

INSTRUMENTATIE VIRTUALA

CURS 2-3

Cuprins

2

- Mediu de programare grafică LabVIEW
 - Noțiuni de bază
 - Ferestre de lucru, uneltele, paletele de controale și funcții
 - Elemente de programare - Programarea modulară



Familiarizarea cu mediul de programare LabVIEW – ferestre, meniuri, tools-uri

Deschiderea aplicatiei LabVIEW

4

The screenshot shows the initial window of the LabVIEW 2024 Q3 application. At the top, there's a toolbar with icons for File, Open, Tools, and Help. Below the toolbar, the title "LabVIEW™ 2024 Q3" is displayed next to a yellow play button icon with a plus sign. On the left, there's a "Create Project" button and a "Recent Project Templates" section containing "Queued Message Handler", "Blank Project", and "Instrument Driver Project". In the center, there's an "Open Existing" button and a dropdown menu showing "All Recent Files" with a list of recent project files: "Untitled Project 17.lvproj", "Untitled Project 16.lvproj", "MRFO.lvproj", "Water Treatment.lvproj", "SMIM.lvproj", "Test SW.lvproj", "System Control.lvproj", and "IV-TI.lvproj". To the right, there's a navigation bar with arrows for navigating through video-based tutorials, currently showing "9 / 9". A section titled "Get Started with LabVIEW and CompactRIO" describes the purpose of these tutorials, and a "Read more" link is provided.

LabVIEW™ 2024 Q3

Create Project

Recent Project Templates

- Queued Message Handler
- Blank Project
- Instrument Driver Project

Open Existing

All Recent Files

- Untitled Project 17.lvproj
- Untitled Project 16.lvproj
- MRFO.lvproj
- Water Treatment.lvproj
- SMIM.lvproj
- Test SW.lvproj
- System Control.lvproj
- IV-TI.lvproj

< 9 / 9 >

Get Started with LabVIEW and CompactRIO

Access video-based tutorials that cover hardware configuration through taking your first measurement.

Read more

Find Drivers and Add-ons

Community and Support

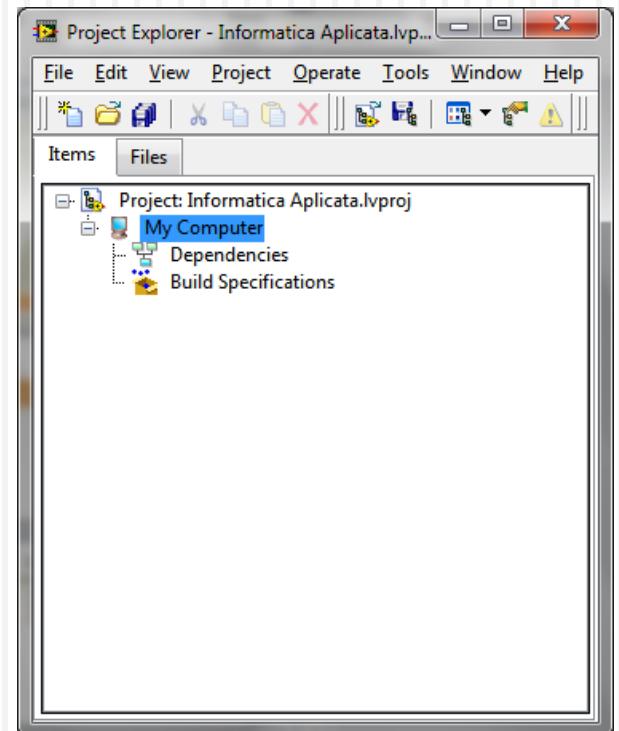
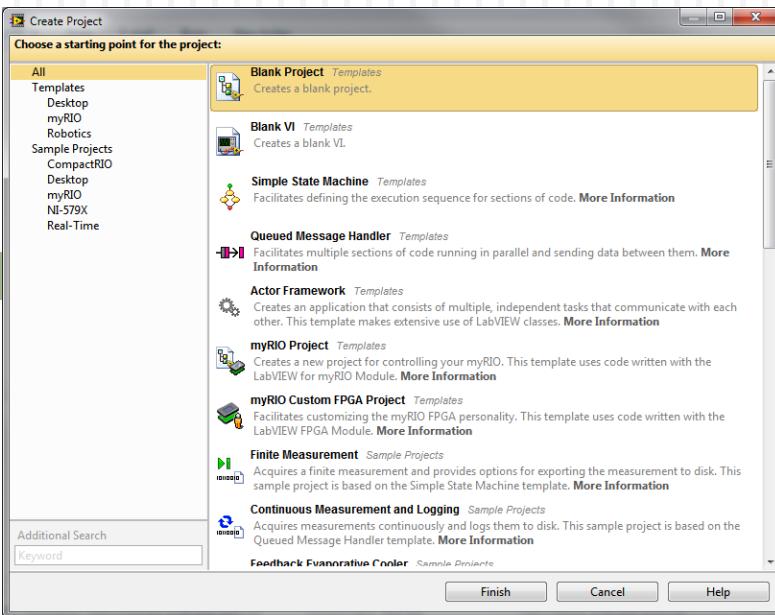
Connect to devices and expand the functionality of LabVIEW.

Participate in the discussion forums or request technical support.

Lucru cu proiecte

5

- Permite:
 - ❑ gruparea de fisiere LabVIEW si non LabVIEW
 - ❑ Realizarea de aplicatii executabile
- la deschiderea platformei LabVIEW se va alege optiunea Create Project
- Adaugarea de noi fisiere
 - ❑ My Computer>>New>>VI



Un Instrument Virtual (VI)

6

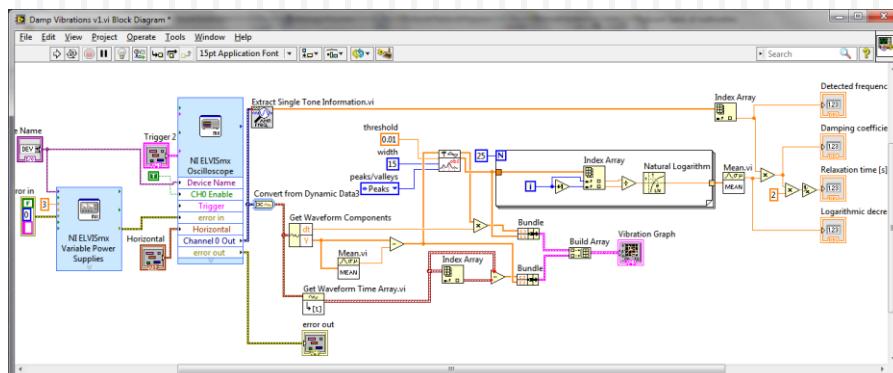
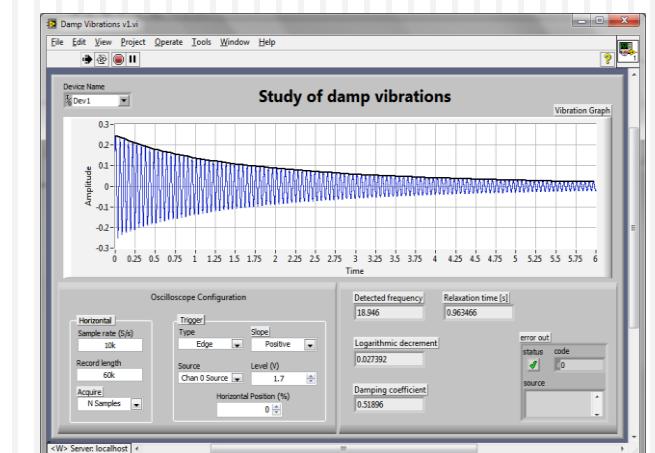
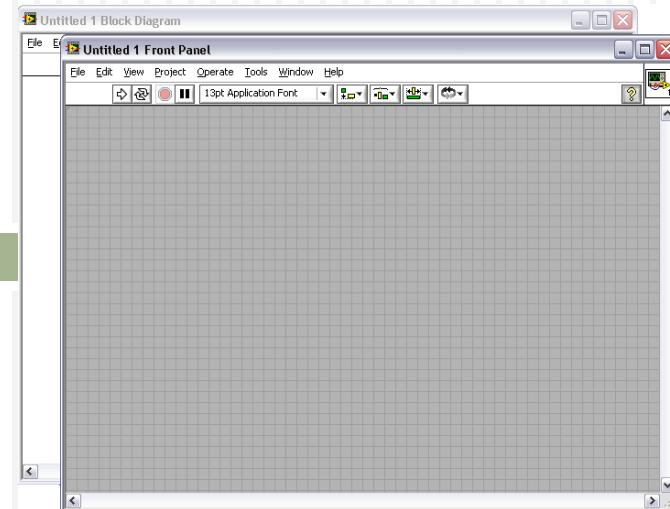
□ Are un PANOU

- Controale = Intrari
- Indicatoare = Iesiri

□ Are o DIAGRAMA

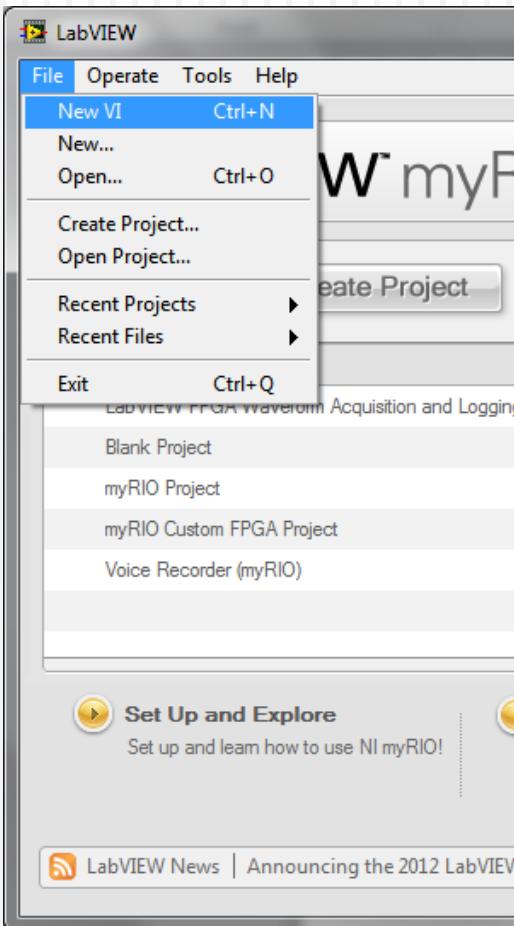
- De fapt este programul realizat grafic folosind elementele din PANOU

- Iconurile (module) legate functional cu fiire



Realizarea primului VI

7

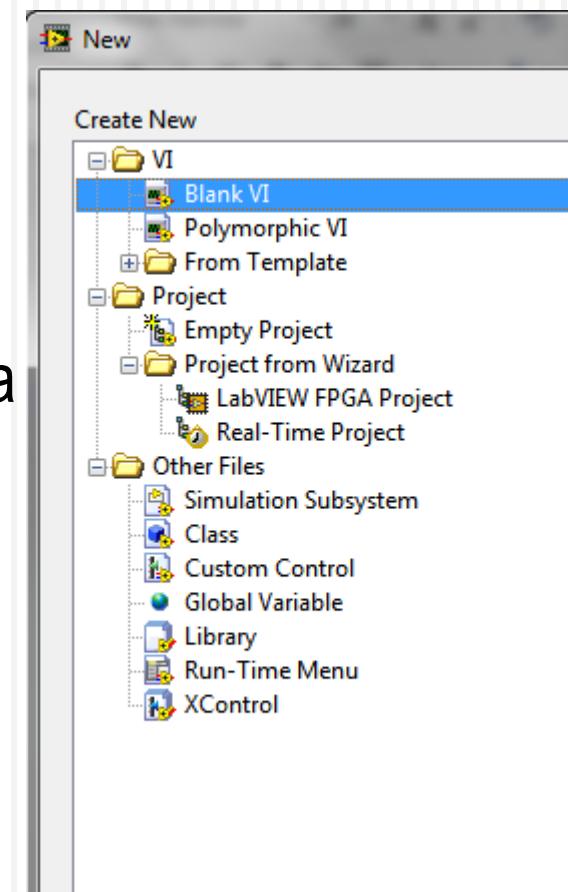


Deschidem un nou VI

- Selectati File»New VI

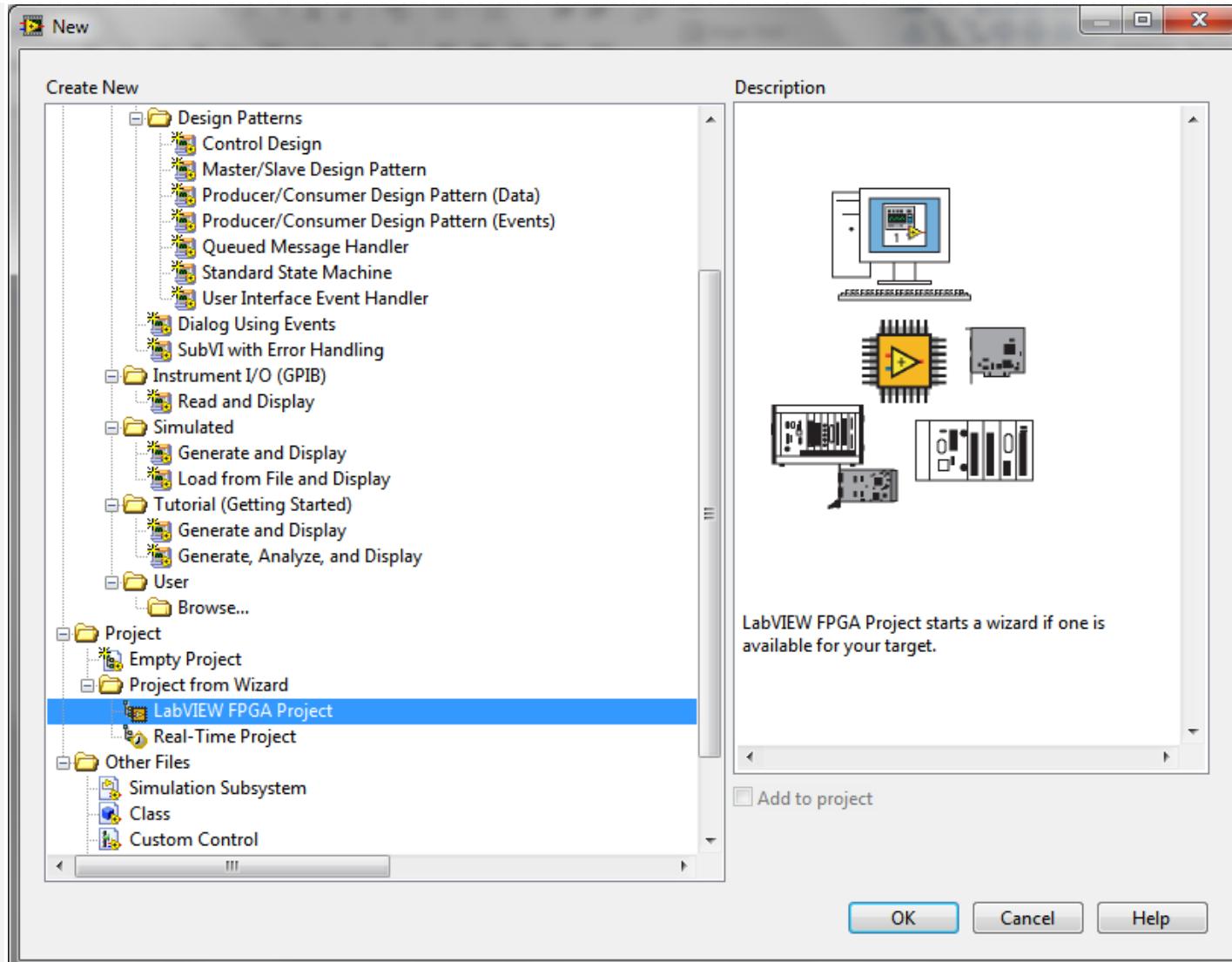
Sa deschidem o noua casuta de dialog New

- Selectati File»New
- Click Blank VI



Template-ul de Browser

8



Lucru cu Project Explorer

9



- Demonstratie
 - Deschidere LabVIEW
 - Crearea unui nou proiect
 - Adaugarea de fisiere
 - Gruparea fisierelor
 - Stergerea fisierelor

