



**IEC COLLEGE OF
ENGINEERING
& TECHNOLOGY**

Greater Noida (College Code-90)

REPORT ON

INDUSTRIAL AUTOMATION

BASED ON PLC

Submitted by :

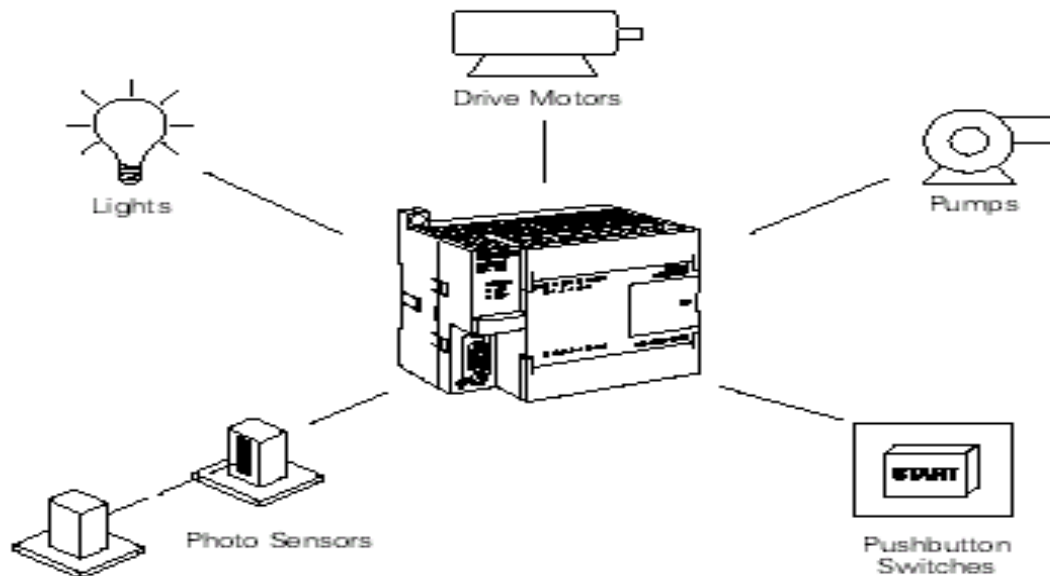
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INDUSTRIAL AUTOMATION BASED ON PLC

Automation is delegation of human control functions to technical equipments for increasing productivity, better quality, increasing safety in working conditions reducing manpower and cost. Making products under the control of computers and programmable controllers is known as “INDUSTRIAL AUTOMATION”.



ABSTRACT

Programmable logic controllers (PLCs) are members of the computer family capable of storing instructions to control functions such as sequencing, timing, and counting, which control a machine or a process. The PLC is composed of two basic sections, the Central Processing Unit (CPU) and the Input/Output (I/O) interface system. The PLC measures input signals coming from a machine and through the internal program provides output or control back to the machine.

Ladder logic is the programming language used to represent electrical sequences of operation. In hardwired circuits the electrical wiring is connected from one device to another according to logic of operation. In a PLC the devices are connected to the input interface, the outputs are connected to the output interface and the actual wiring of the components is done electronically inside the PLC using ladder logic. This is known as soft wired.

PLC is a device that is capable of being programmed to perform a controlling function. Before the advent of PLC, the problem of industrial control was usually solved by relays or hardwired solid-state logic blocks. These are very flexible in design and easy for maintenance personal to understand. However, they involved a vast amount of interconnection. For the wiring cost to be minimized, relays and logic blocks had to be kept together. This led to development of control panel concept for larger and more complex logic control system.

The PLC was first conceived by group of engineers from hydramatic division of GM in 1968. This was designed to provide flexibility in control based on programming and executing logic instruction. Adopting the ladder diagram programming language, simplifying maintenance and reducing the cost of spare parts inventories realized major advantages.

