Getting Started Manual

LabVIEW™ LEGO® MINDSTORMS® NXT Module

The LabVIEW LEGO® MINDSTORMS® NXT Module enables you to perform the following tasks:

- Develop LabVIEW VIs that run on a host computer and communicate with an NXT brick. These programs also can run directly on the NXT brick.

- Create and configure LabVIEW controls to represent TETRIX motors and servos connected to the NXT brick. You then can wire these LabVIEW controls to the NXT VIs to specify the motors and servos you want to control.

This document contains exercises you can use to learn how to develop VIs that run on a host computer or on an NXT brick. These exercises require a basic understanding of the LabVIEW development environment. Refer to the *Getting Started with LabVIEW* document, accessible by navigating to the `labview\manuals` directory and opening `LV_Getting_Started.pdf`, for an introduction to LabVIEW.

Building a VI that Communicates with the NXT Brick

In this exercise, you will build a VI that runs on the host computer and communicates with the NXT brick. This VI measures the brightness of an LED light sensor and displays the value on the screen of the NXT brick.

Building the VI

Complete the following steps to build a VI that communicates with the NXT brick.

1. In the **Getting Started** window, click the **Blank VI** link to create a new VI.

2. Select **Window»Show Block Diagram** to display the block diagram window.

3. If the **Functions** palette does not appear, select **View»Functions Palette** to display the **Functions** palette.

4. Select **NXT Robotics»NXT I/O** from the **Functions** palette. The **NXT I/O** palette contains a library of VIs you can use to communicate with an NXT brick.

5. Add the Read Sensor VI, shown at left, to the block diagram window.

Tip Select **Help»Show Context Help** to display the **Context Help** window. Hover over an object on the palette or block diagram window to view information about that object in the **Context Help** window.

6. Select **Read Light»LED On** from the polymorphic VI selector on the Read Sensor VI. This option specifies that this VI turns the LED light on and reads the light sensor.

7. Right-click the **Port** input of the Read Sensor VI and select **Create»Constant** from the shortcut menu. Port 3 is the default port.

8. Add the Display Control VI to the block diagram window to the right of the Read Sensor VI.

9. Select **Write»Integer** from the polymorphic VI selector on the Display Control VI. This option specifies that the NXT brick displays an integer on the screen. You can use this VI to display the value of the light sensor.

10. Wire the **NXT** output of the Read Sensor VI to the **NXT** input of the Display Control VI.

11. To display the scaled value of the light sensor on the NXT brick, wire the **Scaled Value** output of the Read Sensor VI to the **number** input of the Display Control VI.

After you complete this step, the block diagram window should appear similar to the following figure.
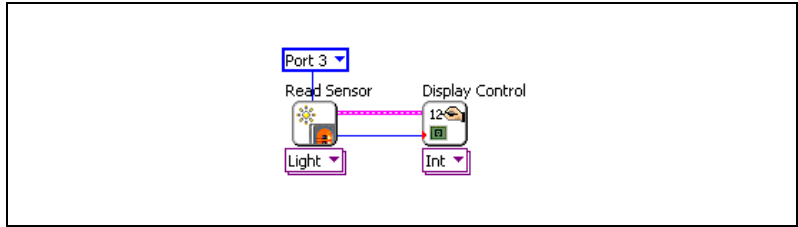

12. Add a Wait For VI to the right of the Display Control VI. The Wait For VI specifies that this VI waits the number of seconds you specify or until the action you specify occurs. By default, this VI waits for one second.

13. Wire the **NXT** output of the Display Control VI to the **NXT** input of the Wait For VI.

14. Add a Read Sensor VI to the right of the Wait For VI.

15. Wire the **NXT** output of the Wait For VI to the **NXT** input of the Read Sensor VI.

16. Select **Read NXT Btns** from the polymorphic VI selector on the Read Sensor VI. By default, this option specifies that this VI returns the value of the orange button on the NXT brick. If the button is pressed, this VI returns TRUE. If the button is not pressed, this VI returns FALSE. You then can wire this value to another object to perform an action based on whether the button is pressed.

In the current state, this VI runs once and then stops. To configure the VI to run continuously, you can use a While Loop. A While Loop specifies that a VI runs until you stop it. Complete the following steps to configure the VI to run continuously.

