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The Principle of Programmable Logic Controller and its role in Automation

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Abstract— This paper introduces Programmable logic controller,discusses the topics of PLC. This paper also discusses the role of PLC in Automation engineering which is a cross sectional discipline that requires proportional knowledge in hardware and software development and their applications.

Keywords— PLC, Ladder Logic, Automation

I. Introduction

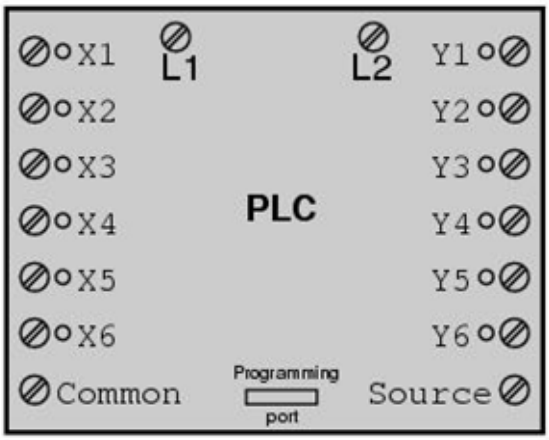
This Systems and processes requiring "on/off" control abound in modern commerce and industry, but such control systems are rarely built from either electromechanical relays or discrete logic gates. Instead, digital computers fill the need, which may be programmed to do a variety of logical functions.

The purpose of a PLC was to directly replace electromechanical relays as logic elements, substituting instead a solid-state digital computer with a stored program, able to emulate the interconnection of many relays to perform certain logical tasks. A **Programmable Logic Controller**, PLC or **Programmable Controller** is a digital computer used for automation of electromechanical processes.

The **Programmable Logic Controller** (PLC) is basically a computer. Even the smallest PLC has a microprocessor, which qualifies it as a computer.

PLCs are used in many industries and machines. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. A PLC has many "input" terminals, through which it interprets "high" and "low" logical states from sensors and switches. It also has many output terminals, through which it outputs "high" and "low" signals to power lights, solenoids, contactors, small motors, and other devices lending themselves to on/off control. In an effort to make PLCs easy to program, their programming language was designed to resemble ladder logic diagrams. Thus, an industrial electrician or electrical engineer accustomed to reading ladder logic schematics would feel comfortable programming a PLC to perform the same control functions.

The following illustration shows a simple PLC, as it might appear from a front view. Two screw terminals provide connection to 120 volts AC for powering the PLC's internal circuitry, labelled L1 and L2. Six screw terminals on the left-hand side provide connection to input devices, each terminal representing a different input "channel" with its own "X" label. The lower-left screw terminal is a "Common" connection, which is generally connected to L2 (neutral) of the 120 VAC power source.



II. PLC Topics

A. Features

The main difference from other computers is that PLCs are armored for severe conditions (such as dust, moisture, heat, cold) and have the facility for extensive input/output (I/O) arrangements. These connect the PLC to sensors and actuators.

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PLCs read a set of digital and analog inputs, process logic statements, and generate analog and digital outputs to the industrial automation process