Fereastra PANOU => interfața utilizator

10

Bara de unelte
a Panoului

Numerice

Alfanumerice

Booleene

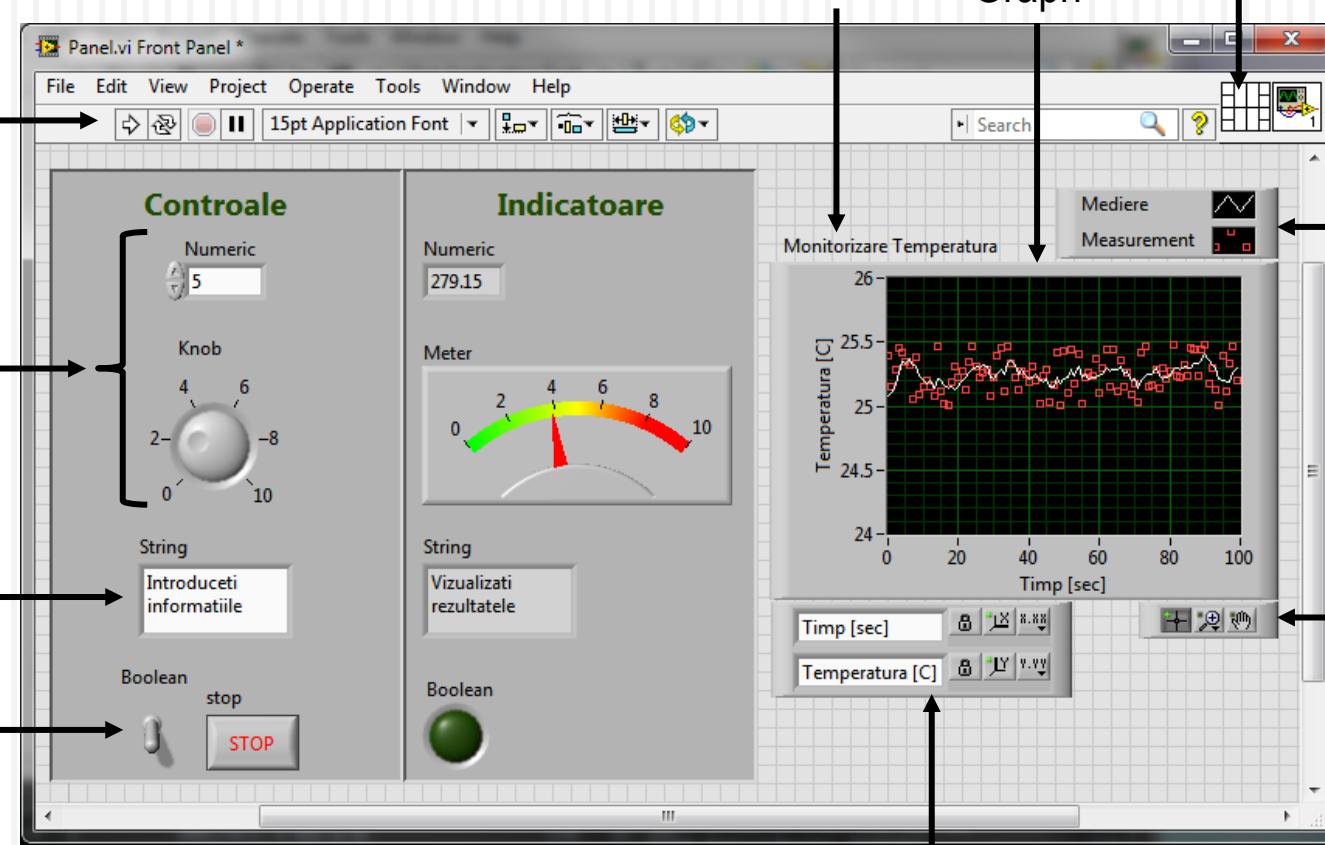
Graph
Label

Waveform
Graph

Connector

Icon
Plot
Legend

Graph
Palette



Legenda
Scalei

Bara de unelte in Panou si Diagrama



Rulare simplă

Rulare continua

Oprire (abort)

Pauza/Continua

Configurare Fonturi

Aliniere

Distribuire

Redimensionare

Reordonare

Cautare globală

Help
contextual



Atentionare



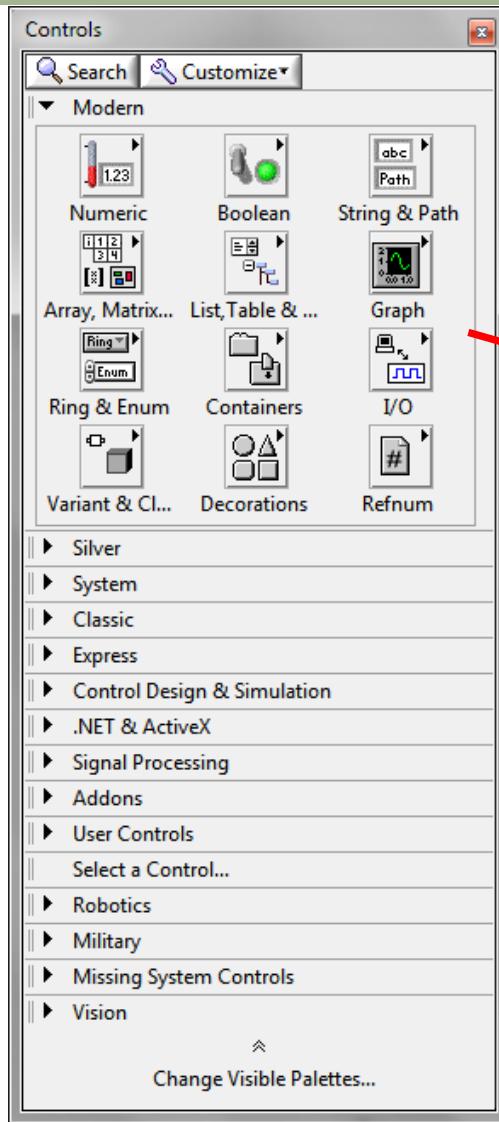
Buton Enter



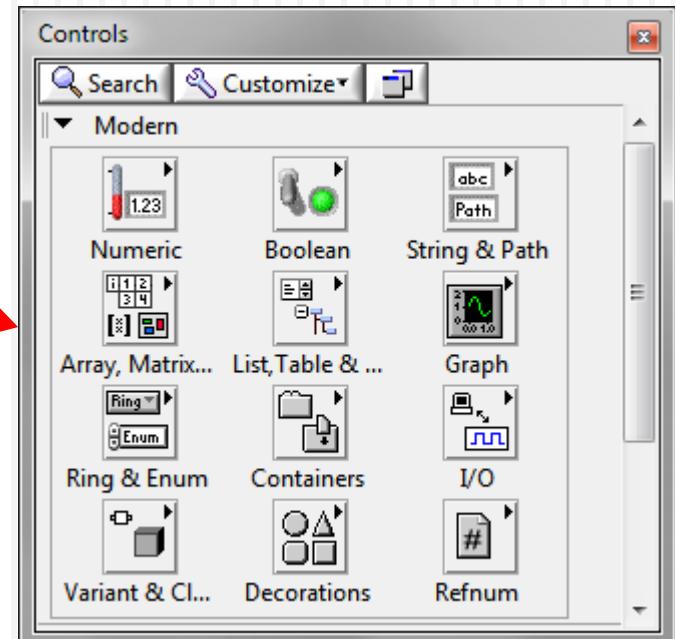
Necesar Debug

PANOU – Paleta de controale

12



Controls Palete
Contine cele mai utilizeze controale



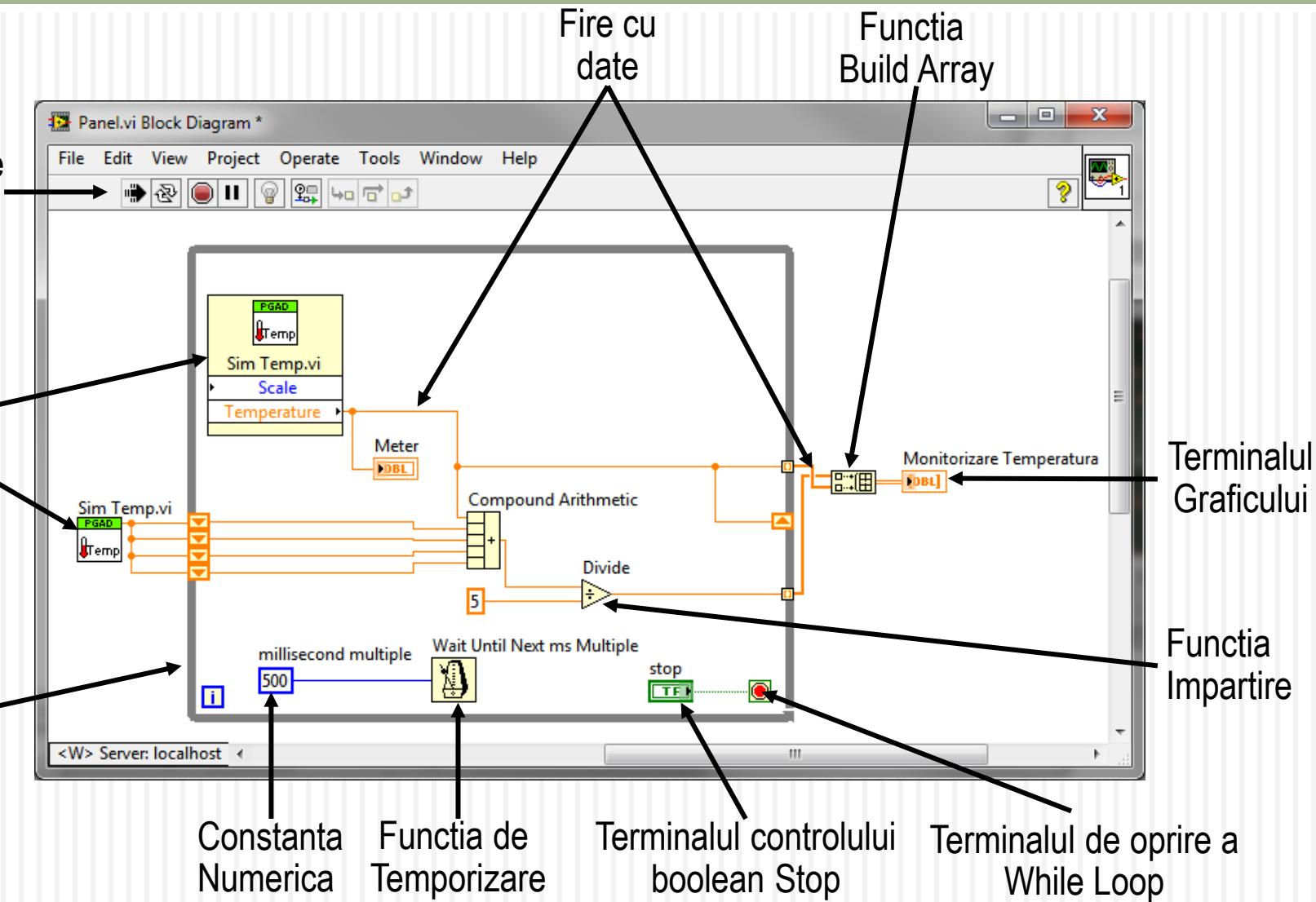
Paleta cu toate controalele Modern

Pentru a deschide paleta de controale:
View»Controls Palette

Fereastra DIAGRAMA => codul sursa

13

Bara de unelte
Diagrama



Bara de unelte in Diagrama

Butoane aditionale in diagrama

- Executie animata -EA
- Memorare valori in EA
- Step In
- Step Over
- Step Out
- Clean Up Diagram
(selection)



Paleta de Unelte

15

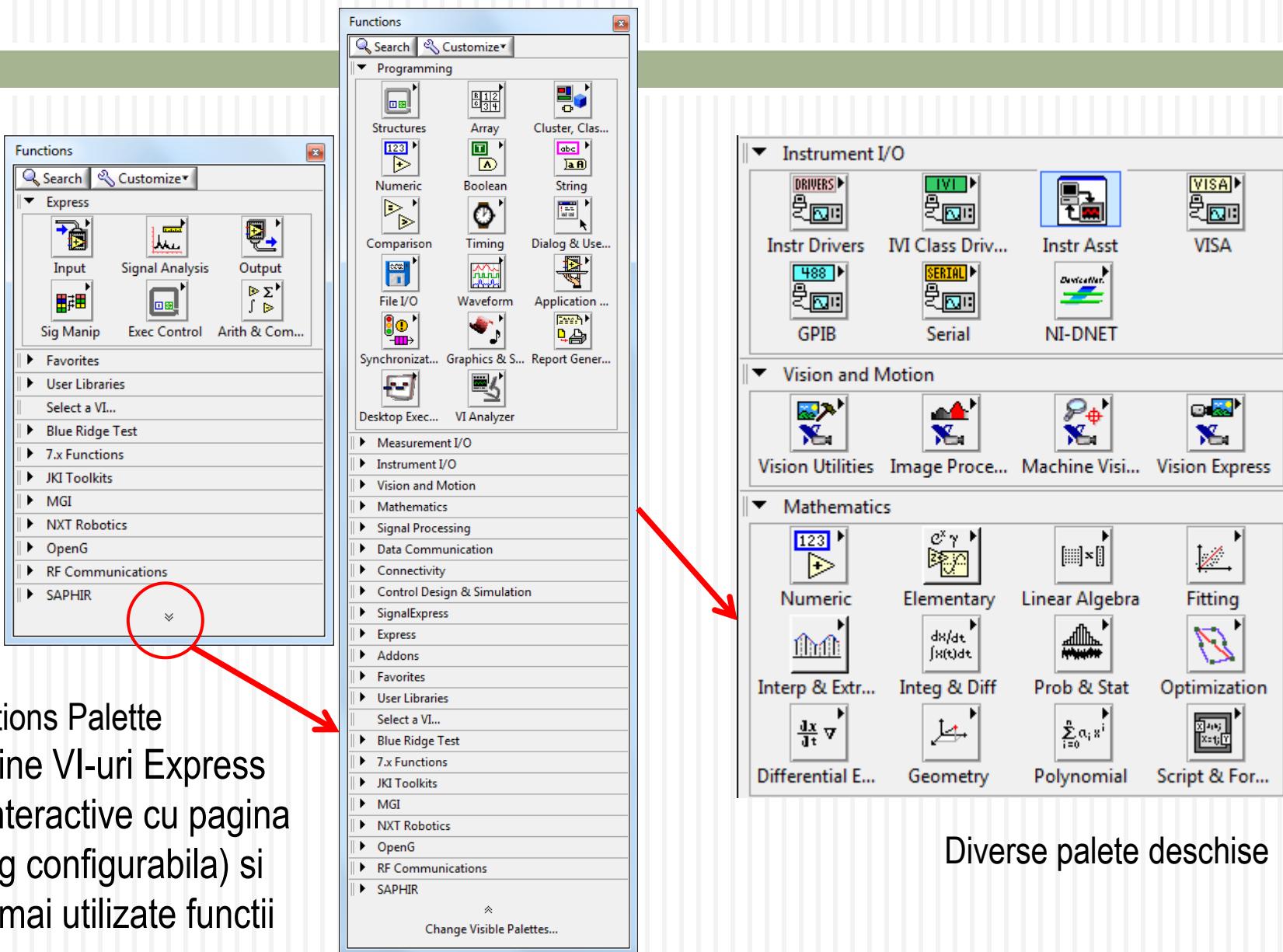
- LabVIEW poate selecta automat sau manual uneltele
 - Disponibile in Panou si in Diagrama
 - Unealta este de fapt un mod special de operare a cursorului mouse-ului
 - Folosim aceste unelte sa lucram cu si sa modificam obiectele din Panou si Diagrama
 - Pentru a deschide paleta de unelte:
View»Show Tools Palette



Simbol	Uneală
	Selectia automată a uneltei
	Uneală de operare
	Uneală de editare, poziționare, redimensionare
	Uneală de editare text
	Uneală de conectare
	Uneală de inserare de probe

