
Certified LabVIEW Developer Examination

Examinee: _____ Date: _____

Administrator: _____ Date: _____

Instructions:

If you did not receive this exam in a sealed envelope stamped “NI Certification,” **DO NOT ACCEPT** this exam. Return it to the proctor immediately. You will be provided with a replacement exam.

- **Do not detach the binding staple of any section. If any part of the exam paper is missing or detached when returned to National Instruments, you will be deemed to have failed the exam.**
- This examination may not be taken from the examination area or reproduced in any way. You may not keep any portion of this exam after you have completed it.
- Do not ask the proctor for help. If any part of the exam is not clear, you may make appropriate assumptions and document them either on the exam paper or on the LabVIEW block diagram.
- A computer with a standard installation of LabVIEW is the only reference allowed for the examination. Externally developed code or third party tools are not allowed in the exam.
- The application must be specifically developed for the exam submission.
- The front panel and associated controls for the application are provided to you in a folder hierarchy on the USB memory stick. You **must** maintain the folder hierarchy and use these components to develop your application. Solutions that do not use the hierarchy or the given components are not graded.
- Do **not** rename the main VI or any of the provided controls. Solutions with renamed main VI or controls are not graded. You may use LabVIEW design patterns, templates, and examples available in the development environment as a guide/resource for the application development.
- **Submit your completed application on the provided USB memory stick.** Failure to provide the solution on the memory stick results in automatic failure.
- Total time allocated for the exam: 4 hours
- Exam passing grade: 70%

Grading:

The application development exam consists of a total of 40 points which are allocated as follows:

- Programming style (**15 points**)
- Functionality (**15 points**)
- Documentation (**10 points**)

IMPORTANT:

- **When you complete the exam, place the exam document and the USB memory stick containing the saved application, along with any deliverables, in the envelope provided.**
- **Please SEAL and give the sealed envelope to your proctor.**

Section I: General Requirements

The Certified LabVIEW Developer exam tests your ability to develop a LabVIEW application.

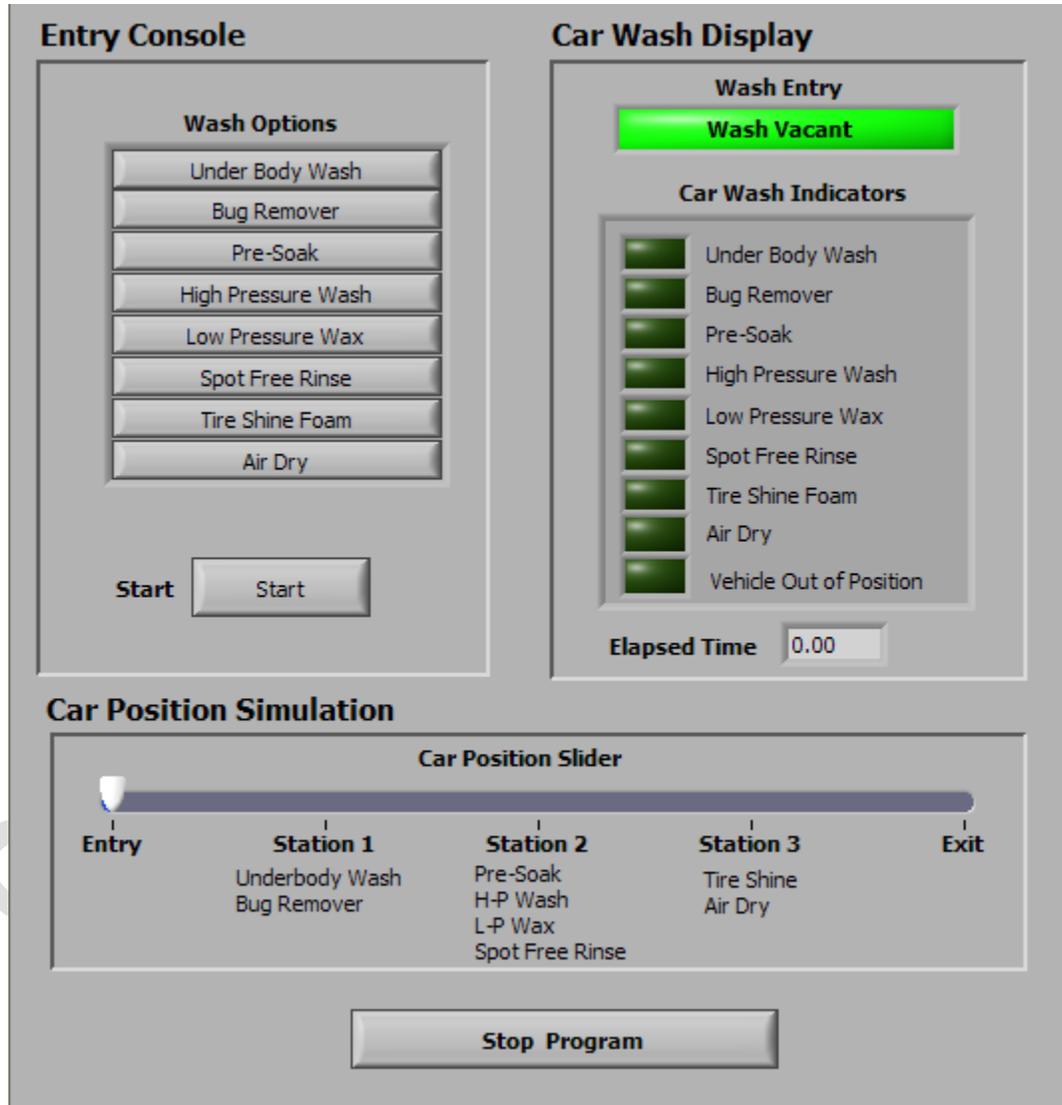
The application should do the following:

