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Ladder Logic Algorithm for Automatic Vending Machine and Automatic Car Parking System

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Abstract: *An industrial Automation System (SCADA &PLCs) is used for the development of the controls of machinery. Industrial Automation is largely based on PLC-based control systems. PLCs are today mostly programmed in the languages of the IEC (International Electrotechnical Commission) 61131 standard. Industrial automation programming and design is still based on PLCs. In this paper ladder logic algorithm for automatic vending machine and automatic car parking system are done by SIMATIC Manager and ALLEN BRADLEY software.*

1. INTRODUCTION

Main parts of Automation are PLC and SCADA. SCADA stands for Supervisory Control and Data Acquisition. SCADA is industrial software by using this we can see pictorial/animation view of any plant. This technology deals with Mechanical, Electrical and Electronics. As the name indicates, it is not a full control system, but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hardware to which it is interfaced, in general via Programmable Logic Controllers (PLCs), or other commercial hardware modules. SCADA systems are used not only in industrial processes: e.g. steel making, power generation (conventional and nuclear) and distribution, chemistry, but also in some experimental facilities such as nuclear fusion. SCADA has window maker and window viewer. Advantages of SCADA are centralized monitoring, data collection, to get centralized controlling.

A Programmable Logic Controller, PLC, or Programmable Controller is a digital computer used for automation of industrial processes, such as control of machinery on factory assembly lines. 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. Programs to control machine operation are typically stored in battery backed or non-volatile memory. A PLC is an example of a real time system since output results must be produced in response to input conditions within a bounded time, otherwise unintended operation will result. Advantages of PLCs are reliability in operation, flexibility in control techniques, flexibility in programming and reprogramming in the plant, large quantity of contacts, online/offline modifications, cost effective for controlling complex systems, small physical size, shorter project time, in-house simulation and testing of project, speed in operation, ability to communicate with computer systems in the plant, ease of maintenance/troubleshooting, documentation, security.

Previously, an object oriented approach, the programming language SFC (Sequential Functional Chart) together with a proper way to organize the inputs and outputs of FBs (Functional Blocks) and supervisory control are proposed to implement industrial automation control systems to meet the new challenges of this field [1]. A physically-based load model and formulation for continuous process industries to use in implementing industrial load management. The formulation utilizes an integer programming technique for minimizing electricity costs by scheduling the loads and satisfying the process, production, and maximum demand constraints [2]. The integrity of PLC-based control systems depends in part on the correctness of their software. In the traditional approach to test the software, a series of manual tests is used to find errors. Simulators are frequently used to test the software formally, but there is a limit in the number of test cases. An automatic verification method to identify errors in RLL, a popular programming language used in PLCs developed [3]. [4] Describes the SCADA systems in terms of their architecture, their interface to the process hardware, the functionality and the application development facilities they provide. Some attention is also paid to the industrial standards to which they abide their planned evolution as well as the potential benefits of their use.

2. AUTOMATIC VENDING MACHINE

When to design a program under which whenever a user's insert 5 rupees coin it will dispense tea and for 10 rupees coin it will dispense coffee and also count the number of coffee and tea served for the time. It requires a PLC Brand and model of SIEMENS S7 SERIES 312, IFM Communication and SIMATIC Manager.

