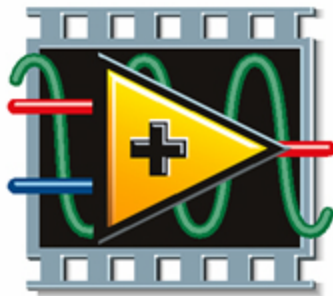




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FIRST Robotics LabVIEW Training



NATIONAL INSTRUMENTS

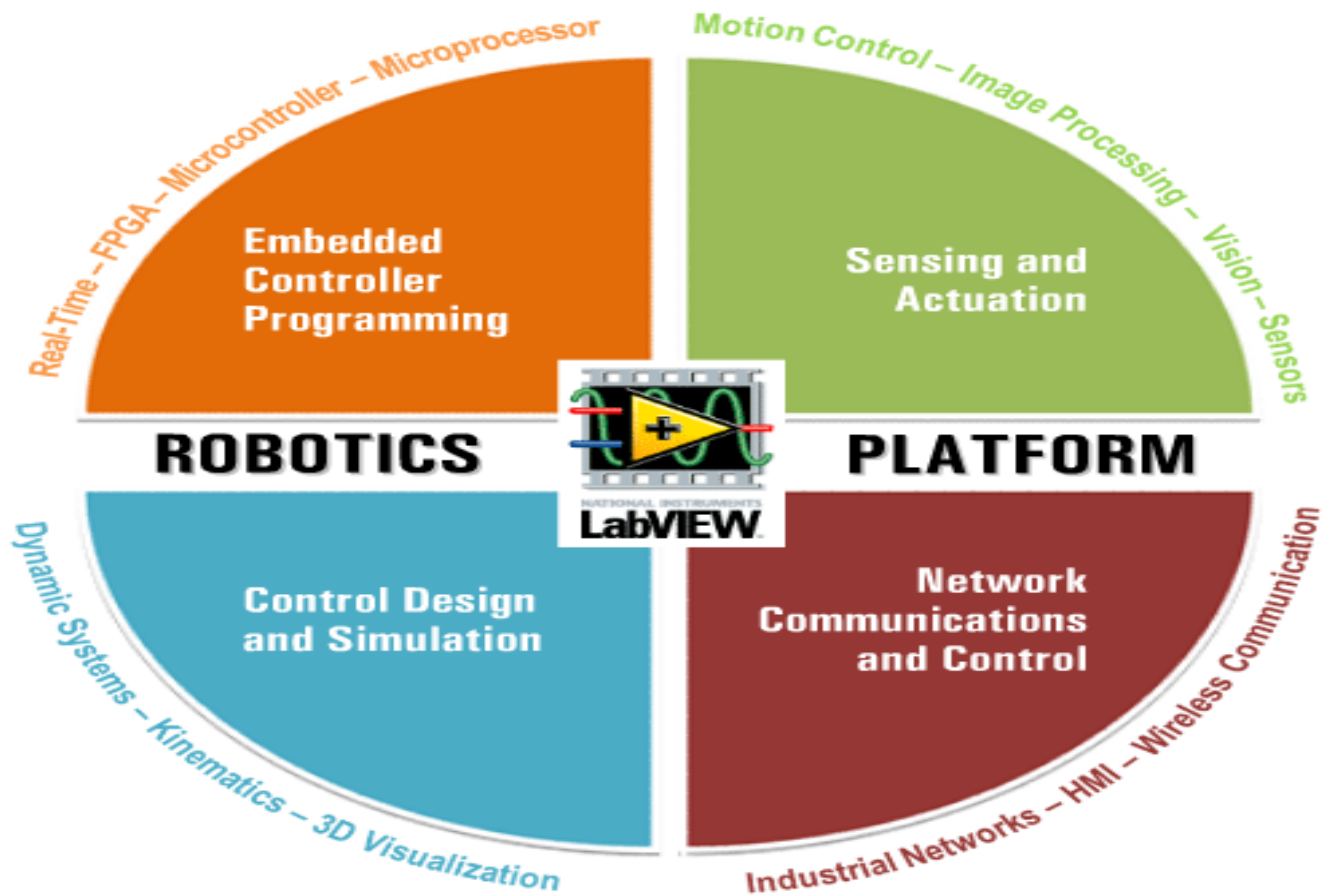
LabVIEW™





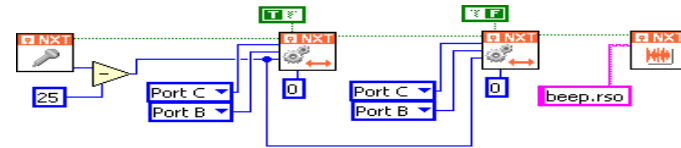
SECTION 1: LABVIEW OVERVIEW





What is LabVIEW?

- It is a tool used by scientists and engineers to measure and automate the universe around us
- It is a graphical programming environment
 - **programming** – it is a programming language and you won't be an expert in a day or two
 - **graphical** – you draw your code
 - **environment** – it is more than measurement and automation, it has analysis and user interface capabilities created for scientists and engineers
- There is a learning curve, so plan to study it



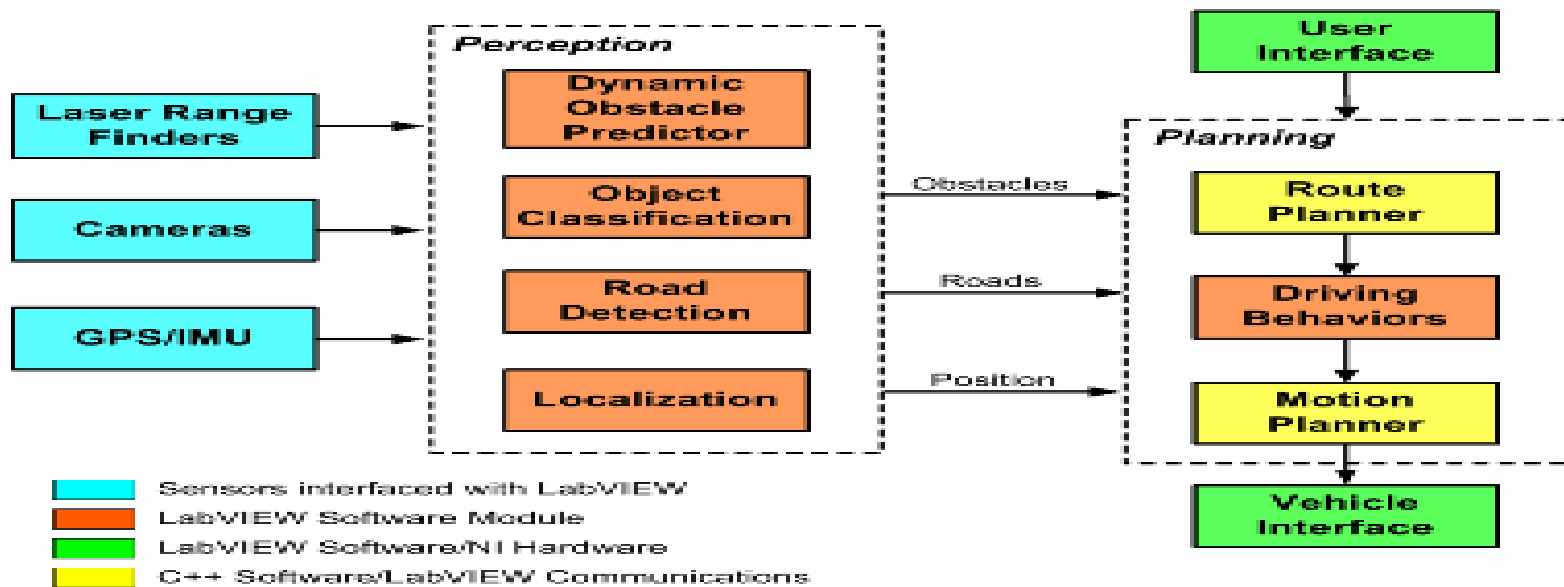
What is LabVIEW?

Examples of LabVIEW in the professional world

- LabVIEW controls the timing in the Large Hadron Collider
- LabVIEW tests the XBox console and controllers
- LabVIEW tests noise characteristics of Boeing planes
- LabVIEW is used for data acquisition more than C++, C#, or any other programming environment
- DARPA challenge video



Urban Challenge Software Architecture



This block diagram shows the uses of NI hardware and LabVIEW in the Victor Tango software architecture.





What is LabVIEW?

DARPA Video :

<http://www.youtube.com/watch?v=JclsrwSWzng&feature=related>





What is LabVIEW?



Learning LabVIEW

- Students will learn fastest by using LabVIEW
 - Online tutorials provide a good start, but most will pick it up and learn faster than you can teach
- Adults need structured lessons
 - www.ni.com/FIRST, LabVIEW Training
 - Mini-modules for quick overviews of various LabVIEW features
- Use the support forums
 - www.ni.com/FIRST, Community Support
 - Most of your questions have been asked, and answered, several times



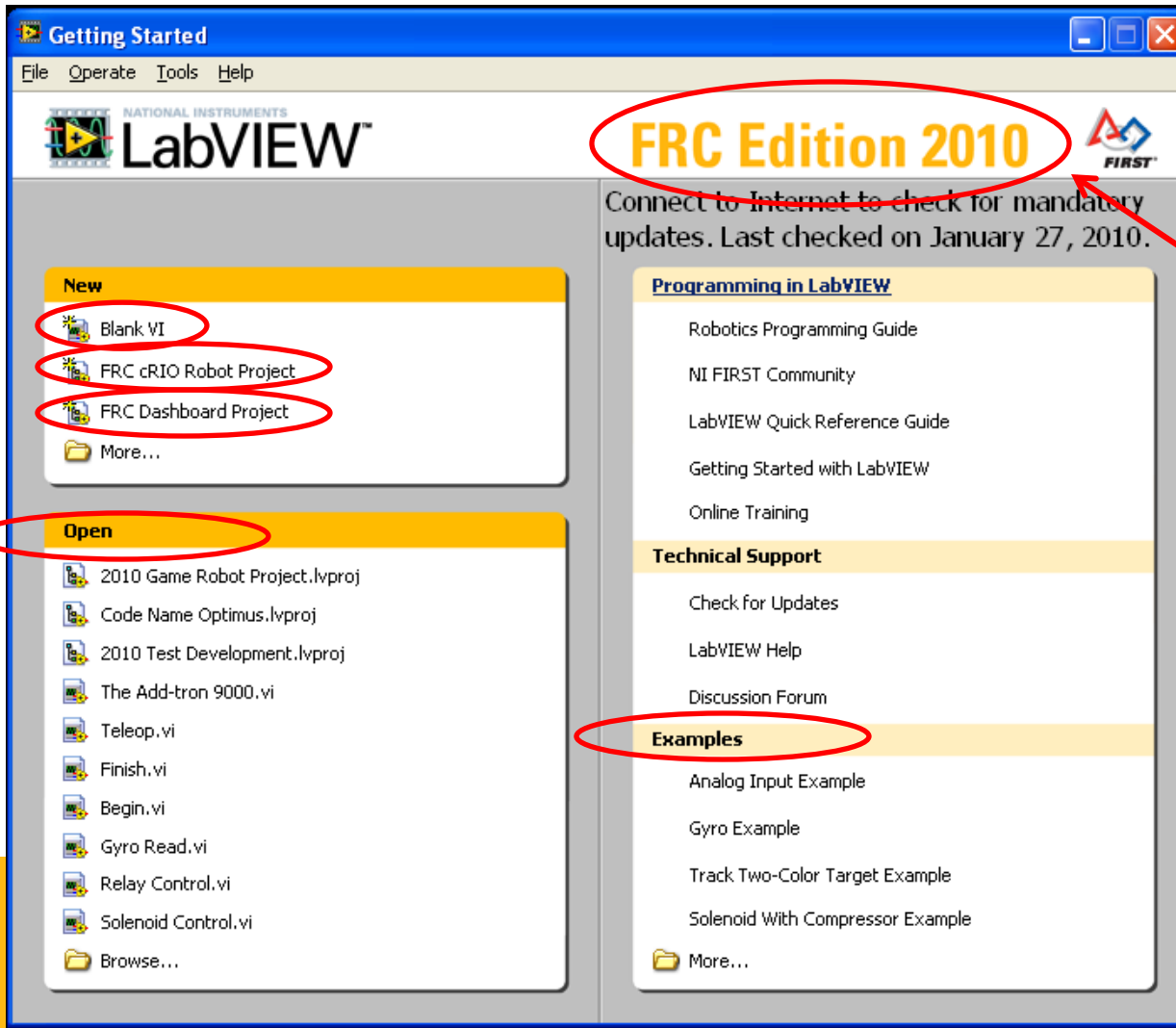


Installation

- Install LabVIEW using the DVD provided to your team.
- Check ni.com/first, “Software Downloads” for updates
- Use your team’s serial number for activations.
- Activate on as many team computers as you need to complete the software programming. Obey the terms and conditions, limiting use to projects related to FIRST Robotics.
- To ensure teams are all on the same version at tournaments, the previous year’s version will expire in January of the following year.
- When your team receives the new DVD as part of your robot kit, install and use this new version.
 - Uninstalling the old version is not required, but recommended.
- Troubleshoot installation and activation problems at ni.com/first



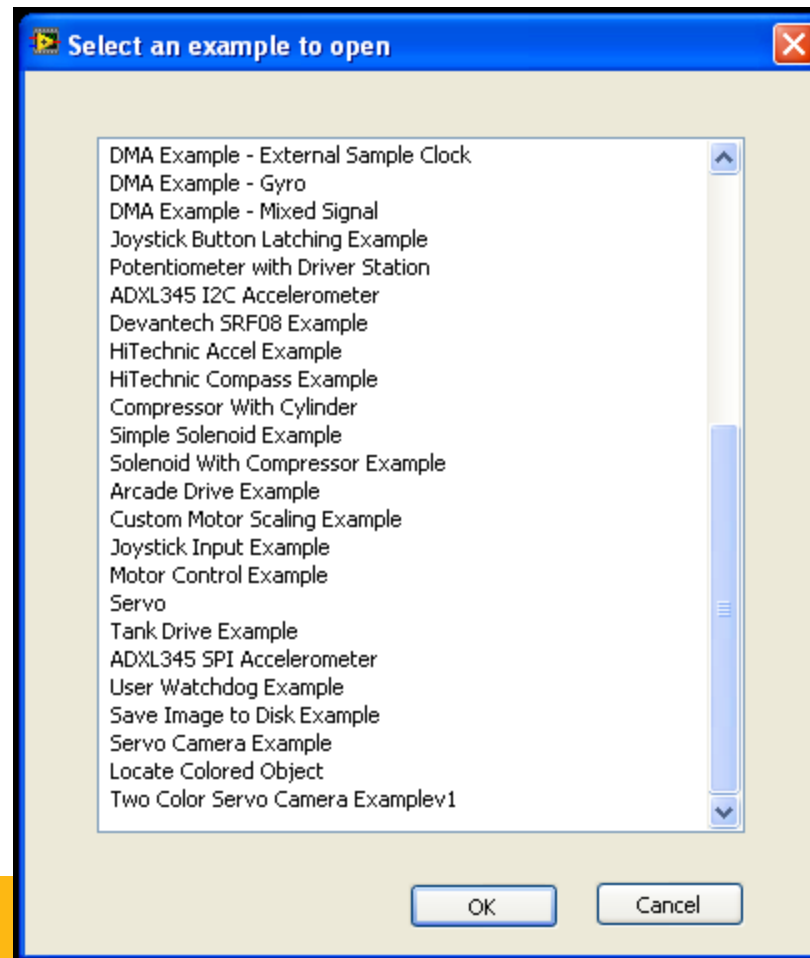
LabVIEW Splash Screen



Check version for
current season

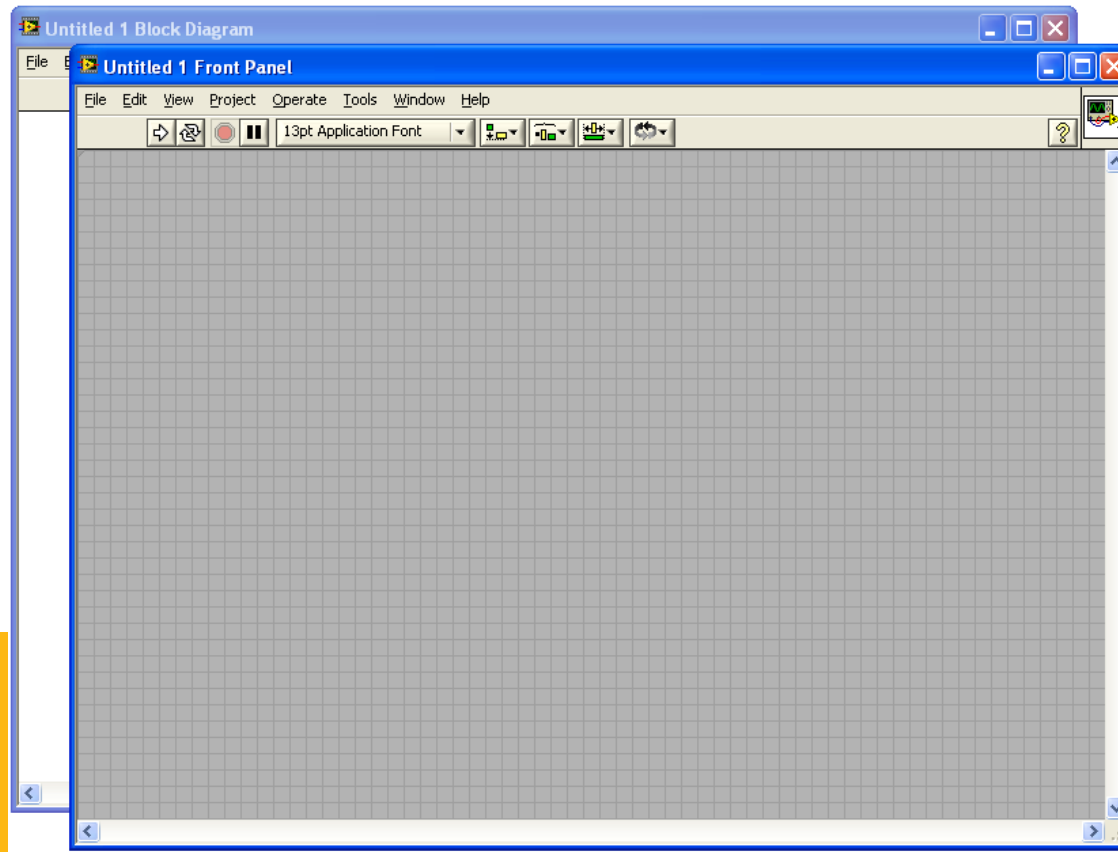
Using Examples

Splash Screen –
Examples –
More...



New Programs

- Create a new program
 - Splash Screen – Blank VI



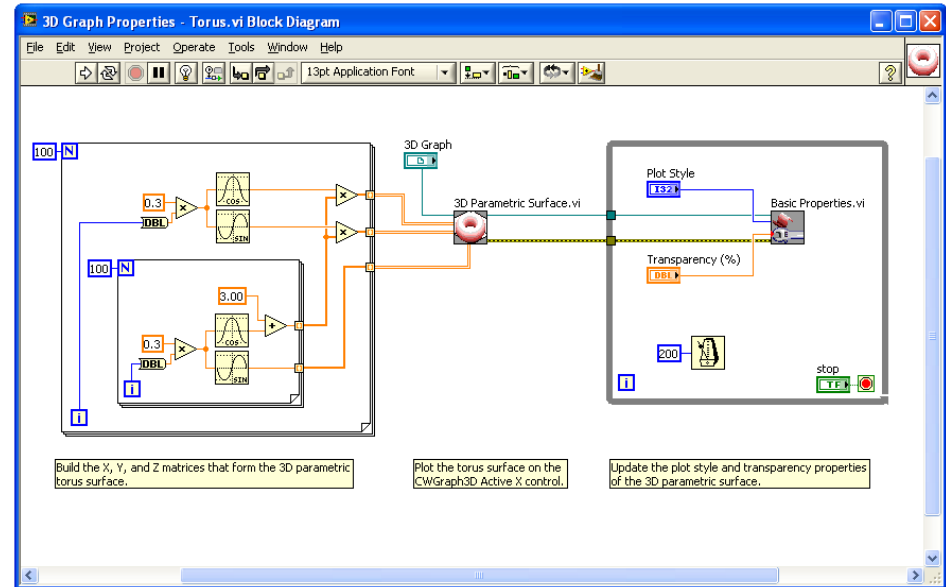
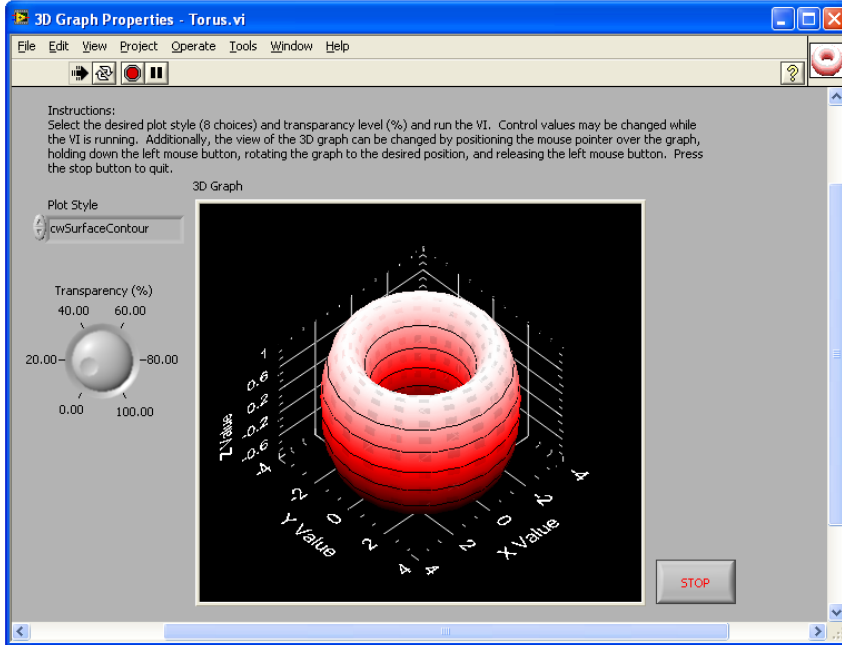


