Robotics I 2014
Final Project Rev C

Welcome

For the Final Project, components from the four earlier labs have been installed on four model Tug Boats, one for each team.

You are to complete missions which model those of the RobotX Competition.

Your missions

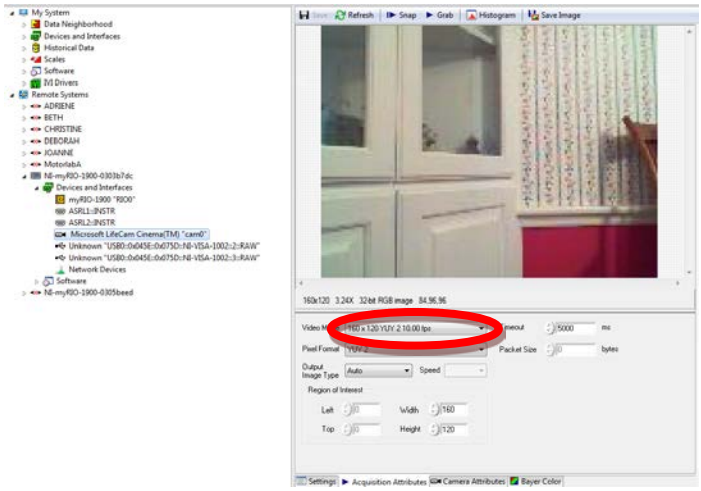
1. Leave the dock and move the tug to round the buoys in a figure “8” pattern.
2. Leave the dock and using starboard wall following move the tug around the pool, under the “cloud” (under which there is not GPS signal) and avoid the obstacle.
3. Leave the dock round both buoys and return to tug to the dock, bow first.
4. The two TA’s for the class also have a tug!!!!!!!!!!!!!! Leave the dock and follow their tug around the pool using any sensor you have available.

However, first of all you must complete a number of tasks to make the software of your system complete.

The Tasks

You have been given a “Students Edition” of the tug code and like all Student Editions it is not complete:

1. Using MAX you must configure the Microsoft LifeCam for proper operations. Because of the limited bandwidth available please set the camera to: 160 x 120 YUY2 10 fps with the focus in manual mode. You may make other changes as you wish.



2. The VI “Find Red Target VI” is to be written by you to locate the Red Target above the dock in the pool.
3. The “Hindbrain Sense VI” is to be written by you. It receives the voltage values from the (6) IR sensors and outputs distances in cm.
4. The “Hindbrain Think VI” is to be written by you. It is to control the output of a tri-colored LED to indicate the status of the tug.
5. The “HindBrain Act VI” is to be written by you. It receives the output of the arbiter as desired rudder angle and boat speed and output values for the motor controller and rudder servo.
6. The behavior “Starboard Wall Following” is to be written by you. Using the 22.5 and 45 degree Starboard IR sensors create a Behavior Array to cause the tug to follow the wall on the starboard side.
7. The behavior “Point to Dock” is to be written by you. It receives the location of the Red Target and creates a Behavior Array to cause the tug to enter the dock within the pool.

Navigation

The environment consists of:

- A 16’ diameter pool of water above which is a B/W camera
- The pool contains buoys, a “cloud”, and a dock with a camera target.
- A model tug boat which contains an myRIO, six IR sensors and Microsoft Lifecam
- A land based base station computer, BS, connected to the overhead camera and the Ethernet
- Your land based laptop PC connected the myRIO using Wifi and to the BS via the Ethernet

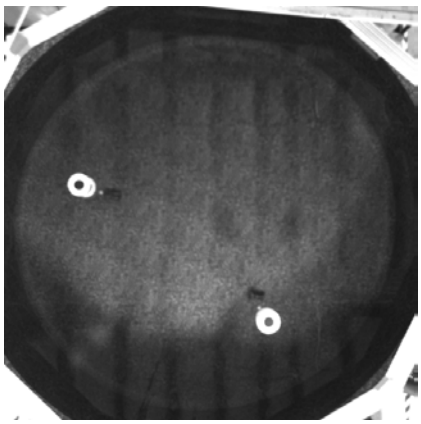


Image of the pool with (2) buoys

In the global coordinate system, the origin (0, 0) is at the top left of the pool image. X, column values, increase to the right while Y, row values, increase downward. North is to the right and the heading values, in degrees, increase in the CW direction from 0 to 360. The image is 1032 x1032 pixels.

The camera above the pool produces black and white images which are received by the Base Station computer. Each tug on the rear deck has a large Greek letter either: gamma, Γ; lambda, Λ; pi, Π; tau,T. The Greek letters are designated in the software by the letters G, L, P and T.

A pattern match by intensity routine is used to find each letter and calculate a global position and heading, based upon a stored image template for each Greek letter. The routine finds all the tugs, if present, and creates a text string with the results (Greek letter, x pos, y pos, heading angle). The camera also locates up to (4) four buoys: A, B, C, D which are added to the string followed by a time stamp which begins with the character “S” followed by hours, minutes, seconds and a carriage return. **Please note the letters designating buoys are but place holders; they do not “name the buoy” in any manner.** See below:

$,G,370,508,327,T,402,463,327,P,469,506,327,L,436,554,326,A,3,4,B,23,34,C,14,35,D,44,20,S,17,16,546\r

This string is broadcast to all who might listen using Ethernet UDP. A “-1” is placed in any field for which there is no data.

