Industrial Automation Notes at OMAF-BURO.

By Muhammad Raheel

PLC:

Introduction: It was developed in 1968 by the general motor engineers to when the company was looking for alternative to replace complex relay systems.

So what is a PLC?

A digital electronic device that uses the programmable memory to store instruction and to implement specific functions such as logic,sequence,timing,counting and arithmetic to control machine and process.
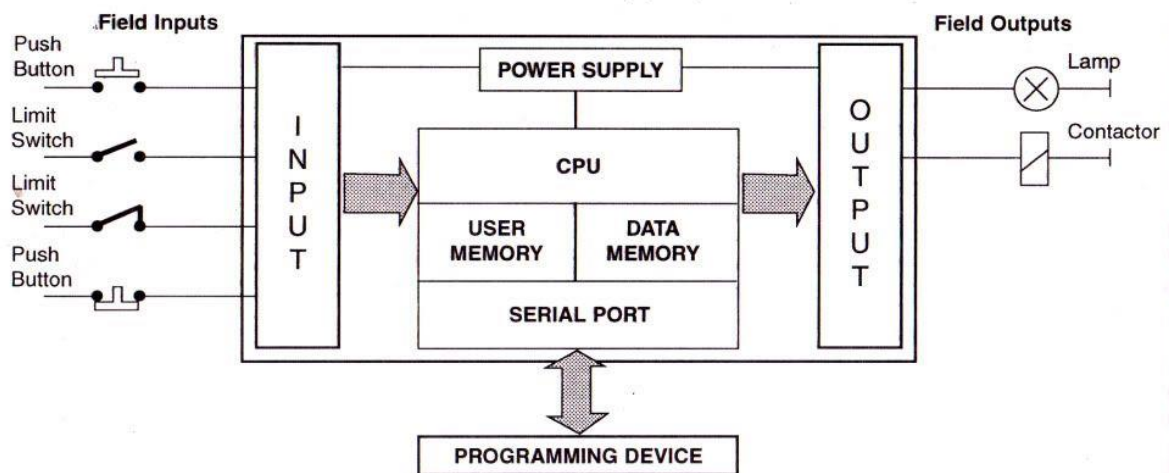
A certain input is given with certain input techniques and there is power supply processor and programming device where ladder logics are written as we write our programs in that.
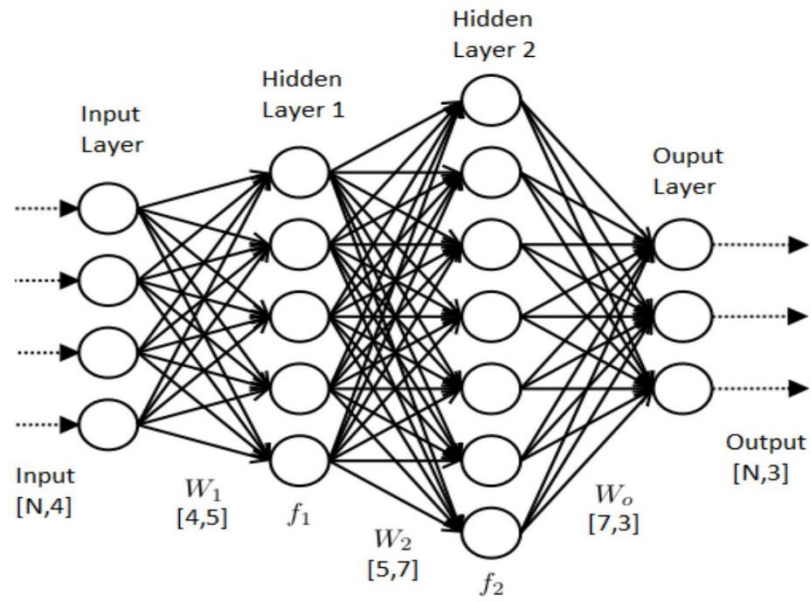
1) What is Automation?

