PLC Programming for Various Application Under Lab Development

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Abstract: **Automation or automatic control is the use of various control system for operating equipment with minimal or reduced human intervention, with some processes have been completely automated. Various benefits can be achieved by automating routine tasks and systems within the Renu PLC trainer KIT. Modern process control systems are used in the industrial automation which is important in all production industries for the sustainable growth. A control system is a combination of various devices that are integrated as system, used to sense, measure, indicate and controls the process variables which inters to the process desired automation. By taking assistance of PLC in small to medium scale industries it is advantageous to introduce automation within present plant layout or with smaller change. In this paper a review is done on the lab development which helps the student to learn PLCs and its working applications. Use of automation systems industries has proved to be highly economical than other means. The main benefits of using automation systems in industries lies in their flexibility that is their ability to undertake a variety of other tasks and functions.**

Keywords: **PLC trainer kit, USB cable, Flexisoft software and Computer.**

1. Introduction

[1] Programmable logic controllers (PLCs)are a specialized type of systems used to control machines and processes. They have been introduced in the early 1970s to replace the existing relay control logic that became obsolete and expensive for implementing systems at that time. On the other hand, PLCs have offered flexibility, higher reliability, better communication possibilities, faster response time, and easier troubleshooting. So far, PLCs have been mainly interest for industrial control engineers that introduced, developed and standardized their own design methods and programming languages. [2] According to mentioned data above a detailed understanding of the operation and use of PLCs is important for many undergraduate students particularly than who seek eventual employment in these industries. However, problems and obstacles in the study and modals and innovations continually being introduced by manufacturers. [2] Future PLCs are dedicated industrial controllers and once purchased for laboratory use in the setting up of comprehensive and modern PLC laboratory facilities and in the required periodic updating of teaching material and equipment are, as a result , very high. PLC is one of the most widely controller used in the industrial control systems. The PLC systems is a computer system that consist of various hardware component such as the CPU, programming devices, external hardware components Input/Outputs and power supply. [1] PLC is an industrial computer which is used to monitor inputs and controls to the process or making designed based on its control. The input of any machine in plant. [9] It is microcontroller device which sense inputs from input devices and execute in cup which update output module to provided data to output devices. [2] Automation is basically the delegation of human control function in technical equipment for,

1. Increasing productivity,
2. Increasing quality,
3. Less cost,
4. Increasing safety in working condition

2. Literature Review

[2] PLC and the SCADA systems are widely used in most industrial processes e.g. chemical industries, steel manufacturing, power generations, etc. Automated level control systems using PLC, SCADA and HMI are used ubiquitously in industrial applications. To prevent industrial accidents by overfilling of any open container to prevent overfilling of any closed container thereby creating overpressure condition.

[3] A paper on the design of bottle filling plant using PLC wherein a bottle filling and capping operation takes place in a synchronized manner. The user can input the desired volume of liquid to fill in the bottle.

[4] The system is desired for the temperature control of solar cell lamination machine using double microcontroller as its core. In this the control system based on double microcontroller improves the temperature control precision and to achieve a closed loop control on the temperature a PID control algorithms are designed.

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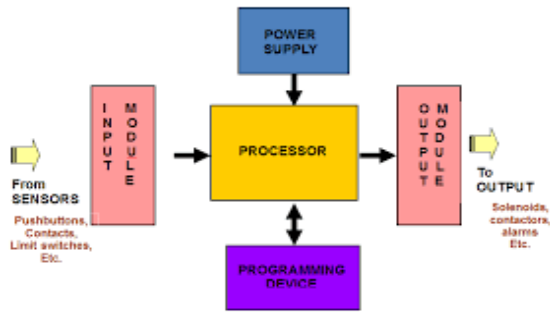**www.ijresm.com | ISSN (Online): 2581-5792**

330

3. Major Components

Fig. 1. Block diagram of PLC

A. What is PLC? [5]

PLC is a digital computer design for multiple inputs and outputs arrangements extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. A PLC is an example of a real time systems.

There are many industrial applications of PLC where we need automation.

B. Input/output Module

[5] There are two types of input module:

1) Digital input/output

Digital I/O consist of 230 V AC, 115 VAC and 24 VDC. Example – Digital input – proximity sensor, limit switch, push button, toggle button, IR sensor etc.
[5] Digital output- lamps, motors, relay on/off, solenoid valves etc.

