Lab 3

In this Lab, we will run Traffic Signal Control application on new PLC System (The Mitsubishi FX0-30MR). Details about the PLC, the application unit, and the IO Interface are available in the appendix. Similar to the Glofa GM6 PLC, the Mitsubishi PLC can be programmed using the PC via RS-232 Serial Port.

Problem Statement:

Design ladder diagram that will automatically control the operation of the traffic lights on the Traffic Signal Application module (see appendix). The traffic light sequence must be as follows:

Time Periods	ON lights
T0 = 6 seconds	N/S Green W/E Red
T1 = 2 seconds	N/S Amber W/E Red
T2 = 6 seconds	N/S Red W/E Green
T3 = 2 seconds	N/S Red W/E Amber

Where N/S is the North-South traffic light, W/E is the West-East traffic light.

- Make your assumptions to include the PED "Pedestrian Crossing" lights appropriately in the above sequence.
- The above sequence should be repeated infinitely.

Bonus Part

Add to your program the use of the 5 pushbuttons described in table 2 in the Appendix (for Car Auto-detection and Pedestrian Crossing Requests).
If the 5 buttons are not pressed, the sequence should go as described before without any interruption. Pushing any of these buttons interrupts the sequence described before.

The system should serve immediately the buttons requests. For example, if south vehicle detector is pressed, the system should jump to the appropriate state from the sequence table, which achieves that north/south traffic should be green for 6 seconds. It should continue its cycle after that normally and so on.

How to resolve conflicting requests?

If two or more buttons are pressed at the same time, we will prefer to give the upper hand to the request which has higher priority.
Assume priorities to be as follows from higher to lower:

1. North or South vehicle detector.
2. West or East vehicle detector.
3. Crossing request.

Notes

- You should send your program along with a report showing your ladder logic design using software "Mitsubishi GX Developer version 8" on piazza before the lab discussion.
- Make sure to bring with you a soft copy of your program, as this shall be used for direct upload to the PLC in the Lab after review with the TA.
- All the wiring connections are already done for you and you will not need to change it. The PLC is connected to the Feedback® PLC interface such that output Y0 of the Mitsubishi PLC corresponds to Y0 in the Feedback® interface, and input X0 of the Mitsubishi PLC corresponds to X10 in the Feedback® interface, as per Tables shown the Appendix.

Appendix

General description

The traffic signal control module is an interactive mimic diagram of the traffic and pedestrian control lamp signals at a crossroads with one pedestrian crossing. It is designed to be controlled by a range of PLC's for the purpose of providing exercises in the use of PLC to monitor and control external objects. The Layout of the module is as shown in Fig. 1.

