Getting Started with the LabVIEW Toolkit for LEGO® MINDSTORMS® NXT

The LabVIEW Toolkit for LEGO® MINDSTORMS® NXT enables you to:

- Write standard LabVIEW code that you can compile and download to the NXT
- Write LabVIEW programs that run on a PC or Mac and communicate with the NXT through USB and Bluetooth
- Create blocks that you can import into the LEGO MINDSTORMS NXT Software. Creating blocks requires LabVIEW 7.1 and the 7.1 toolkit. Refer to `http://digital.ni.com/express.nsf/bycode/rdlvlm` to download the 7.1 toolkit.

Note The LEGO® MINDSTORMS® NXT Toolkit is based on LabVIEW 7.1, and you must have LabVIEW 7.1 or later to use the toolkit. You must use LabVIEW 7.1 to create blocks that you can import into the LEGO® MINDSTORMS® NXT software. If you are developing for *FIRST* Tech Challenge (FTC), you must use LabVIEW 8.5.1.

This document contains exercises that you can use to learn how to develop NXT VIs with the LabVIEW Toolkit for LEGO® MINDSTORMS® NXT. These exercises require a basic understanding of the LabVIEW development environment. Refer to the *Getting Started with LabVIEW* document, accessible from `ni.com/documents`, for an introduction to LabVIEW.

NATIONAL INSTRUMENTS™

Mass Compiling

Note If you are using LabVIEW 7.1 and the 7.1 toolkit or you are using LabVIEW 8.5.1 for *FIRST* Tech Challenge, you do not need to mass compile.

To run this toolkit efficiently, you must mass compile the toolkit VIs in the version of LabVIEW in which you installed the toolkit. Complete the following steps to mass compile the LabVIEW Toolkit for LEGO® MINDSTORMS® NXT.

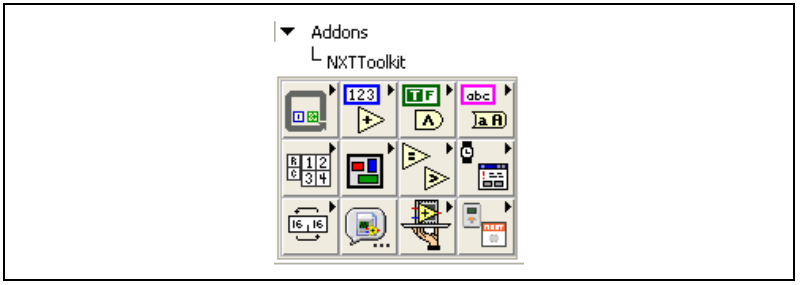
1. Launch the version of LabVIEW in which you installed the toolkit.
2. Select **Tools»Advanced»Mass Compile**.
3. Browse to the `labVIEW\vi.lib\addons\NXTToolkit` folder and select **Curr Dir**.
4. Select **Mass Compile** to begin the mass compile process.

Note Mass compiling the toolkit takes around 10 minutes on most computers.

Building a LabVIEW VI that Runs on the NXT

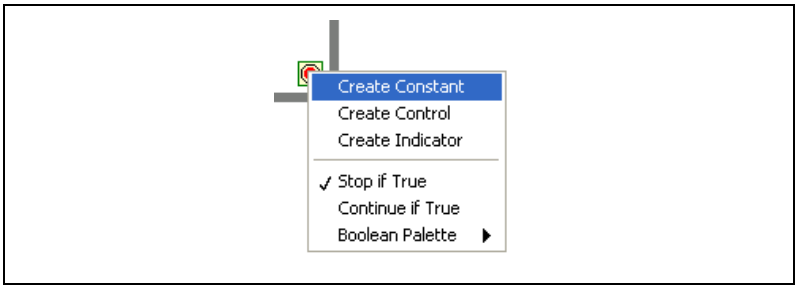
In this exercise, you will build a program that reads the value of the sound sensor on the NXT and displays a sound level graph on the PC. Using this program, you can monitor the sound sensor live.