Configuration in PLC

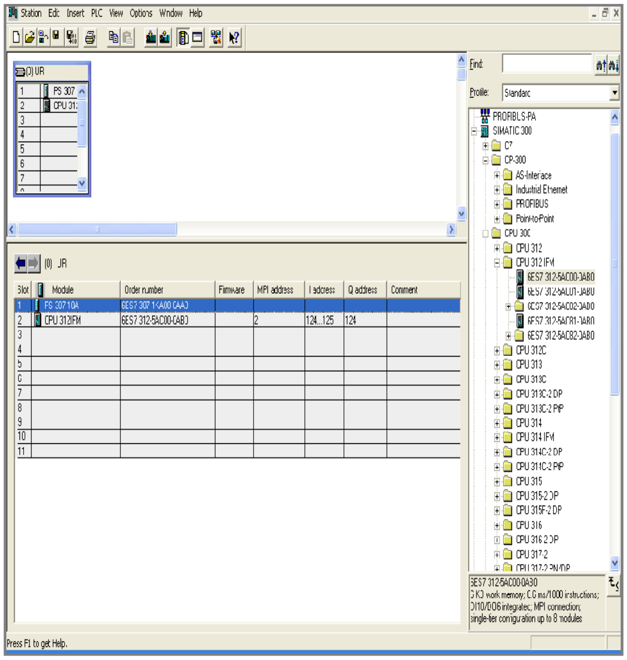

Fig. 1: Configuration in PLC

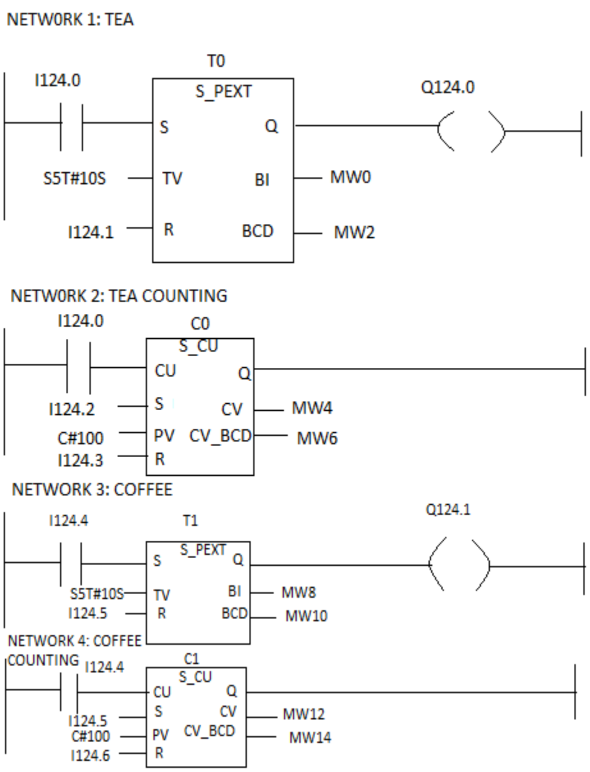

Fig. 2: Modelling of control signals generated

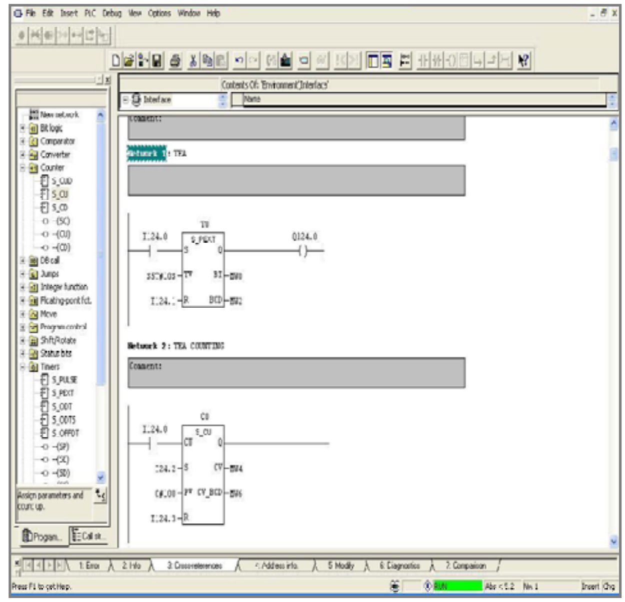

Fig. 3: Networks 1 and 2 of control signals generated

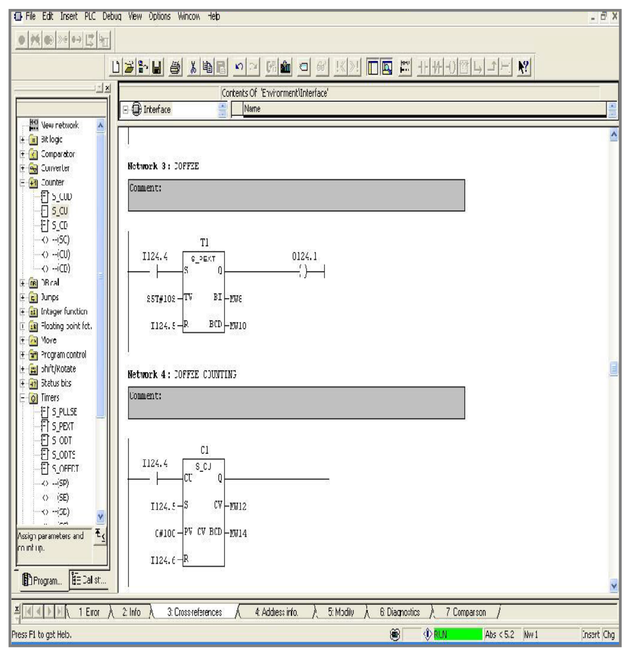

Fig. 4: Networks 3 and 4 of control signals generated

Table 1. Role of different networks.

