

PLC BASED INTERLOCK FOUR DOOR SYSTEM

¹POOJA SURALKAR, ²SIDDHI NAR, ³SHEHA RATHOD, ⁴KOMAL MATSAGAR, ⁵R N RATHOD,
⁶S L. NALBALWAR

^{1,2,3,4}B.tech Student, Department of E&TC , Dr.BATU Lonere, Raigad MH 402103 India

⁵Assitant Professor, Department of E&TC , Dr.BATU Lonere ,Raigad MH 402103 India

⁶Head of Department, Department of E&TC , Dr.BATU Lonere ,Raigad MH 402103 India

E-mail: ¹poojags1507@gmail.com, ²siddhinar1997@gmail.com, ³sneharathod069@gmail.com,

⁴komalmatsagar11@gmail.com, ⁵ravindrathod@dbatu.ac.in, ⁶nalbalwar_sanjayan@yahoo.com

Abstract- Aiming at enhancing the probity of the automatic door operation micrologix 1400 programmable logic controller (PLC) was used as the core of the door interlocking system. In this paper we are centering on programmable logic controller used for door interlocking system which will be open at doorway and at exit. This door interlock controller can provide power and control for four doors. The PLC logic allows only one door , in any defined area to be unsecured at a time . The requests for a access or requests for accesses while another door is unsecured are denied to maintain highest level of control . Control system provides the various clues which are used to operate a nuclear facility. In some cases operators record these clues for use in day to day services. The information recorded assist the operator valuate the current status of the system and proceeds action if the status are not as expected. In this paper PLC programmed in “ladder language” which is strongly resembles with the 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 PLC is used to control the virtual model of a door control module. Door interlocking system is important from security point of view.

Index terms- PLC , HMI , SMPS Micrologix 1400, ladder logic ,NO , NC

I. INTRODUCTION

Door interlocking system controls the locking of two or more doors, such that if one door is open or unlocked, the remaining door decline access. Door interlocking system is used for pharmacy industry, security industry. The most important feature a door system can have to prevent squalor is an interlocking management. The general operation of door depends upon the person who is adjacent to the door. This automatic door will be opened between doorway and the number of fellows will also be displayed on the display screen and this door control system also helpful because of security motive. This automatic door will be closed when capacity of hall will be replete. The aim of this paper is to compute the number of fellows and the programme also help in open and close the doors between doorway and exit. For this motive two sensors are used. Here one sensor on the doorway gate and one sensor on the exit gate. A door control system with PLC used for the controller design which uses the ladder language. Here the ladder logic used is RSLOGIX500 and help in compute the number of fellows and also control the door. The PLC used to implement the control system of door

II. RELATED WORK

In this paper S7-200 PLC was used as the core of the automatic door system. The principle of control system analyzed with verbal description of the control system hardware was introduced that the procedure of control circuits about human body

detection sensor and obstacle detection and door position detection and so on. This system is highly reliable, flexible and easy to maintain work for single door control [1]

To increase the security of the industrial this paper describes the extra security as a biometric finger print module and the IoT [2] The locking system prevents a door to the interior of the switchgear from opening until the circuit breaker is in disengaged position[3] In this paper basically focusing on programmable logic controller used for automatic door control system which will be opens during doorway and exit. And computing the number of fellows enters or leaves in industries . Here the total number of fellows present will be display on the screen. PLC was designed to replace relay logic systems. [2]In this paper describes how the present automation system comes in to being through its various stages with the coming of microprocessors & microcontrollers several tools as PLC come in to use. These have reduced human intercession. Which in turn has increased accuracy, preciseness and efficiency.[3]

III. INTERLOCK FOUR DOOR SYSTEM

An interlock is a feature that makes the state of two mechanisms or functions mutually dependent. It may be used to prevent undesired states in a finite state machine, and may consist of any electrical, electronic, or mechanical devices or systems. In most applications, an interlock is used to help prevent a machine from harming its operator or damaging itself by preventing one element from changing state due to the state of another element, and vice versa. We

create a secure lobby inside a virtually any entrance area. Then add our exceptionally reliable automatic door operator and robust magnetic locks hold the door and required position. The required entire system accurately controlled using programmable plc. In standby mode the “PUSH HERE” and “DISABLED” buttons will be flashing. Both interlock door secured by overhead magnetic locks. Once the “PUSH HERE” button is pressed the other buttons will stop flashing and the red “WAIT” light will eliminate on all other buttons clusters. The door will unlock the local buzzer within the cluster will give an audible sound to proceed. The green “GO” indicated will also illuminate to give visual indication that the door is unlocked. The user can push and pull the door accordingly . Following objectives are taken to build the system