1. Launch LabVIEW and select **File»New VI** to begin developing a new VI.
2. Display the block diagram and select **View»Functions Palette**.
3. In the Functions Palette, select **Addons»NXTToolkit** to access the NXTToolkit palette. The NXTToolkit palette contains the LabVIEW objects supported by the MINDSTORMS NXT compiler as well as additional libraries that access the NXT inputs and outputs.

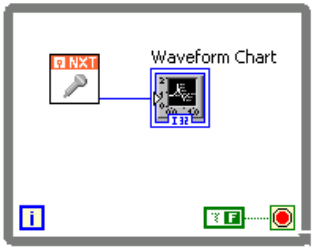


Note To compile your VI to an NXT, you must use only the items found in the NXTToolkit palette and its subpalettes.

4. Select **NXTToolkit»Structures»While Loop** and place the While Loop on the block diagram.
5. Right-click the **Loop Condition** of the While Loop and select **Create Constant** from the shortcut menu.



6. Select **NXTToolkit»NXT Library»Input»Sound Sensor** and place the Sound Sensor VI in the While Loop.
7. Display the front panel and select **View»Controls Palette**.
8. Select **Addons»NXTToolkit»Graph»Waveform Chart** and place the waveform chart on the front panel.
9. Display the block diagram. Then, move the waveform chart inside the While Loop and wire the **Volume** output from the Sound Sensor VI to the waveform chart. When you complete this exercise, the block diagram should appear similar to the following figure.

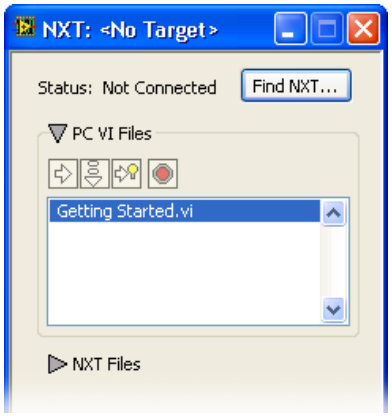


10. Save the VI, and follow the steps in the next section to compile, download, and execute the VI on the NXT. Use the **Debug** button to view the waveform graph on the front panel.

Running a LabVIEW VI on the NXT

In this exercise, you will learn how to compile, download, and run a VI on an NXT device using the NXT Terminal. You can use the NXT Terminal to compile, download, and run VIs on the NXT. You also can use the NXT Terminal to upload, download, or delete files on the NXT. If multiple NXTs are connected to the computer through USB or Bluetooth, you can add additional NXT Terminals as necessary.

1. Open the LabVIEW VI you want to run on the NXT.
2. Launch the NXT Terminal by selecting **Tools»NXT Module»NXT Terminal**. The VIs you currently have open automatically appear in the PC VI Files listbox.



3. To connect the NXT Terminal to an NXT device, click the **Find NXT** button and choose an NXT connected through USB or scan for available NXTs using Bluetooth.
4. After you connect the NXT Terminal to an NXT device, select the VI you want to run from the **PC VI Files** listbox, and use one of the following options.

Note To run the VI you created in the previous exercise, you must use the **Debug** button.

- Click the **Compile, Download and Run** button to compile, download, and execute the VI on the NXT without maintaining a link to the host computer.
- Click the **Compile and Download** button to compile and download the VI to the NXT without running the VI.

- Click the **Debug** button to compile, download, and execute the VI on the NXT. This option maintains a link back to the host computer so you can use the front panel controls and indicators to communicate with the NXT.

Note Using the **Debug** button with multiple NXT Terminals at once is not supported.

- Click the **Abort** button to stop running the VI.

Note The compile process generates a `.rxe` file with the same name as your VI. If your VI name contains over 15 characters, LabVIEW truncates the name of the `.rxe` file to 15 characters.

Refer to the `LabVIEW\examples\NXT Toolkit\NXT Programs` directory for more NXT programming examples.

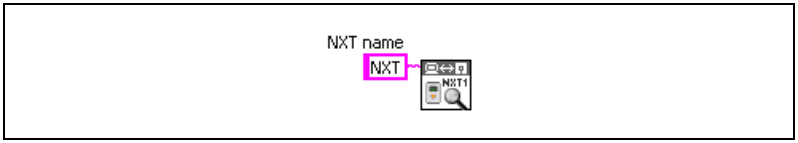
Building a LabVIEW VI that Communicates with the NXT

In this exercise, you will build a VI that runs on the host computer and communicates with the sound sensor on the NXT.

