Launcher Programming Guide (LabVIEW™ for LEGO® MINDSTORMS®)

Introduction:
In this guide, the Ranger Bot will be programmed to follow a line, detect an object, and then launch a ball. This guide is for use with the LabVIEW™ for LEGO® MINDSTORMS® programming language.

Review:
• To review the basic principles of connecting to the NXT Brick and configuring LabVIEW for LEGO MINDSTORMS for use with various sensors and motors, review the Programming Guides and Tutorial Videos from Lessons 2 and 3.
• To review the basic principles of programming in LabVIEW for LEGO MINDSTORMS, review the Programming Guides and Tutorial Videos from the Line Follower Programming Extension.
• These materials contain detailed information about how to use the Schematic Editor and how to create the structures, functions, constants, and wires that are presented in this guide.
• This program makes use of the Screen Update SubVI, provided on the TETRIX® Getting Started Guide DVD. This function uses the NXT to display custom text as well as light and ultrasonic sensor readings.
• Use these steps to add the function to the program:
  a. Within the block diagram, right-click to bring up the Functions palette and choose Select a VI.
  b. Then navigate to where the Screen Update SubVI is saved.

  Note: If the Screen Update SubVI has not been saved on the computer in a specific location already, download it from the DVD by navigating to the Resources tab and selecting the Screen Update SubVI Program (LabVIEW for LEGO MINDSTORMS) button.
  c. Once the Screen Update SubVI has been located, open it and place it on the block diagram.

Getting Started:
1. Create a new Ranger robot project and name it Launcher.
2. Using the Schematic Editor, configure the robot to have two LEGO motors attached to Motor Ports A and B. These will be used to launch the ball.
3. Also configure the robot to have one TETRIX 180° Servo Motor attached to Servo Port 1. This will control the arm to load the ball to be launched.
4. Create a new VI.
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Initialize the Servo, Wait for Touch Sensor:
5. The code involves three steps: first, initializing the servo position; second, outputting a message to the screen; and third, waiting for the touch sensor to trigger.
   a. Create the code shown, beginning with the Move Servos function, then the Screen Update SubVI, and finally the Read Touch (Pressed) function.
   b. Create a While Loop around these functions and wire the Conditional Terminal to the output of the Read Touch (Pressed) function.

Initialize the Motors, Follow the Line, Check for Object:
6. Note that there is a large While Loop enclosing the remainder of the code. Create this While Loop and ensure that it is wide enough to contain all of the code that follows.
   a. Inside the While Loop, the code initializes the NXT motors, updates the display, follows a line, and then checks the ultrasonic reading to determine if an object is nearby. If one is, the robot stops and begins the launch procedure.
   b. To achieve this, create the code shown, beginning with the Motor On function, followed by the Screen Update SubVI.
   c. Next, create the Line Follower code, which contains the Read Light function and comparison wired to a Case structure containing the appropriate Move DC Motors function.
   d. Then, create the Read Ultrasonic function and Less? comparison function.
   e. Create a large Case structure to contain the code for the launch procedure and wire the result of the comparison function to the conditional terminal of the Case structure.
   Note: The False case will contain no code, and the True case will contain the launch procedure code.
   f. Use the output of the Read NXT Buttons function wired to the conditional terminal of the While Loop to control this loop.
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Stop After Finding the Object, Launch the Ball, Return to Initial State:

7. Next, after the object is detected, the robot stops moving, waits for a second, starts the launcher motors, and then waits again.

   a. To achieve this, create the code shown, beginning with the Screen Update SubVI, followed by the Move DC Motors function to stop the robot from moving, then the Wait For Time (sec) function, the NXT Motor On function to turn on the launcher motors, and then the Wait For Time (sec) function again.

8. Then, the servo arm is lowered to push the ball into the launcher motors. The robot waits for one second while the ball is launched, then the servo arm returns to its initial position and the launcher motors stop. To achieve this:

   a. Create the code shown, beginning with the For Loop to move the servo arm from 128 to 180 units, in steps of 1 with a 10-millisecond delay between steps. Follow this with the Wait For Time (sec) function, then another For Loop to return the servo arm from 180 to 128 units, in steps of 1 with a 10-millisecond delay between steps. Finally, add the Motor On function to stop the launcher motors.
Detect an Object and Wait to Start Again:

9. Finally, the robot holds still and waits for the detected object to be farther than 25 units away.
   a. To achieve this, use a **While Loop** with the **Move DC Motors** function, **Screen Update SubVI** with a **Greater? 25** comparison inside.
   b. The result of the comparison should be wired to the **conditional terminal** of the **While Loop**.