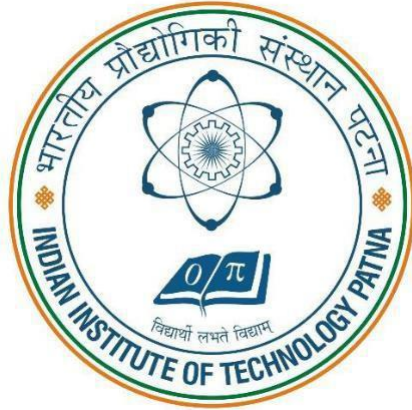# Indian Institute of Technology Patna

Mechatronics, Instrumentation And Controls Laboratory Lab 6 Report

Topic:
PLC

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1. Aim of the Experiments.

a) **Perform simple expansion and retraction of a double acting cylinder.**
b) **Expand two double acting cylinders, one after other and after expansion, retract both cylinders simultaneously.**
c) **Design a pneumatic circuit to bond two components together with a defining force for 5 seconds.**

2. Pre-Requisites/Components Required

In the Simulation Implementation I have used the following Software:

- CODESYS V3.5 SP17

3. Notation Used: -
  ➢ Push Button → Toggle
  ➢ R1,R2 → SensorExpPos & SensorRetPos respectively
  ➢ M1,M2 → CylCoil1 & CylCoil2 respectively

1.a) Simple Expansion and Retraction of a Double Acting Cylinder
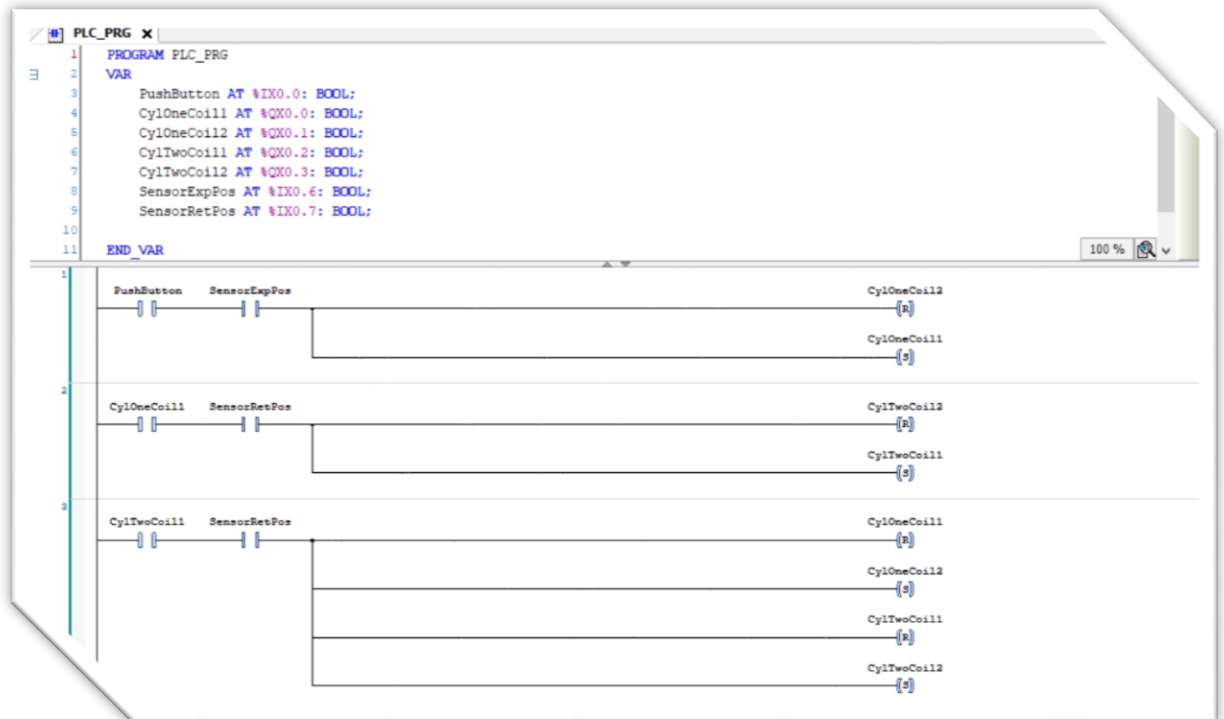
Ladder Diagram: -