2) Analog input/output

Analog I/O consists of 0-10v, 4-20ma.
Example- Analog input-thermocouples, pressure thermometer, level thermistor, etc.

4. Objective [2]

1. Learn the basic parts of a PLC, how a PLC is used to control a process and the different kinds of PLCs and their applications.
2. PLC Hardware components
3. Basics of PLC Programming
4. Programming counters
5. Program Control Instructions

5. Programming Language of PLC [7]

Most programming–languages encountered in PLC programming are:
1. Ladder Logic
2. Functional Block diagram
3. Sequential Function chart

A. Ladder logic

[7] One of the widely used methods of controlling PLCs is using Ladder logic programming. The ladder logic diagram is a representation of the steps of programming. Input address can be used in series and parallel. Output address can be used in parallel. Output address can be used as Input address. All PLCs follow a template that is consisting au of 2 bus bars that are connected to one another using rung lines in the ladder programming. Ladder logic is originally design and construction of relay rack as used in manufacturing and process control of PLC. Ladder logic is used to develop a program for PLC application which is used in the automation industries.
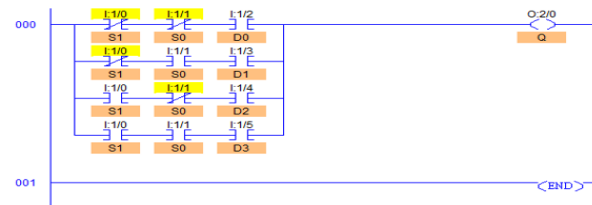

[7] Fig. 2. Ladder logic of AND Gate

[7] Fig. 3. Ladder logic of NAND Gate

[7] Fig. 4. Ladder logic of Exclusive-OR Gate

[7] Fig. 5. Ladder logic of 4:1 multiplexer

6. Equipment Used in the Project

1. PLC Trainer kit
2. USB cable
3. Flexisoft software
4. Computer

Fig. 6. PLC trainer kit

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331

7. Specifications

1. Back panel mounted compact PLC with 32-bit RISC
2. Processor
3. DC inputs(24v)
4. Support for high speed timer and counters
5. Upto 16 input/output ports
6. One USB device port
7. High speed PWM output
8. Simple Ladder programming using window based software
9. 16 Digital inputs
10. 16 Digital outputs(PNP) 0.5A
11. 16 Digital outputs(NPN) 0.5A
12. FL 1600

8. Salient Features of PLC

[8] The various functionalities of PLC have evolved over the years to include sequential relay control, distributed control systems, process control, motion control and networking. There are many salient features of PLCs,

1. *High Reliability:* High reliability is the most important features of PLC. Many techniques are applied in PLC.
2. *Good Flexibility:* There are many programming languages like ladder logic, SFC, STL, ST etc. used in the PLC so that the operation is easy. Every person who want to use PLC has good choice.
3. *Quality of strong Easy – Operating:* It is very easy to program and operate PLC if you have knowledge of any one of the PLC programming language. It is very easy to configure PLC because of modularization, standardization and serialization.
4. *Scan Time:* Scan time of the PLC is very fast and easily operate.

9. Applications of PLCs

[9] Wherever automation is designed the PLCs are best suited to meet the task. PLCs has been used more and more as total solution to a batch problem in the industries rather than just a tool. In the cycle automation it provides rigid control to eliminate human errors and to minimize manual intervention. By using PLC automation, it increases the efficiency of the plants.

[8] In the large process plants we use PLC for startups and shutdown of the critical equipment's. By using that the accidents in the plants may not occur. A PLC ensures that an equipment cannot be started unless all the permissive conditions for safe start have been done.
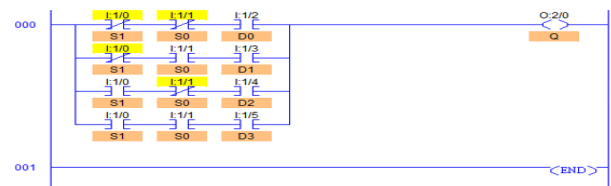
[8] The PLC is used in the process plants like chemical, food, paper and manufacturing industries for the purpose of automation so that human interruption is less and also error may not be occurred.