Front Panel vs. Block Diagram



Front Panel

Block Diagram

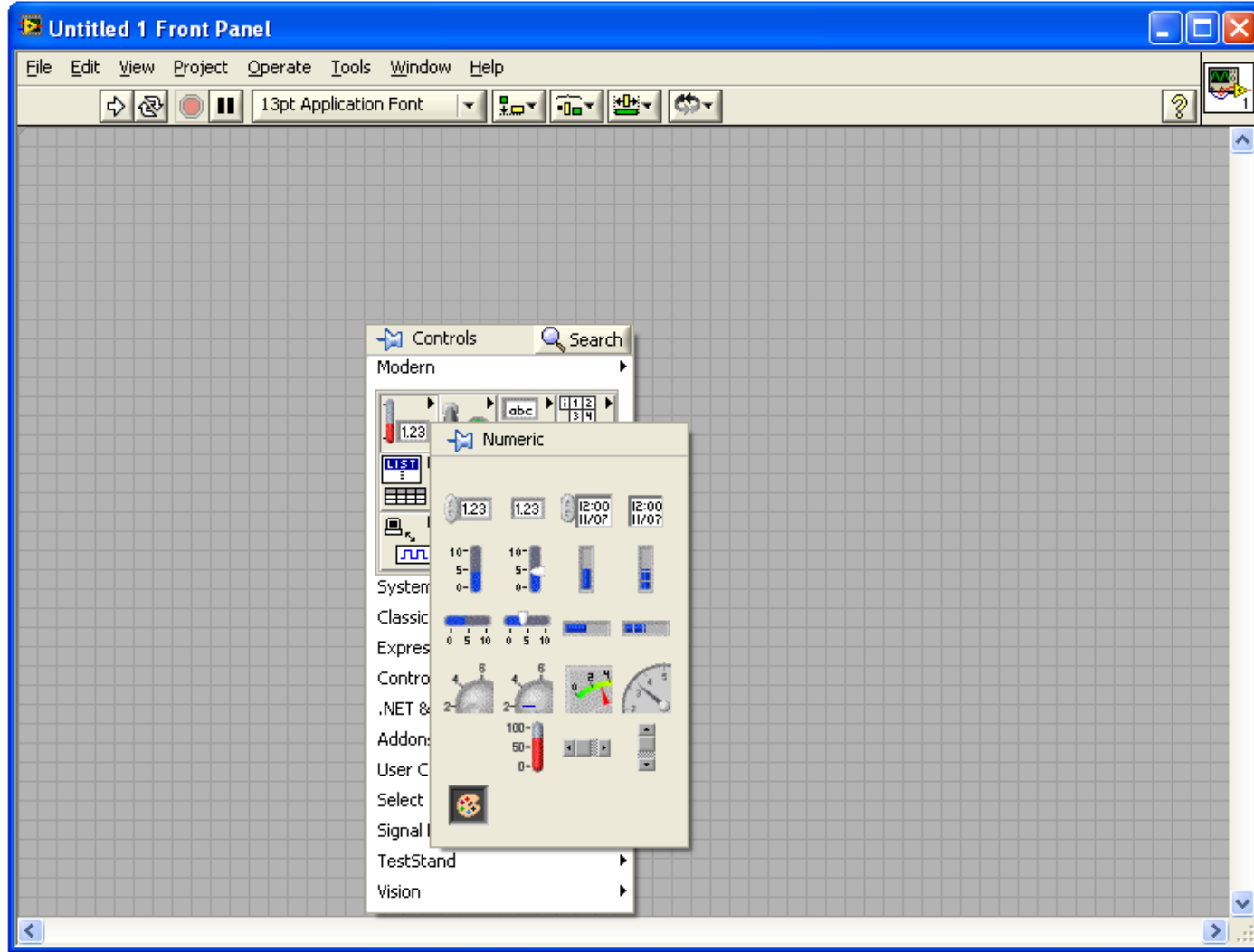


- User interface
- Input/Output to user

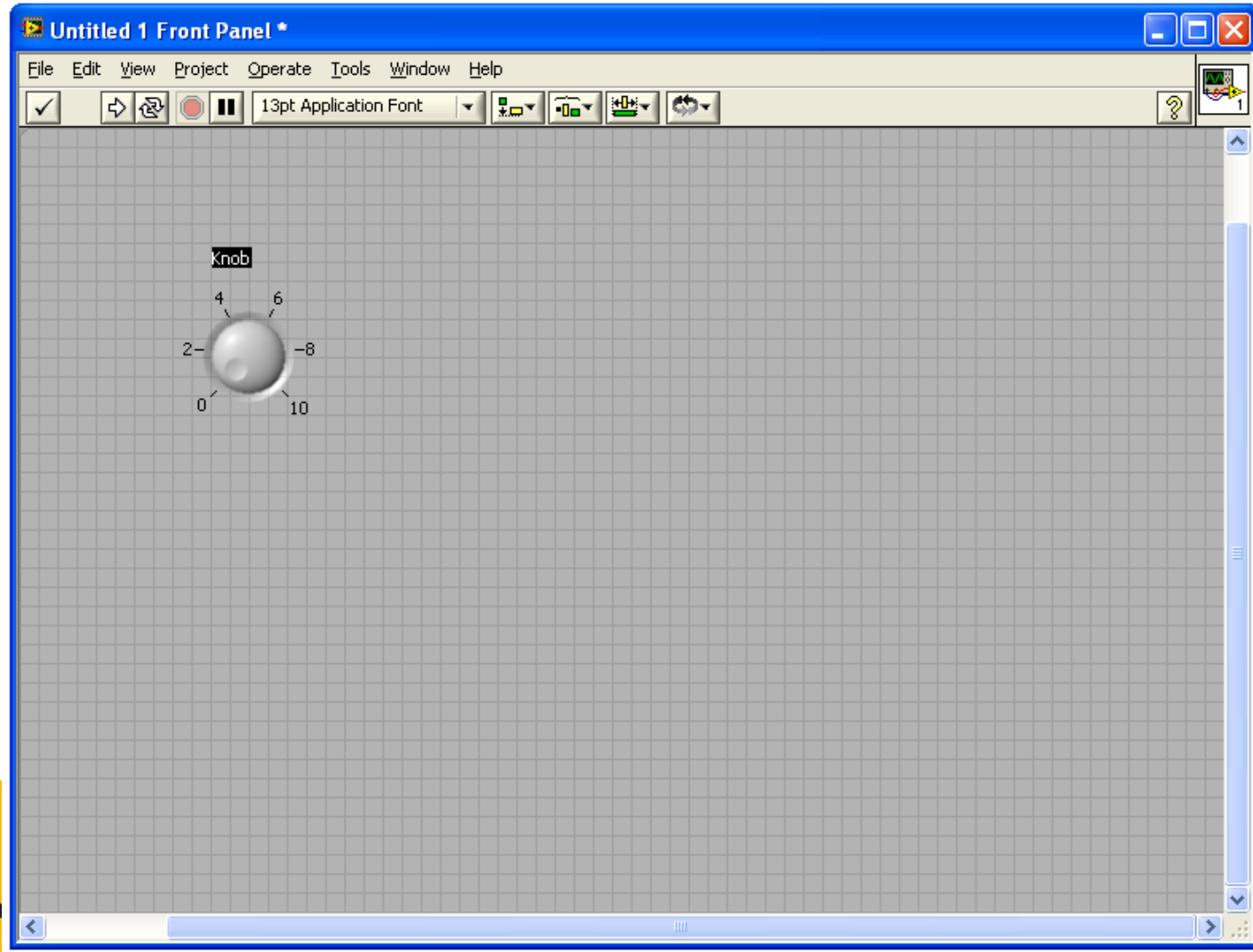
- Program instructions
- Programming functions