Software Structure

First of all, there are now (3) computers: a Base Station PC, your Laptop and a myRIO inside the tug boat.

The Base Station PC

The Base Station PC, BS has only one task. It is connected to a camera above the pool using a Firewire interface. It continuously takes images of the pool, locates all the tugs and buoys present and transmits their location as a character string to the Ethernet using a UDP protocol. This data represents the GPS information and is received by all the tugs and all the laptops around the pool area.

Your laptop PC

Your laptop PC has three functions:

1. It serves as the development platform for the code to be used on the myRIO
2. When the myRIO is "running" it serves as a User Interface to the myRIO operation.
3. It also runs a single VI, "FP PC main.vi", which is the "mission planner" for the tug operation. This VI is the source of the Mission Definition File, MDF. The MDF is transmitted to the myRIO using the LabView "Shared Variable Engine" every 10 milliseconds.

The myRIO aboard the tug boat

The "target system" is the myRIO aboard the tug boat. The software resembles that from the Think Lab but has several changes:

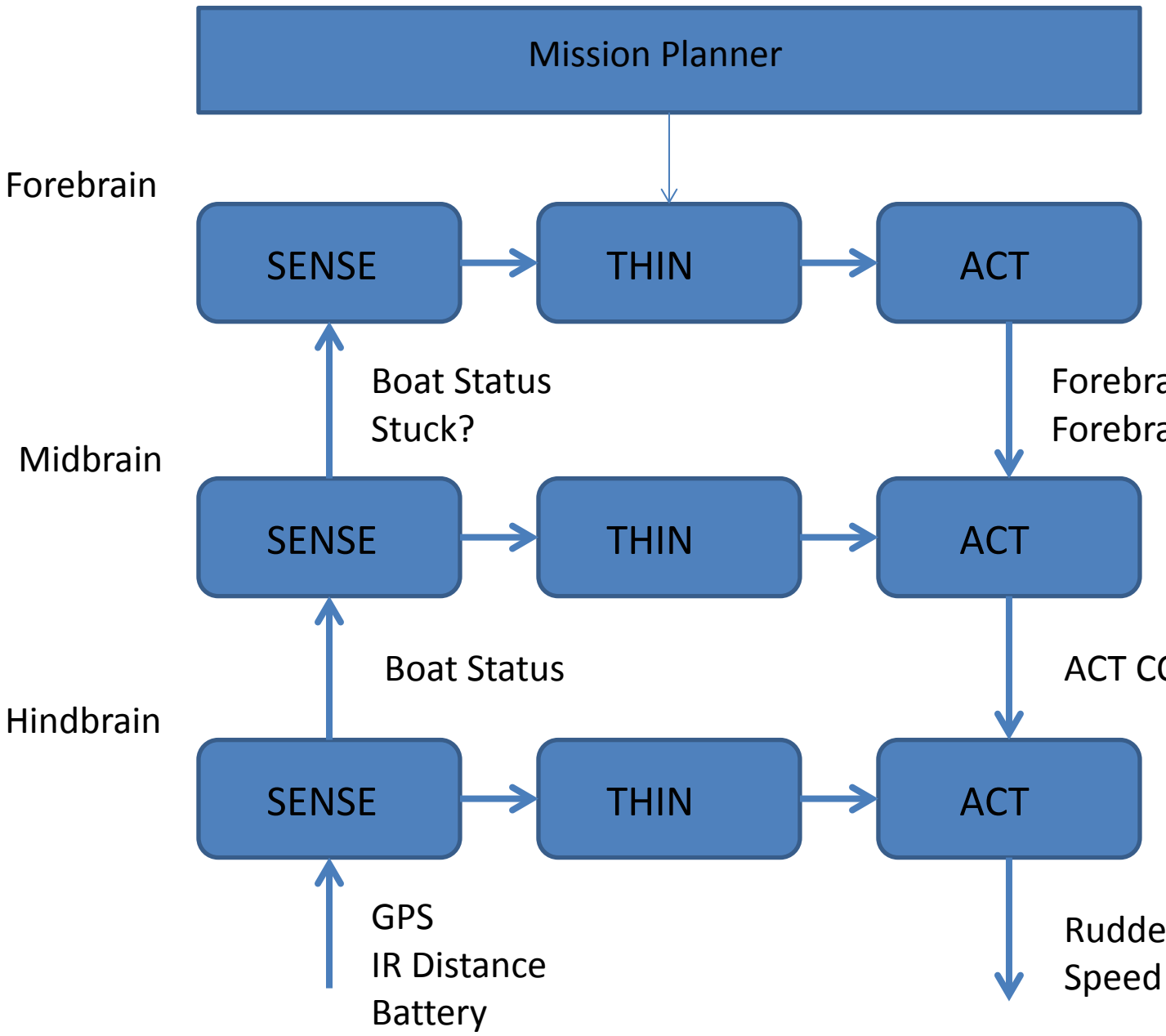
- The Hindbrain, Midbrain and Forebrain code now reside in the Real Time section of myRIO.
- The Simulator has been removed and connections to the myRIO FPGA functions have been added to the Hindbrain.
- A Camera loop has been added which receives images from the Lifecam camera on the tug.
- A UDP communication loop has been added which receives the location and heading of the tugs from the Base Station Computer.

