Itasdi

Innovative Teaching Approaches in development of Software Designed Instrumentation and its application in real-time systems

The Advanced Applications of LabVIEW

Lecture 1: Sequential state machine

Co-funded by the Erasmus+ Programme of the European Union

The goal of this course

The aim of this course is to deepen the students knowledge of advanced topics in LabVIEW, which are required for CLD exam (Certified LabVIEW Developer).

Topics

1. The user interface
2. Block Diagram Layout and Style
3. Programming Practices, SubVI Design Practices
4. The design patters
5. Timing
6. Error Handling, Documentation

The books

- "Effective LabVIEW Programming" Thomas J.Bress, National Technology and Science Press 2013.
- "LabVIEW Core 3 Course Manual"

The completing conditions

- The condition for passing the subject is an attendance on laboratory.
- The final mark will be:
  1. 3.0 - when student was present on 8/10 laboratories.
  2. 3.5 - when student was present on 9/10 laboratories.
  3. 4.0 - when student was present on 10/10 laboratories.
  4. 4.5 - when student finishes the project on the last laboratory with mark more than 50%.
  5. 5.0 - when student finishes the project on the last laboratory with mark equal or more than 70%.

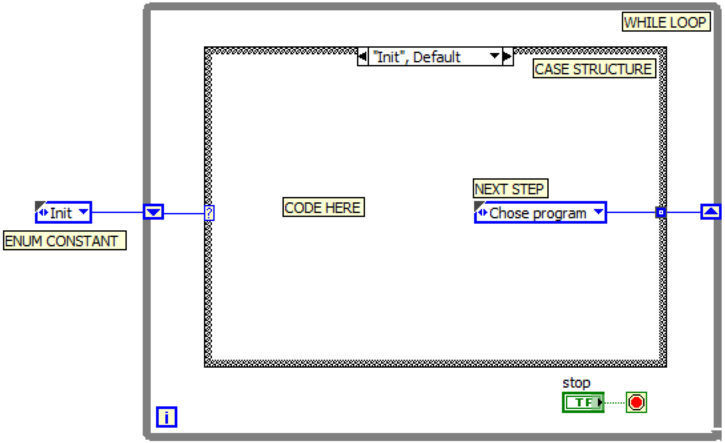
Schedule

1. Sequential state machine,
2. Master/Slave Design Pattern,
3. Producer/Consumer Design Pattern,
4. Producent/Consumer User Event Design Pattern,
5. Queued Message Handler,
6. User Interface,
7. Object-Oriented programming,
8. Documentation, managing and logging errors,
9. Timing,
10. Project.

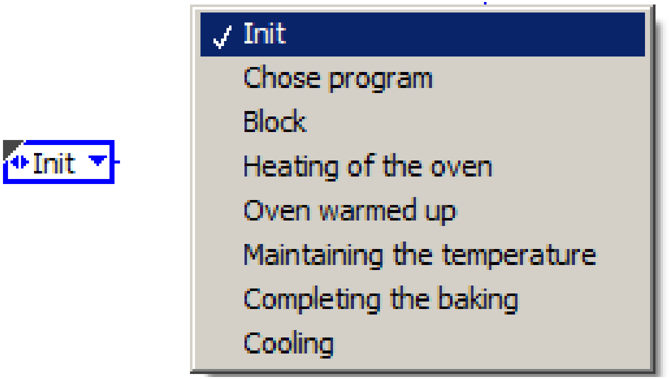
Application of state machine

- State machine can be used for all sequential tasks e.g. implementation of all functionality of machines, management of processes in experiments, etc.
- The state machine can be easily modified by adding another step as next frame in its case structure.
- The code is getting smaller and easy to read and modify.

