PLC Program for Sequentially Light on Application

Hnin Yu Wai[1]
[1](Department of Electronic Engineering, Technology University, Panglong, Myanmar)
Email: powerlay@gmail.com)

ABSTRACT
The scope of this paper is to present the structure, language, size, programming device, application and advantages of PLC system. The ladder diagram method is used to represent the application of sequentially switch on the light. The LogicPro software is used for the proposed work. The critical timing operation is required to be carried out to switch the light on sequentially according to the programmed preset time. Timer ON delay timer (TON) and greater than or equal to (GEQ) instructions are used in the program.

Keywords *- PLC, ladder diagram, Logicpro, On delay timer, GEQ.*

1. INTRODUCTION
A programmable logic controller (PLC) is a special form of microprocessor-based controller that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes [1]. In order to control machines and processes, PLC is designed to be operated by engineers even by a limited knowledge of computers and computing languages [2]. PLC are used in almost every aspect of industry to expand and enhance production. Where older automated systems would use hundreds or thousands of electromechanical relays, a single PLC can be programmed as an efficient replacement. Sophisticated motion control, process control, distributive control systems, and complex networking have now been added to the PLC's function [3].

2. WHAT IS PLC?
A Programmable Logic Controller (PLC) is an industrial computer control systems that continuously monitors the states of input devices and make decisions based upon a custom program to control the states of output devices. It is designed for multiple inputs and outputs arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact[4].

The term logic is used because programming is primarily concerned with implementing logic and switching operations. Input devices, e.g, sensors such as switches, and output devices in the system being controlled, e.g. motors, valves, etc., are connected to the PLC. The operator then enters a sequence of instructions, i.e. a program, into the memory of the PLC. The controller then monitors the inputs and outputs according to this program. The programmable logic controller consists of computer hardware, which is programmed to simulate the operation of the individual logic and sequence elements that might be contained in a bank of relays, timers, counters and other hard-wired components.

The PLC is basically comprised of a Central Processing Unit (CPU), memory, power supply unit, Input/Output (I/O) interfaces, communication interface and the programming device. The basic arrangement is shown in Figure 1[5].

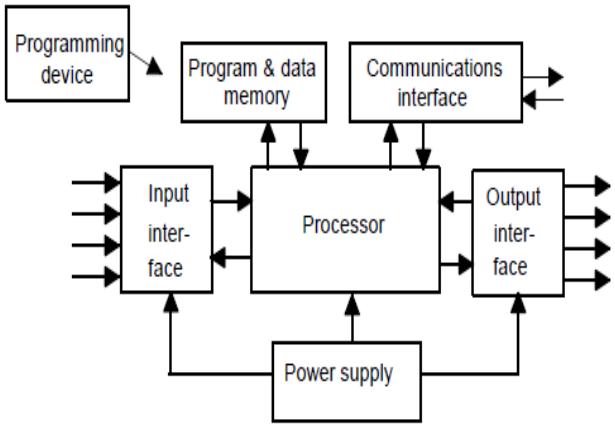

Figure 1 The PLC System

2.1 Types of PLC
PLCs are integrated as either single or modular units. An integrated or compact PLC is built by several modules within a single case. Therefore, the I/O capabilities are decided by the manufacturer, but not by the user. Some of the integrated PLCs allow to connect additional I/Os to make them somewhat modular. Modular PLCs is built with several components that are plugged into a common rack or bus with extendable I/O

capabilities. It contains power supply module, CPU and other I/O modules that are plugged together in the same rack, which are from other manufacturers. Modular PLCs are further divided into small, medium and large PLCs based on the program memory size and the number of I/O features. Small PLC is a mini-sized PLC that is designed as compact and robust unit mounted or place beside the equipment to be controlled. This PLC I/O module expandability is limited for one or two modules and it uses logic instruction list or relay ladder language as programming language.