1. Add a While Loop, located on the **NXT Robotics»NXT Programming»Structures** palette, to the block diagram window. Make sure that you include all the objects on the block diagram inside the While Loop.

2. Wire the **Yes/No** output of the last Read Sensor VI to the conditional terminal of the While Loop. When you press the orange button on the NXT brick, the **Yes/No** output returns TRUE, and the VI stops running.

3. Save the VI as Read Light Sensor.vi in an easily accessible location on the host computer.

After you complete this step, the block diagram window should appear similar to the following figure.
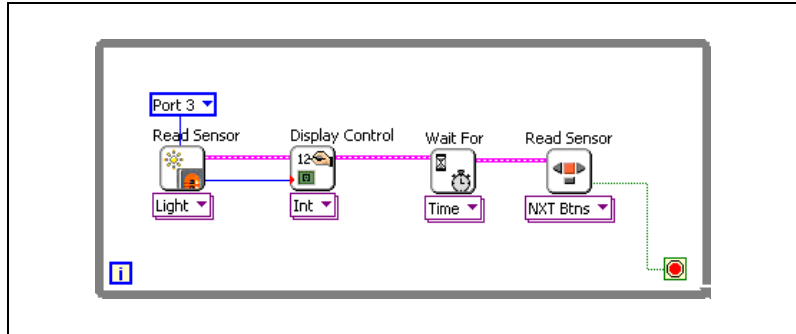
This VI reads the light sensor connected to the NXT brick and displays the scaled value of the light sensor on the screen of the NXT brick.

Understanding How the VI Works

You can use the LabVIEW execution highlighting tool to see how a VI works.

Use execution highlighting to view an animation of the execution of the block diagram. Execution highlighting shows the movement of data on the block diagram from one node to another using bubbles that move along the wires.

Complete the following steps to use execution highlighting for the Read Light Sensor VI.

1. Connect the NXT brick to the host computer through a USB connection.

2. Press the orange button on the NXT brick to power on the NXT brick.

3. Connect the light sensor to port 3 of the NXT brick.

4. In LabVIEW, click the **Highlight Execution** button, shown at left, on the block diagram toolbar of the Read Light Sensor VI to enable execution highlighting.

5. Click the **Run** button, shown at left, and view the block diagram as the VI runs. Notice that with execution highlighting, bubbles move along the wires to mark the movement of data from one node to another, and the values at each terminal are displayed.

6. Cover the light sensor to see the scaled value on the screen of the NXT brick change.

7. Click the **Highlight Execution** button again to disable execution highlighting.

8. Click the **Abort Execution** button on the block diagram window to stop the VI.

Deploying and Running the VI on the NXT Brick

After you see how the Read Light Sensor VI works, you are ready to run the Read Light Sensor VI directly on the NXT brick. Complete the following steps to deploy and run the Read Light Sensor VI on the NXT brick.

1. Select **File»Target to NXT** to open the Read Light Sensor VI in the NXT application instance. LabVIEW targets the VI to the NXT brick connected to the host computer. Notice that the application instance shortcut menu in the bottom left corner of the block diagram window turns orange and displays the name of the NXT brick to which the VI is targeted.

2. Click the **Run** button on the front panel window or block diagram window to run the VI on the NXT brick.

3. Cover the light sensor to see the scaled value change on the screen of the NXT brick.

4. Press the orange button on the NXT brick to stop the VI.

5. Save and close the VI.

Refer to the `labview\examples\NXT Robotics` directory for more examples of VIs you can develop with the NXT Module.

Creating Controls for Motors and Servos

Some VIs you use to program the NXT brick require that you specify which motors and servos you want to control. If you build a robot using TETRIX motors or servos, you can use the TETRIX Motor Configurator to create controls that specify the names and configurations for the TETRIX motors and servos. You then can wire these controls to the VIs you build in LabVIEW to specify the motors and servos you want to control.

You can use the TETRIX Motor Configurator, available by selecting **Tools»NXT Tools»TETRIX Motor Configurator**, to create new LabVIEW controls or to update the configuration of existing controls.