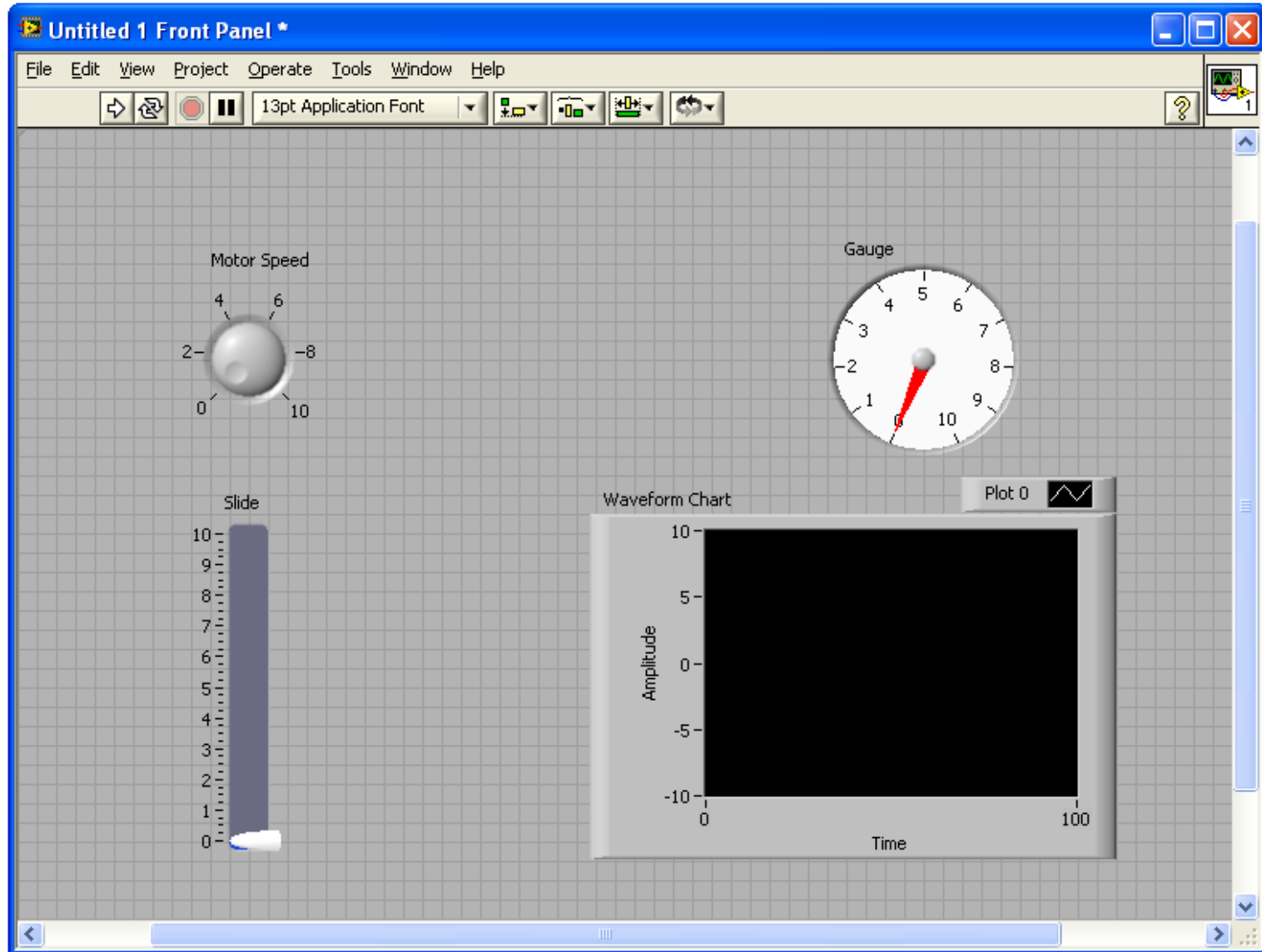
Front Panel



Front Panel



Front Panel



Tools Palette

Automatic Tool Selection

Operate Value

Position/Size/Select

Edit Text

Connect Wire

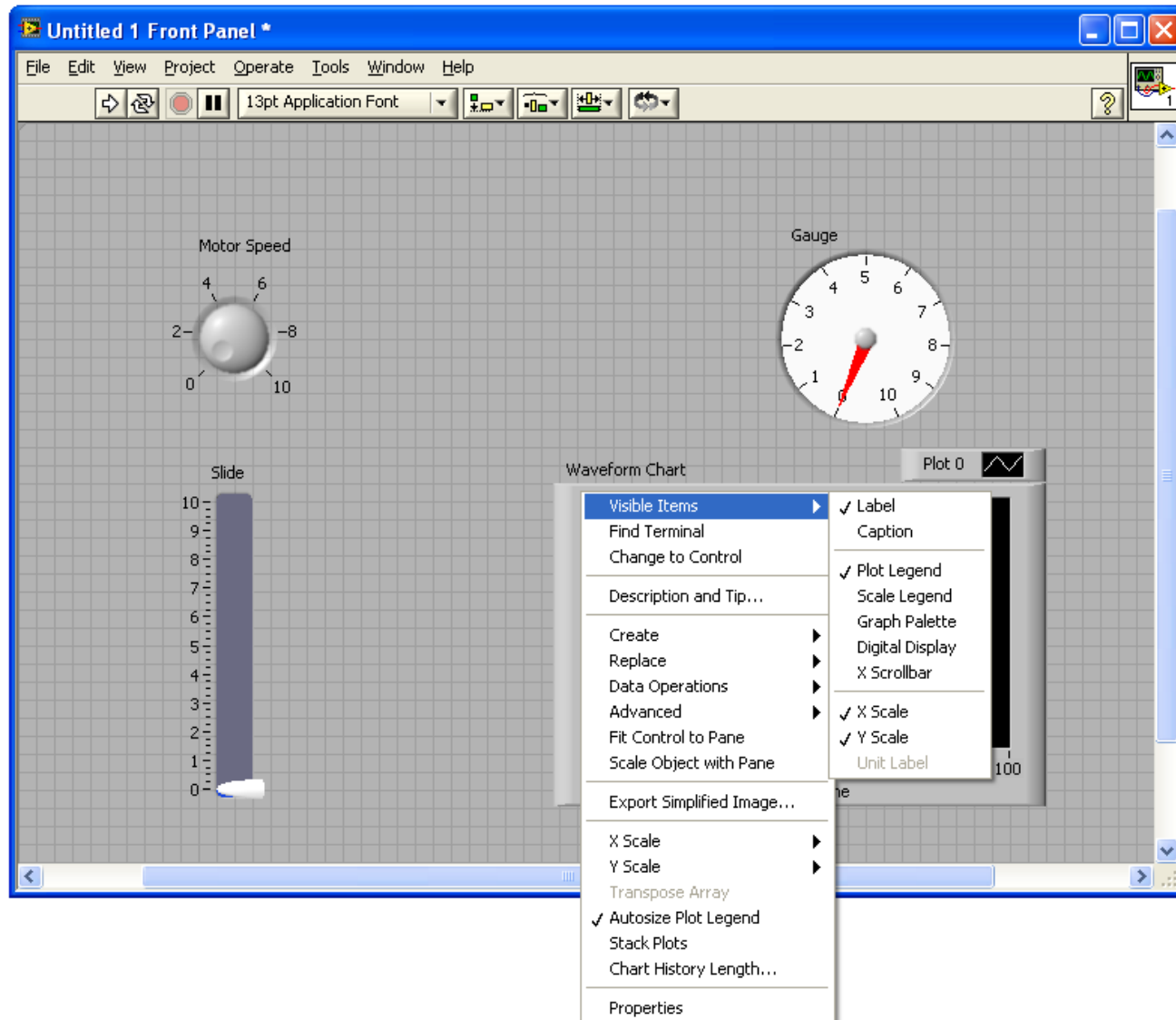
Set/Clear Breakpoint

Probe Data

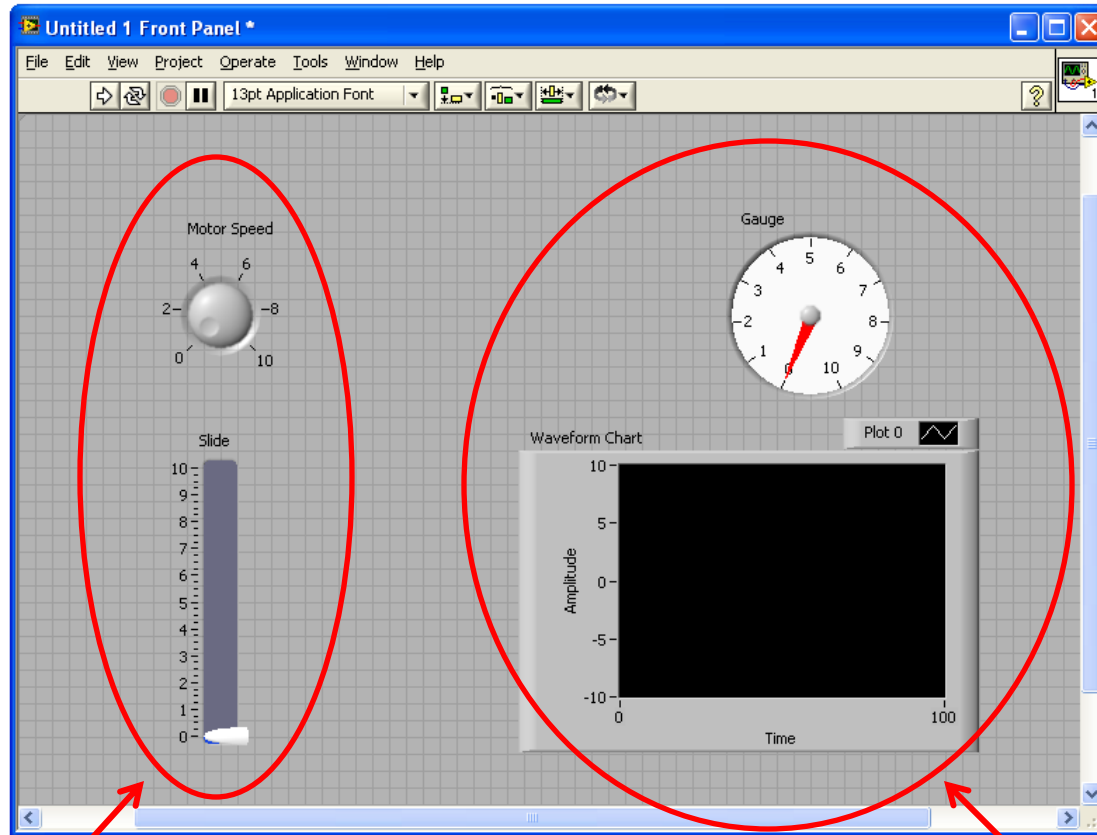
Set Color



Control Properties



Controls and Indicators

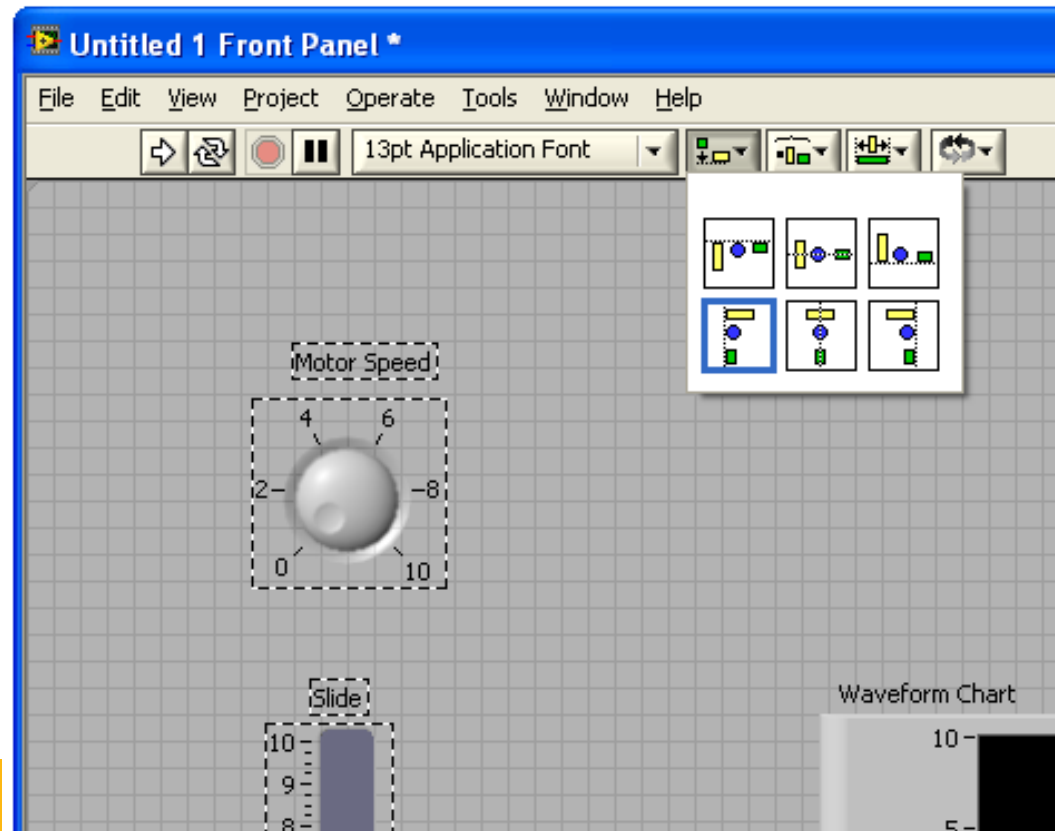


Controls

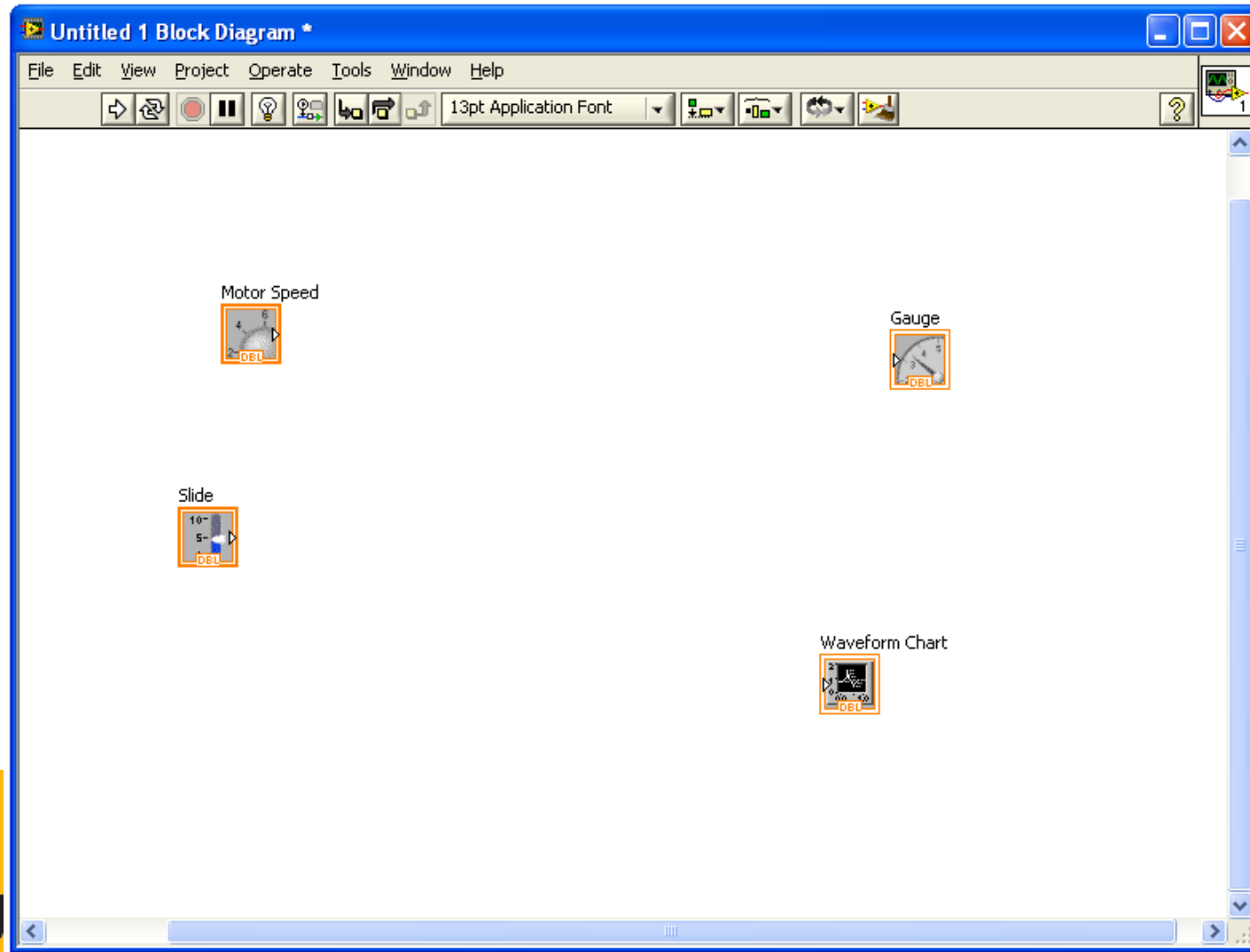
Indicators



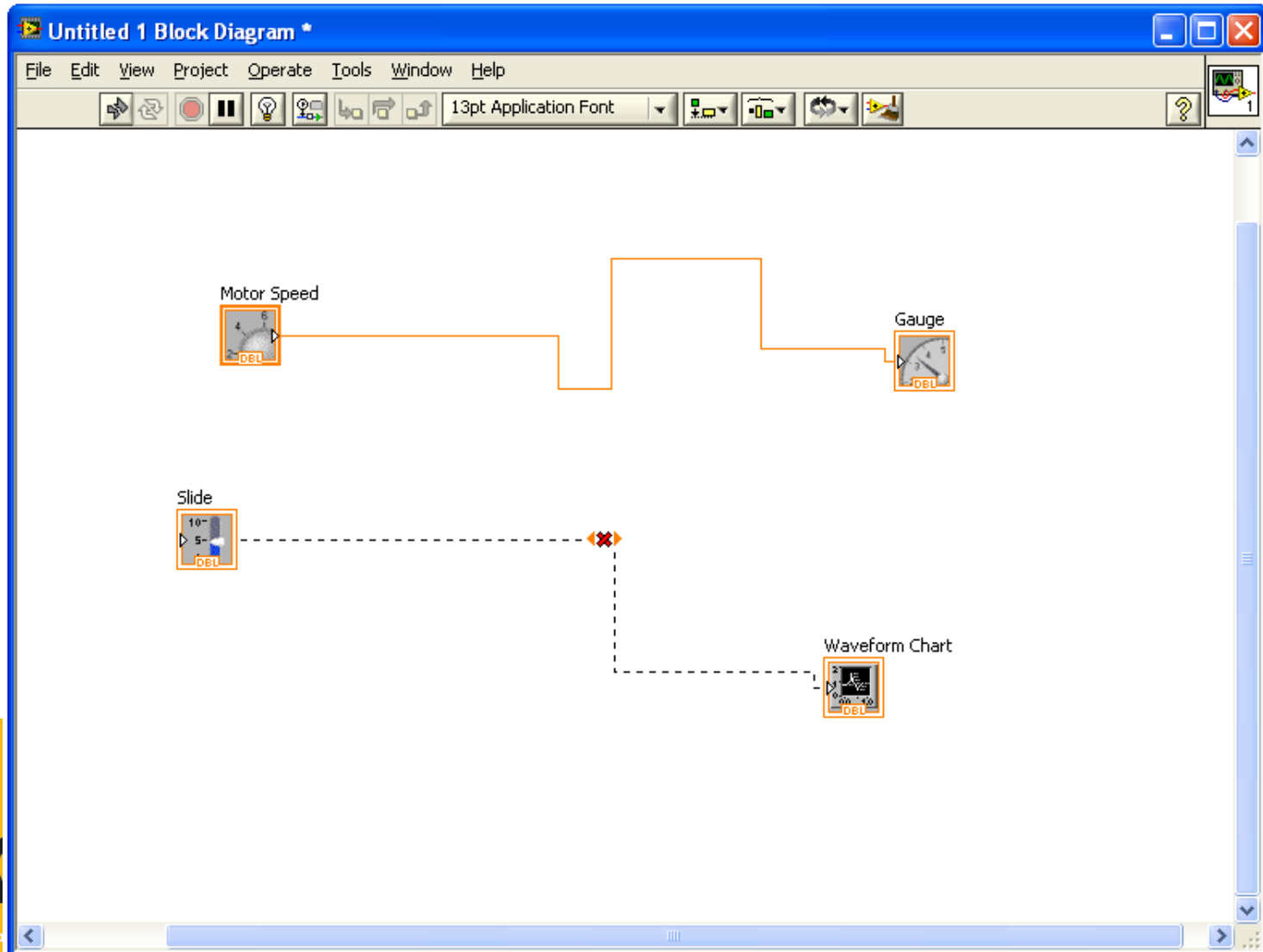
Front Panel Properties



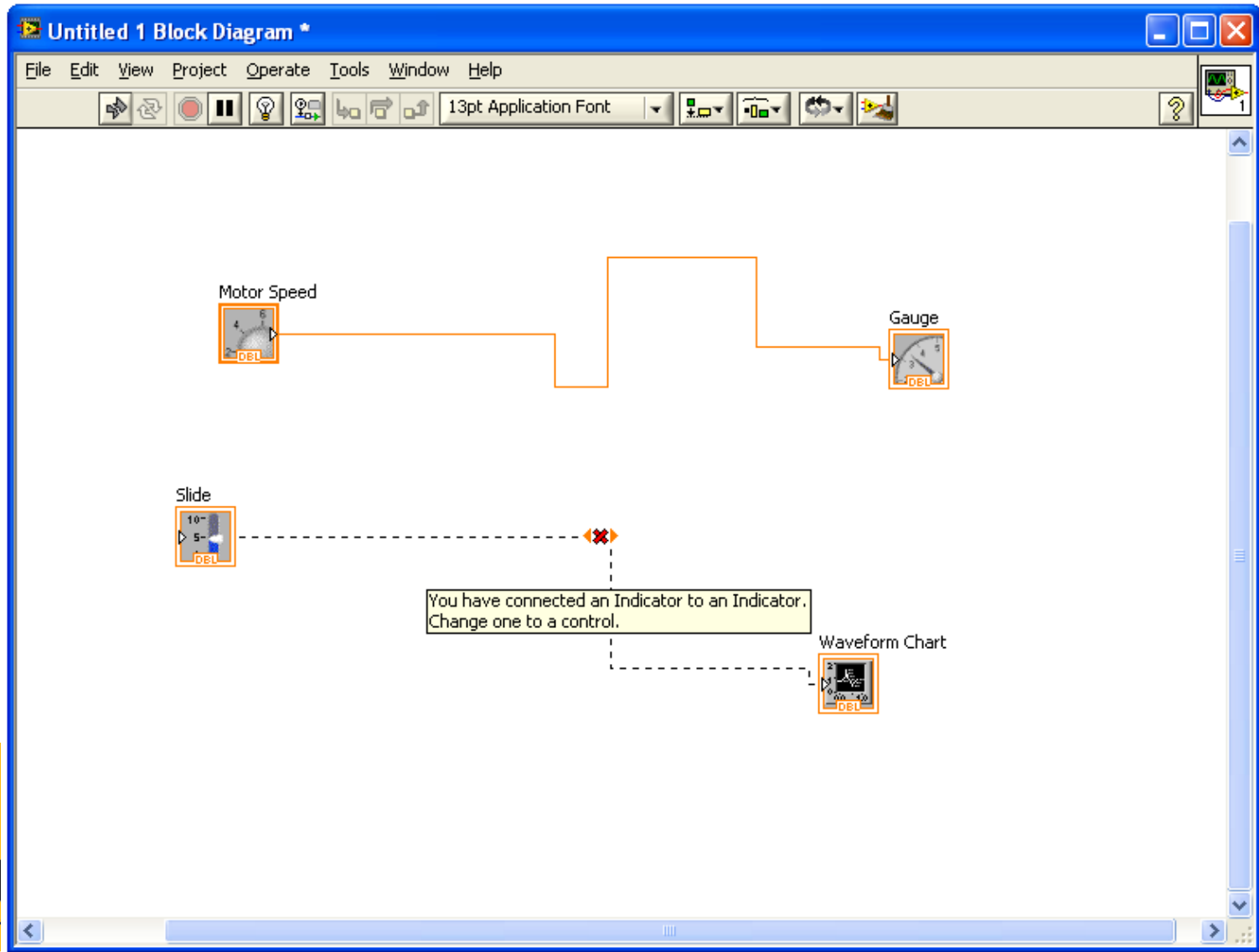
Block Diagram



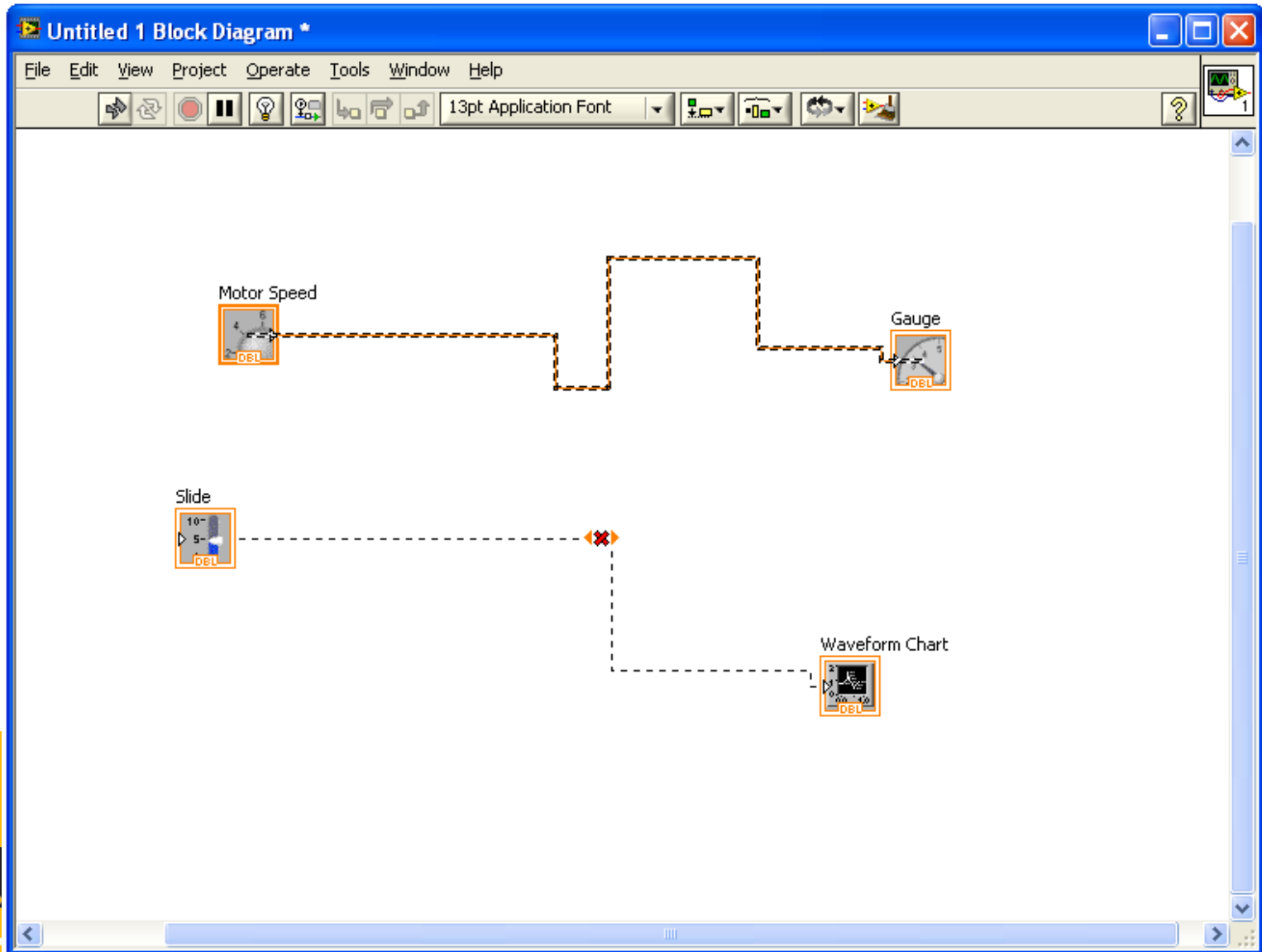
Wiring



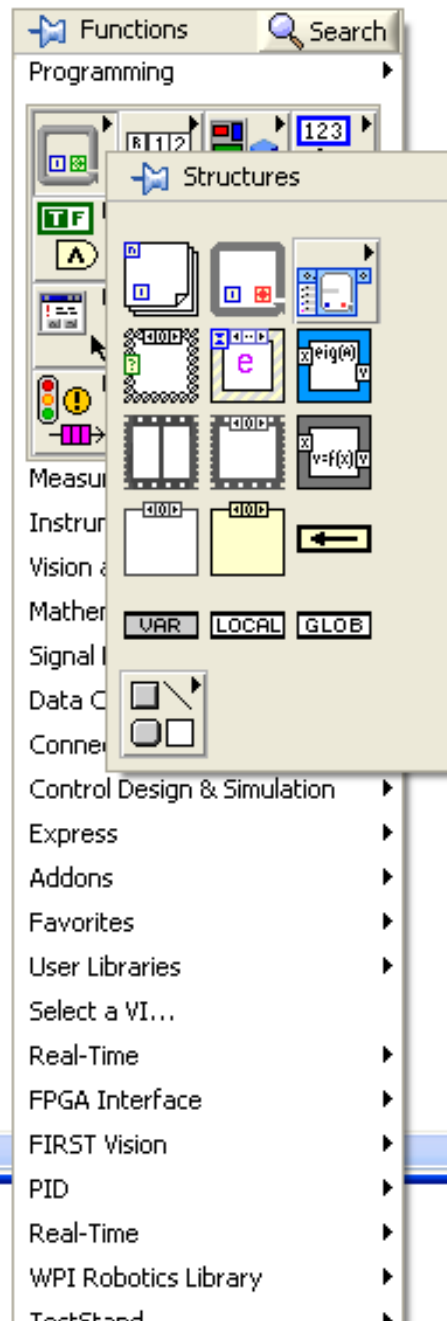
Wiring



Wiring



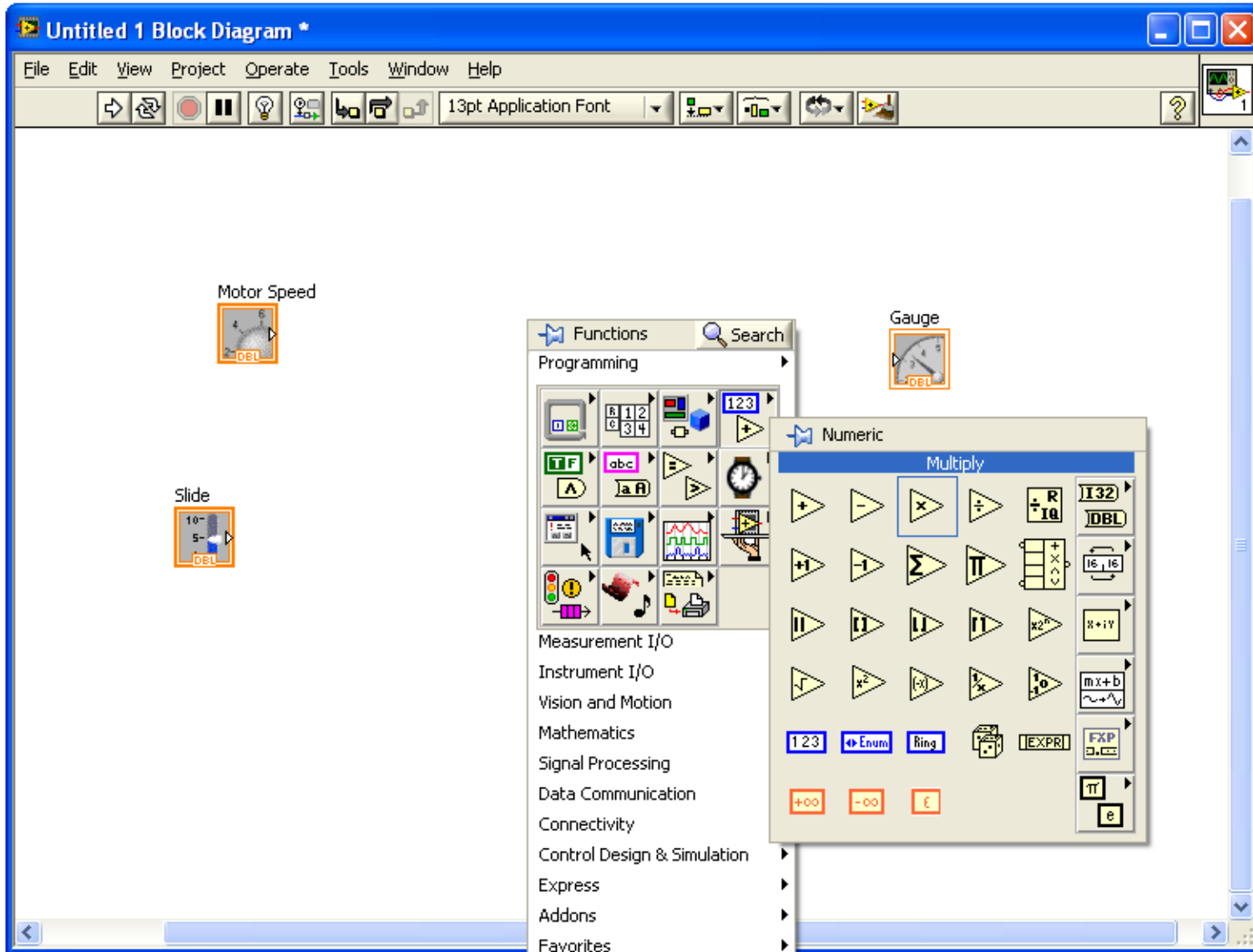
- Categories
 - Palettes
 - Sub-palettes



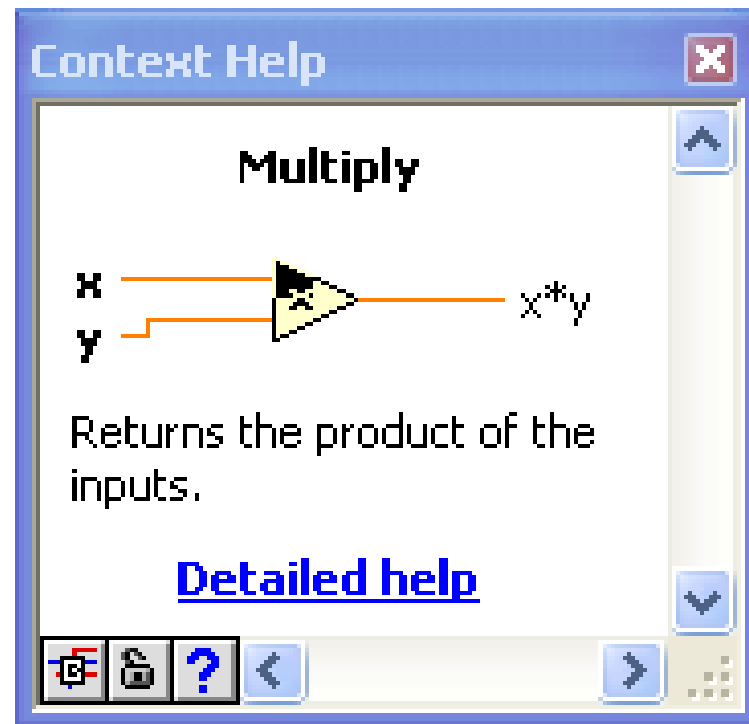
Functions



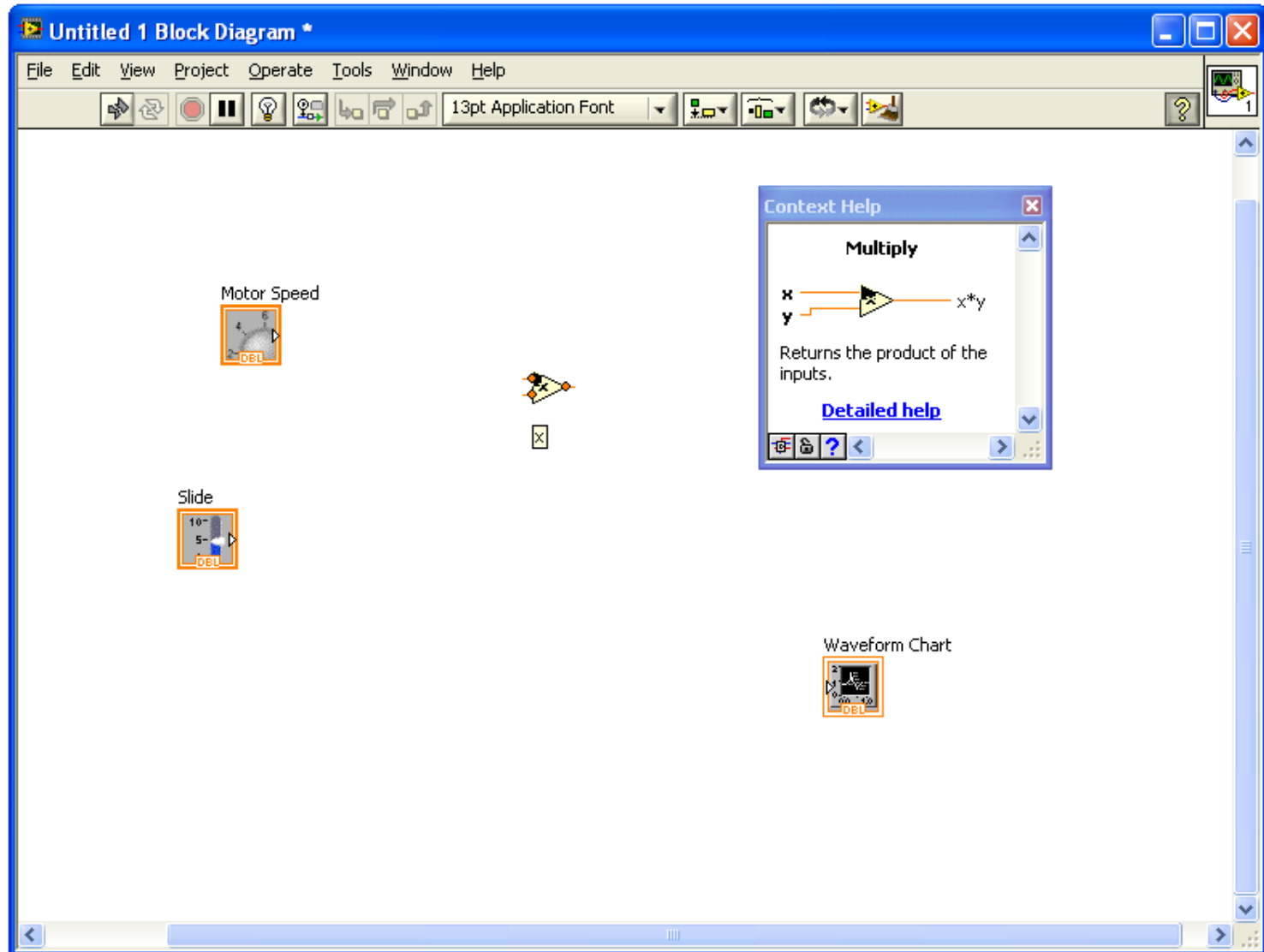
Functions



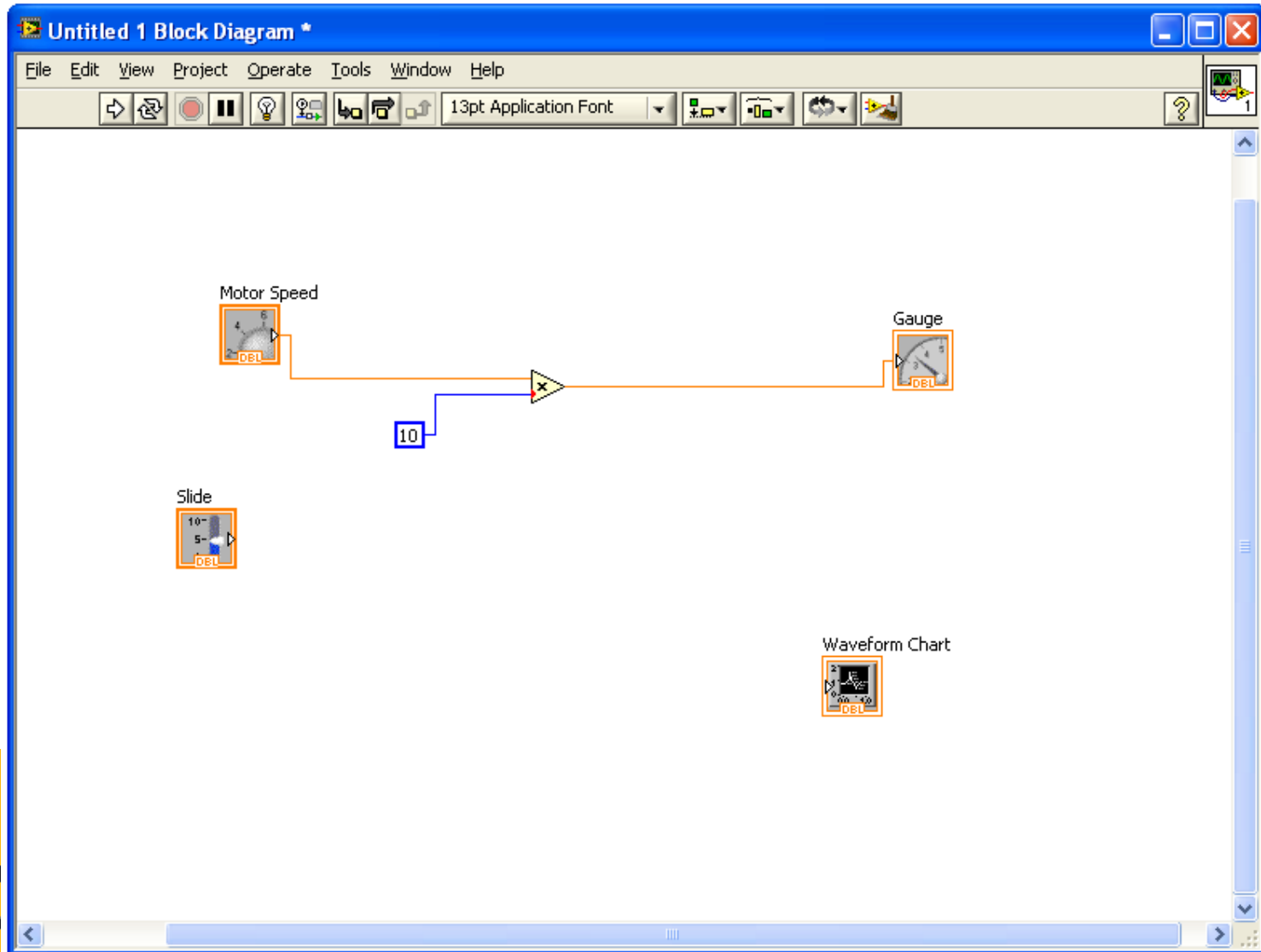
Help Window



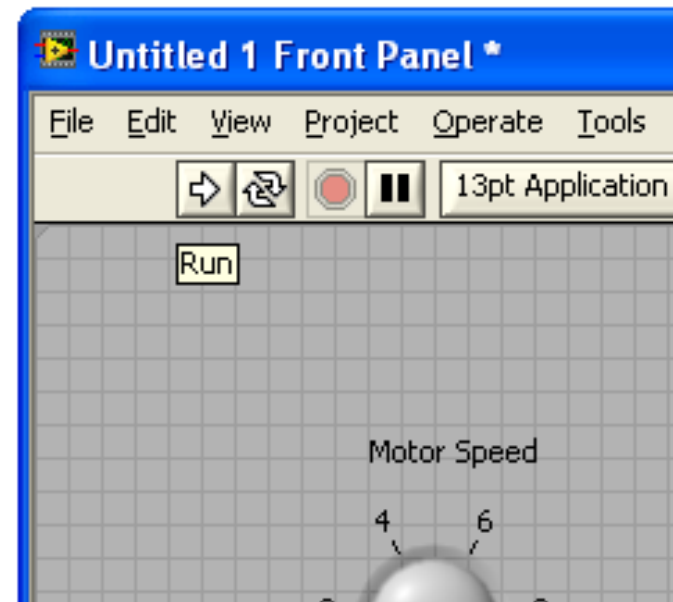
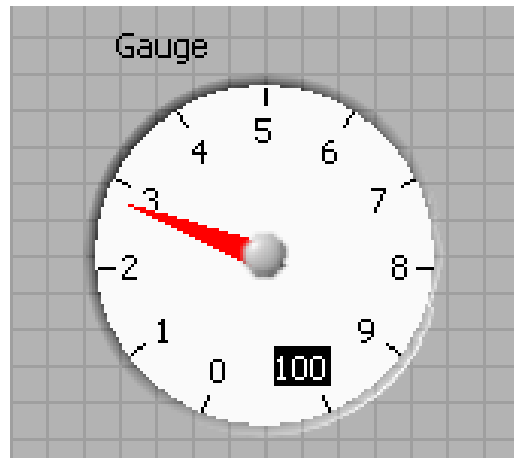
Wiring Functions



