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A Mechatronics Approach For Concerting the Programmable Logic Controller With Ladder Programming To Regulate The Elevator

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Abstract - *Mechatronics is a multidisciplinary field that refers to the set of skills needed in the current industry, advanced automated production and deals with robots, control systems, electronic systems. A programmable logic controller (PLC) is a type of small computer that can receive data through its input and send instructions for its output and requires input from auto-capture data points or input areas such as switches or buttons. Staircling is an old and representative language of the system with a staircase drawing based on circuit drawings. It is widely used in developing systems or software for systematic thinking controls. In this project we are going to develop a mechatronics approach for designing the programmable logic controller with ladder programming to control the elevator.*

Index terms: *PLCs, Mechatronics, Ladder programming.*

1. INTRODUCTION

Mechatronics is a multi-industry component focusing on the skill sets required in the current, advanced automation manufacturing industry. Mechatronics works with robots, control systems, and electromechanical systems. The main components of Mechatronics are Modeling of Visual Systems, Sensors and Actuators, Signals and Systems, Computers and Sensitive Systems, Software and Data Recovery. Mechatronics is used in manufacturing, health care, spatial testing, and tools that make our lives easier every day.

A logical controller is a type of small computer that can receive data according to its input and send operating instructions for its results. Industrial computers are used to control various electro-mechanical processes for use in production, plants, or other automotive applications.

The systematic mind control receives information from connected devices and sensors, processes the received data, and triggers the required output according to its pre-set parameters. Based on inputs and outputs, PLC can easily monitor and record operating time data such as operating temperature, machine production, alarm production when the machine fails, automatic start and stop processes and more. This means that PLCs are robust and flexible production control control solutions that are compatible with most applications.

The operating system of an elevator or elevator is similar to a pulley system. A water pump system is used. This pulley system can be designed with a bucket, a wheelbarrow. The bucket is attached to a rope that passes through the entire wheel.

1.1 Programmable logic Controller

The A programmable logic controller (PLC) system is specially designed with a digital-based microprocessor control system that uses systematic internal memory for instruction and internal storage for ordering and using functions such as thinking, scheduling, time, calculation and arithmetic to control equipment. and procedures.

Figure 1 PLC

1.2 BASIC STRUCTURE OR (INTERNAL ARCHITECTURE) OF A PLC SYSTEM

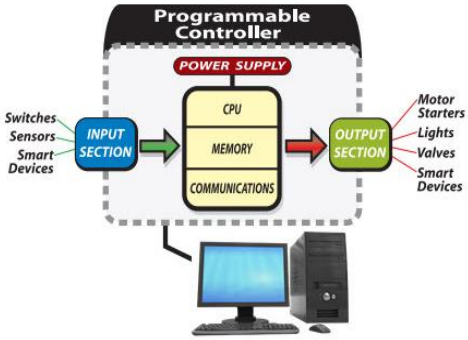

Figure 2 PLC Internal Diagram

Central Processing Unit:

The CPU controls and processes all activities within the PLC. It is provided with a clock with a normal frequency

between 1 to 8 MHz. This figure determines the PLC operating speed and provides time and synchronization across all system components. The information within the PLC is handled by digital signals. The processor is a microprocessor that performs a task program specified in a ladder drawing or set of Boolean statistics. The CPU consists of the following units

Arithmetic and Logic Unit (ALU):

This unit performs data manipulation and arithmetic and logical functions in flexible input data and determines the appropriate state of output variability. Arithmetic operations include addition, subtraction etc., and logical functions include AND, OR, NAND, X - OR.

Memory Unit:

Memory termed registers located within the microprocessor and used to store information involved in a program execution. These programs contain control actions to be executed by the microprocessor for the given input. There are several memory elements in a PLC system. System Read-only Memory (ROM) gives permanent storage for the operating system and fixed data wed by the CPU.RAM for the user to develop program and acts a temporary memory. In addition, temporary buffer stores for the I/O channels.

Control Unit:

The control unit is used to control the operating time. The processor operates under a permanent monitoring operating system that directs all operations from input and output to user operating systems. The controller can perform only one task at a time. Therefore, it checks each input sequence, checks the step diagram program, gives each output, and then repeats the whole process. Therefore, time management is required in the PLC system.