Automation is the work device to the automatic control of the systems such as machinery, boilers, and processes in the factories, telephone network and stabilizers to aircrafts, ships and other machinery with the minimal or reduced human intervention. However, some processes are completely automated.

It also reduces the human effort in any work.

2) Tools for Automation:

2.1) Artificial Neural Network (ANN)

ANN is generally used to work in the self-automated decisions with the pre-defined trained models and its diagram is:

Input Layer — Input [N,4]

Hidden Layer 1 — W_1 [4,5] f_1

Hidden Layer 2 — W_2 [5,7] f_2

Ouput Layer — W_o [7,3]

Output [N,3]

2.2) Distributed Control System (DCS)

It is the system with many control loops which means different systems are with different automated controls including, each different automated system has its own system to control a certain operation.
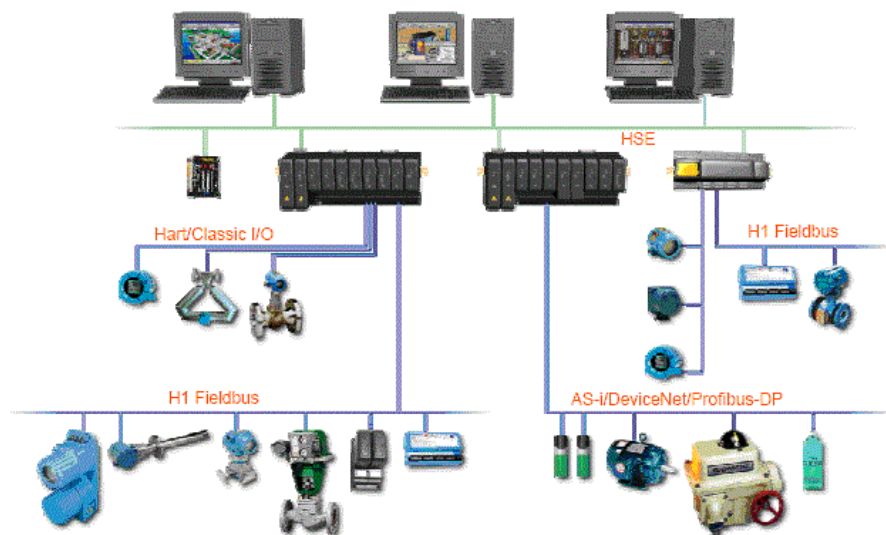

2.3) Human Machine Interface (HMI)

HMI is the system or protocol that is used to provide a way of communication between the system and the machine. What is communication? Communication is often referred as two people talking but communication is the way to make a commodity to understand what the other one is saying.

2.4) Supervisory Control and Data Acquisition (SCADA)

Using SCADA we can create the line diagram as well as we can also use it to make an overview of a machine currently placed in the industry.
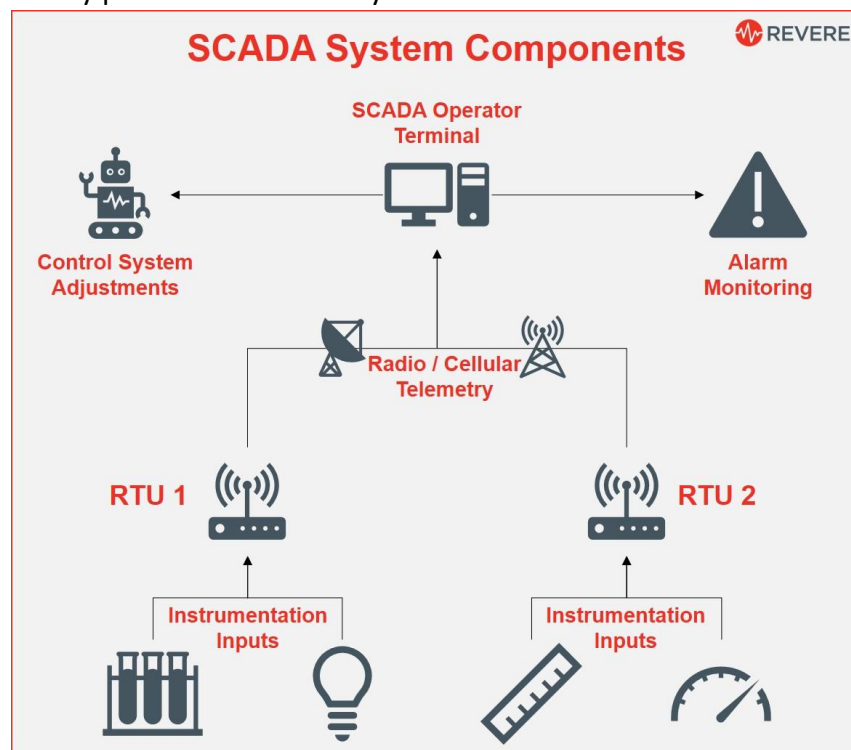
2.5) Programmable Logic Control (PLC)

