Mechatronics System Integration (MCTA3203)

Week **5**: Understanding both software and hardware aspects of PLC interfacing with Microcontrollers.

Programmable Logic Controller (PLC) is a specialized industrial computer used for controlling and automating electromechanical processes in manufacturing plants, machinery, and various other applications. In this session, we shall use the OpenPLC Editor and interface it with a microcontroller. The OpenPLC Editor can be downloaded to your laptop/pc using the following link: https://autonomylogic.com/

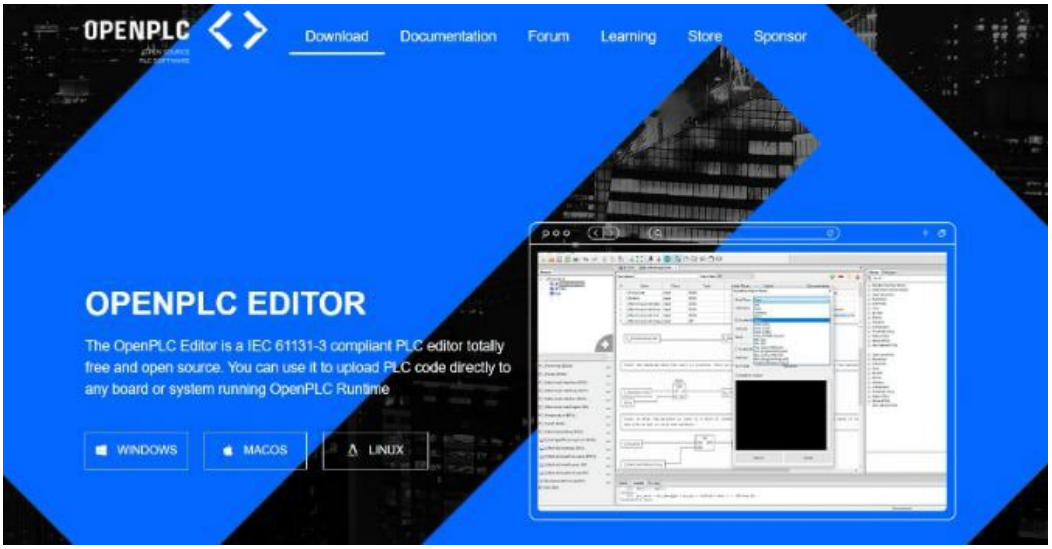


Fig.1: OpenPLC Editor website

Example:

In this example, a basic ladder diagram consist of a single contact and coil on a rung will be created and simulated in the software and later uploaded onto the Arduino microcontroller. The ladder diagram representing the operation of a blinking led is as shown in the **Fig.2**

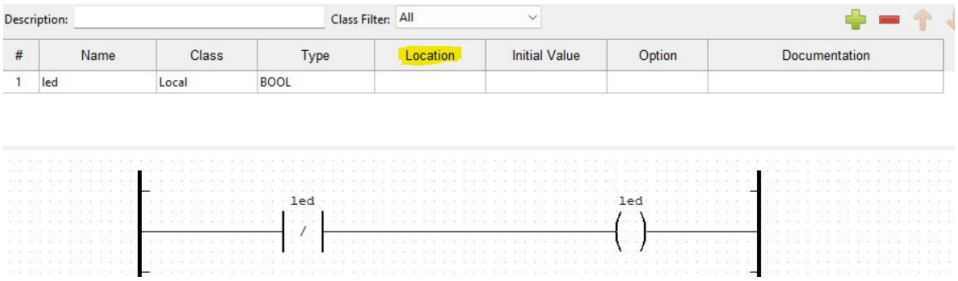
Fig. 2: Ladder diagram for blinking led

Create and Simulate the Ladder Diagram using OpenPLC Editor

1. Download OpenPLC Editor
2. Launch the software after downloading.
3. Start a new project (File → New → New Folder and name it →Select Folder)
4. Name the project: in the Create a new POU pop up window, name the project and select language → LD (ladder diagram)
5. Press the  to create new variable and name it. (Class Filter= local, Type = BOOL).
6. Start creating the Ladder Diagram by right clicking and choose Add.
7. Create the Left the Right power rails, Contact (negated), Coil as shown in Fig. 2.
8. Once the ladder diagram is created, compile it by clicking the icon  .
9. The blinking led simulation can now be seen in the editor.

