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Multipurpose Use of Programmable Logic Controller (PLC)

Mr. Tamboli J. I.[1], Mr. Shinde Shailesh A.[2], Mr. Pharne S. B.[3]
[1.]M. E. (Electronics), Rajarambapu Institute Of Technology, Islampur, Sangli, Maharashtra, India, jitamboli23@gmail.com
[2.] M. Tech. (Electronics Technology-Appear), D.O.T. Shivaji University, Kolhapur, Maharashtra, India, shinde.shailesh@yahoo.com
[3.]M. E. (Electronics-Appear), Bharati Vidyapeets Collage of Engineering, Kolhapur, Maharashtra, India, pharnesuhas15@gmail.com

Abstract

PLCs were programmed in "Ladder logic" which strongly resembles a schematic diagram of relay logic.PLC has ability to arrangement the inputs/outputs. It has low cost compared with microcontroller system because using PLC in different application only required changing the software for each application. But in case of using Microcontroller the hardware components itself must be changed with different applications. PLCs different applications are available in today's market. But important application of PLCs are traffic Control system and use of PLC in robot system.

Keywords: - PLC-Controller , Applications of PLCs Traffic control system , robot system.

1. Introduction

PLC is one of the controller. It includes a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic as shown in fig 1. It has a important advantage of changing the PLC ladder diagram after it had been built or worked, which gives the facility of using the same PLC unit for controlling different system after erasing it each time [2].

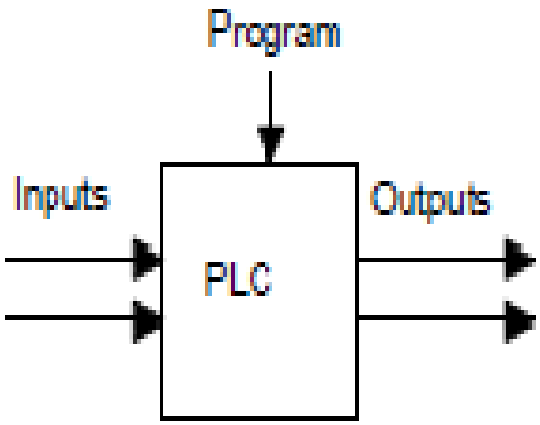

Fig 1:- Programmable logic controller.

PLCs has used for mostly for industrial applications. It could be easily programmed by using a simple. Programming language which is concerned with logic and switching operations. PLCs contain a hardware and Software system which is used for single input/output or multi inputs/outputs modular system. PLCs are also Used for analog or digital controller systems [2].

2. Programming logic control structure

The structure of PLC consisted of two systems hardware and software systems.

PLC hardware:-

Typically a PLC system has basic functional components of processor unit ,memory, power supply Unit, input/output interface section, communication interface and programming device.

The main task of each components has given as per following.

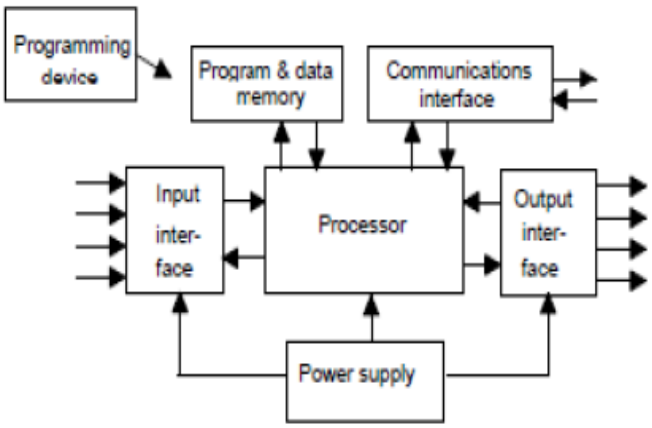

Fig 2 :- The PLC system

1) The programming has stored for interpret the input signals and communicate between this inputs and Outputs decisions for controlling the actions ,done in central processing unit(CPU).
2) The power supply provides DC voltage necessary for the processor and the circuits in the input and output Interface modules.
3) The programming has enter into memory of processor by using the programming device and then Transferred to memory unit of PLC.
4) The program has stored in the memory unit to be used for the control actions to be exercised by the Microprocessor and data stored from the input of processing and for the output for outputting.
5) The input and output sections are where the processor receives information from external devices and Communicate information to external devices.
6) Finally the communications interface is used to receive and transmit data by means of communi-

cation Networks from to or to other remote PLCs[2][3].

