LESSON 7 DANCE! WEEEBOT!

Lesson Overview

Students will learn ultrasonic sensor, use the knowledge of ultrasonic sensor and math to create a dancing robot and obstacle avoidance robot.

Lesson Target

1. Learn how ultrasonic works.
2. Learn mathematic logic “and, or, not”, and solve problem with compound conditions.
3. Create a dancing robot and obstacle avoidance robot.

Lesson Tag

GRADE LEVEL	SUBJECTS	DIFFICULTY	DURATION	GROUP
Elementary, middle	STEAM, computer science physical	Beginner	2 x 50 mins	2 student

Supplies

Robot	Accessories	Other Material	Tools Used
WeeeBot Kit	USB cable	PC with WeeeCode software USB port required;	

Lesson Outline

INTRO: Talk about echo, introduce sound wave and ultrasonic. (20 mins)

CREATE: Students will learn about ultrasonic module and its coding block in WeeeCode, and create a dancing robot. (30 mins)

PLAY: Each group tests, then records learnings from their invention. Students explore how their invention works, plus the coding concepts behind it. (30 mins)

REMIX: Students will customize and enhance their inventions to create an obstacle avoidance robot. (20 mins)

Routine

1. INTRODUCE SOUND WAVE AND ULTRASONIC.

In life, if we yell at valley, we can hear echo; if we yell at sky, we cannot hear echo. So we know that sound wave can be reflected by object

In natural world, a lot of animals can use sound to navigate, such as bat and dolphin. They use ultrasonic to echolocate object nearby and determine the direction.

In daily life, the sweeping robot also use ultrasonic to locate objects nearby to avoid hitting.

In a word, ultrasonic is a kind of sound wave that human cannot hear, it has a feature that will be reflected by object.

2. HARDWARE AND SOFTWARE INTRODUCTION

Hardware - Ultrasonic Module

Ultrasonic sensor has two “eyes”, see picture in the right. One “eye” will transmit ultrasonic, the other one will receive the reflected ultrasonic.

In math class we learnt how to calculate distance:

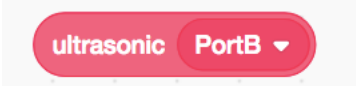
Distance (s) = velocity (u or v) x time (t) s=vt

The spread speed of sound wave is fixed, so we can use this formula understand how ultrasonic module works.

Time = time when received ultrasonic - time when transmit ultrasonic
Round-trip distance = ultrasonic spread speed * time
Single way distance = round-trip distance/2

Software - WeeeCode module

Open WeeeCode software, find “WeeeCode” category in coding block zone, and check below Ultrasonic coding block. The default port of ultrasonic sensor is port B, if wiring port changed, please change in software accordingly.



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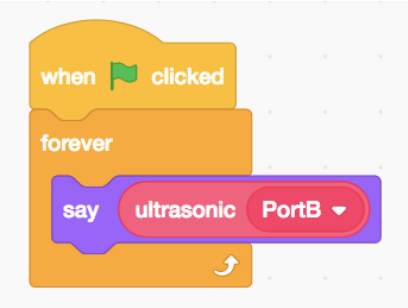
Exercise:

1. Connect USB cable, restore online firmware for robot to enter online mode.
2. Write program as below picture and observe the result.



Result: the measured distance will be said by elephant.

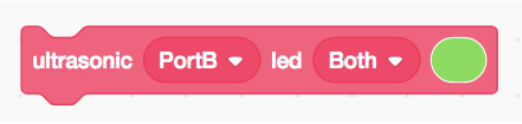
Tips:

1. If no value come out, firstly please check whether robot is under online mode, secondly please check the port of ultrasonic sensor.
2. Do not change power supply during testing, or communication might be shut down and value will maintain 500.
3. The value of ultrasonic coding block is the distance between ultrasonic sensor to the object in front, the value unit is centimeter.

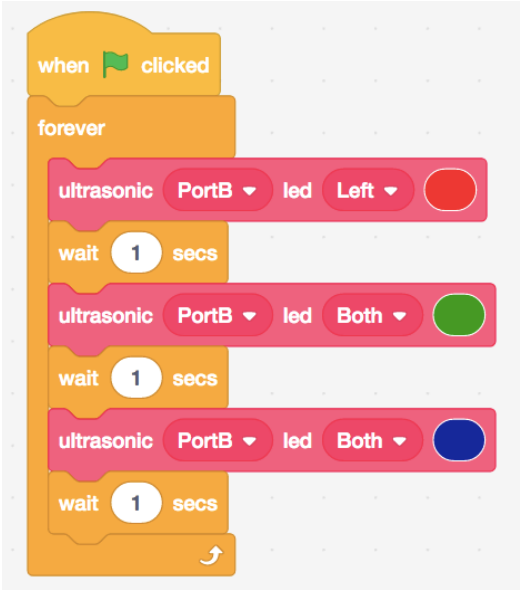
Ask students cover the ultrasonic sensor and observe distance value changes.
Ask students put robot towards open space, observe the maximum value of it.
Ask students put hands in front of robot and move forward until the value near 4.

Result: the maximum detecting range is 500 centimeters. When the distance between ultrasonic and object is less than 4 cm, errors might be happen. Please avoid using ultrasonic value to test distance under 4 cm.

The ultrasonic sensor has an additional function, RGB LED. Use below coding block to control. Select the first drop box to choose port, select the second drop box to select RGB LED, select color in the last drop box.



Testing the right program:



Result: RGB LED Ultrasonic Sensor will first light up red in the left LED, one second later it will light up green in the right LED, one second later it will light up blue on both LED.