Project objective

1. To design & develop door interlocking system
2. Interface HMI
3. Installation and testing

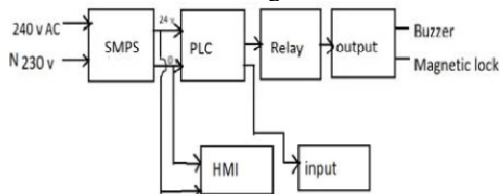


Figure 1: Block Diagram of Door Interlocking System

The System uses programmable logic controller and Human man machine interface panel. To indicate opening and closing of the door buzzer is used. The introduction of various system components are as follows.

3.1 PLC (Allen Bradley micrologix 1400) :

This PLC has large memory to puzzle out an assortment of applications. Its recipe storage (up to 64 KB that is take off from data logging memory) that is facile by ladder program, enabling quick and easy batch modification of program data for timers ,counters and other data types. Twelve high-speed inputs that can be used severally as latching inputs. There are three high speed outputs that can be configured as 100 KHZ pulse train outputs or 40 KHZ as pulse width modulated output and multiple inputs commons permit to use the controller for either sinking or sourcing input devices and multiple outputs commons furnish single isolation in multi voltage output applications .Communication channels furnish isolated RS-232. Through with RS-232 supports all serials protocols.[4]



Figure 2: PLC(Allen Bradley Micrologix 1400)

3.2 Human –Machine Interface(HMI)

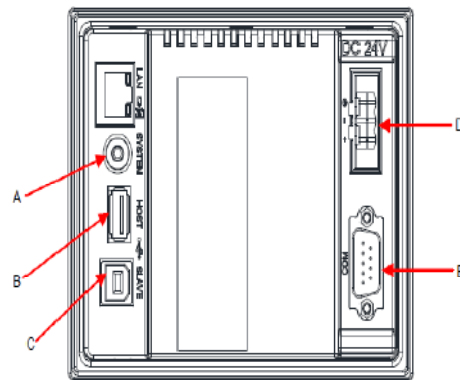
HMI software enables operators to contain industrial and process control machinery via a computer based graphical user interface. HMI means the computer on which HMI software is installed.

Two basic types of HMI :

- 1)Supervisory level and
- 2)Machine level.

Supervisory level is designed for control room environment and used for system control and data acquisition . A process control application collects a data from sensors on the shop floor and send the info to a central computer for processing. Some HMI software supply data logging, alarms, security, forecasting, operation planning and control. Communication on multiple networks can supports up to four channels.

This system uses Delta HMI panel , Model number B03S211 having resolution up to 480*272 , support up to 65536 colors .The rear view of DOP-B03S211 will help to you to interfacing with Micrologic PLC 1400 as shown in figure 3.



A	System Key	B	USB Host	C	USB Slave
D	Power Input Terminal	E	COM1		

Figure 3: DOP- B03S211(Rear View)

3.3 Switch Mode Power Supply

Switch Mode Power Supply is an electronic power supply that incorporates a switching regulated to convert electrical power efficiently. Main advantage of SMPS is greater efficiency than linear regulator because switching transistor dispels little power when acting as a switch. The first stage is to convert the input to DC if the SMPS has AC input. This is called rectification. An SMPS with a dc input does not need this stage. Rectifier produces an unregulated dc voltage which is then sent to a large filter capacitor. An SMPS used for ac input commonly can be run from a dc supply because the dc would pass through the rectifier unchanged.

This model features 5 volt and 24 volt output at a maximum of 6 and 4 AMPS respectively , allowing it to power a large numb of low voltage appliances .



Figure 4: Open Case Switch Mode Power Supply

3.4. Relay Board

A relay is an electrically controlled switch. Relays use an electromagnet to mechanically operate a switch. Relays are used where it is compulsory to control a circuit by a separate low power signal or where discrete circuit must be controlled by one signal

3.5. Magnetic Lock

The principal of an electromagnetic lock is the use of electromagnetism to lock a door energized the holding force should be collinear with load and lock and armature plate should be face to face accomplish optimal operation. Basically it consist of an electromagnet pull in a conductor with a force large adequate to prevent the door from being open. Magnetic lock is mostly easy to install than other lock since there are no Interconnecting parts. Magnetic lock may also endure fewer damages from multiple glows than do conventional locks. If a magnetic lock forced open with a crowbar it will oftentimes do little or no loss to the door. And no moving parts in a magnetic lock