3. Programming in PLCs

Programming devices can be hand held device, a desktop console or a computer. The program has been designed on the programming device and then transferred to the memory unit of PLC.

1) Hand held programming devices will normally contain enough memory to allow the unit to retain programs.

2) Desk top consoles are likely to have a visual display unit with a full keyboard and screen display.

3) Personal computers are widely configured as program development work stations[3].

4. Procedure for PLC software preparation

The PLC program is executed as a part of repetitive process referred to as a scan . PLC scan Starts with the CPU reading the status of inputs. Then the application program is executed using the status of the inputs. At the end when the program is completed, the CPU performs internal diagnostics and communication tasks. Scan cycle ends by updating the outputs and then starts over.

Scan cycle time depends on the size of program, the number of inputs/outputs and amount of communication required. The instructions are little computer codes that make the inputs and outputs do what the programming want to get the results need. There are different types of PLC program such as function block program (FBD),statement list(STL) and ladder logic diagram (LAD).

LAD is the most famous PLC programming language used. Ladder logic diagram uses components Like elements used in a line diagram format to describe hardwired control. The left vertical line of LAD represents the power conductor. The output element represents the return path of the circuit.

5. Area of PLCs applications :-

PLC represents such a universal controller. It can be used for different applications and via the program installed in its memory, provides the user with a simple means of changing, extending and opt ionizing control processes. The original PLCs tasks are involving the interconnections of input signals according to specified program and if “true” switch the corresponding output. Boolean algebra as explain in [2] forms the mathematical basis for this operation which recognizes precisely two defined statues of one variable “0” and “1” and so the output can only assume these two statues. Timer and counter functions memory setting resetting mathematical computing operations all represents functions, which can be executed by practically any of PLCs. Programming logic control using as explained [4] for industrial field like automatic machines, cars and robots.

The applications of PLC discussed here are traffic control system and glass washing robot. PLC used to control traffic and to control movement of robot and flow rate of different liquids which are used in this robot[2][7].

6. Smart Traffic control system :-

A smart traffic control system atomizes the traffic control activity and uses certain logical Mathematical operations and derives priority order of the lanes based on the certain factors and hence controls the traffic in an optimized manner. It uses inputs from sensors and sends interrupt signals to the controlling unit which in turn handles the operation of traffic signals automatically.

Need for smart traffic control :-

1) Increasing number of vehicles and lower phase of highways developments have led to traffic congestion problem.

2) Time of travel ,environment quality ,road safety are all adversely affected as a result of traffic congestion.

3) Delays caused due to traffic congestions, indirectly affect productivity, efficiency and energy losses.

4) Human error can cause mismanagement.

5) Emergency situations like medical emergencies , construction work, accidents etc.

Modes of operation :-

Traffic load is dependent on factors such as time, day, season, weather unpredictable situations like a accidents or construction activity or any other special event.

Traffic control system can be broadly classified as,

a) Saturated – Aim to serve as many drives as possible.

b) Unsaturated – Reduces mean delay for drives.

The main purpose of this system is to minimize waiting time for each lane as well as serving the busy lanes as much as possible.

The system can be divided into four main parts

1) Hardware model.
2) Programming.
3) Sensors.
4) PLC.

The objective is to prepare a prototype that has the ability to collect information of the busy tracks by sensors and using a control unit to shift service to a given lane as per priority.

The traffic system works in four different modes

1) Normal flow
2) Peak flow.
3) Off time
4) Manual operation.