Medium-sized PLC is mostly used PLC in industries which allows many plug-in modules that are mounted on backplane of the system. Some hundreds of input/output points are provided by adding additional I/O cards. Large PLCs are used wherein complex process control functions are required. These PLCs' capacities are quite higher than the medium PLCs in terms of memory, programming languages, I/O points, and communication modules, and so on. Mostly, these PLCs are used in supervisory control and data acquisition (SCADA) systems, larger plants, distributed control systems, etc [6].

2.2 Program Languages

As PLCs have developed and expanded, programming languages have developed with them. Programming language allow the user to enter a control program into a PLC. The International Electrotechnical Commission (IEC 1131-3) standard defines three graphical languages and two text-based languages for use in PLC programming. The graphical languages use symbols to program control instructions, while the text-based languages use character strings to program instructions. The three graphical languages are ladder diagrams, functional block diagram and sequential function charts [5].

Ladder diagram is the most widely used programming language in industrial automation today. Its ease of use, traceability, and visual representation of physical components make it the favored programming method of many engineers. ladder diagram is a graphical programming language, initially programmed with simple contacts that simulate the opening and closing of relays. Ladder logic programming has been expanded to include functions such as counters, timers, shift registers and math operations.

2.3. PLC Programming Devices

Various types of programming devices are used to enter, modify and troubleshoot a PLC program. These programming terminal devices include handheld and PC based devices. In the handheld programming device method, a proprietary device is connected to PLC through a connecting cable. This device consists of a set of keys that allows entering, editing and dumping the code into the PLC. These handheld devices consist of small display to make the instruction that has been programmed visible. These are compact and easy to use devices, but these handheld devices have limited capabilities. The handheld programmer is shown in Figure 2. The PC based programming device is shown in Figure 3. The connection diagram of the PLC and programming devices are shown in Figure 4 [7].

