NATIONAL INSTRUMENTS™

LabVIEW Programming for FRC Beginners (Using Simulation for Testing)

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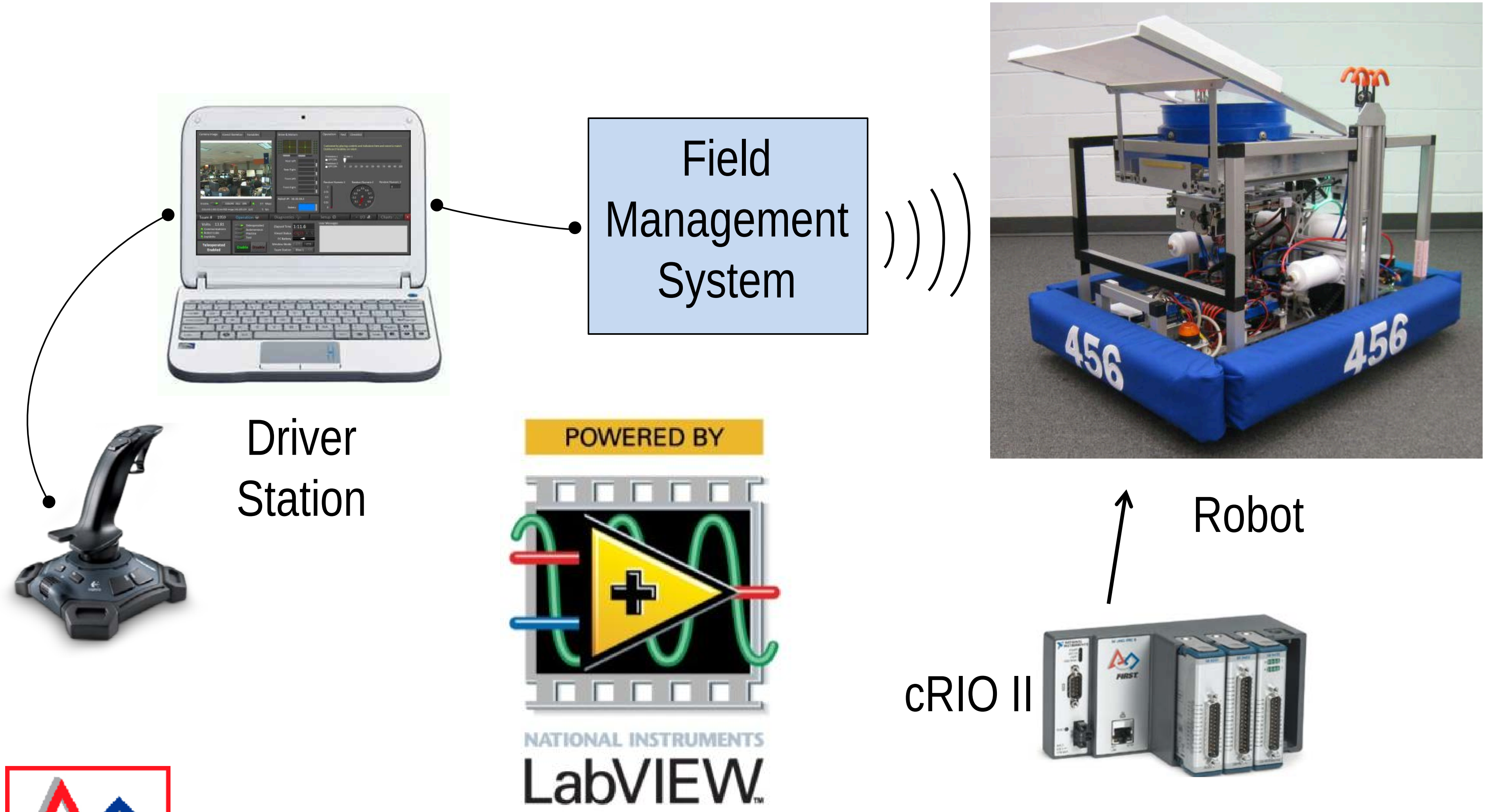
National Instruments

April 24, 2013

What you will learn

- How simulation simplifies learning LabVIEW for FRC
- How to create and edit a robot program
- How to program sensors and actuators
- How to test drive your robot code
- How to write and test Autonomous code
- How to create a custom Dashboard

