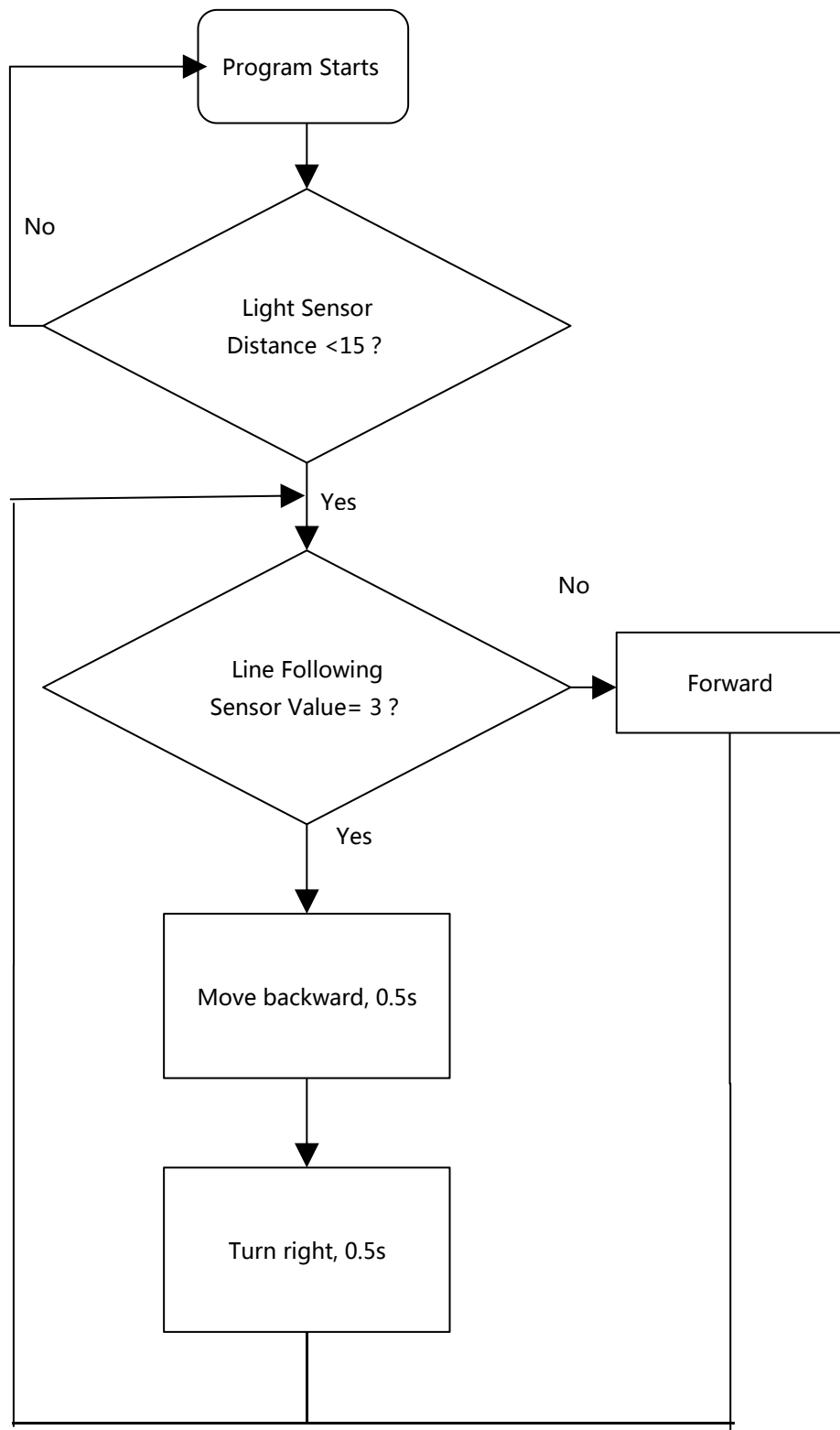


To avoid robot from starting motor and rushing forward at the beginning, we can use the [Wait until light sensor on board1<15] command and make a virtual switch. Let's control robot to start action.

