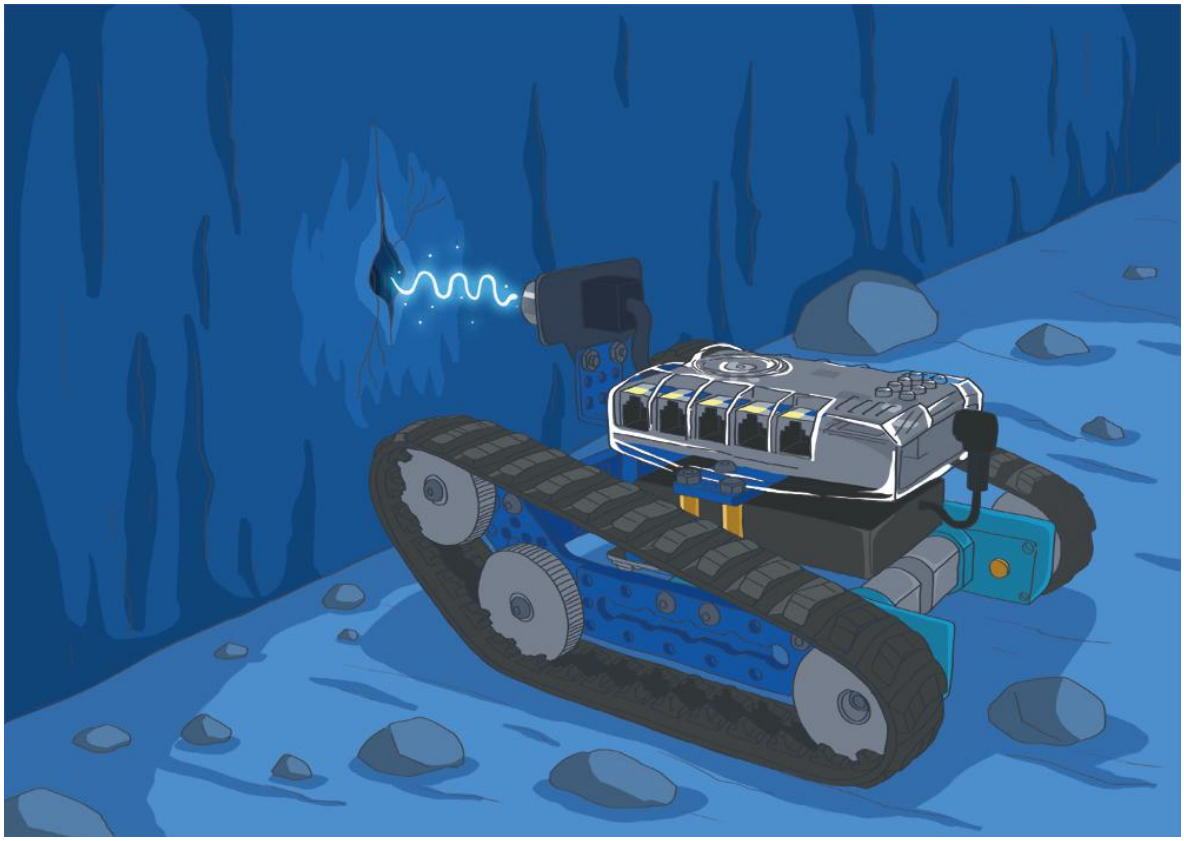
# Password



Jennifer makes Ranger Tank keep advancing at a low speed along a huge structural body. Peter and Dr. Chiu also attempt to find the access to this jumbo through data transmitted back from extra vehicular cameras and various sensors.

As soon as the beam of searchlight moving with Ranger Tank shines into a round-hole object, the extravehicular sound sensor immediately detects sound signals. Mark asks Jennifer to stop Ranger Tank right now and Peter to make the beam shine into the round hole again. As expected, it can respond to a sound signal and various colored lights get the response from different scales.

All of a sudden Mark thinks of the received scale signals transmitted from the Mars to the earth and that will it be the password to open the entrance.

He immediately asks Peter to use three-primary-color searchlight to create different combined colored lights that then illuminate the round-hole to enable the responding scale to align with the frequency decoded on the earth.