System Topology



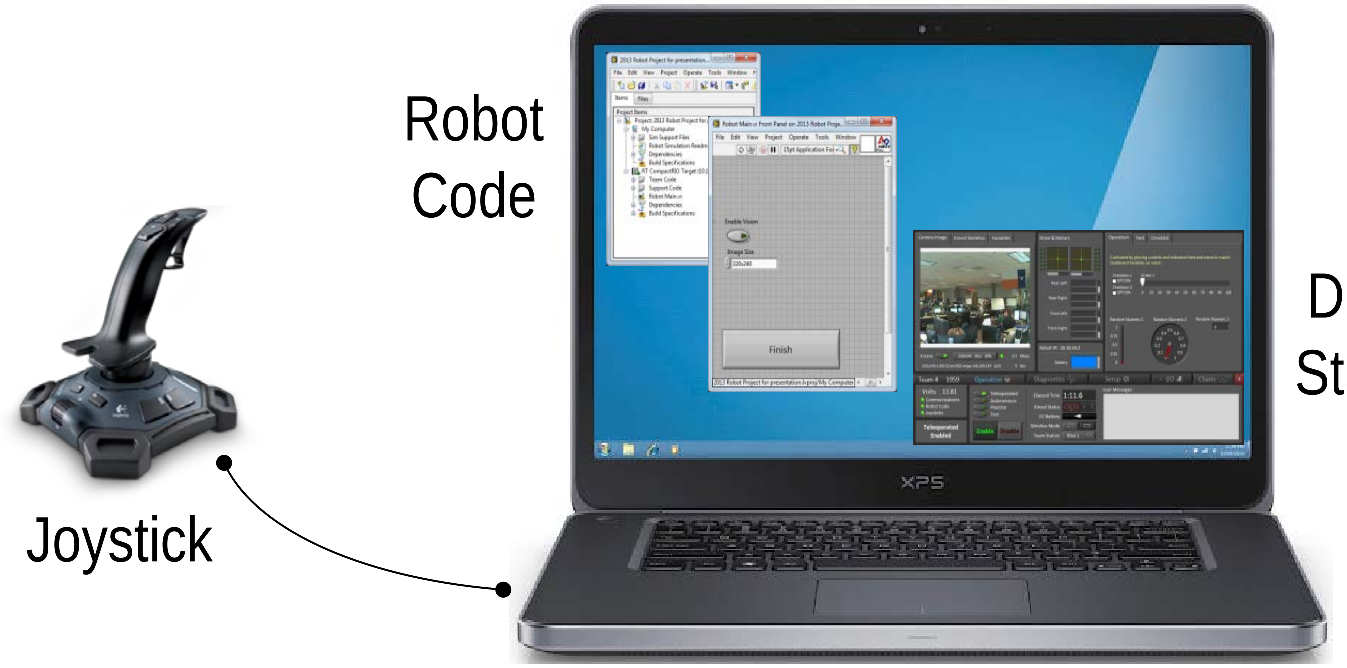
Field Management System

Driver Station

Robot

cRIO II

All you need for Simulation



Robot Code

Driver Station

Joystick

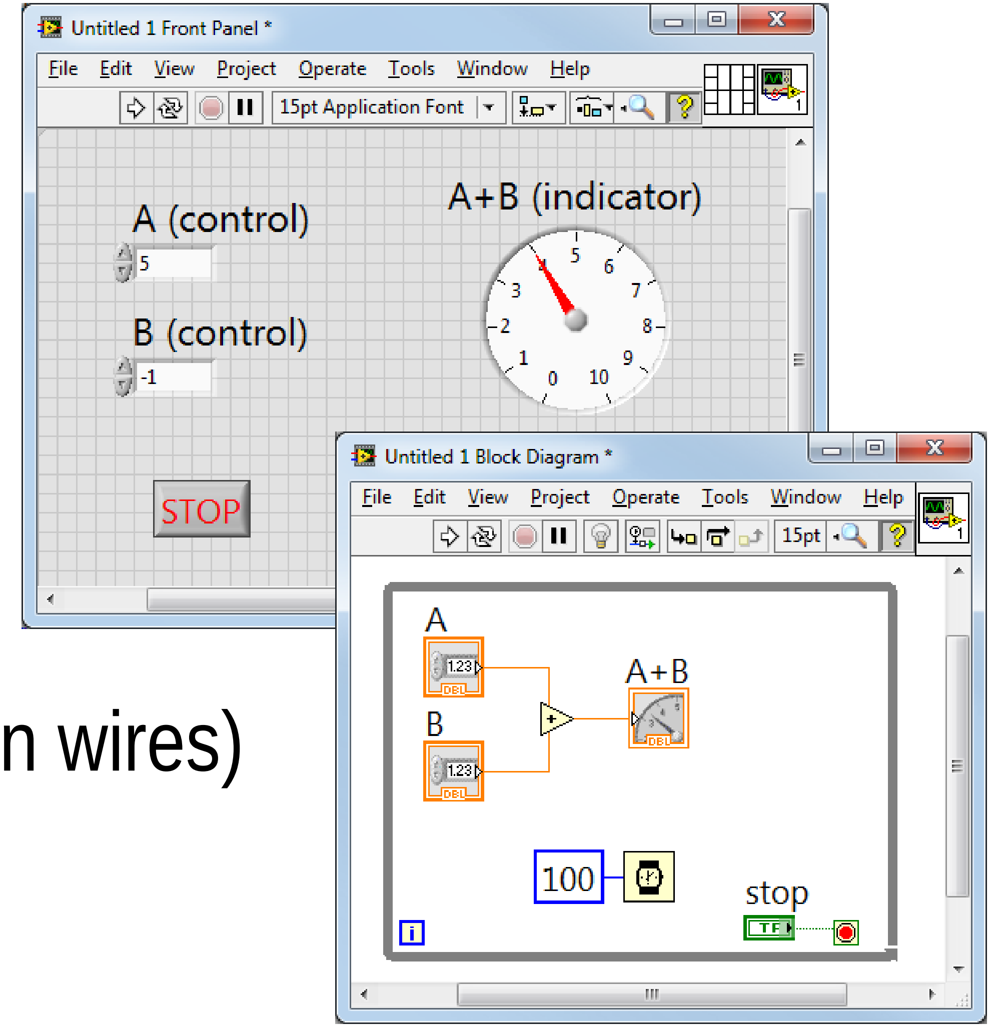
Laptop or Desktop PC*

* video card with dedicated memory

POWERED BY NATIONAL INSTRUMENTS LabVIEW

What is LabVIEW?

- Graphical programming
- Virtual Instrument (VI)
    - Front panel (UI)
    - Block diagram (code)
    - Icon/connector
- Dataflow (data travels on wires)
- A VI can be a subVI



What is LabVIEW for FRC?

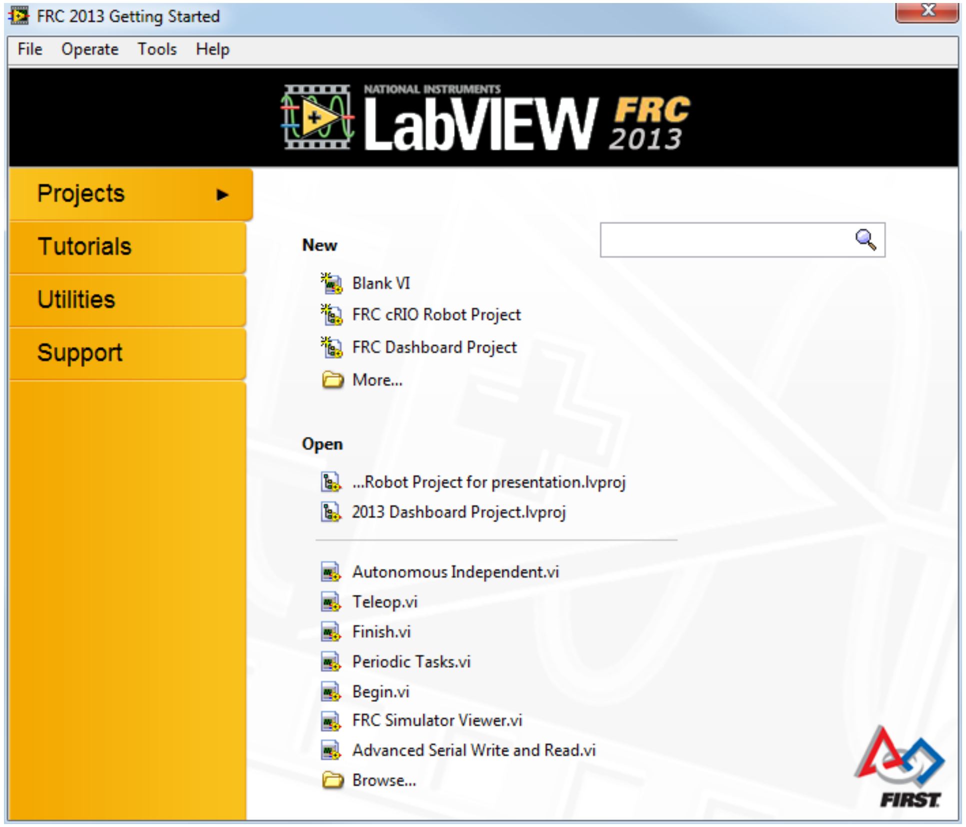
- LabVIEW Professional Development Package
- FRC specific Getting Started Window
- FRC specific library of VIs – WPILib
- FRC specific Robot Projects
- FRC specific examples and tutorials
- FRC support: phone, forums, videos, documents