SCADA provides control through PLC using Ladder Logic. PLC is decided on the basis of machine on what and where to use that particular logic that is these logics are mainly dependent on the type of the problem required to solve it.
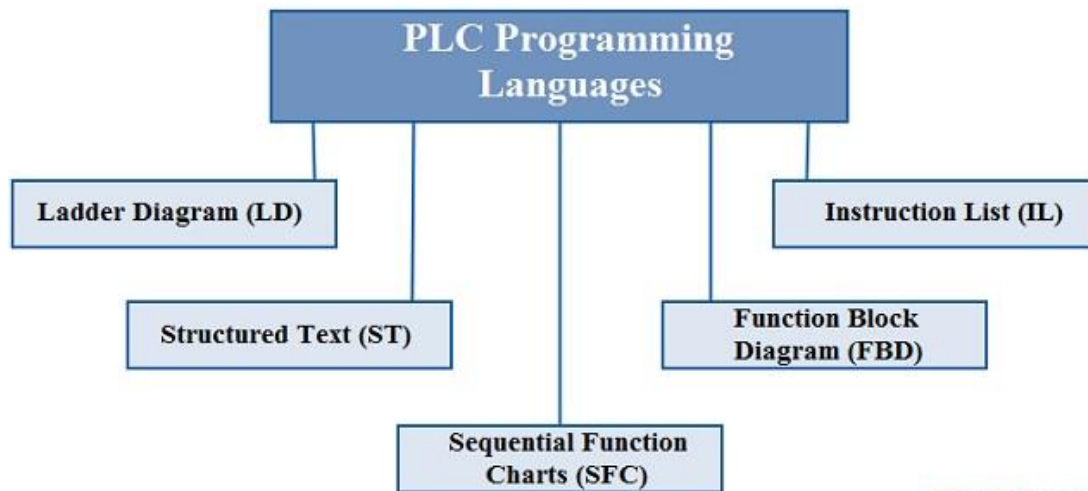
2.6) Instrumentation