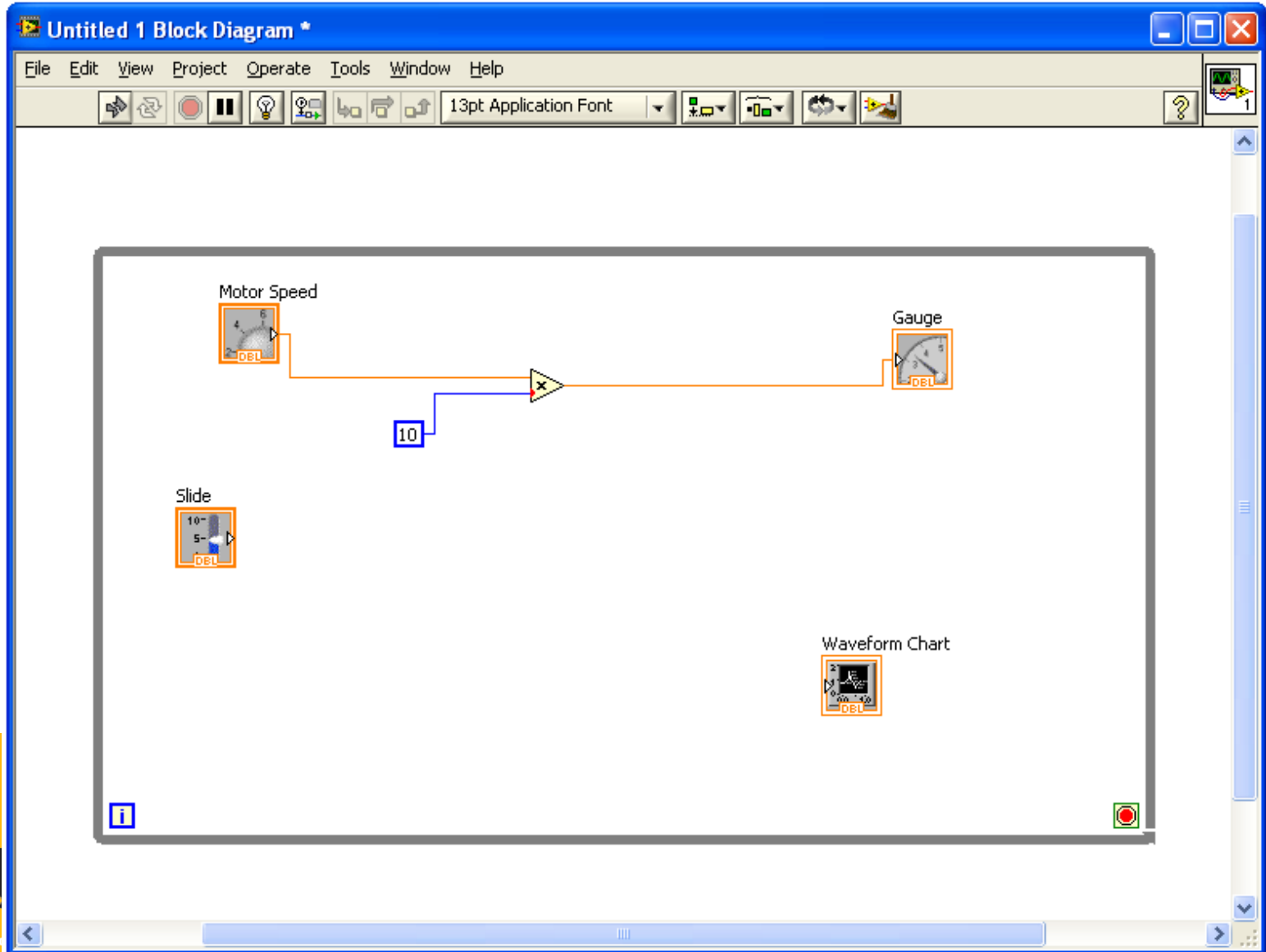
Wiring Functions



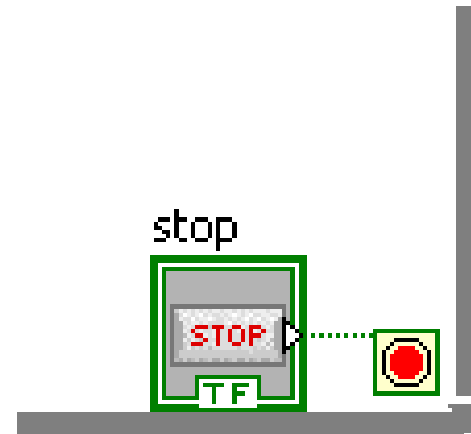
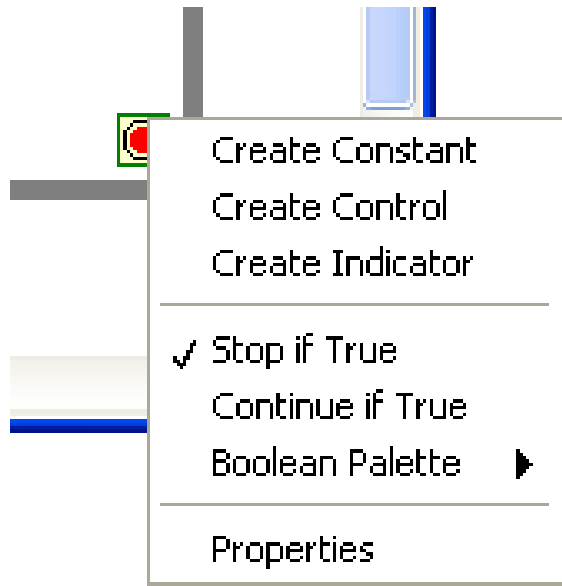
Running Programs



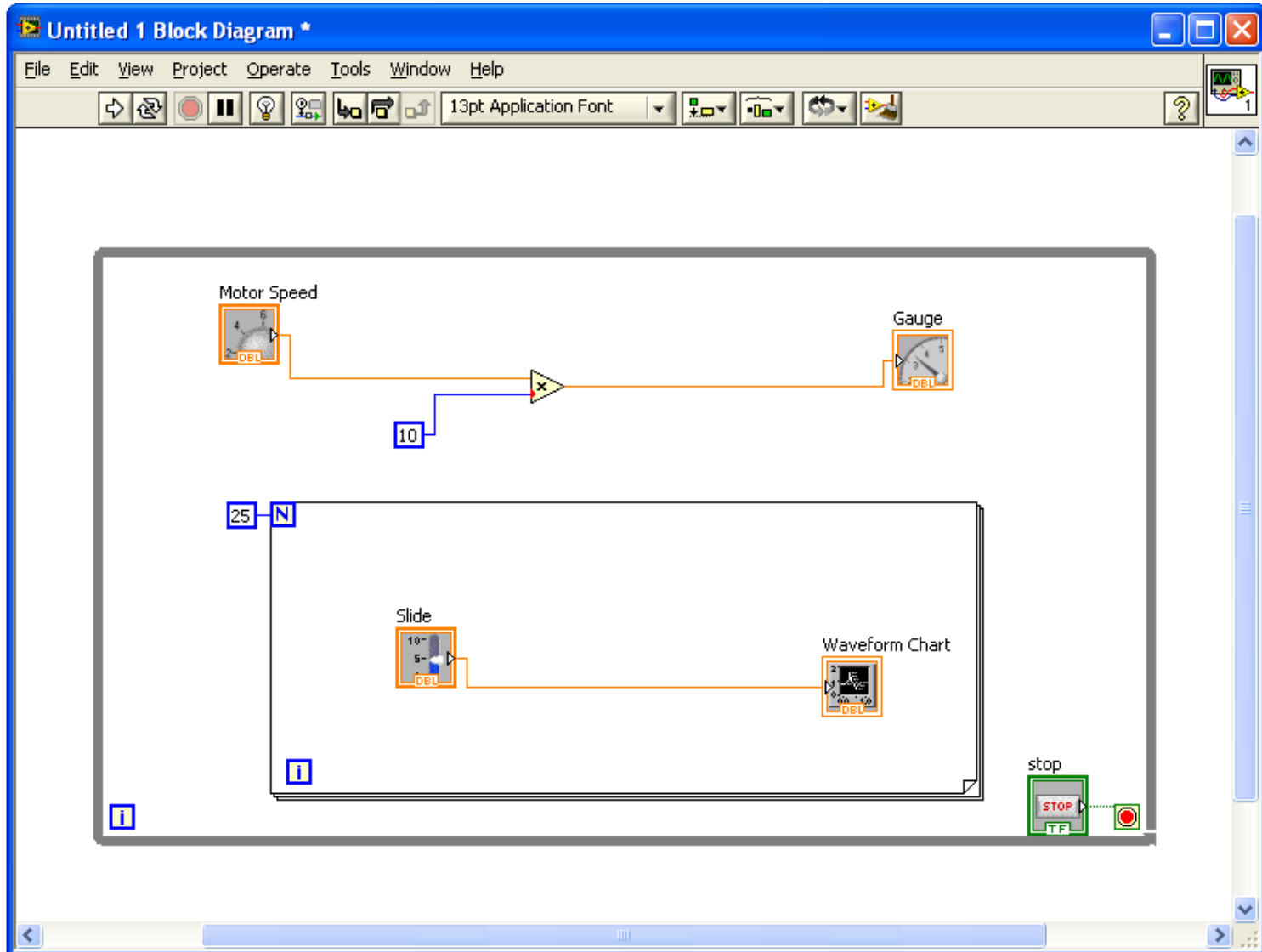
Structures



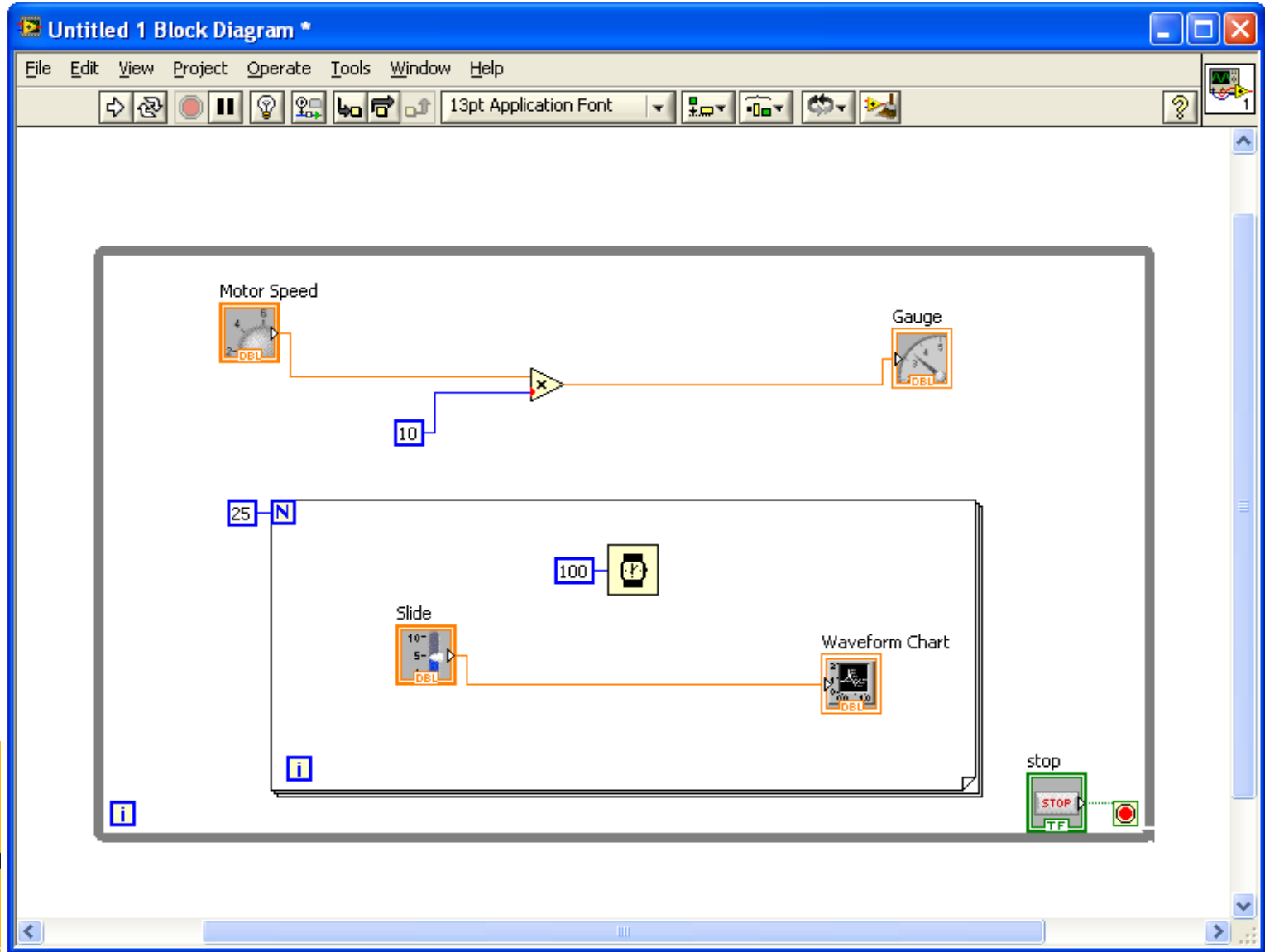
Create Control

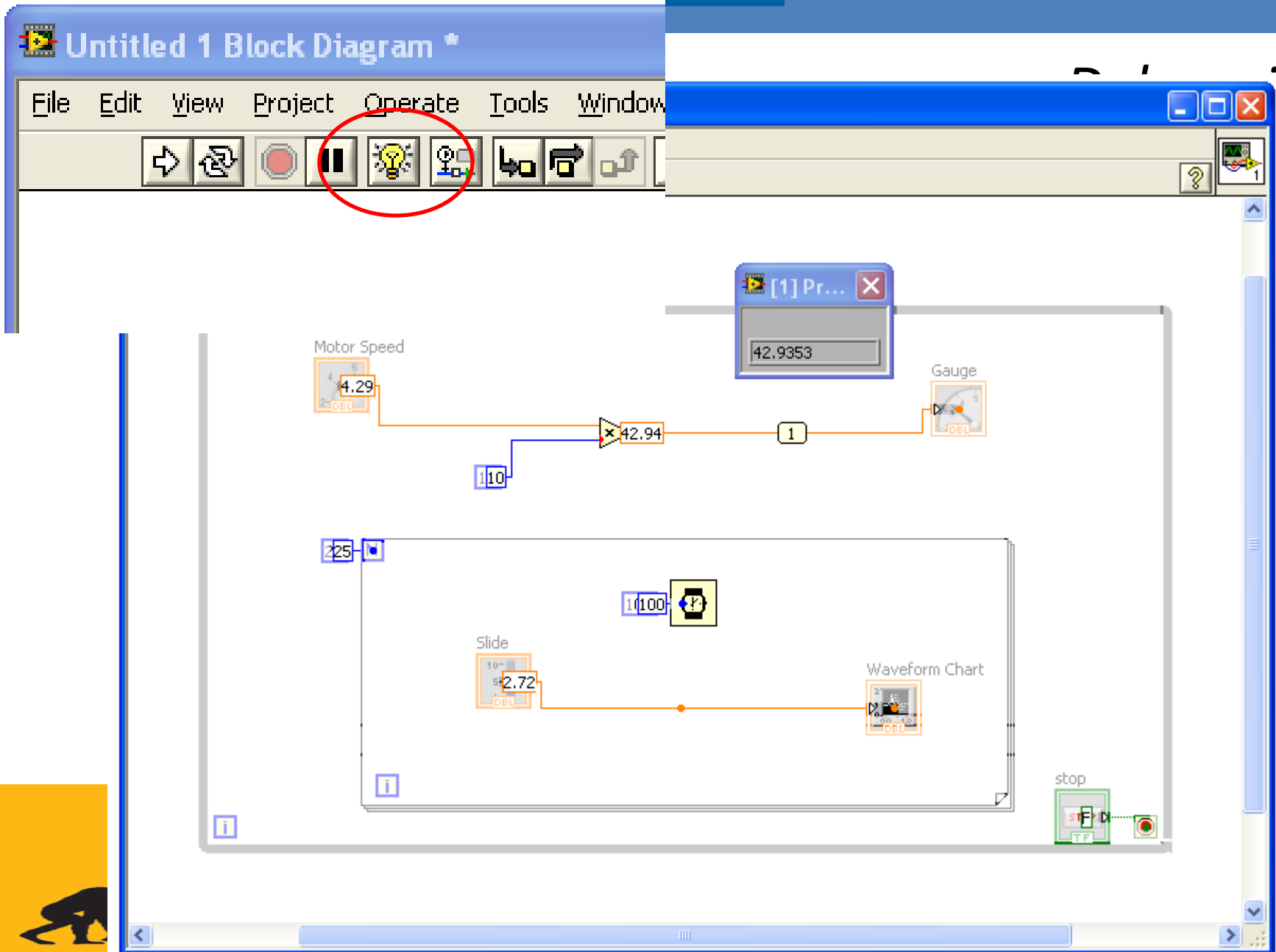


For Loop

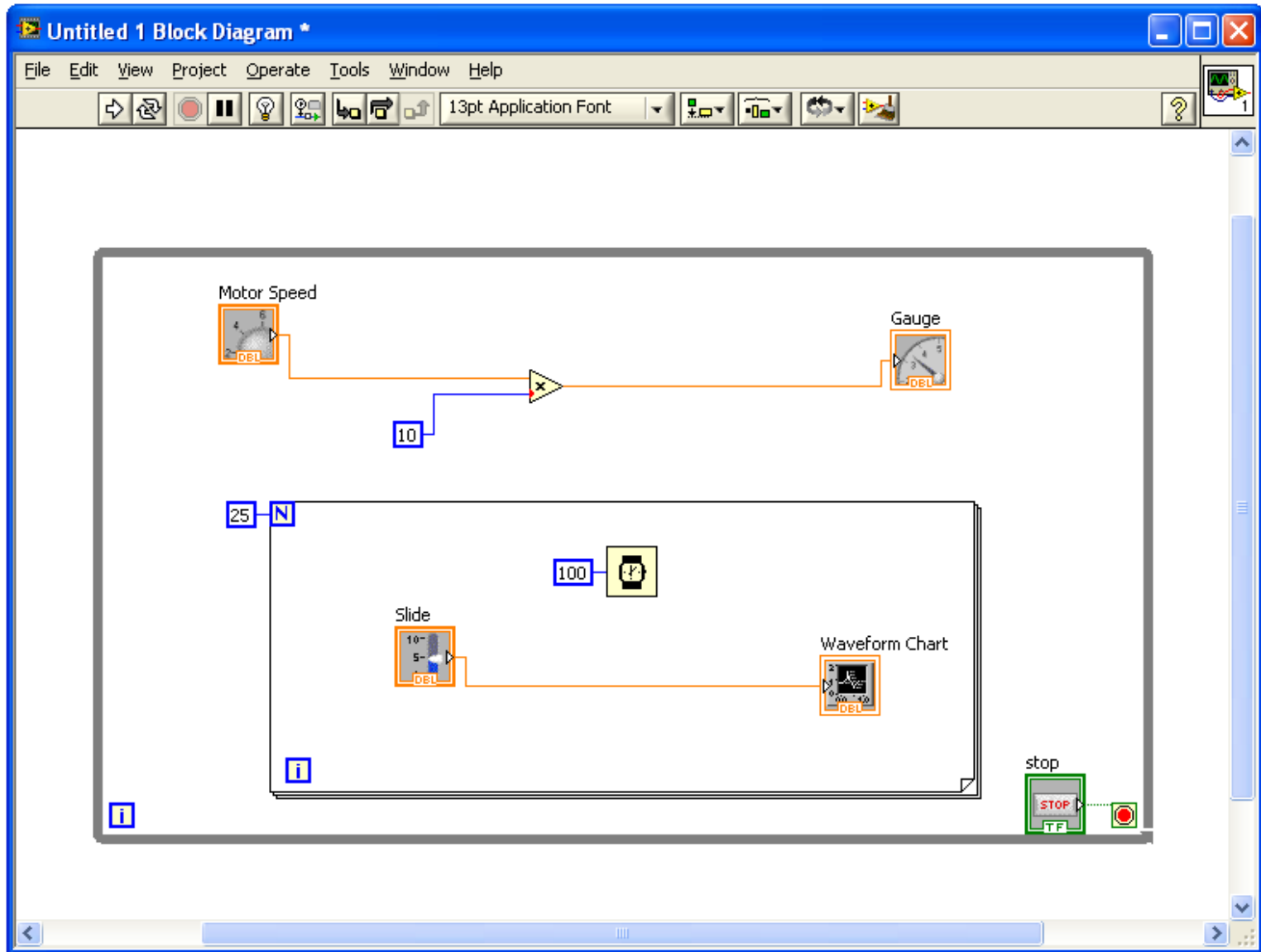


Timing

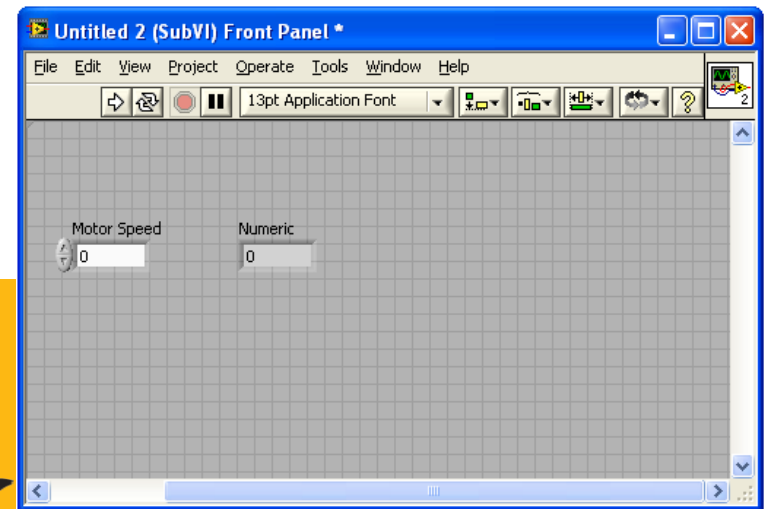
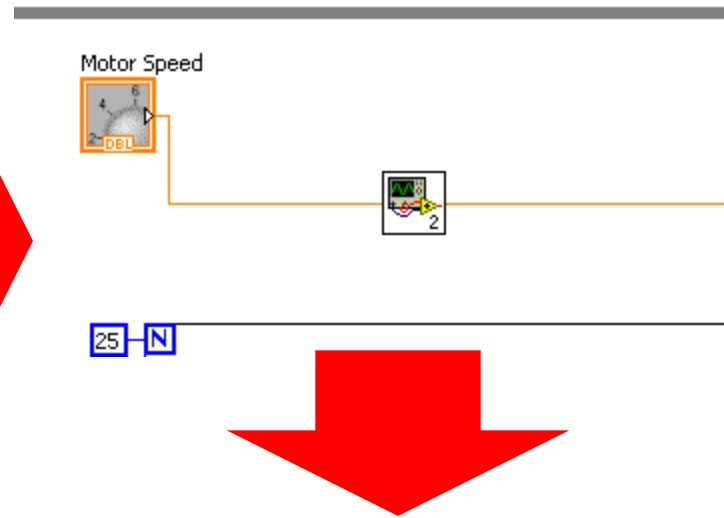
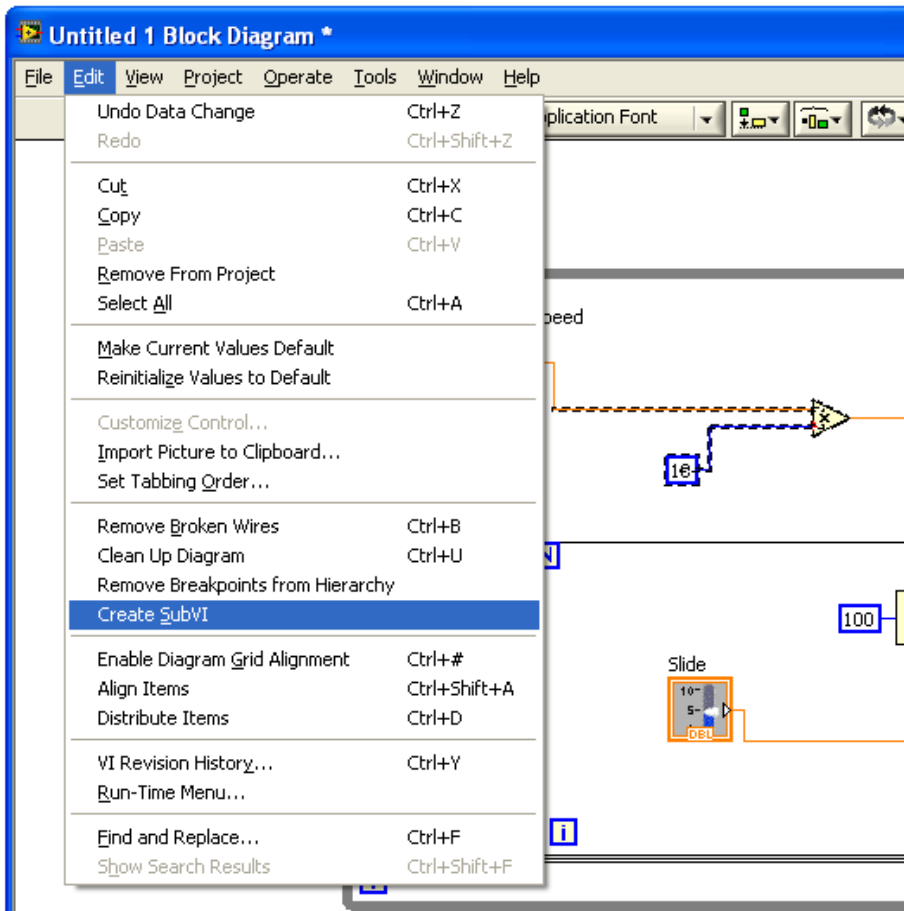




