

Implementation of Door Control System Using Ladder Language

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Abstract: *With ever-growing increase in computing power and personal computer popularity, the processors are becoming relatively inexpensive. This has led to a surge in the affordability of Programmable Logic Controllers- the brain behind many machines. In this paper mainly focuses on programmable logic controller used for automatic door control system which will be open during entrance and during exit. In this paper we also focus on counting the number of people enters or leaves in industries or conference hall. Here the total number of people present will be display on the screen. PLC was designed to replace relay logic systems. Automated industrial production line in the sixties and seventies consisted of huge electrical system controls and frequently it covered an entire wall. Within this board there were a great number of relays to make the whole system work. The plan given to electrician, for making connections, was called "Ladder schematic". In this paper PLC programmed in "ladder language" which strongly resembles with relay logic. PLC ladder logic allows the programmer (the person writing the logic) to see any issues with the timing of the logic sequence more easily than other formats. PLC interface some input and output with a hardware device and it operate with the help of programmer. Here an Allen Bradley (AB) PLC is used to control the virtual model of a door control module. Door Control System is important from security point of view as well as for disabled persons also.*

Keywords: Ladder Logic, Automation, PLC, DOOR, LED, SENSOR, Counter, move, Limit, RS Logix500 etc.

1. Introduction

Security is requirement of throughout the world and lack of security led unpredictable damage [1]. The general operation of door depends upon the person who is near the door [2]. Almost any application that needs some type of electrical control has a need for a PLC for security purpose door are programmed with PLC. These kind of programmed doors do not just improve the appeal of any office but also make straightforward entry for incoming and outgoing people [1]. This automatic door will be opened during entrance and the number of people will also be displayed on the display screen and this door control system also useful because of safety purposes. This automatic door [6] will be closed when capacity of hall or conference will be full. Locks and programmed doors are two analogous mechanisms of access control. Programmed doors do not just appeal of any office or conference hall but also make straightforward entry for incoming and outgoing passerby. Here with the help of this door control system we can limit the number of peoples enters in any conference hall. Because of this door control system the door will be closed after a given limit. And in the display board the number of peoples present will also displayed. The aim of this paper is to count the number of peoples and programme also help in open and close the doors during entrance and exit. For this purpose two sensors are used. Here one sensor on the entrance gate and one sensor on the exit gate. Developments provides to improve the quality of door control system and for this door control system advances with the help of programming. Door access control can be as simple as required and the budget will allow.

2. Designing of PLC

Here in the architecture of PLC will be explained with working. PLC connected with number of peripheral devices.

A door control system with PLC used for the controller design which uses the ladder language. Here the ladder logic used is RSLOGIX500ENGLISH and help in calculate the number of people and also control the door. In this sensors are used for sense the entered and exit person. The PLC used to modify the control system of door. In base Implementation of PLC based elevator control system used in which PLC used for controlling the elevator model [8]. PLC is an electronic device to be used in the field of industry that controls the system with the help of counters, timers and with other arithmetic operation.

A. Related Work

In 1968 GM Hydra-Matic (the automatic transmission division of General Motors) issued a request for proposals for an electronic replacement for hard-wired relay systems based on a white paper written by engineer Edward R. Clark. Some drawbacks found in traditional system:

- A basic machine might need a wall covered in relays to control all of its functions and with this type of relay control some limitations like relay fail, delay when relay turns on/off is obtained.
- PLC's are free from several conditions such as dust, heat, cold and have the facility for input/output arrangements. Because of these few reasons PLC is preferred.

What does a PLC look like? The illustration below (Figure1) shows the typical parts of a PLC just used for door control system. Here PLC connected to PC and then to the output device [4]. Here whole of the procedure to be performed will be explained through programming.