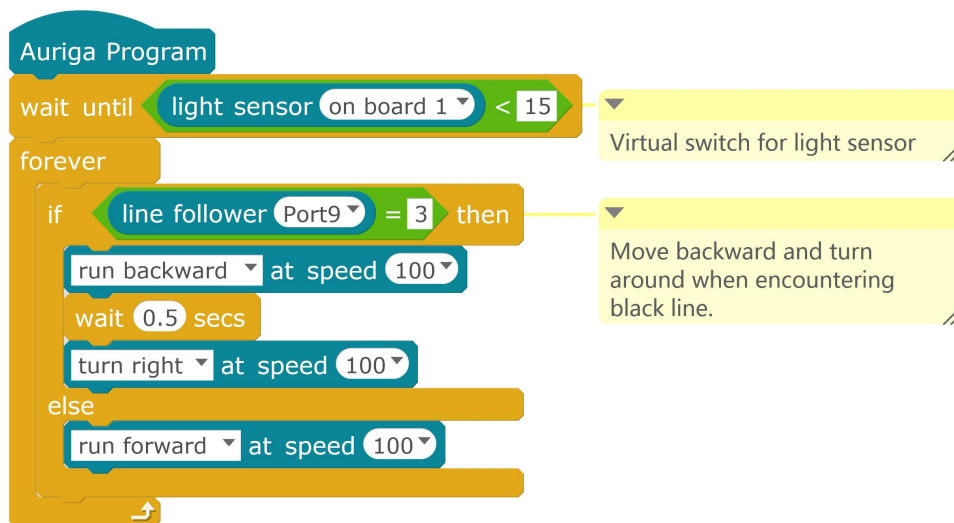
After uploading to Arduino, the user should remove USB cable and then robot enters waiting state. Now use your fingers to gently touch the enclosure on the top of light sensor. When your fingers cover the light and the sensing value of light sensor is less than 15, the robot executes [Keep repeating] internal command.

## Learning Task 2 – Limit Range (within an area)

Modify the action of [Stop upon encountering black line] and change it to [Move backward 0.5s, turn right 0.5s]. The program is as below:



mBlock program is as below:



In the above program, mBlock Robots commands are used for moving and turning. You can also use the command of encoder motor to directly control the speed of motor, achieving turning effect.