Introduction

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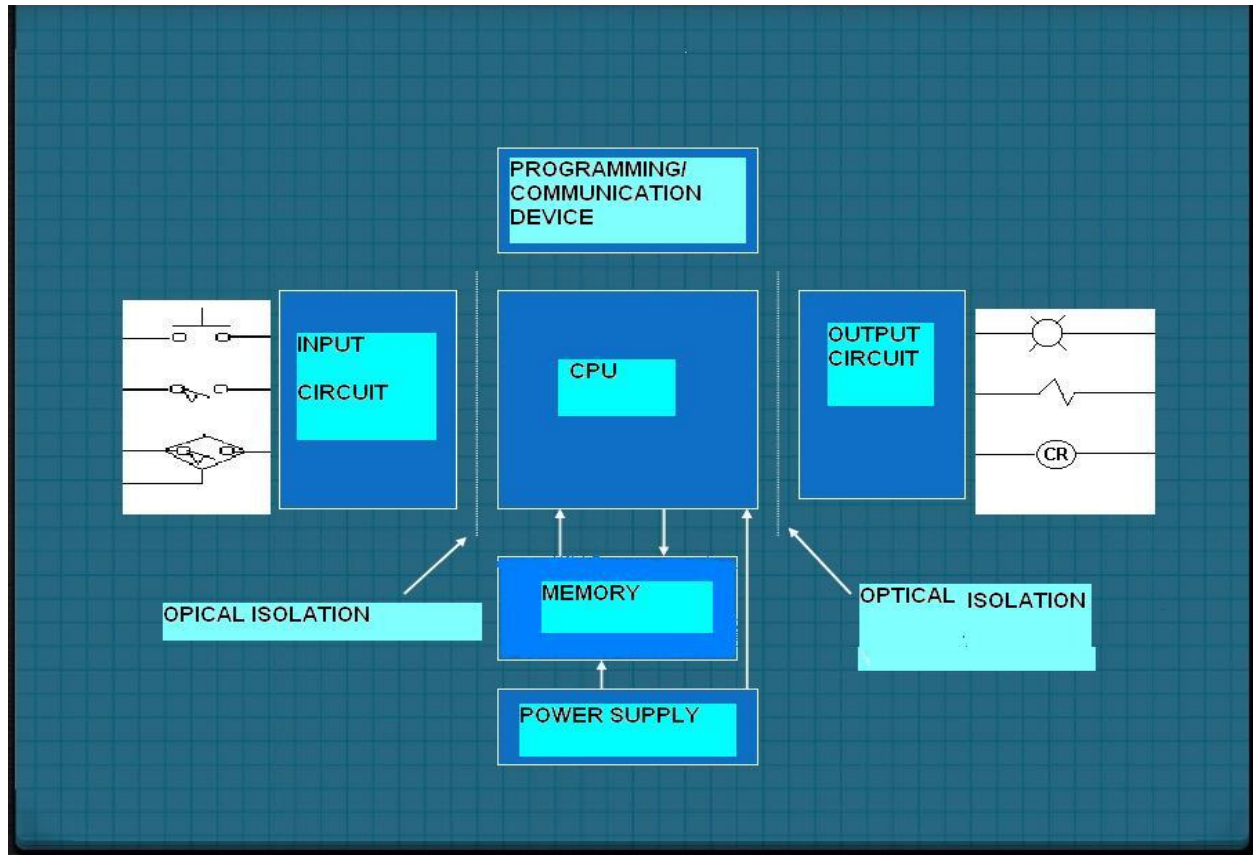
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PROGRAMMABLE LOGIC CONTROLLER

Block Diagram -:



PLC Components -:

- Processor Unit
- Power Supply
- Input/Output Section
- The Programmable Device

INPUT MODULE

- Push Button
- Selector Switches
- Proximity Sensor
- Limit Switches
- Motor Starter
- Photo Electric Sensor
- Relay Contact

These input act as field input sensor and the sensor. Analog input module: Typical input to these modules is 4 to 20 mA, and 0-10V. Ex- pressure, level, flow. Digital Input module : input to these module is 24V dc, 19V ac, 230V ac. Switches, Push Button, Relays Pump valve on/off status.

OUTPUT MODULE

- Flow Sensor
- Humidity Sensor
- Load Cell
- Potentiometer
- Temperature sensor
- Pressure sensor
- Vibration sensor
- Analogue Valves

PLC HARDWARE

A programmable logic controller consists of the following components:

Central Processing Unit (CPU).

Memory.

Input modules.

Output modules and

Power supply.

A PLC hardware block diagram is shown in Figure. The programming terminal in the diagram is not a part of the PLC, but it is essential to have a terminal for programming or monitoring a PLC. In the diagram, the arrows between blocks indicate the information and power flowing directions.