Normal flow occurs when the traffic in a lane is less than a certain fixed threshold value. In this time the traffic signal operate sequentially. Peak flow is the period in which the traffic density crosses the threshold value in given lane and lane gets service irrespective of its sequence. Manual operation involves the closing of lanes and opening of lanes manually in case of an emergency or for allowing pedestrians to pass through[10].

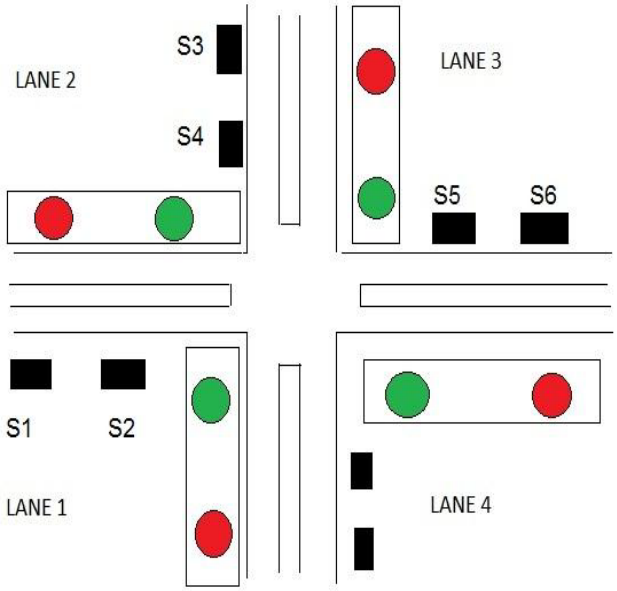

Fig 3:- Smart traffic light model

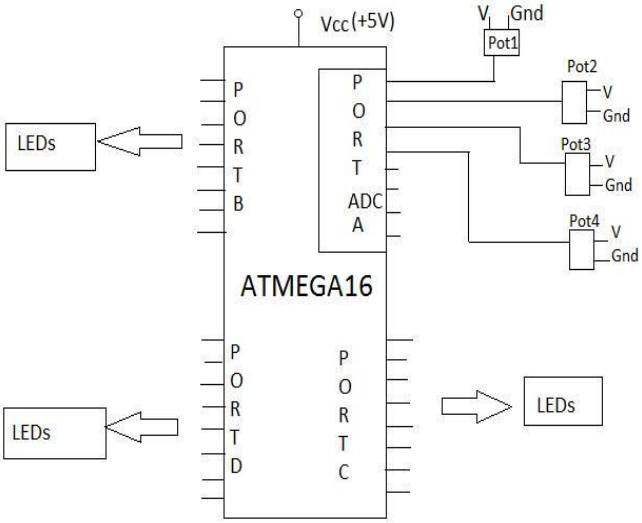

Fig 4:- Circuit diagram of smart traffic control

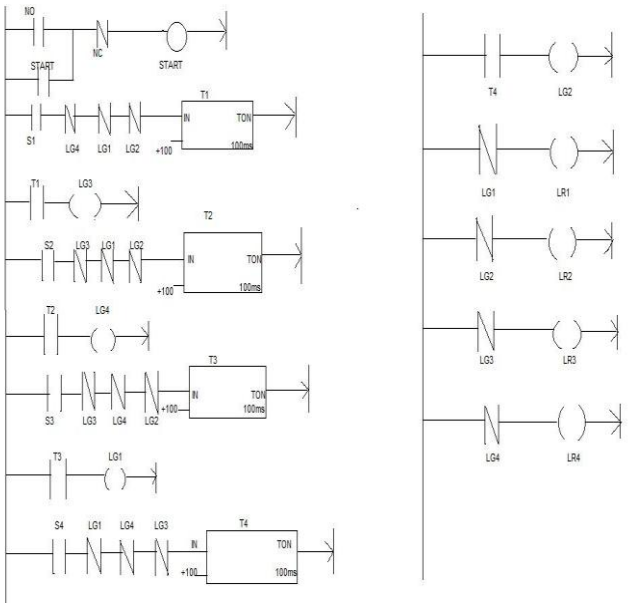
Fig 5:- Ladder logic diagram of smart traffic control system.