LabVIEW for FRC with Simulation

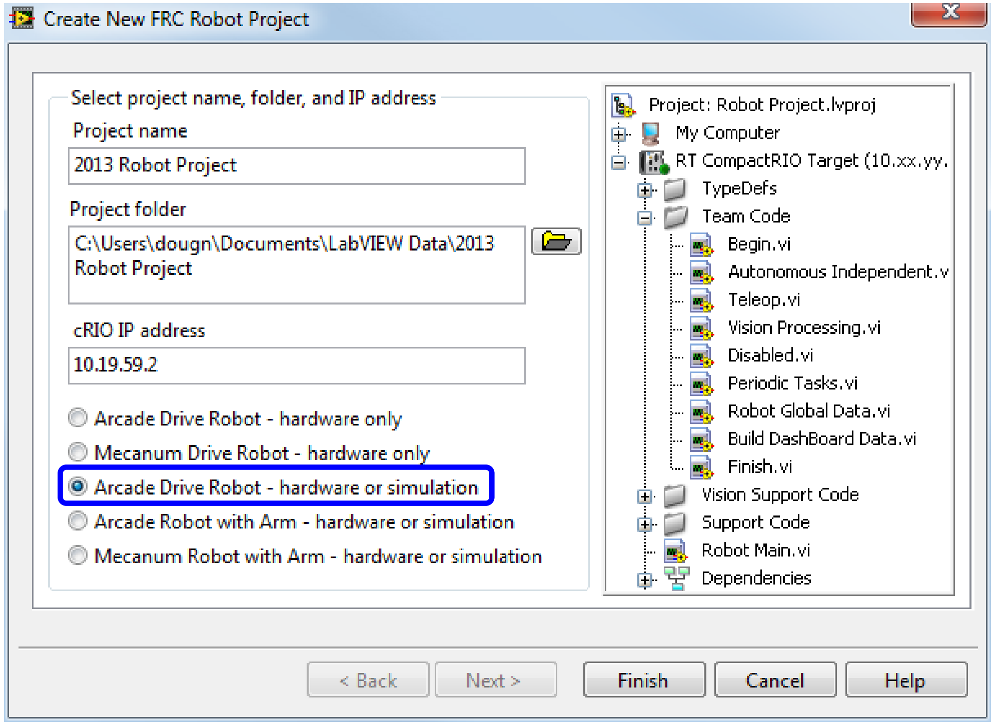
- Some Robot Projects contain predefined robots
  - Each robot has specific sensors and actuators
  - Each robot contains a wiring manifest (html file)
  - Predefined robots cannot be edited
- Simulator opens when code is run on My Computer
- Same code can run on a real robot
- Still need the Driver Station

Getting Started Window

- Projects
  - Create Robot Project
  - Create Dashboard Project
- Tutorials
  - Robot Simulation
  - Integrating Examples
- Support
  - Example Finder



Create FRC Robot Project



Create New FRC Robot Project

Select project name, folder, and IP address

Project name: 2013 Robot Project

Project folder: C:\Users\dougn\Documents\LabVIEW Data\2013 Robot Project

cRIO IP address: 10.19.59.2

○ Arcade Drive Robot - hardware only

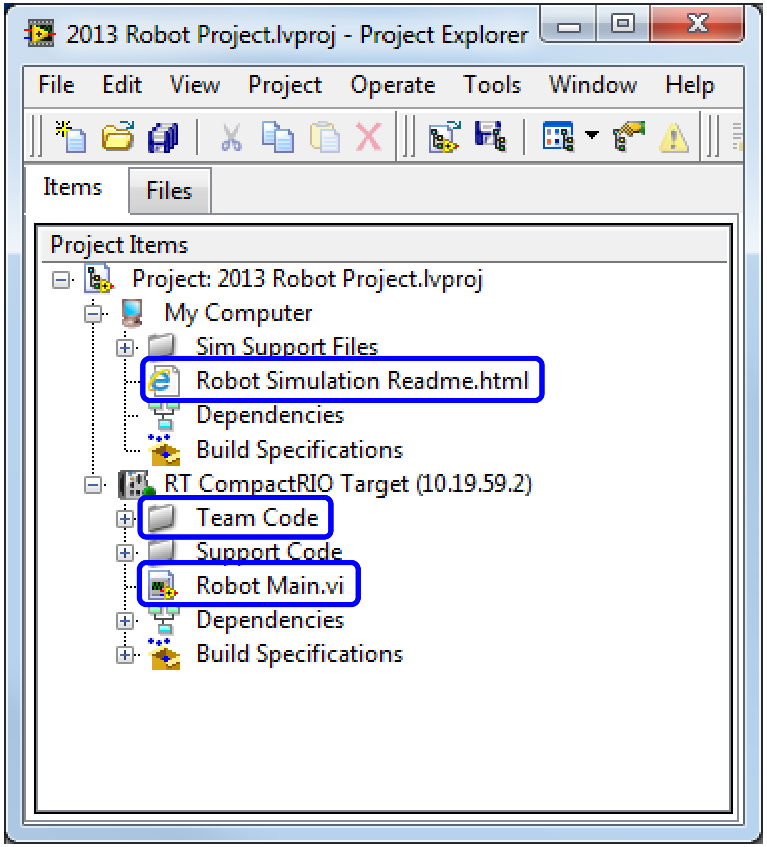
○ Mecanum Drive Robot - hardware only

● Arcade Drive Robot - hardware or simulation

○ Arcade Robot with Arm - hardware or simulation

○ Mecanum Robot with Arm - hardware or simulation

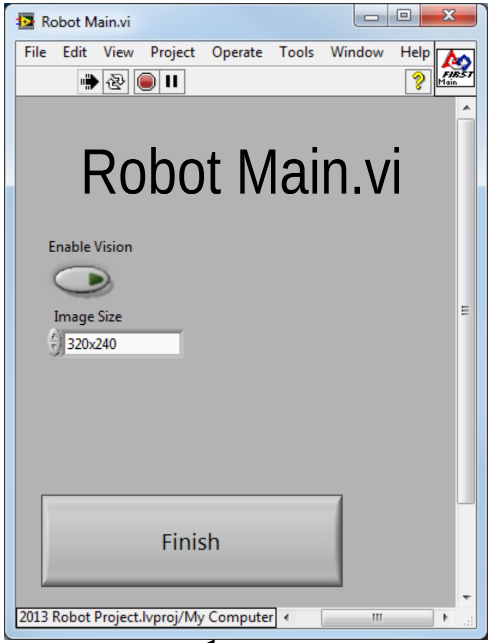
```
Project: Robot Project.lvproj
  My Computer
  RT CompactRIO Target (10.xx.yy.
    TypeDefs
    Team Code
      Begin.vi
      Autonomous Independent.v
      Teleop.vi
      Vision Processing.vi
      Disabled.vi
      Periodic Tasks.vi
      Robot Global Data.vi
      Build DashBoard Data.vi
      Finish.vi
    Vision Support Code
    Support Code
    Robot Main.vi
    Dependencies
```