Explanation: -
- When Puss-Button is pressed, it will energize/(Set) CylCoil1/(M1) and thus advancing the Cylinder and CylCoil2(M2) is deenergize (Reset).
- When the press is removed from Push-Button, it will energize/(Set) CylCoil2/(M2) and thus Retracting the Cylinder, and CylCoil1/(M1) is deenergize/(Reset).

1.b) Expand two double acting cylinders, one after other and after expansion, retract both cylinders simultaneously.

Ladder Diagram: -

```
    PLC_PRG  X
  1    PROGRAM PLC_PRG
  2    VAR
  3        PushButton AT %IX0.0: BOOL;
  4        CylOneCoil1 AT %QX0.0: BOOL;
  5        CylOneCoil2 AT %QX0.1: BOOL;
  6        CylTwoCoil1 AT %QX0.2: BOOL;
  7        CylTwoCoil2 AT %QX0.3: BOOL;
  8        SensorExpPos AT %IX0.6: BOOL;
  9        SensorRetPos AT %IX0.7: BOOL;
 10
 11    END_VAR                                                    100 %
```

```
1
    PushButton    SensorExpPos                              CylOneCoil2
     ┤├           ┤├                                           (R)

                                                            CylOneCoil1
                                                               (S)

2
    CylOneCoil1   SensorRetPos                              CylTwoCoil2
     ┤├           ┤├                                           (R)

                                                            CylTwoCoil1
                                                               (S)

3
    CylTwoCoil1   SensorRetPos                              CylOneCoil1
     ┤├           ┤├                                           (R)

                                                            CylOneCoil2
                                                               (S)

                                                            CylTwoCoil1
                                                               (R)

                                                            CylTwoCoil2
                                                               (S)
```
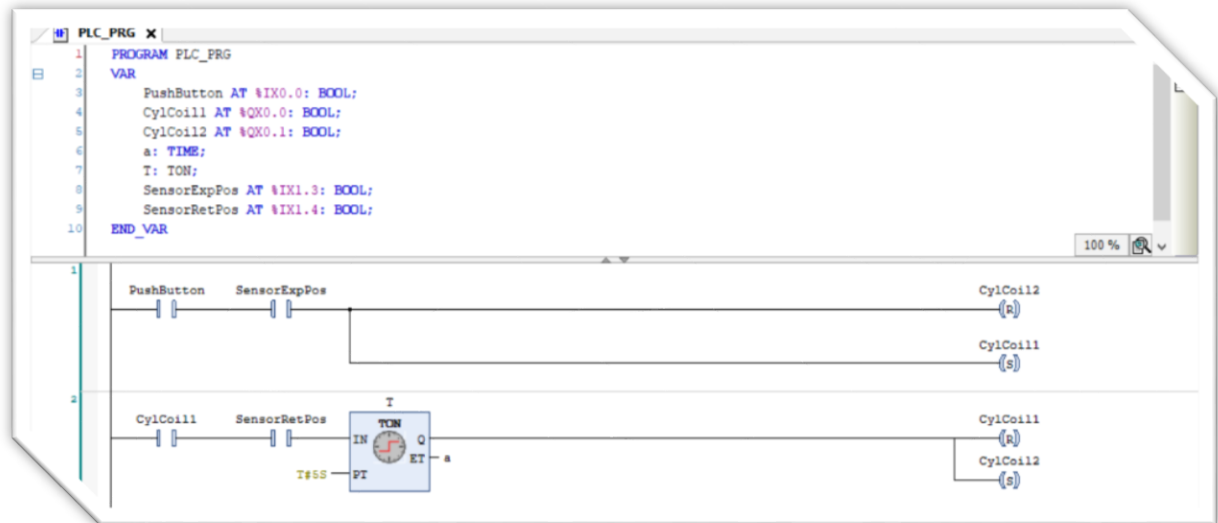
Explanation: -
- When Push-Button is pressed and SensorExpPos (R1 of Cylinder 1) contact is high, then it energize/(Set) CylOneCoil1/(M1 of Cylinder 1) and deenergize/(Reset) CylOneCoil2/(M2 of Cylinder 1).
- When SensorRetPos(R2 of Cylinder 1) and CylOneCoil1/(M1 of Cylinder 1) contact is high, then it energize/(Set) CylTwoCoil1/(N1 of Cylinder 2) and deenergize/(Reset) CylTwoCoil2/(N2 of Cylinder 2).
- When CylTwoCoil1/(N1 of Cylinder 2) and SensorRetPos (R2 of Cylinder 1) contact is high, then it energize/(Set) CylOneCoil2/(M2 of Cylinder 1) and CylTwoCoil2/(N2 of Cylinder 2) and deenergize/(Reset) CylOneCoil1/(M1 of Cylinder 1) and CylTwoCoil1/(N1 of Cylinder 2).