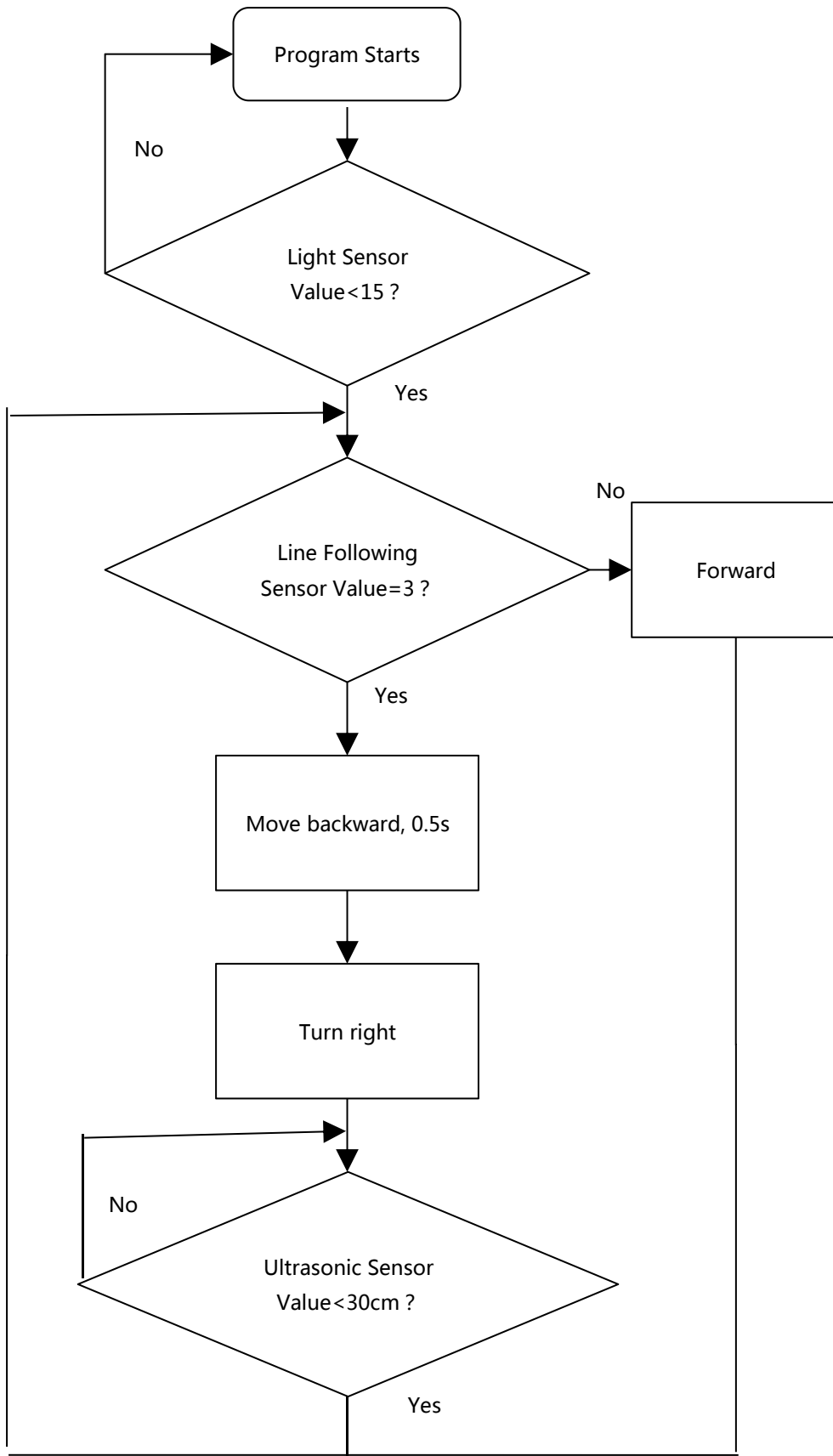
set encoder motor on board Slot1 rotate at the speed of 100 rpm

Have a try. Can your robot walk around within the range encircled by black line without going beyond the boundary?

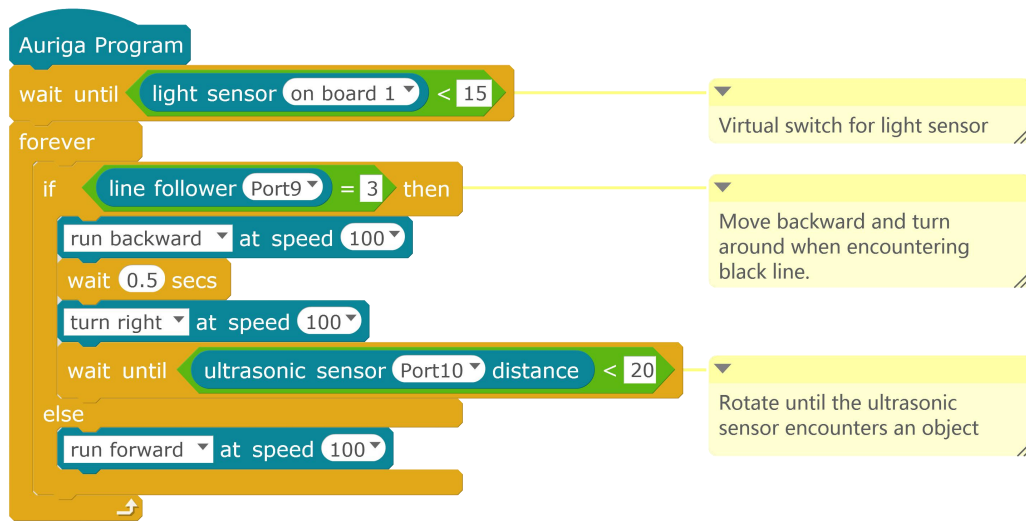
## Target Task

### Target Task 1 – Push Bottles

In Learning Task 2, the robot can only turn right for 0.5s, but you can slightly modify the action of the robot. When it turns right, just wait for its ultrasonic sensor to detect PET bottles (with ultrasonic distance less than 20 meters). The program is as below:



The program is as below:

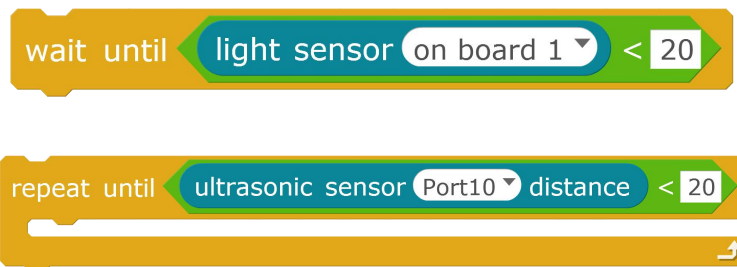


Please adjust the distance judgment value of ultrasonic sensor according to the size of the site.

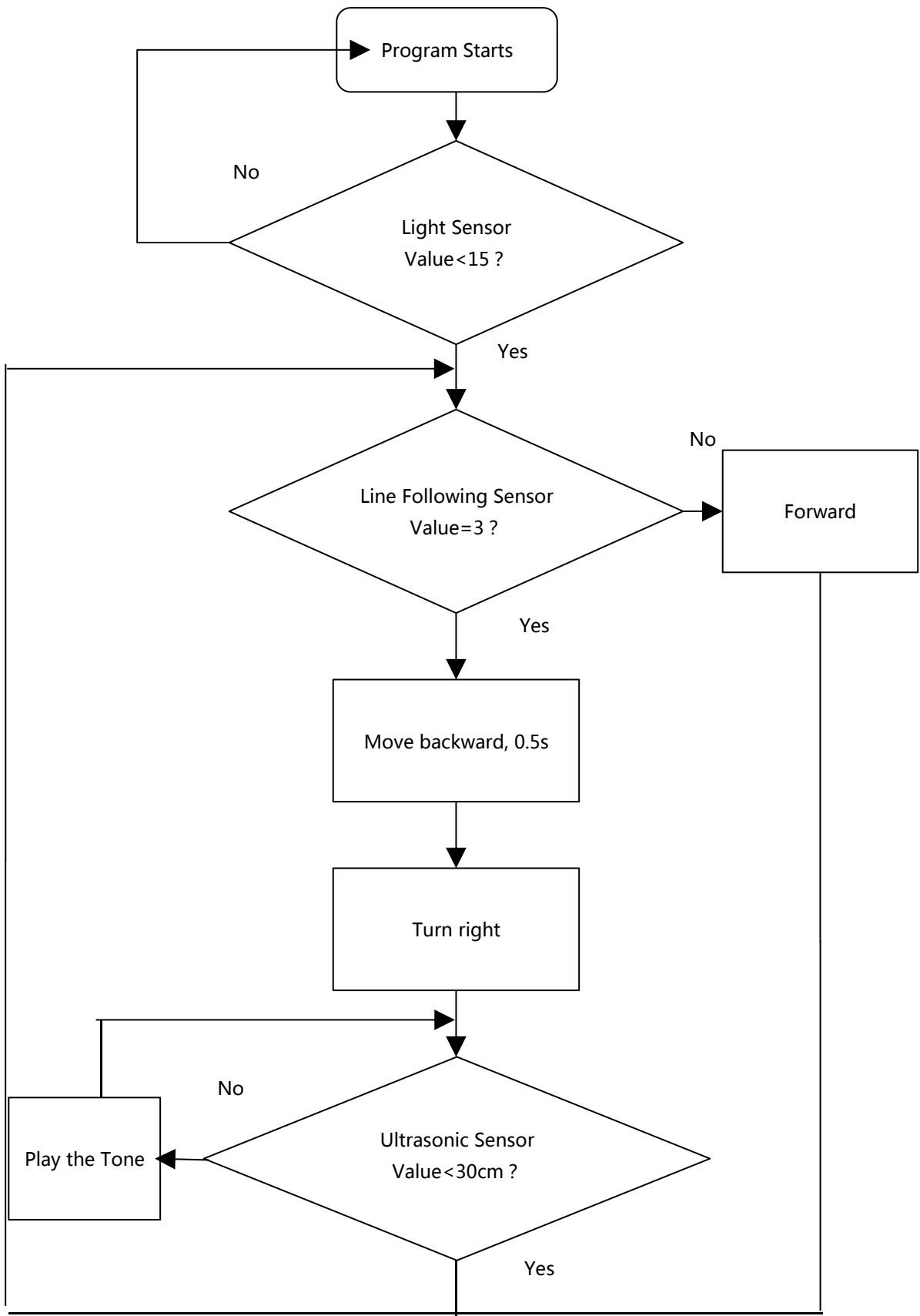
## Target Task 2 – Do Something else during Waiting

