International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 4 Issue 7, July-2015

Role of PLC in automation and its various applications

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ABSTRACT

Automation is not a newer concept. Automation is the use of machines, control systems and information technologies to optimize productivity in the production of goods and delivery of services. A Programmable Logic Controller, PLC is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. Simplification of engineering and precise control of manufacturing process can result in significant cost savings.

ROLE OF PLC IN AUTOMATION

A constant demand for better and more efficient manufacturing and process machinery has led to the requirement for higher quality and reliability in control techniques. With the availability of intelligent, compact solid state electronic devices, it has been possible to provide control systems that can reduce maintenance, down time and improve productivity to a great extend. By installing efficient and user friendly industrial electronics systems for manufacturing machinery or processors, one can obtain a precise, reliable and prolific means for generating quality products. Considering the varied demand and increasing competition, one has to provide for flexible manufacturing process. One of the latest techniques in solid state controls that offers flexible and efficient operation to the user is "PROGRAMMABLE LOGIC CONTROLLER". The basic idea behind these programmable controllers was to provide means to eliminate high cost associated with inflexible, conventional relay controlled systems. Programmable controllers offer a system with computer flexibility:

1. Suited to withstand the industrial environment
2. Has simplicity of operation
3. Maintenance by plant technicians and
4. Reduce machine down time and provide expandability for future.

DEFINITION OF PLC

A Programmable controller is a solid state user programmable control system with functions to control logic, sequencing, timing, arithmetic data manipulation and counting capabilities. It can be viewed as an industrial computer that has a central processor unit, memory, input output interface and a programming device. The central processing unit provides the intelligence of the controller. It accepts data, status information from various sensing devices like limit switches, proximity switches, executes the user control program store in the memory and gives appropriate output commands to devices like solenoid valves, switches etc.

Input output interface is the communication link between field devices and the controllers; field devices are wired to the I/O interfaces. Through these interfaces the processor can sense and measure physical quantities regarding a machine or process, such as, proximity, position, motion, level, temperature, pressure, etc. Based on status sensed, the CPU issues command to output devices such as valves, motors, alarms, etc. Programmer unit provides the man machine interface. It is used to enter the application program, which often uses a simple user-friendly logic.

HARDWARE COMPONENTS OF A PLC SYSTEM:

Processor unit (CPU), Memory, Input/ Output, Power supply unit, Programming device, and other devices.

CENTRAL PROCESSING UNIT (CPU):

Microprocessor based, may allow arithmetic operations, logic operators, block memory moves, computer interface, local area network, functions, etc. CPU makes a great number of check-ups of the PLC controller itself so eventual errors would be discovered early.

MEMORY:

System (ROM) to give permanent storage for the operating system and the fixed data used by the CPU. RAM for data. This is where information is stored on the status of input and output devices and the values of timers and counters and other internal devices. EPROM for ROM‟s that can be programmed and then the program made permanent.

I/O SECTIONs:

Inputs monitor field devices, such as switches and sensors. Outputs control other devices, such as motors, pumps, solenoid valves, and lights.

POWER SUPPLY:

Most PLC controllers work either at 24 VDC or 220 VAC. Some PLC controllers have electrical supply as a separate module, while small and medium series already contain the supply module.

PLC COMMUNICATION:

Serial communication is used for transmitting data over long distances. Might be used for the connection between a computer and a PLC. Serial standards RS-232 communications is the most popular method of plc to external device communications. RS 232 is a communication interface included under SCADA applications. Other standards such as RS422 and RS423 are similar to RS232 although they permit higher transmission rates and longer cable distances.

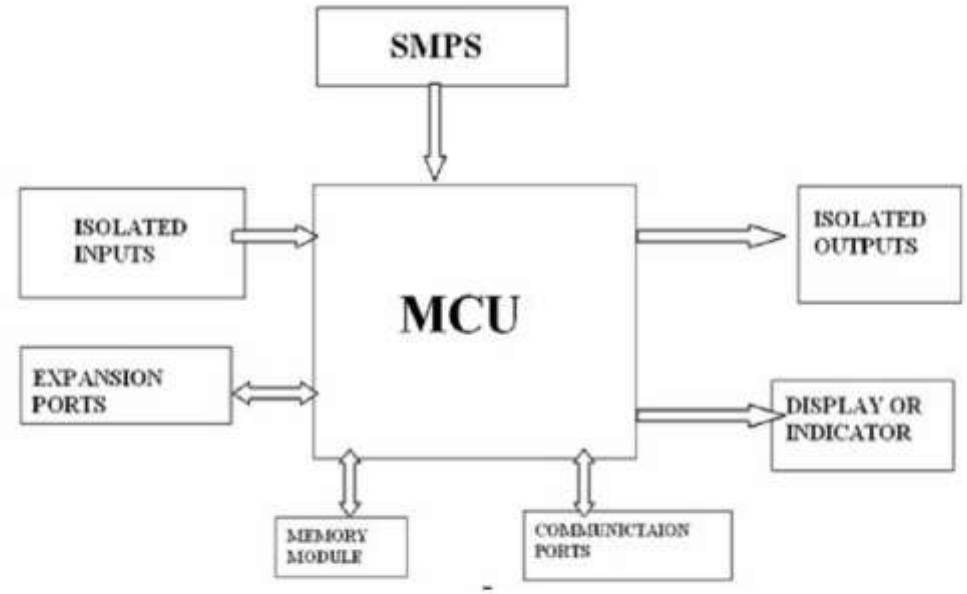

Fig 1. PLC Architecture

PLCs contain three basic sections:

1. Central processing unit (CPU).
2. Memory: EPROM, RAM, and so on.
3. Input/output section for communication with peripherals (ADC, DAC).