2013 Robot Project.lvproj - Project Explorer

```
Project Items
Project: 2013 Robot Project.lvproj
  My Computer
    Sim Support Files
    Robot Simulation Readme.html
    Dependencies
    Build Specifications
  RT CompactRIO Target (10.19.59.2)
    Team Code
    Support Code
    Robot Main.vi
    Dependencies
    Build Specifications
```

Run Robot main.vi – Test Default Code



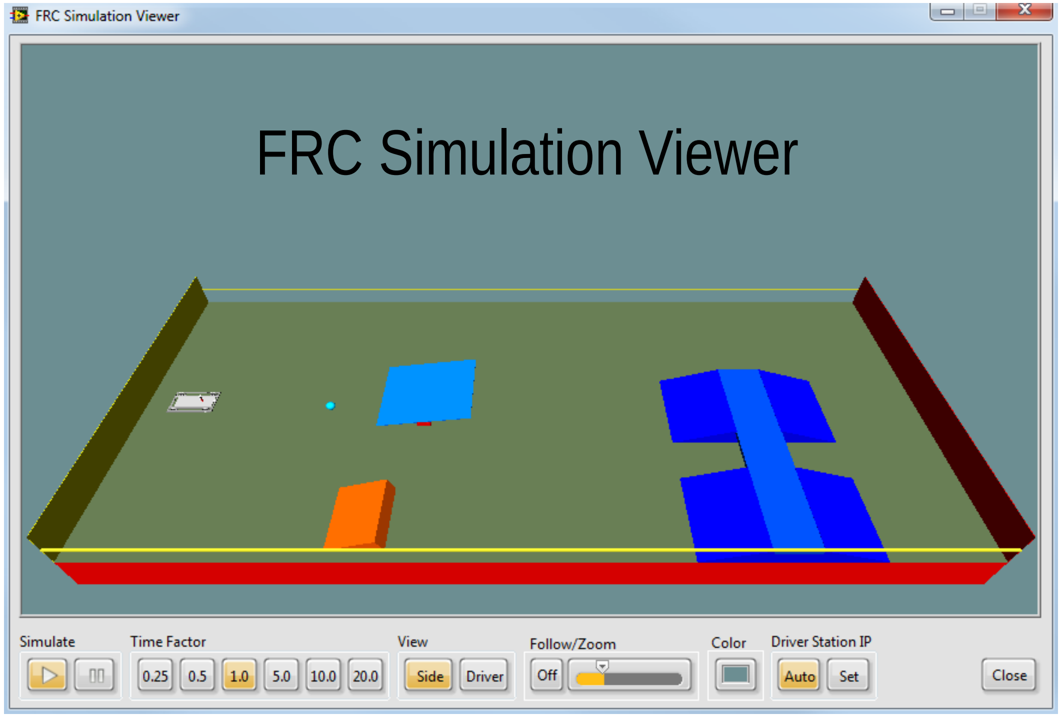
Robot Main.vi

Enable Vision

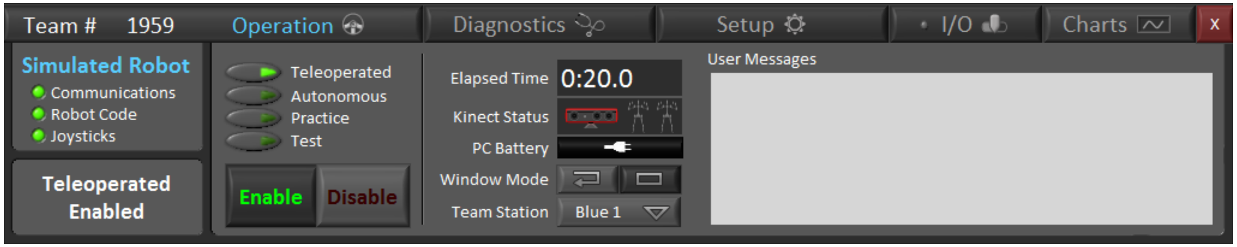
Image Size: 320x240

2013 Robot Project.lvproj/My Computer

My Computer



FRC Simulation Viewer



Team # 1959

Simulated Robot
- Communications
- Robot Code
- Joysticks

Teleoperated Enabled

Elapsed Time: 0:20.0

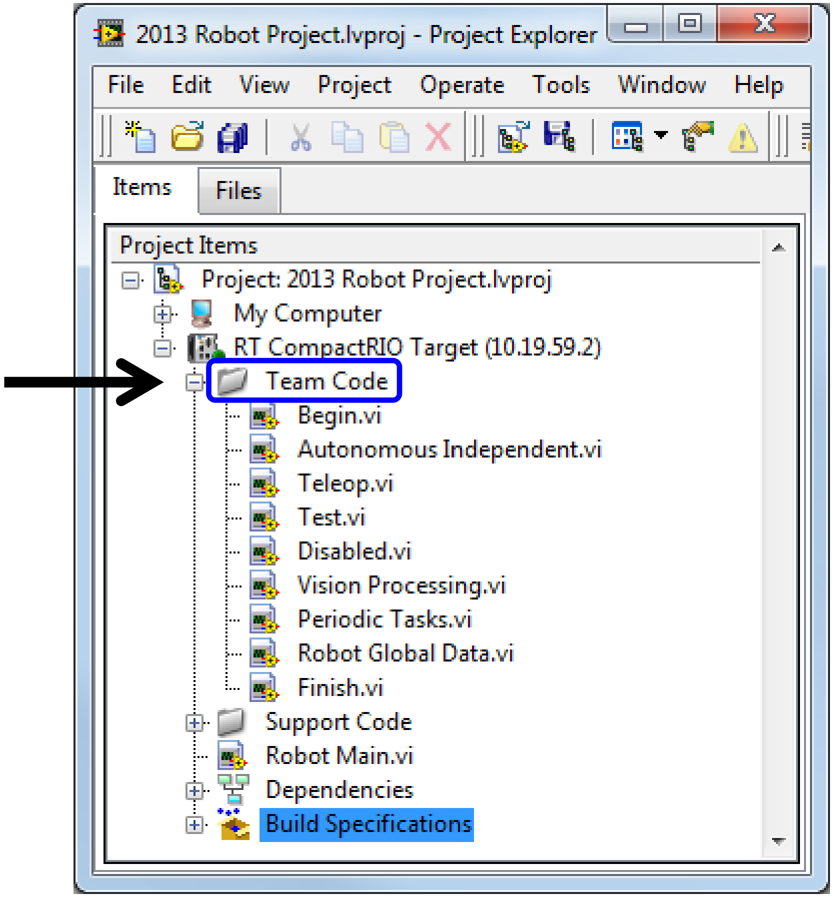
Team Station: Blue 1

User Messages

Driver Station

Team Code VIs

- Begin Begin.vi
- TeleOp Teleop.vi
- Finish Finish.vi
- Timed Tasks Periodic Tasks.vi
- Global Robot Global Data.vi
- Auto Indep Autonomous Independent.vi



