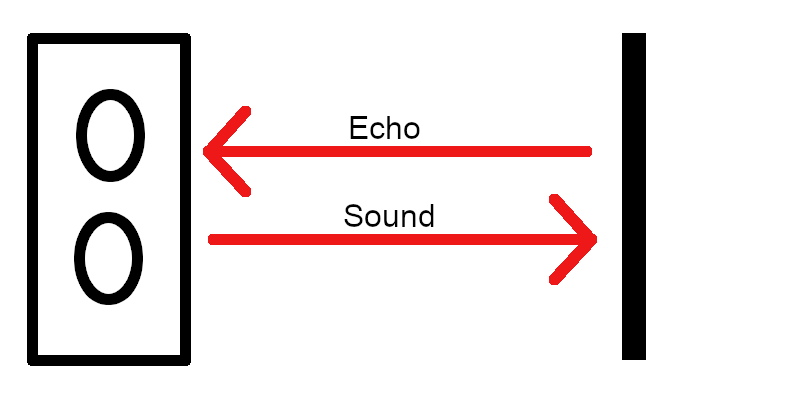
**Pi2go Programming: Exercises with Sensors**

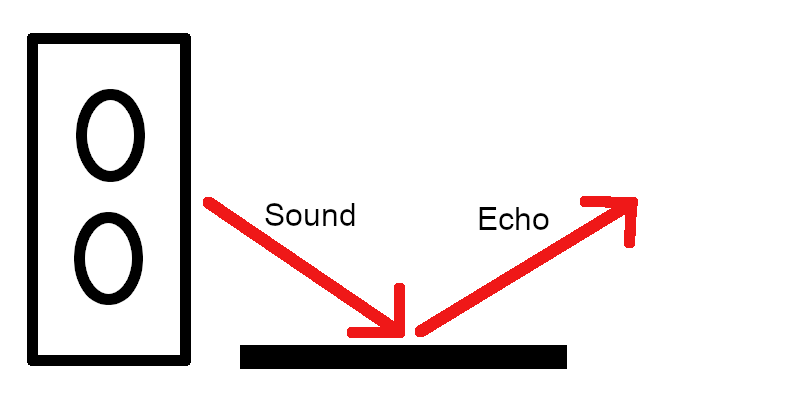
**Aim:** This exercise sheet provides additional activities for investigating the Initio robot sensors. It assumes familiarity with the material in the Initio Programming Worksheets 1-4.

**Exercise 1:** Because the ultrasonic sensor uses echoes to detect distances it can be affected by the angle at which its sound wave hits an object.



Ultrasonic Sensor with Obstacle Directly in Front of It

When the sound from the ultrasonic sensor hits an obstacle squarely then the echo bounces straight back to the sensor.



Ultrasonic Sensor with an Obstacle at an Angle to it.

When the sound from the ultrasonic sensor hits an obstacle at an angle then the echo can bounce away from it.

**Experiment Aim:** The aim of this experiment is to discover the angle at which your Initio robot’s ultrasonic sensor can not detect an object.

**Method:** To perform the experiment place the robot directly facing a flat surface such as a wall. Use a ruler and protractor to make sure a line from the sensor to the flat surface meets the surface at a right angle (90 degrees)

Take a distance reading from the ultrasonic sensor.

Now turn either the robot or the surface through 10 degrees and take another reading. Continue doing this until you have taken 8 readings.

**Results:** Record your results and state at what angle the sensor could no longer detect the obstacle.

**Exercise 2:** The same effect can be observed with the infrared distances sensors. Remember that these sensors just return True or False depending upon how close the object is so you will have to make sure your flat surface is always close enough to the robot that it should return True.

Devise and run an experiment to find out at what angle the infrared sensors stop being accurate.



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