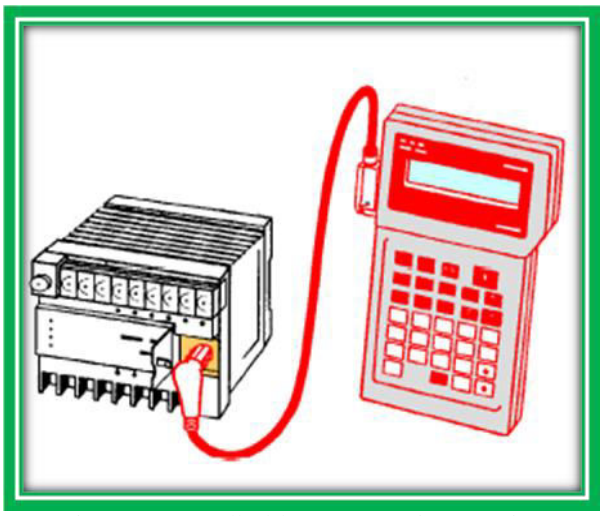

Figure 2. Handheld Programming Device

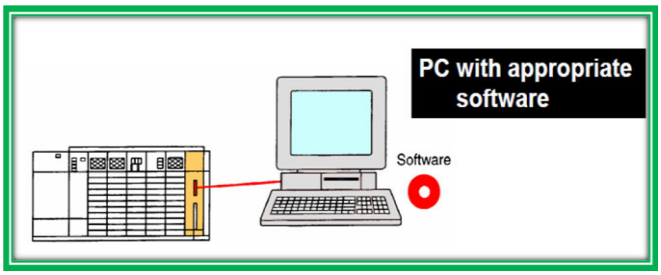

Figure 3. PC Based Programming Device

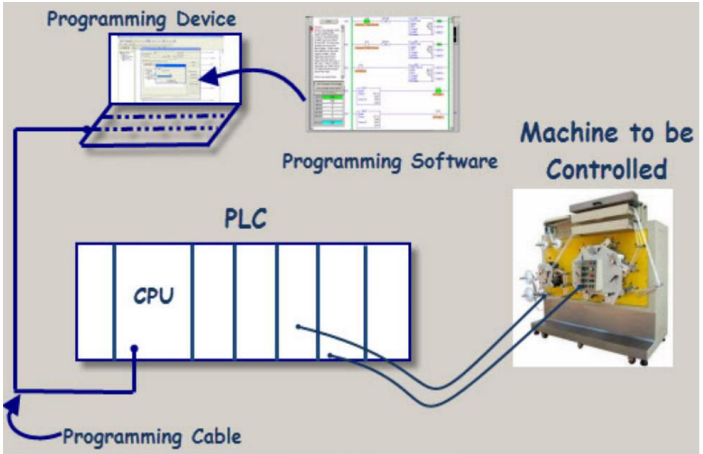

Figure 4. Connecting Diagram of PLC and PC Based Programming Device

2.4. Functions and Instructions of PLC

There are many functions and instructions of PLC. Some of them are as follows:

- Relay-type Instruction: Input (I), Output (O), Set (S), Reset (RES).
- Data Handling Instructions: data movement instructions (Move (MOV), To Decimal (TOD), From Decimal (FRD)), comparison Instructions (Equal (EQU), not equal (NEQ), greater than or equal (GEQ), greater than (GRT)), mathematical instruction.
- Program Flow Control Instruction: master control reset (MCR), jump (JMP), LBL.
- Specific Instructions: bit shift left/right (BSL/BSR)[8].

2.5. PLC Applications

PLC controls manufacturing and industrial processes such as robots and assembly lines. PLC is used in machine tool industry where Computer Numerical Controls (CNC) have been used in the past. The PLC can also be used in industrial departments of all the developed countries in industries like chemical industry, automobile industry, steel industry and electricity industry. Based on the development of all these technologies, functionality and application, the scope of the PLC increases dramatically [9].

2.6. Advantages of PLCs

There are six major advantages of using PLC over relay systems as follows:

- Flexibity
- Ease of troubleshooting
- Space efficiencty
- low cost
- Testing
- Visual Operation [10]

3. PROCEDURE

- Make a Ladder Logic of Sequentially Switch On the lights
- Save the program on Logic Pro Software.
- Simulate the program and check for errors.
- Run the program using run option. Program is completed.
- Document the programs.

4. DESIGN PROGRAMS & SIMULATION RESULTS

The ladder programming method and LogicPro software is used for the designed programs. The LogicPro software is adopted by Allen's Bradley manufacturer. In this program, an on delay timer (TON) and greater than or equal to (GEQ) data instructions are used to sequential switch on the light. The data comparison instruction gets the PLC to compare two data values. Thus it might be to compare a digital value read from some input device with a second value contained in a register. With ladder programs, for data comparison the typical instruction is contained the data comparison instruction, to compare the data, the value in the source and another source B value.

When an I:1/0 is set at 1, the output O2:0 (Light 1) switches on. At the same time, T4:0 timer starts and this timer will be done after 10 seconds (100 Present values). As soon as the timer has done (T4:0/DN) is set to 1 and this will switches on output O2:3 (Light 4). Before this, two greater than or equal instructions are used to compare the accumulated value of timer T4:0 (T4:0. ACC) with the register preset value of 20 (which is 2 sec). The output is 1 if the comparison is successful otherwise 0. Therefore, after T4:0.ACC value is greater than 20, the O2:1 output (Light 2 output) will be switches on and aftwer T4:0.ACC value is greater than 40, the O2:2 output (Light 3 output) will be switches on. The ladder program for sequential light on using TON and GEQ instructions are shown in Figure 5 and its simulation is shown in Figure 6.