S. No.	Networks	Role
1.	Networks1	Dispense tea whenever a user's insert 5 rupees coin.
2.	Networks2	Count the number of tea served for the time.
3.	Networks3	Dispense coffee whenever a user's insert 10 rupees coin.
4.	Networks4	Count the number of coffee served for the time.

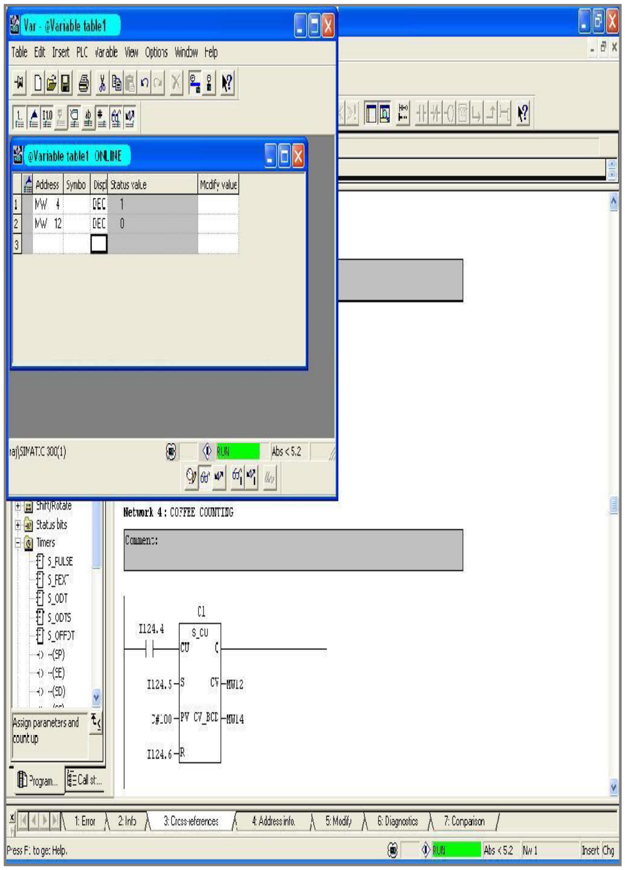

Fig. 5: Final stage of control signals.

3. AUTOMATIC CAR PARKING

To design automatic car parking system, an entry gate must open automatically when parking space is available and closed when parking full. The system requirements are follows as.

- PLC Brand: Allen Bradley
- PLC Type: COMPACT LOGIX PROCESSOR 1769-L23E
- Communication Port in PLC & PC: Ethernet RJ-45
- Communication Cable: CP03
- Driver Software: RS-232 DF-1 DEVICE ETHERNET/IP DRIVER
- Communication Software: RS Linx
- Programming Software: RS Logix 5000
- Protocol: RS232 –DF1
- Communication Adaptor: 1734 AENT/A COMMN.ADAPTER
- Allen Bradley Brand
- Remote cards:

✓ Allen Bradley 1734-IBB
✓ Allen Bradley 1734-OBB
✓ Allen Bradley 1734-IE2C
✓ Allen Bradley 1734-OE2C

Table II: Role of different Rungs for automatic car parking system

S.NO.	Rungs	Role
1.	Rung 00	Car coming inside from the gate ENTRY in the parking.
2.	Rung 01	Car coming inside from the gate ENTRY 1 in the parking.
3.	Rung 02	Car exit from the gate EXIT.
4.	Rung 03	Car exit from the gate EXIT 1.
5.	Rung 04	Add the cars coming from gate ENTRY and ENTRY 1.
6.	Rung 05	Add the cars exit from gate EXIT and EXIT 1.
7.	Rung 06	Subtract the exit cars from entry cars.
8.	Rung 07	Shows the EMPTY space in the parking.
9.	Rung 08	Shows the SPACE available in the parking.
10.	Rung 09	Shows the FULL space in the parking.