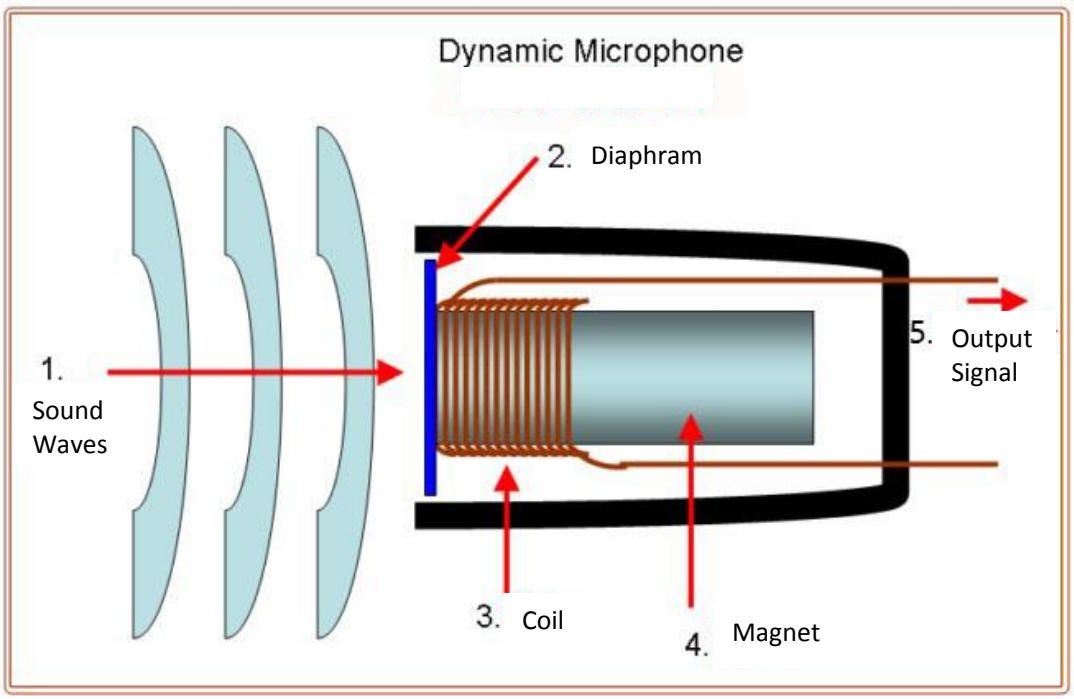
## Learning Objectives

In this chapter we will learn how to apply the sound sensors of Ranger and take the opportunity to find the change of sound volume through comparison of volume value of sound sensors. We can use sound sensor as a simple switch to control Ranger's LED light and motors, making it a voice control vehicle.

## Scientific Knowledge

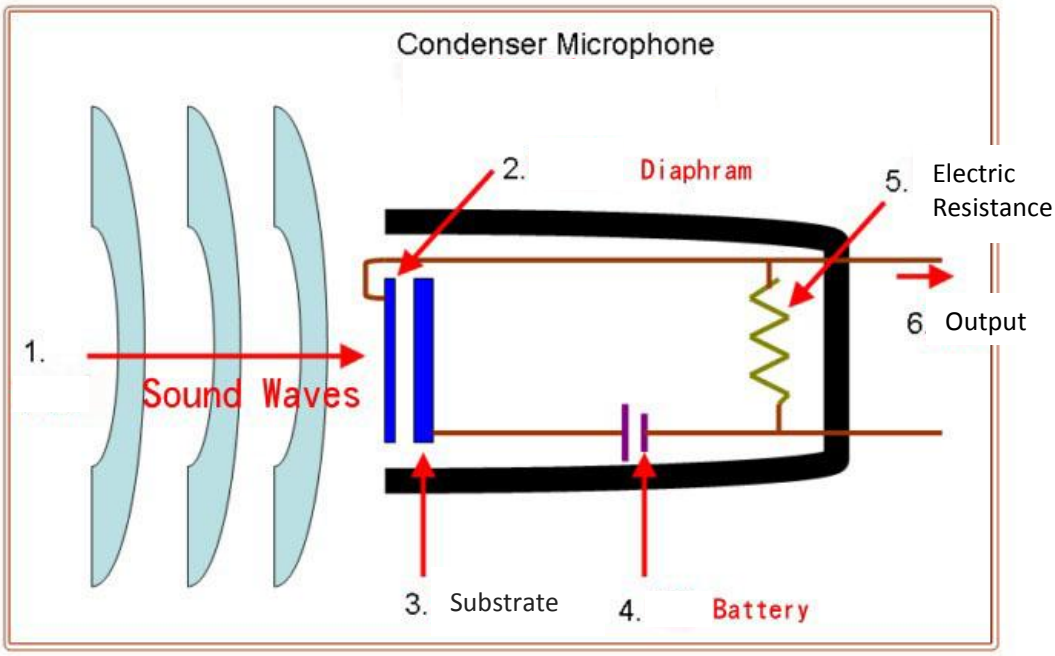
Microphone is a mechanical-electrical structure that converts the signals of sound to those of electricity. Here we introduce two common types according different conversion methods:

1. We use the mode of the interaction of magnet with coil and call it Dynamic Microphone.




When sound waves propel the coil connected on the vibration diaphragm, make it move back and forth in the magnetic field generated by the magnet, bringing the change of current in the coil (Faraday's Law, Lenz's Law).

2. We leverage the change of condenser size to make a voltage change and call it Condenser Microphone.



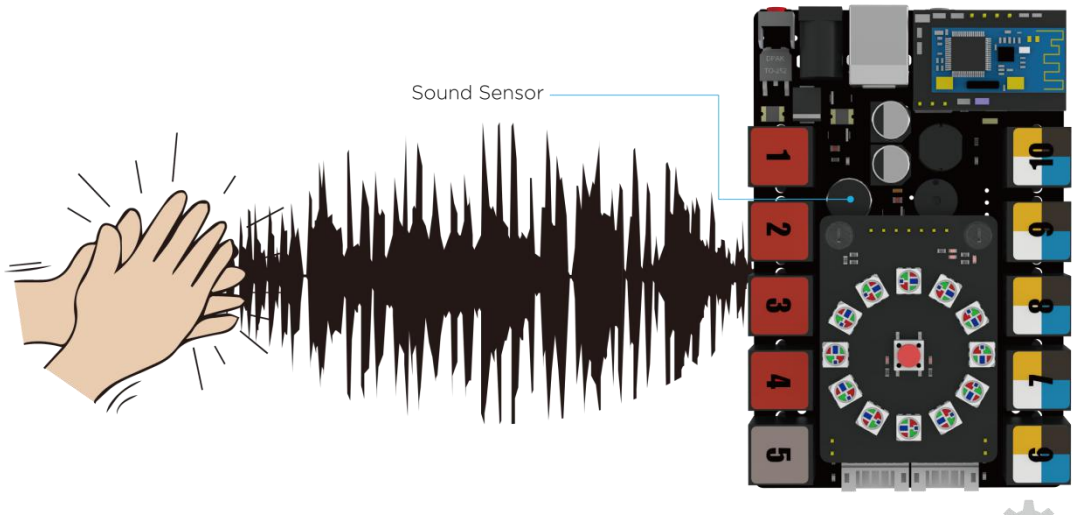

Capacity stored in the condenser varies because of different distances between two polar plates. When sound waves change the distance of condenser plates, the capacity will be absorbed or the capacity stored in the condenser will be discharged by the battery. In doing so, the change of sound will be reflected in the output voltage.