Creating New Controls for Motors and Servos

Use the TETRIX Motor Configurator, shown as follows, to create controls that contain the names and configurations for motors and servos before you begin to program a robot.
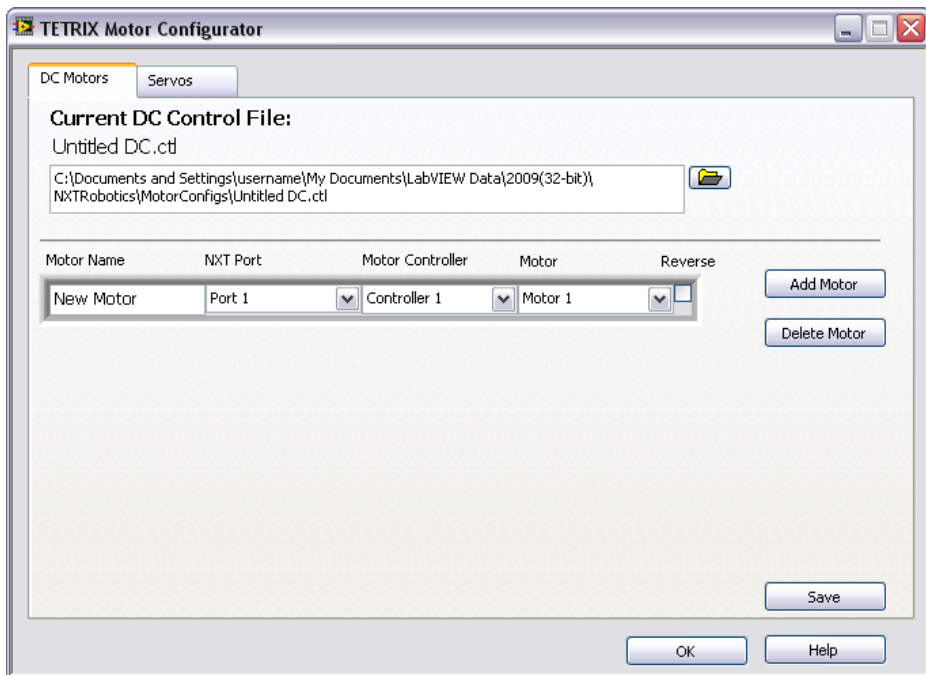
Complete the following steps to create a new motor control.

1. In the **Getting Started** window, click the **Blank VI** link to create a new VI.

2. Select **Tools»NXT Tools»TETRIX Motor Configurator** to display the TETRIX Motor Configurator.

3. Click the **Browse** button to specify where you want to save the new motor control. Save the control in the default data directory so that the control appears on the **Functions** palette in the block diagram window and the **Controls** palette in the front panel window.

4. Specify a unique file name for the control and click the **OK** button to close the file dialog box.

5. On the **DC Motors** page of the TETRIX Motor Configurator, enter Left Drive in the first **Motor Name** text box to specify the name of the first motor.

6. Place a checkmark in the **Reverse** checkbox for Left Drive. This option specifies that Left Drive will move in the opposite direction of the command you send to it.

7. Click the **Add Motor** button to add a second motor to the motor list.

8. Name the second motor Right Drive.

9. Select **Motor 2** from the corresponding **Motor** pull-down menu to specify that Right Drive connects to the Motor 2 terminals on the HiTechnic Motor Controller.