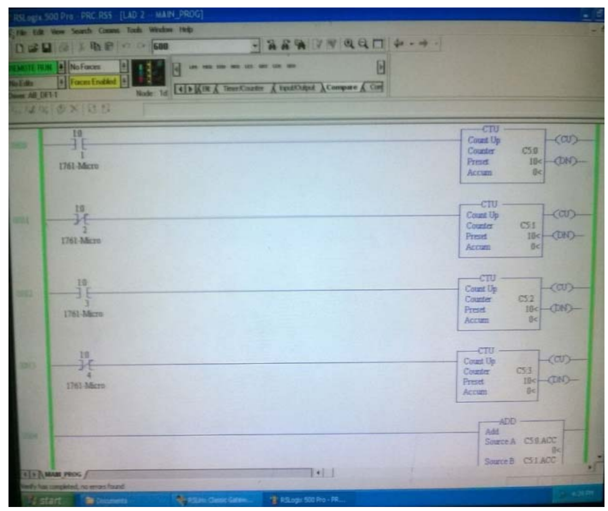

Fig. 6: Stage 1 of control signals generated

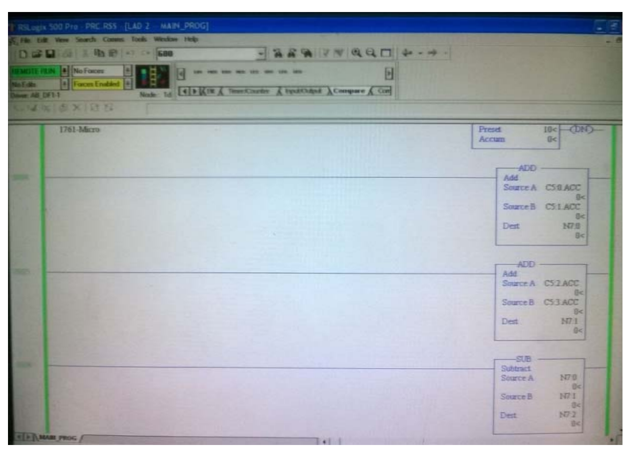

Fig. 7: Stage 2 of control signals generated

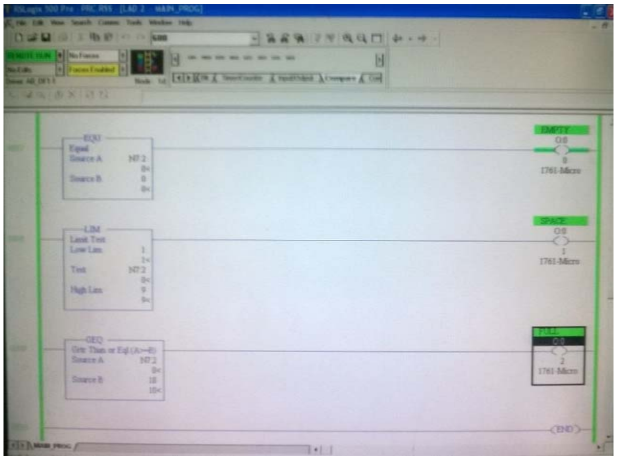

Fig. 8: Stage 3 of control signals generated

Table III: Different output stages for automatic car parking system

S.NO.	Stages	Output
1.	Stages1	Blinking of first light shows the EMPTY space in the parking.
2.	Stage 2	Blinking of second light shows the SPACE available in the parking.
3.	Stage 3	Blinking of third light shows the FULL space in the parking.

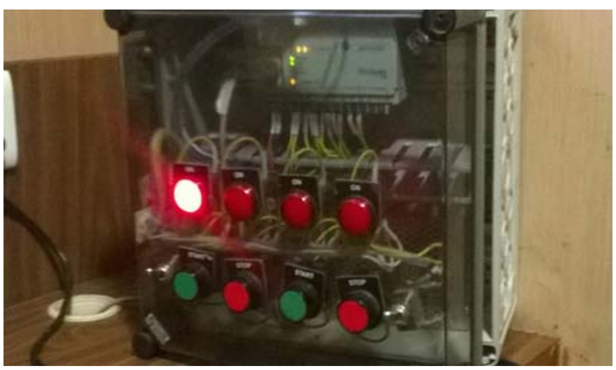

Fig. 9: Stage 1 of output generated on PLC.

Fig. 10: Stage 2 of output generated on PLC

Fig. 11: Stage 3 of output generated on PLC.

4. CONCLUSION

This paper represents the physically-based model that could be applied to any continuous process industry. This methodology is implemented in the SIMATIC Manager SIEMENS S7 SERIES 312 IFM Programmable Logic Controller (PLC). In the increasingly automated industrial sector, real time implementation by using Programmable Logic Controllers, which is investigated in this article, is also very important.

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