## Assembly Preparation

In this chapter we use tracked robot.

## Learning Tasks

**Sound Sensor.** Based on microphone, sound sensor in combination with low power amplifier can be used to detect the sound intensity (volume) of surrounding environment, with analog output value ranging from 0 to 1023. Sound sensor is widely used. For example, we can use sound sensor together with LED light or motor to turn, by which the volume of environment is sensed and the LED light is turned on/off with sound sensor, creating a man-machine interactive device.

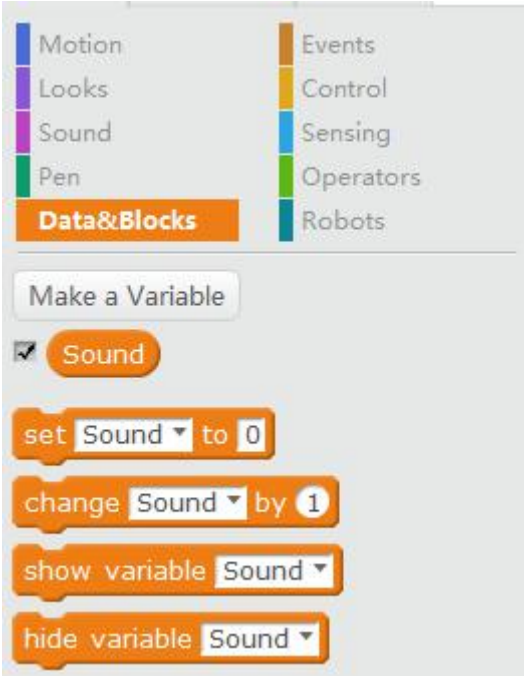



## Learning Task 1 – Value of Sound Sensor

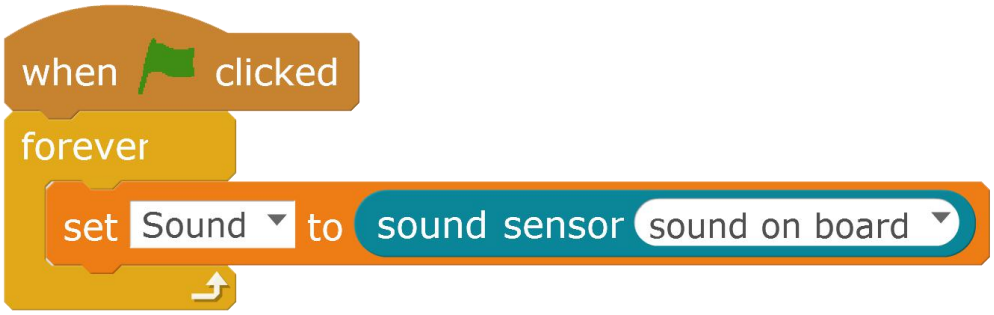
Control command of Ranger's sound sensor

| | | |
|---|---|---|
| Motion Looks Sound Pen Data&Blocks Events Control Sensing Operators **Robots** | sound sensor sound on board | Value of sound sensor |
| Function: Return the value of Me Auriga onboard sound sensor<br>The value range of the sound returned by the command: 0-1023 | | |

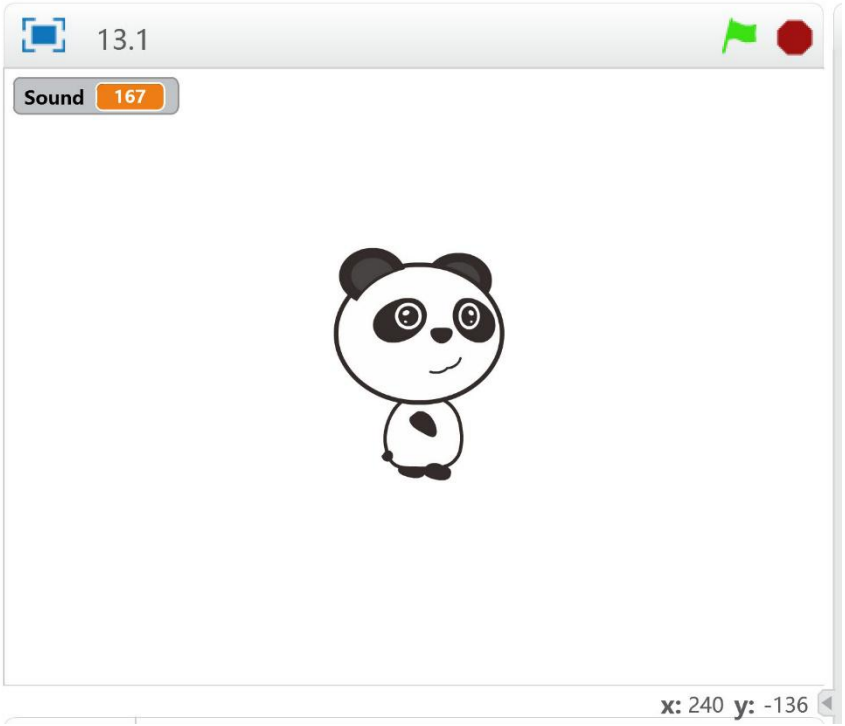
What the command sends back is the volume of sound sensor. By convention, we should create a variable called Sound first.