Diagrama – Paleta cu functii

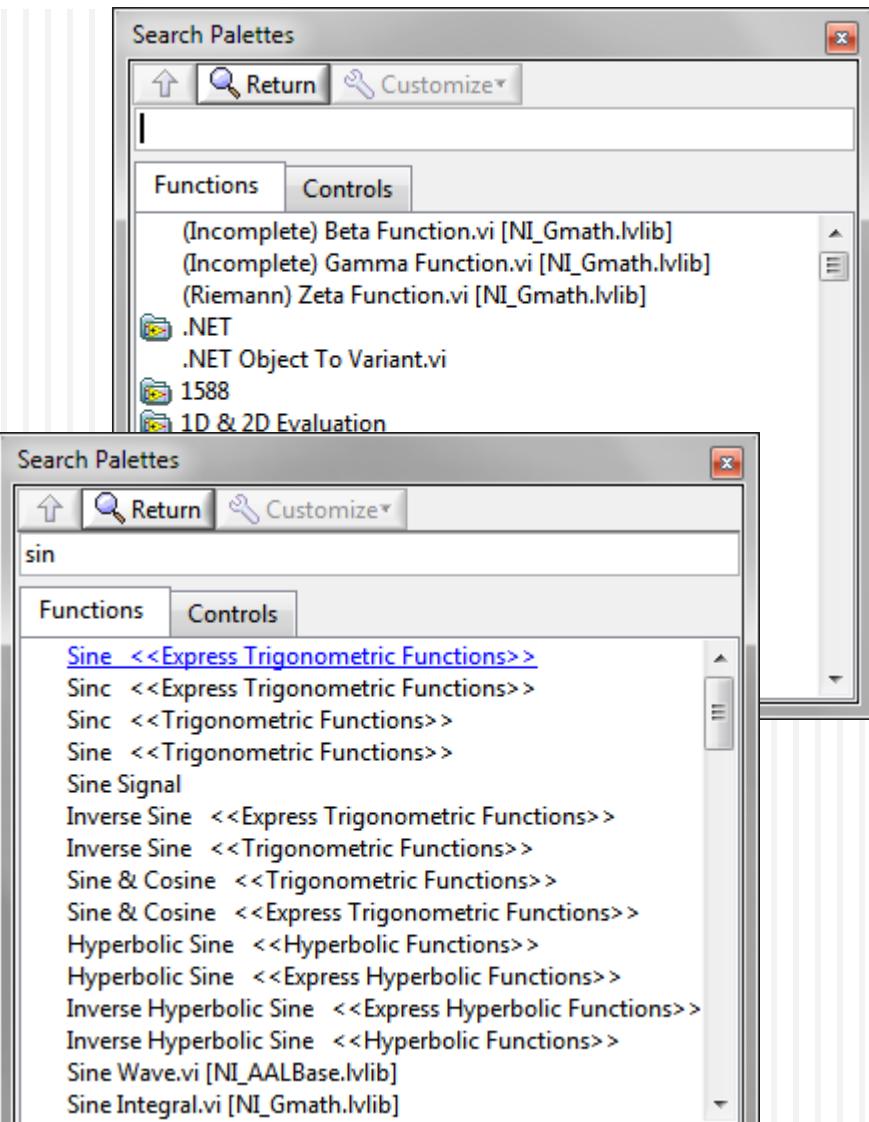
16



Cautarea Controalelor, VI-urilor si a Functiilor

17

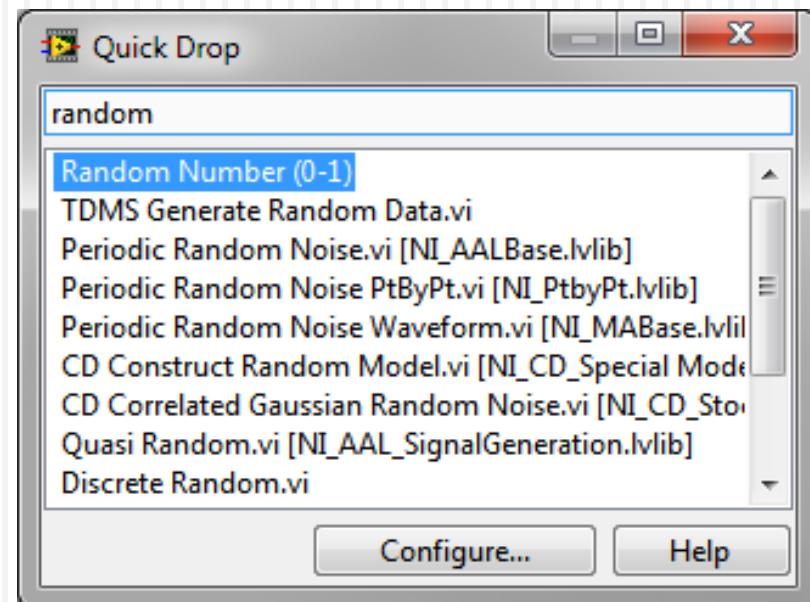
- Apasati butonul Search pentru a face cautari text in paleta (exemplu: sin)
- “Click and drag” un element din fereastra de cautare in “Diagrama” sau “dublu click” pe un item sa deschizi paleta parinte (superioara)



Cautarea cu Quick Drop

18

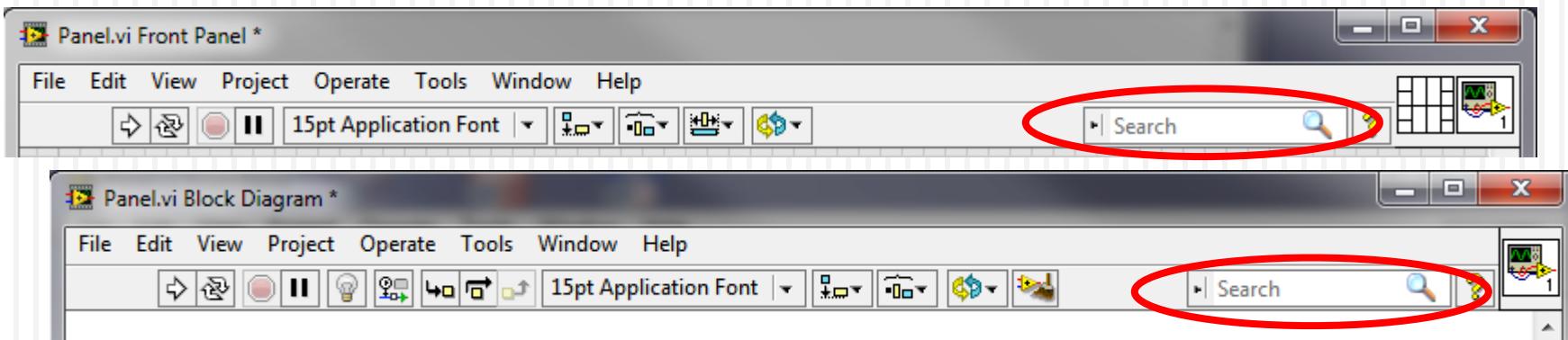
- Fereastra Quick Drop permite cautarea de:
 - ❑ Controle
 - ❑ Indicatoare
 - ❑ Functii
 - ❑ VI-uri
- Activarea ferestrei se face prin apasarea simultana a tastelor <Ctrl-Space> sau din meniul View>>Quick Drop.



Search

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- În bara de unelte din Panel sau Diagrama
- Permite căutarea:
 - în palete
 - LabVIEW Help,
 - ni.com.



Creati Panoul Frontal al unui VI

20

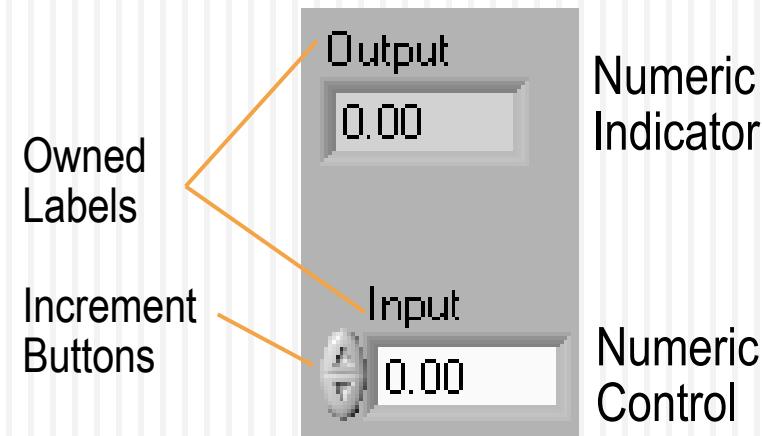
Construiti panoul frontal cu:

- Controle (intrari)
- Indicatoare (iesiri)



Boolean
Control

Boolean
Indicator



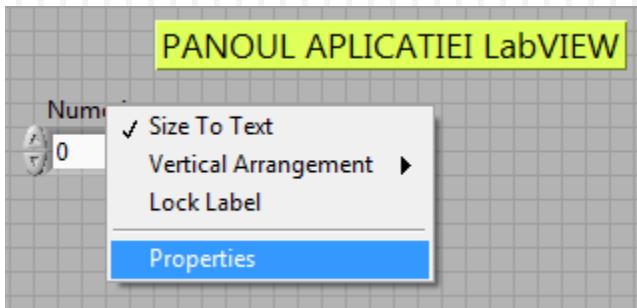
Numeric
Indicator

Numeric
Control

“Shortcut Menus” pentru obiecte din Panou

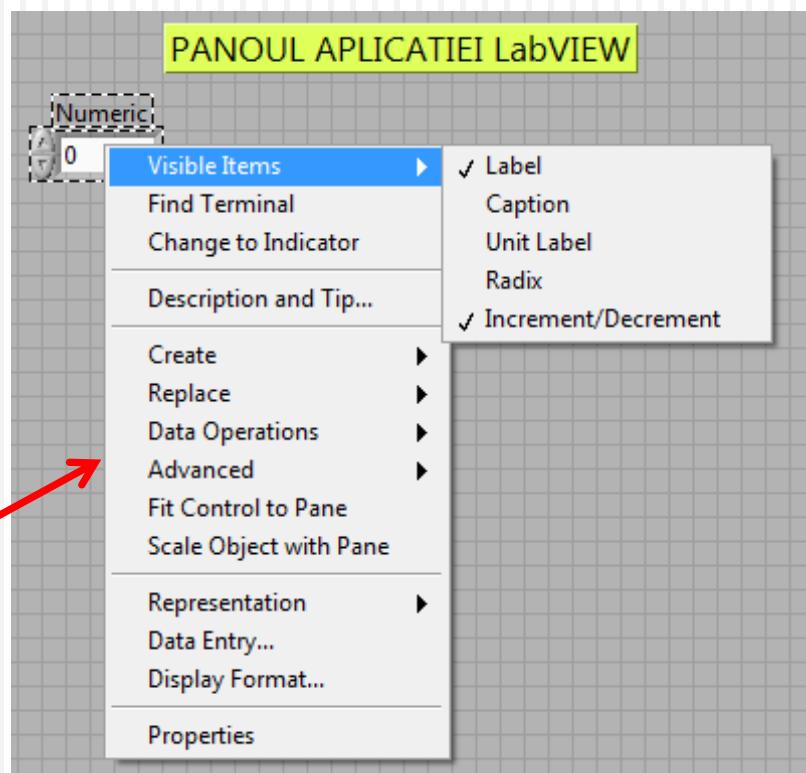
21

“Right-click” pe eticheta pentru ai accesa “shortcut menu”



Prin Right-click pe un obiect se acceseaza proprietatile obiectului

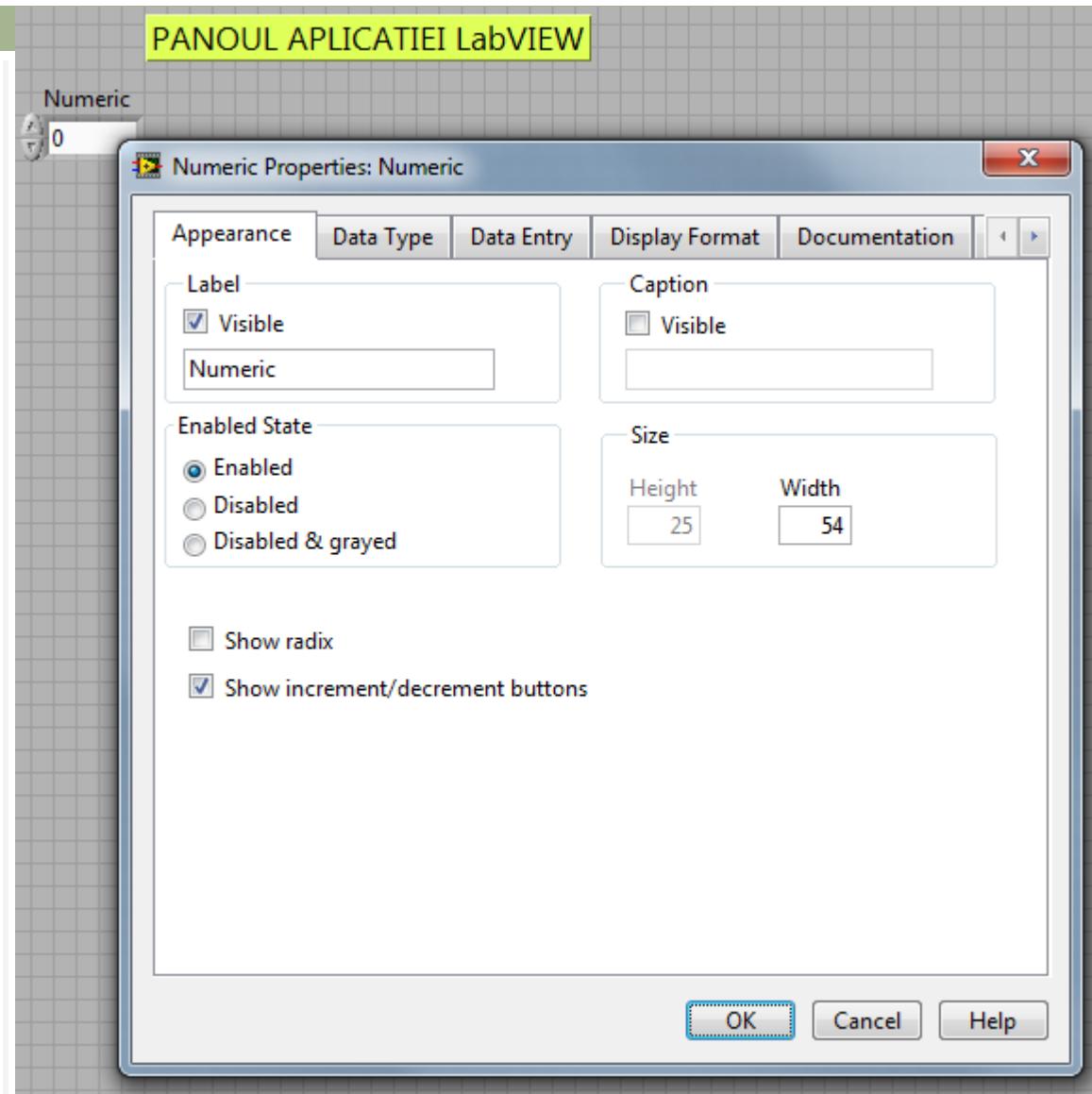
Right-click pe afisorul digital pentru ai accesa “shortcut menu”



Pagina de Proprietati

22

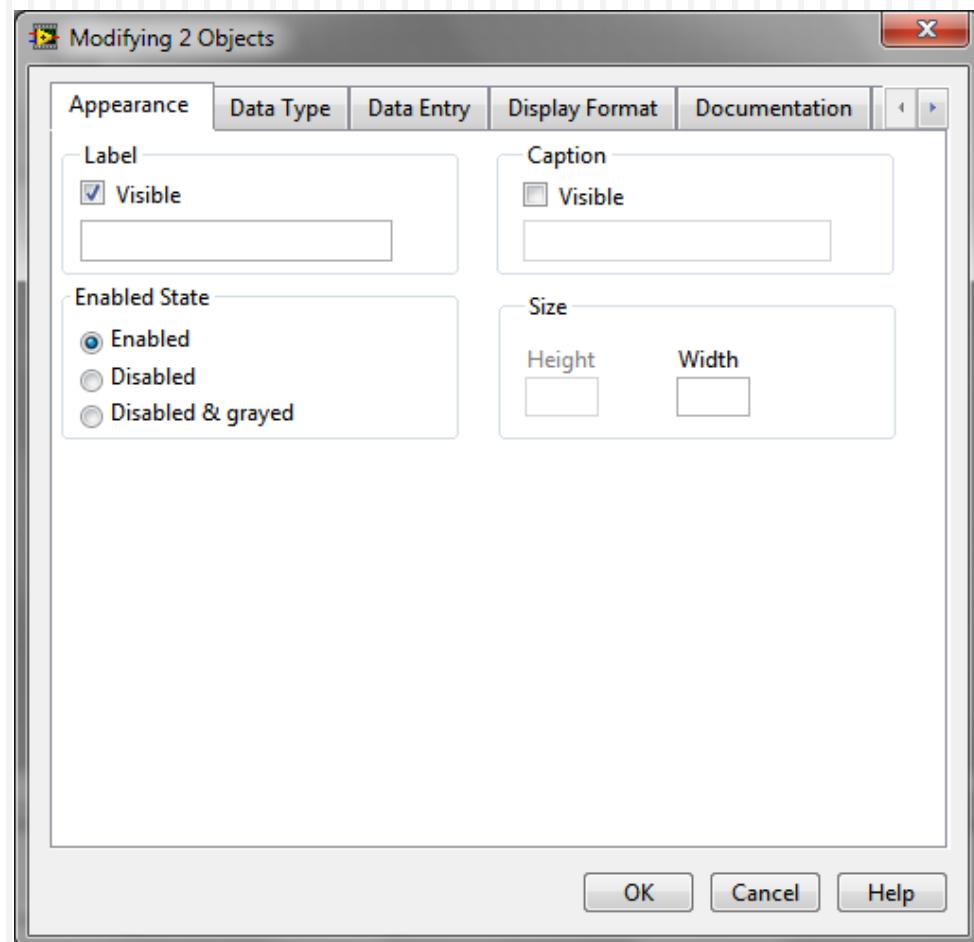
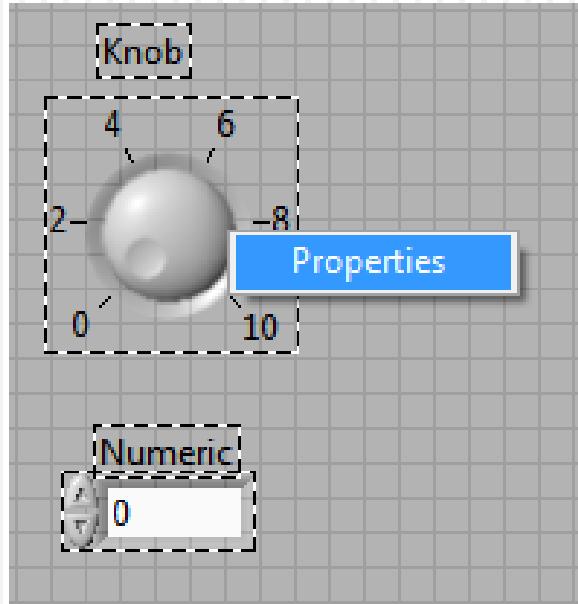
Right-click pe un control sau indicator din Panoul frontal si selectati **Properties** din menu-ul “shortcut” pentru a ajunge la panoul de dialog al proprietatilor acelui obiect.