CPU:

Like other computerized devices, there is a Central Processing Unit (CPU) in a PLC. The CPU, which is the brain of a PLC, does the following operations:

- Updating inputs and outputs. This function allows a PLC to read the status of its input terminals and energize or deenergize its output terminals.
- Performing logic and arithmetic operations. A CPU conducts all the mathematic and logic operations involved in a PLC.
- Communicating with memory. The PLCTMs programs and data are stored in memory. When a PLC is operating, its CPU may read or change the contents of memory locations.
- Scanning application programs. An application program, which is called a ladder logic program, is a set of instructions written by a PLC programmer. The scanning function allows the PLC to execute the application program as specified by the programmer.

Communicating with a programming terminal. The CPU transfers program and data between itself and the programming terminal.

A PLCs CPU is controlled by operating system software. The operating system software is a group of supervisory programs that are loaded and stored permanently in the PLCTMs memory by the PLC manufacturer.

MEMORY -:

Memory is the component that stores information, programs, and data in a PLC. The process of putting new information into a memory location is called writing. The process of retrieving information from a memory location is called reading. The common types of memory used in PLCs are Read Only Memory (ROM) and Random Access Memory (RAM). A ROM location can be read, but not written. ROM is used to store programs and data that should not be altered. For example, the PLC™s operating programs are stored in ROM.

A RAM location can be read or written. This means the information stored in a RAM location can be retrieved and/or altered. Ladder logic programs are stored in RAM. When a new ladder logic program is loaded into a PLC™s memory, the old program that was stored in the same locations is over-written and essentially erased.

The memory capacities of PLCs vary. Memory capacities are often expressed in terms of kilo-bytes (K). One byte is a group of 8 bits. One bit is a memory location that may store one binary number that has the value of either 1 or 0. (Binary numbers are addressed in Module 2). 1K memory means that there are 1024 bytes of RAM. 16K memory means there are $16 \times 1024 = 16384$ bytes of RAM.

Input modules and output modules

A PLC is a control device. It takes information from inputs and makes decisions to energize or de-energize outputs. The decisions are made based on the statuses of inputs and outputs and the ladder logic program that is being executed.

The input devices used with a PLC include pushbuttons, limit switches, relay contacts, photo sensors, proximity switches, temperature sensors, and the like. These input devices can be AC (alternating current) or DC (direct current). The input voltages can be high or low. The input signals can be digital or analog. Differing inputs require different input modules. An input module provides an interface between input devices and a PLC™s CPU, which uses only a low DC voltage. The input module™s function is to convert the input signals to DC voltages that are acceptable to the CPU. Standard discrete input modules include 24 V AC, 48 V AC, 120 V AC, 220 V AC, 24 V DC, 48 V DC, 120 V DC, 220 V DC, and transistor-transistor logic (TTL) level.

The devices controlled by a PLC include relays, alarms, solenoids, fans, lights, and motor starters. These devices may require different levels of AC or DC voltages. Since the signals processed in a PLC are low DC voltages, it is the function of the output module to convert PLC control signals to the voltages required by the controlled circuits or devices. Standard discrete output modules include 24 V AC,

48 V AC, 120 V AC, 220 V AC, 24 V DC, 48 V DC, 120 V DC, 220 V DC, and TTL level.

Power Supply -:

PLCs are powered by standard commercial AC power lines. However, many PLC components, such as the CPU and memory, utilize 5 volts or another level of DC power. The PLC power supply converts AC power into DC power to support those components of the PLC.

Programming Terminal

A PLC requires a programming terminal and programming software for operation. The programming terminal can be a dedicated terminal or a generic computer purchased anywhere. The programming terminal is used for programming the PLC and monitoring the PLCTMs operation. It may also download a ladder logic program (the sending of a program from the programming terminal to the PLC) or upload a ladder logic program (the sending of a program from the PLC to the programming terminal). The terminal uses programming software for programming and talking to a PLC.

WORKING OF PLC -:

Bringing input signal status to the internal memory of CPU

- The field signals are connected to the I/P module. At the output of I/P module the field status converted into the voltage level required by the CPU is always available.
- At the beginning of each cycle the CPU brings in all the field I/P signals from I/P module & stores into its internal memory called as PII, meaning process image input.
- The programmable controller operates cyclically meaning when complete program has been scanned; it starts again at the beginning of the program.

I/O BUS -:

A PLC works by continually scanning a program. We can think of this scan cycle as consisting of 3 important steps. There are typically more than 3 but we can focus on the important parts and not worry about the others. Typically the others are checking the system and updating the current internal counter and timer values.

Step 1- Check Input Status-First the PLC takes a look at each input to determine if it is on or off. In other words, is the sensor connected to the first input on How about the second input How about the third... It records this data into its memory to be used during the next step.

