Control Using Sound

Control Using Sound Pre-Quiz

1. **What is sound?**

2. **How does the LEGO sound sensor sense sound?**

Control Using Sound Pre-Quiz Answers

1. **What is sound?**

   Vibrations of air, or pressure pulses, are picked up by human ears as sound.

2. **How does the LEGO sound sensor sense sound?**

   The LEGO sound sensor has a diaphragm that vibrates with pressure fluctuations, similar to our ears, and converts the diaphragm motion into electricity, which it transmits to the LEGO brick/computer.

Control Using Sound Activity

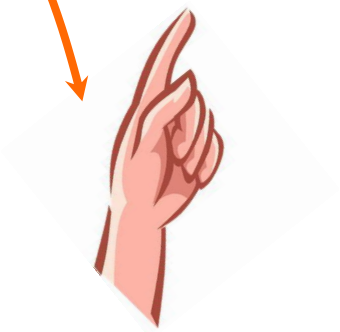
Let's get started:

- **Divide the class into groups.**
- **Distribute the assembled LEGO taskbots and the necessary parts to attach the sound sensors onto the taskbots.**
- **Have each group attach its sound sensor to its taskbot using instructions in the LEGO base kit.**

Human-Robot Similarities

Based on sensor input, our brains control our hands.

Similarly, based on sensor input, the LEGO brick commands its motor to move the taskbot.



The next slide provides a design challenge to show how this might be done. ➔

Control Using Sound Activity

Programming Objective – Engineering Challenge

- Design a program that causes the robot to move forward until a clap sound is detected by its sound sensor.
- Once this occurs, have the robot turn right, and then continue moving forward until it hears a second clap, and then have the robot turn left.
- Continue this sequence until the LEGO brick's "Stop" button (gray button below the orange button) is pressed.

Discuss as a group the logic of the program. Write down your program plan. Create, test and debug your program.

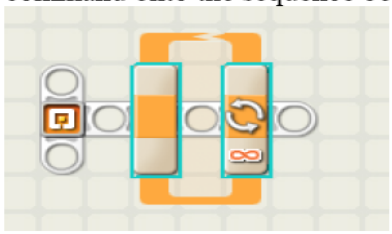
Sound Sensor – Go straight and turn right on first clap and turn left on second clap….and continue till 'Stop' is pressed.

Description:

This program is for an NXT robot with a sound sensor attached to the robot and connected to the NXT. The program will cause the robot to move forwards until clap sound is detected by the NXT robot. Once this occurs, the robot will turn to the right, and then continue on its way until it hears a second clap then it turns left. This sequence is continued till the 'Stop' button on the Brick (grey button below the orange one) is pressed.

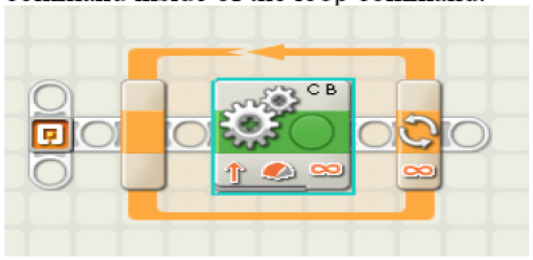
Programming:

1) Click the "Loop" icon [second icon from the bottom] and drag and drop the loop command onto the sequence beam.



With the loop command highlighted, verify the loop control is set to forever in the control panel.

2) Click the "move" icon [first icon from the top] and drag and drop the move command inside of the loop command.



With the move command highlighted, verify the following settings in the control panel.

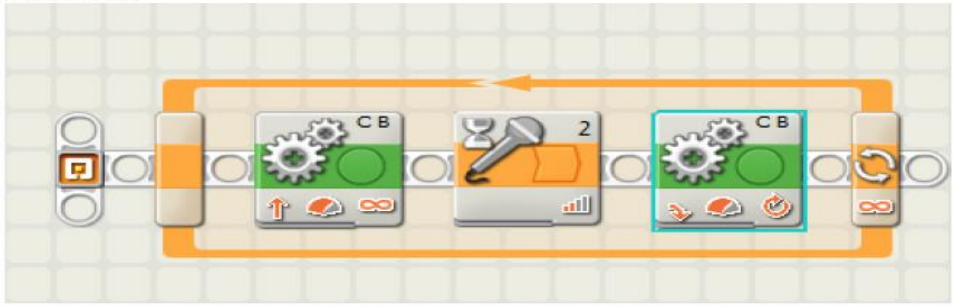
a. Port: B and C selected
b. Direction set to forward
c. Steering slider set to forwards [in the middle]
d. Power set to 75
e. Duration drop down menu set to "Unlimited"

3) Mouse over the "wait for" icon [third from the bottom] and click on the touch icon [second in the pop-up list] then drag and drop the touch wait for command to the right of the move command, and inside the loop.