Pagina de Proprietati

23

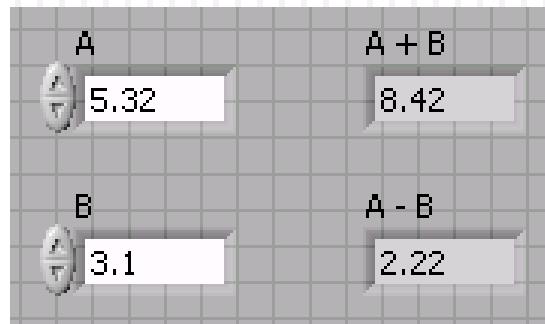
Selectie multipla pentru configurarea proprietatilor comune



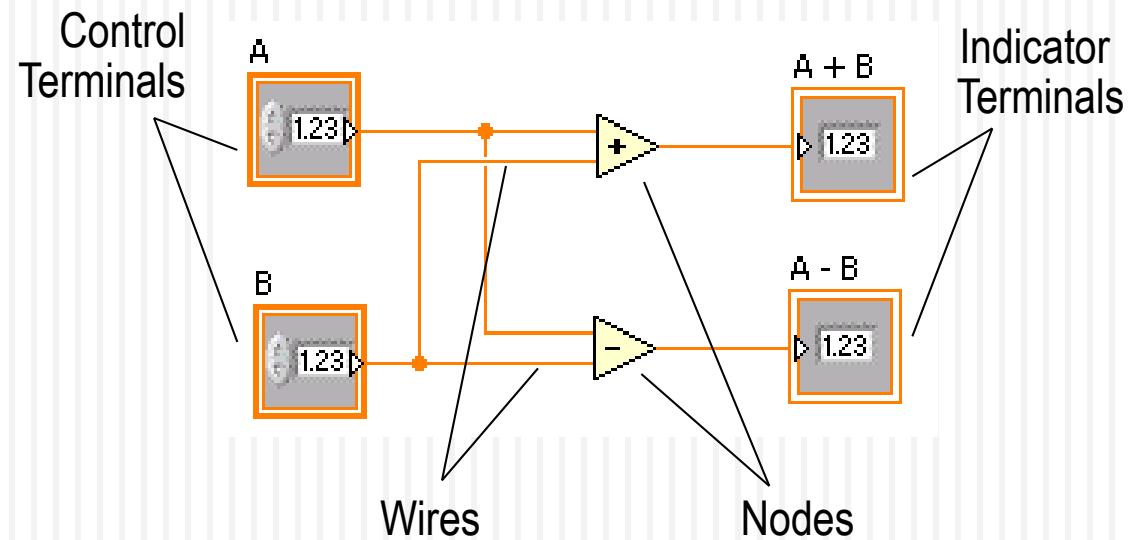
Crearea unei DIAGRAME (program)

24

Front Panel



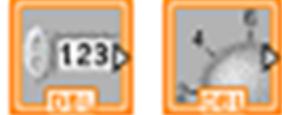
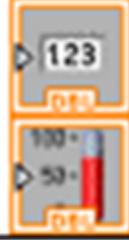
Block Diagram



Realizati diagrama cat mai ordonat posibil:

- controalele in dreapta indicatoarele in stanga,
- cat mai putine intersectii ale firelor,...

Noduri

Noduri		Descriere	
Controale	Indicatoare		
		Dupa tipul de terminal	Noduri asociate obiectelor din panou
		Dupa tipul de date	
		Noduri asociate functiilor	
		Noduri asociate subVI-urilor	
		Noduri asociate VI-urilor express	

Noduri

26

**Click dreapta
pe nod**

VI	VI-uri expres
Restrânsă Extinsă Redimensionată (Default)	Restrânsă Extinsă Redimensionată (Default)

The screenshot displays two LabVIEW VI windows. The left window shows a 'Sine Waveform.vi' icon with its palette open, listing parameters such as amplitude, frequency, offset, phase, reset signal, sampling info, error out, and signal out. The right window shows a 'Simulate Signal' icon with its palette open, listing error in (no error), error out, and signal. A context menu is open over the right VI, with the 'View As Icon' option highlighted in blue.

Visible Items

Help

Examples

Description and Tip...

Breakpoint

Waveform Generation Palette

Dialog & User Interface Palette

Cluster, Class, & Variant Palette

Create

Replace

Relink To SubVI

SubVI Node Setup...

Enable Database Access

Call Setup...

Find All Instances

Open Front Panel

Show VI Hierarchy

✓ View As Icon

Properties

Cablare in Diagrama (realizarea programului)

27

Tipul de fir	Scalar	Vector 1D	Vector 2D	Culoare
Numeric				Portocaliu (virgulă mobilă), Albastru (întreg)
Boolean				Verde
Alfanumeric				Roz
Dinamic				Albastru închis

Cablare nereusita –



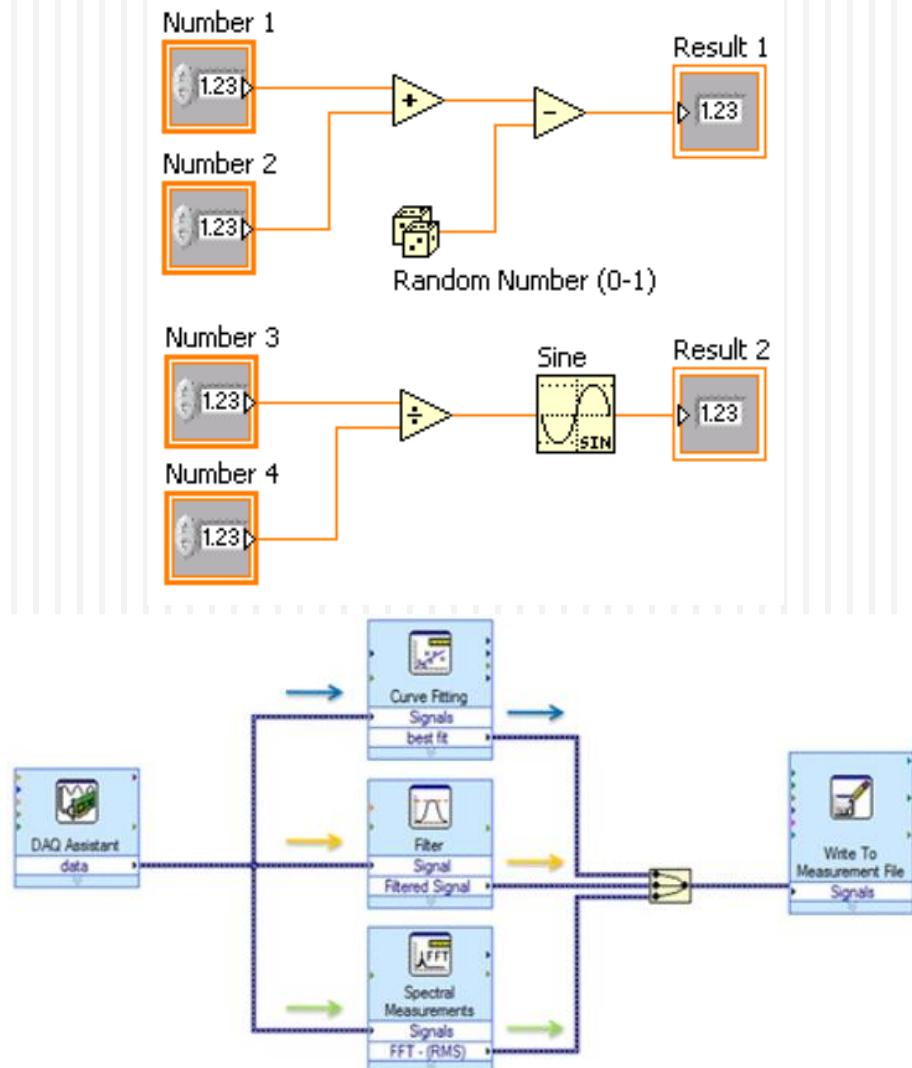
linie neagra punctata cu un x rosu

(sunt marcate prin sageti tipurile de date)

Programare cu flux de date

28

- Digramele se executa in functie de fluxul de date; schema bloc nu se executa de la stanga la dreapta
- Nodul se executa atunci cind datele sunt prezente la toate terminalele de intrare
- La terminare nodurile livreaza date la toate terminalele de iesire

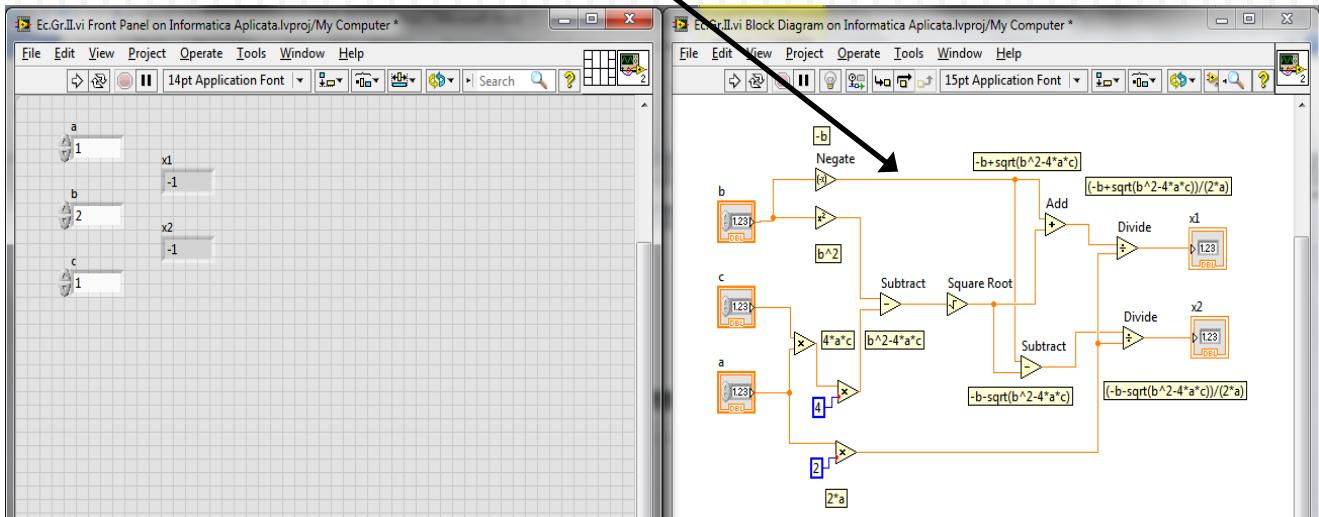


Ex. Primele aplicatii

29

□ Rezolvarea ecuatiei de gradul II

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



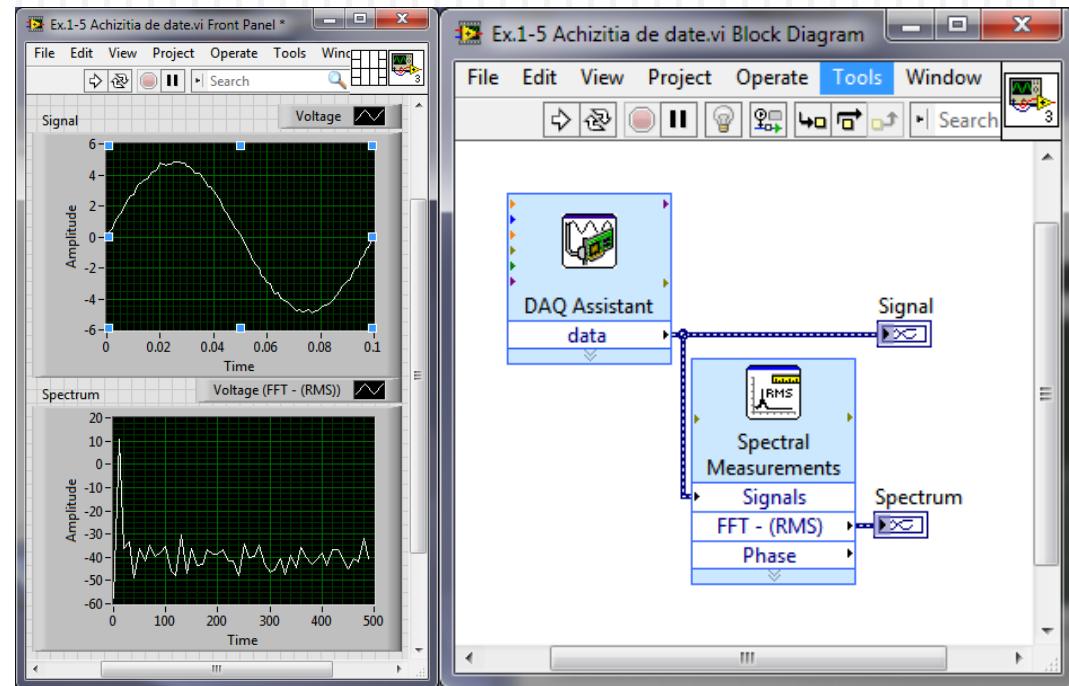
Ex. Masurarea semnalelor

30



□ Exercitiu

- Realizarea unei aplicatii care permite achizitia si prelucrarea datelor in LabVIEW





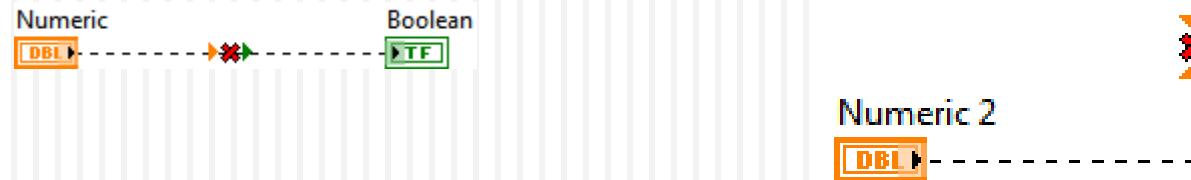
Depanarea aplicatiilor (debugging) si elemente de programare.

Tehnologii de depanare “Debugging”

32

□ Erori de sintaxă

- Conectari intre tipuri de date diferite
- Conectarea a doua intrari
- Nedefinirea conditie de oprire a buclelor
- Neconectarea intrarilor obligatorii ale nodurilor
- ...

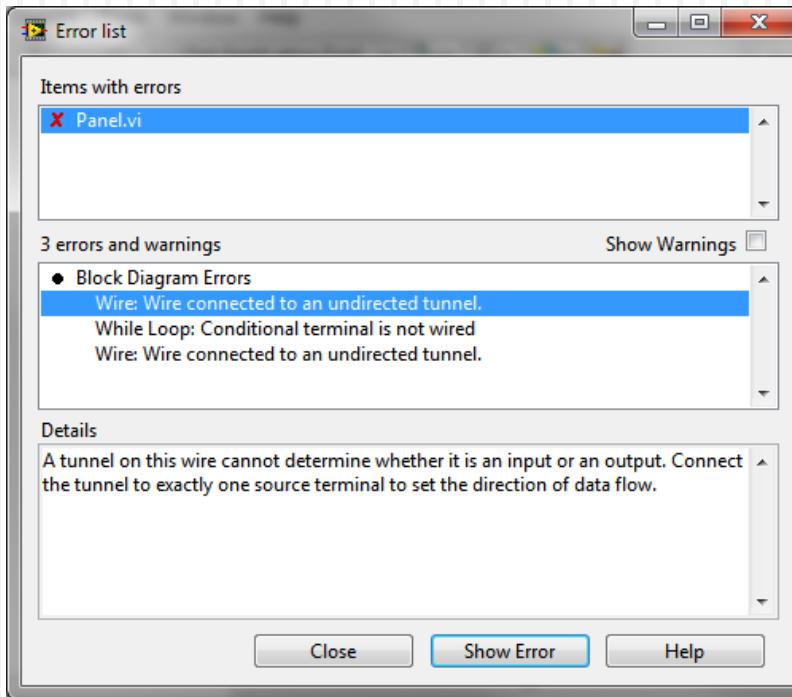


Tehnologii de depanare “Debugging”

33

□ Erori de sintaxă

- Dati click pe sageata “intreruptă” de rulare simplă.
- Apare o fereastra care va prezenta erorile de programare



Tehnologii de depanare “Debugging”

34

□ Erori de programare

- Aplicatia este functionala - , dar se obtin rezultate neasteptate
 - Date de intrare incorecte introduse
 - Conectarea incorecta a nodurilor
 - Reprezentarea numerica a variabilelor
 - Ordinea de executie a nodurilor