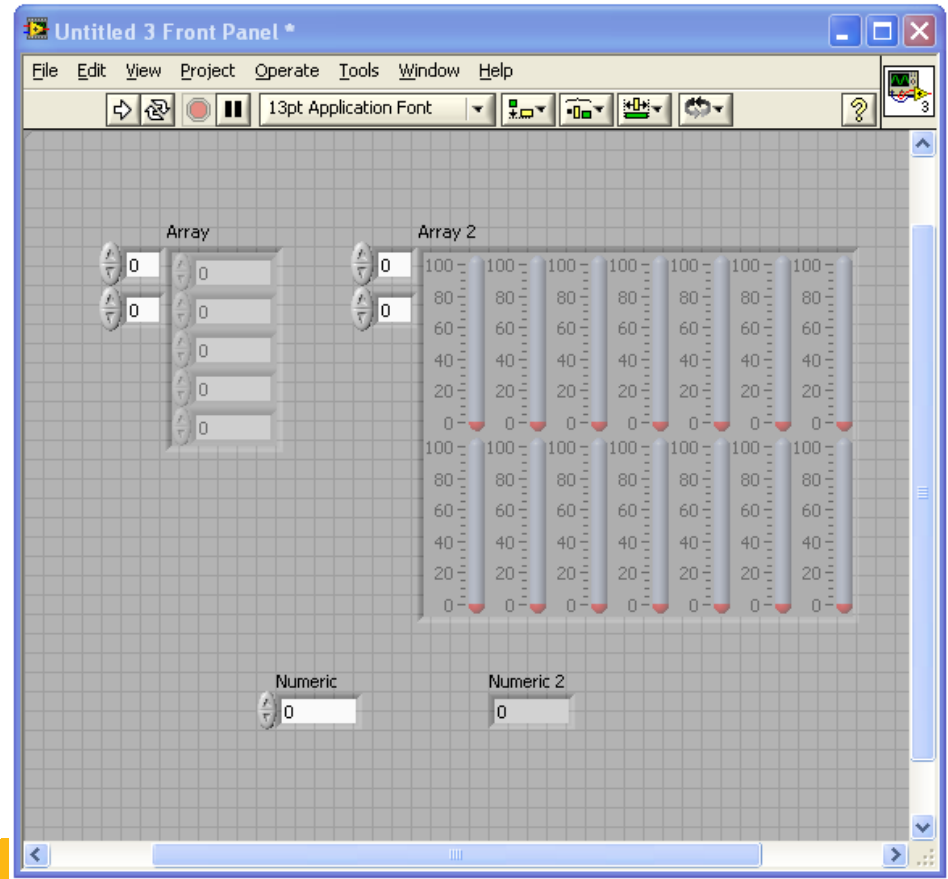
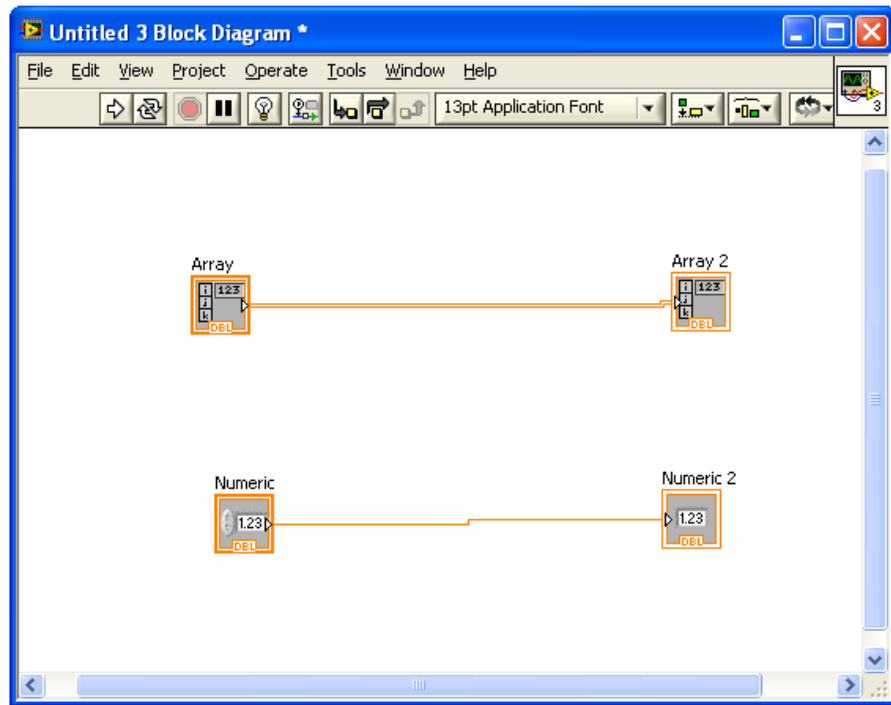
Data Flow



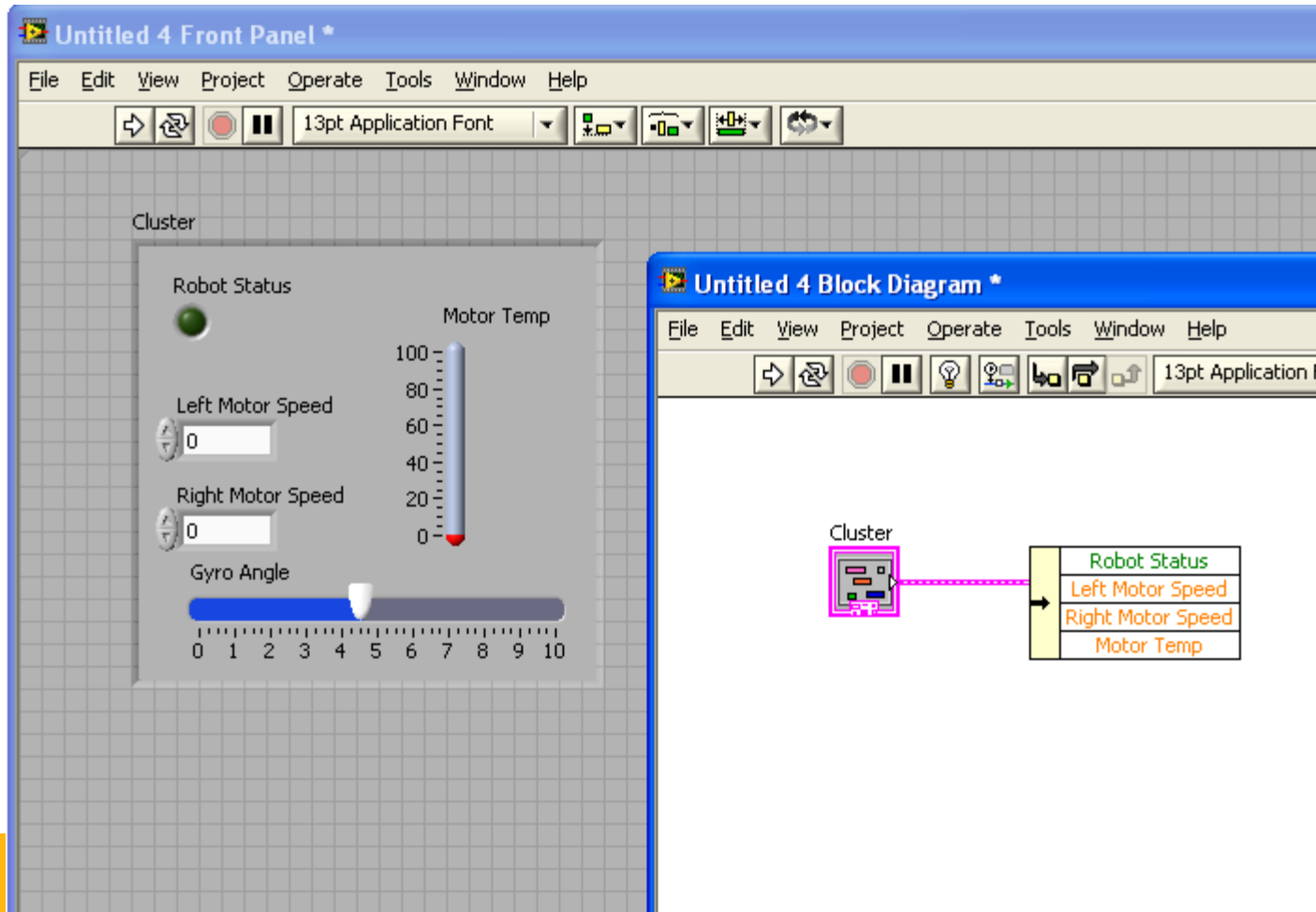
Sub VI's



Arrays



Clusters





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SECTION 2: FIRST ROBOTICS TRAINING





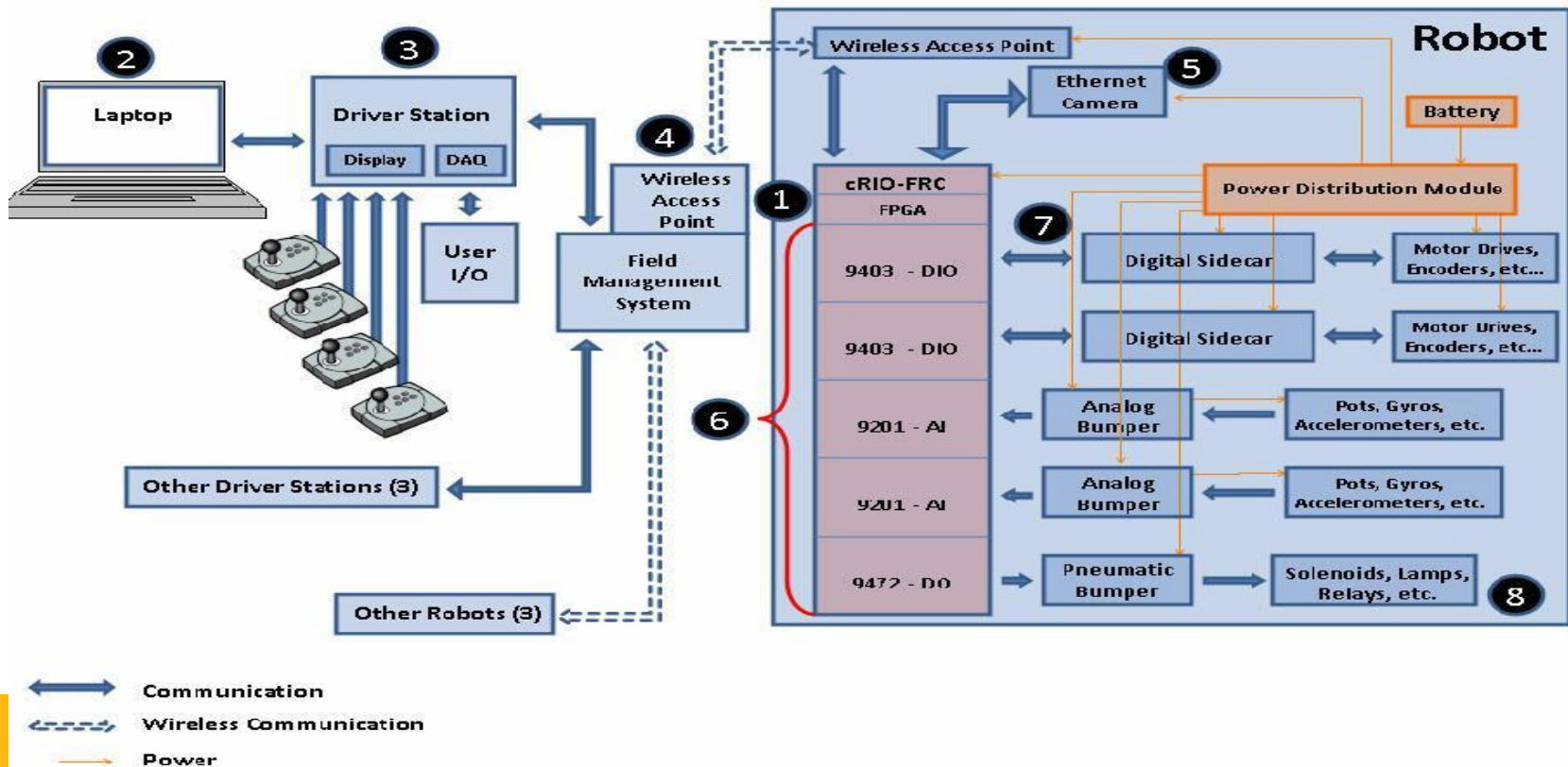
2. Understanding the hardware

- Architecture
- CompactRIO
- Programming approach
- FIRST version



FRC Topology

FRC Topology





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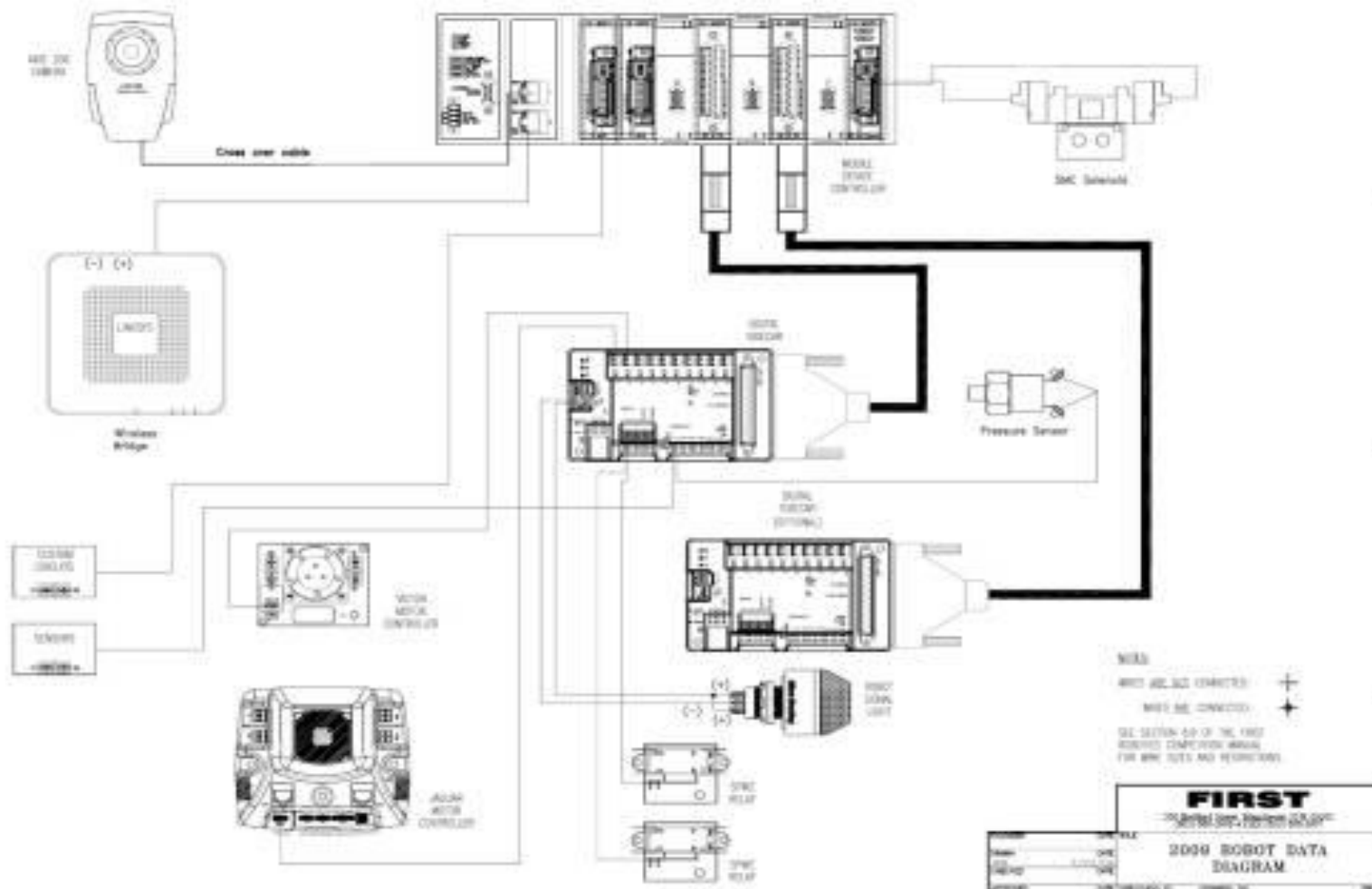


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LabVIEW™



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FRC System

LabVIEW Host Application



Ethernet



Access Point

LabVIEW cRIO Application



CompactRIO System

Programming Flow

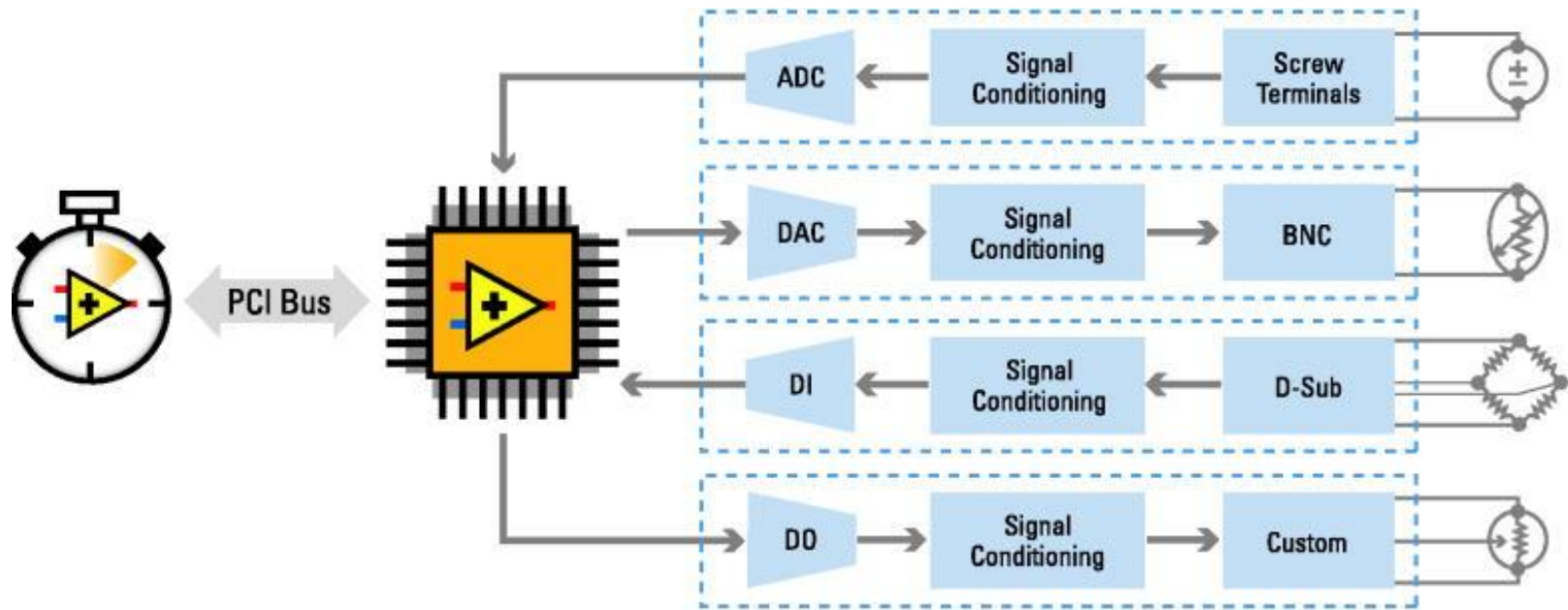
1. Develop CompactRIO Program using Laptop or Desktop
2. Test/Debug across Ethernet
3. Develop Windows Host Program
4. Deploy Standalone cRIO code (build executable)
5. Enjoy!