7. Glass washing robot

This robot used for washing the external glass windows of any building. The robot consist of two cars shown in fig 6 ,the first car for horizontal movement and second for vertical movement. The vertical movement cars consist of four motors which are brushes motor, water pump motor, soap motor and driver motor.

The first three motors are working simultaneously and fourth motor has a delay time after them. The car of horizontal motion consist of two motors for horizontal direction movement and the other for carrying the car which move in vertical direction. For washing process to make it from up to down for cleaning the windows of building.[6]

The robot begins its motion from the roof top of building by use PLC unit Fanuc with nine input/outputs. The robot movement begins when the PLC units switch turn on then the vertical car starts at the top of building. The motors of brushes, water pump and driver starts to work. Also the motor which is responsible moving this car from up to down begins to work.

The duration period for vertical motion (from up to down) takes 42 seconds. Followed by five seconds for vertical motion (from down to up). In order to start the second cycle horizontal car moves horizontal five seconds.so it has been tested on 2.8 m by 2 m glass windows. It takes 10 cycles on 5.2 min to complete cleaning process.[6]

Ladder diagram of glass washing robot is shown in fig 6 below.

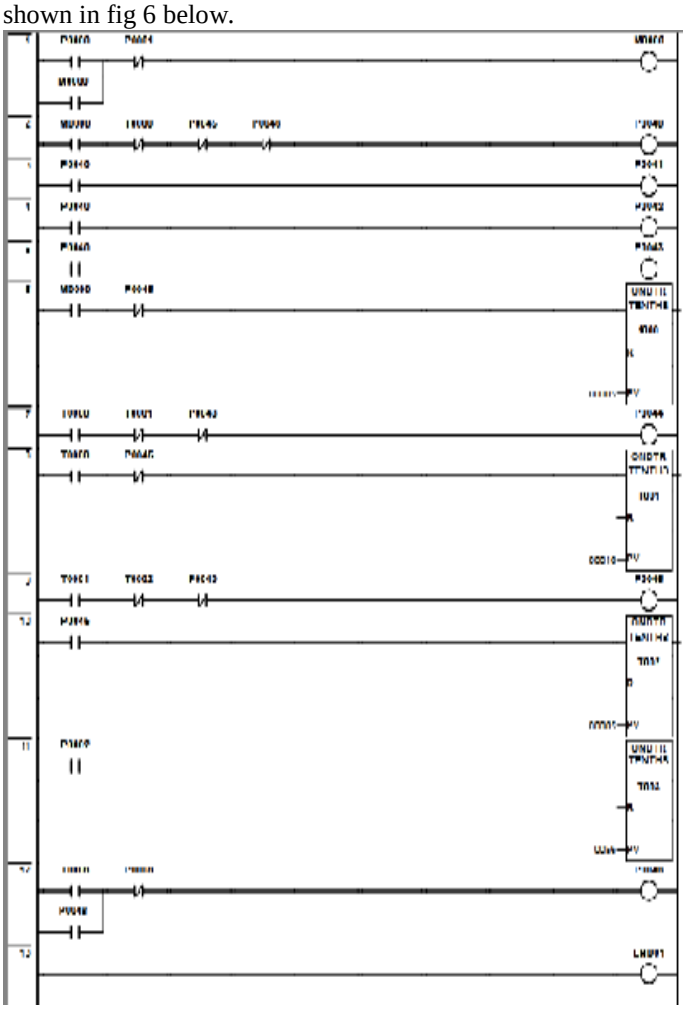
Fig 6 :- Ladder diagram of glass washing robot.

Conclusion

In this paper concept of programmable logic controllers(PLC) and its different applications discussed. Ladder diagram programming method used for PLCs units which used in these applications.

Two applications had been introduced PLC as a new application of this control system in smart traffic control system and glass washing robot gave a good results. PLC must easier and safe control system for industrial applications.

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