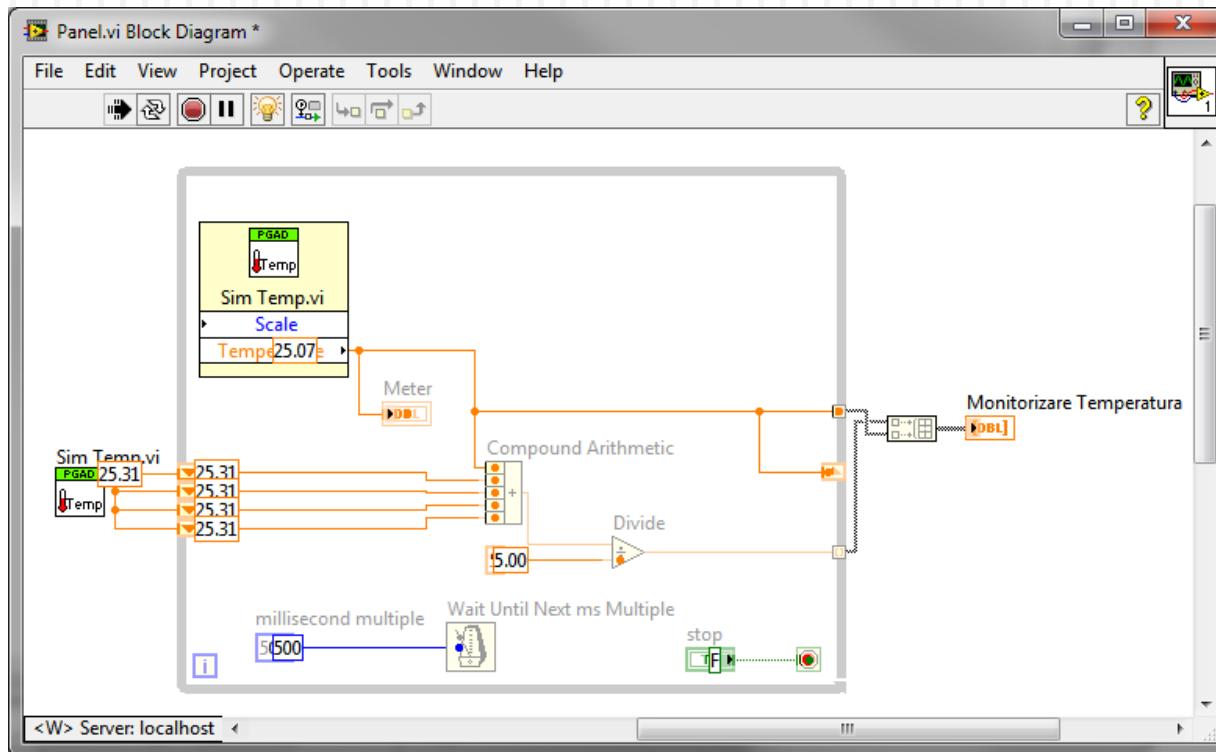
Tehnologii de depanare “Debugging”

35

Highlight Execution



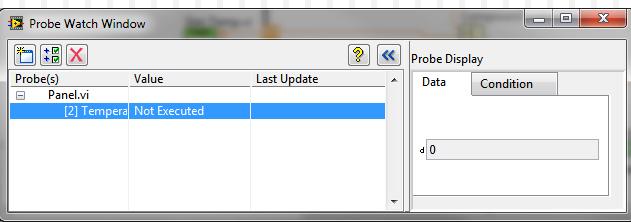
Dati Click pe butonul de Executie animata; se vizualizeaza animat fluxul de date. Se vizualizeaza valorile care trec prin fire



Tehnologii de depanare “Debugging”

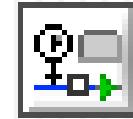
36

Proba



Right-click pe un fir si selectionati “PROBE” si se vor afisa datele care ajung in acel punct

Memorarea valorilor pe fire



prin apasarea butonului se memoreaza valorile pe fire a.i. vor fi disponibile si dupa executia aplicatiei

Probe conditionale

Custom Probe

Breakpoint

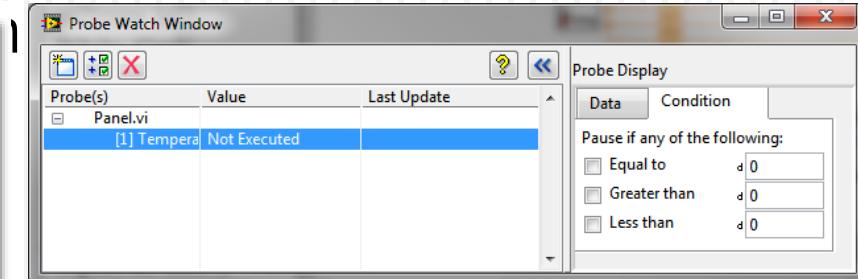
Description and Tip...

Conditional Double Probe

Generic Probe

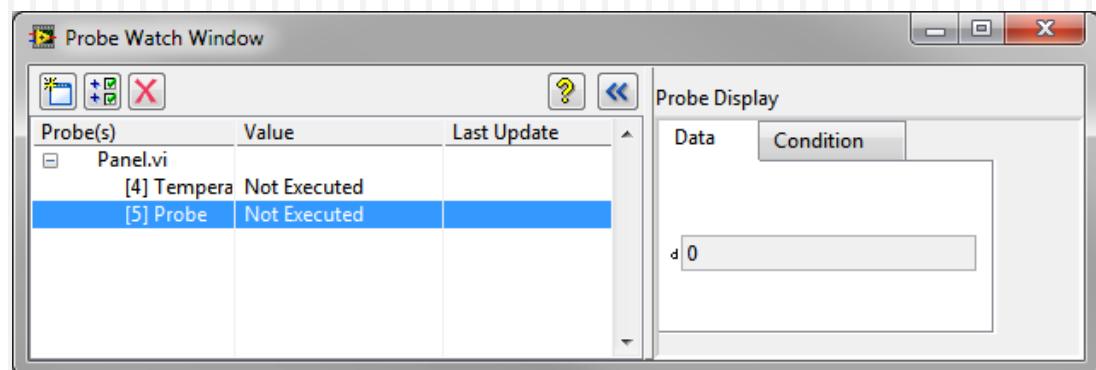
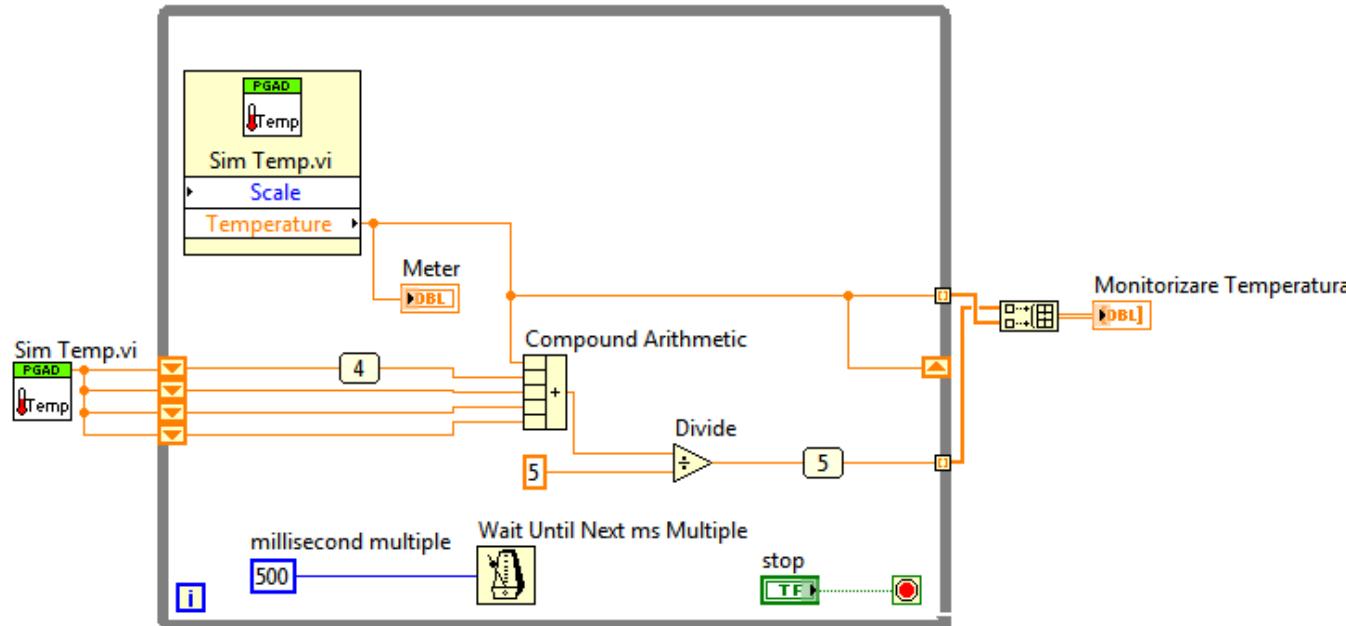
Controls

New...



Tehnologii de depanare “Debugging”

37

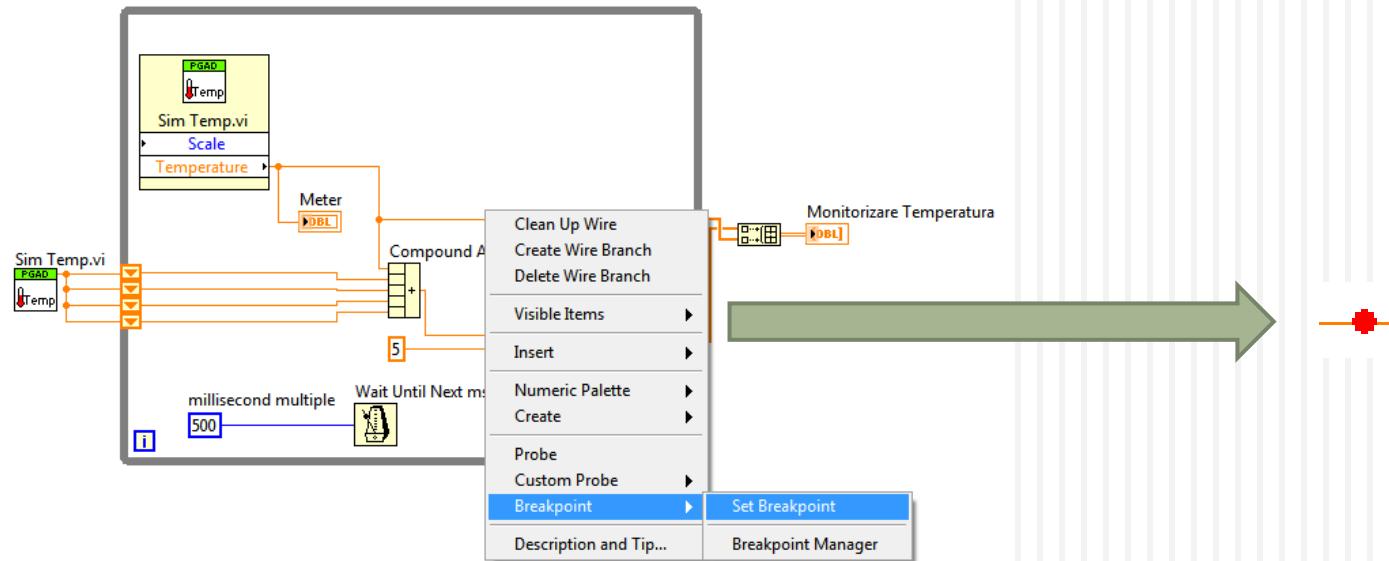


Tehnologii de depanare “Debugging”

38

Breakpoints

Right-click pe un fir si selectionati “Set Breakpoint”; se face o pauza de executie la acest punct de oprire



Tehnologii de depanare “Debugging”

39

Butoanele Step Into, Over, si Out pentru “Single Stepping”



Click pe butonul **Step Into** pentru a enable “single stepping”
Pornit procesul “Single Stepping”, butonul ruleaza nodurile



Click pe butonul **Step Over** pentru a enable “single stepping”
sau pentru a trece peste noduri



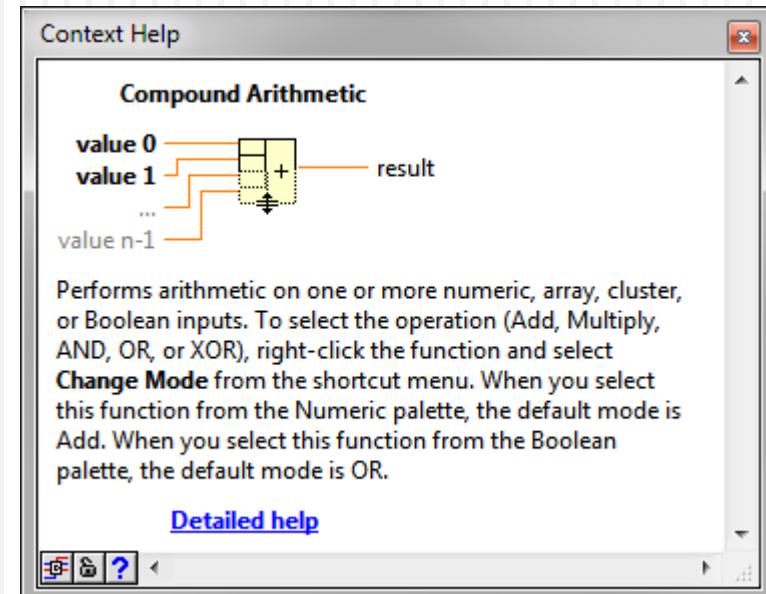
Click pe butonul **Step Out** pentru a iesi din noduri

Help in LabVIEW

- Orice limbaj de programare este insotit cu o documentatie – Help
- In LabVIEW exista
 - Help-ul interactiv – Context Help
 - Help-ul general – LabVIEW Help
 - Biblioteca de exemple functionale – NI Example Finder
 - Comunitatea ni.com

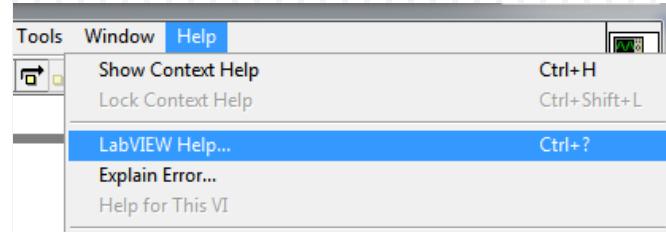
Context Help

- Prezinta informatii de baza pentru nodul peste care se trece cu mouse-ul
- Activare/dezactivare:
 - **Help»Show Context Help sau**
 - Apasarea tastelor **Ctrl-H** sau
 - Apasarea butonului **Show Context Help Window** din bara de unelte



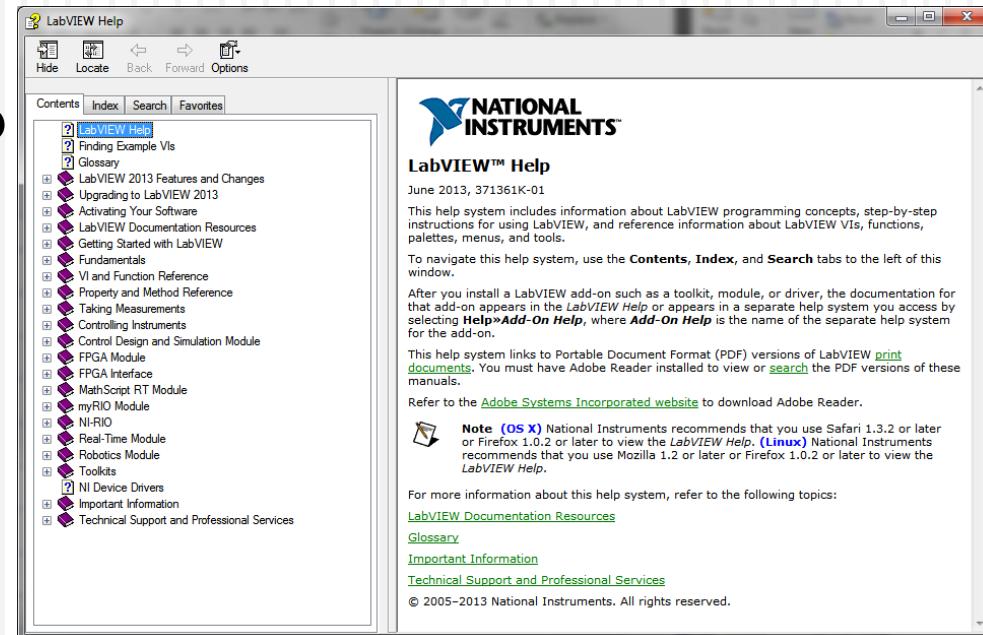
LabVIEW Help

- Întreaga documentație ce insoteste LabVIEW
- Deschidere prin opțiunile:
 - ▣ Help»LabVIEW Help
 - ▣ Detailed help din fereastra de Context Help
 - ▣ Right-click pe nod și alegerea opțiunii Help din meniul deschis
 - ▣ Tastele Ctrl+?