2013 Robot Project.lvproj - Project Explorer

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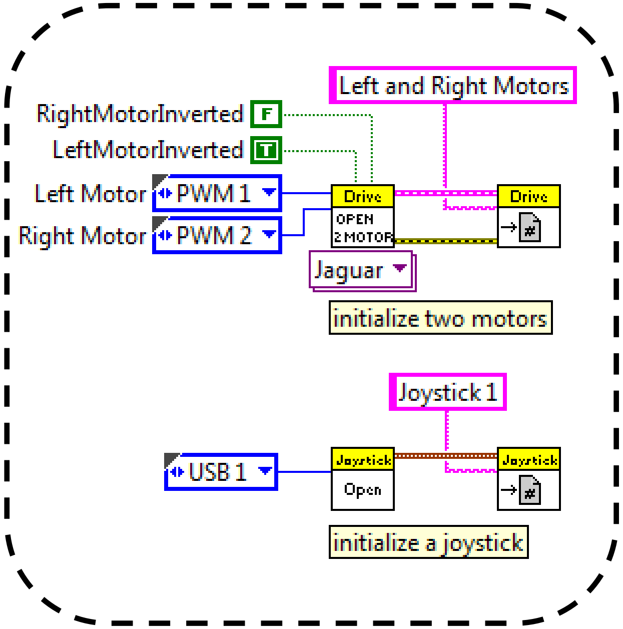
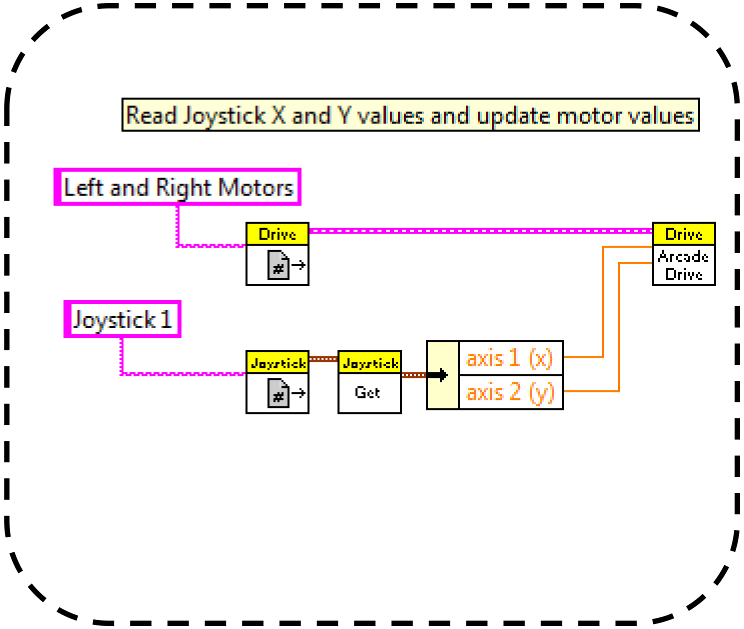
            Periodic Tasks.vi
            Robot Global Data.vi
            Finish.vi
        Support Code
        Robot Main.vi
        Dependencies
        Build Specifications
```

Default Joystick and Motor Code



Begin.vi

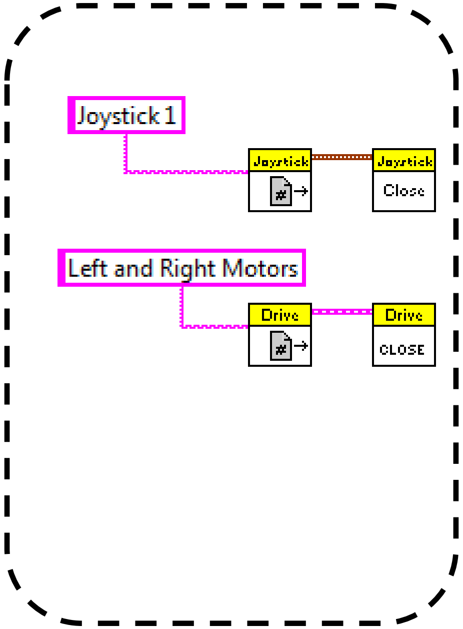
(open, register refnums)



Teleop.vi

(drive code)

(no loops, keep it lean)



Finish.vi

(close refnums)

Robot Simulation Readme.html
(Simulated Robot Manifest)

- List of actuators on the simulated robot
- List of sensors on the simulated robot
- Tutorial 10 – Robot Simulation

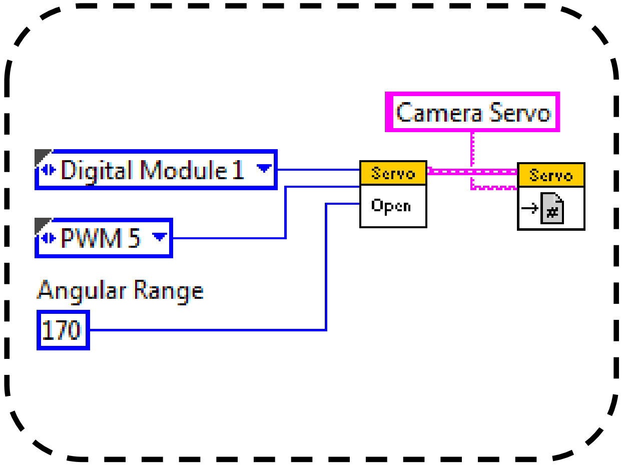
Camera Servo

- Digital Module = Digital Module 1
- PWM Channel = PWM 5
- Angular Range = 170

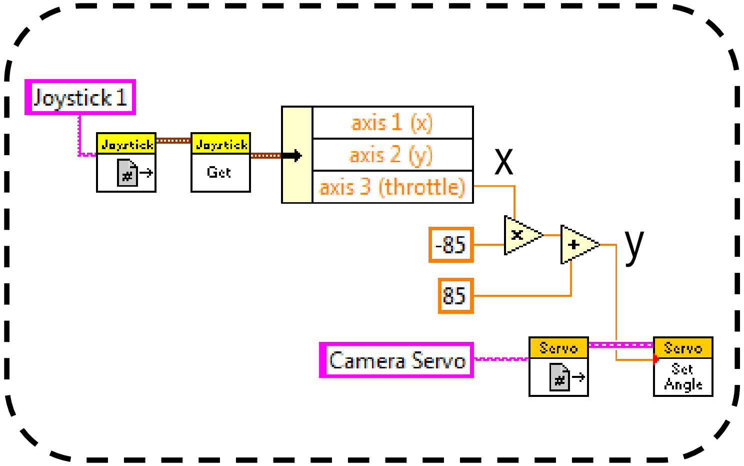
Ultrasonic

- Ping Digital Module = Digital Module 1