Then repeatedly put the values of sensor into Sound, and the command we use is “Set Sound to Sound Sensor onboard”.




After connecting Ranger to a serial port, click the green flag, then you can see the variable value jumping up and down on the stage as below.

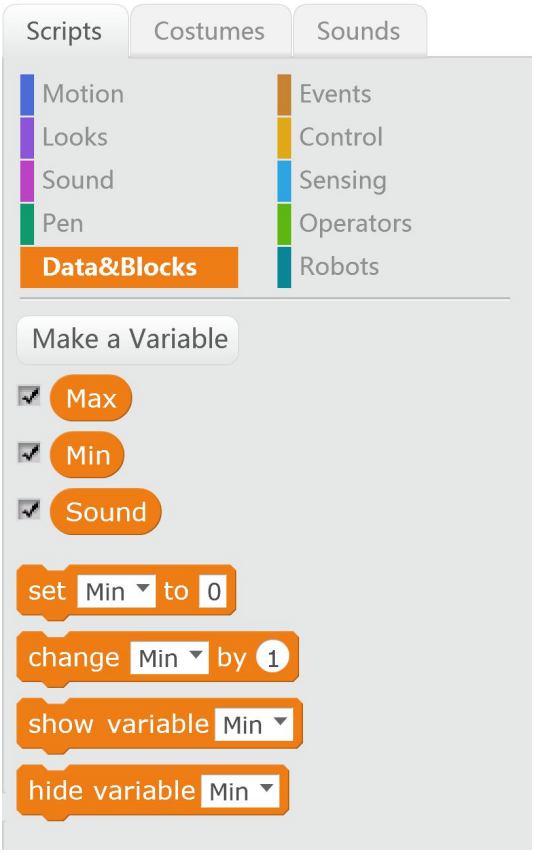



Try to clap your hands or speak to or shout at Ranger's sound sensor, and then observe the change of volume value.

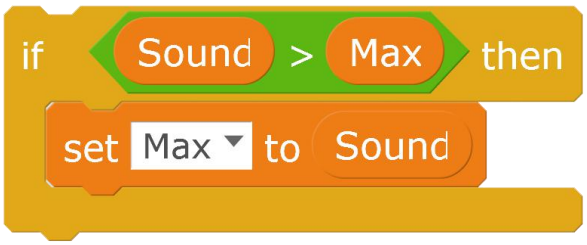
## Learning Task 2 – Maximum Value and Minimal Value

Since the volume changes very quickly, we have no enough time to observe the numerical change of volume, but we can store the maximum and minimal values through a simple calculation method for the convenience of reference and use in the future.

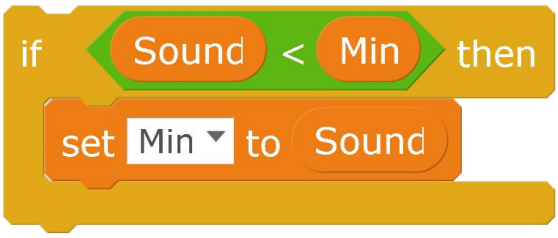
Create another two variables Max and Min respectively representing the maximum value and minimal value first.



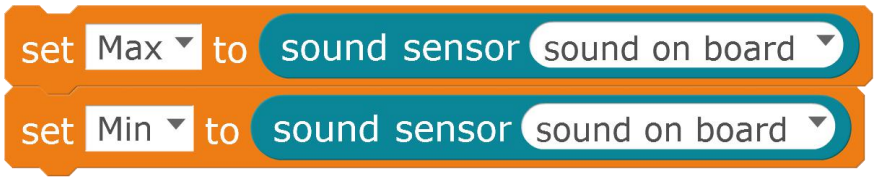

Let's add the [If...then…] judgment command and constantly compare current value. If the current value is larger than the previously stored value of Max, put the current value that is larger in Max.