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1.c) Design a pneumatic circuit to bond two components together with a defining force for 5 seconds.

Ladder Diagram: -

Explanation: -
- When Pushbutton is pressed and SensorExpPos(R1) contact is high, it energize/(Set) CylCoil1/(M1) and deenergize/(Reset) CylCoil2/(M2).
- When CylCoil1/(M1) and SensorRetPos(R2) contact is high then it energize IN of Timer T and it get started ,whose PT is set as 5sec and upon completion of 5sec, it energizes/(Set) CylCoi2/(M2) and deenergize/(Reset) CylCoil1/(M1).

Question: -
i. Explain process for sending the ladder to the hardware
ii. What is the role of timer.
iii. What is latching in PLCs. Explain with a simple latching circuit figure.

Answer: -

i. In general, the following step are required for sending the ladder to hardware: -
   ➢ At first we have to ensure that our PLC is connected to PC with a programming cable.
   ➢ Then we have to open the software that the PLC supports.
   ➢ Then we have to link our PLC, by going to communication setting. Then we have to provide the type of connection established by PLC like RS232,Ethernet,etc and then providing the communication setting like COM port and other related setting. Generally most of the setting are default and we then click on Auto-Detect (we have to ensure that PLC is running)and software itself detect the PLC automatically and then click Ok .
   ➢ Then the ladder that we have written,is needed to be compiled.
   ➢ Then we click on Write to PLC and then after going through various prompt window. Then the program will be downloaded.

An example: -
   ➢ Download program in Allen Bradley Micrologix 1000: -
      o The software that we have to use for this are: -
         ▪ RSLinx: -Used to connect PLC with PC.
            • At first we have to ensure that our PLC is connected to PC with a programming cable.
            • Go to Communications→Configure Drivers
            • Choose the Driver type from the dropdown list and then click Add New and give a name for this driver and click ok.
            • Then we have to provide COM port and click Auto-Configure and we have to ensure PLC is running. It will automatically detect the PLC and show a message "Auto Configuration Successful".Then Click Ok.
            • Thus,our PLC have been connected to PC.
         ▪ RSLogix500: -
            • Open the Software and here also we have to configure our PLC.
            • Go to Tools→Options→System Communications
               ▪ Select the Driver and click Apply and then Okay and close the window.
            • Go to download and click Yes.
            • Then the program will be downloaded to PLC hardware.

ii.)
A timer is a PLC instruction measuring the amount of time elapsed following an event.
Timer instructions generally comes in three basic types:
- on-delay timers: -
  - On delay means that once a timer has received a power on signal, its output will change state after a predetermined delay.
  - The timer will be ON when a start input 6signal is received, and the signal status of the output adjusts from 0 to 1 when the preset time is reached.