Memory Unit:

The sequence of instructions to be executed, programs are stored in the memory unit. During entering and editing including Debugging, the program is stored in the temporary storages called RAM (Random Access memory). Once the program is completely finished (free & from errors).It may be 'burned' into ROM When the ROM is plugged into the PLC, the device is ready to be placed into service in the industrial environment. For network programmed PLCs, the final PLCs program is downloaded into a special re-programmable ROM (EPROM, PROM, and EEPROM) in the PLC. Memory may be either volatile type or Non-volatile type.

Volatile Memory:

Flexible memory or temporary memory or Application memory is a user memory, in which the user can log in and edit the program. Flexible memory will lose all its scheduled content if the operating system is discharged or lost. Therefore, it is necessary to provide battery power at all times.

Non Volatile Memory:

Fixed memory or permanent memory or system memory (used) system memory that keeps track of startup programs, viewing tables, etc., This is usually planned and provided by the manufacturer. This controls the operation of PLC. It does not lose. its content at the time of expiration. It does not require a battery. R ROM memory provides the CPU to use a limited amount of data only.

2. PROPOSED METHOD

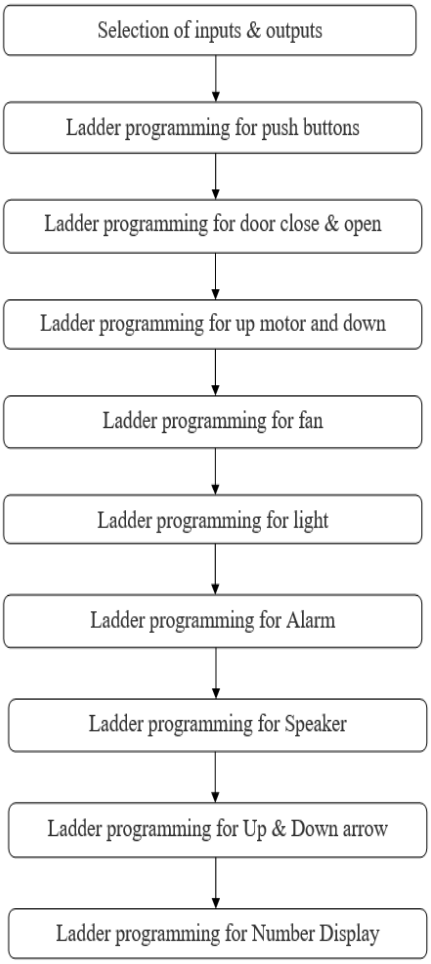

Figure 3 Flow Chart

2.1.1 Selection of inputs and outputs

According to this project, the design of the cash ladder system required is provided by a programmable logic control (PLC), so depending on the input output is available.

Required inputs are key switch, door opening and closing sensors, weight sensor, census sensor, pressure buttons, light switch, alarm switch, obesity sensor.

PLC effects for Up & down engine, lift indicator, fan, light, up and down arrow, speaker, alarm and number indicator.

2.1.2 Ladder programmingfor push buttons

To perform any operation with the lift, the master switch will be always in ON condition irrespective of the other push buttons.

If we press the first push button, irrespective of other push buttons the lift will move to first floor.

If we press the second push button, irrespective of other push buttons the lift will move to second floor.

If we press the third push button, irrespective of other push buttons the lift will move to third floor.

The push buttons will work based on the priority base first press first priority irrespective of other push buttons.

Master switch	P1	P2	P3	Lift indicator
1	0	0	0	0
1	1	x	x	1
1	0	1	x	2
1	0	0	1	3

2.1. Ladder programming for Door open &close sensors

S.NO	Master	Timer (sec)	Person counter	Weight sensor (kg's)	Door close
1	1	2	5	100	0
2	1	4	4	200	0
3	1	6	6	300	0
4	1	10	4	100	1
5	1	10	5	300	1
6	1	10	3	200	1

Based on the below truth table, to close the door automatically we have taken some parameters based on that the door will close automatically they are

The parameters timer, person counter, weight sensor and door close

The door will close automatically, when there are five members or four members in the lift and the lift will wait up to 5 seconds or 10 second and the weight it takes up to 400kgs or 300kgs or 200kgs.

2.1.4 Ladder programmingfor Up motor & down motor

We have written the ladder programming for three floors, so for the three floors we have taken the parameters master switch, lift indicator-1, lift indicator-2,lift indicator-3, lift position-1,lift position-2,lift position-3, door close to tell when the UP motor will ON/OFF and Down motor ON/OFF.

To perform any operation with the lift, the master switch will be always in ON condition irrespective of the up and down motors.

Based on the below truth table we can say at what condition the UP motor will turn ON and turn OFF and what condition the Down motor will turn ON and turn OFF.