Robot Control Hardware - CompactRIO



CompactRIO Architecture



- **Processor** for stand-alone operation and advanced floating-point analysis
- **Reconfigurable FPGA** for high-speed and custom I/O timing, triggering, control
- **I/O Modules** direct connection to industrial sensors/actuators



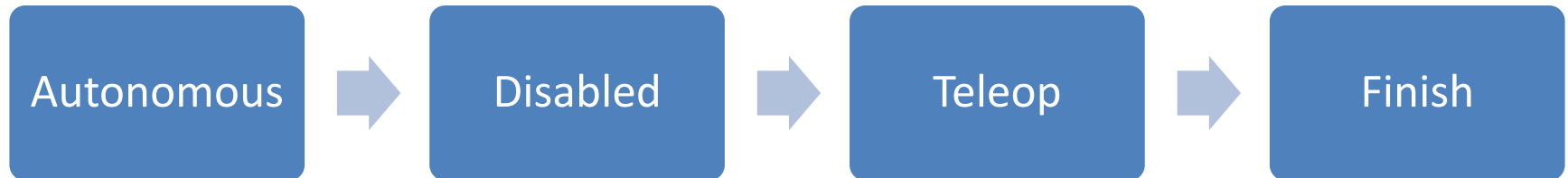
3. FIRST Architecture in LabVIEW

- WPI Robotics
- FRC Robot Framework
- Dashboard Framework

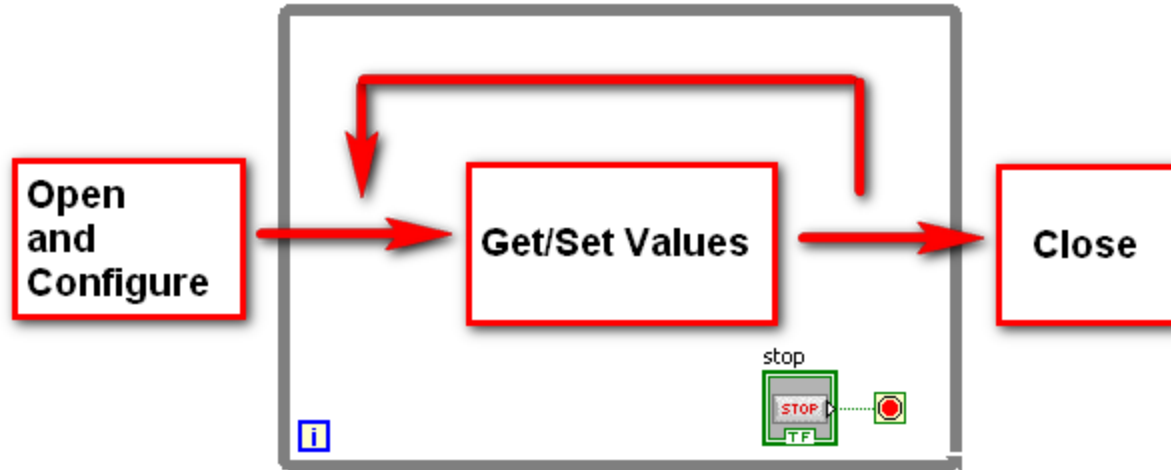




Competition Flow



WPI Programming

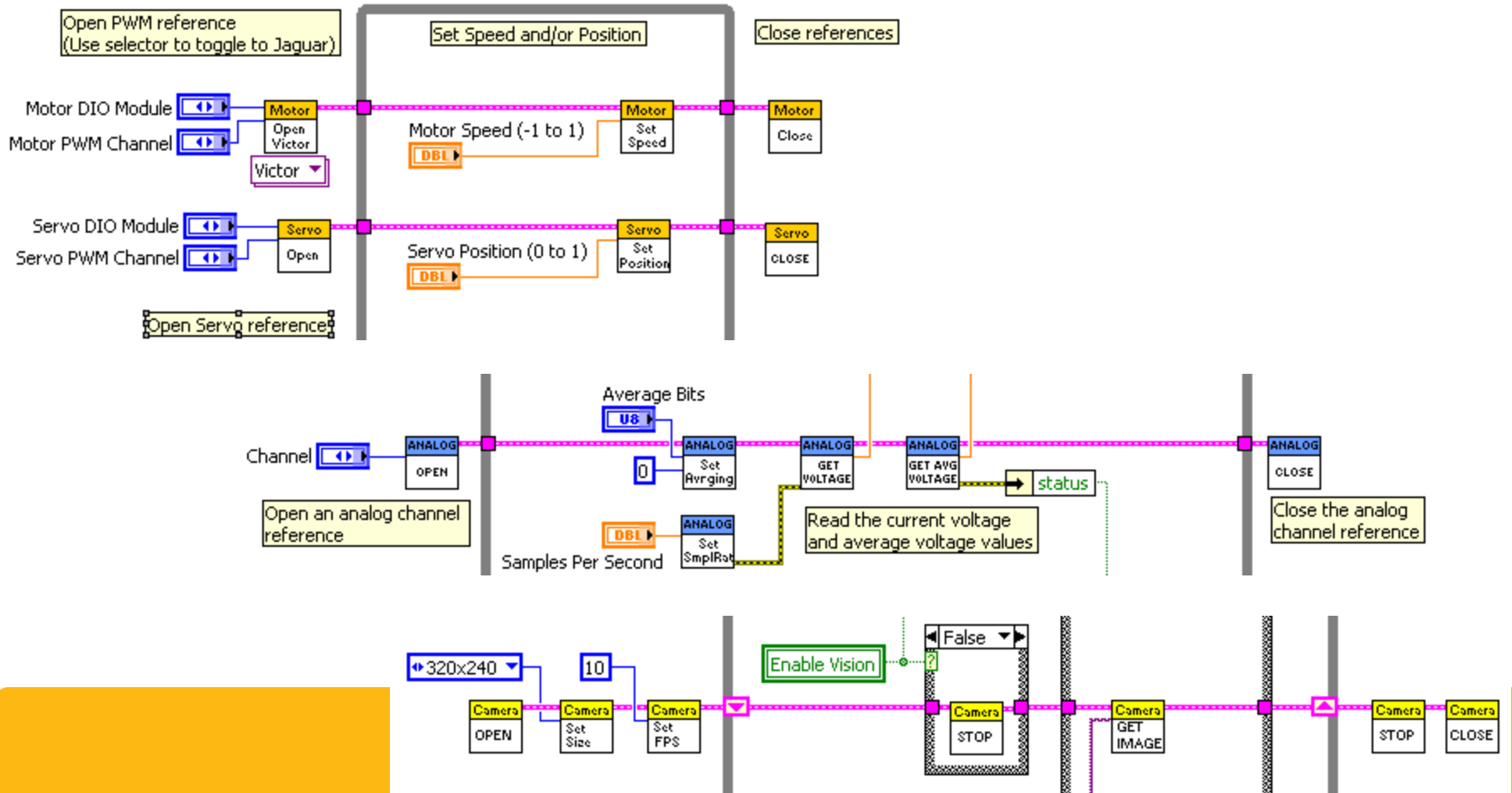


All WPI Robotics Library Functions follow these steps:

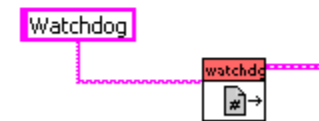
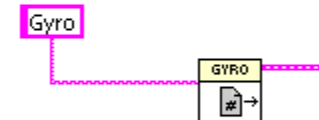
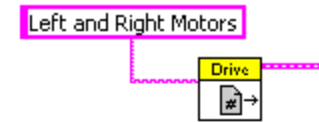
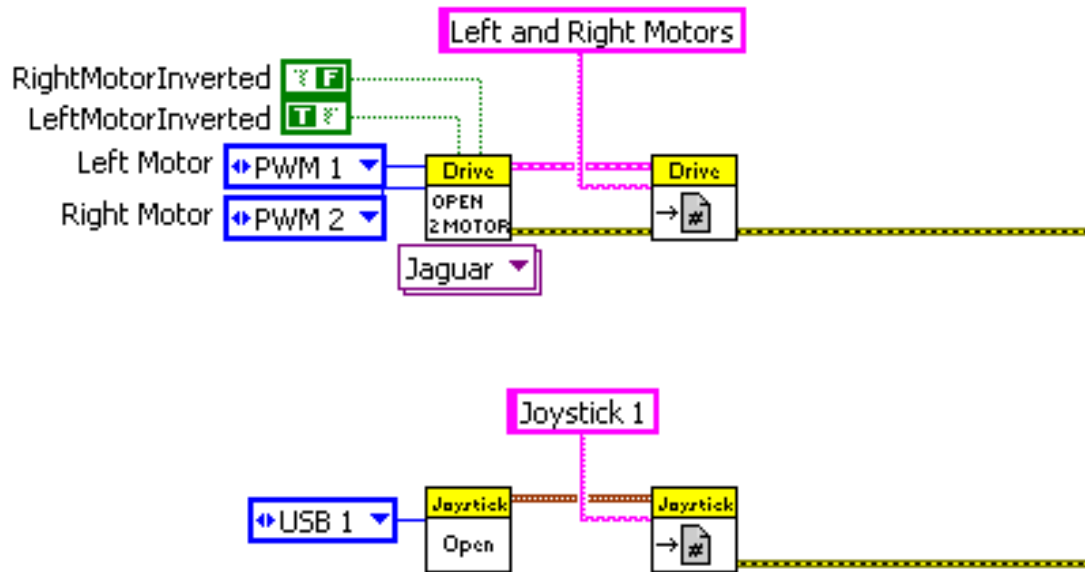
- Initialize
- Get/Set values
- Close



WPI Programming

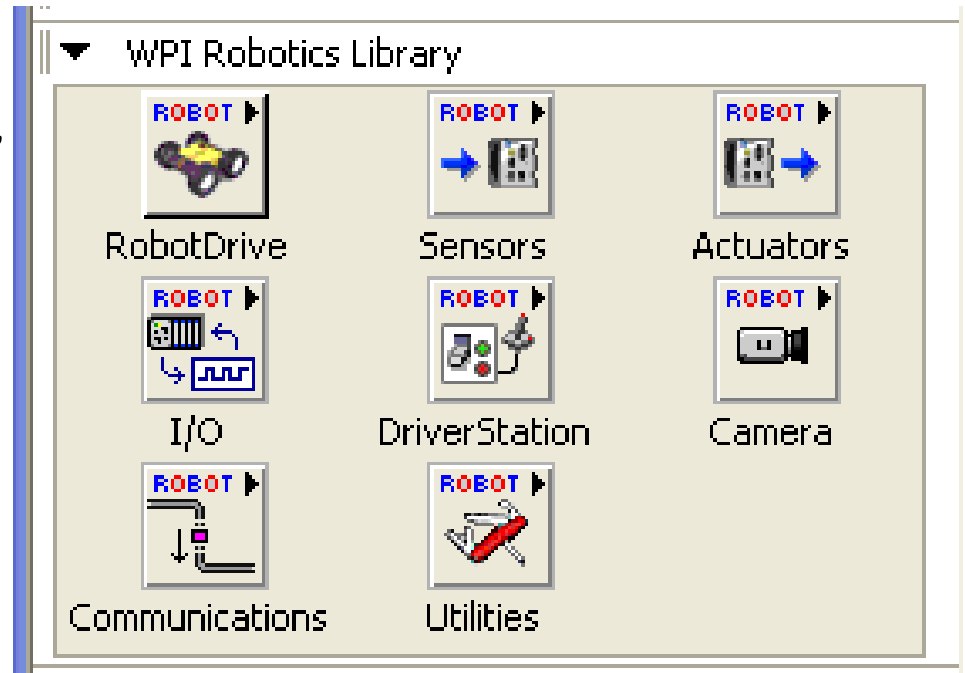


RefNums



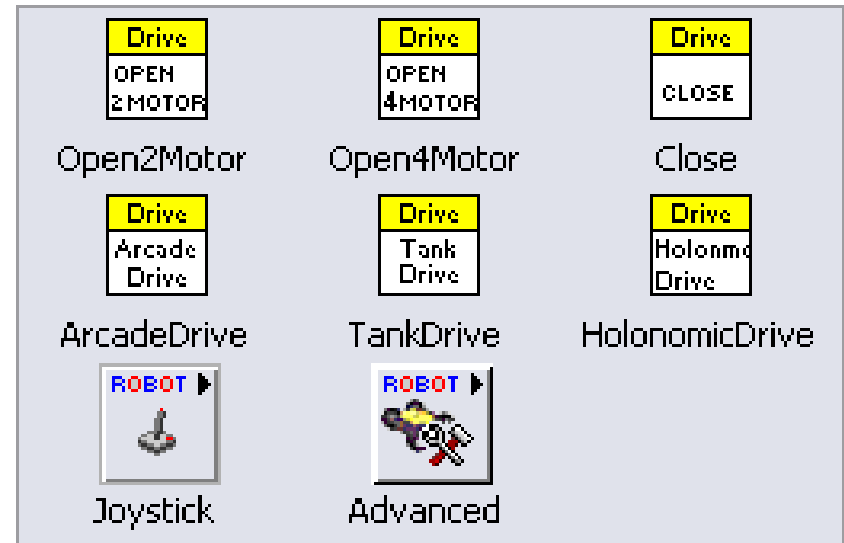
WPI Functions

- Functions for controlling motors, sensors, actuators, I/O, camera, driver station, and to perform other functions in the robot.
- All follow the same Open, Get/Set, Close process.



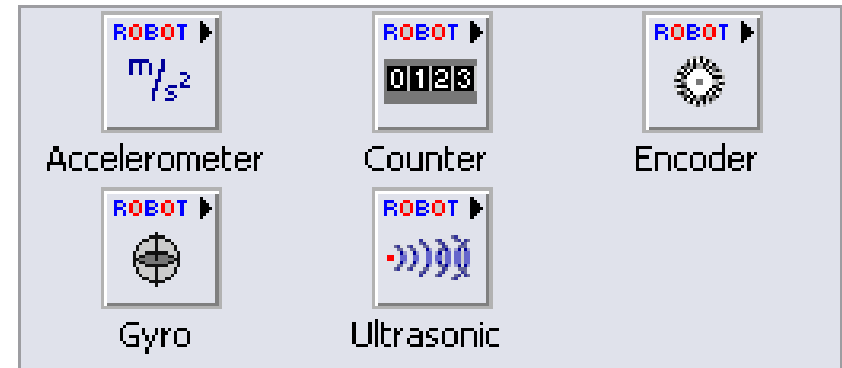
RobotDrive

- Open 2- or 4- motor version
- Drive using Arcade, Tank, or Holonomic Drive
- Close Motor
- Use Joystick palette to read values from Joystick



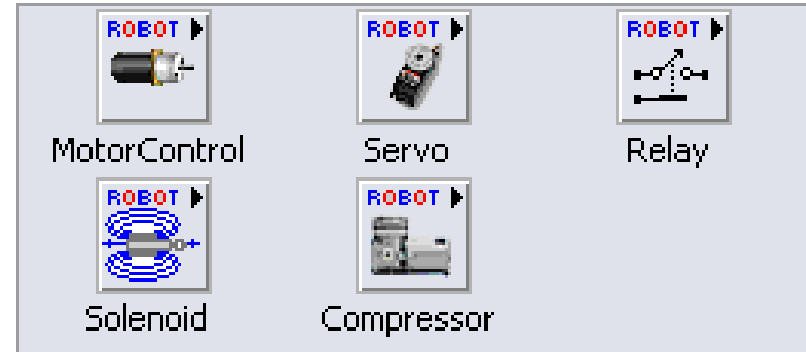
Sensor

- Access sensors on your robot.
Use these values to determine
your robot's next moves.



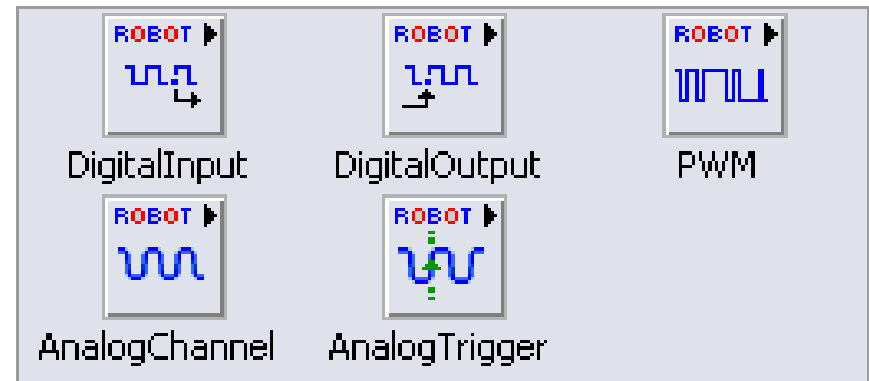
Actuators

- Use these VI's to control additional motors and actuators on your robot to control arms, launchers, and other tools.



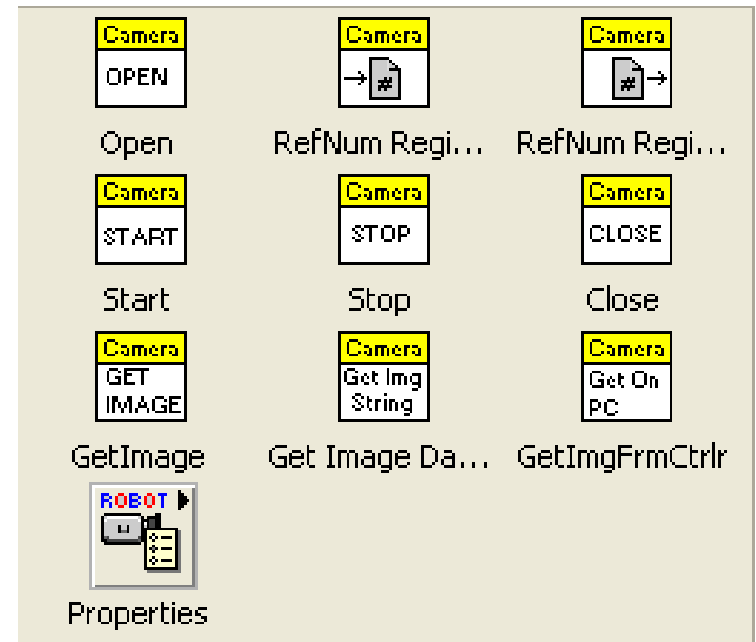
I/O

- Send and receive analog and digital values on the cRIO, when other actuator and sensor VI's don't fit your application.



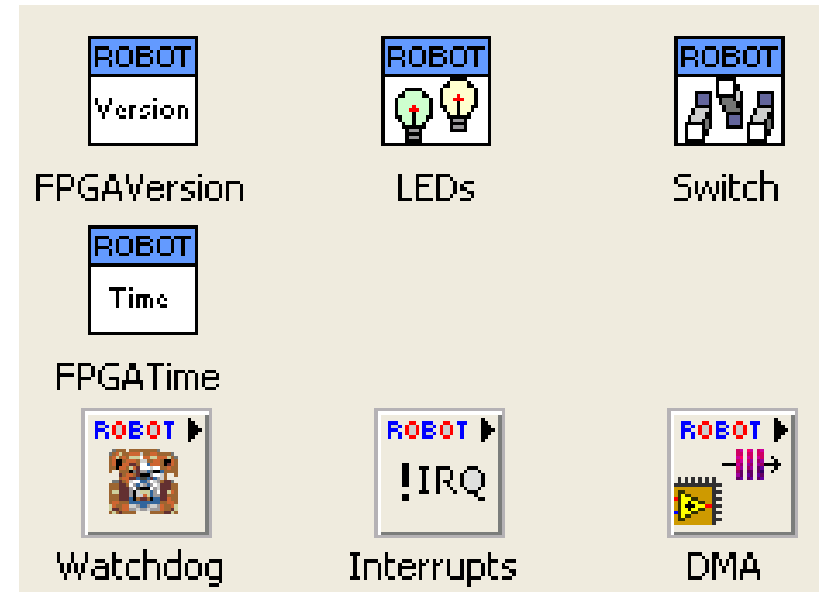
Camera

- Acquire images from the camera.



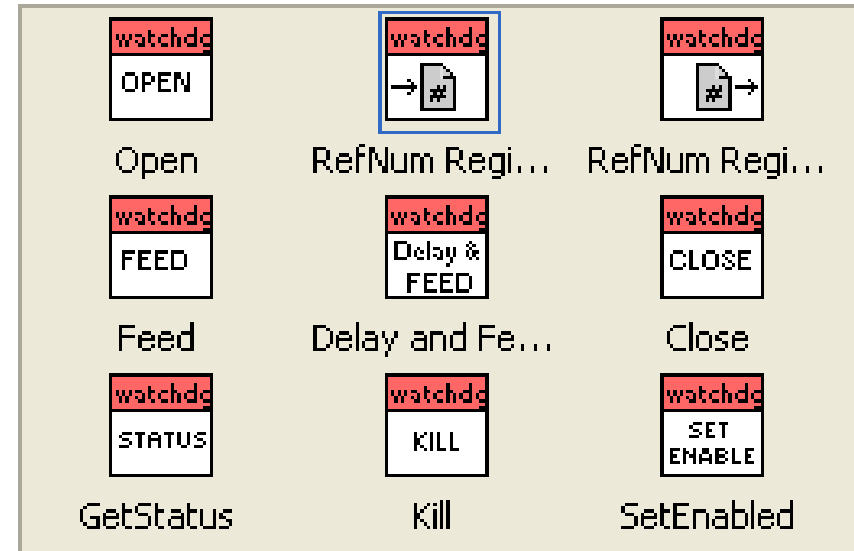
Utilities

- Several useful functions for low-level control of cRIO,
- Watchdog timer is an important set of VI's for your robot.



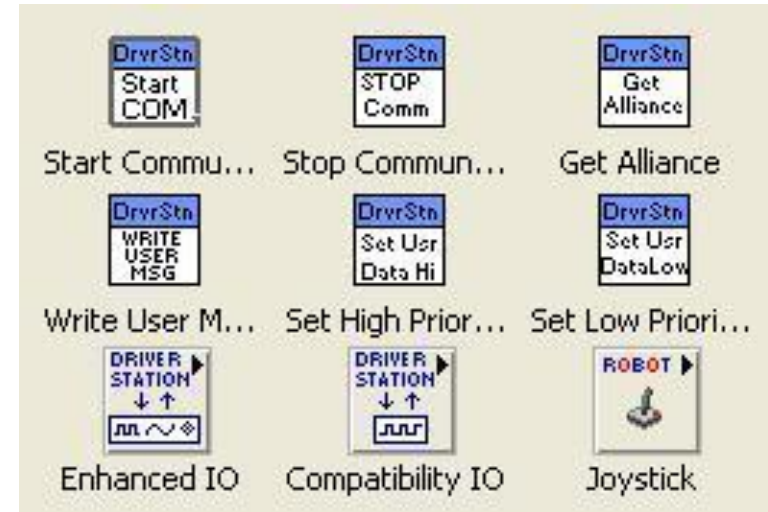
Watchdog

- Shuts down robot in the event that your driver station loses communication with the robot.
- Requires that you periodically “feed” the watchdog to keep it from shutting down your robot.
- If your driver station shuts down, the watchdog is not fed and your robot turns off.
- Make sure you feed the watchdog or your robot will stop.



Driver Station

- Used to program the driver station and to pass data between driver station and robot.





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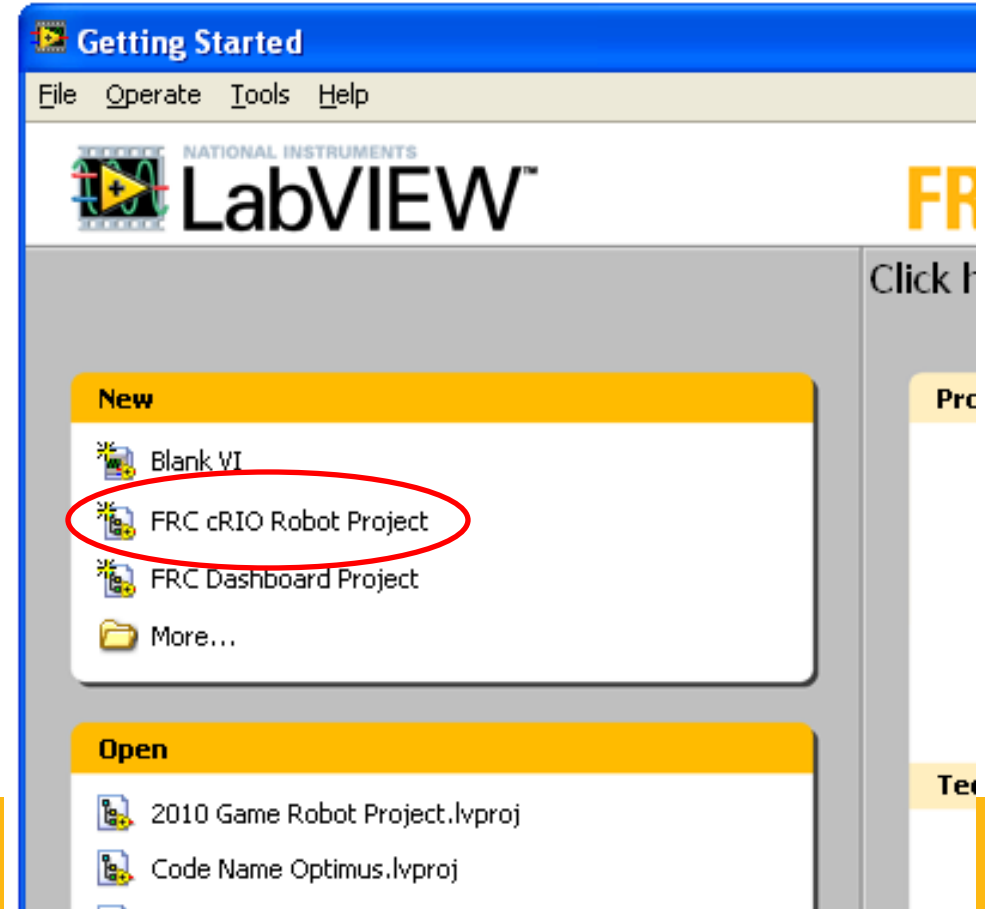
LabVIEW™



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Robot Project

- Create from splash screen



Robot Project

Create New FRC Robot Project

Select project name, folder, and IP address

Project name
2010 Game Robot Project

Project folder
C:\Documents and Settings\asttest\My Documents\LabVIEW Data\2010 Game Robot Project

cRIO IP address
10.xx.yy.02

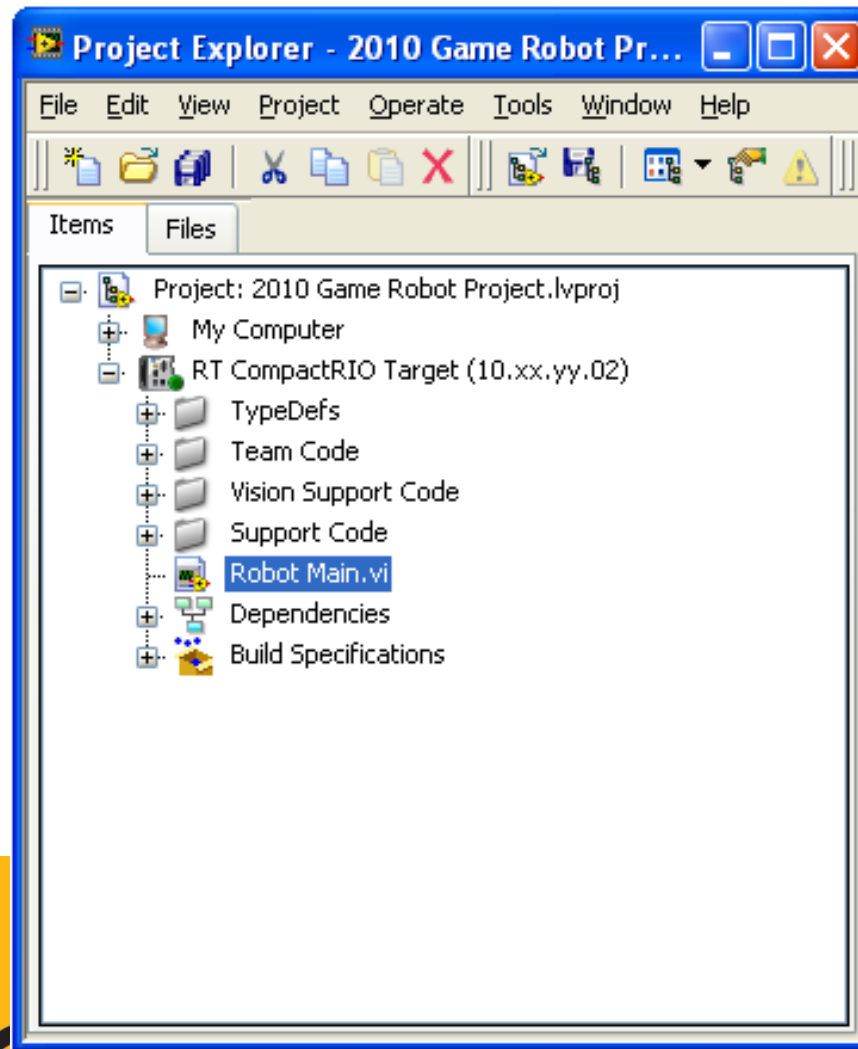
Project: 2010 Game Robot Project.lvpr

- My Computer
 - Dependencies
 - Build Specifications
- RT CompactRIO Target (10.xx.yy.02)
 - TypeDefs
 - Team Code
 - Begin.vi
 - Autonomous Independent.vi
 - Autonomous Iterative.vi
 - Teleop.vi
 - Vision Processing.vi
 - Disabled.vi
 - Periodic Tasks.vi
 - Robot Global Data.vi
 - Build DashBoard Data.vi
 - Finish.vi
 - Vision Support Code