1. Select **File»New VI** to begin developing the VI.
2. Display the block diagram and select **View»Functions Palette**.
3. Select **Addons»NXT Direct Commands**. This palette contains a library for communicating with an NXT, regardless of whether a program is currently running on the NXT.

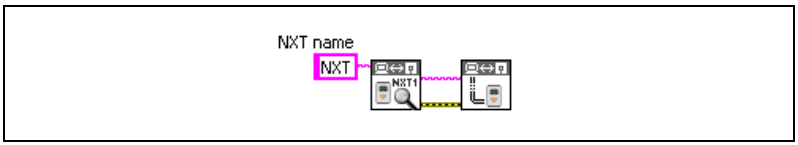
Note The **BT Messages** palette contains a library for communicating with an NXT through mailboxes accessible only to a running program.

4. Select **NXT Direct Commands»Connection»Find NXT**, and place the Find NXT VI on the block diagram.
5. Right-click the **NXT name** input on the Find NXT VI and select **Create»Constant** from the shortcut menu. Enter the name of your NXT in the string constant. After you complete this step, the block diagram should appear similar to the following figure.

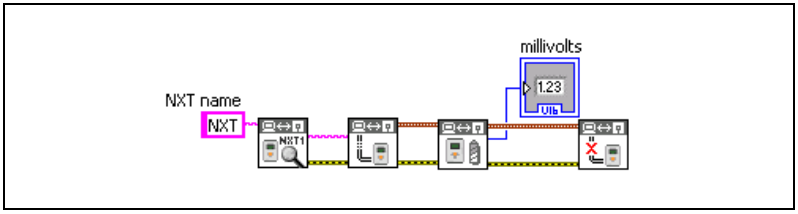


Note Ensure that the capitalization of your NXT name is correct.

6. Select **NXT Direct Commands»Connection»Create NXTObject**, and place the Create NXTObject VI next to the Find NXT VI. Wire the **VISA resource string** output of the Find NXT VI to the **VISA resource string** input of the Create NXTObject VI. Wire the **error out** output of the Find NXT VI to the **error in** input of the Create NXTObject VI. After you complete this step, the block diagram should appear similar to the following figure.



7. Select **NXT Direct Commands»Utilities»Get Battery Level**, and place the Get Battery Level VI next to the Create NXTObject VI. Wire the NXTObject output of the Create NXTObject VI to the **NXTObject** input of the Get Battery Level VI. Wire the **error out** output of the Create NXTObject VI to the **error in** input of the Get Battery Level VI.
8. Select **NXT Direct Commands»Connection»Destroy NXTObject**, and place the Destroy NXTObject VI next to the Get Battery Level VI. Wire the **NXTObject output** of the Get Battery Level VI to the **NXTObject input** of the Destroy NXTObject VI. Wire the **error out** output of the Get Battery Level VI to the **error in** input of the Destroy NXTObject VI. After you complete this step, the block diagram should appear similar to the following figure.



9. Press the **Run** button to execute the program.

Note Since this VI executes on the host computer and not on the NXT, use the **Run** button on the front panel or block diagram instead of the **Run** button on the NXT Terminal.

10. You now can view the NXT battery level on the front panel.

Refer to the `LabVIEW/examples/NXT Toolkit/Direct Commands` directory for more NXT direct command programming examples.

Creating New Blocks for LEGO MINDSTORMS NXT Software

Blocks are the objects you use to program NXT devices in the MINDSTORMS software. You can use the LabVIEW Toolkit for LEGO® MINDSTORMS® NXT with LabVIEW 7.1 to create blocks that you can import into the LEGO MINDSTORMS NXT Software. Refer to `labVIEW/documents/NXT_Creating_MINDSTORMS_Blocks.pdf` for an introduction to the block creation process. Refer to `http://digital.ni.com/express.nsf/bycode/rdlvlm` to download version 7.1 of the toolkit.

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