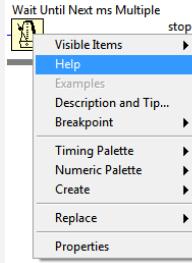
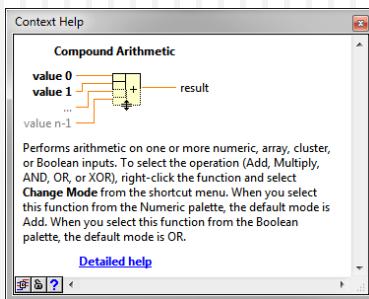


Tools Window Help

- Show Context Help Ctrl+H
- Lock Context Help Ctrl+Shift+L
- LabVIEW Help... Ctrl+?
- Explain Error...
- Help for This VI



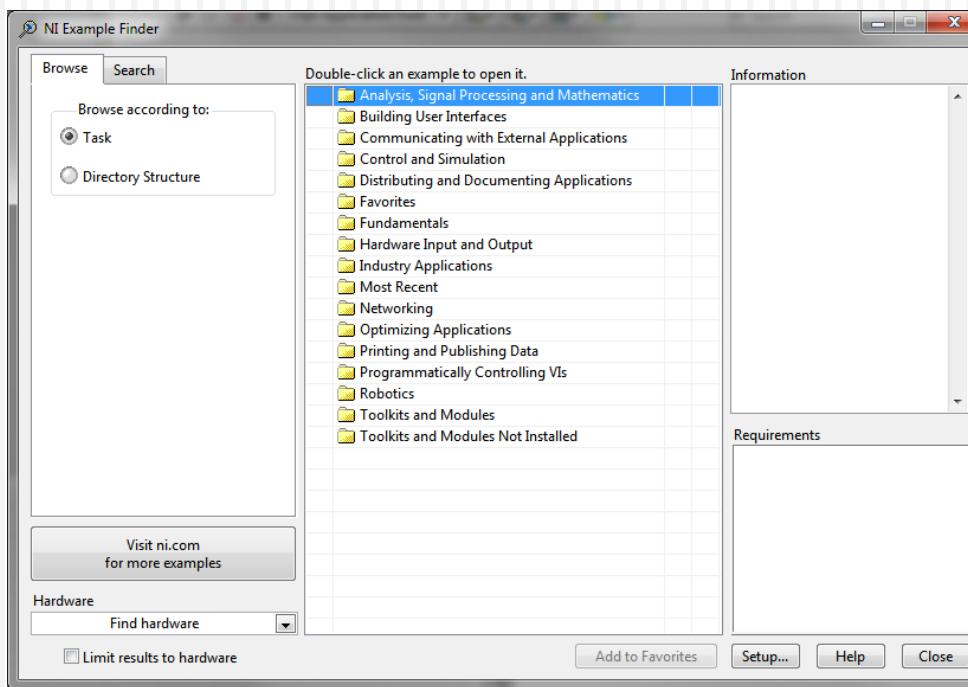
The screenshot shows the LabVIEW Help window. At the top, there's a menu bar with Tools, Window, and Help selected. Below the menu is a toolbar with icons for Hide, Locate, Back, Forward, and Options. The main area has tabs for Contents, Index, Search, and Favorites. The Contents tab is active, displaying a tree view of help topics. Topics include LabVIEW Help, Finding Example VIs, Glossary, LabVIEW 2013 Features and Changes, Upgrading to LabVIEW 2013, Activating Your Software, LabVIEW Documentation Resources, Getting Started with LabVIEW, Fundamentals, VI and Function Reference, Property and Method Reference, Taking Measurements, Controlling Instruments, Control Design and Simulation Module, FPGA Module, FPGA Interface, Math Script RT Module, myRIO Module, NI-RIO, Real-Time Module, Robotics Module, Toolkits, NI Device Drivers, Important Information, and Technical Support and Professional Services. To the right of the tree view is a large text area with the National Instruments logo and the title "LabVIEW™ Help". It includes a note about the help system, instructions for navigating it, and information about PDF versions of the documentation. It also mentions the Adobe Systems Incorporated website for downloading Adobe Reader.



NI Example Finder

43

- Permite gasirea exemplelor functionale instalate pe PC structurare pe categorii sau prin cautare – Search
- Activare
 - ▣ Help»Find Examples...



Curs 3 – Partea 1

Realizarea aplicatiilor

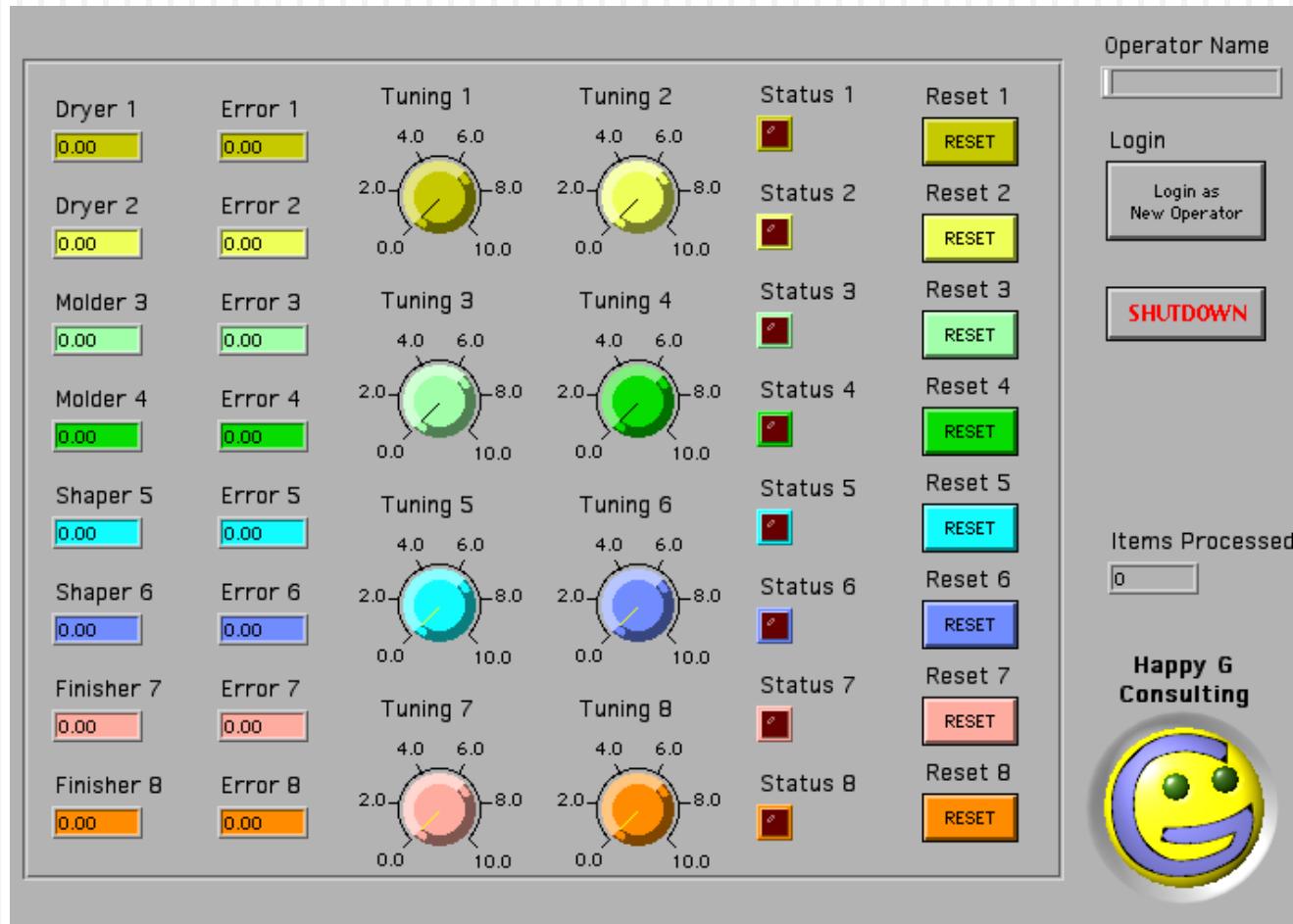
Proiectarea Aplicatiilor

45

- Interfata Utilizator trebuie sa fie:
 - ❑ Prietenoasa
 - ❑ Usor de utilizat
 - ❑ ...
 - ❑ => Front Panel Design
- Diagrama
 - ❑ Bine structurata
 - ❑ Documentat codul
 - ❑ => usor de depanat, modificat sau actualizat
 - ❑ Reutilizarea codului

Front Panel Design

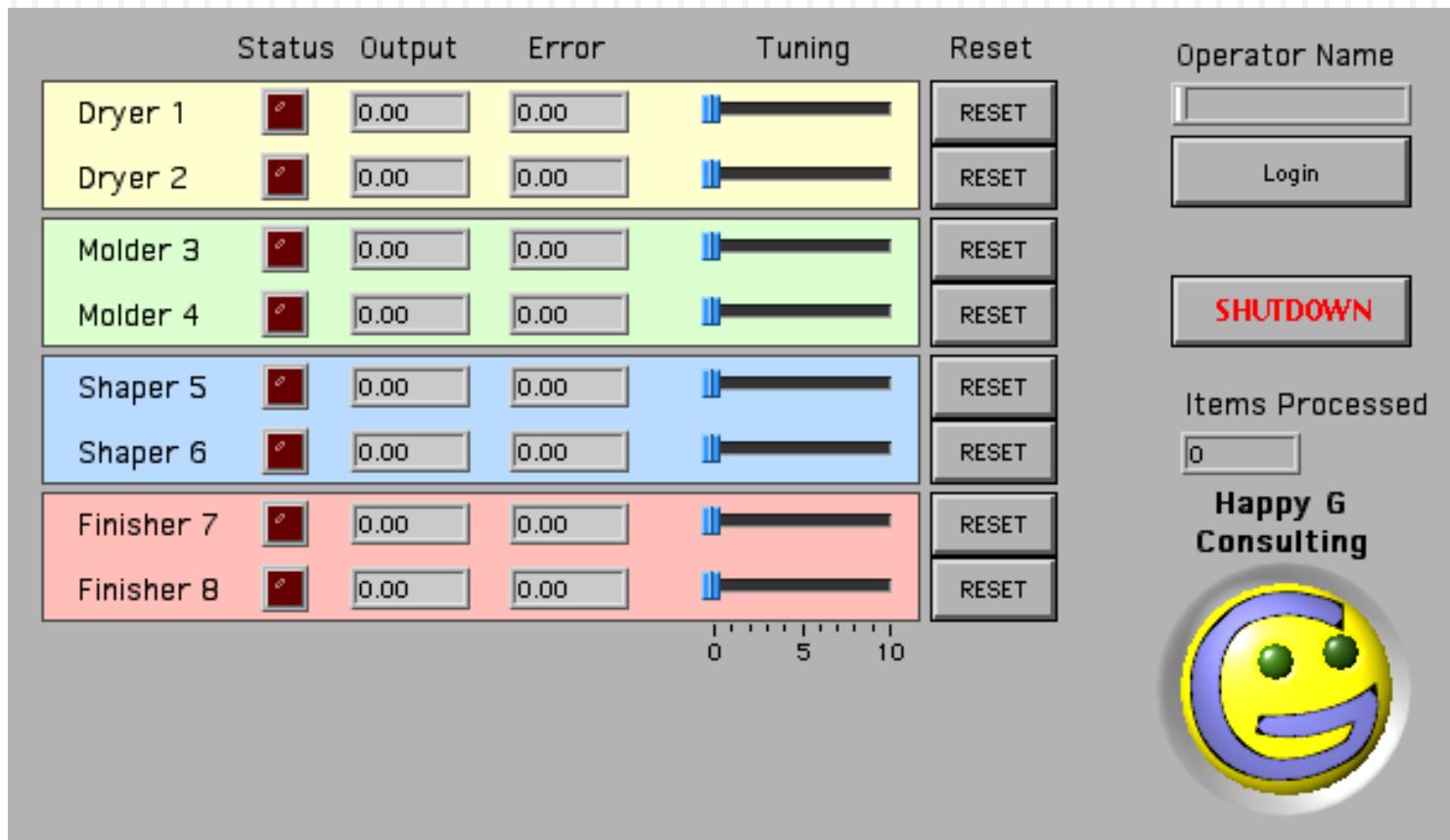
- Ce este gresit?



- Cam multe culori...

Redesign

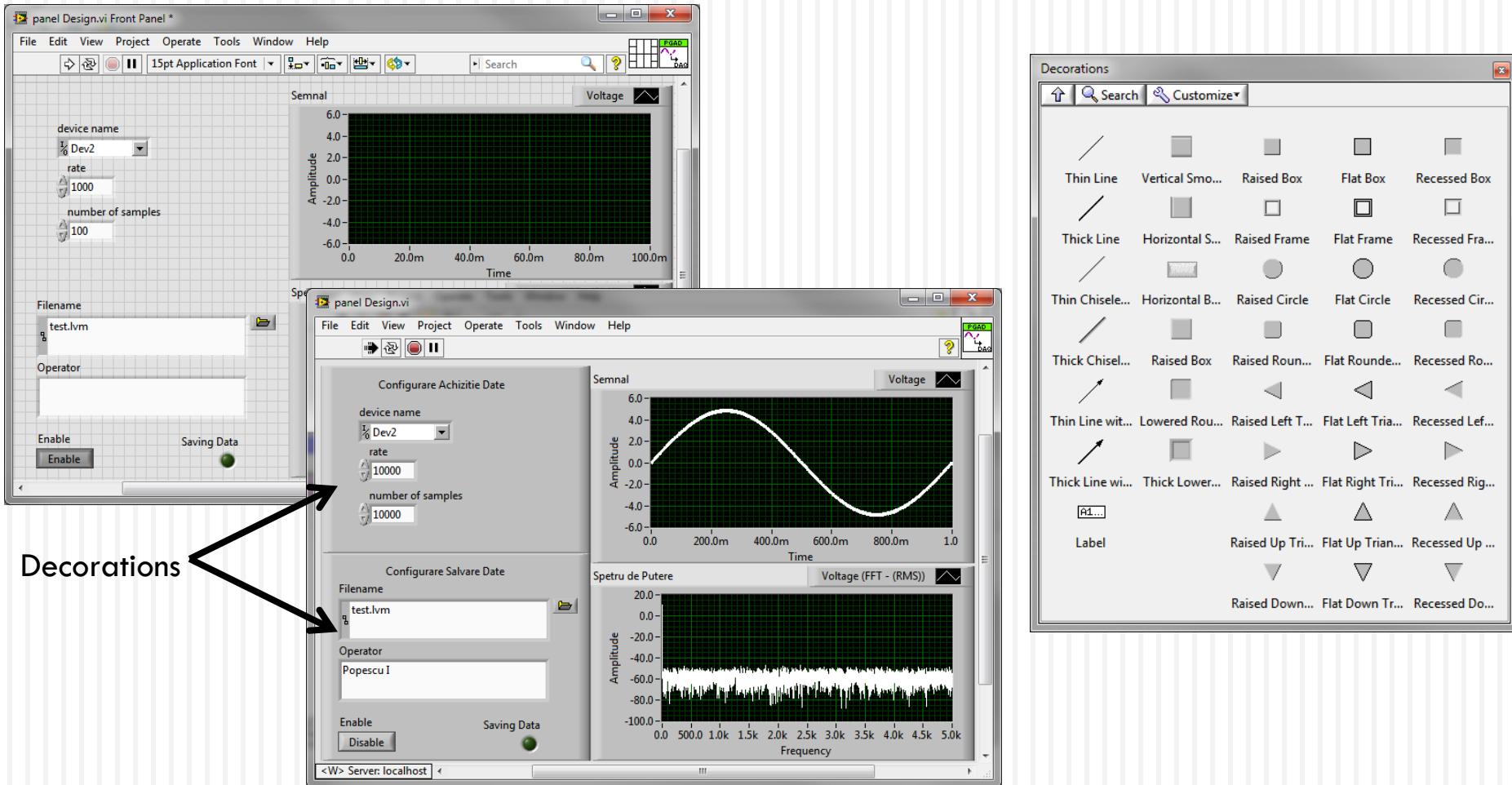
- Putina culoare (client-utilizator)
- Utilizare decoratii



Front Panel Design

48

□ Grupare obiecte pe domenii – utilizare paleta

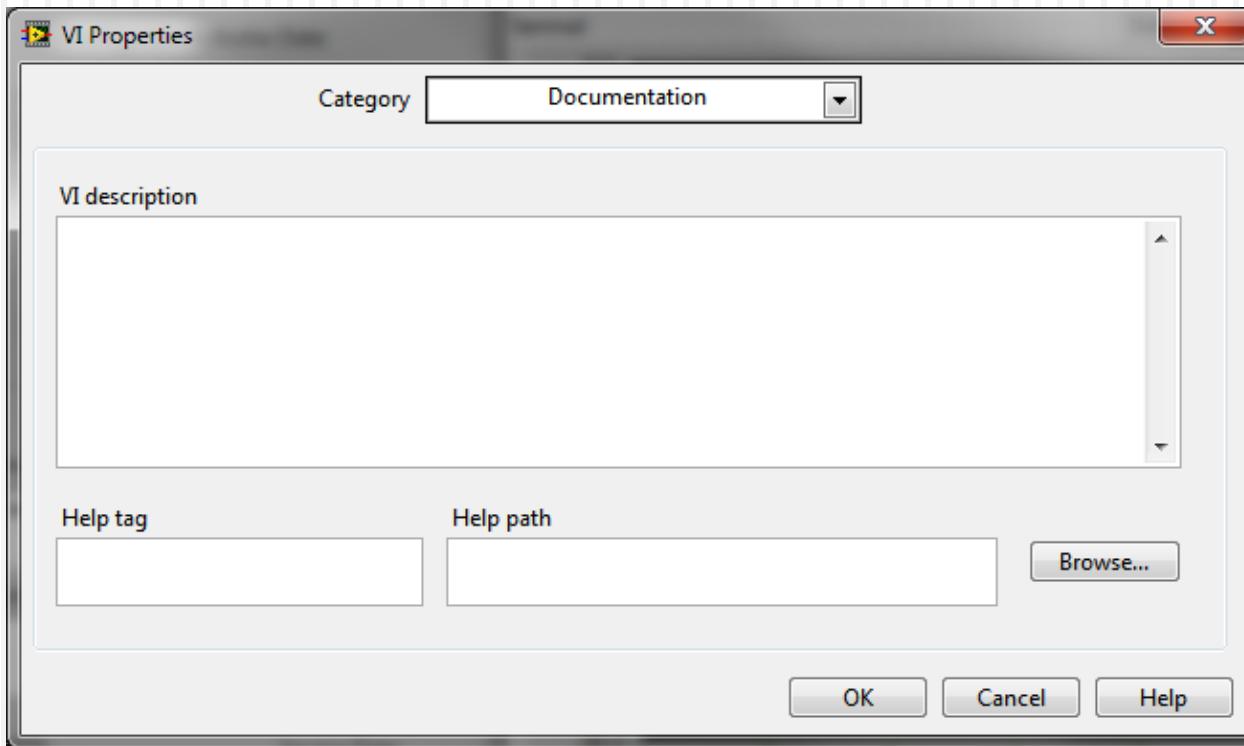


Documentarea aplicatiei

49

□ Documentarea panoului

- Descriere aplicatie VI Properties
(File>>VI Prop.)