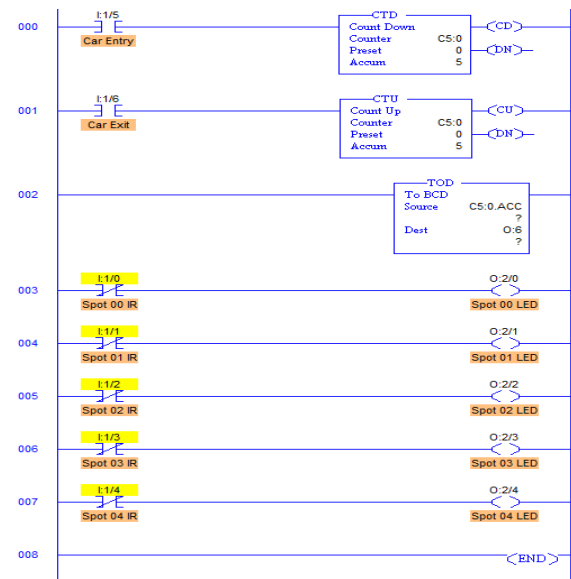## 10. List of Experiments to be Performed in this Projects
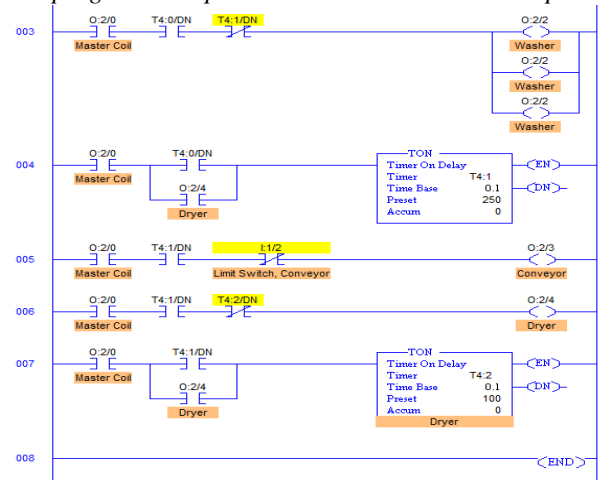
1) *PLC program to implement various logic gate*
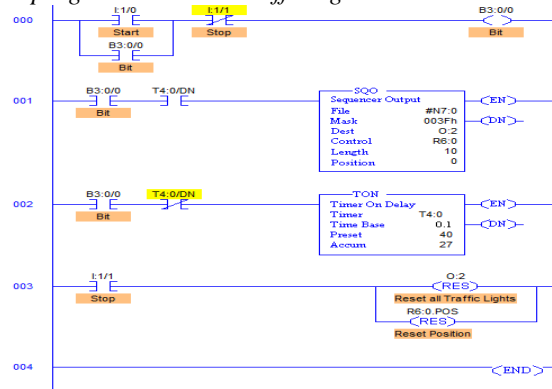

2) *PLC program to implement 4:1 multiplexer*

3) *PLC program for a car parking system*

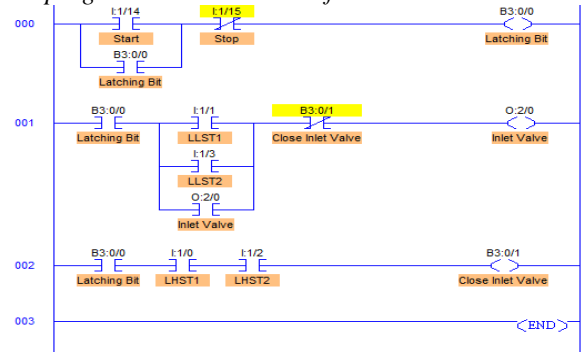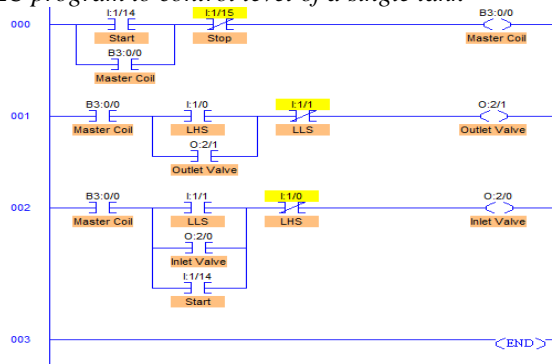4) *PLC program to implement an Automatic car wash process*