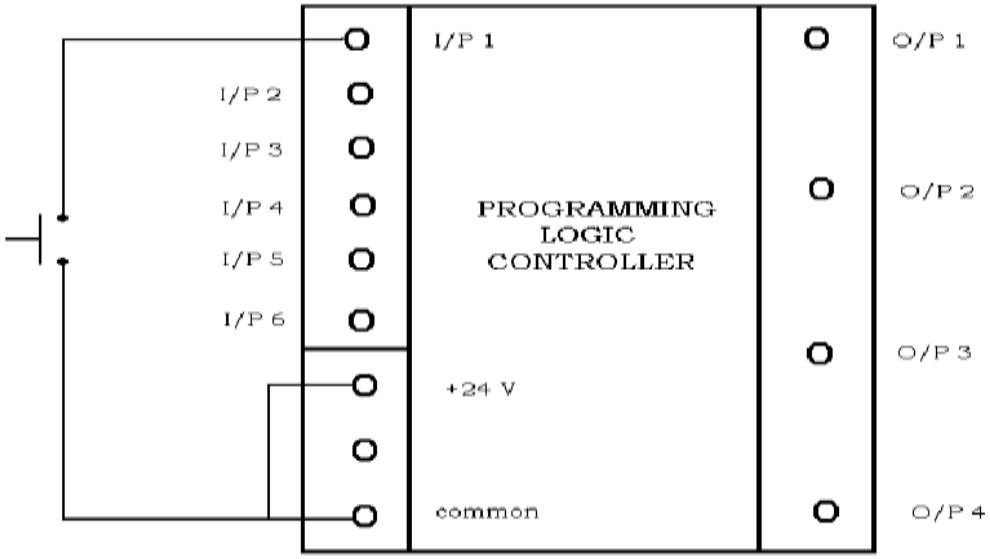

Fig. 2: PLC PIN DIAGRAM

PLC PROGRAMMING: There are six programming language available for any PLC, But the most common between them is **Ladder Programming**. The name of all of the programming Languages are :

-Ladder Diagram. (LD)
- Sequential Flow Chart. (SFC)
- Function Block Diagram. (FBD)
- Instruction List. (IL)
- Structured Text. (ST)
- Continues Function Chart. (CFC)

A program loaded into PLC systems in machine code, a sequence of binary code numbers to represent the program instructions. Assembly language based on the use of mnemonics can be used, and a computer program called an assembler is used to translate the mnemonics into machine code. High level Languages (C, BASIC, etc.) can be used.

APPLICATIONS OF PLC

In the present industrial world, a flexible system that can be controlled by user at site is preferred. Systems, whose logic can be modified but still, used without disturbing its connection to external world, is achieved by PLC. Utilizing the industrial sensors such as limit switches, ON-OFF switches, timer contact, counter contact etc., PLC controls the total system. The drive to the solenoid valves, motors, indicators, enunciators, etc are controlled by the PLCs. The above said controlling elements (normally called as inputs of PLCs) and controlled elements (called as outputs of PLCs) exist abundantly in any industry. These inputs, outputs, timers, counters, auxiliary contacts are integral parts of all industries. As such, it is difficult to define where a PLC cannot be used. Proper application of a PLC begins with conversion of information into convenient parameters to save money, time and effort and hence easy operation in plants and laboratories.

The areas where PLC is used maximum are as follows:

1. The batch processes in chemical, cement, food and paper industries which are sequential in nature, requiring time of event based decisions is controlled by PLCs.
2. In large process plants PLCs are being increasingly used for automatic start up and shut down of critical equipment. A PLC ensures that equipment cannot be started unless all the permissive conditions for safe start have seen established. It also monitors the conditions necessary for safe running of the equipment and trips the equipment whenever any abnormality in the system is detected.
3. The PLC can be programmed to function as an energy management system for boiler control for maximum efficiency and safety.
4. In automation of blender reclaimers
5. In automation of bulk material handling system at ports.

6. In automation for a ship unloader.
7. Automation for wagon loaders.
8. For blast furnace charging controls in steel plants.
9. In automation of brick moldings press in refractories.
10. In automation for galvanizing unit.
11. For chemical plants process control automation.
12. In automation of a rock phosphate drying and grinding system.
13. Modernization of boiler and turbo generator set.
14. Process visualization for mining application.
15. Criteria display system for power station.
16. As stored programmed automation unit for the operation of diesel generator sets.
17. In Dairy automation and food processing.
18. For a highly modernized pulp paper factory.
19. In automation system for the printing industry.
20. In automation of container transfer crane.
21. In automation of High-speed elevators.
22. In plastic moldings process.
23. In automation of machine tools and transfer lines.
24. In Mixing operations and automation of packaging plants.
25. In compressed air plants and gas handling plants.
26. In fuel oil processing plants and water classification plants.
27. To control the conveyor/classifying system.

Thus PLC is ideal for application where plant machine interlock requirements are finalized at a later stage and need changes during engineering trial runs, commissioning or normal use. It can be used extensively to replace conventional relay controls in power stations, refineries, cement, steel, fertilizer, petrochemical, chemical industries etc.
Applications can thus be extended from monitoring to supervision, control and management.

FUTURE OF PLCs

The PLC offers a compromise between advance control techniques and present day technology. It is extremely difficult to forecast the rate and form of progress of PLCs, but there is strong evidence that development is both rapid and cumulative. With the capability of functioning as local controllers in distributed control systems. PLCs will retain their application in large process plants. A further development of PLCs leads to the development of programmable function controller (PFC) is compatible to PCs and directly controls the desired functions. In India every process industry is replacing relay control systems by PLCs and will go for PLCs in near future. In the near future every flats and offices may possess PFCs to control room temperature, as elevator controller, maintain water tank levels, as small telephone exchange etc.

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