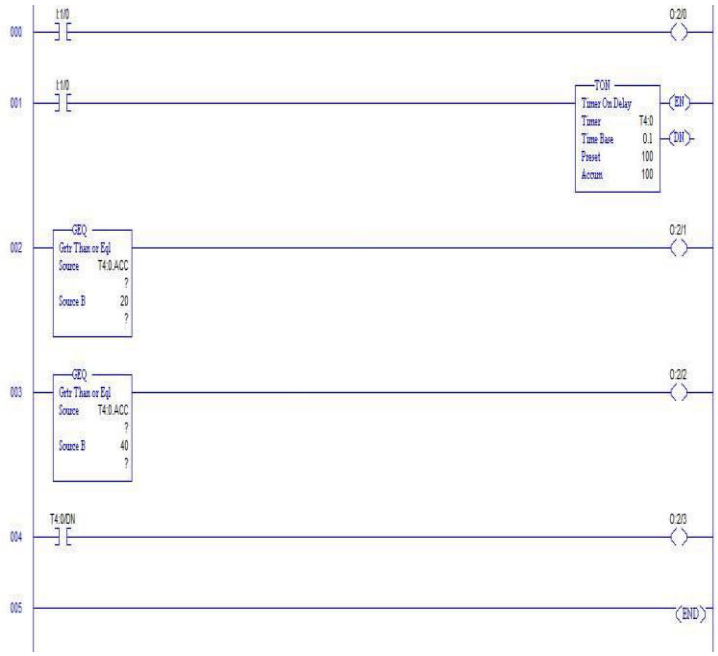

Figure 5. Sequential Light ON Program using TON and GEQ Instruction

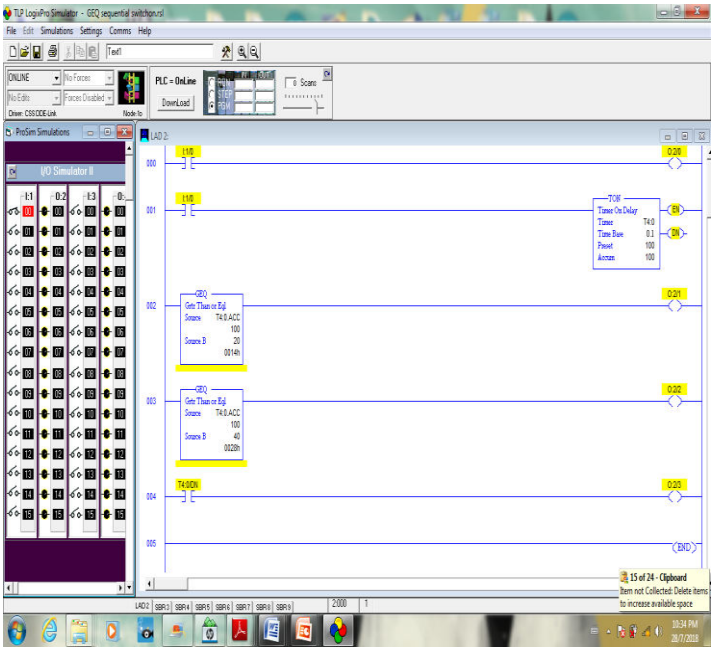

Figure 6. Simulation of Sequential Light ON Program

5. CONCLUSION

In this paper, the concepts of PLC, and its applications are described. The ladder diagram programming method is used for application of sequential light on. An On Delay Time (TON) and Greater Than or Equal (GEQ) comparison instruction is used for this program.

ACKNOWLEDGMENT

The author is greatly indebted to her parents and all of her teachers who have taught her during the whole life.

REFERENCES

[1] Petruzella, F.D., *Programmable Logic Controllers*, McGraw Hill, 2005.

[2] Sanjeev Gupta and SC Shama "Selection and Application of Advanced Control System PLC, DCS and PC Based System", Journal of Scientific and Industrial research, April 2005, Vol 64, pp.249-225.

[3] Liping Guo, Design Projects in a Programmable Logic Controller (PLC) Course in Electrical Engineering Technology, *The Technology Interface Journal, Volume 10 No.1,* 2009.

[4] Smita Kumari, Seema Kumari "*Traffic Control System using PLC"*, International Journal of Engineering Science and Computing (IJESC), Vol.7, No.4, April 2017.

[5] W.Bolton, *Programmable Logic Controllers,* Elsevier Newnes, 2006.

[6] https:// www.ecmweb.com/content/ knowing basics of PLCs.

[7]https://www.edgefx.in/how-to-program-the programmable-logic controllers.

[8] https:// www.plcmanual.com/plc-instructions

[9] https:// www.edgefx.in/ industrial-applications-of-programmable-logic controller.

[10] https://www.myodesie.com/wiki/index/returnEntry