The UP motor will turn in the following conditions, they are:

The UP motor will turn ON when the lift indicator -2, the lift position-1 and door close should be in ON state.

The UP motor will turn ON when the lift indicator -3, the lift position-1 and door close should be in ON state.

The UP motor will turn ON when the lift indicator -3, the lift position-2 and door close should be in ON state.

Except these conditions the UP motor will be in OFF state. The Down motor will turn in the following conditions, they are:

The Down motor will turn ON when the lift indicator -1, the lift position-2 and door close should be in ON state.

The Down motor will turn ON when the lift indicator -1, the lift position-3 and door close should be in ON state. The Down motor will turn ON when the lift indicator -2, the lift position-3 and door close should be in ON state. Except these conditions the Down motor will be in OFF state.

Master	LI-1	LI-2	LI-3	LP-1	LP-2	LP-3	Door close	Up Motor	Down Motor
1	1	0	0	1	0	0	1	0	0
1	1	0	0	0	1	0	1	0	1
1	1	0	0	0	0	1	1	0	1
1	0	1	0	1	0	0	1	1	0
1	0	1	0	0	1	0	1	0	0
1	0	1	0	0	0	1	1	0	1
1	0	0	1	1	0	0	1	1	0
1	0	0	1	0	1	0	1	1	0
1	0	0	1	0	0	1	1	0	0

2.1.4 Ladder programming for fan

Based on the moment of UP motor and Down motor the fan will be turned ON. From the below truth table, we can observe that the Fan turn on only in two conditions they are:

When the up motor is in OFF state and down motor is in ON state the fan will be turned ON and when the up motor is in ON state and down motor is in OFF state the fan will be turned ON. When both up motor and down motor is ON state then the fan state is either in ON or in OFF state.

Up motor	Down motor	Fan
0	0	0
0	1	1
1	0	1
1	1	x

2.1.5 Ladder programming for Light

The light in the lift is turned ON only based on the condition of up motor, down motor and state of light switch that is either in OFF/ON state.

The light is turned ON only in three conditions they are:

If the light switch is in ON state then the light in the lift will be in ON state, irrespective of the up motor and down motor conditions. If the up motor is in ON state, light will be turned ON, where the light switch and down motor are in OFF state. If the down motor is in ON state, light will be turned ON, where the lights switch and up motor are in OFF state.

Light switch	Up motor	Down motor	Light
1	X	X	1
0	1	0	1
0	0	1	1

2.1.6 Ladder programming for Speaker

Based on the below truth table, the speaker will be turned ON in the following condition that is When both the master switch and door close are in ON state then the speaker will turned ON.

Master	Door close	Speaker
1	0	0
1	1	1

2.1.7 Ladder programmingfor Up & Down arrow

Based on the below truth table, the up and down arrow will be turned based the conditions they are: The UP arrow will be turned ON when the up motor is in ON state, irrespective of the down motor state. The Down arrow will be turned ON when the down motor is in ON state, irrespective of the up motor state.

UP motor	Down motor	UP arrow	Down arrow
1	x	1	0
x	1	0	1

2.1.8 Ladder programmingfor Number Display

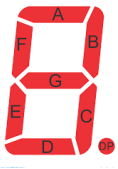

Figure 4: 7-Segment Display

The above picture shows the seven segment display, which is used to display the current status of the lift position.

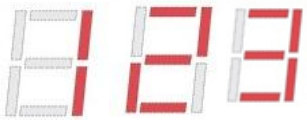

Figure 5 Number Display

The above picture indicates that the lift position was in first floor, where only 'B' and 'C' states are in ON state and remaining states are in OFF state, so it indicates the number ONE.

The above picture indicates that the lift position was in second floor, where only 'A', 'B', 'G', 'E' and 'D' states are in ON state and remaining states are in OFF state, so it indicates the number TWO.

The above picture indicates that the lift position was in third floor, where only 'A', 'B', 'G', 'C' and 'D' states are in ON state and remaining states are in OFF state, so it indicates the number THREE.