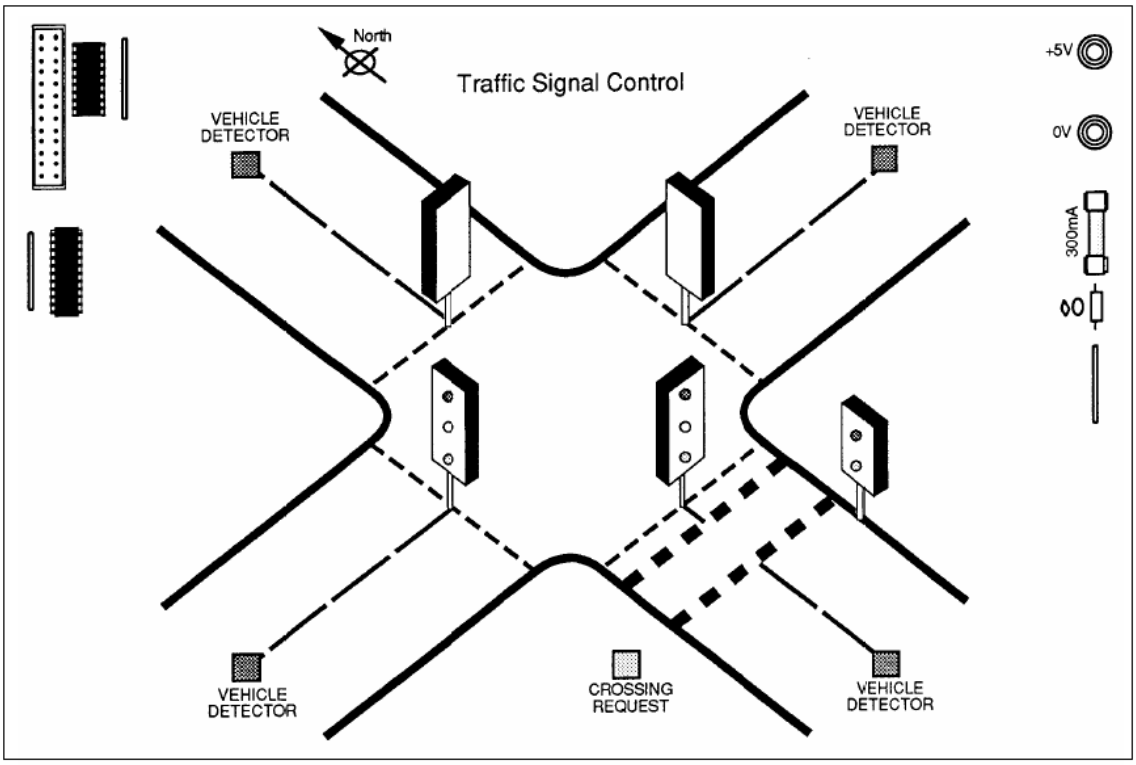


Fig. 1 – Layout

The module comprises:

- A fiber glad panel with a mimic diagram of a crossroads with a pedestrian crossing and traffic controls signals as shown in Fig. 1. The panel contains:
    - A set of colored lamps (Light Emitting Diodes) representing the normal traffic control signals. Three lamps for the north-south and three for the east-west with two lamps for the pedestrian crossing to make a total of eight lamps that are controllable by the PLC.

- A multi-way connector at the top of the module to receive the ribbon cable from the Feedback® PLC-Interface Module, which provides means for all the required connection of the Mitsubishi PLC.

The PLC interface is a box with a connector to accept the ribbon cable from the module together with screw-in terminals to accept the connection lines from the chosen PLC. The 24 V dc line from the PLC is used to provide the +5 V dc supply that the traffic signals module require. 4mm sockets are provided for this supply connection.

A typical system connection diagram, similar to the one used in our Lab is shown in Fig. 2.

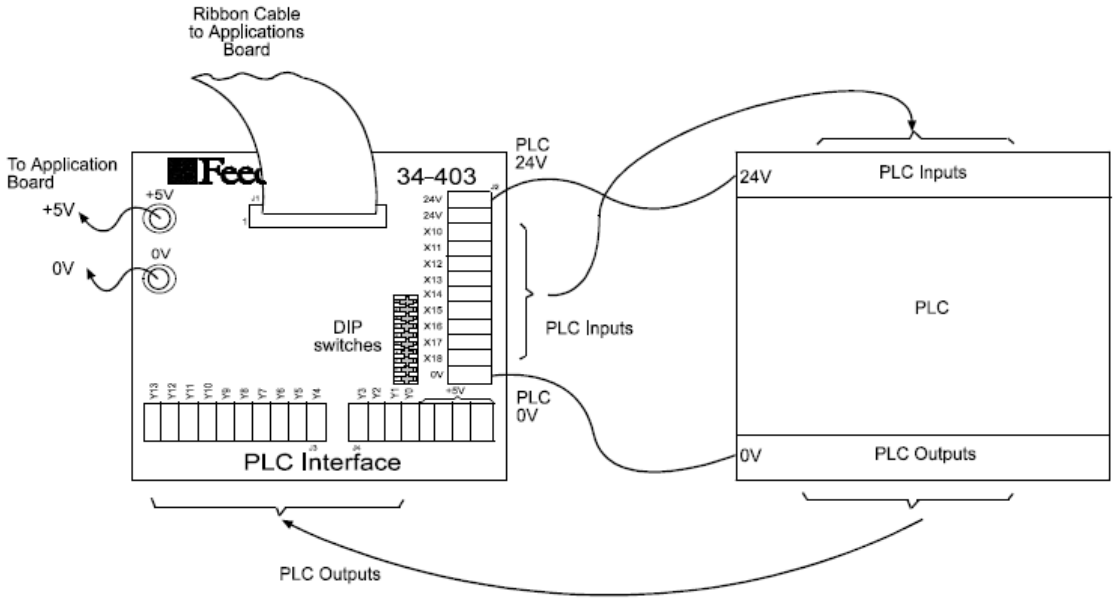


Fig. 2 – Connection Diagram

Technical Data

On the PLC interface box, Outputs Y0 to Y7 must be connected to the output lines of the PLC and are used to send lamp data to the board. There are 8 lamps on the board, controlled by sending an appropriate signal to the corresponding output line from the PLC. The lines that control the lamps are as follows:

Function	PLC Line
South Red	Y0
South Amber	Y1
South Green	Y2
West Red	Y3
West Amber	Y4
West Green	Y5
Crossing Red	Y6
Crossing Green	Y7

Table 1 – PLC Digital Outputs

There are also 5 PLC Inputs that correspond to Pushbuttons which can be used to simulate vehicle detection, as well as Pedestrian Crossing Requests, as shown in Fig. 1.
The wiring on the PLC for these inputs is as shown in the below table.

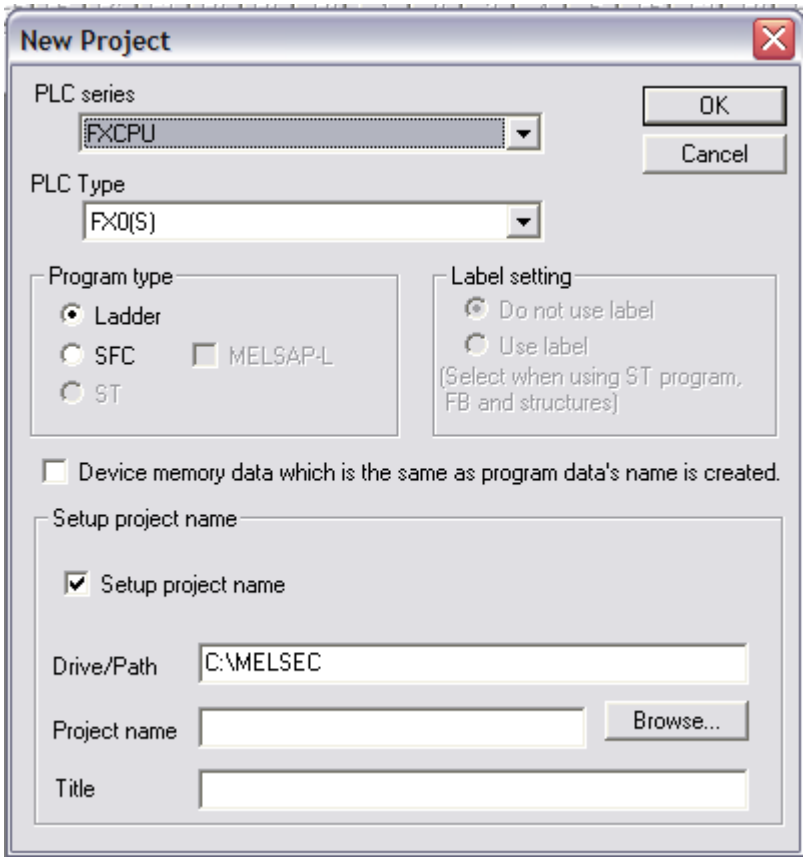
Function	PLC Line
East Pushbutton	X0
West Pushbutton	X1
South Pushbutton	X2
North Pushbutton	X3
Pedestrian Crossing Request Pushbutton	X4

Table 2 – PLC Digital Inputs

Writing Ladder diagrams for *Mitsubishi* PLC

GX developer program can be used to program Mitsubishi PLC. Steps to use the program are described as follows:

1. Make a new project. Change the PLC series to be FXCPU. Choose PLC Type FX1S. Choose setup project name to change the name and path of the project.



2. Make sure that the project is opened in write mode by pressing F2. Then press F5, or use the menus to add symbols to the ladder diagram lines. X's and Y's indicate direct inputs and outputs respectively. Use memory bits (M) for intermediate signals. Timer names should begin with T followed by the timer ID, a space and the timer timeout. An example of adding a timer with 1 second timeout is shown in the figure.

The following ladder diagram shows the timer T0 is ON after 1 second from resetting the memory bit M0. T0 is used to set the output Y0.