Instrumentation is collective term for measuring instruments that are used for measuring, indicating and recording physical quantity.
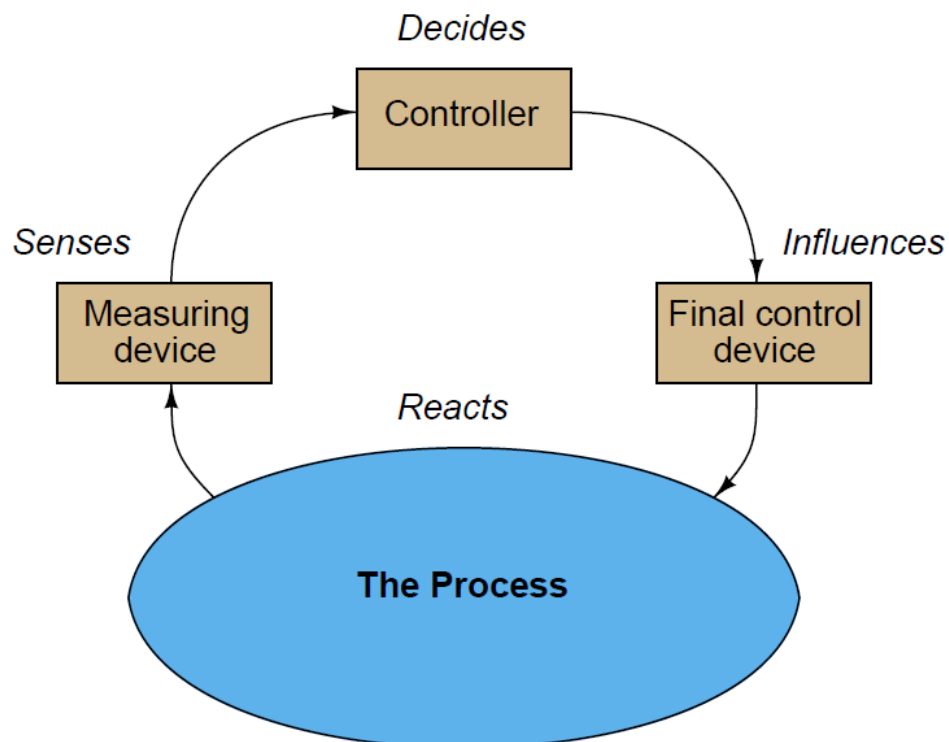
2.7) Motion Control

It is a sub-part of the automation it is used to control only the motion of the particular object such as pump or any other function.

2.8) Robotics

Robotics is the amalgamation of mechanical engineering, electrical engineering and computer science which helps in placing the system which is equivalent to the human a robotic may not be a physical system but I can also be a software related to be intelligent or an expert at its job.

Emerging application of Automation:

1) Food and Drink
2) Automated Mining
3) Automated Waste Management
4) Home Automation
5) Industrial Automation

PLC to PC communication:

Plc name: micrologix 1100 b (manufactured by Allen Bradley)

Software: rslogix 500

Features: Supply 220 volts, Smp which provides 24 volts, its CPU requires low voltage so internal circuits are build-in, it has 8 inputs and 6 outputs it has one +24 and -24 here is also a relay card from 0 to 8 and then it also has pushbuttons for inputs and also the metal detector, it has motor, three leds one for fan, one for horn. Communication is done through the RS232 or the Ethernet.

One Ethernet is connected to the machinery and the other link is connected to the PC and the connection is established with the program "RS LINK LITE".

1) Select communication from top bar menu.
2) Select Configured Drive.
3) Select Ethernet IP driver as we are establishing Ethernet connection.
4) Select ADD New and then select windows default to configure drive.

5) Now select and start.
6) Open Control Panel.
7) Select Network and Internet and then select Network and Sharing.
8) Now Select Local Area Connection and then select Properties.
9) Now Select Internet Protocol Version 4 (TCP/Version4).
10) Now check the IP Address and subnet Mask and select OK.
11) Now Open BOOT-DHCP server select tool from toolbar menu at the top and select network settings and then place network gateway and subnet mask.
12) Now select New from Relation list and then place Ethernet Mac Address and also the IP address and then OK.
13) Now the options on the toolbar menu with the relation list will be available and then select enable BOOTTP enable command OK if shown then the connection is made which means our PC is connected with the PLC.
14) Now whatever program is made on RS Logics its output will be seen at the PLC.
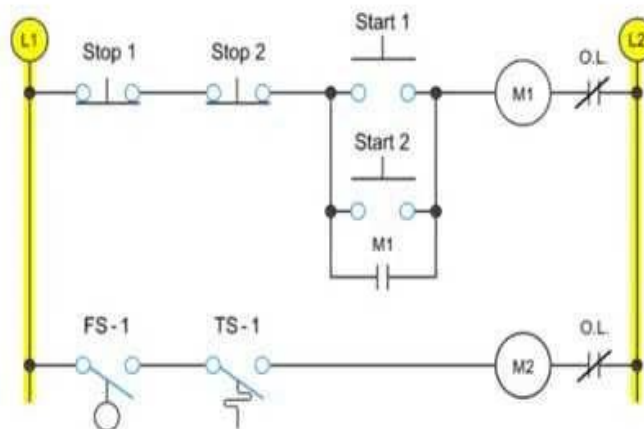
Ladder Logic:

Ladder Logic is a program that is used to give instructions to the PLC to execute commands and perform actions. The other programming languages use to program PLC includes Basic, C and Boolean algebra.