< Back Next > Finish Cancel Help

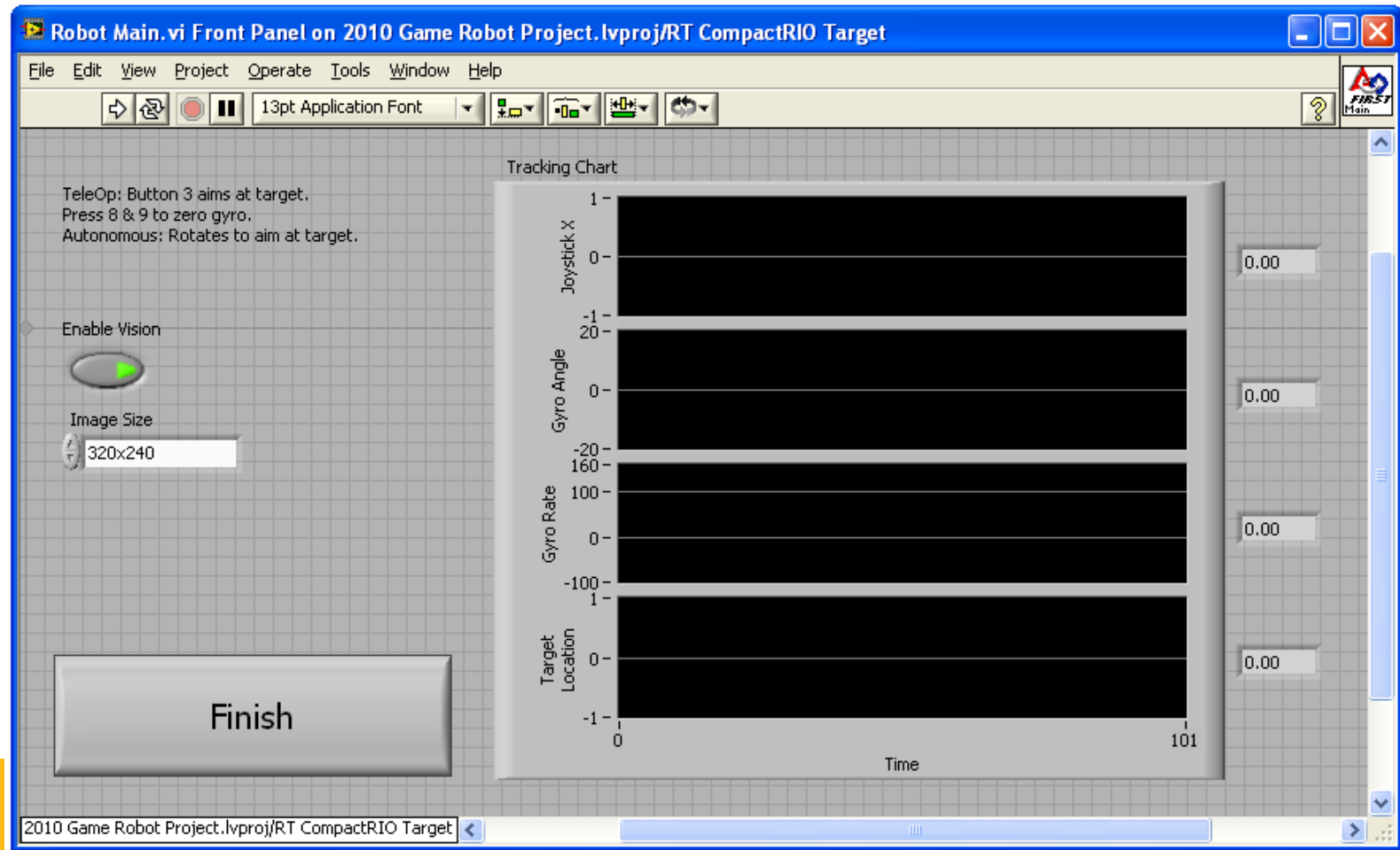


FRC Robotics Project





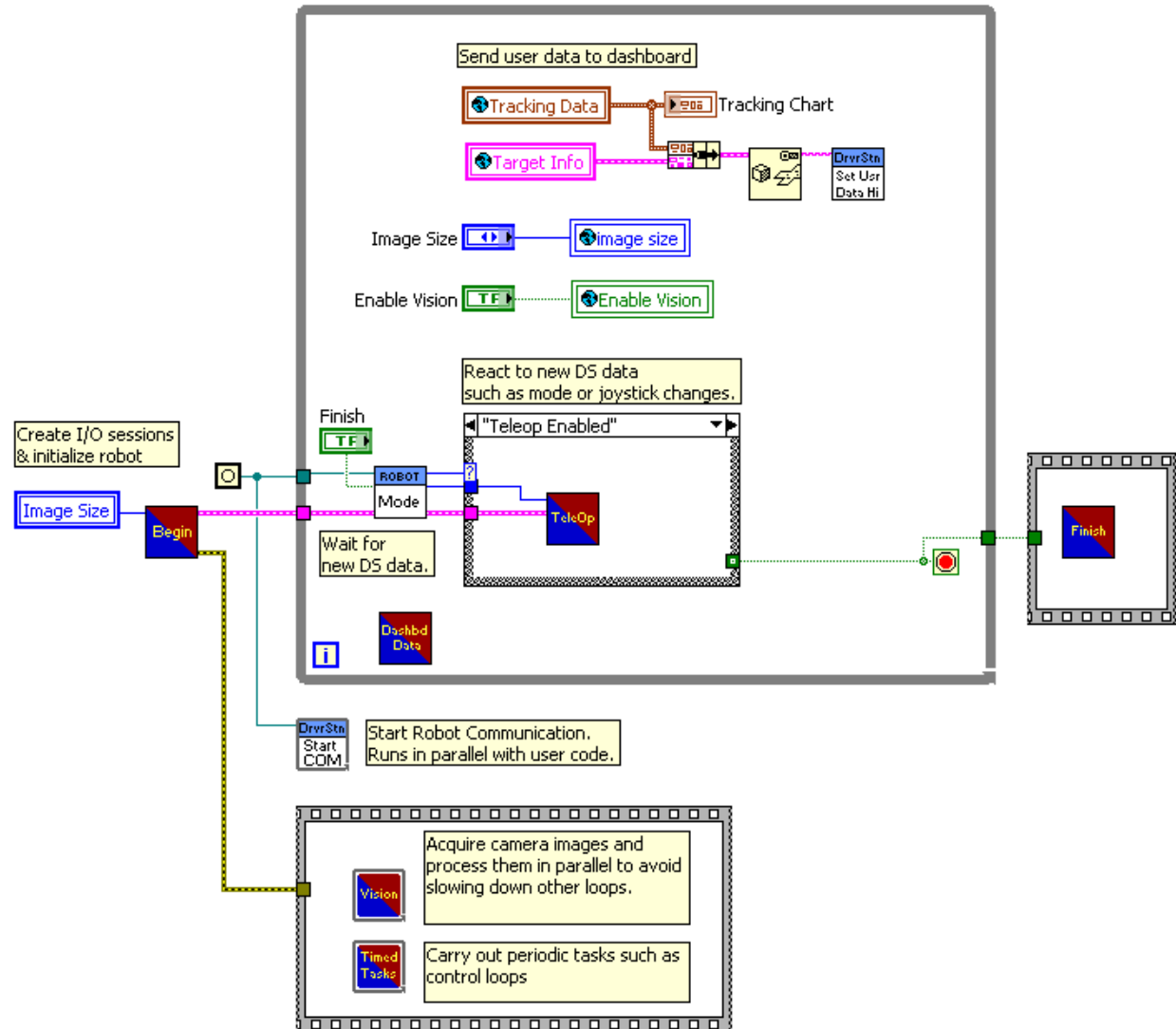
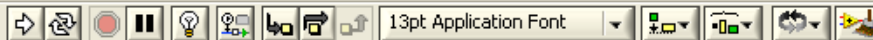
FRC Robot Front Panel



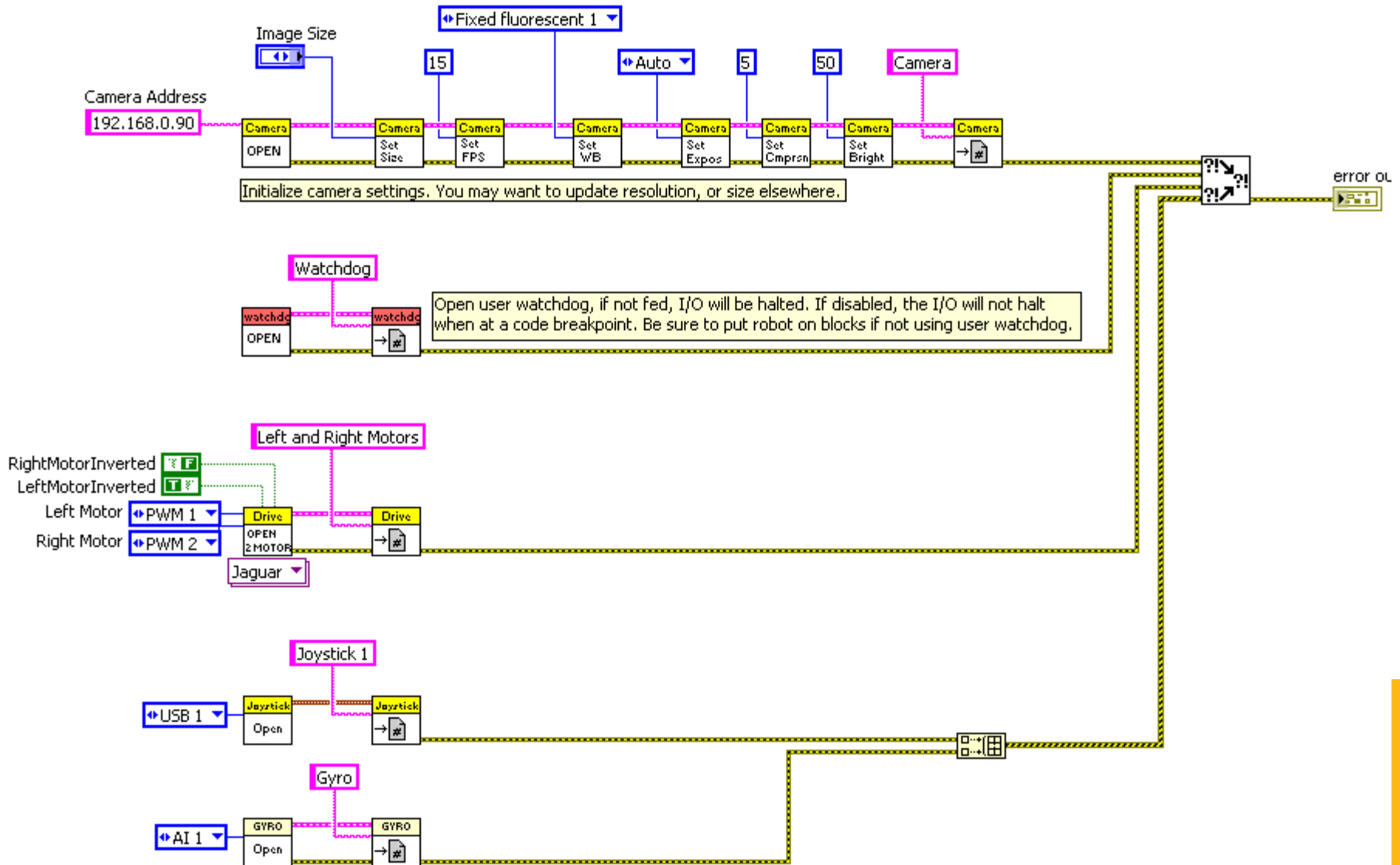


Robot Main.vi Block Diagram on 2010 Game Robot Project.lvproj/RT CompactRIO Target

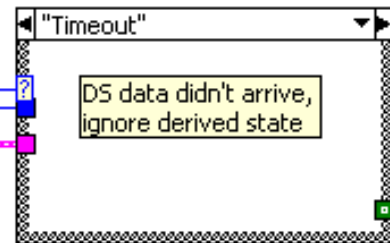
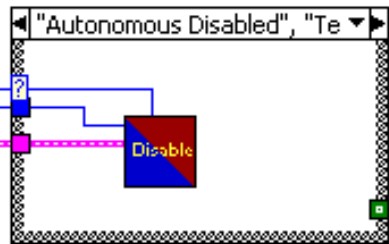
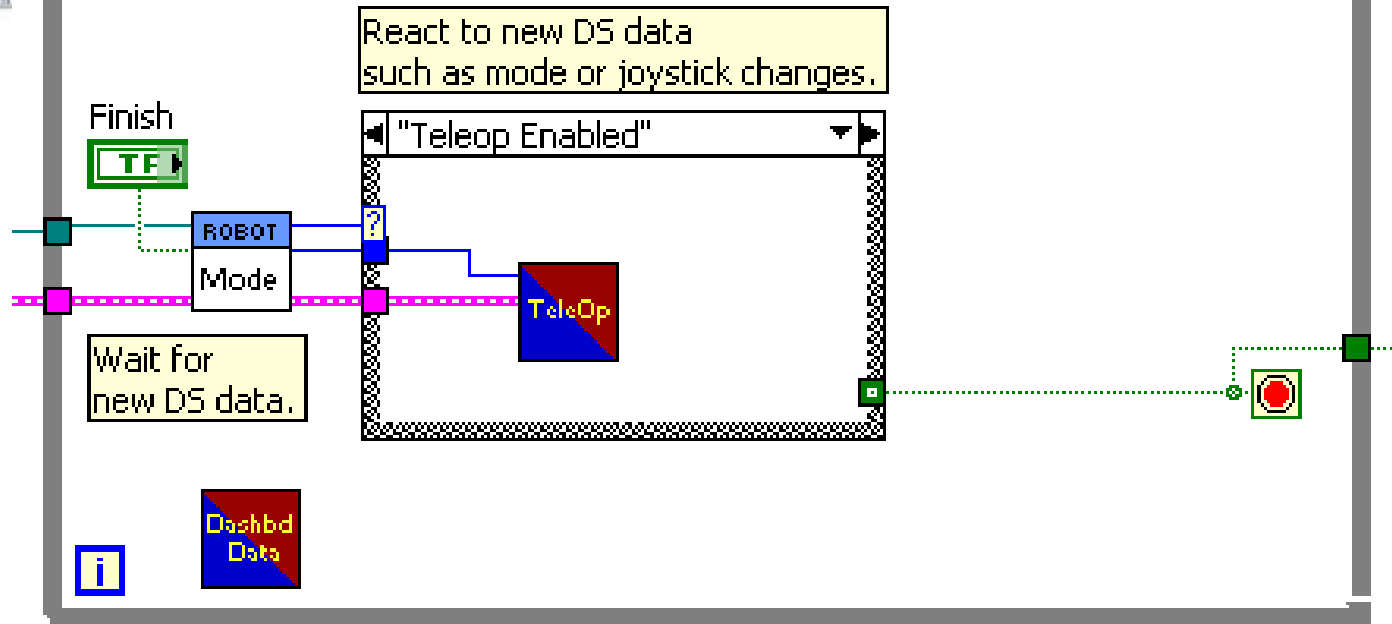
File Edit View Project Operate Tools Window Help



Begin.vi



Mode



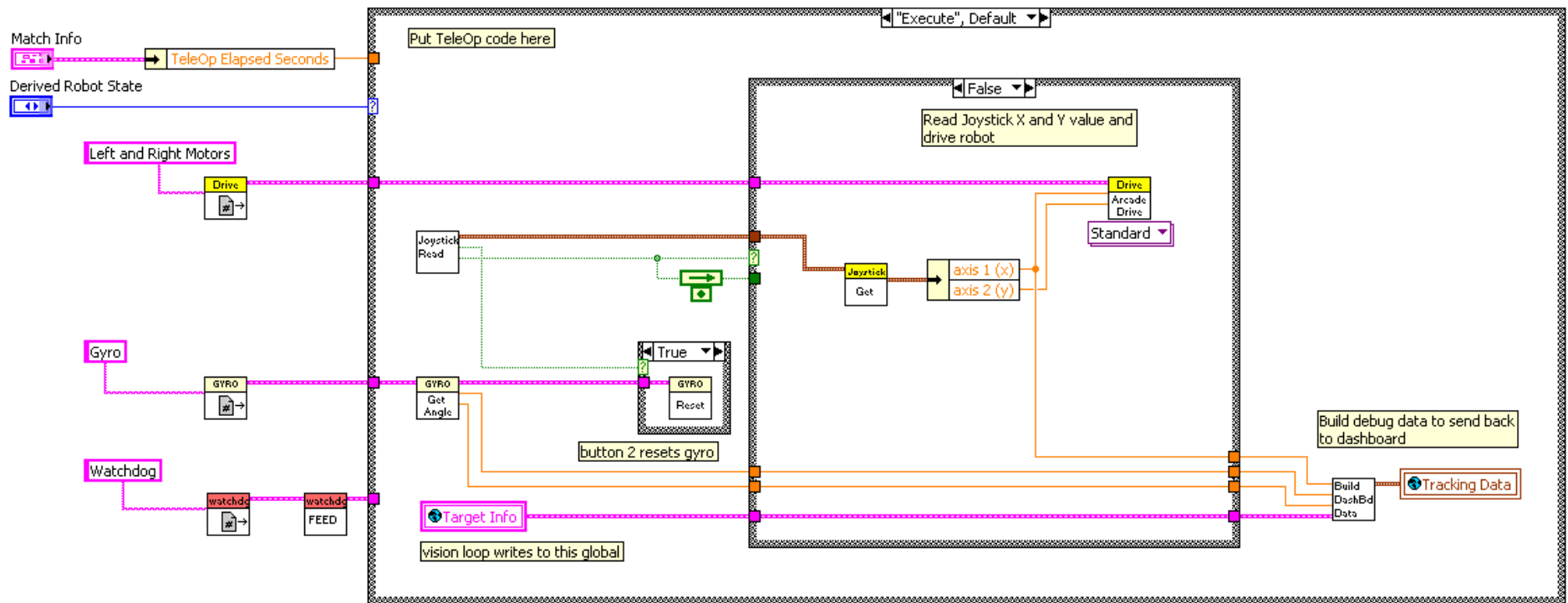
- "Autonomous Enabled"
- "Teleop Enabled"
- "Autonomous Disabled", "Teleop Disabled"
- "Timeout"
- ✓ "Finish"



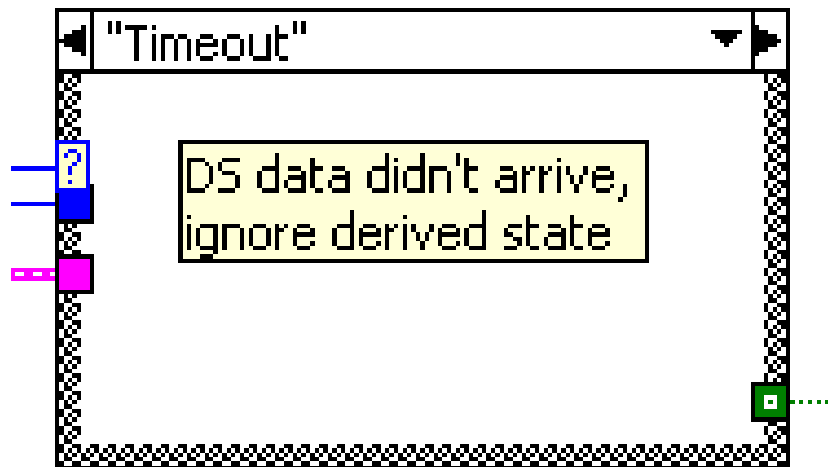
TeleOp Mode

This VI is called each time an teleop DS packet is received.
Place your teleop code into the Execute case, using the Elapsed time to affect the task being carried out.

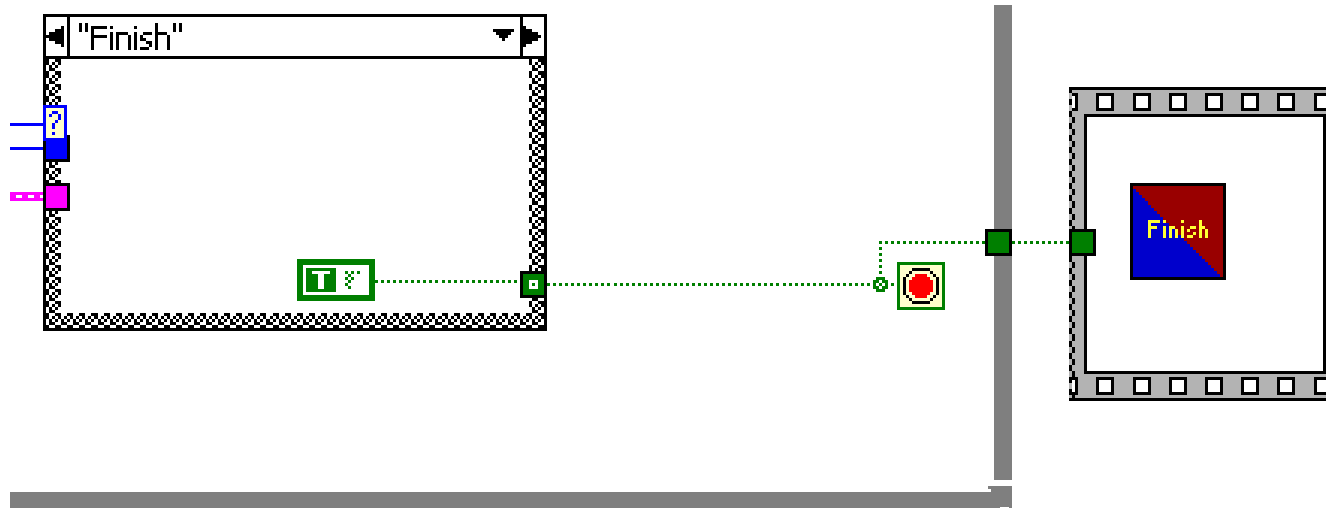
You can open I/O and initialize value in the init case, or in Begin.vi.