- Ping DIO Channel = DIO 1
- Echo Digital Module = Digital Module 1
- Echo DIO Channel = DIO 2

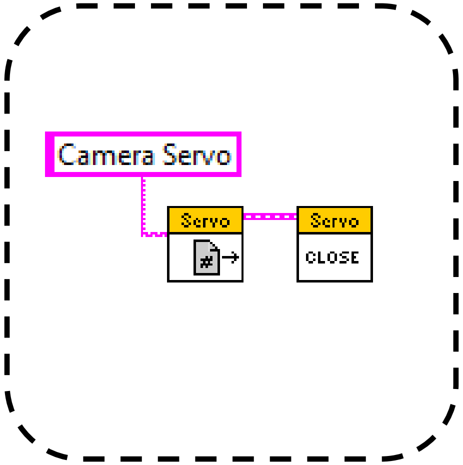
Add Camera Servo Code



Begin.vi



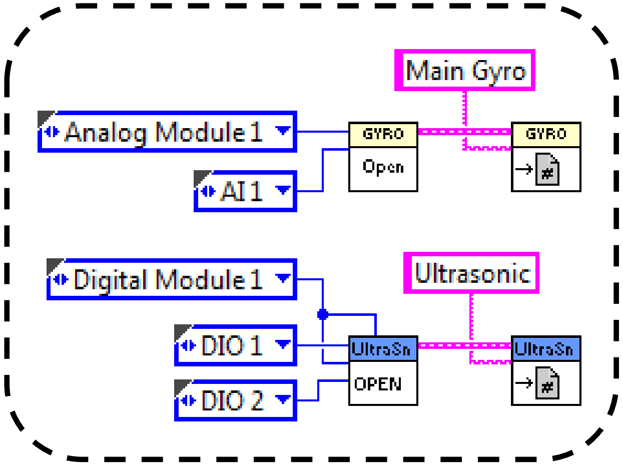
Teleop.vi



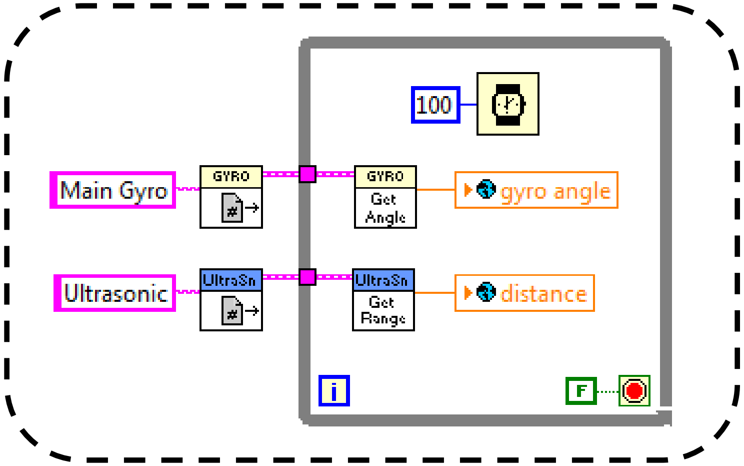
Finish.vi

- Servo angle: left = 170, right = 0
- Joystick axis 3: up = -1, down = 1
- Line equation: y = -85x + 85
  - y = servo angle, x = joystick value

Add Gyro and Ultrasonic Code

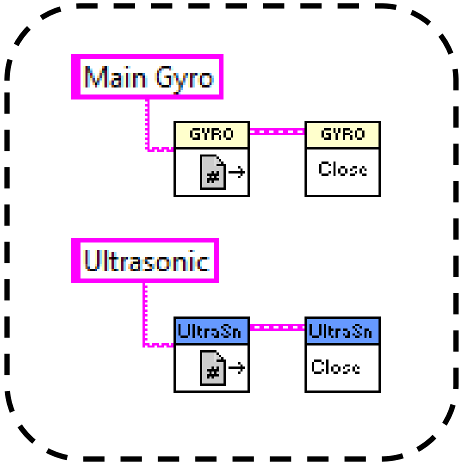


Begin.vi



Periodic Tasks.vi

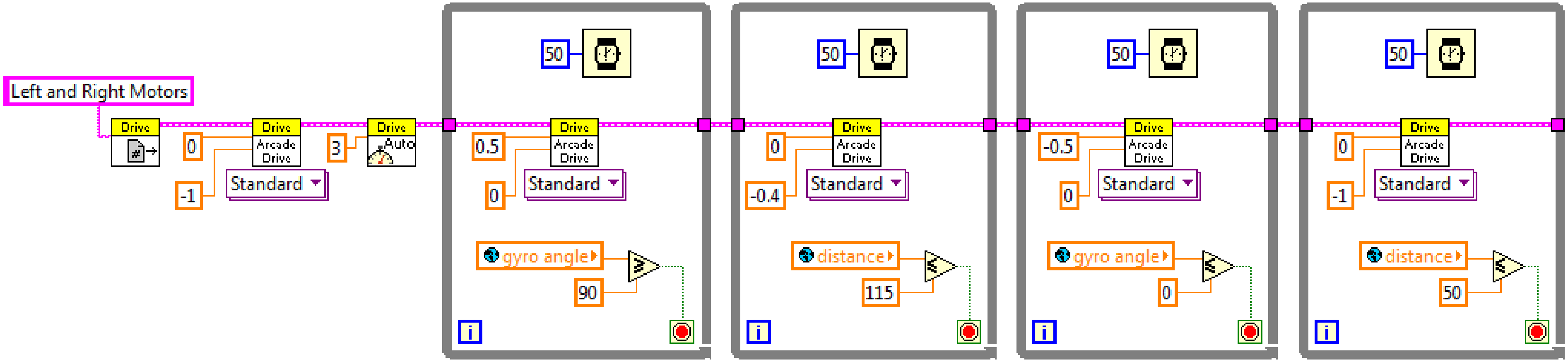
Robot Global Data.vi



Finish.vi

- Read gyro and ultrasonic in Periodic Tasks – Why?
- Write their values to global variables – Why?
- Run and test this code using probes

Add Autonomous Code



Straight for 3 seconds

Turn right 90°

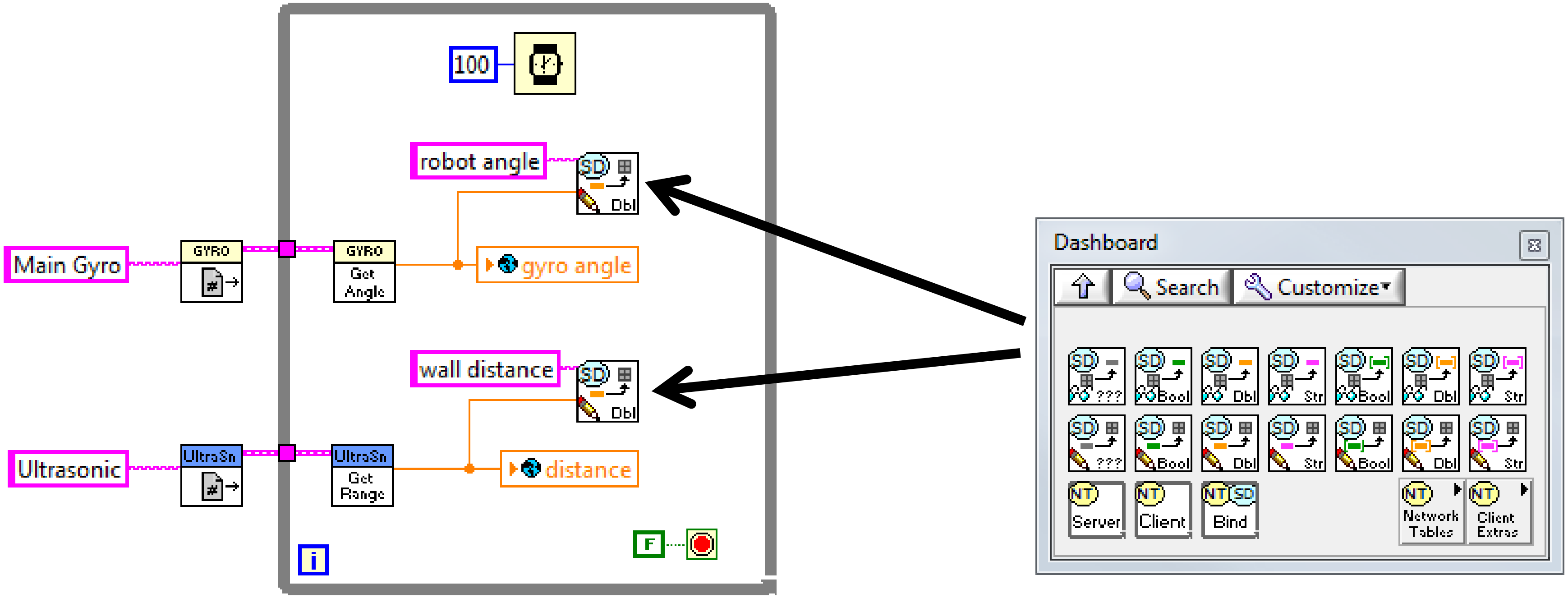
Drive 115 inches from the wall

Turn left 90°

Drive 50 inches from the wall

- Easy to get and use the Gyro and Ultrasonic data