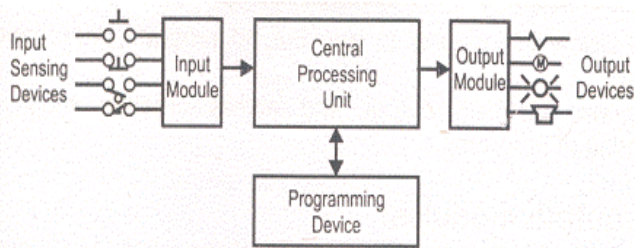


Figure 1: PLC Architecture

As shown in above figure all the input devices attached with the input module and output devices attached with output module which performed according to the program installed in PLC. Early PLCs, up to the mid-1980s, were programmed using proprietary programming panels or special-purpose programming terminals, which often had dedicated function keys representing the various logical elements of PLC programs. As PLCs became more advanced, methods were developed to change the sequence of ladder execution, and subroutines were implemented [6]. This simplified programming could be used to save scan time for high-speed processes; for example, parts of the program used only for setting up the machine could be segregated from those parts required to operate at higher speed.

A. Programming Procedure (Ladder language)

- FBD(Function Block Diagram)
- ST(Statement list)
- STL(Sequential text list)
- IL(Instruction List)
- Ladder

But mostly we use ladder language because it is easy to use and operator can easily understand this language. The winning proposal came from Bedford Associates of Bedford, Massachusetts. The first PLC, designated the 084 because it was Bedford Associates' eighty-fourth project, was the result [5]. Bedford Associates started a new company dedicated to developing, manufacturing, selling, and servicing this new product: Modicon, which stood for Modular Digital Controller. One of the people who worked on that project was Dick Morley, who is considered to be the "father" of the PLC. The Modicon brand was sold in 1977 to Gould Electronics, and later acquired by German Company AEG and then by French Schneider Electric, the current owner. Some more programming techniques also used. PLC contains real time operating system and exploits for these system exit much as they do for dekstop computer. Many early PLCs did not have accompanying programming terminals that were capable of graphical representation of the logic, and so the logic was instead represented as a series of logic expressions in some version of Boolean format.

Door control systems provide secure and safe means to allow entry in and out of offices and homes [7]. These systems are valuable for people with disabilities, who have difficulties using normal entry system. As programming terminals evolved, it became more common for ladder logic to be used, for the aforementioned reasons and because it was a familiar format used for electromechanical control panels.

But ladder language is easier than others [5]. Prior to the discovery of the Stuxet Computer Virus in june 2010, PLC received attention. Newer formats such as State Logic and Function Block (which is similar to the way logic is depicted when using digital integrated logic circuits) exist, but they are still not as popular as ladder logic. A primary reason for this is that PLCs solve the logic in a predictable and repeating sequence, and ladder logic allows the programmer (the person writing the logic) to see any issues with the timing of the logic sequence more easily than would be possible in other formats. PLCs easy to program, their programming language was designed to resemble ladder logic diagrams. First it takes input from field and processes it according to pre-defined instruction means program and then provide output.

3. Implementation of PLC

PLC programs are typically written in a special application on a personal computer and then downloaded by a direct-connection cable or over a network to the PLC. The program is stored in the PLC either in battery-backed-up RAM or some other non-volatile flash memory. PLCs are well adapted to a range of automation tasks. These are typically industrial processes in manufacturing where the cost of developing and maintaining the automation system is high relative to the total cost of the automation, and where changes to the system would be expected during its operational life. PLCs contain input and output devices compatible with industrial pilot devices and controls; little electrical design is required, and the design problem centers on expressing the desired sequence of operations.