Figure 5: Magnetic Lock

IV. INTERLOCK FOUR DOOR SYSTEM HARDWARE

4.1 Connection with the Limit Switch

Figure 6 shows wiring diagram of SMPS with the Limit Switch .Limit Switch are commonly used to detect the presence of moving object when the object reaches a specific location. One type of limit switch is a mechanical limit switch .it is used to detect the presence of an object when physical contact is made between the object and the switch . Mechanical limit switch has a lever . When the moving object touches and moves the lever , a set of electrical contacts is forced either open or closed . Limit switches have normally open (NO) or normally closed (NC) Contacts .

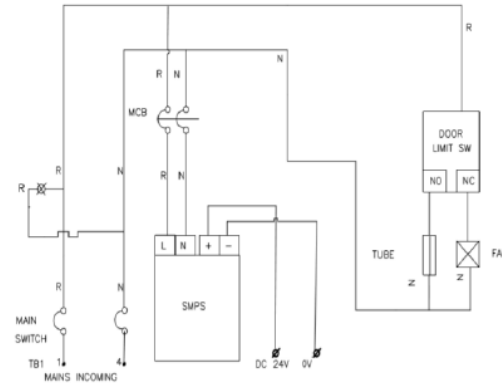


Figure 6:Wiring Diagram SMPS to Magnetic Lock

4.2 Interfacing of Door Sensor and Door lock with the PLC

Figure 7 shows the interfacing of four different door sensors and four different door lock with PLC . The PLC digital I/O pins are used from I0:0 to I0:7 to interface door sensor and door lock to the PLC . The input sensor and door lock are defined as input to the PLC to get the present status of door . This is in digital input interfacing mode .This is powered by 24Volts DC supply by SMPS .

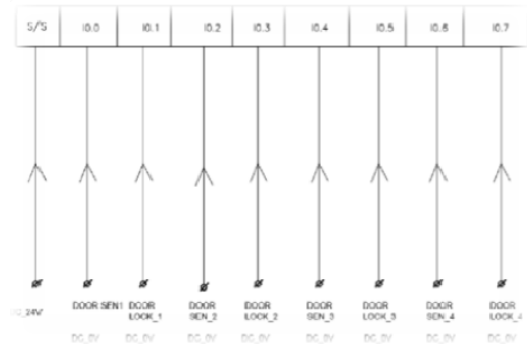


Figure 7: interfacing of Door Sensor and Door lock with PLC

4.3 Interfacing of four Buzzer and four Magnetic Lock

Figure 8 shows the interfacing of four different buzzers and four different magnetic lock with PLC output pins . Theses interfaced with PLC Port pins from O0:0 to O0:7 respectively . Similarly these port pins are defined as output . This used digital output Mode . The Buzzer and the Magnetic locks are powered by 24 Volts DC power supply from SMPS .

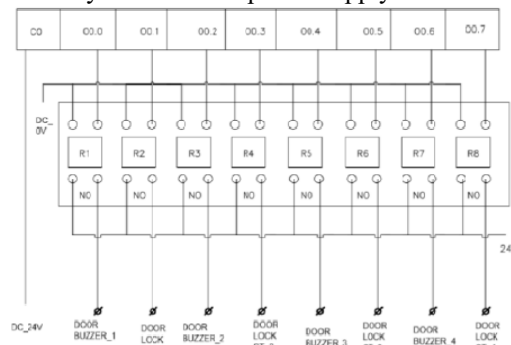


Figure 8: Four Buzzers and Four Magnetic Lock Interfacing with the PLC

4.4 Control Panel Wiring

Figure 9 shows the control panel wiring. This control panel design such a way that all the sensor and actuator connection comes to one central place and connection are done between them. This will help easy power distribution to sensor and actuators. This also helps you for trouble shooting point of view. An emergency switch is a safety mechanism used to shut off machinery in an emergency situation, when it cannot be shut down in the usual manner. Unlike a normal shut down switch, this shut down all system in order and turns off the machine without damage, emergency switch is designed and configured to abort the operation as quickly as possible



Figure 9: Control Panel Wiring

4.5 Door panel control

In this control panel we are using no touch sensor. This sensor senses palm and opens the door. If any person stands in front of the sensor or any object comes in front of it, sensor will not respond to it. It only responds to palm. Black and red wires are connected to input. The ideal temperature for sensor shown in above figure is 20C-50C. Size of the sensor is 115*70*29. Weight of the sensor is 85gm.