- off-delay timers: -
  - The OFF delay means that it will change state after a predetermined time when the timer has received the shutdown signal.
  - When the off-delay timer is energized in PLC programming, it immediately turns its output on. The timer begins to work when the rung signal is false The timer continues to accumulate times until the accumulated value becomes equal to the preset value. When the accumulated value is equal to the preset value, the output turns off.
- Retentive timer: -
  - A retentive timer is used when you want to retain accumulated time value through the power loss or the change in the rung state or any device interruption occurs.
  - When its rung goes from false to true, the Accumulate value of the retentive timer counts from where it stopped the last time.

iii.) There are often situations where it is necessary to hold an output energized, even when the input ceases.

A simple example of such a situation is a motor, which is started by pressing a push button switch. Though the switch contacts do not remain closed, the motor is required to continue running until a stop push button switch is pressed.

The term latch circuit is used for the circuit used to carry out such an operation. It is a self-maintaining circuit in that, after being energized, it maintains that state until another input is received.
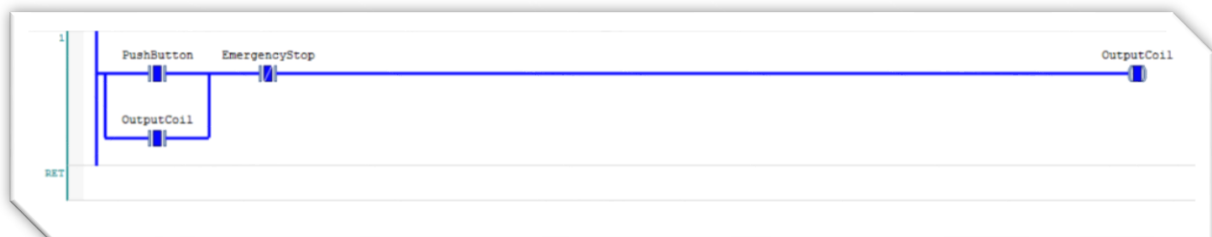Thus, in other word, we can say Latching is used for circuit that is able to hold the output energized even though the input which energizing it ceases. It is used to set output permanently with momentary switch usage.
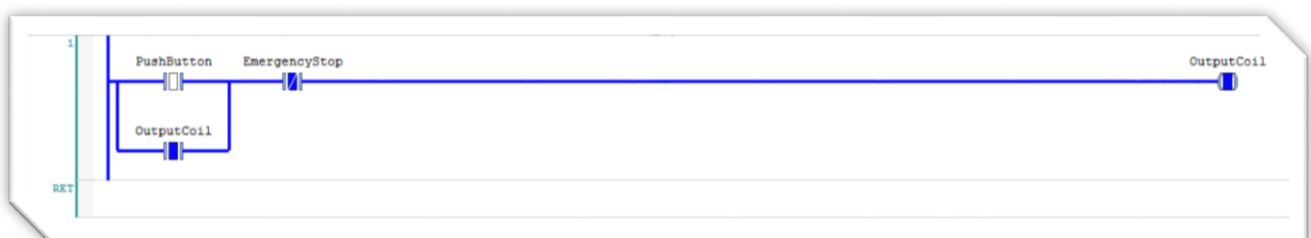
An Example: -

Explanation: -

➢ When PushButton is in pressed condition. The PushButton contact gets closed.

- o We observe that the output coil is energized.
- o Also, we also observe that the parallel NO contact of Output Coil, in parallel to PushButton is also closed.

➢ When PushButton is released (Not Pressed). The PushButton contact gets opened.

- o We observed that the parallel NO contact of Output Coil, form an OR logic gate with the input PushButton contacts. Therefore, even if the PushButton input is opened, the circuit will keep the output energized. Thus, the output is latched by using the output contact itself, so even though the input state has changed, the output state is fixed.
- o The only way to release the output/change the output state is to activate the normally closed contact of EmergencyStop. Thus, unlatching the circuit via an NC contact of EmergencyStop.

- ❖ The Program is given in the below Link: -
  - ○ Program Files