10. Click the **Save** button to save the motor names and configurations.

11. Click the **OK** button to close the TETRIX Motor Configurator.

After you create and save the motor control, the control appears on the **Functions»NXT Robotics»TETRIX»Motor Configurations** palette and the **Controls»NXT Robotics»Motor Configurations** palette, shown as follows.
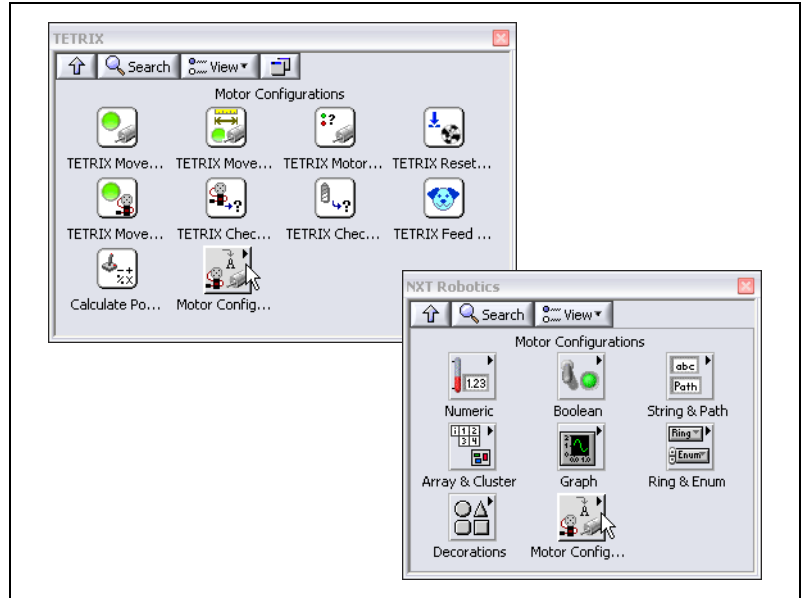
You can add the motor control to the block diagram and wire the control to the **DC Motor** input of the TETRIX VIs, located on the **TETRIX** palette, to begin programming a robot. An example program might appear similar to the following figure.
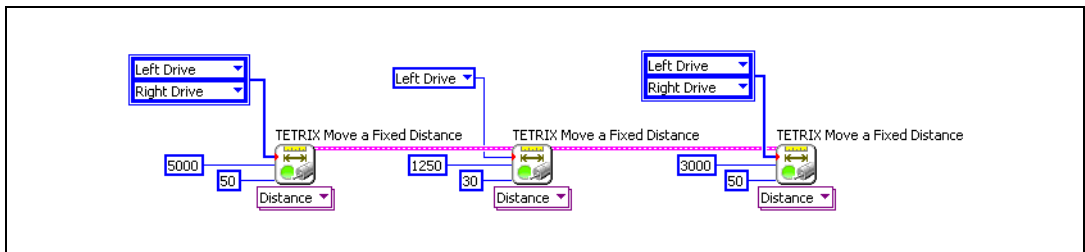
You can create and use servo controls similarly to how you create and use motor controls.

Editing Existing Motor and Servo Controls

You also can open an existing motor or servo control in the TETRIX Motor Configurator to edit that control. After you save the new configurations for the control, the TETRIX Motor Configurator prompts you to update the VIs in which you use the control.

Where to Go from Here

The following documents contain information about programming concepts and provide step-by-step instructions for using LabVIEW and the NXT Module.

- *LabVIEW NXT Module Help*—Use the *LabVIEW NXT Module Help* to access information about NXT Module programming concepts, step-by-step instructions for using the NXT Module, and reference information about NXT Module VIs, functions, palettes, menus, tools, dialog boxes, and so on. Access the *LabVIEW NXT Module Help* by selecting **Help»NXT Module Help** in LabVIEW.

- *LabVIEW LEGO® MINDSTORMS® NXT Module Programming Guide*—Use the *LabVIEW LEGO® MINDSTORMS® NXT Module Programming Guide* to access information about advanced programming in the LabVIEW NXT Module. The *LabVIEW LEGO® MINDSTORMS® NXT Module Programming Guide* details the NXT-specific modifications and extensions to LabVIEW provided by the NXT Module. Access this guide by navigating to the `labview\manuals` directory and opening `NXT_Advanced_Programming_Guide.pdf`.

- *LabVIEW Help*—Use the *LabVIEW Help* to access information about LabVIEW programming concepts, step-by-step instructions for using LabVIEW, and reference information about LabVIEW VIs, functions, palettes, menus, tools, properties, methods, events, dialog boxes, and so on. The *LabVIEW Help* also lists the LabVIEW documentation resources available from National Instruments. Access the *LabVIEW Help* by selecting **Help»Search the LabVIEW Help** in LabVIEW.

- *LabVIEW Quick Reference Card*—Use this card as a reference for information about documentation resources, keyboard shortcuts, data type terminals, and tools for editing, execution, and debugging. Access this manual by navigating to the `labview\manuals` directory and opening `LV_Quick_Reference.pdf`.