In Target Task 1 program, when the robot starts turning and waits for ultrasonic sensor to find object, the robot can only attentively wait for conditions to be met (with ultrasonic sensor value less than 20m) due to the [Waiting] command. If you want to see the robot make a sound during the period of waiting time, how should you write the program?

As described in Chapter 13, compare the following two commands first, namely, [Wait until the <condition>...] command and [Repeat until the <condition>...].

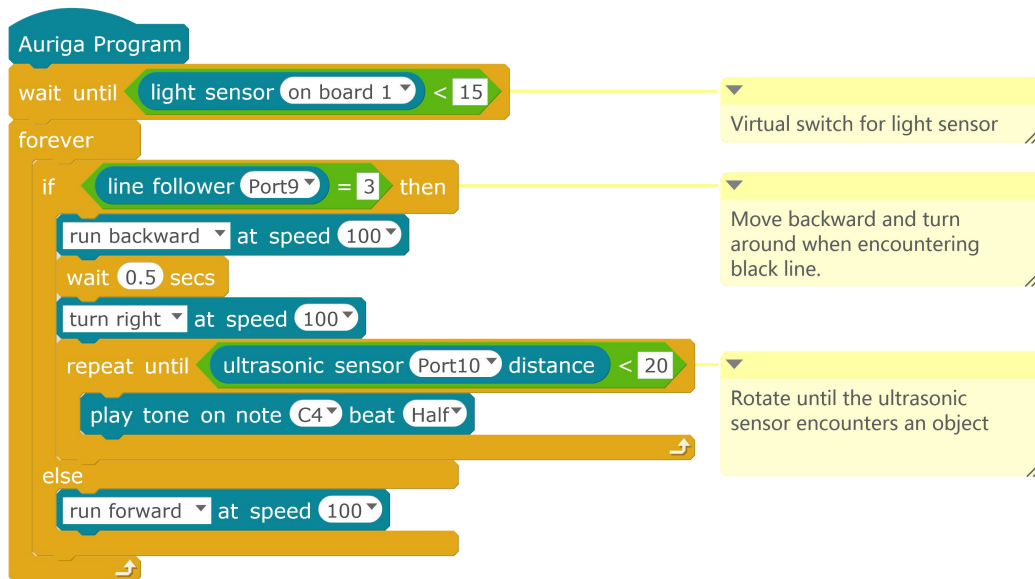


Please change the [Waiting] command in Target Task 1 program to [Repeat executing...until] command block, which executes other command blocks when the user is waiting for some conditions. Here we let the program to execute playing the tone command. You can also add LED light control. In principle, do not execute too many commands in repeated operations, in order not to affect the detection judgment of [Until...]. The program is as below:





The program is as below for reference:



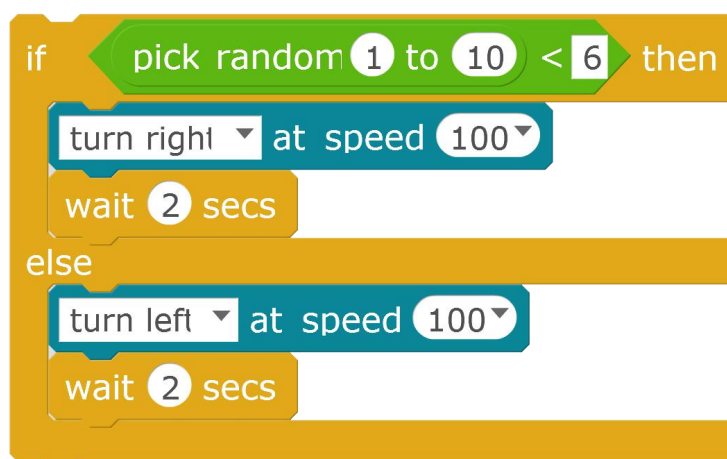
Please connect the USB cable and upload the program. Test and observe the action of the robot, that is, if it continuously makes Do sounds when it turns right to look for objects.

## The Challenge

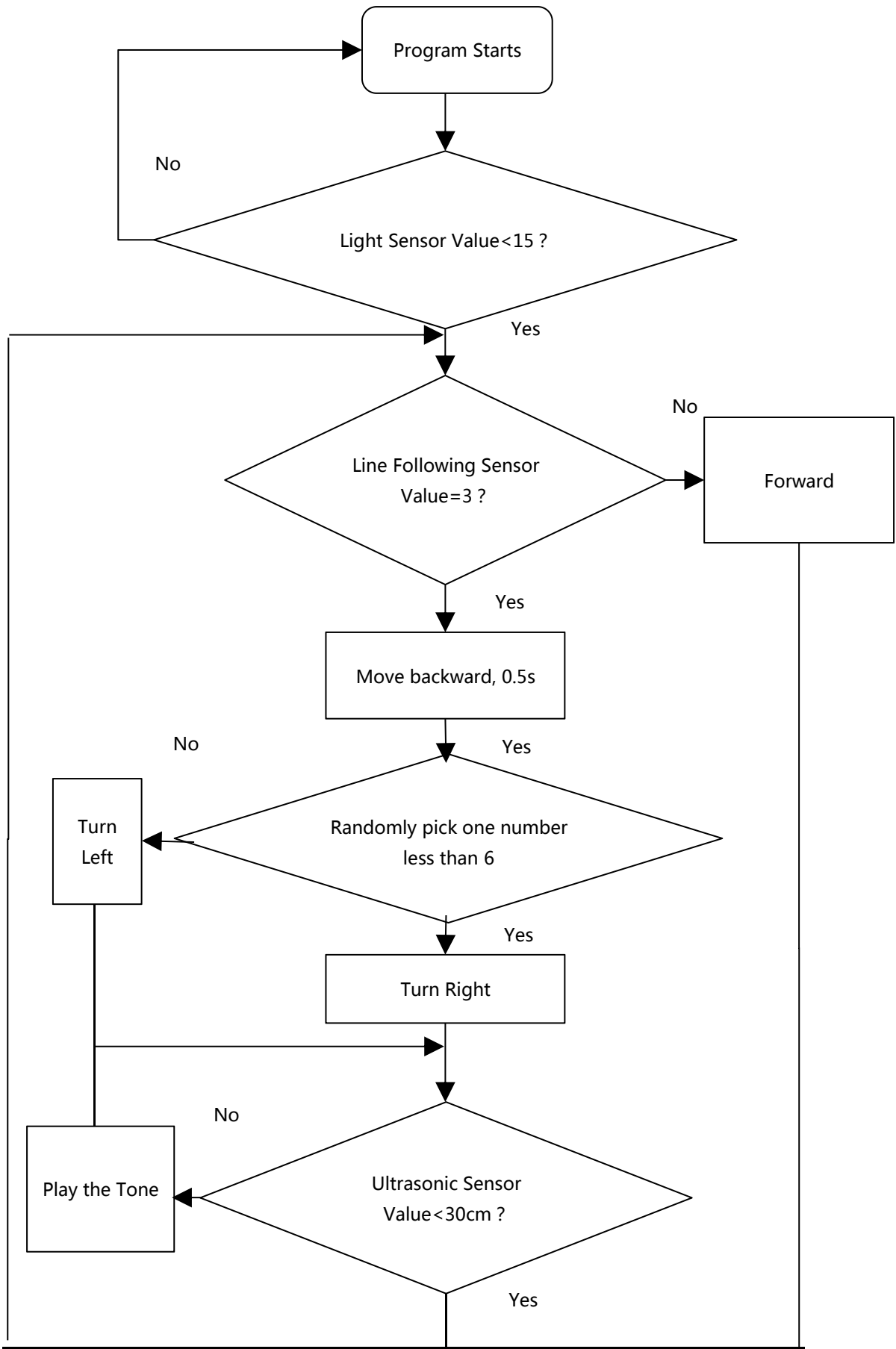
### Challenge Task 1 – Choose to Turn right or Turn left