Structure of state machine

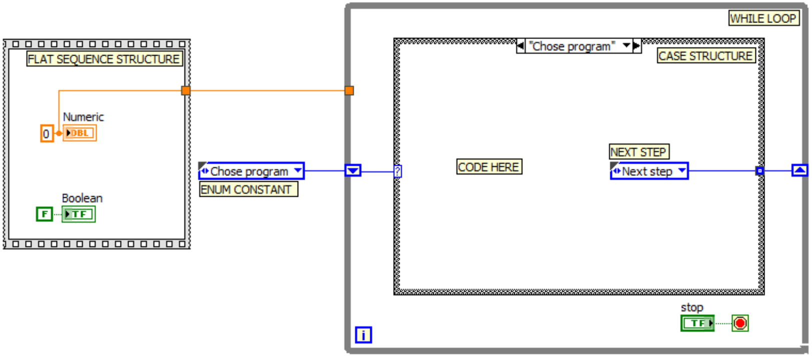


- Enum constant should include all necessary steps. You should draw algorithm of code using blocks. All blocks should be the steps included in enum.
- Remember to make type def from enum to easily modify it in future.


Init
✓ Init
Chose program
Block
Heating of the oven
Oven warmed up
Maintaining the temperature
Completing the baking
Cooling

Initialization of variables

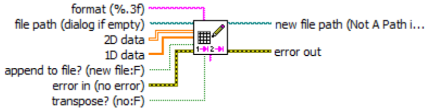
- Variables can be initialized in the beginning step in case structure (see previous slide).
- We can also use the *Flat Sequence Structure* to initialize the values of controls/indicators. Remember to connect the *Flat Sequence Structure* with *While loop* to make sure that *Flat Sequence Structure* will work first.



Initialization from the disk

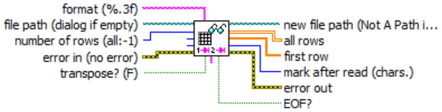
- Reading data from the disk is very useful especially if you want to modify it in the future.
- You can read configuration data from CSV files by using *Write/Read Delimited Spreadsheet* functions:

Write Delimited Spreadsheet.vi


format (%.3f)
file path (dialog if empty)
2D data
1D data
append to file? (new file:F)
error in (no error)
transpose? (no:F)
new file path (Not A Path i...
error out

Converts a 2D or 1D array of strings, signed integers, or double-precision numbers to a text string and writes the string to a new byte stream file or appends the string to an existing file. Wire data to the **2D data** input or **1D data** input to determine the polymorphic instance to use or manually select the instance.

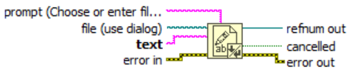
Read Delimited Spreadsheet.vi



Initialization from the disk

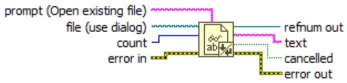
- You can read configuration data from CSV or TXT files by using functions:

Write to Text File



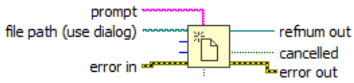
Writes a string or an array of strings as lines to a file. This function does not work for files inside an LLB.

Read from Text File



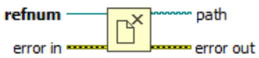
Reads a specified number of characters or lines from a byte stream file. This function does not work for files inside an LLB.

Open/Create/Replace File



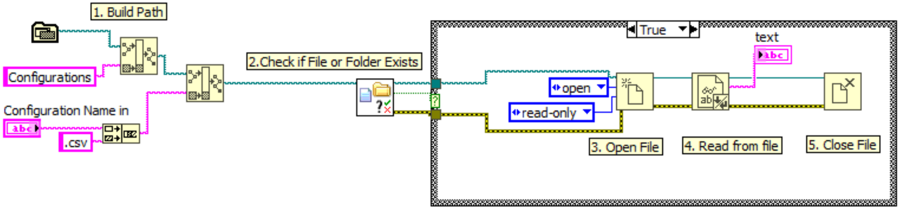
Opens an existing file, creates a new file, or replaces an existing file, programmatically or interactively using a file dialog box. This function does not work for files inside an LLB.