Why Ladder Logic?

Ladder Logic programming language is an adaption of relay electrical wiring diagram also known as the Ladder Diagram. Ladder Logic is a graphical system of symbols and terms even those not familiar with the relay wiring diagram can easily learn it.

Ladder Diagram is the way or processes to let know how the electrical current flow through a circuit to complete an electrical circuit.

Ladder Diagram

Each electrical circuit in a diagram is called as rung.

Every Rung has two components.

1) It contains at least one device that is controlled.
2) It contains the condition that control device.
3) A ladder logic program exists only in PLC software.
4) In ladder logic it is not the actual flow of current thru circuit.
5) Ladder Logic, instructions are either true or false.
6) Ladder program usually contains one control instruction (output) and usually one or more than one conditionals (inputs).

The instructions in Ladder Logic is usually N.O. (Normally Open) , N.C. Normally closed instructions and output energized.

The normal open instruction examines a PLC memory location for an ON condition. If PLC detects ON conditions, the instruction is true and has logical continuity.

The normal close instruction examines a PLC memory location for an OFF conditions. If PLC detects OFF conditions, the instruction is false and doesn't has logical continuity.
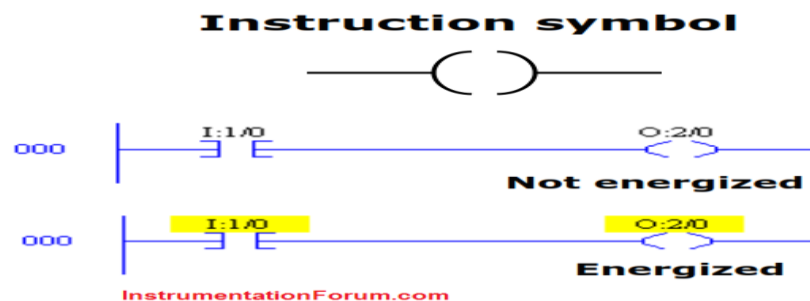
DIFFERENT TERMINOLOGY USED FOR NORMALLY OPEN AND NORMALLY CLOSED INPUT INSTRUCTIONS	
⊣ ⊢	Normally open Examine if closed AND
⊣/⊢	Normally closed Examine if open AND invert OR invert AND NOT

Normally open and normally closed instruction identification.
Fig (n)

Output Energized Instruction ---()---

When logical continuity exists on a rung, the On condition (binary 1) is written to the location in the memory associated with the output energize instruction.

Instruction symbol
—( )—

I:1/0 ... O:2/0
000 ⊣ ⊢ ... < > **Not energized**

I:1/0 ... O:2/0
000 ⊣ ⊢ ... < > **Energized**

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High Level Instruction:

While relay logic is simple for many ON/OFF sensing and control, many application require more powerful instructions, these instructions deals with 1's and 0's by manipulating data in bytes or words

Example of higher level instruction inludes counters, timer sequence, comparison and other operations.

Logical OR Conditionals.

Logical AND Conditionals.

The function of a branch is to allow both conditionals and control instructions to be programmed in parallel in single rung.