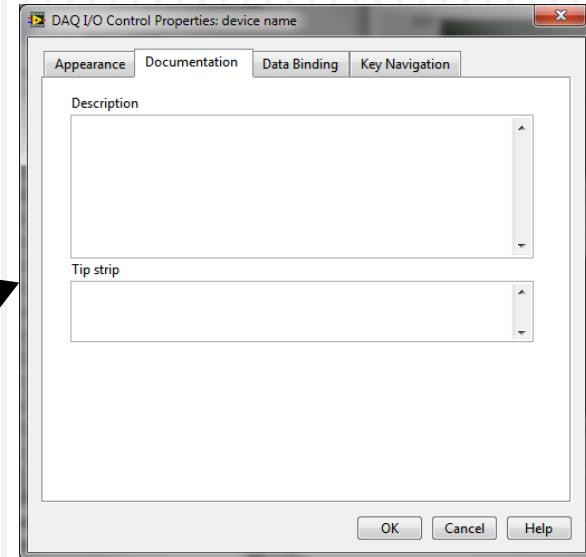
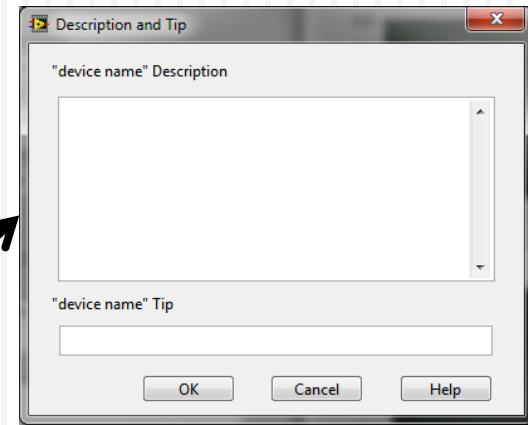
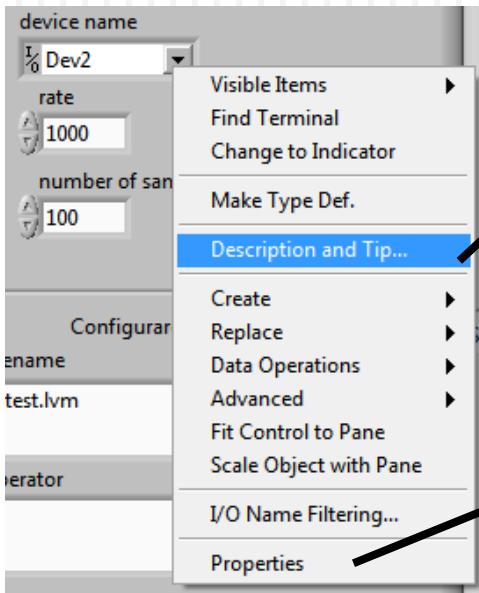


Documentarea aplicatiei

50

□ Documentarea panoului

- Descrierea obiectelor din Panou
(right-click)
 - Description
 - Tip Strip



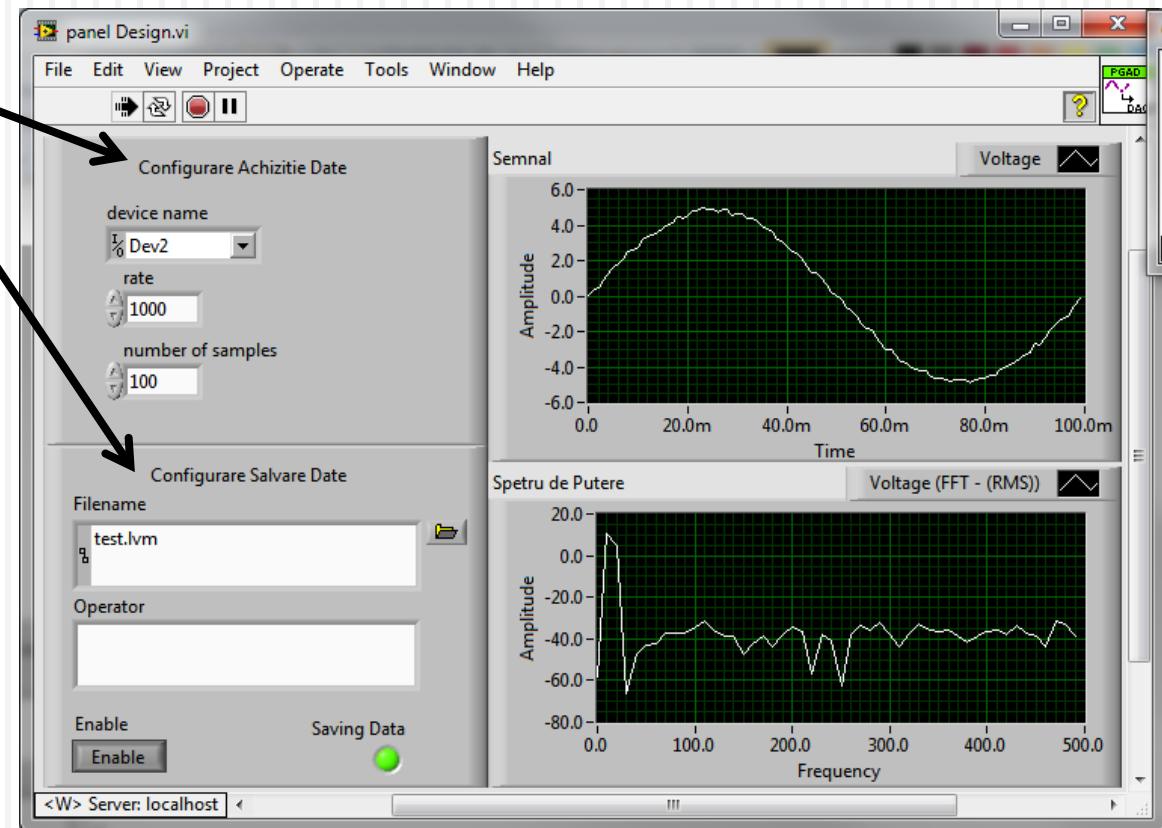
Documentarea aplicatiei

51

□ Documentarea panoului

■ Etichete obiecte (**sugestive**)

■ Etichete libere

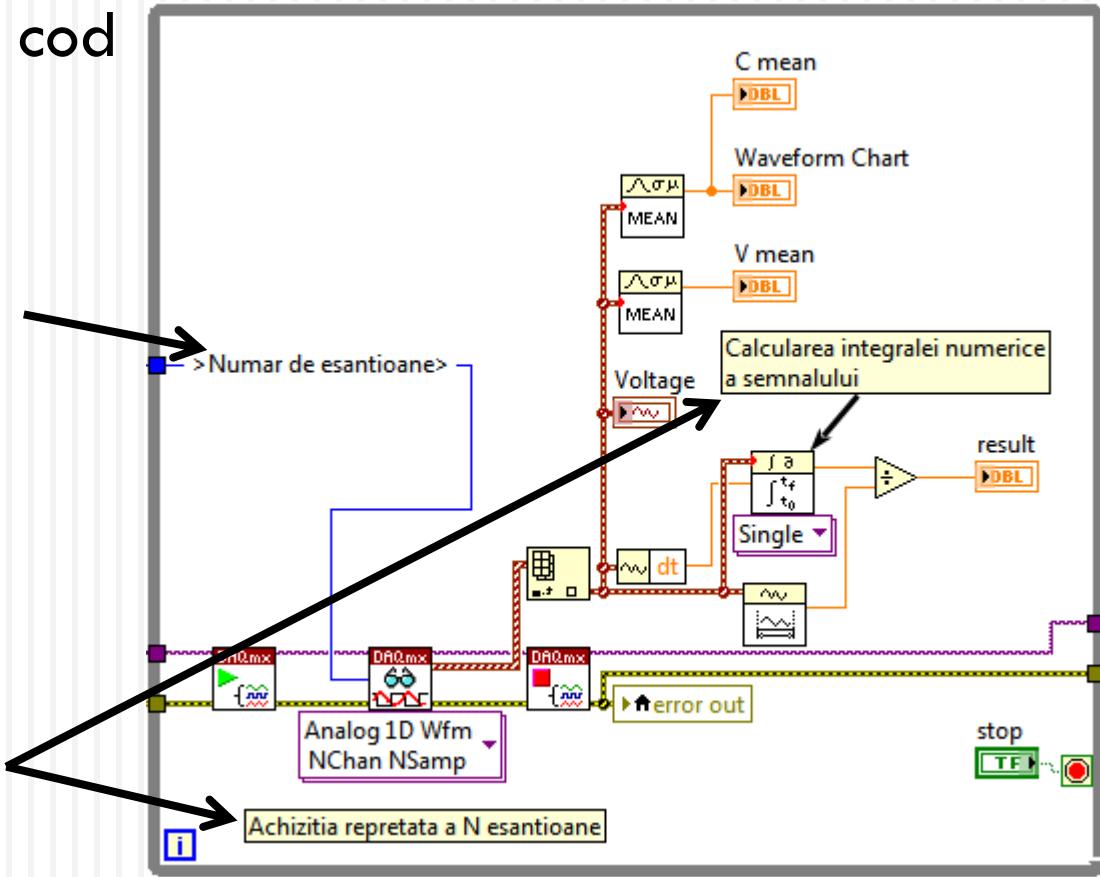
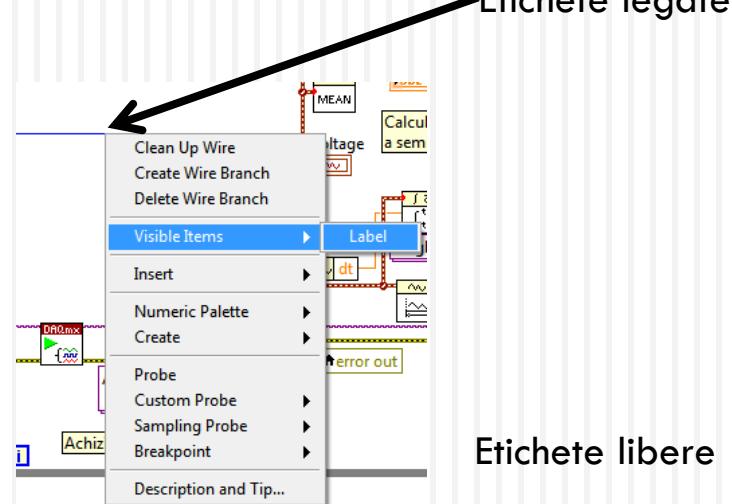


Documentarea aplicatiei

52

□ Documentarea diagramei

- Comentarii – etichete libere – descriere algoritmi, explicare zone de cod
- Descriere datelor asociate firelor





Programarea modulară

Modularizare si incapsulare

54

- diagrame mari, complexe trebuie modularizate
 - Portiuni de cod dedicate
 - Codurii apelate de mai multe
 - =>
 - se realiza module incapsulate care sa poata fi apelate de cate ori este nevoie si unde este nevoie (asemanator cu programarea clasica bazata pe proceduri).

Modularizare si incapsulare

55

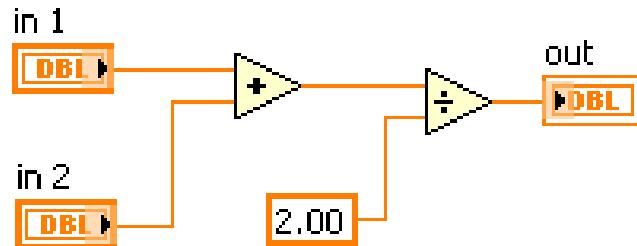
Function Pseudo Code

```
function average (in1,  
    in2, out)  
{  
out = (in1 + in2)/2.0;  
}
```

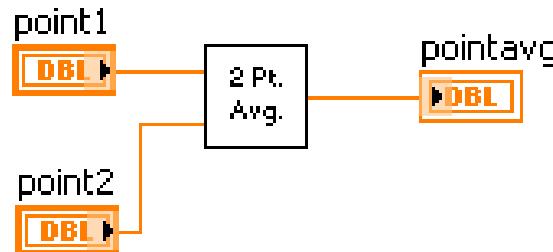
Calling Program Pseudo Code

```
main  
{  
average (point1, point2,  
    pointavg)  
}
```

SubVI Block Diagram



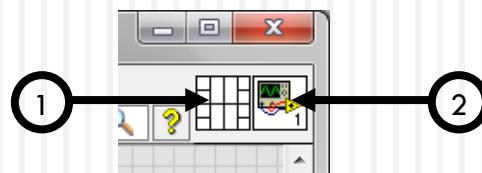
Calling VI Block Diagram



Modularizare si incapsulare

56

- Fiecare VI realizat sub LabVIEW poate fi utilizat ca un subVI intr-o alta aplicatie.
- Pentru a utiliza un VI ca subVI trebuie incapsulat intr-un icon si realizat conectorul sau.
- Conectorul presupune definirea intrarilor si iesirilor din subVI.
- La deschiderea unui VI, in partea dreapta sus exista iconul predefinit si conectorul langa el.

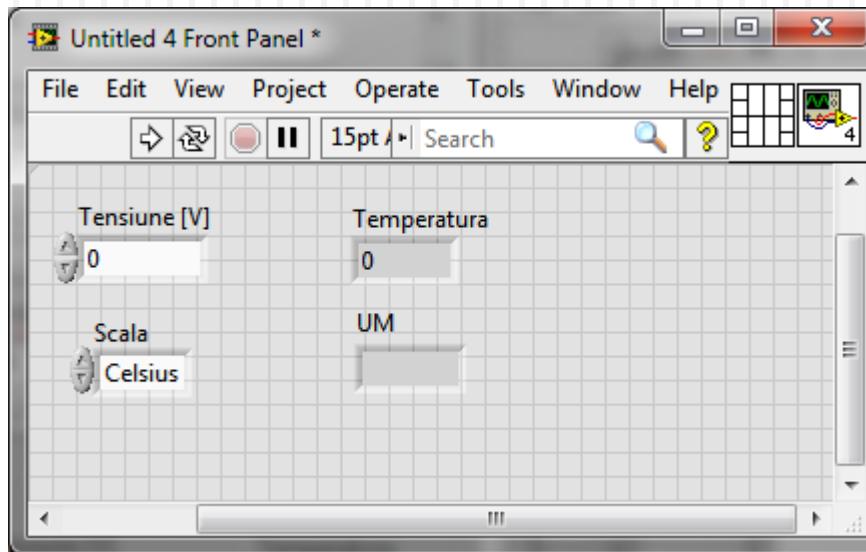


1. Conector; 2. Icon

Exemplu de SubVI

57

- Un VI în interiorul unui alt VI se numește subVI
- Dupa ce am facut Panoul si respectiv Diagrama unei aplicatii VI, pentru a utiliza acest VI ca un subVI, trebuie sa realizam Iconul lui si un Conector (connector pane),