- Loops are okay here – Why?

Add Code for Dashboard (Robot Side)



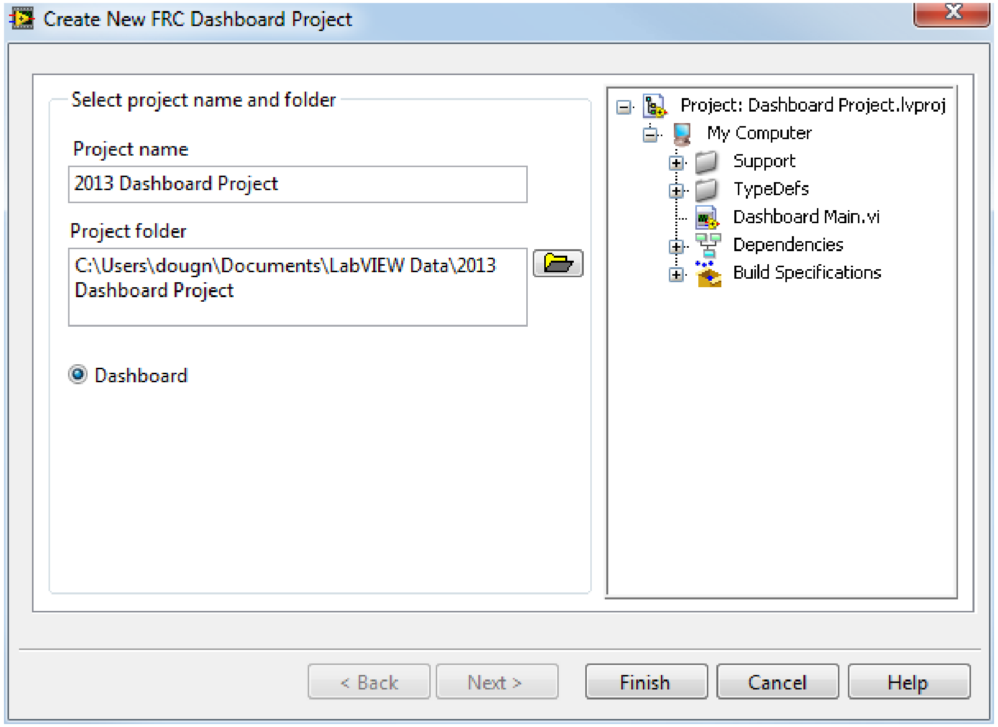
Periodic Tasks.vi

- Use Dashboard VIs to write a number, string, or Boolean value
- Use same names **robot angle** and **wall distance** on Dashboard

Team Code VIs - Review

- Begin.vi – open, register refnums
- Teleop.vi – new joystick data, drive code
- Finish.vi – close refnums
- Periodic Tasks.vi – read sensors, share data, etc.
- Robot Global Data.vi – added **gyro angle** and **distance**
- Autonomous Independent.vi – use sensor data to drive

Create FRC Dashboard Project



Create New FRC Dashboard Project

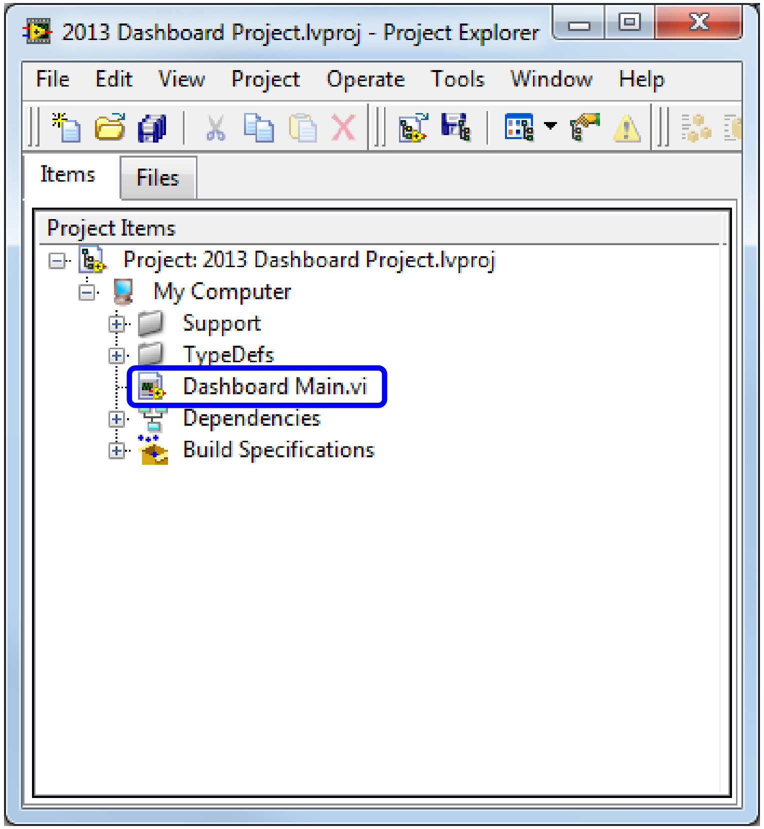
Select project name and folder

Project name: 2013 Dashboard Project

Project folder: C:\Users\dougn\Documents\LabVIEW Data\2013 Dashboard Project

● Dashboard

- Project: Dashboard Project.lvproj
  - My Computer
    - Support
    - TypeDefs
    - Dashboard Main.vi
    - Dependencies
    - Build Specifications