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332

5) PLC program to control traffic light

6) PLC program to control level of a single tank

7) PLC program to control level of two tank
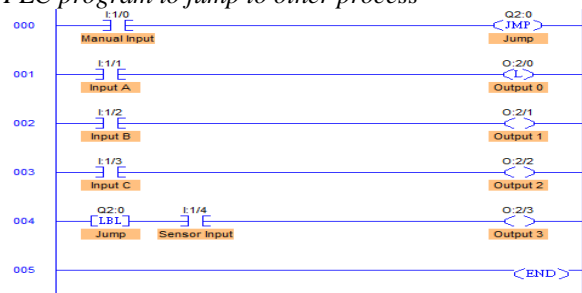

8) PLC program to implement 8:1 multiplexer

9) PLC program to control level of series tank

10) PLC program to control level of parallel tank

11) PLC program to jump to other process
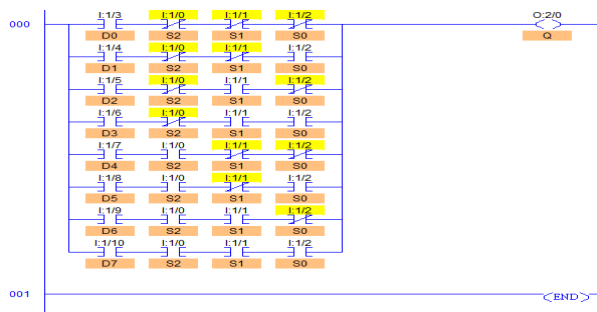
12) PLC program to maintain the pressure head in a bottle filling system
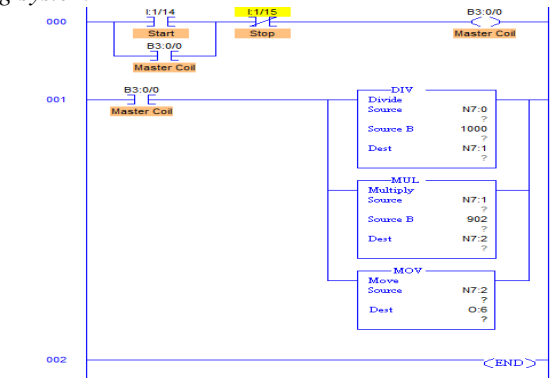
11. Advantages of PLC [6]

1. *Reduce space:* PLCs are completely solid state devices and hence are extremely compact in comparison to hard –wired controller where electro-mechanical devices are used.
2. *Flexibility in programming and reprogramming:* In the PLC applications there is no requirement of rewiring if any change is required to be implemented. It can carry out complex function like arithmetic operations, counting, comparing, generation of time delay etc. It has very high processing speed and greater flexibility in both analog and digital.
3. *Small physical size shorter project time:* When the task is fully defined the hard wired control system can be constructed.
4. *High speed of operation:* The operation performed in the PLC is very fast and very efficient.
5. *Reduced man power:* By using PLC in the industries it reduces the human interruption and also the operation is faster and very efficient.
6. *Energy saving:* Average power consumption is just $1/10^{th}$ of power consumed by an equivalent relay based control.
7. Ability to communicate with computer systems in the plant
8. *Ease of maintenance/troubleshooting:* When any failure is done in the PLC it is easy to replace. IT has easy troubleshooting

12. Disadvantages of PLC [6]

1. PLC devices are proprietary it means that part or software of one manufacturer can't be used in combination with parts of the another manufacturer [6].
2. Limited design and cost option.
3. PLCs manufacturers offer only closed architectures.
4. Number of optional modules must be added to maximize flexibility and performance.
5. There are limitations of working of PLCs under high temperature conditions.

13. Future Scope

In recent years the industries are adopting automation in the industries. In the field of automation PLC is the best tool to automate the system. By doing automation the work of the industries is easy and faster. It takes less time for the production. This project is works under lab development. By this project the student can learn PLC and understand the working of it like how it works on the industries. It is based on the real time application.

14. Conclusion

It is considered that this platform has an impact in the automation where PLC is the part of system and so student can understand heart of the system. This projects help the student to learn and understand the various application and working of the PLC. The PLC is works on the real time application. In that project we worked with PLC trainer kit where we were going to interface different PLC application. The results of the application of our approach to education have been excellent both in terms of student's motivation and knowledge.

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