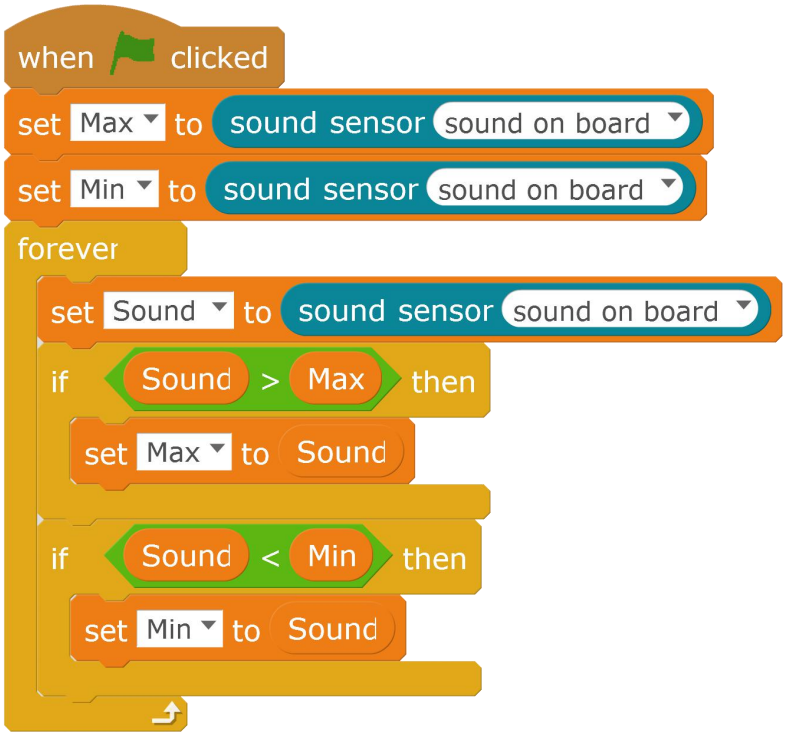

It holds true for the minimal value. Let's add another [If...then] judgment command and constantly compare current value. If the current value is less than the previously stored value of Min, put the current value that is less in Min.



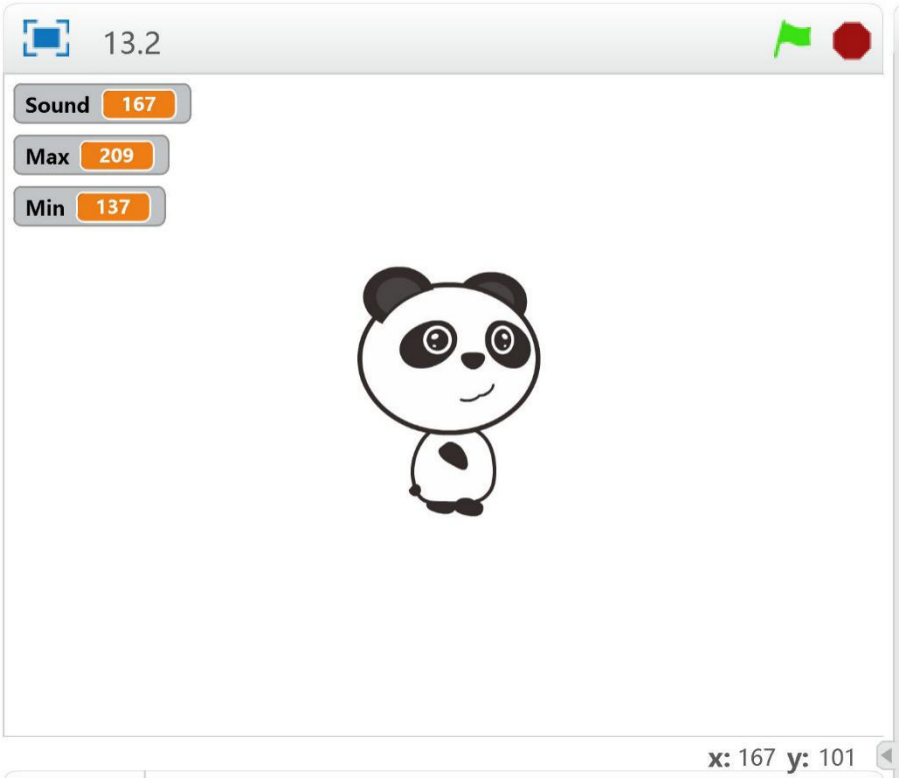

Never forget to handle the initial value of the maximal and minimal values at the very beginning of the program. In doing so, the minimal value will not be 0 for long.




The whole program is shown below:




Clap your hands or shout softly again, and then the maximal and minimal values of the sound sensor will be displayed on the stage.

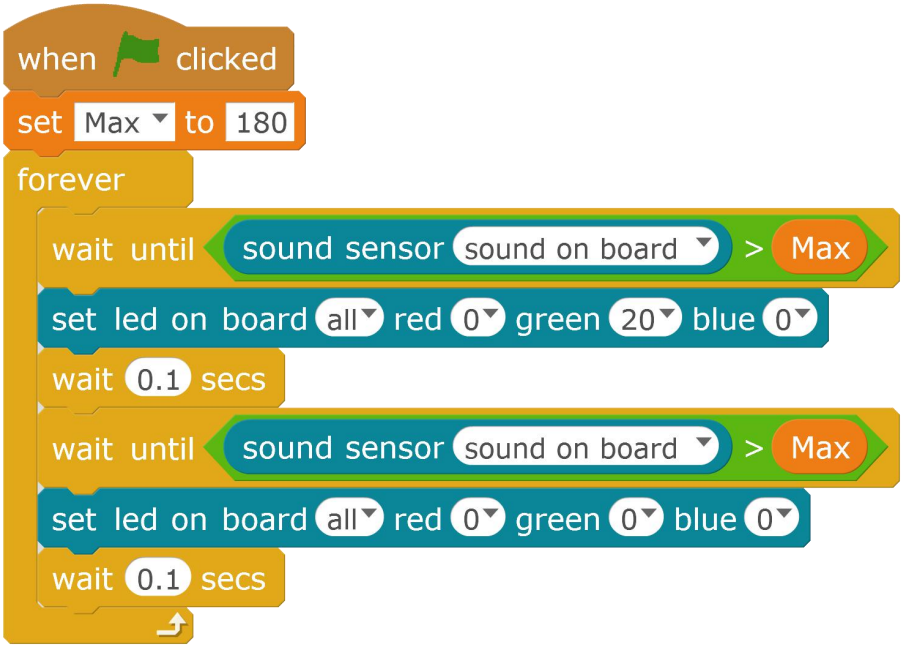



We can know the changes of the sound sensor according the maximal and minimal values.

