Light Listener

Guided Project Instructor Set

Figure 1 Example completed light listener

Related Core Concepts:

Mini-mixer

Lights Out!

"You will be able to hear the signal of infra-red flashes from a remote control without ever seeing those flashes!"

Learn It!

Your eyes and ears are two finely tuned inputs for analog information in your surroundings. Your eyes are able to process light as well as images flickering at lower frequencies of around 30Hz, while your ears can process sounds that span between 20 and 20,000Hz. After about 30Hz, your eyes no longer can decipher the flickering light and instead process it as a constant with varying intensity that follows the frequency of the flickering light. While your eyes may be limited in what they can see, what if you could hear light flickering?

In this activity, you will create a simple circuit to measure the voltage of a solar panel. By monitoring the variation in the voltage of the solar panel and sending that signal to a set of headphones, you can "listen" to changes in light. You will be able to hear the signal of infra-red flashes from a remote control without ever seeing those flashes!

Build It!

Task 1: Design a circuit that will read the differential signal from a solar panel with the analog input channels of your acquisition device. You can use the concepts gained from the Lights Out Core module to properly wire a differential signal. Figure 1 shows an example finished circuit.

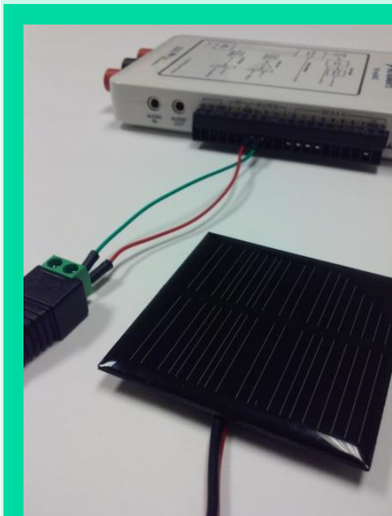

Figure 2 Solar cell differential connection

Guiding Questions:

- What are some benefits of measuring a signal differentially?
- What range did you use to read your signal and what is its significance?
- Describe the noise you see on the signal, how can we remove that noise in hardware? How can we try to remove that noise in software?

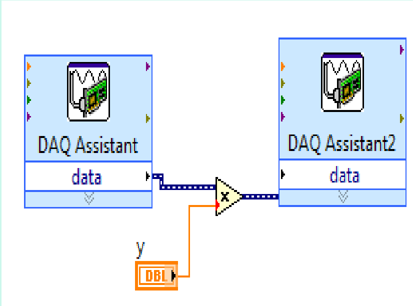

Figure 3 Example code showing how to acquire data and pass it back out using analog input and output

Task 2: Create in LabVIEW, code that will process the signal read into your acquisition hardware and output it on the audio output lines. Vary the amplitude of your output to find where the signal begins to distort. Include functions that will allow you to view the frequency spectrum of the signal you are acquiring.

Guiding Questions:

- Gather light data from several sources (at least 5, one being infrared) and describe the frequency content of each of them. What do you think is the reason for the different peaks in frequency you encountered?
- How strong is the sound signal you are hearing? Is there a way to make this stronger?

Expand it!

- Using a TV remote and your light listening system, devise a way to interpret the information coming from the remote. See if you can figure out the packet of data sent from a particular button press. Use this to characterize multiple buttons.
- Create a simulation to display a button press from your remote on the front panel.

Guiding Questions:

- How is the data being displayed back in the time domain? Is it repeating?
- Is there a constant amount of time between lows and highs in the signal you are seeing?
- Does this follow some sort of communication protocol?
- Does the sound change for each button press? What type of communication is this?

Research it!

Include a list of sections of textbooks this project touches on. Include the title, chapter and section name as well as page numbers. This section can also contain a listing of sections that can be taught in parallel with or after this project.