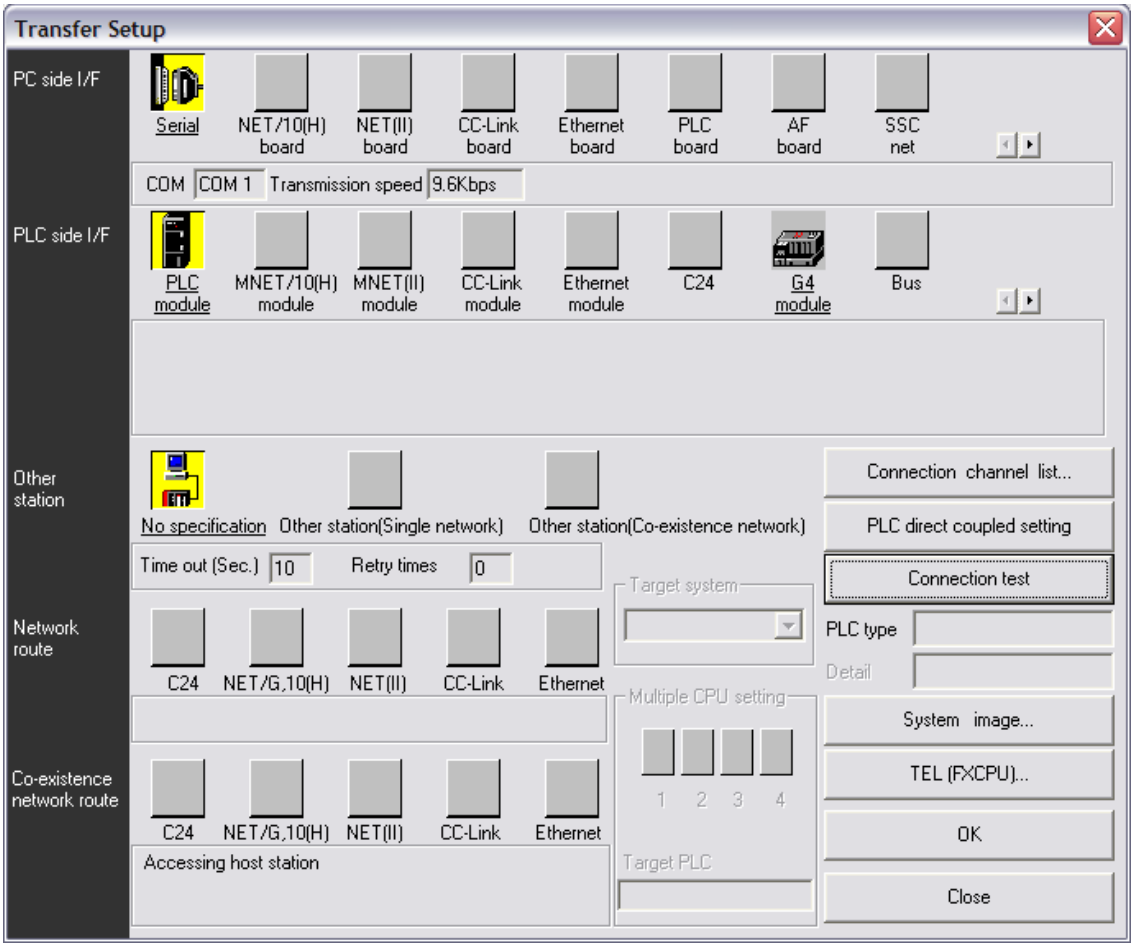
You can choose to set or reset elements when their inputs are high. To do this, add the following symbols.

Note that all timers/coils in the Mitsubishi PLC are similar to the ones used in LadSim Software (i.e they are provided with Latch Option when you use the "set" symbol as in above example) and once latched they also need special rung to reset them using the "rst" symbol as in above example. Also note that the timer input is by default a non-Latched on-delay timer.

3. Make sure the PLC is stopped.

4. Press F4 to convert the program to its assembly listing.

5. From Online menu, choose transfer setup. Press the Connection test button to test the connection of the PLC to the serial port.



6. Choose Write to PLC from Online menu to write the program to the PLC.

7. Switch ON the PLC to begin execution. You can view the values of elements of the ladder diagram during execution by changing the project to monitor mode F3.