Timeout



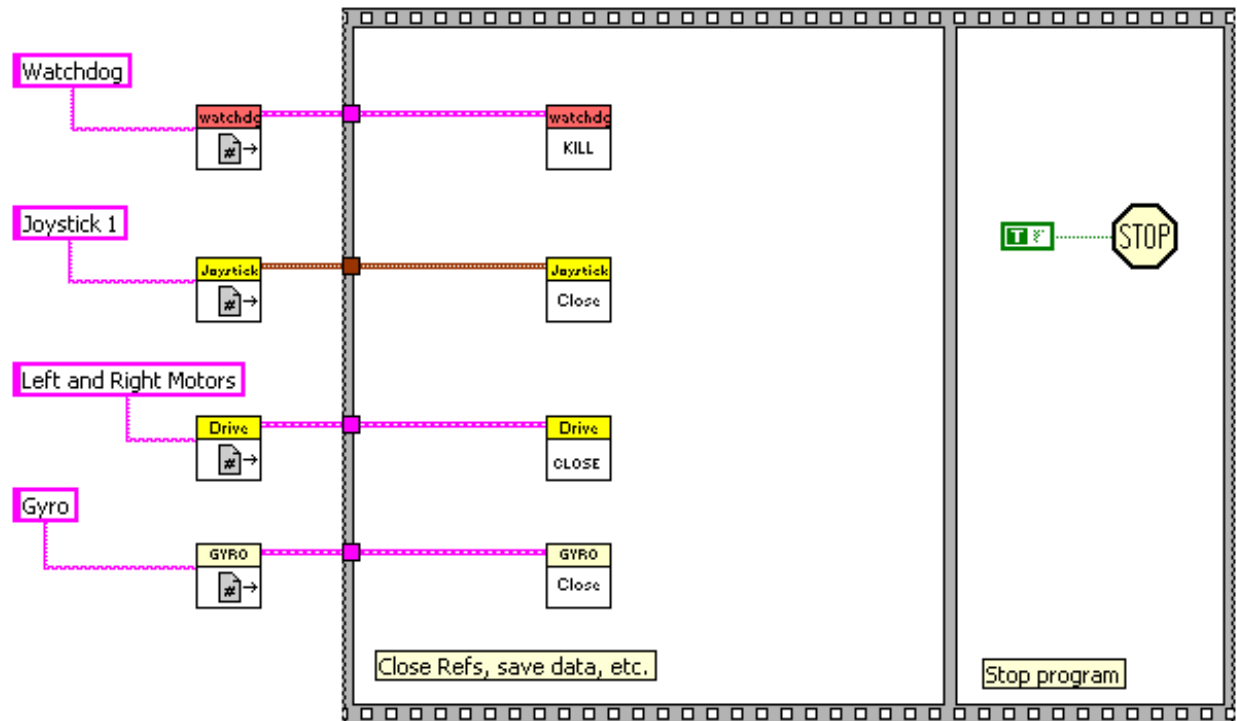
Finish



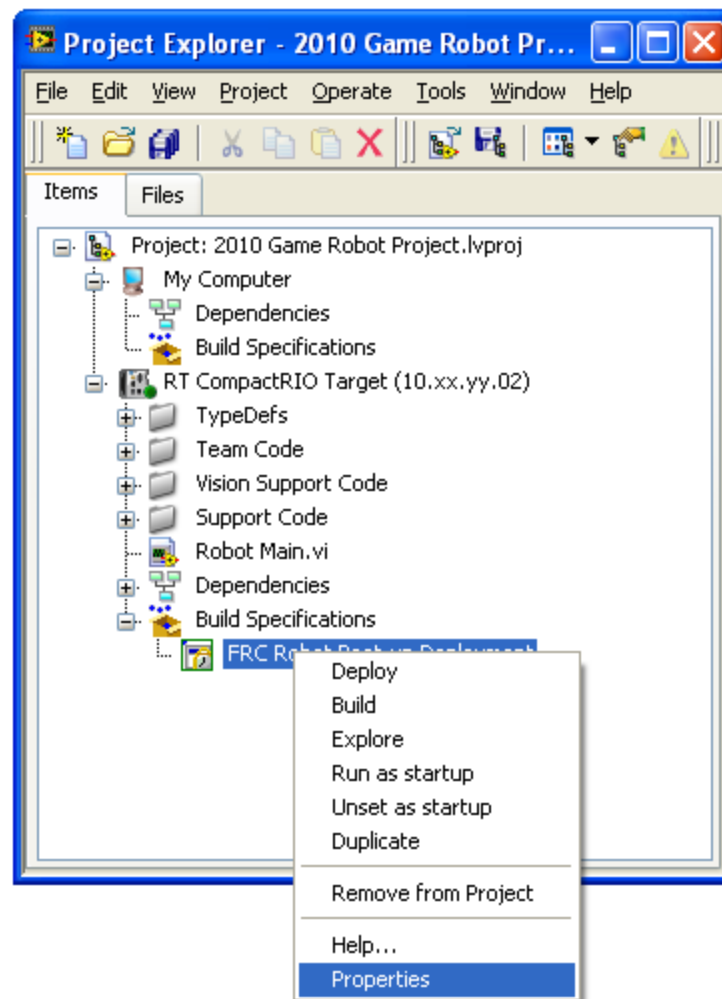
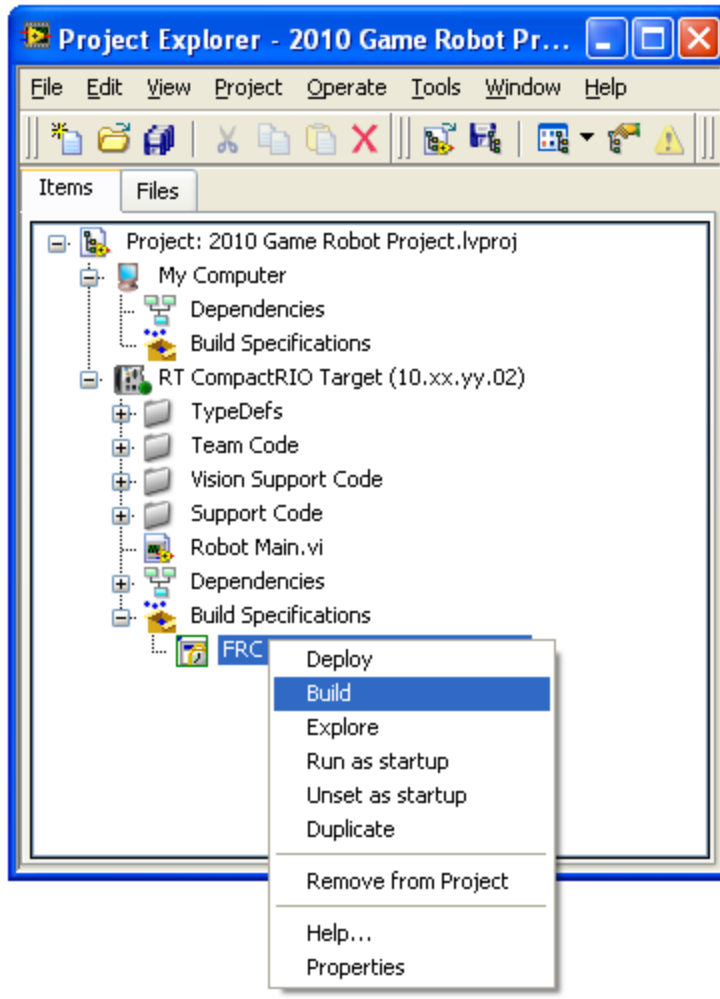
Finish

The robot controller program is about to finish.

Save collected data to files, and carry out any other tasks you'd like before exiting. You can close refnums opened earlier in your program, but they will be cleaned up automatically anyway.



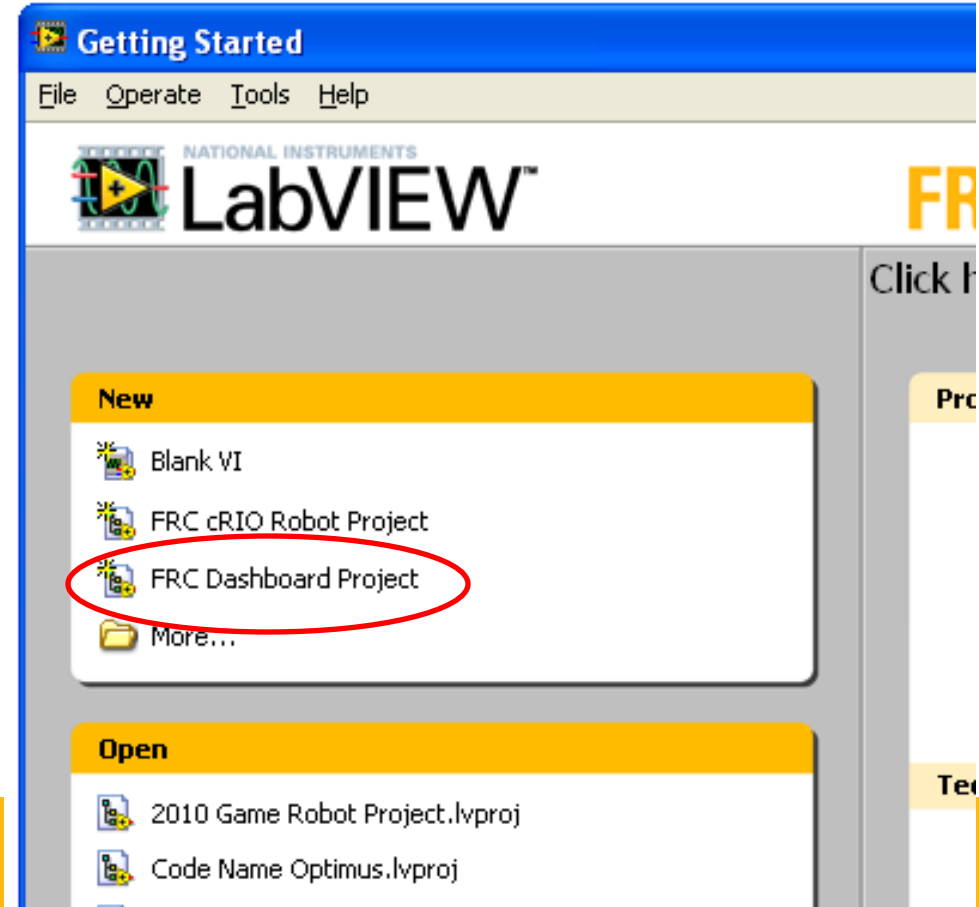
Deploying the Robot Code



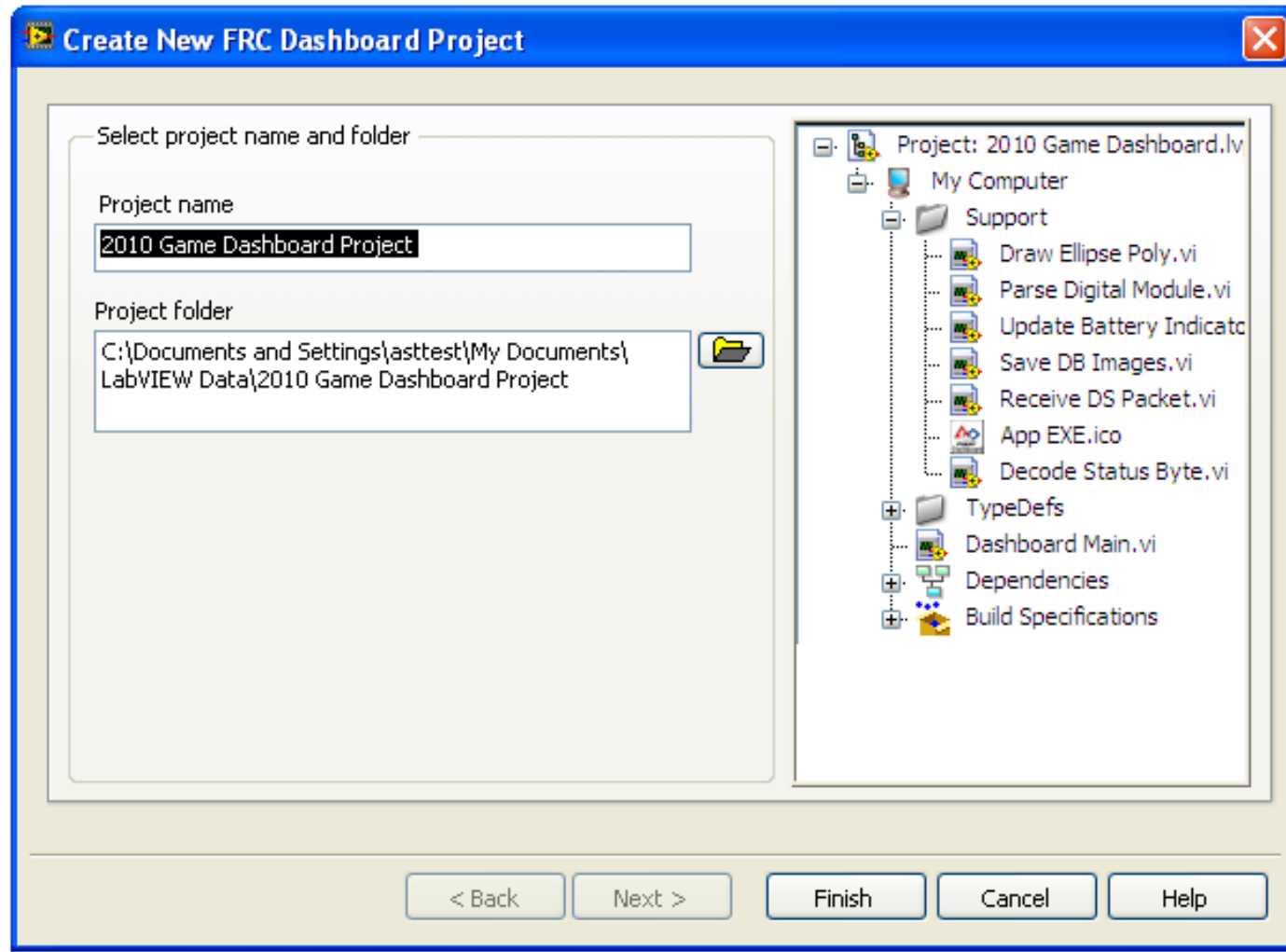


Dashboard Project

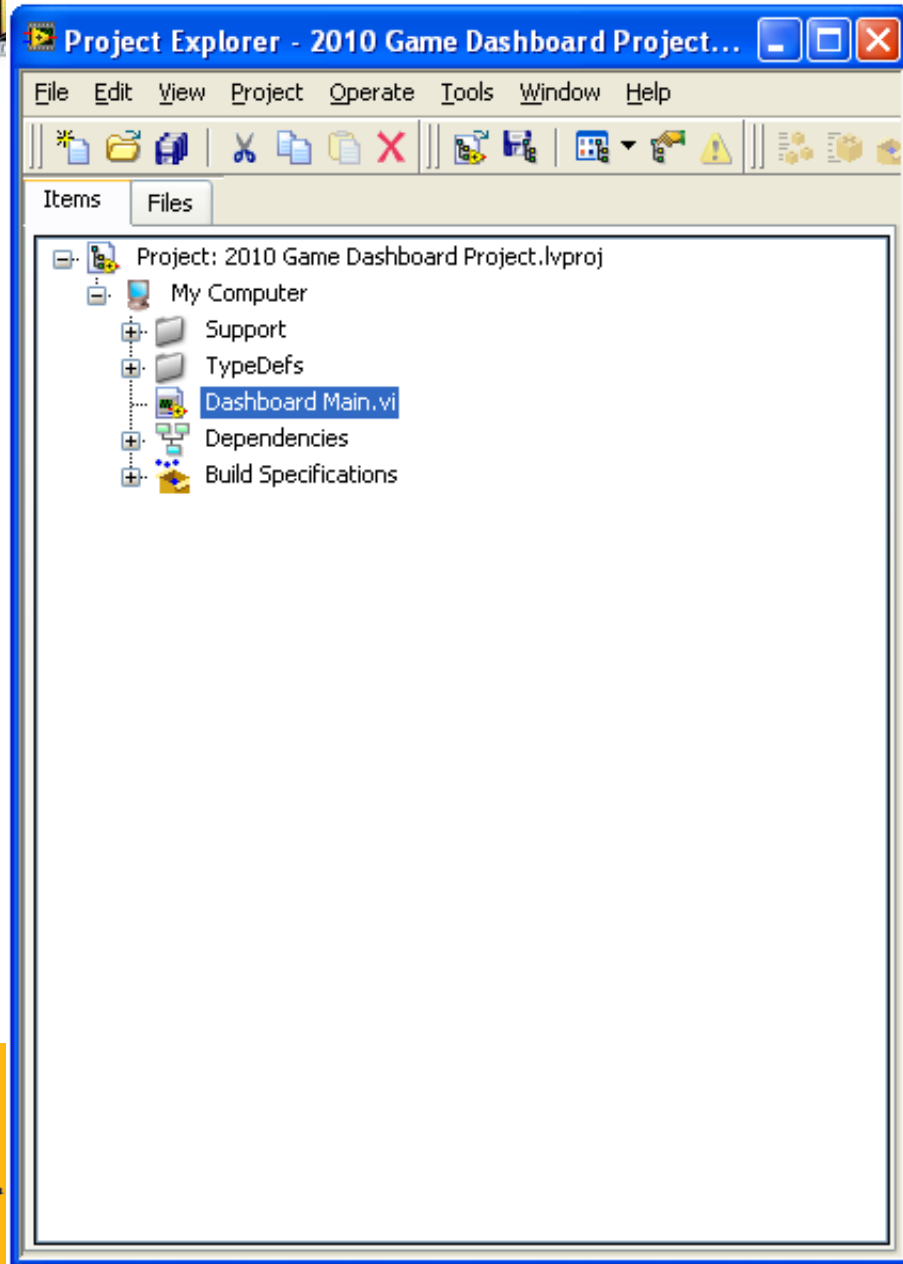
- Create from splash screen



Dashboard Project

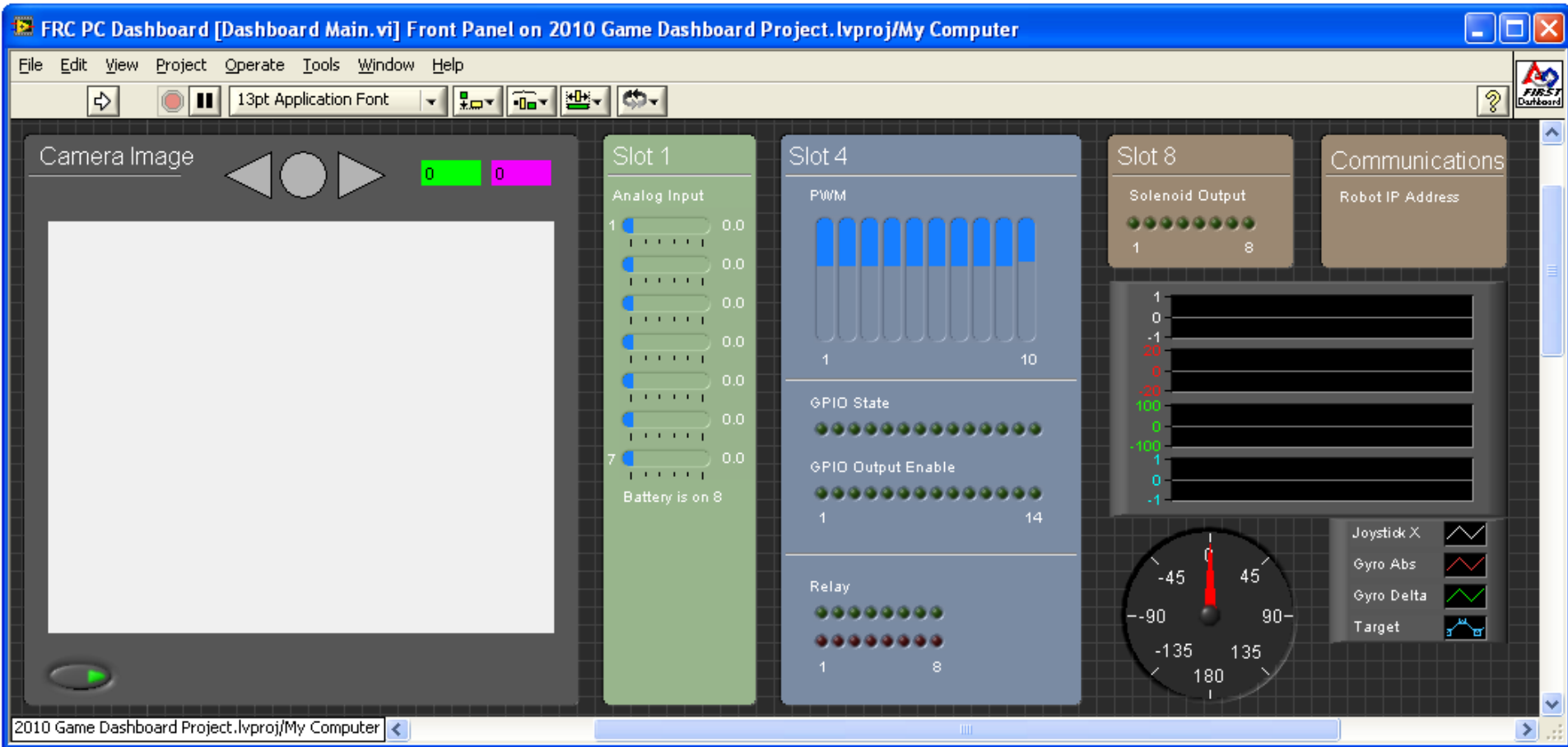


Dashboard Project

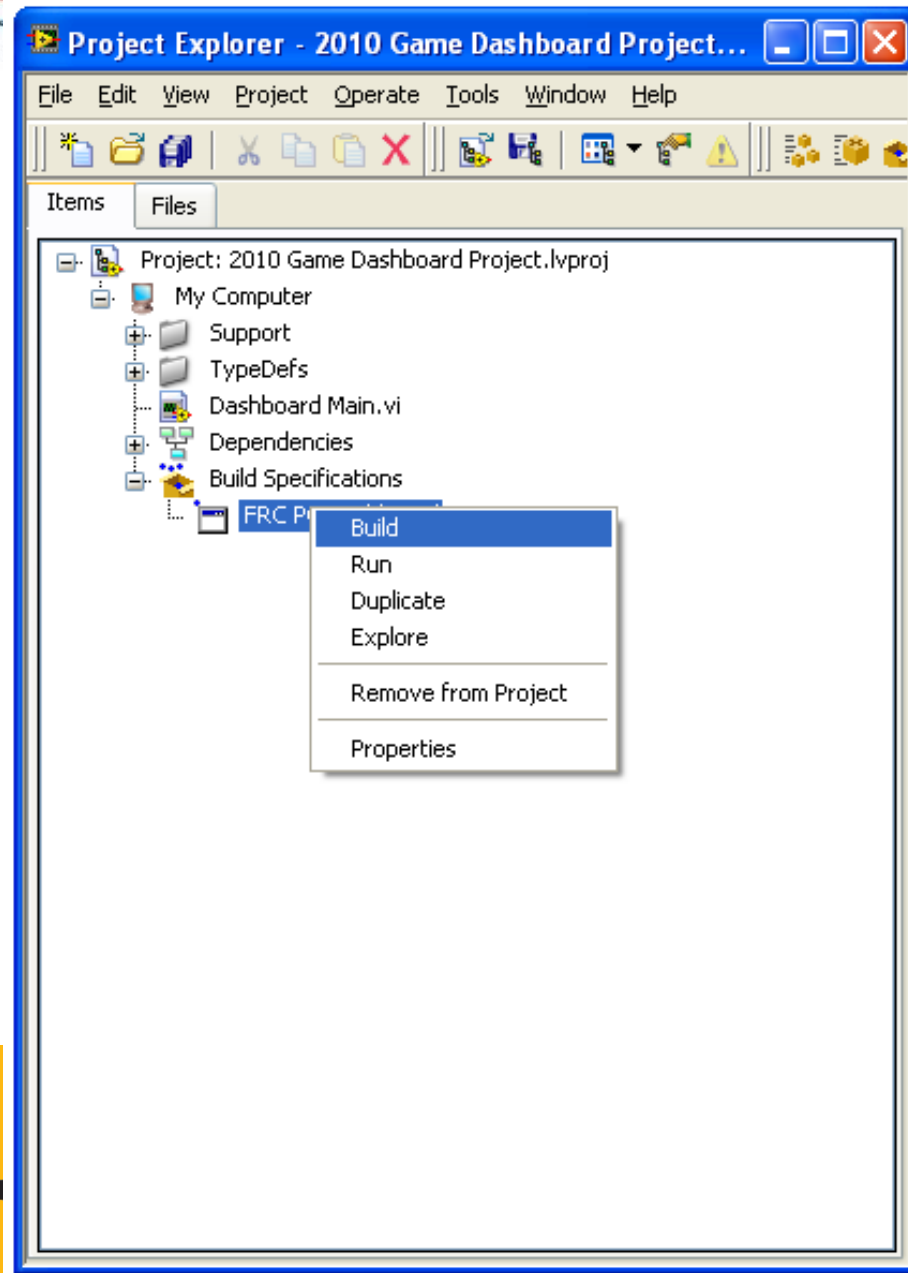




Dashboard Front Panel



Dashboard Build





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FIRST Robotics Software 2010 - Windows - LabVIEW & NI Utilities



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Second 2010 Mandatory LabVIEW & NI Utilities Update

Available Downloads:

Download Language: English
Product Line: Academic
Version: 2010
Release date: 02-01-2010
Software type: Application Software
Operating system: Windows

Description

This software is the second mandatory update for the LabVIEW portion of the FIRST Robotics Competition Software 2010. You **MUST** install this update in order to compete in the FIRST Robotics Competition.

Because this software also contains the update to the cRIO Imaging Utility, teams using Java and C/C++ will also need to install it.

This software update is meant to be installed **ONLY** after installing LabVIEW FRC from the DVD that comes with the 2010 Controls Kit or on the Classmate computer that comes with the kit.



4. Additional Resources

- Documentation
 - From LabVIEW splash screen
 - WPI Robotics Programming Guide
- NI.com/FIRST
 - LabVIEW tutorials for your team
 - Motor Basics
 - Sensors basics
 - PID tutorial
 - Video processing
 - New software feature training
 - Software downloads
 - Community support

