

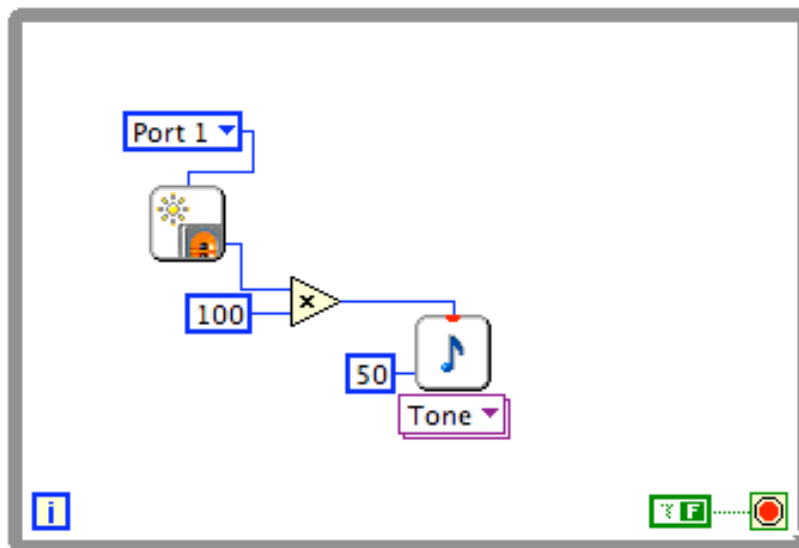
Musical Instrument

Build a musical instrument using either the light sensor or the ultrasonic sensor. Write a program to convert your sensor readings into tones that are audible to people; the human ear can detect frequencies between about 20 and 20,000 hertz. Then download the program and move your NXT around to create a song.

If you choose to use the light sensor, program the instrument to play higher pitches when the light is bright and lower pitches when the light is dim. If you choose the ultrasonic sensor, program the instrument to play higher pitches when the sensor is close to an object and lower pitches when it is farther away.

To write the program, you will use a program similar to the one you wrote for Applause Meter. This program, like the applause meter program, will use a while loop and a sensor value. However, remember that the frequencies detected by the human ear (20-20,000 hertz) are generally much larger numbers than the sensor output. You will need to do some math to adjust the sensor output before wiring it to the frequency input of the sound icon.

The example program below multiplies the light-sensor value by 100 to create the frequency. You can choose whatever number you wish. You can also adjust the duration of each tone by wiring the appropriate number of milliseconds into the duration input.



As an added complication, your NXT internal speaker is able to produce tones between approximately 200 and 12,000 hertz. Knowing this, modify your conversion factor if necessary.

Download and run your program. Experiment with varying the duration of the note and the conversion factor. See which combination sounds best.

Musical Instrument Extras

1. Try modifying your instrument and your program to use the other sensor (light or ultrasonic).
2. Turn your instrument into a trombone, with a sliding piece that changes the pitch of the sound.
3. Program your instrument to play a recognizable song. We will provide a program that will display the frequencies as they are generated.

To help you, a list of musical frequencies and a few tunes are included below.

| | | | | | |
|--------|--------|--------|--------|--------|--------|
| A | A# | B | C | C# | D |
| 440.00 | 466.16 | 493.92 | 523.28 | 554.40 | 587.36 |

| | | | | | |
|--------|--------|--------|--------|--------|----------------|
| D# | E | F | F# | G | A _b |
| 622.24 | 659.28 | 698.48 | 740.00 | 784.00 | 830.64 |

Each note is 1.059463 times the preceding note.

ROW, ROW, ROW YOUR BOAT

Row, row, row your boat, gently down the stream
C C C D E E D E F G

merrily, merrily, merrily, merrily, life is but a dream
C' C'C' G G G E E E C C C G F E D C

HOT CROSS BUNS

Hot cross buns, hot cross buns, one a penny, two a penny, hot cross buns.

B A G B A G G G G A A A A B A G
TWINKLE, TWINKLE LITTLE STAR

Twinkle, twinkle, little star, how I wonder what you are.
C C G G A A G F F E E D D C

Up above the world so high, like a diamond in the sky
G G F F E E D G G F F E E D

Twinkle, twinkle, little star, how I wonder what you are.
C C G G A A G F F E E D D C

MARY HAD A LITTLE LAMB

Mary had a little lamb, little lamb, little lamb
B A G A B B B A A A B D D

Mary had a little lamb, its fleece was white as snow.
B A G A B B B B A A B A G

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