Step 2- Execute Program-Next the PLC executes your program one instruction at a time. Maybe your program said that if the first input was on then it should turn on the first output. Since it already knows which inputs are on/off from the previous step it will be able to decide whether the first output should be turned on based on the state of the first input. It will store the execution results for use later during the next step.

Step 3-Update Output Status-Finally the PLC updates the status of the outputs. It updates the outputs based on which inputs were on during the first step and the results of executing your program during the second step. Based on the example in step 2 it would now turn on the first output because the first input was on and your program said to turn on the first output when this condition is true.

Process Control and Automation

Process Control

The process of recognizing the state of the process at all times, analyze the information according to the set rules and guidelines and accordingly actuate the control elements is referred to as process control.

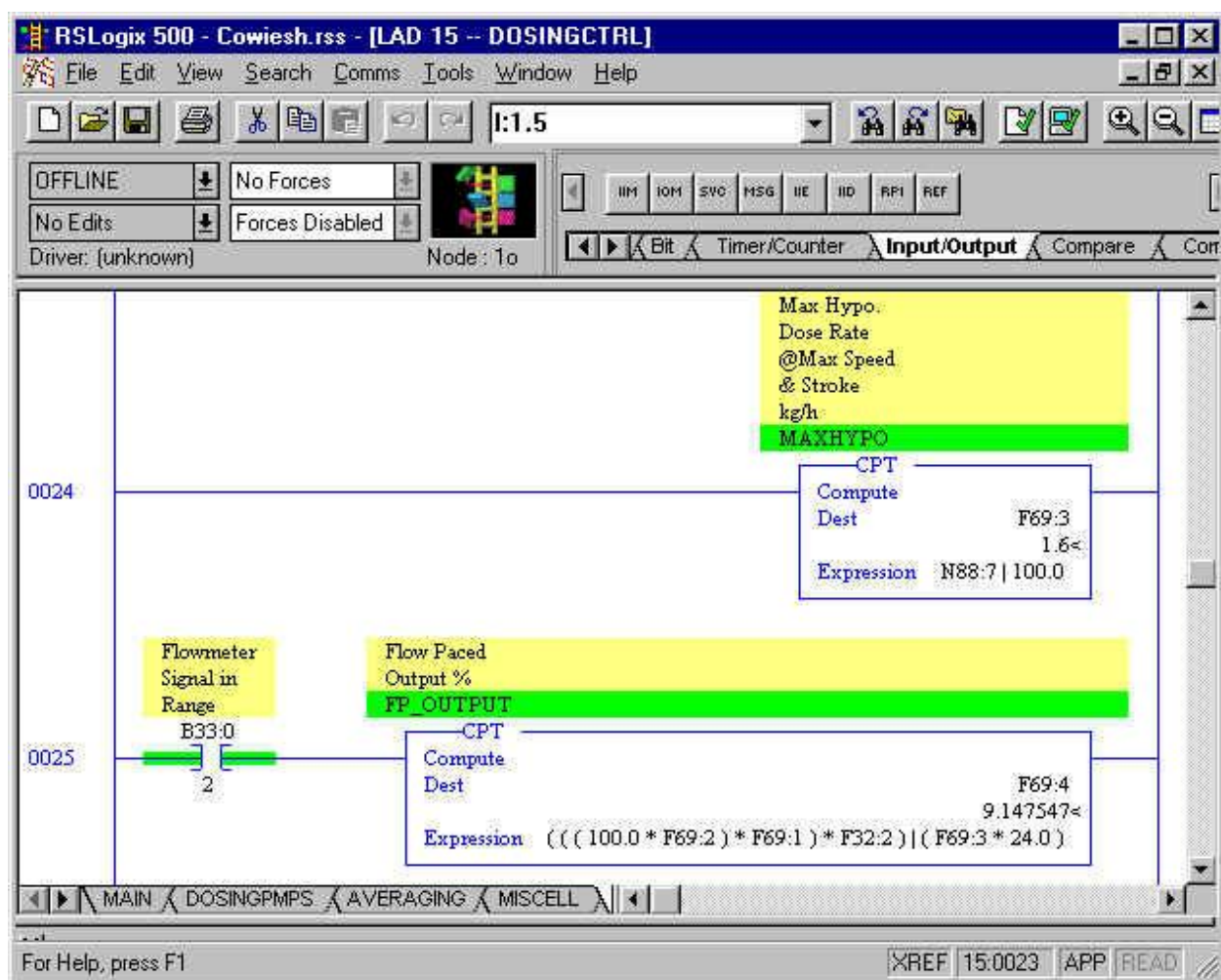
PLC PROGRAMMING

Ladder Logic-:

Ladder logic is the main programming method used for PLCs. The ladder logic has been developed to mimic relay logic. The decision to use the relay logic diagrams was a strategic one. By selecting ladder logic as the main programming method, the amount of retraining needed for engineers and trades people was greatly reduced.