- Function as specified in Section II of this document
- Conform to LabVIEW coding style and documentation standards (found in LabVIEW documentation – *LabVIEW Development Guidelines*)
- Be created expressly for this exam using VIs and functions available in LabVIEW. Templates, examples, or code developed outside the bounds of this exam are not acceptable for use in the application
- Be hierarchical in nature. All major functions should be performed in subVIs
- Use a state machine that either uses a type-defined enumerated control, queue, or Event structure for state management
- Be easily scalable to add more states/features without manually updating the hierarchy
- Minimize the use of excessive structures, variables (locals/globals) and property nodes
- Respond to front panel controls (within 100 ms) without utilizing 100 % of CPU time
- Close all opened references and handles where used
- Be well-documented, and include the following:
 - Labels on appropriate wires within the main VI and subVIs
 - Descriptions for each algorithm
 - Documentation in **VI Properties»Documentation** for both main VI and subVIs
 - Tip strips and descriptions for front panel controls and indicators
 - Labels for constants

Application Development
Section II: Application Requirements
Car Wash

Objective

Design a car wash controller using LabVIEW. The front panel of the simulator resembling the following front panel is provided to you as a VI on the USB memory stick. You **must** use the provided VI and controls to develop your application.



General Operation

The car wash controller simulates the control system of an automated car wash. The user interacts with controls and indicators on the front panel to select the car wash options and simulate the travel of the vehicle in the car wash.

The controller should perform the following general operations:

- Indicate on the **Wash Entry** LED if the car wash is vacant or a wash is in progress.
- Allow the user to select **Wash Options**
- Start the washing process when the user clicks **Start**
- Indicate the current wash step on the **Car Wash Indicators** LEDs and display the **Elapsed Time** on the indicator
- Turn ON the **Vehicle Out of Position** LED and pause the elapsing time if the vehicle moves from the designated position during a cycle

Sequence of Operation

Start (Application Run): When the application starts, the front panel controls and indicators should be in the following states:

- **Entry Console:** All controls should be enabled.
- **Car Wash Display:** The **Wash Entry** LED should be green and display *Wash Vacant*. All **Car Wash Indicators** should be turned OFF and the **Elapsed Time** indicator should display 0.00.
- **Car Position Simulation:** The **Car Position Slider** should be at the **Entry** position.

Select Wash Options: Click the **Wash Options** buttons to select the washing steps. The buttons should remain clicked until the completion of the wash cycles.

Start: Click the **Start** button to begin the car wash process. This should configure the controller to execute the steps selected by the **Wash Options** buttons.

Note The High Pressure Wash step is the default wash. If the user did not select High Pressure Wash, or if the user did not select any options, High Pressure Wash must be added to the options programmatically after the user clicks **Start**.

The controller should disable the **Wash Options** buttons.

The controller should signal the start of the wash by changing the color of the **Wash Entry** LED to red and displaying *Wash In Progress*.

The controller should check if the vehicle is at the appropriate station for the first step in the selected wash type by monitoring the **Car Position Slider**.

Note Refer to the *Car Wash Step Timing and Station Positions* table at end of the specification for a list of stations that correspond to the car wash steps.

If the vehicle is not at the appropriate station, the controller should turn ON the **Vehicle Out of Position** LED and not begin timing.

If the vehicle is at the appropriate station, the appropriate wash step LED should turn ON and the **Elapsed Time** indicator should count up from zero to indicate elapsed time for that step.

Upon completion of a step, the **Elapsed Time** indicator should reset to zero. Each wash step should not last for more than the time allocated in the *Car Wash Step Timing and Station Positions* table at the end of the specification.

Upon completion of a step, if the vehicle is in the appropriate station, the controller should continue to the next wash step by resetting and restarting the elapsed timer.

Upon completion of a step, if the vehicle is not in the appropriate station, the controller should turn ON the **Vehicle Out of Position** LED and not begin timing.

If the vehicle moves away from the wash station in the middle of a wash step, the elapsed time should pause, the **Vehicle Out of Position** LED should turn ON and the appropriate wash step LED should turn OFF. When the vehicle position is restored to the correct position by moving the **Car Position Slider**, the **Vehicle Out of Position** LED should turn OFF, the appropriate wash step LED should turn ON, and timing should continue from the paused time until completion of the step.

When all the wash steps are complete, the **Vehicle Out of Position** LED should turn ON, indicating to the user to exit the car wash. When the user moves the **Car Position Slider** to the **Exit** position, all **Car Wash Indicators** should turn OFF and the **Car Position Slider** should reset to the **Entry** position. The **Wash Entry** indicator should turn green and display *Wash Vacant*, and the controls in the **Wash Entry Console** should be enabled to allow the user to select and start another car wash process.

Stop Program: Click **Stop Program** to abort the car wash process at *any time* and stop the application. When the application stops, the front panel controls and indicators should be in the following states:

Entry Console: All controls should be enabled.

Car Wash Display: The **Wash Entry** LED should be green and display *Wash Vacant*, all **Car Wash Indicators** should be turned OFF, and the **Elapsed Time** indicator should reset to zero.

Car Position Simulation: The **Car Position Slider** should reset to the **Entry** position.

Car Wash Step Timing and Station Positions:

Wash Steps	Step Time	Station
Under Body Wash	5 seconds	Station 1
Bug Remover	5 seconds	Station 1
Pre-Soak	5 seconds	Station 2
High Pressure Wash	5 seconds	Station 2
Low Pressure Wax	5 seconds	Station 2
Spot Free Rinse	5 seconds	Station 2
Tire Shine Foam	5 seconds	Station 3
Air Dry	5 seconds	Station 3