Figure 10: Door panel control

The ENFORCER Outdoor No Touch Request-To-Exit Sensor is a full-featured exit plate which uses IR technology to allow egress from a protected area or activate a device with the simple wave of a hand. Since it is No Touch, this sensor is ideal for use in hospitals, clinics, labs, clean rooms (to reduce the risk of contamination), schools, factories, or offices

4.6 Control Panel Designing Steps

To design control panel material should be chosen wisely. Then panel size should be selected according to function for which it is designed. And panel cost depends upon size of it. Before building control panel we should draw basic panel diagram and after that component should be mount according to diagram which reduces chances of mistake. Power wiring

should be done properly. Apply power supply to panel. Then panel should be programmed according to requirement

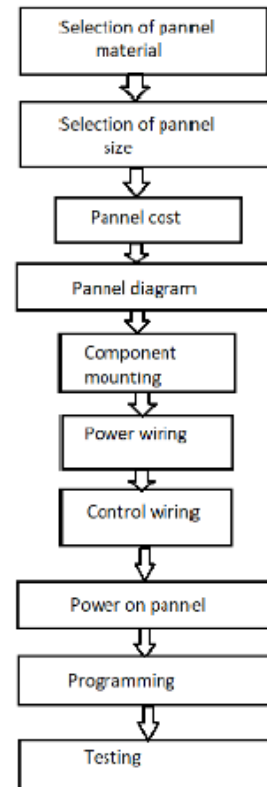


Figure 11: Control Panel Designing Steps

4.7 PLC PROGRAMMIG

Our PLC programme in ladder language and we have used RX logix 500 software. Input is denoted as I.0 and output is denoted as O.0 . B3.0 is a memory bit and each bit has separate address bit. At first line door sensor 1 bit. If it is use as an input then door lock 1 bit will on. Output mapping has 8 to 15 addresses bit.

4.8ACTUAL SYSTEM INSTALLATION

Figure 12 shows the actual system installation at the site. The photographs shows the position of HMI panel, door lock and the emergency switch for the single door like this installation of the rest four door is done



Figure 12 : Actual System Installation

4.9 ADVANTAGES

1. Better for Security
2. Easy to design
3. Ease of Installation
4. Ease of management

4.10 APPLICATIONS

1. Process Industry
2. Farming Industry
3. Pharmaceutical Industry
4. Warehouses
5. Hospitals

CONCLUSION

In this paper industrial automation is done using PLC technologies. The application of this system is limited to door control only. In most of the industry where number of people are entering and leaving the industrial premises are need to be control through automation. Implementation and installation of door control system described with the help of various required components to build the system PLC communicated with devices using a variety of protocols and verifies the performance of the system. Door control system is necessary for daily use as well as for industrial application [6]. This paper contributes to the step to be followed for control panel designing. And also explain the how four doors can be interface and control using PLC technologies

And also we are centering on to keep count of the fellows enters or leaves in industry. Interlock door control system application can be extended to the requirements.

REFERENCES

- [1] Xu, Yangyang, and Ying Wang. "Control System Design of Automatic Door Based on PLC." 2016 International Conference on Mechatronics Engineering and Information Technology. Atlantis Press, 2016.
- [2] Rao, Ch Narasimha, and M. Rambabu. "Design and Implementation of Industrial security system using Fingerprint Authentication and IOT." International Journal of Research 5.16 (2018): 1340-1343..
- [3] Hare, Neal Thomas, and Thomas Matthew Stevens. "Circuit Breaker Internal Manipulator and Door Lock." U.S. Patent Application No. 16/204,366..
- [4] https://literature.rockwellautomation.com/idc/groups/literature/documents/sg/1761-sg001_-en-p.pdf
- [5] http://www.technideal.com/uploads/Products/product_647/HMI_DOP-B03S211.pdf.
- [6] Kinner, Russell H, P.E. Designing Programmable Controller Application Programme using More Than one Designer. 14th Annual International Programmable Controllers Conference Proceedings, 1985, p- 97-110
- [7] Roncolatto, R.A., Romanelli, N.W., Horikawa, O., Hirakawa, A., Amancio, S.M. and Silverio, M. (2006) 'Automatic elevator system for maintenance services', IEEE 11th International Conference on Transmission & Distribution Construction, Operation and Live-Line Maintenance.