Communication

In summary, the complete software communication structure is as follows:

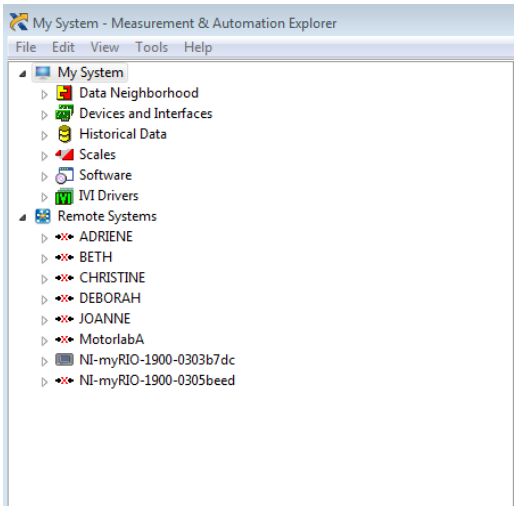
- The Base Station sends the "GPS" and "Buoy" information to both your laptop PC and the myRIO using UDP.
- Your PC runs "FP PC main.vi" which sends the MDF file information to the RT processor on the myRIO using the "Shared Variable Engine" installed on the myRIO.
- There is no communication from the myRIO to the PC running code.
- The PC does, however, display the "front panel" of the "FP RT main.vi" using the debug feature of the myRIO.
- Using the "front panel" the user my change the operation dynamically.

A block diagram of the software structure is shown below:



The Tug, the LAN and the Project

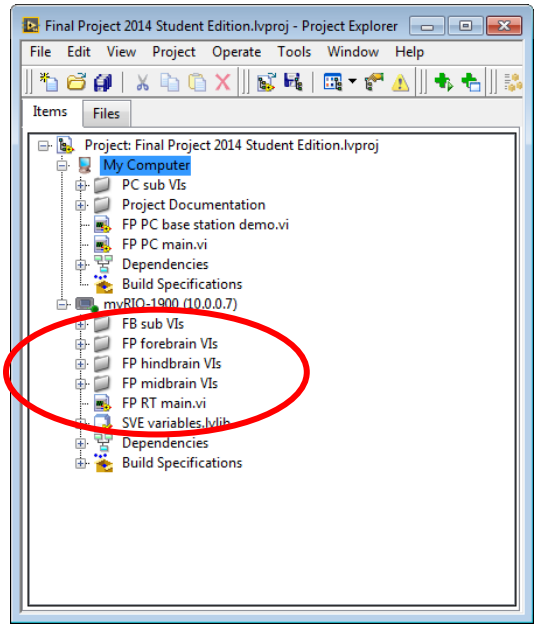
The myRIO aboard each tug has been programmed to connect to a wireless router named "POOLROBOT". There are (5) tug boats each of which is named as have the myRIO's inside. The image below is of a MAX screen showing the tug boat/myRIO names.



Each team will be assigned a tug and a Greek letter target. Within the pool area a "local area network" has been created which is not attached to the Olin network. The network supports the (5) tugs, the Base Station computer and the (4) laptops of the teams. To connect everything:

1. Connect the 7.2 volt battery which powers the myRIO within your tug. The blue light on the face of the Camera will indicate that the myRIO has power.
2. At each tug boat station around the pool, there is an Ethernet cable.
3. Plug the Ethernet cable into your laptop and select "POOLROBOT" to connect to the LAN; no password is required.
4. After a period of time, MAX will show the myRIO is connected to the network and that your laptop is as well.
5. Next open the LabView Project which you have been given: "Final Project 2014 Student Edition.lvproj"

6. With the mouse pointer over the top line, “right click” and select “New” then “Targets and Devices” and then expand the myRIO menu item…after a period of time you myRIO will appear…please select it and your myRIO will appear on the project.
7. Next click and drag all the files shown below from the starting myRIO to your target myRIO.



8. Then “right click” on the original myRIO and and select “remove from project”.
9. Then “save” the project.
10. Now go to the Base Station computer and insure that the LabView program “BS The Tug reversed main.vi” is running.
11. Now open the PC program “FP PC main.vi” and start the VI.
12. Once this VI is running you are correctly connected to your myRIO…as the Shared Variable Engine on the myRIO must be operational for the “FP PC main.vi” to run.
13. Now plug in the Motor battery with the tug.
14. Open and start “FP RT main.vi”.
15. After a period of time, you will see (3) “blinky lights” showing at all three “brains” are running. You will also see an LED blink within the “wheel house” of the tug.
16. If you place the tug within the pool under the camera view…you will see GPS locations on both the PC program window and the RT program window.
17. You are done!!!!!!!!!!!!!!!!