## Target Task

## Target Task 1– Sound Sensor Switch

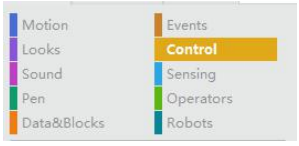
It is a very simple thing to use sound sensor as the switch. We can use the [Wait] command to set the condition as [The value of the sound sensor is larger than the specific value], and Ranger will execute the command of green LED light on after the condition is met. Turn off the LED light after the condition is met a second time.



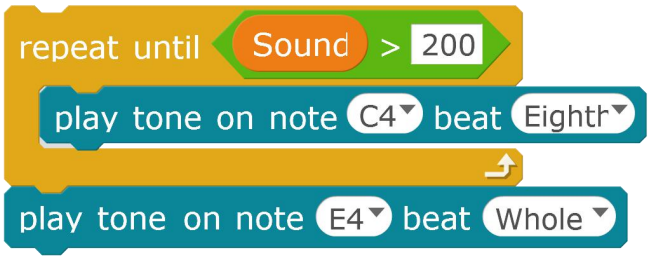

In the above program, we put the specific value in Max. In such a way, only if we set the variable value in Max to 180 at the beginning of the program, all the variable values in Max will be set to 180 when they are called, allowing the program to be easily modified and utilized.

Note: The setting of values in Max needs to refer to that in Learning Task 2.

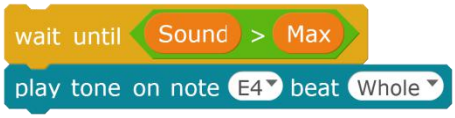
## Target Task 2– Write Program in another Way

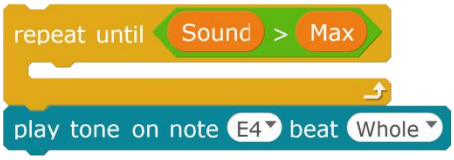
| | | |
|---|---|---|
|  |  | Repeat until… |
| Function: Before the condition is reached, constantly repeat all commands in C-type command. After the condition is reached, stop operating this command and execute the following commands. | | |

For example:
If the value of Sound is more than 200, the program executes the following commands, that is, to play the tune E4 at the takt time (1s). If the value of Sound is no more than 200 (less than or equal to 200), play the tune C4 all the time (one-eighth beat of time duration 0.125s).



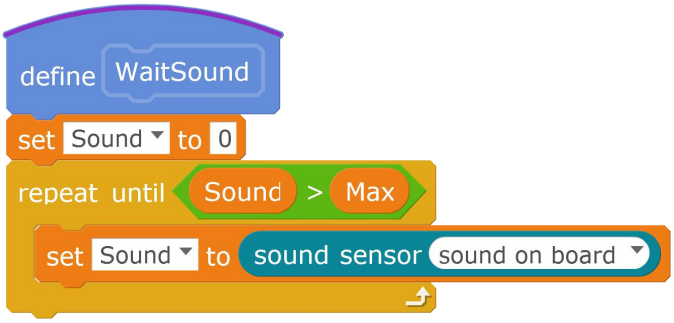

This [Repeat until…] command can replace the [Wait until…] command.



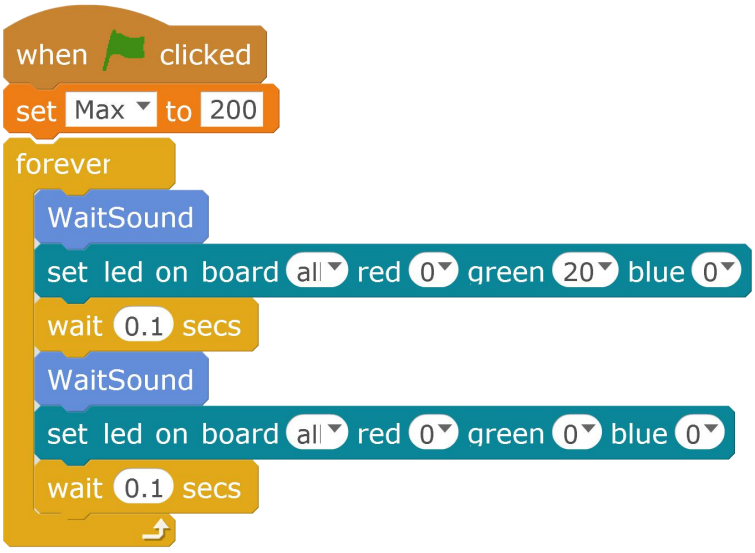

The program cannot execute other actions during waiting. If the [Wait until…] command is replaced with the [Repeat until…] command, other actions can proceed.