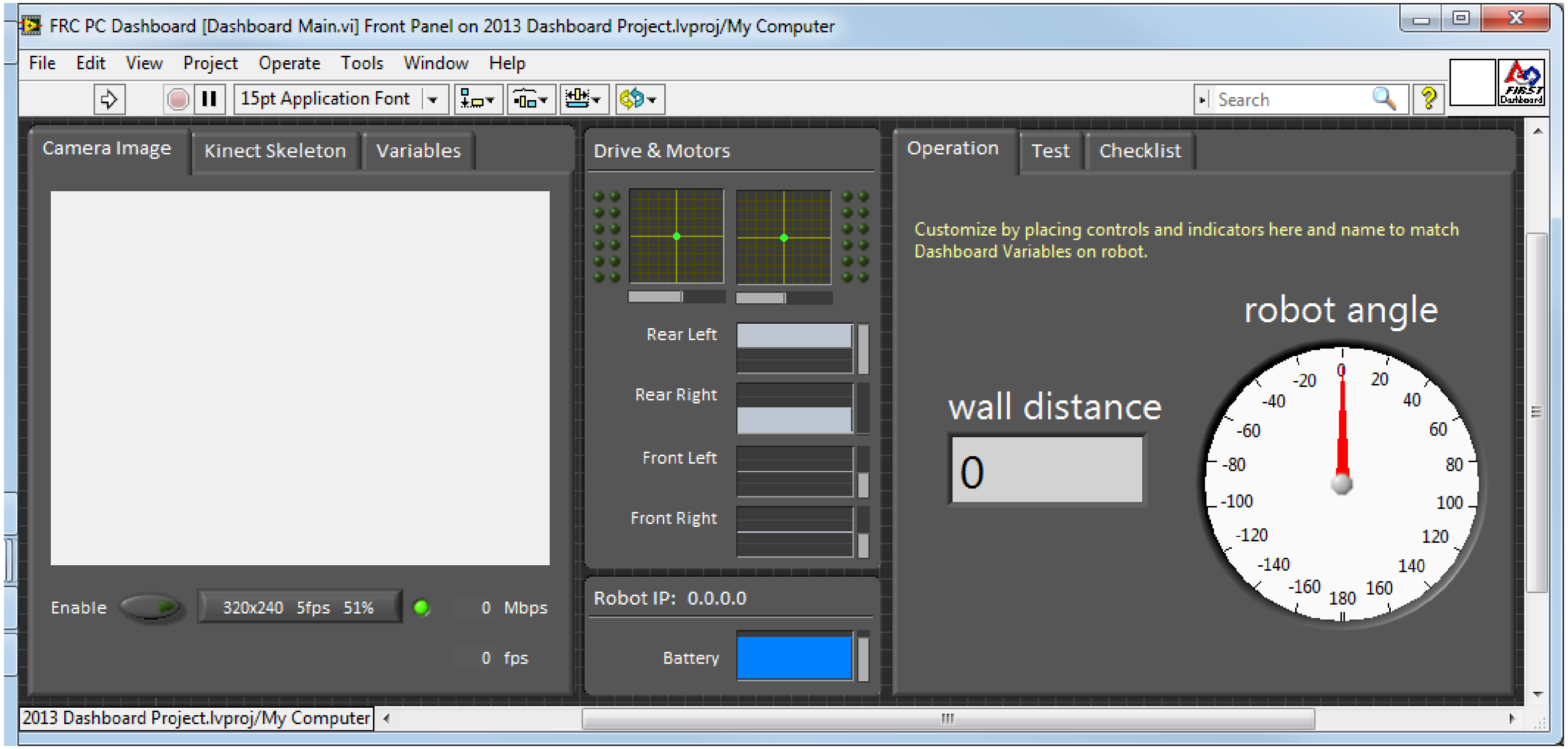


2013 Dashboard Project.lvproj - Project Explorer

Project Items

- Project: 2013 Dashboard Project.lvproj
  - My Computer
    - Support
    - TypeDefs
    - Dashboard Main.vi
    - Dependencies
    - Build Specifications

Add Indicators to Dashboard Main.vi



Customize by placing controls and indicators here and name to match Dashboard Variables on robot.

- Place indicators on the Operation tab
- Same names used in Periodic Tasks.vi on the robot

Troubleshoot Robot Code

- Use debugging techniques
  - Broken Run Arrow
  - Execution Highlighting
  - Probes
- Check for errors on Diagnostics tab of Driver Station
- Check that sensor data is what you expect

Conclusion

- Simulation simplifies learning LabVIEW for FRC
  - Only need a PC and a joystick
  - Same code can run on a real robot
- Experiment with other robot projects
  - Mecanum drive, arm and gripper

Questions?

Visit us at the National Instruments booth