In Target Task 2 program, the robot can only turn right, which might cause so monotonous action without any changes. How to modernize Ranger robot and to make it possible to choose to turn left or turn right?

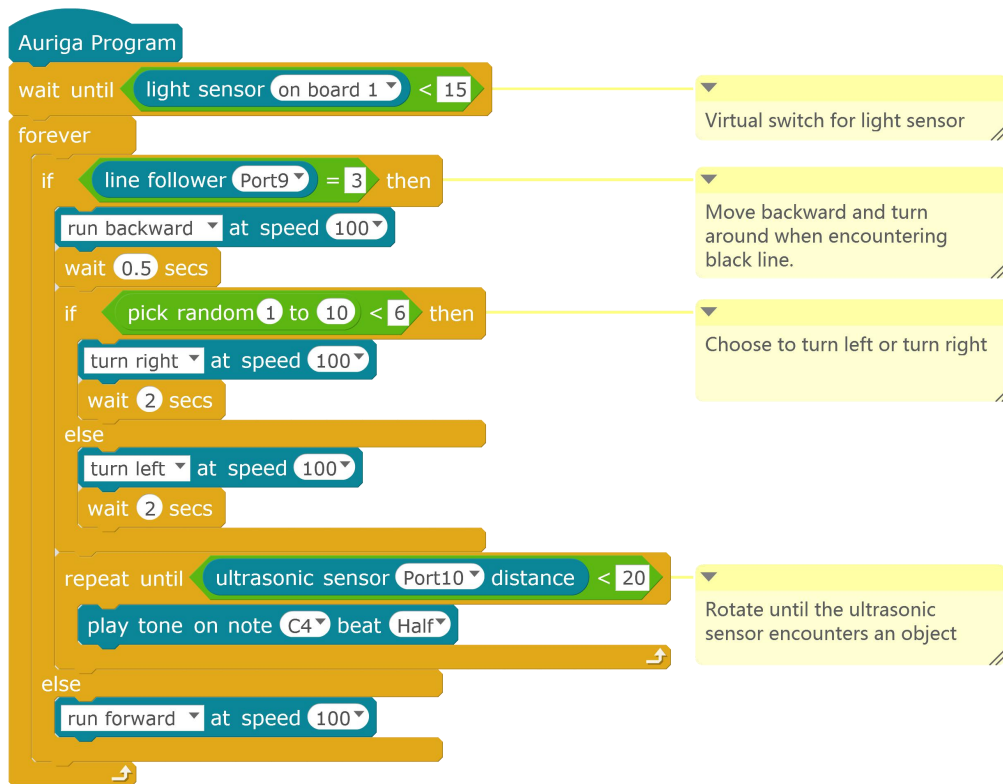
Let's do this with [Pick random 1 to 10] command, and compare the value, then determine the rotating direction of the robot.