1) Condition instruction programmed in parallel are the equivalent of OR operations.
2) Control Instructuion programmed in parallel are equivalent of AND operations.
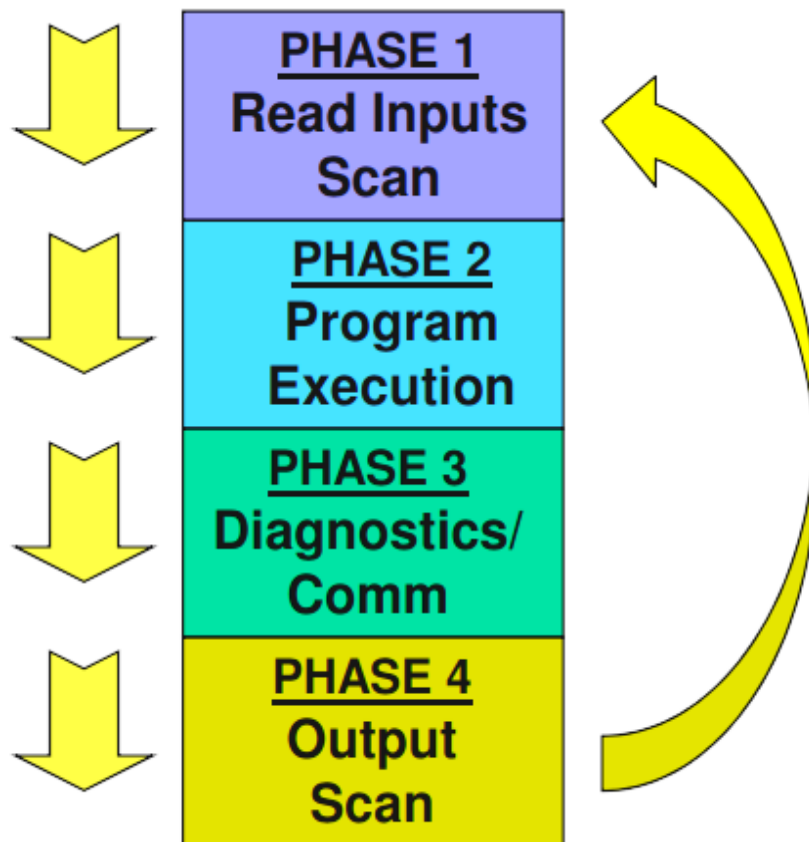
Electrical Ladder Diagram:
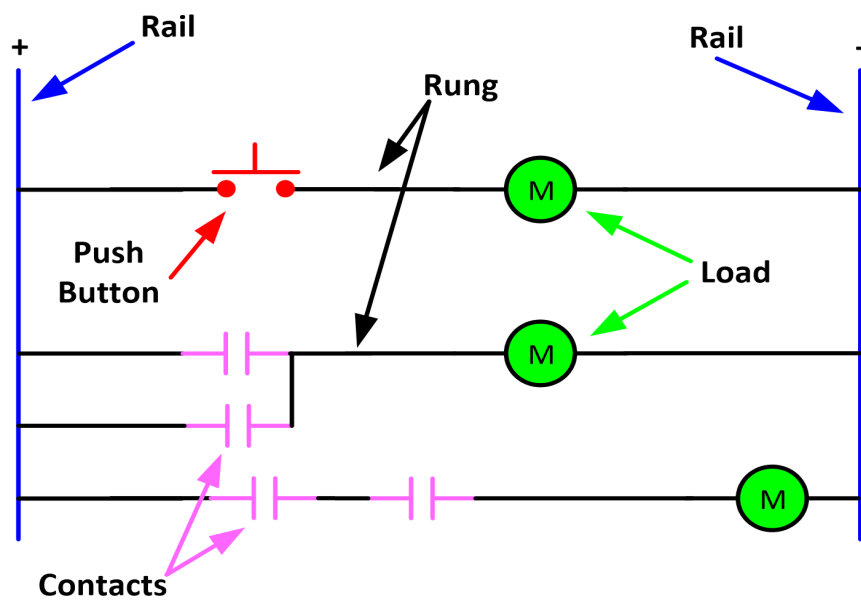
1) Program files are 0 to 8 and the subroutines are 9 to 255
2) Data files are system and subroutines