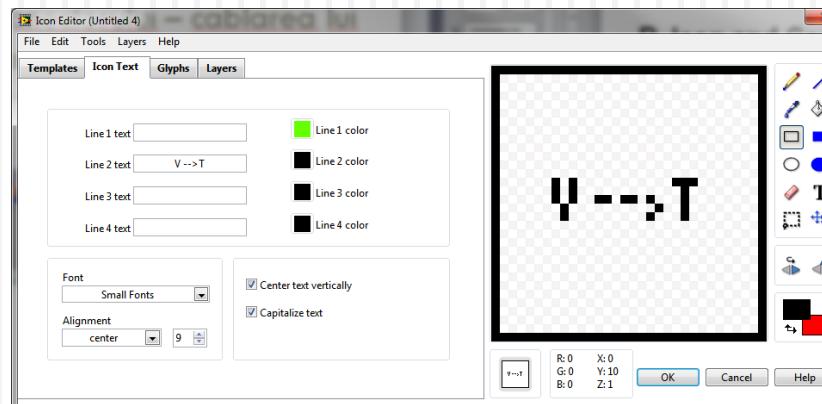
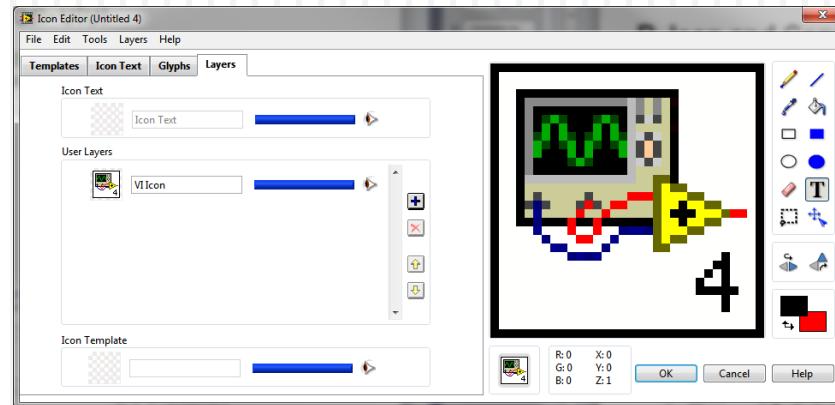
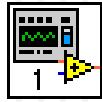


Realizarea Icon-ului

- Icon: este reprezentarea grafica a unui VI
- Prin Right-click pe icon-ul generic (default) din Panou sau Diagrama

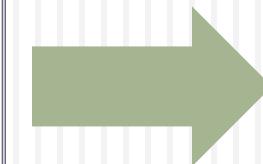
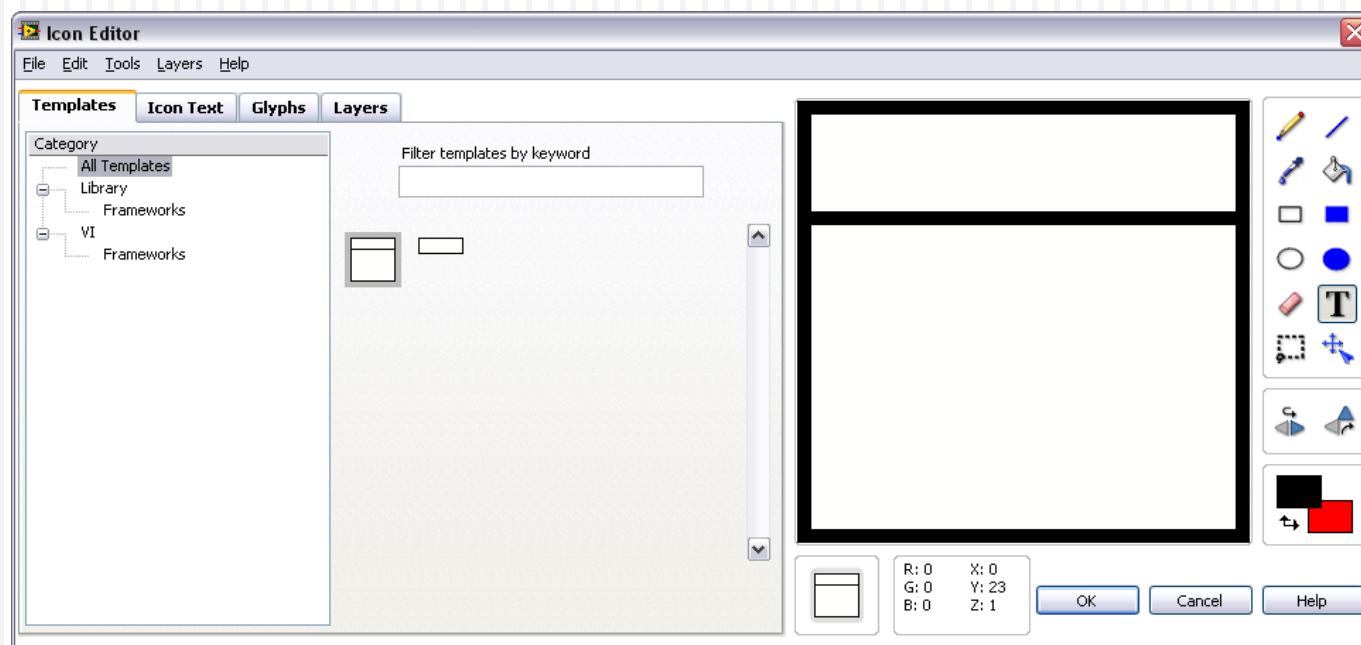
Un editor de Icon-uri

Default Icon



Realizarea Icon-ului

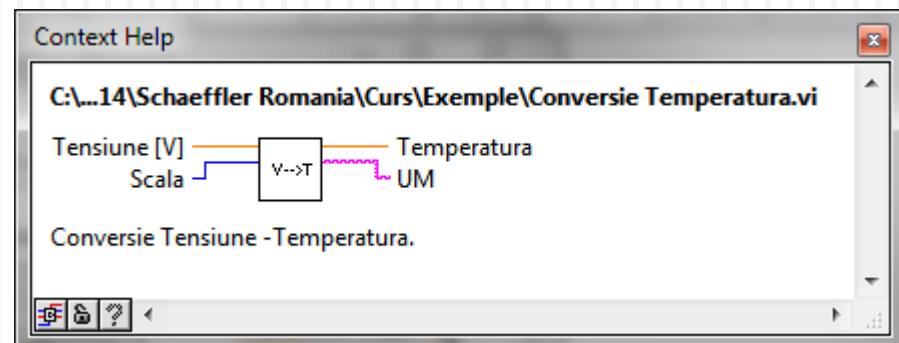
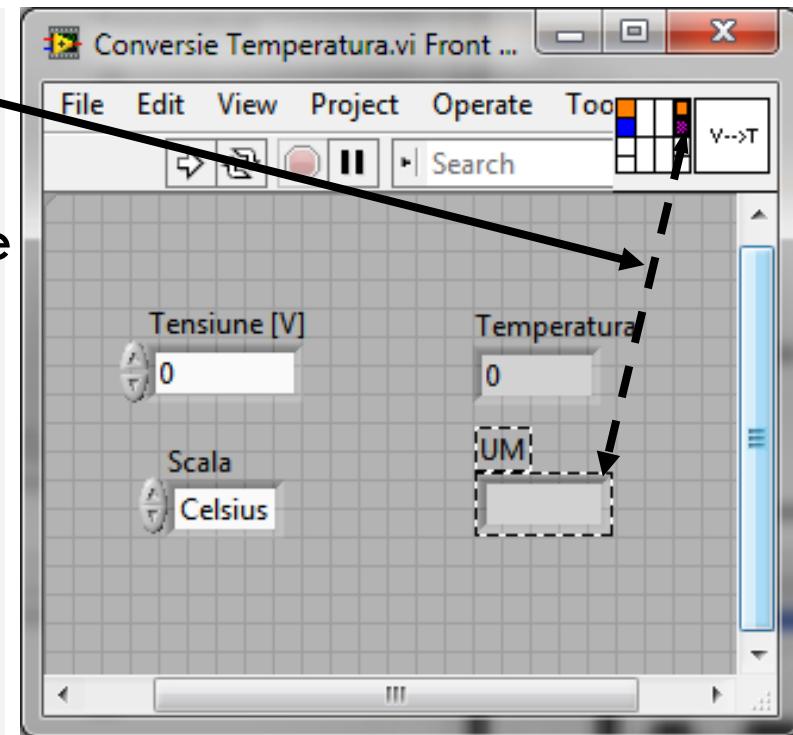
- Utilizarea sabloanelor - Templates tab
- Identificarea subVI-urilor pe proiect (grup de interes)



Realizarea Conectorului – cablarea lui

60

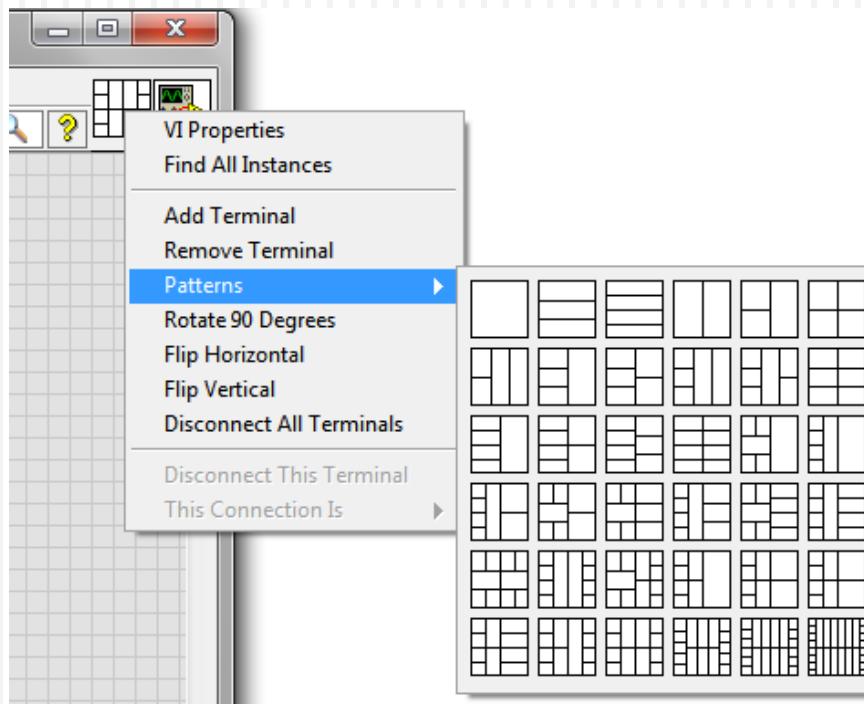
- Utilizand unealta de conectare
- Colorile terminalelor din conector, sunt alese automat functie de tipul de date la care terminalul este conectat
- Prin Left-Click pe un terminal va arata automat obiectul asociat din PANOU



Realizarea Conectorului – Alegerea conectorului

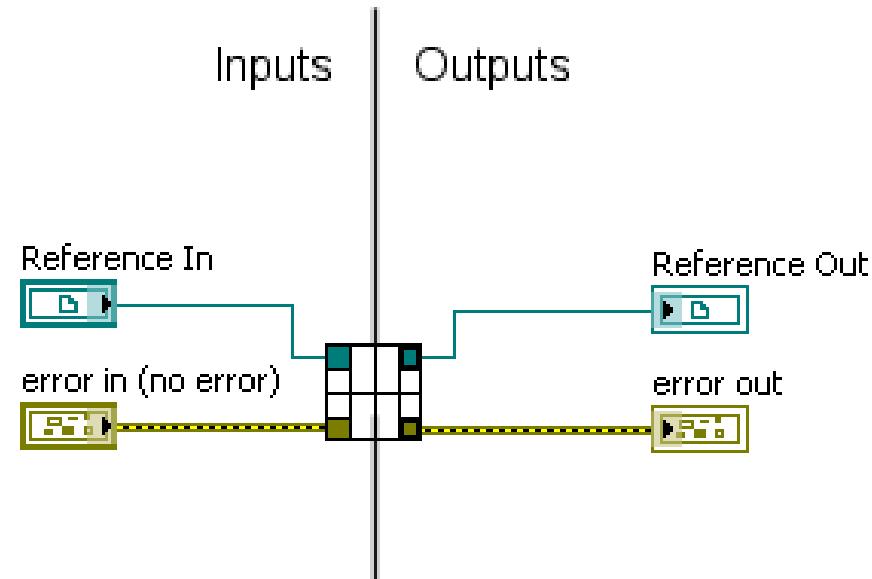
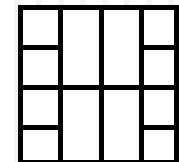
61

- Daca tipul conectorului predefinit nu este cel dorit acesta se poate schimba prin Right-Click pe conector urmat de alegerea unui tip de conector convenabil din fereastra corespunzatoare optiunii Patterns



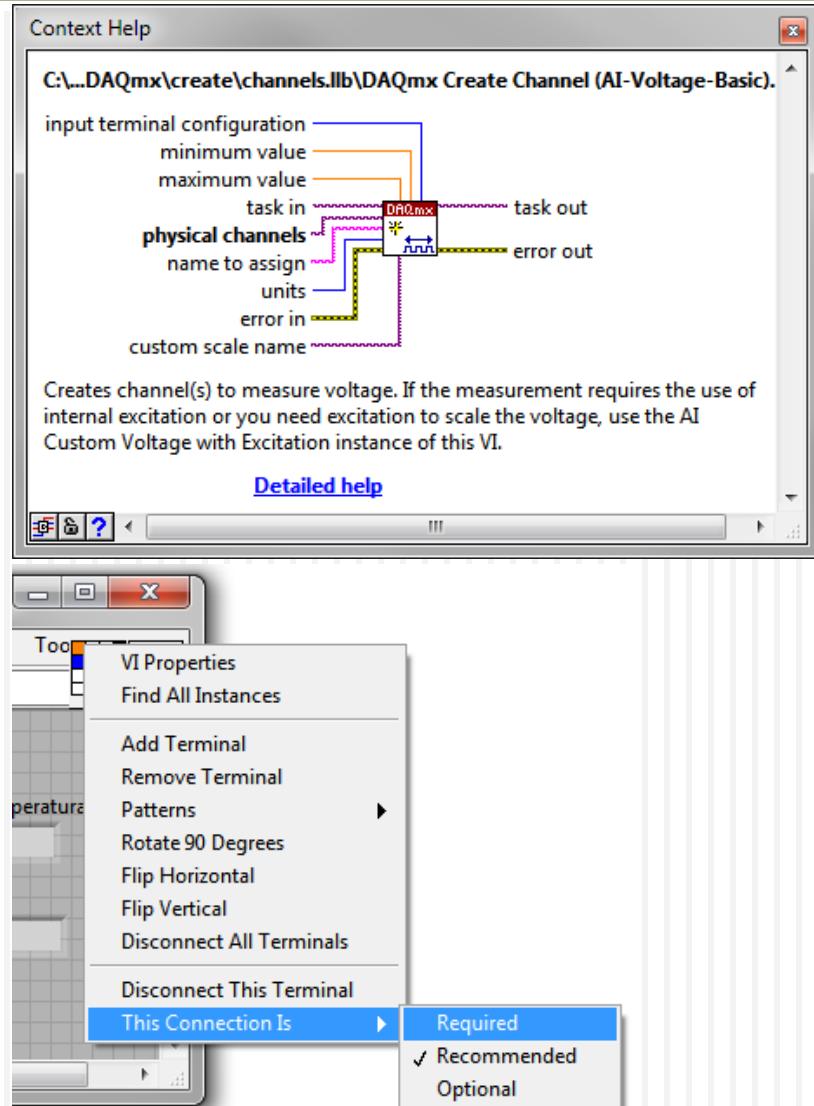
Conector – Standard

- Default se utilizeaza conectorul cu 12 terminale
- Recomanda pentru a fi folosit
 - Structura standard
 - Terminalele de sus (stanga si dreapta) sunt utilizate pentru conectarea referintelor (file reference, DAQmx task)
- Terminalele de jos (stanga si dreapta) sunt utilizate pentru conectarea cluster-ilor de eroare



Configurare terminale

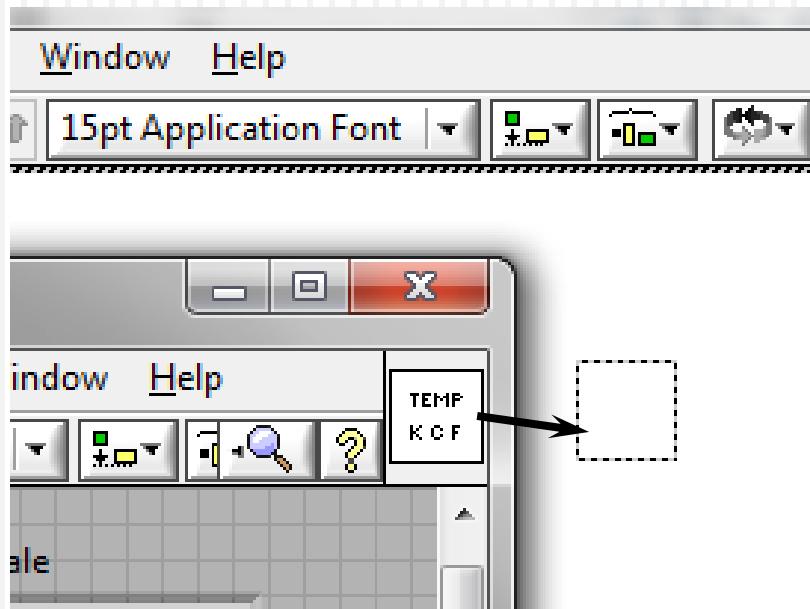
- **Bold** – obligatoriu de conectat
 - Plain – recomandat pentru a fi conectat
 - Dimmed – optional
-
- Alegerea opțiunii pentru terminal:
 - ▣ Right-Click pe terminal și alegeră opțiunii dorite



Utilizarea unui VI ca un SubVI

64

- All Functions»Select a VI... >> cautare VI pe HDD >> selectare – Open sau Double Click
- sau
- Daca este deschis Panoul prin “Drag icon” in Diagrama dorita



subVI in VI

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