3 Programme

Figure 6 Ladder program for overweight and door close

Figure 7 Ladder program for lift indicator

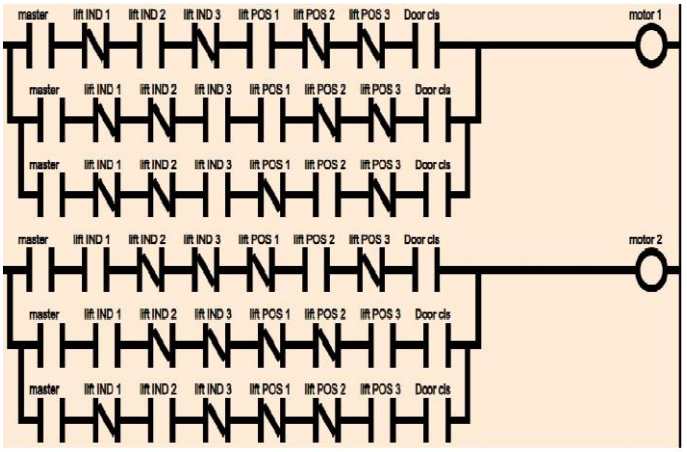

Figure 8 Ladder program for motor1 and motor2

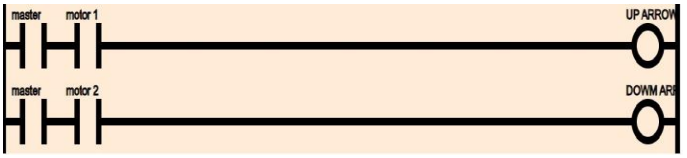

Figure 9 Ladder program for up and down arrows

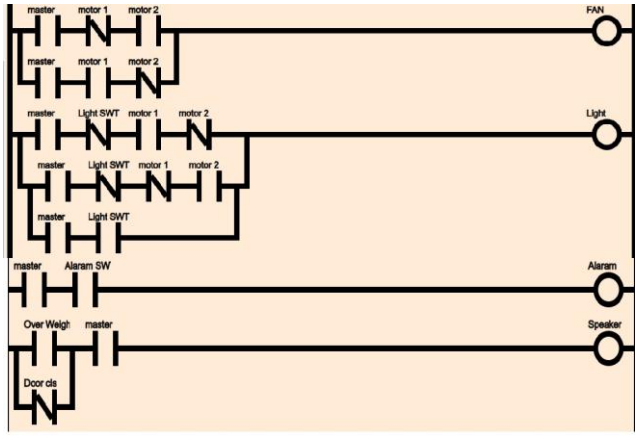

Figure 10 Ladder program for fan, light, alarm, speaker

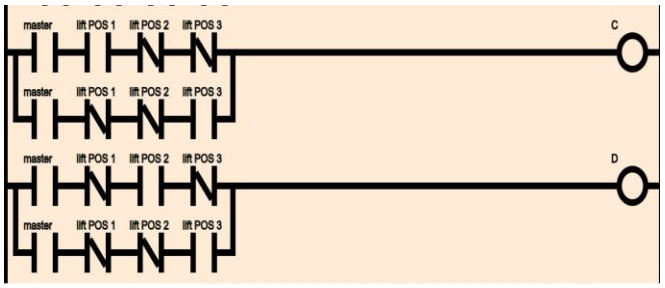

Figure 11 Representation of lift positions in SSD

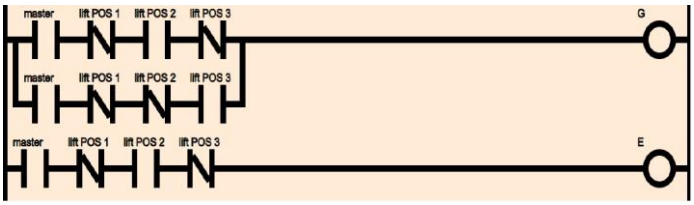

Figure 12 Representation of lift positions in SSD

4 ADVANTAGES

Therefore, this paper describes the design and development of PLC elevated supported. The ladder concept is implemented using an online PLC template. It can be concluded

PLCs can be used to design a cash management system.

Traditionally used relay boards and IC boards can be replaced by PLC to make it easier and cheaper to control elevators.

The desired cash position can be predicted using a PLC-based control system.

By using a PLC based on cash management system, the size of the entire infrastructure can be reduced, including material costs, installation costs and personnel costs.

CONCLUSION

In today's developed world elevators are becoming increasingly important through the development of architectural technology. The design of the cash-based control system is very important as it is very important to do all the work. Staircase layout is preferred as it is easy to plan different PLCs. Before embarking on this project it has been a challenge for us to develop a proper step ladder approach as we started in the PLC planning field. Gradually we are able to design a ladder by adapting to different types of PLC systems. By splitting all the interfacing modules into separate sections we also successfully completed.

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