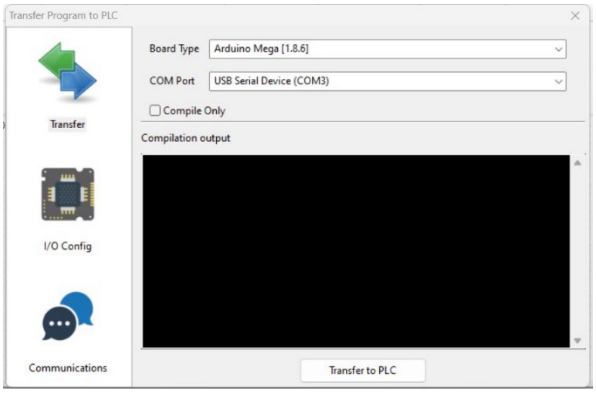
Uploading and Testing the Ladder Diagram on Arduino

1. Associate the variables that have been created in the Ladder Diagram with the led pin on the Arduino board. You can check the associated pin between open PLC variables and various types of microcontrollers from the OpenPLC Editor website. On the *Documentation* menu, choose *OpenPLC Runtime* and then *Physical Addressing*. Refer to the correct microcontroller type and digital out pins.
2. For example, if using Arduino Mega board, and the led is connected to pin no. 14, the associated Digital Out pin on the OpenPLC Editor should be %QX0.0. This need to be typed into the Location of the variable in the editor.



3. Connect the Arduino board to your laptop and take note of the COM port number.

4. Once connected, compile the ladder diagram program to the Arduino board by clicking the icon  . A window will pop up, select the correct board, type in the correct COM port number and proceed by pressing *Transfer to PLC* button.



5. The led should now be blinking according to the written ladder diagram program.

Exercise:

Modify the ladder diagram so that the blinking time interval of the led can be increased. For this exercise, you can use a timer block in the OpenPLC editor to control the led blinking time. Timer block (Right click, Add→Block→Standard function blocks→ Timers), Variable to input time delay (Right click, Add→Variable→Expression = T# xxx ms). Simulate this in OpenPLC Editor and transfer this modified ladder diagram program to your Arduino board.

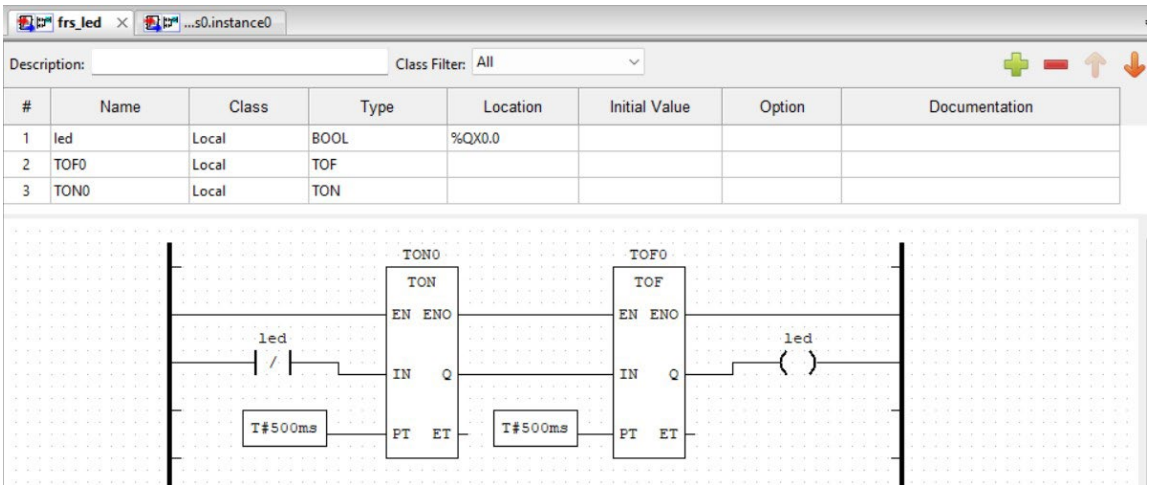


Fig. 3

THE TASK

Start – Stop Control Circuit

Develop a Start-Stop Control Circuit by using ladder diagram created in OpenPLC, compile, simulate and transfer the ladder diagram program to Arduino Board. The circuit with pin configuration is shown in Fig.4 below.