The robot will pick a number from 1 to 10. If the number is less than 6 (i.e. 1, 2, 3, 4, 5), the robot will turn right. On the contrary, if the number is not less than 6 (i.e. 6, 7, 8, 9, 10), the robot will turn left. The program is as below:



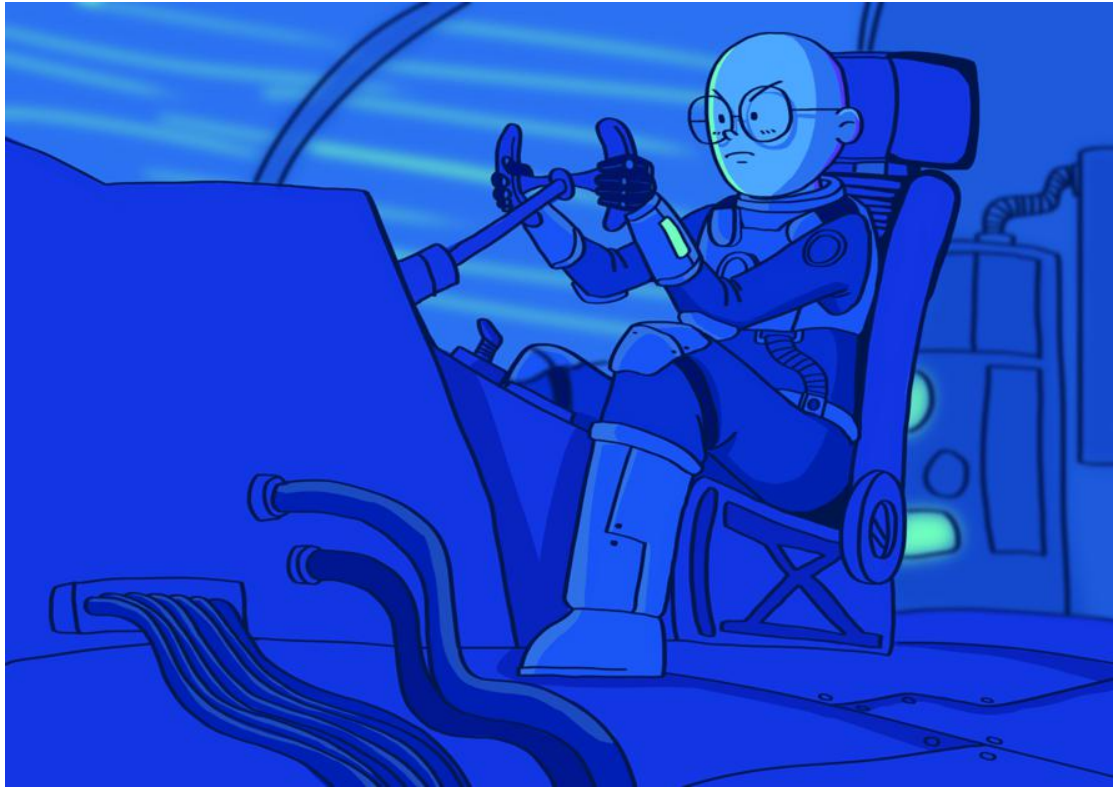
This program is used to replace the command of turning right only. The whole program is as below for reference:



Have a try! Your robot will choose to turn left or turn right by itself, and is not restricted to one rotating direction any more. In this way, the robot seems to be given a life, which can choose its own rotating direction by itself. If you can make the most of the [Pick random 1 to 10] command, your robot will change more!

## Conclusion of This Chapter

In this chapter, we combine line following sensor and ultrasonic sensor to be comprehensively applied for the robot to look for and impact objects, which will not go beyond the boundary.



With Jennifer's superb driving technology, plus sensor data offered by Peter, Ranger Tank successfully levels the three folded empty bridges. Since the round platform has been elevated to a certain height, and it seems that Ranger Tank cannot pass through the long and swallow empty bridges, Mark, together with Peter, Dr. Chiu and Rex, gets ready to walk through these empty bridges to look for any possible lives...