myDAQ® LASER Listener Building Instructions

Background
A laser listener is a surveillance device that uses a laser beam to detect sound vibrations in a distant object. A laser listener is designed to allow eavesdropping with a minimal chance of exposure. Ideally an infrared laser would be used to ensure that the chances of detection are kept as low as possible, but for safety reasons, a visible laser should be used instead. The Laser Listener goes by several names such as Laser Microphone, Laser Spy, Laser Bug, and a few other similar names. By building your own Laser Listener, you can experiment with this technology as you can adjust this primary design to suit your needs. This project will cost a small amount when compared to a professional Laser Listener system which can cost tens of thousands dollars. This design is a basic proof of concept test system that will show you how the Laser Listener converts vibration into sound and how careful alignment of the laser and receiver are required for optimal performance. This document explains how to build a laser listener using the NI myDAQ platform and NI LabVIEW. The hardware and software are explained in detail and a step by step guide to build your own Laser Listener is included.

(Source: https://decibel.ni.com/content/servlet/JiveServlet/download/23166-3-48983/myLaserListener.pdf)

Warning
DANGER - Laser Radiation - Do Not Stare Into Beam or View Directly With Optical Instruments

Required Components
- LASER Pointer
- Photodiode (e.g. L14Q1)
- OpAmp (e.g. LM741)
- Resistor
- Capacitors (1μF and 10μF)
- myDAQ with proto board
- LabVIEW installed computer
- Speakers with shiny surface for testing (e.g. Logitech LS11)
- Connecting wires
- Holder for the photo-diode
- Convoluted Foam Sheet
**LASER Listener Circuit**

The setup for the LASER listener is shown in Fig. 01. The circuit consists of a photo-diode or photo-sensor ([http://en.wikipedia.org/wiki/Photodiode](http://en.wikipedia.org/wiki/Photodiode)), operational amplifier (op-amp), resistors, capacitors and connecting wires. When a beam of LASER reflects from the shiny surface, vibration of the surface is picked up by the listener which causes a change in the photo-sensor output. This change is further amplified by op-amp and fed to myDAQ analog input. Further, LabVIEW VI amplifies, processes and converts the signal to sound output.

**LASER Listener Building Steps**

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**Fig. 01: The final setup for the LASER listener.**

Note: In order to reduce effect of ground vibrations, you would like to setup the whole system on a convoluted foam base as shown in Fig. 01.

**Step 1.** Connect proto-board to myDAQ.
Step 2. Connect myDAQ to computer via USB port.

Step 3. Open NI-ELVISmx and then, double click on Scope. Scope will be useful for initial test of setup.

Step 4. Assemble circuit shown in Fig. 02 on proto-board using photo-diode (e.g. L14Q1), op-amp, capacitor ($C_F = 1\mu F$) and resistor ($R_F = 1 \text{ K}\Omega$ for L14Q1 photo-sensor).

Step 5. Connect Vout to A0 analog input of myDAQ and ground to AGND of myDAQ.

Note: The feedback resistance may be different for different photo-sensor. For L14Q1, the $R_F$ is adequate.

Fig. 02: The photo-sensor signal amplifier circuit.

Step 6. Use $+15V$ as positive power supply and AGND as ground for op-amp.

Step 7. Use $10 \mu F$ capacitor between $+15V$ and AGND to reduce AC noise in power lines.

Step 8. Now setup LASER pointer carefully such that the light reflecting from the metallic disk of speakers fall on photo-sensor. You can use a holder to mount photo sensor as shown in Fig. 03.
Fig. 03: Photo-sensor on the holder.

**Step 9.** To test the setup, run Scope from NI-ELVISmx with channel AI0 enabled.

**Step 10.** Now, slightly move photo-sensor and you will see change in the signal on scope if the reflected LASER beam from speaker is falling on the photo-sensor. Keep moving the photo-sensor until signal on the scope reaches maximum value as shown in Fig. 04.

**Note:** It is possible that signal on the scope is saturated (≈ 10V) and no changes will occur while you move photo-sensor. In this case, you need to turn off LASER pointer and reduce feedback resistance and until you get a reasonable low value (≈ 2-3V). After this, again turn on LASER beam and adjust photo-sensor for its maximum value. Once everything adjusted, you should stop the scope VI.
Fig. 04: Change in the signal output after photo-sensor adjustment.

**Note:** To minimize the effect of stray light, you may want to turn off lights or carefully cover the setup with a box.

**Step 11.** Connect speakers to sound output of computer and play a song or a lecture. The level should be low so that you can only just hear it when your ear is next to the speaker.