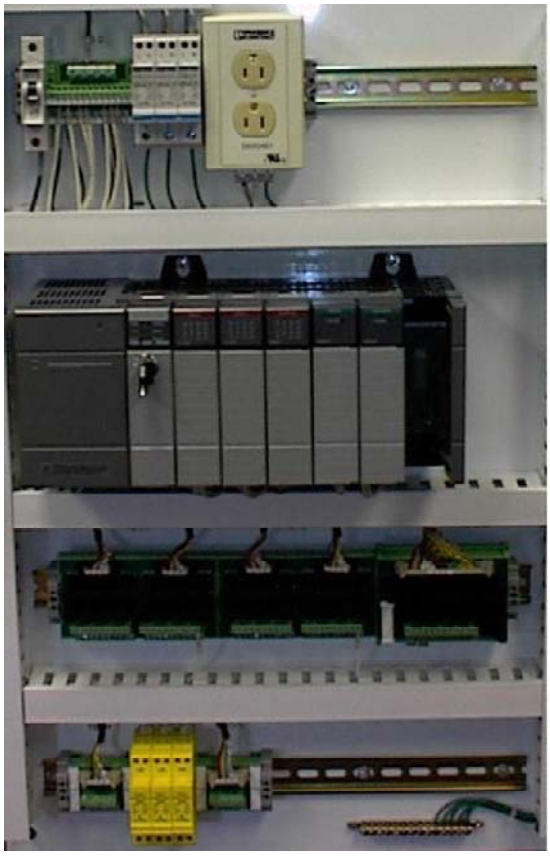

Fig: Control panel with PLC (grey elements in the center). The unit consists of separate elements, from left to right; power supply, controller, relay units for in- and output.

B. Programming

PLCs are programmed using application software on personal computers. The computer is connected to the PLC through Ethernet, RS-232, RS-485 or RS-422 cabling. The programming software allows entry and editing of the ladder-style logic. Ladder logic is a programming language that represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware. It is primarily used to develop software for programmable logic controllers (PLCs) used in industrial control applications. The name is based on the observation that programs in this language resemble ladders, with two vertical rails and a series of horizontal rungs between them.

Here are a few examples of how the ladder logic program might look like. In real world applications, there may be hundreds or thousands of rungs.

```
1. ---- [ ]        .....    |--[ ]      --|------     ( )
   X                        |             Y      |            S
                            |                    |
                            |          --[ ]--   |
                                         Z
```

The above realizes the function: S = X AND (Y OR Z)

```
------[ ]--------------[ ]------------
----( )
    Key Switch 1                Key Switch 2
Door Motor
```

The above circuit shows two key switches that security guards might use to activate an electric motor on a bank vault door. When the normally open contacts of both switches close, electricity is able to flow to the motor which opens the door. This is a logical AND.

Generally the software provides functions for debugging and troubleshooting the PLC software, for example, by highlighting portions of the logic to show current status during operation or via simulation. The software will upload and download the PLC program, for backup and restoration purposes. In some models of programmable controller, the program is transferred from a personal computer to the PLC through a programming board which writes the program into a removable chip such as an EEPROM or EPROM.

C. Scan time

A PLC performs a repetitive cycle of operations. First, the PLC sequentially scans the input devices and updates a memory table indicating their status. Next, the PLC executes its control programming, or ladder logic. As it processes the ladder logic, the PLC updates a memory table which indicates

whether output devices should be ON or OFF. Finally, the PLC uses the output table to actually change the condition of the output devices.

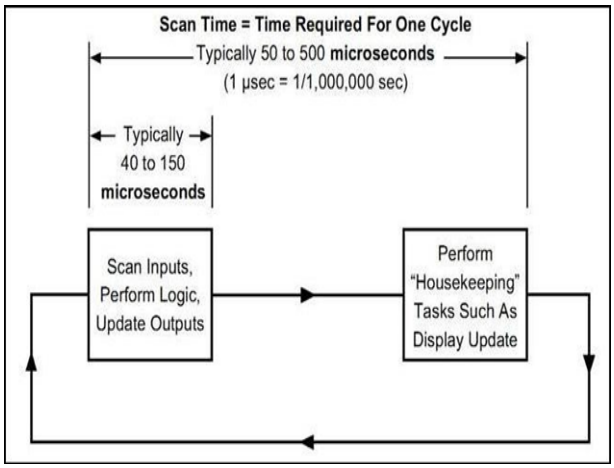

Fig: Scan Time

Engineers can now have numerical control over automated devices. The result has been a rapidly expanding range of applications and human activities. Information technology, together with industrial machinery and processes, can assist in the design, implementation, and monitoring of control systems. One example of an industrial control system is a programmable logic controller (PLC). PLCs are specialized hardened computers which are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events.

III. CONCLUSIONS

Programmable Logic controllers (PLC's) are widely used in motion control, positioning control and torque control. The main intensions of this paper are fully unfolded. The Programmable Logic is the one of most influential inventions of this Century. The impact of the Automation in the Industry is realised more now than ever in this field of manufacturing.

The Automation in the industry is going to be more multiplied over time than ever before.

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