After understanding how to use the [Repeat until…] command, we can add a new block command called [WaitSound], with the program as shown below:



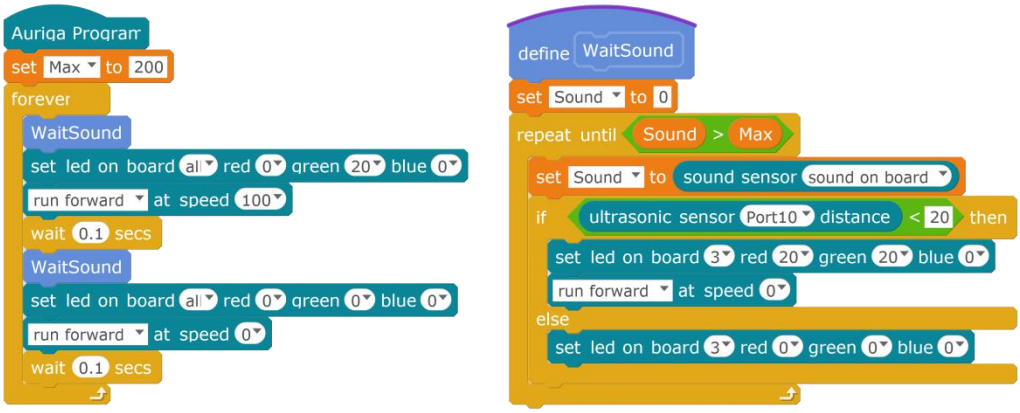

If Sound is larger than Max, repeatedly put the values of the sound sensor in Sound; if Sound is not larger than Max, the program will stop repeated actions, and execute the successive command instead.

The master program is as shown below: Use the block command [Wait Sound] added by yourself to replace the [Repeat until…] command.




Execute the program after the green flag is pressed and obverse whether it has the same effect as the previous program.

Then, please delete the [When the green flag is clicked] command. We need to change the [Upload to Arduino] command in offline mode, by dragging and adding the C-type command of [Auriga Program], and adding the [Advance] command for Ranger after controlling the command of the LED light as below:

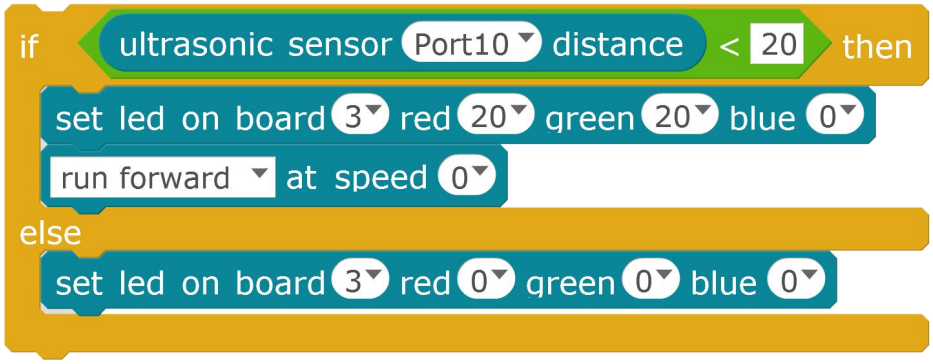



After uploading the program to Arduino, please remove the USB cable, put Ranger in a safe area, and observe whether you can control Ranger to advance or stop over voice. Be careful of Ranger’s safety.

## The Challenge

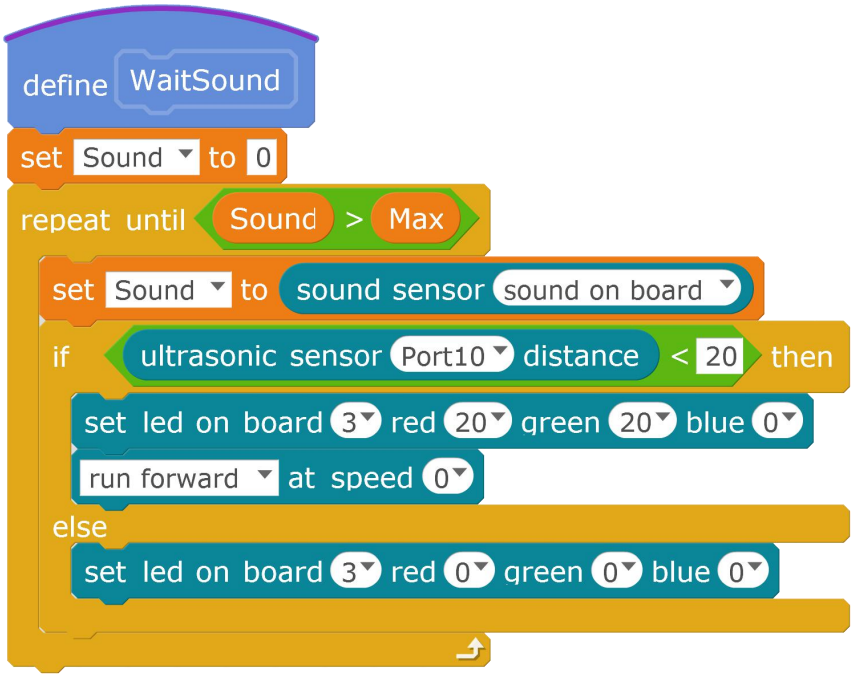
## Challenge Task1 – Add the Function of Ultrasonic Automatic Obstacle Avoidance

I believe that you are not strange to ultrasonic obstacle avoidance. We can use the [If…then…else] command to handle the state of ultrasonic sensor as below:

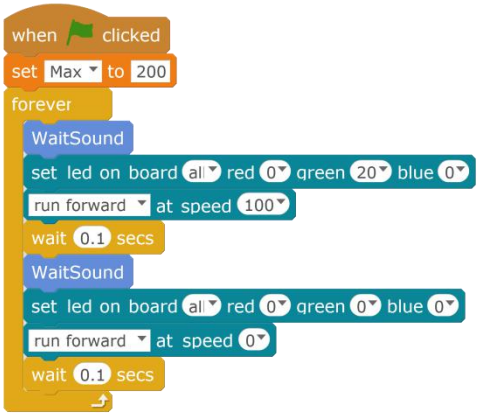


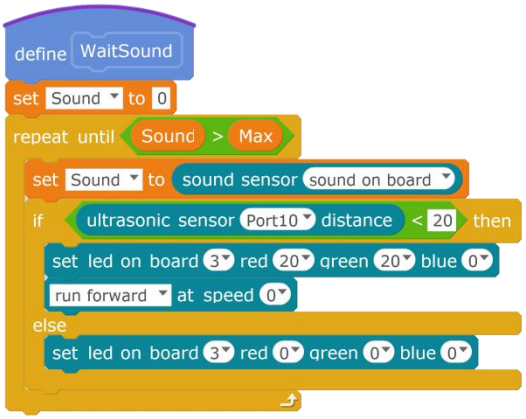

In Target Task 2, we have mentioned the program can be written by the [Repeat until…] command, so we can repeatedly detect the state of ultrasonic sensor.

Let’s modify the WaitSound command and then add the state detection of ultrasonic sensor as below:




All the reference programs is as shown below:



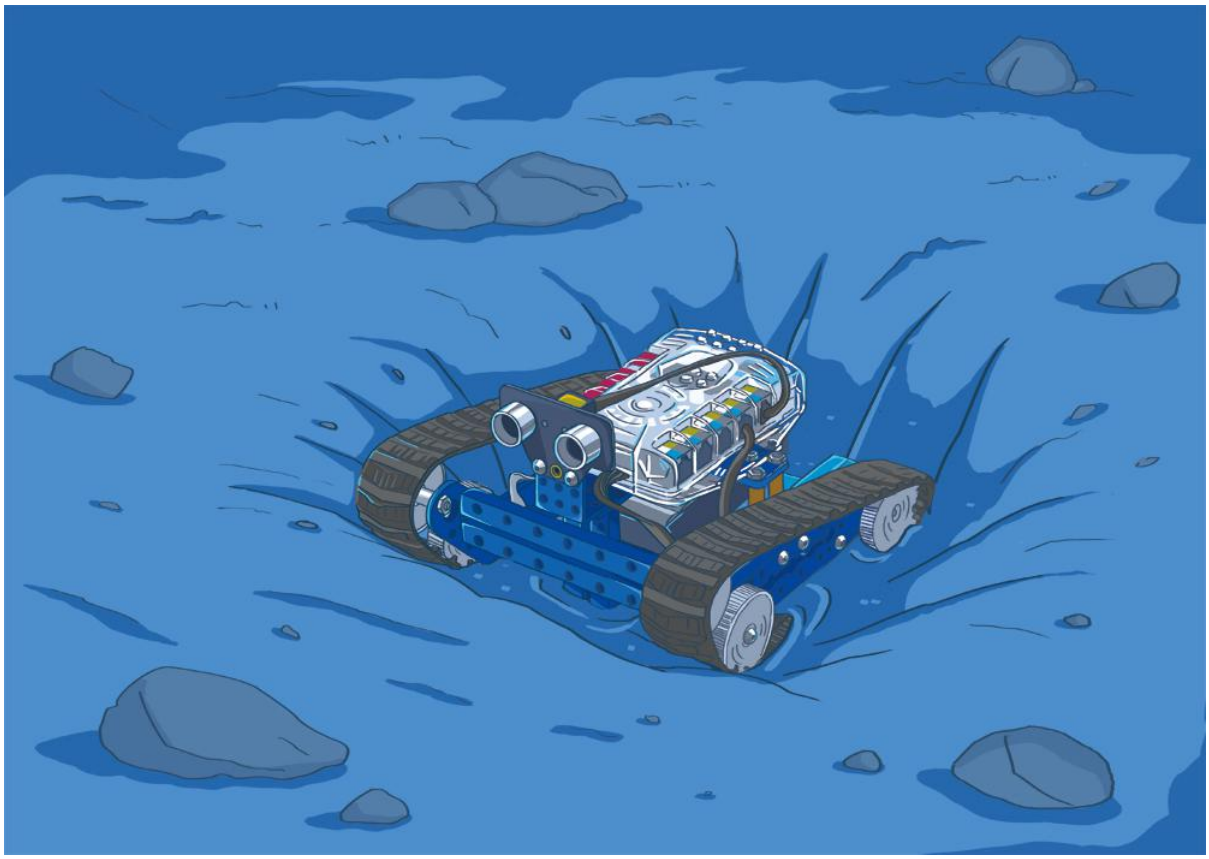

Whenever there is an obstacle ahead of ultrasonic waves (less than 20cm in distance), the motor will stop running and No. 3 LED will turn yellow; when the obstacle is cleared, No. 3 LED will turn off.

In case of green LED, the green light needs to be turned off for the voice control part. Only when the green light is turned on by voice control, Ranger can return to the advance situation.

You can think about how to improve the program.

## Conclusion of This Chapter

In this chapter, we have learned how to use sound sensor to judge the numerical magnitude of volume and use sound sensor as the switch to control the LED light to turn on/off. In addition, Ranger can be controlled to advance and stop by voice.



When Mark turns the white light, the sound responds to D5 scale. Then, he uses the four colored lights that have been decoded in turn to shine into the round hole, and the sound sensor receives other four responding scales E5, C5, C4 and G4 in turn. The time G4 scale ends, there are rumbling sounds from the underground.

“Bingo, we make it finally, the door is opened!” Peter shouts joyfully…

Suddenly, Jennifer turns back to stop Peter from shouting and says nervously, “The tank… the tank is rolling!”

Ranger Tank starts to sink into the sand slow. Is the trap initiated?