Materials Needed:

- OpenPLC Editor software
- Arduino Board
- 2 Push Button Switches
- Jumper Wires
- LED
- Resistors
- Breadboard

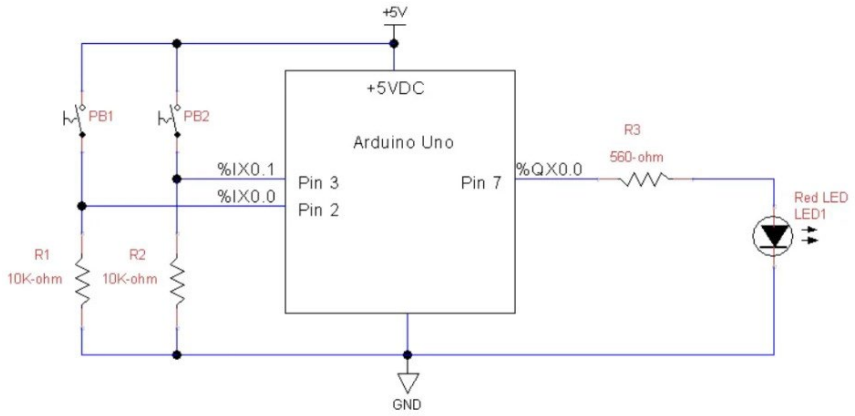
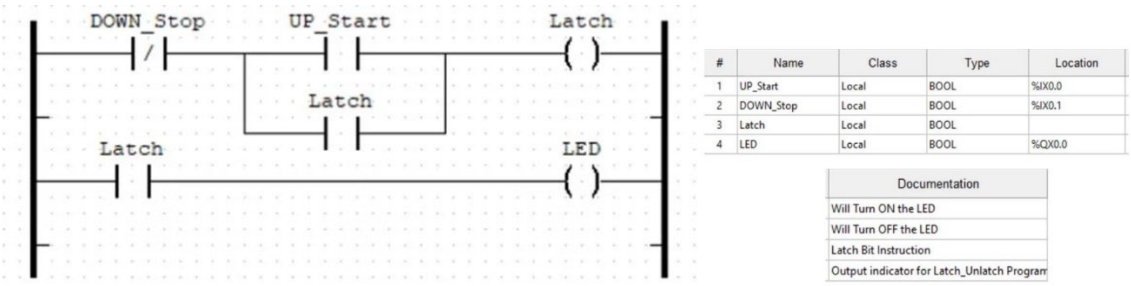


Fig. 4: Start-Stop Control Circuit



#	Name	Class	Type	Location
1	UP_Start	Local	BOOL	%IX0.0
2	DOWN_Stop	Local	BOOL	%IX0.1
3	Latch	Local	BOOL	
4	LED	Local	BOOL	%QX0.0

Documentation
Will Turn ON the LED
Will Turn OFF the LED
Latch Bit Instruction
Output indicator for Latch_Unlatch Program

Fig. 5: Ladder Diagram for the Start-Stop Control Circuit

Experiment Steps:

1. Create the ladder diagram shown in Fig. 5.
2. Specify all variables used in the ladder diagram.
3. Compile and simulate the ladder diagram in OpenPLC Editor.
4. Upload the ladder diagram to the Arduino board.
5. Ensure to select correct COM port number and all pin association between the OpenPLC variables and Arduino board.
6. Build the circuit as shown in Fig. 6.
7. Test the functionality.

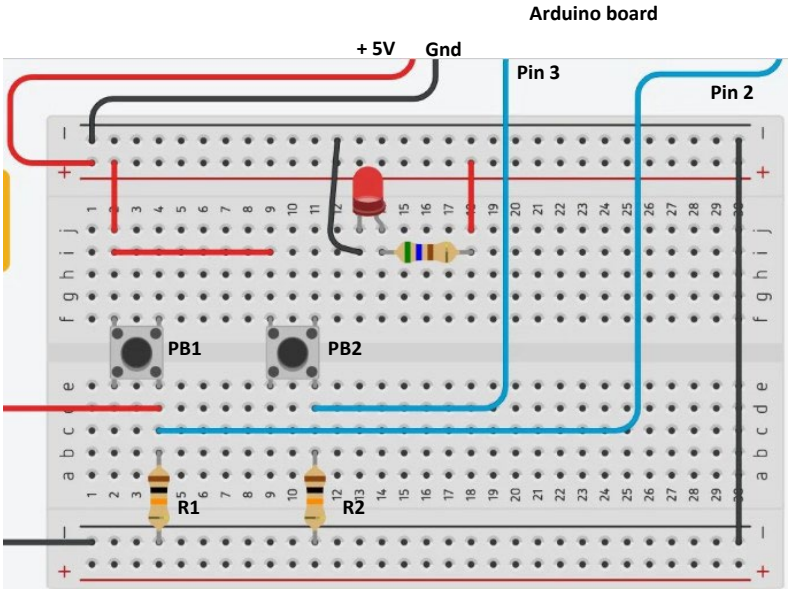


Fig. 6

References

1. https://autonomylogic.com/
2. https://control.com/technical-articles/plc-ladder-logic-on-an-arduino-introduction-to-openplc/
3. https://control.com/technical-articles/plc-ladder-logic-on-an-arduino-building-a-start-stop-circuit/