

**Unit 2: Skill Builder 2 - Distance Ranger**
**Goals:**

You will write programs that use the ranger to measure distances then make decisions based on those measurements. You will write programs that use array lists to record data then display the data on a graph.

1. Use the distance ranger to measure distances in front of the rover.
2. Record measurements in an array list.
3. Turn the rover to an angle heading.
4. Use a conditional statement to determine a maximum value

**Background:**

Driverless cars need to be able to “know” how close surrounding cars and obstacles are to avoid collisions and to assist in autonomous navigation. There are many different technologies used to accomplish this task. One method uses high frequency sound waves referred to as ultrasound. The prefix ultra- means “beyond”, thus, ultrasound is beyond the human hearing range. So, you will not hear the sound coming from the ultrasonic ranger mounted on the front of Rover. The ultrasonic ranger appears to be two “eyes” on Rover. One of the “eyes” is the emitter of the sound wave, while the other is the receiver of the sound wave. The ranger works by sending out a pulse of waves with the emitter and then listening for reflected pulse, or echo, with the detector. This distance is determined by using the formula of speed = distance/time. In this case, the speed is that of the sound (~344 m/s) and the time is the period between the emitted and detected pulse. Knowing the speed and the time, the distance to the object can be quickly calculated on the Innovator Hub. This same method, called echolocation, is used by some mammals and a few aves (birds) to make sense of their surroundings. These animals can produce a high frequency click that reflects off of nearby obstacles and is then heard by the two ears. The animal’s brain then makes a kind of image of the surroundings using the echo information. Dolphins in particular make excellent use of echolocation to be extremely efficient hunters and are able to detect their prey that may be hiding below sand on the bottom of the ocean. The ultrasonic ranger on Rover can be used to help your program make sense of the surroundings and avoid obstacles.

Command	Example	Behavior
READ RANGER	Send("READ RV.RANGER")	Reads the distance to an obstacle in front of the Rover and returns that reading to the calculator in meters.
READ RV.WAYPOINT.TIME	Send("READ RV.WAYPOINT.TIME")	Reads the elapsed time Rover has been moving since the beginning of the first drive command.
READ RV.WAYPOINT.HEADING	Send("READ RV.WAYPOINT.HEADING")	Reads the present angular heading of the Rover in degrees as measured by the internal gyroscope.
RV TO ANGLE heading	Send("RV TO ANGLE 105")	Turns Rover 105° counter-clockwise from the initial heading at the start of program execution.
RV.STOP	Send("RV STOP")	Stops the Rover immediately.
Get(variable)	Get( <i>a</i> )	The Get command retrieves the value returned to the calculator from the Hub after a READ command is issued. In this example, the brightness measurement is stored in the variable named <i>b</i> .
SET SOUND frequency TIME duration	Send("SET SOUND 440 TIME 10")	Plays a tone of a given frequency in Hz. The tone will play for the duration in seconds given after the TIME keyword. In this example, a pitch of 440 Hz will sound for 10 seconds.
getKey	getKey→K	Returns the last key pressed as a two-digit value, row number counting from the top of the keyboard and column number from the left, to the variable named K. e.g. the number 1 key is returned as 92 (9 <sup>th</sup> row and 2 <sup>nd</sup> column) and the clear key is returned as 45 when the value of K is accessed.

While b $\neq$ 10.....End	While b $\neq$ 10.....End	Repeats commands within structure until the variable b equals 10.
<b>num</b> $\rightarrow$ <b>dim</b> ( <i>list</i> )	<b>0</b> $\rightarrow$ <b>dim</b> ( <i>L</i> <sub>2</sub> )	Sets the initial element in <i>L</i> <sub>2</sub> to the value 0
<b>num</b> $\rightarrow$ <i>L</i> <sub>2</sub> ( <i>index</i> )	<b>D</b> $\rightarrow$ <i>L</i> <sub>2</sub> ( <i>C</i> )	Puts the value of variable D into <i>L</i> <sub>2</sub> at index C

### Challenges:

**Challenge 1:** Write a program named **c1** for Rover that reads the ranger and then scales that distance into an audible tone and plays it on the Hub speaker. Test your program by moving your hand in front of the Rover's ranger sensor. Does the tone change as you move your hand in front of the sensor?

**Challenge 2:** Write a program named **c2** that reads and records distances using the ranger and array lists.

How could you graph your data?

What do the slope and Y-intercept of the graph represent about the drive path?

**Challenge 3: (Escape the Room)** Write a program that determines the path to escape the room.

Write a program named **c3** that:

1. turns a full 360° circle
2. measures the distance to the nearest obstacle every 15° arc and updates a variable with the heading that points in the direction of the escape path (greatest distance).
3. after all directions have been measured, turn Rover to the correct heading and drive forward and escape the room.

