PLC Programming & Implementation

Part 1

An Introduction to PLC Programming Methods and Applications

By

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About the Author

My name is Bolakale Aremu. I am a Control Systems Engineer. I have worked with hundreds of clients across the Programmable Logic Controllers (PLC) automation industry. I have written many books and articles, and created courses for higher education institutions. With my 15 years of experience in the Control Systems Engineering, I have helped some world class organizations like Post Holdings, Kraft Heinz and Procter & Gamble.

I have used several PLC-based systems like the Allen-Bradley's RSLogix 5, 500, 5000, Studio 5000 and PACs. I am also a master of other great technologies like Cognex In-Sight Vision Systems to mention a few.

How this Book can Help You

This short book is part 1 of a 6-part series. It is a valuable introduction to Programmable Logic Controllers, and also a reference guide for beginners. It provides an overview of how relay logic can be converted into PLC logic. I included lots of examples, tables, and ladder diagrams to help simplify the topics I covered for beginners.

You will find this book very helpful if you are an electrician, an instrumentation technician, an automation professional or engineer that wants to improve their knowledge of PLC programming.

Getting Started

Simple Key Terms to Understand Relay Logic to PLC Logic Conversion

Control strategy: This is the sequence of steps that take place in a PLC program, which produces our desired output control.

Control task: It is our desired results of a control program.

Flowcharting: This is a method used to pictorially represent the operation of a process in a sequential manner.

Program coding: This is the process of translating a logic or relay diagram into the PLC ladder program form.

The implementation of a control program requires complex organizational and analytical skills, which change depending on the application. Because they are so varied, we cannot explain how to solve every specific control task.

Nevertheless, we can provide you with techniques and guidelines for completing this problem-solving process. In this handbook, we will introduce a strategy for implementing a control program, which includes program organization, system configuration, and I/O programming.

These strategies also apply to PLCs with the IEC 1131-3 programming standard. Additionally, we will present both simple and complex PLC programming examples. After you finish, you will be ready to learn how to document the PLC system—the last step in implementing the control program.

1. Control Task Definition

A user should begin the problem-solving process by defining the **control task**, that is, determining what needs to be done. This information provides the foundation for the control program. To help minimize errors, the control task should be defined by those who are familiar with the operation of the machine or process. Proper definition of the task is directly related to the success of the control program.

Control task definition occurs at many levels. All of the departments involved must work together to determine what inputs are required, so that everyone understands the purpose and scope of the project. For example, if a project involves the automation of a manufacturing plant in which materials will be retrieved from the warehouse and sent to the automatic packaging area, personnel from both the warehouse and packaging areas must collaborate with the engineering group during the system definition.

Management should also be involved if the project requires data reporting. If the control task is currently done manually or through relay logic, the user should review the steps of the manual procedure to determine what improvements, if any, can be made. Although relay logic can be directly implemented in a PLC, the procedure should be redesigned, when possible, to meet current project needs and to capitalize on the capabilities of programmable controllers.

2. Control Strategy

After the control task has been defined, the planning of its solution can begin. This procedure commonly involves determining a **control strategy**, the sequence of steps that must occur within the program to produce the desired output control. This part of the program development is known as the development of an algorithm. The term *algorithm* may be new or strange to some readers, but it need not be. Each of us follows algorithms to accomplish certain tasks in our daily lives.

The procedure that a person follows to go from home to either school or work is an algorithm—the person exits the house, gets into the car, starts the engine, and so on. In the last of a finite number of steps, he or she reaches the destination.

The PLC strategy implementation for a control task closely follows the development of an algorithm. The user must implement the control from a given set of basic instructions and produce the solution in a finite number of steps. If developing an algorithm to solve the problem becomes difficult, he or she may need to return to the control task definition to redefine the problem.

For example, we cannot explain how to get from where we are to Bullfrog County, Nevada unless we know both where we are and where Bullfrog County is. As part of the problem definition, we need to know if a particular method of transportation is required. If there is a time constraint, we need to know that too. We cannot develop a control strategy until we have all of this problem definition information.

The fundamental rule for defining the program strategy is *think first, program later.* Consider alternative approaches to solving the problem and allow time to polish the solution algorithm before trying to program the control function. Adopting this philosophy will shorten programming time, reduce debugging time, accelerate start-up, and focus attention where it is needed—on design when designing and on programming when programming.

Strategy formulation challenges the system designer, regardless of whether it is a new application or the modernization of an existing process. In either case, the designer must review the sequence of events and optimize control through the addition or deletion of steps. This requires a knowledge of the PLC-controlled field devices, as well as input and output considerations.