Modern control systems still include relays, but these are rarely used for logic. A relay is a simple device that uses a magnetic field to control a switch, as pictured in Fig. When a voltage is applied to the input coil, the resulting current creates a magnetic field. The magnetic field pulls a metal switch (or reed) towards it and the contacts touch, closing the switch. The contact that closes when the coil is energized is called normally open. The normally closed contacts touch when the

input coil is not energized. Relays are normally drawn in schematic form using a circle to represent the input coil. The output contacts are shown with two parallel lines. Normally open contacts are shown as two lines, and will be open (non-conducting) when the input is not energized. Normally closed contacts are shown with two lines with a diagonal line through them. When the input coil is not energized the normally closed contacts will be closed (conducting).



SCAN CYCLE OF PLC



Ladder Logic Inputs : PLC inputs are easily represented in ladder logic. In Figure there are three types of inputs shown. The first two are normally open and normally closed inputs, discussed previously. The IIT (Immediate Input) function allows inputs to be read after the input scan, while the ladder logic is being scanned. This allows ladder logic to examine input values more often than once every cycle.

ADVANTAGE OF PLC

- Reduced space.
- Energy saving.
- Ease of maintenance.
- Economical.
- Greater life and reliability.
- Tremendous flexibility.
- Shorter project time.
- Easier storage, archiving and documentation.
- PLCs are armored for severe conditions (such as dust, moisture, heat, cold) and have the facility for extensive input/output (I/O) arrangements.
- PLCs read limit switches, analog process variables (such as temperature and pressure), and the positions of complex positioning systems.
- PLCs are used in many "real world" applications. If there is industry present, chances are good that there is a plc present. If you are involved in machining, packaging, material handling, automated assembly or countless other industries you are probably already using them. If you are not, you are wasting money and time. Almost any application that needs some type of electrical control has a need for a plc.

APPLICATION OF PLC

In industry, there are many production tasks, which are of highly repetitive nature. Although repetitive & monotonous, each stage needs careful attention of operator to ensure good quality of final product.

- Many times, a close supervision of the processes cause high fatigue on operator resulting in loss of track of process control.
- Sometimes itTMs hazardous also as in the case of potentially explosive chemical processes.
- Under all such conditions we can use PLCs effectively in totally eliminating the possibilities of human error.
- Some capabilities of PLCs are as follows:
 1. Logic control
 2. PID control
 3. Coordination & automation
 4. Operator control
 5. Signaling and listing etc.
- In short, wherever sequential logic control & automation is desired the PLCs are the best suited to meet the task. It includes simple interlocking functions to complicated analog signal processing to PID control action in closed loop control etc.
- Few examples of industries where PLCs are used for control & automation purpose are listed below: -
 1. Tyre industry.
 2. Blender reclaimer.
 3. Bulk material handling system at ports.
 4. Ship unloader.

5. Wagon loaders.
 6. Steel plants.
 7. Blast furnace charging.
 8. Brick-moulding press in refectories.
 9. Galvanizing plant.
 10. Dairy automation.
 11. Pulp factory.
 12. Printing industry etc.
- Today the PLCs are used for control and automation job in a single machine and it increases up to full automation of manufacturing or testing process in a factory.

PLC DISADVANTAGE

- In contrast to microcontroller systems that have what is called an open architecture, most PLCs manufacturers offer only closed architectures for their products.
- PLC devices are proprietary, which means that parts and software from one manufacturer can't easily be used in combination with parts of another manufacturer, which limits the design and cost options.

CONCLUSION

PLC is a device that is capable of being programmed to perform a controlling function. The PLC was designed to provide flexibility in control based programming and executing logic instruction. PLC allowed for shorter installation time and faster commissioning through programming rather than wiring.

The PLC have in recent years experienced an unprecedented growth as universal element in industrial automation .It can be effectively used in applications ranging from simple control like replacing a small number of relays to complex automation problems.

Today the PLCs are used for control & automation job in a single machine & it increases up to full automation of manufacturing / testing process in a factory.