- PLC architecture

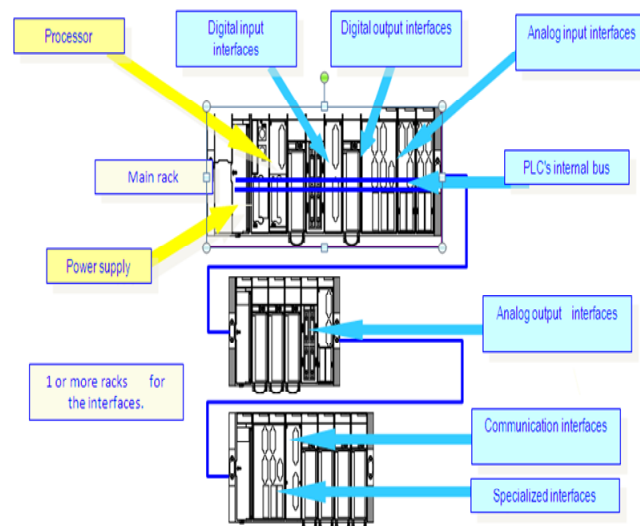


Figure 2: PLC internal structure

PLC applications are typically highly customized systems, so the cost of a packaged PLC is low compared to the cost of a specific custom-built controller design. On the other hand, in the case of mass-produced goods, customized control systems are economical. This is due to the lower cost of the components, which can be optimally chosen instead of a "generic" solution, and where the non-recurring engineering charges are spread over thousands or millions of units often, a single PLC can be programmed to replace thousands of

relays. PLCs can also be attacked by gaining control a computer they communicate with [6].

Under the IEC 61131-3 standard, PLCs can be programmed using standards-based programming languages. A graphical programming notation called Sequential Function Charts is available on certain programmable controllers. In recent years "Safety" PLCs have started to become popular, either as standalone models or as functionality and safety-rated hardware added to existing controller architectures (Allen Bradley Guardlogix, Siemens F-series etc.). These differ from conventional PLC types as being suitable for use in safety-critical applications for which PLCs have traditionally been supplemented with hard-wired safety relays. For example, a Safety PLC might be used to control access to a robot cell with trapped-key access, or perhaps to manage the shutdown response to an emergency stop on a conveyor production line. Such PLCs typically have a restricted regular instruction set augmented with safety-specific instructions designed to interface with emergency stops, light screens and so forth. The flexibility that such systems offer has resulted in rapid growth of demand for these controllers. PLC language have few types which named above .Prior to the discovery of the Stuxet Computer Virus in june 2010, PLC received attention. As PLCs became more advanced, methods were developed to change the sequence of ladder execution, and subroutines were implemented. A primary reason for this is that PLCs solve the logic in a predictable and repeating sequence, and ladder logic allows the programmer (the person writing the logic) to see any issues with the timing of the logic sequence more easily than would be possible in other formats.

PLC contains real time operating system and exploits for these system exit much as they do for dekstopcomputer. PLCs can also be attacked by gaining control a computer they communicate with. We will load and configure the sample ladder logic program and download. Start RSLogix500. It should come up to a blank window:

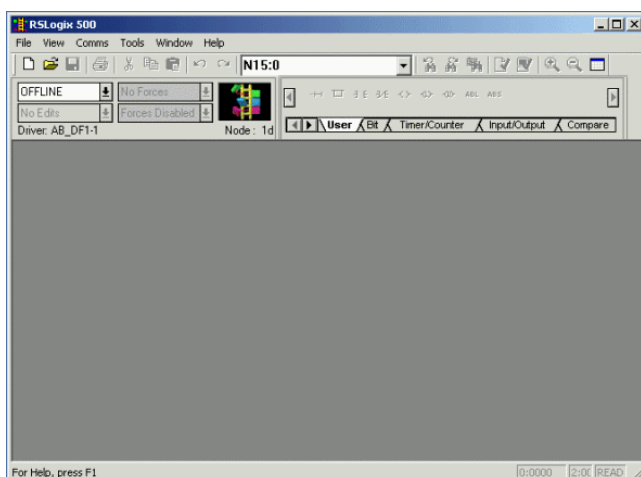


Figure 3: RS Logix Window

The advantage of using PLC tools such as PLC LOGIX are that they save time in design of automated control applications and they also increase the level of safety associate with equipment because various “what if” scenerios can be tried and testeed before the programme is activated .

Here in above figure the screen of RSLogix has shown with whom we will precede our programme. Ladder language make easy all the controlling with less wiring and there is another advantage we can reload the program because it have all the controlling in program and we can easily change the program [3]. Ladder language have two vertical lines one is positive and another is negetive and these lines called power rails,There are some horizontal line which are connected with these vertiial lines called rungs. Ladder have many instruction for different type of application like XIC,XIO,Timer,Counter,Compare,Latch/Unlatch,Scaling,li mit and others. In this program we use XIC,XIO,Counter.We design all the program on these rungs with the help of some instruction.In order to design the control circuit PLC system divides into few points and ladder language make easy all the controlling with less wiring and there is another advantage we can reload the program because it have all the controlling in program and we can easily change the program [5].