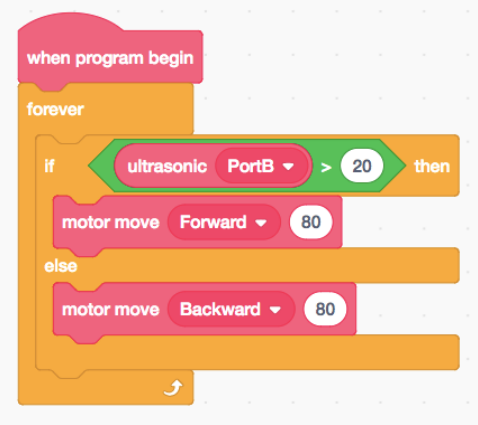
Tips:
Reference value
Red - 100, 100, 100
Green - 30, 100, 60
Blue - 70, 100, 60

3. WRITE CODES AND OPTIMIZE CODES

Write codes to make a dancing robot

Tango is a two-people dance, one people move forward and one people move backward. Let's write program to let robot dance with our hands. If our hand move close to robot, robot move backward; if our hand move away from robot, robot move forward.

Sample program:



Result: If our hand move close to robot, robot move backward; if our hand move away from robot, robot move forward. However, we do not set a condition to stop moving robot, robot will move forward and backward repeatedly when hand stop moving.

Use math logic "and, or, not"

Ultrasonic sensor value	Robot movement
⩾20	Move forward
15＞value＞20	Stop
⩽15	Move backward

In WeeeCode, we use below command to express those logic.

: And. When both condition is fulfilled, the result is true.

: Or. Either one of the two conditions is true, the result is true.

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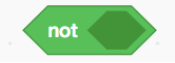
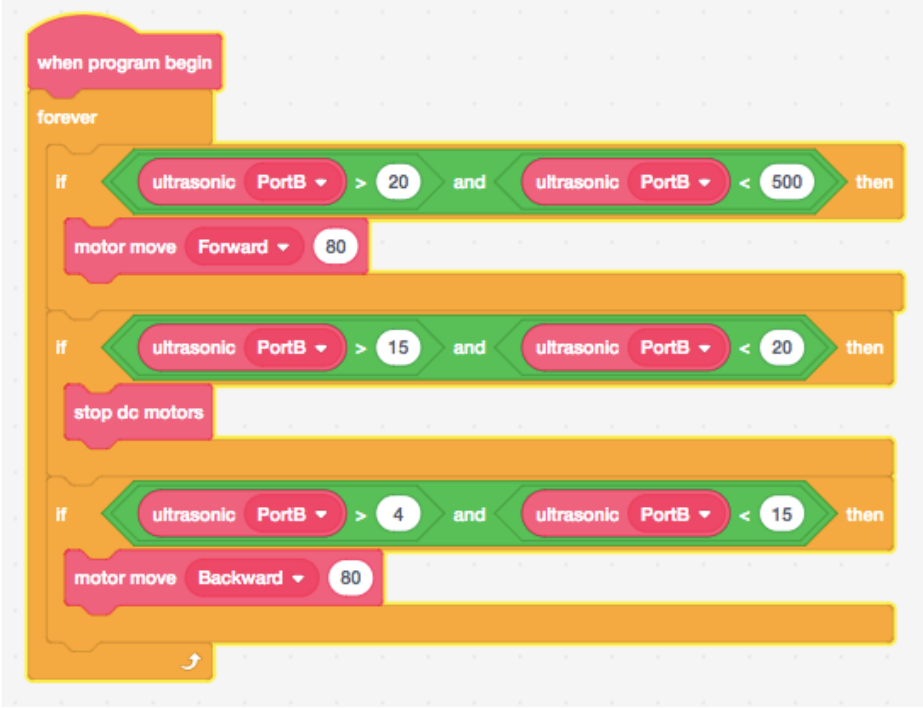


: not. Get the contrary result.

Now we can use the logic coding block to express the number between 15 to 20.

Code and Optimize

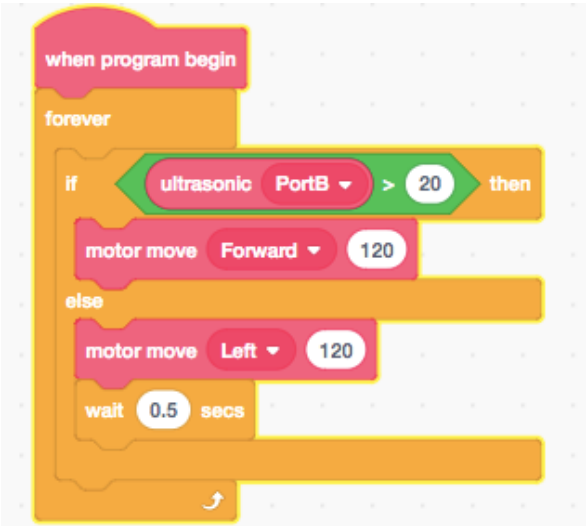
As we learn, the detection range of ultrasonic sensor is between 4cm to 500cm. The margin of error will increase a lot beyond this scope, which should be avoided.



4. REMIX

Basic version obstacle avoidance robot.
When robot move forward, robot should test whether obstacle is in front or not. If yes, robot make a turn; if not, robot keep moving forward.

Sample program as right picture.



Advanced version obstacle avoidance robot.

When robot move forward, robot should test whether obstacle is in front or not. If yes, the RGB led light should flash twice and robot make a turn; if not, RGB led light should be white light and robot keep moving forward. Sample program as below.