**TRC2400 Computer Programming**
**ECE2071 Computer Organisation and Programming**

Laboratory Session 6

Week 7– Semester 1 2011

**IMPORTANT – MARKING**

You will receive marks for preliminary work and lab completion by completing quizzes on Blackboard
All quizzes receive equal marks and these will be scaled to give a final lab mark worth 10% of your final assessment.
You MUST complete the preliminary work quiz BEFORE midnight of the day before your lab otherwise you will receive a zero mark for the lab exercise (both preliminary and completion mark)
You must start the completion quiz before the end of your laboratory period (you will need the demonstrator to enter a password which will only be provided when you complete the lab)

## 1. Objectives

This laboratory exercise provides an introduction to the S7-200 Programmable Logic Controller (PLC). You will gain familiarity with its input/output and communications modules, and program some simple tasks for the PLC using ladder logic diagrams.

## 2. Preliminary work

Before coming to the lab you should complete the preliminary work quiz on Blackboard. This week's quiz will cover your understanding of the exercises in this prac.

## 3. First Programming Exercise

In this first exercise you are going to find out how to enter a ladder logic program, download it to the PLC and then run it.

In a coal mine a sump collects water that seeps into the mine workings and when the sump is almost full (upper level switch opens) a pump switches on and empties the sump until the lower level switch opens (bear in mind that the switches on the traffic control board are normally closed and open when you press the button).

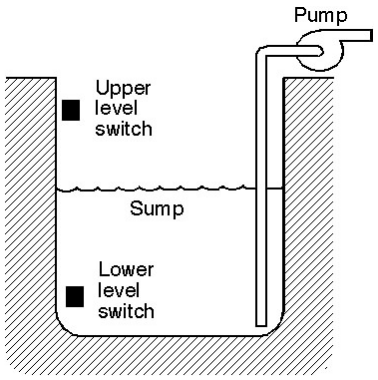


Figure 6.1 The sump pump application

The pump is to be controlled by a PLC running the following program:

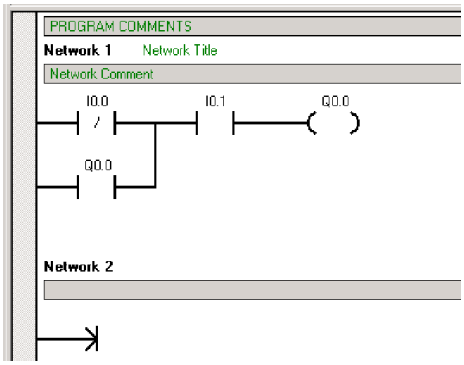


Figure 6.2 The ladder diagram for the sump pump

Here is the procedure for entering the program:

1) Start the application V4.0 Step7 MicoWin by double clicking on this icon:


2) By selecting the place you would like to insert things and then clicking on the appropriate icon

Figure 6.3 Important icons

you can build up the ladder diagram shown in Figure 6.2. In Figure 6.3 the arrow icons allow you to insert connections and the next two icons allow you to insert contacts and coils. After inserting each item you should name it to identify which component it corresponds to in the PLC.

3) After completing the ladder diagram you then DOWNLOAD it to the PLC (WARNING if you accidentally click on the upload icon you will delete your program. Make sure that the PLC is in RUN mode (switch under the little door on the PLC). Therefore, it is a good idea to save your program before downloading). Download by clicking on the underlined downward facing arrow shown in Figure 6.3. Confirm downloading in the window that pops up.

4) Switch the PLC to run mode (green right-facing arrow in Figure 6.3).

5) Press the appropriate buttons (I0.0 Car South for the upper level switch and I0.1 Walk South for the lower level switch) on the TRAFFIC CONTROL panel to check that your program works.

## 4. Second Exercise - Modify the sump pump program.

We want to add an extra switch to the sump pump system (I0.2 Car East button) so that the sump can be emptied before the water level reaches the upper level switch (note that the switches are normally closed).