Our PLC programme in ladder language will be divided in three steps:

1. In the first step the processing of gate and counter will be explained. Here in this programme one sensor used for IN GATE. Here up counter used for counting the number of people on entrance. LED glows when the capacity of hall or industry full and LED will also glow during the entry of persons. Sensor senses the people when they will be in front of door. LED will glow with each entry and when the capacity will be full then LED will also glow. Here done bit will be DN bit high when acc.<=preset. Here when value of accumularor is less or equal to preset then done bit will be ON.

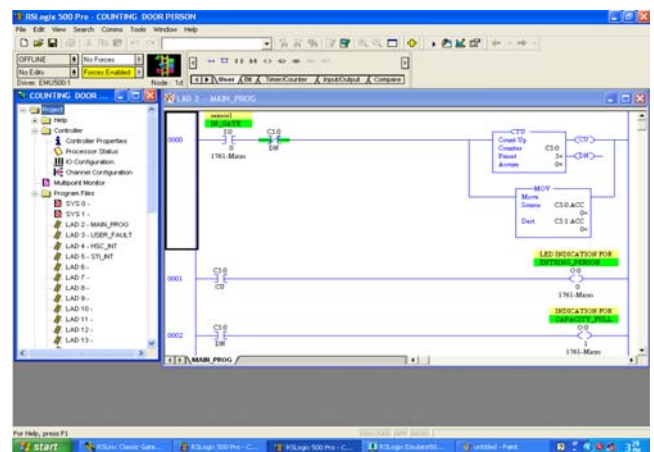


Figure 4: Ladder Logic for Entrance gate

2. In the next step, another sensor used for the exit gate. Where LED also used for indication of exit person and also for the capacity full indication. Here LED will glow when it sense person near the sensor and it will also glow when the capacity of conference hall will be full. With the help of down counter the number of people can be counted on the exit gate.CD bit means counter down bit. DN bit high when acc.<=preset.Here door will be opened if anyone wants to leave the hall or room.

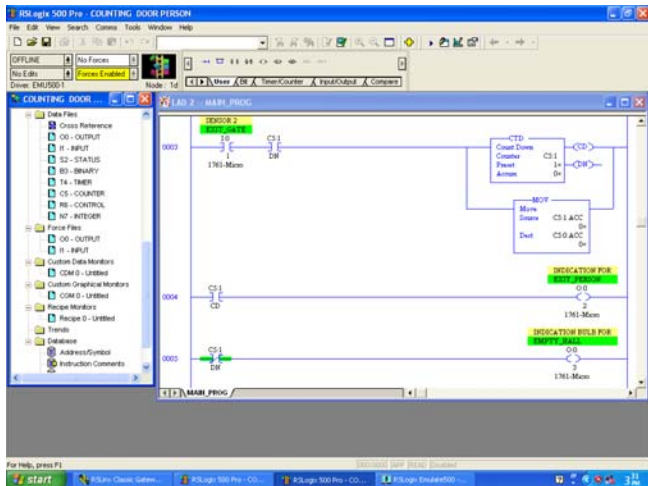


Figure 5: Ladder Logic for Exit Gate

Counter, the word itself defines their meaning which indicates that it is used for counting. In different types of PLC, different types of counter are used, but here we use two types of counter. First is up counter and the second one is down counter. An up counter is used for counting in an increment order, meaning if we count from 0, the next value will be 1, 2, 3, A down counter is used for counting in a decrement order, meaning if we count from a maximum value, for example if we give a maximum value of 10, the next value will be 9, 8, 7, 6, 4, 3, 2, 1, It will also go to a negative value and a minimum value will be -32768.