With the touch wait for command highlighted, verify the following settings in the control panel.

a. Control: Sensor
b. Sensor: Sound Sensor
c. Port: 2 (or whatever port the touch sensor is connected to)
d. Until: >60dB (Note: Clap sound has a dB greater than 60)

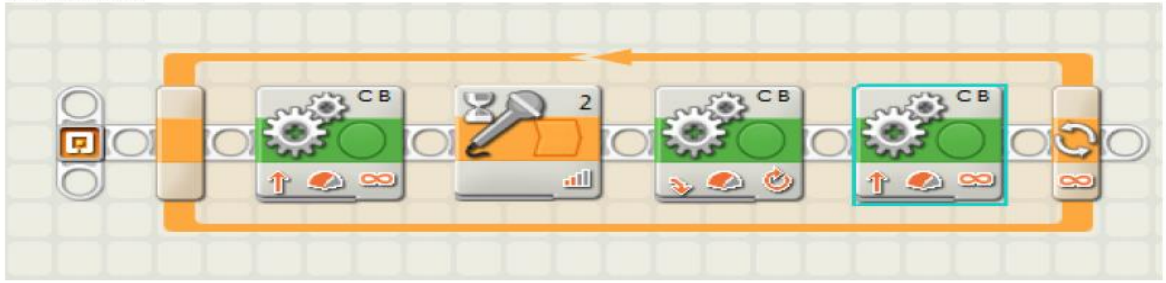
4) Click the "move" icon [first icon from the top] and drag and drop the move command to the right of the sound wait for command, and inside of the loop command.



With the move command highlighted, verify the following settings in the control panel.

a. Port: B and C selected
b. Direction set to forward
c. Steering slider to the right
d. Power set to 75
e. Duration set to 0.5 "Rotations"
f. Next action set to brake

5) Click the "move" icon [first icon from the top] and drag and drop the move command to the right of the last move command, and inside of the loop command.

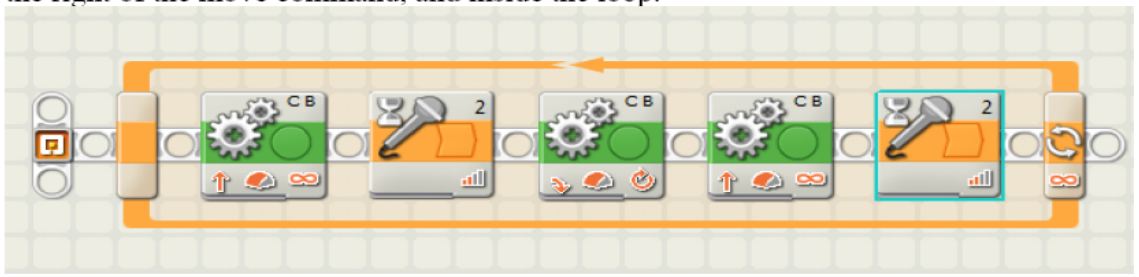


With the move command highlighted, verify the following settings in the control panel.

a. Port: B and C selected

b. Direction set to forward
c. Steering slider to middle
d. Power set to 75
e. Duration set to unlimited
f. Next action set to brake