**Step 12.** Now the system is ready to record speaker sound output.

**Step 13.** Download the ENGR190_Vis.zip from following link and extract it.

[http://www.clemson.edu/ces/departments/ece/document_resource/undergrad/electronics/ENGR190_VIs.zip](http://www.clemson.edu/ces/departments/ece/document_resource/undergrad/electronics/ENGR190_VIs.zip)

**Step 14.** Open the myLaserListener.lvproj which will open a window as shown in Fig. 05.

**Step 15.** Double click to open myLaserListener.vi as shown in Fig. 06.
Step 16. Browse the test.wav from the unzipped folder on the front panel of the VI.

Step 17. Now, run the myLaserListener.vi and hit record. You will start seeing waveforms on the front panel graph as shown in Fig. 07. This VI can only record for about 1 minute.
Fig. 07: Screen shot of myLaserListener.vi with recorder sound waves.

**Step 18.** To finish the recording, click on Stop button on the VI.

**Step 19.** Once the recording is over, you can either play recorded sound from the test.wav file or from the VI itself. In order to play recorded sound from VI, you will need to connect speakers on Audio Out port of the myDAQ and click on Play button of the VI.

**Step 20.** To stop the VI, click on Exit button.

**Filter for Recorder Sound Signal**

The recorded sound signal is post processed using signal processing express VIs. For example, open block diagram of myLaserListener.vi. A block diagram window will be opened as shown in Fig. 08. This block diagram has several sub VIs and the recorded signal is processed in sub VI called Offset.vi shown in red circle of Fig. 08. To open Offset.vi, double click on this VI which will open a window as shown in Fig. 09. The Offset.VI contains a Filter express VI which can be used to modify the filter parameters to process recorded signal.
Fig. 08: Bock diagram of myLaserListener.vi.

Fig. 09: Block diagram of Offset.vi.
More Information
The VIs and circuit design are adopted from https://decibel.ni.com/content/docs/DOC-23166. For more detailed information about this project, please refer to https://decibel.ni.com/content/servlet/JiveServlet/download/23166-3-48983/myLaserListener.pdf.
**Record a PowerPoint Slide Show (Office 2010)**

PowerPoint allows you to easily record timing and narration for a slide show. You simply click “Record Slide Show” and then start talking (assuming your computer has a microphone). The timing of when you advance slides will also be recorded.

**Instructions**

From the “Slide Show” menu, select “Record Slide Show.” You can choose to either start recording from the beginning of the presentation or at the current slide.

![Slide Show Toolbar](image1)

This should bring up the full screen slide show view along with a small window in the top left corner of the screen.

![Recording Window](image2)

This window controls the recording. The arrow button on the left advances to the next slide, the pause button pauses recording, and the U turn discards the recording for the current slide and starts it over. The time on the left is the time recorded for the current slide and the time on the right is for the entire presentation.

When you are finished recording your presentation, close the recording window and exit the slide show. You can review what you’ve recorded by playing the slide show from the “Slide Show” toolbar.

![Play Slideshow](image3)
You can also have your mouse pointer show up in the recorded slide show by holding both the CTRL key and the left mouse button while moving the mouse around. The pointer will be displayed as a “laser pointer.”

After recording a slide, in the left column of the “Normal” view, there will appear a star icon under the slide number and an audio icon in the bottom right corner of the slide to indicate that the slide has a transition and narration set.

The audio icon also appears in the bottom right corner of the slide itself in “Normal” view.

You can mouse over this to play the narration or adjust its volume. Also, you can select the icon and delete it to remove the narration and timing from that slide.
**Microphone Settings (Windows 7)**

To adjust the volume on your microphone, open the Control Panel. Click on “Hardware and Sound” and then click on “Sound.”

In the window that opens, select the “Recording” tab.

Select your microphone device, and click the “Properties” button. In the window that opens, select the “Levels” tab. From here, you can adjust the microphone volume and boost.
Export to Video

After you have recorded all your narration, you can convert your PowerPoint presentation to a video. In PowerPoint, open the “File” menu and select “Save & Send.” Under “File Types,” select “Create a Video.” In the options on the right side of the screen, select “Internet & DVD” and “Use Recorded Timings and Narrations.” When you are ready to start, click “Create Video.” This process can take several minutes, depending on the length of your presentation and the size of embedded videos and narration.

You will be prompted for a location to save the video. This will create a Windows Media Video (.wmv) file, which is playable in Windows Media Player.