## 5. Third Exercise

This exercise is to implement a protection scheme for a motor that is not continuously rated. After pressing the start switch (I0.0 Car South switch) the motor should run for 5 minutes (to save time we will reduce this to 5 seconds). To allow the motor to cool it must not be started again for another 5 minutes (once again this will be represented by 5 seconds) (the PLC program must ensure that the cool off time occurs before the motor can be restarted). The following PLC program was written to implement the motor control:

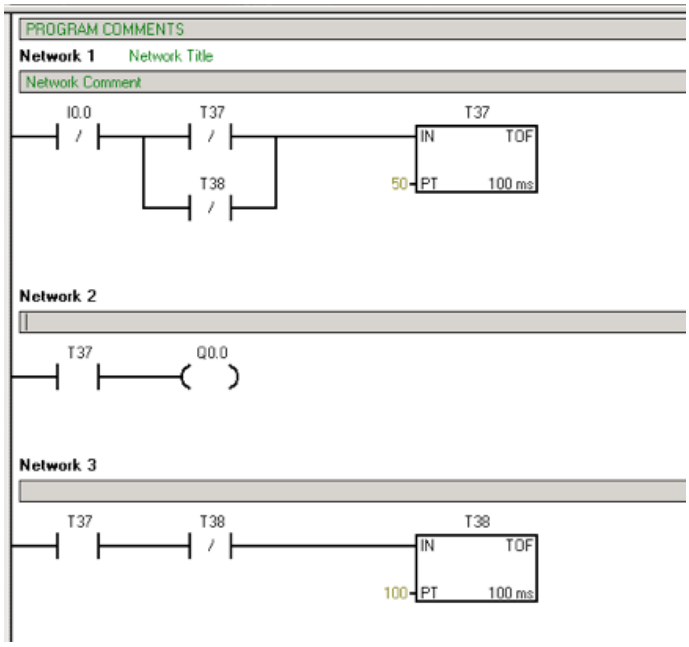


Figure 6.4 Motor protection program

Unfortunately, this program contains an error. Enter this program, identify the error, correct the error and ensure that your corrected program works correctly.

## 6. Fourth Exercise

For this exercise you are to program the PLC so that pressing the Emergency button (I0.4) causes all four amber lights on the traffic lights (Q0.2, Q0.5, Q1.0, Q1.3) to flash together with a repeated sequence of 1 second off and 1 second on. (Hint use two TOF delay modules, one to time the on period and one to time the off period. each timer triggers the other when it finishes its time period). You can select timers to include in you program from the window second from the left under Instructions, Timers.

## 7. Conclusion

Please note that marks will not be allocated to people who do not attend their allocated lab and complete the appropriate quizzes by their deadline. Under no circumstances will marks be recorded after the laboratory period is finished.

RAR 17/2/2009; RAR 1/3/2011

## Appendix A

# Siemens S7-200 PLC Input/Output

### Digital Input

| | |
|---|---|
| Car Push Button - South | I0.0 |
| Walk Push Button - South | I0.1 |
| Car Push Button - East | I0.2 |
| Walk Push Button - East | I0.3 |
| Emergency Push Button | I0.4 |

### Digital Output

| | |
|---|---|
| North Traffic LED - Red | Q0.1 |
| North Traffic LED - Yellow | Q0.2 |
| North Traffic LED - Green | Q0.3 |
| South Traffic LED - Red | Q0.4 |
| South Traffic LED - Yellow | Q0.5 |
| South Traffic LED - Green | Q0.6 |
| East Traffic LED - Red | Q0.7 |
| East Traffic LED - Yellow | Q1.0 |
| East Traffic LED - Green | Q1.1 |
| West Traffic LED - Red | Q1.2 |
| West Traffic LED - Yellow | Q1.3 |
| West Traffic LED - Green | Q1.4 |
| Walk LED – South - Red | Q1.5 |
| Walk LED – East - Red | Q1.6 |
| Address – LED - Red | Q0.0 |