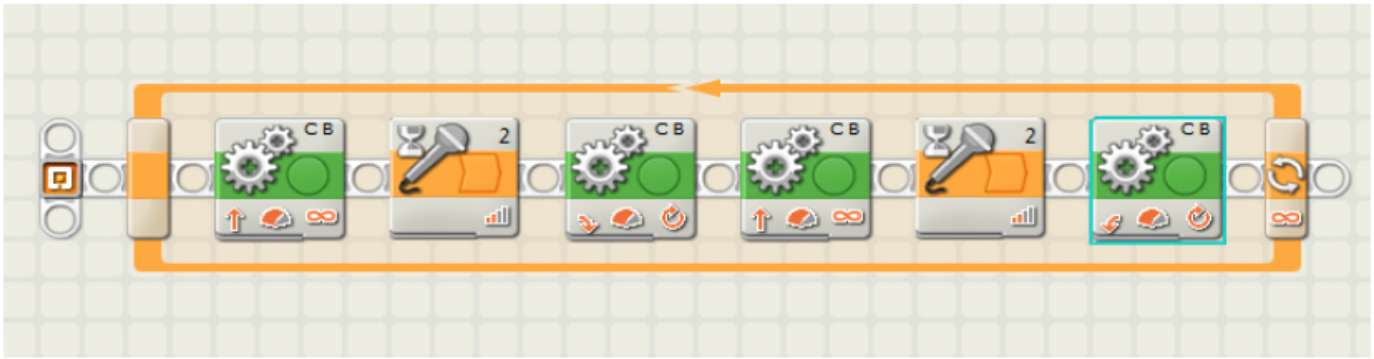
6) Mouse over the "wait for" icon [third from the bottom] and click on the touch icon [second in the pop-up list] then drag and drop the touch wait for command to the right of the move command, and inside the loop.



With the touch wait for command highlighted, verify the following settings in the control panel.

a. Control: Sensor
b. Sensor: Sound Sensor
c. Port: 2 (or whatever port the touch sensor is connected to)
d. Until: >60dB

7) Click the "move" icon [first icon from the top] and drag and drop the move command to the right of the sound wait for command, and inside of the loop command.



With the move command highlighted, verify the following settings in the control panel.

a. Port: B and C selected
b. Direction set to forward
c. Steering slider to the left
d. Power set to 75
e. Duration set to 0.5 "Rotations"
f. Next action set to brake

Troubleshooting:

If the robot does not turn when it hears the clap as expected:

1) Make sure the sensors/motors are connected to the correct ports.
2) Read back through the instructions and make sure all the properties for the commands are set correctly.

Control Using Sound Post-Quiz

1. **Sketch clearly a "stimulus-sensor-coordinator-effector-response" framework using the sound sensor on the LEGO taskbot and compare it with a stimulus-to-response framework using the human ear.**

2. **Give examples of sensors in engineering systems that are similar to the human sound sensor.**

Control Using Sound Post-Quiz **Answers**

1. **Sketch clearly a "stimulus-sensor-coordinator-effector-response" framework using the sound sensor on the LEGO taskbot and compare it with a stimulus-to-response framework using the human ear.**

   ***LEGO taskbot*: sound of clap > LEGO sound sensor > signal to LEGO brick via wire > brick decides to move the motor > signal sent to LEGO motor > motor moves robot**

   ***Human ear*: sound of thunder > human ear > human brain > leg muscles > run for shelter**

2. **Give examples of sensors in engineering systems that are similar to the human sound sensor.**

   ***Examples*: Microphones in phones, computers and karaoke machines; voice-activated door openers**

Vocabulary

- **sensor: A device that converts one type of signal to another, such as the tachometer that displays the speed that a car is traveling.**
- **auditory: Related to hearing.**
- **ultrasonic: A sound of a frequency that humans cannot hear, but dogs and bats can.**
- **transducer: Another term for a sensor (see above).**

Image Sources

Slide 1: A pair of hands clapping; source: 2011 Evan-Amos, Wikimedia Commons {PD}: http://commons.wikimedia.org/wiki/File:Hands-Clapping.jpg

Slide 5: brain; source: ADAM, Medline Plus, U.S. National Library of Medicine, National Institutes of Health: http://www.nlm.nih.gov/medlineplus/braindiseases.html

Slide 5: ear image; source: 2005 David Benbennick, Wikimedia Commons [PD}: http://commons.wikimedia.org/wiki/File:Ear.jpg

Slide 5: pointing finger; source: Microsoft® clipart: http://office.microsoft.com/en-us/images/results.aspx?qu=pointing+finger&ex=1#ai:MC900233154|

Slide 5: LEGO device images; source: LEGO NXT User's Guide

Slides 7-11: screen capture images by the author