3. Display screen will be used to display the number of people present at the end of operation. Here, in the third step, the total number of people present will be displayed on the screen. Here, a move instruction is used to display the total number of people present. Here, in this RSLinx Classic, it is used as communication software, which communicates between PC and PLC. RSLinx 500 is a kind of programming software which communicates between PC and connecting devices. With the help of this software, the whole of the process of automation will be performed. The controller allows programming of the system and the door will be opened with LED glows.

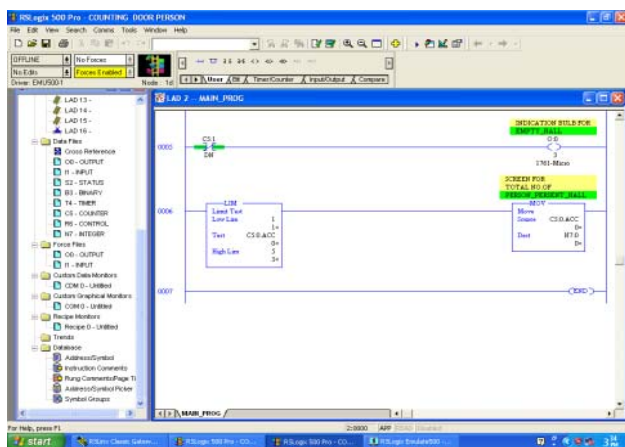


Figure 6: Ladder Logic for total number of people

4. Conclusion and Future Scope

The conclusion of this programming language shows that it is very easy to program. This system is important because of

the security and also for the new age generation. This language is very useful to run all types of industrial applications. In our result, we calculate the people who enter a room and also control a gate system. This system is very useful in metro trains, not only metro, it is very useful for the entry gate system of any company, college, conference hall, elevator system, so we can easily count the people [8]. This system can also be used in our home automation system. This system also uses very low power consumption because PLCs use only 24V DC to operate their input and output modules and only 5V DC is used to operate their CPU. Automatic Door Control not only looks beautiful but it is also more secured and convenient [9]. PLCs communicate between devices using a variety of protocols and verify the performance of the system. We consistently try to reduce the cost of our product and with the help of programming, the cost is reduced and programming advances. PLCs are mainly used for automation processes in many industries and machines [6]. A PLC is a real-time system, meaning it is a kind of system which provides output with respect to input. PLCs are well adapted to a range of automation tasks. These are typically industrial processes in manufacturing where the cost of developing and maintaining the automation system is high relative to the total cost of the automation, and where changes to the system would be expected during its operational life.

Another advantage of this system is that wiring of the input and output devices is very easy. Easy to repair and we can change the program as per our need again and again.

This system is very useful for the future with the help of this system, we can complete automation of our home with less energy consumption and within a low period of time. As time passes, people have no time for their home security, so with the help of this system, we can secure our home without manpower with the help of connection to a GSM system. We can also control all home appliances and also industrial operations with the help of a mobile phone from some remote location. Door control systems are widely used in large shopping malls, banks, conference halls, large hotels, airports, and office buildings, etc. Our safety PLC systems bring the benefits of traditional relay systems to complex safety applications, replacing the relay system required to bring a process to a safe state. Safety PLCs allow standard and safety-related programs, providing flexibility in programming as well as a familiar, easy-to-use environment. We have to download the program from the emulator; then we can run it, otherwise, processing will not be obtained.

According to the above figures, sensor one is the input sensor which we connect at the input module of the PLC. When people come in front of the sensor, the value will increase in the counter, and here we use the counter CU bit, which will be high at each pulse, so that the output which connects at the output module of the PLC. Here, our output is the entry gate which will attach with the PLC output. Similarly, when the second sensor which connects at the other terminal of the input module senses the input and gives the signal to the counter down, and the value will decrease, and the gate will be opened with the help of the CD bit (count down). And the number of people present will also be displayed on the screen.

Implementation and performance of door control system described with the help of this programming language. The performance of door control system explained with the help implementation. With each step performance can also be seen during the running programmes. Door control system is necessary for daily use as well as for industrial applications[4]. Door control system application can be extended according to the requirements.

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