Close File



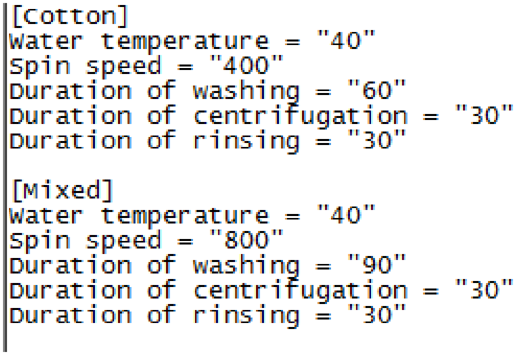
Closes an open file specified by **refnum** and returns the path to the file associated with the refnum.

An example of reading the data from CSV/TXT file



Initialization from the disk

- You can read configuration data from initialization files (.INI).
- Initialization files contain sections and keys. A key is a constant value. A section is a group of related keys.

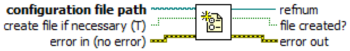


```
[Cotton]
Water temperature = "40"
Spin speed = "400"
Duration of washing = "60"
Duration of centrifugation = "30"
Duration of rinsing = "30"

[Mixed]
Water temperature = "40"
Spin speed = "800"
Duration of washing = "90"
Duration of centrifugation = "30"
Duration of rinsing = "30"
```

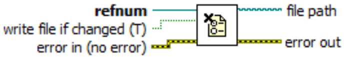
- You can read configuration data from initialization files (.INI) by using the functions:

NI_LVConfig.lvlib:Open Config Data.vi



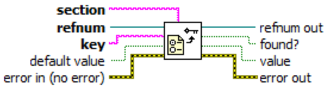
Opens a reference to the configuration data found in a platform-independent configuration file.

NI_LVConfig.lvlib:Close Config Data.vi



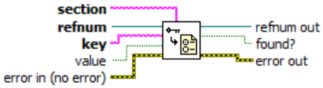
Writes data to the platform-independent configuration file identified by **refnum** and then closes the reference to that file.

NI_LVConfig.lvlib:Read Key.vi



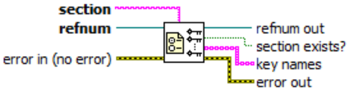
Reads a value associated with a key in a specified section from the configuration data identified by **refnum**. If the key does not exist, the VI returns the default value. This VI supports multibyte characters in strings. Wire data to the **default value** input to determine the polymorphic instance to use or manually select the instance.

NI_LVConfig.lvlib:Write Key.vi



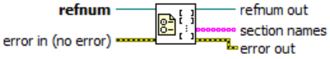
Writes a value to a key in a specified section of the configuration data identified by **refnum**. This VI modifies data in memory. To write data to disk, use the Close Config Data VI. Wire data to the **value** input to determine the polymorphic instance to use or manually select the instance.

NI_LVConfig.lvlib:Get Key Names.vi

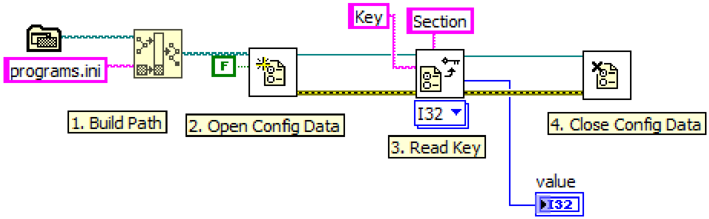


Gets the names of all keys in the specified section from the configuration data identified by **refnum**.

NI_LVConfig.lvlib:Get Section Names.vi



Gets the names of all sections from the configuration data identified by **refnum**.


Key
Section
programs.ini
F
I32
1. Build Path
2. Open Config Data
3. Read Key
4. Close Config Data
value
I32

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Thank you for your attention!

The lecture was prepared based on materials from "LabVIEW Core 3 Course Manual".

This project has been funded with support from the European Commission. This communication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.