PLC Controlled Elevator System using XC1 PLC through Ladder Programming

G. Rajitha[#1], A. Sunantha[*2], S. Mani Kuchibhatla[#3] , S. Prabhu Priya [#4]
[#1]*Assistant Professor,* [#2]*Assistant Professor,* [#3]*Associate Professor,* [#41]*Assistant Professor &*
Department of Electrical & Electronics Engineering, ACE Engineering College & JNT University Hyderabad
Ghatkesar, Hyderabad, India

Abstract

Present days we are using elevator as a vertical transport medium in multi-storage buildings. With the development of better architecture technology, buildings are raising in height. Hence more important is given to design of an elevator control system, which is easy for the maintenance and to perform an efficient function. Elevator control system work on the relay logic. More number of connections of relay logic is found in traditional elevator system and it is difficult of debugging. But through XC1 PLC based system, it is easy to debug the failures in the system as it contains the simple logics and easy maintenance. The mainly focusing in this paper is to replace the relay logic elevator control system with the modern PLC based elevator control system through xc1.Push buttons are used to call the elevator.

Keywords - *Elevator System (ES), Programmable Logical Controller (PLC), Supervisory Control and Data Acquisition (SCADA, Ladder (LAD), Normally Open (NO), Normally Closed (NC)*

I. INTRODUCTION

1st reference to an elevator in the works of the roman, who has reported that Archimedes built his first elevator probably in 236 BC After few years with the advent of electricity, the electric motor was integrated into elevator technology. With the motor placed at the bottom of the cab, this particular design employed a gearing system to climb shaft walls fitted with racks. After

Few decades, an electric elevator was developed in using a revolving drum which is in circular shape to wind the hoisting rope, but these drums could not practically be made large enough to store the long hoisting ropes that would be required by skyscrapers. Motor technology and control methods evolved rapidly. Later direct-connected geared electric elevator, allowing for the building of significantly taller structures. Few years later the technology had changed into the without gear electric elevator system and allowing large number of story buildings to become possible and forever changing the urban landscape. Multi-speed motors replaced in the place of single-speed motors to help with the land levelling and smoother overall operation. Electromagnet technology replaced manual rope-driven switching and braking. Pushbutton controls the process and various complex signal systems modernized the elevator even further. Safety improvements have been continual, including a notable development by Charles Otis-son of original "safety" inventor Elisha- that engaged the "safety" at any excessive speed, even if the hoisting rope remained intact.

II. PROGRAMMABLE LOGIC CONTROLLER (PLC)

PLC is a solid state electronic device in which response depends on input & user defined program. PLC has the related construction as that of a digital computer, as shown in the Fig. 1. consisting an input and response section, CPU, memory card and, power supply.

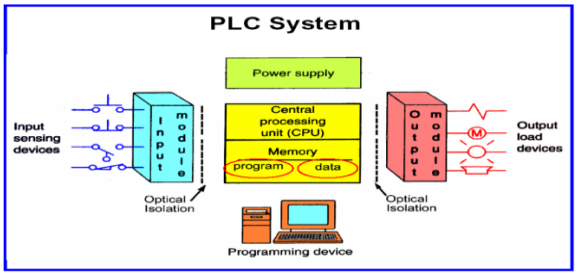

Figure1: PLC Block Diagram

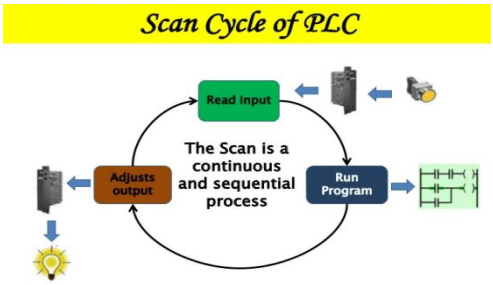

Figure2: Scan Cycle of PLC

Fig. 2 shows the functioning of PLC in which it scans all the inputs constantly and triggers the response coil according to the program. Maintenance program stores the entire status bit which is used in the upcoming and, essential for the continuity.

III. ELEVATOR WORKING

The conventional method of controlling modern elevators is using a computer. The computer enables

to process the relevant information of the elevator and switch on the motor at the correct time to place the elevator car where it needs to be. To do this, the computer needs the knowledge of the following things:

- Where to go?
- Where the floor is?
- Where is the position of elevator car?

Finding out how the people can go vertical easily. All the buttons in the elevator box and of each floor are wired to the PLC. When any one of these buttons is pressed, the XC1 PLC logs a request. There are different ways to find out the position of the elevator box. Generally, a light or magnetic sensor placed on the side of the box reads a series of holes on a long vertical tape in the shaft. The XC1 PLC knows exactly the position of the elevator box is in the shaft by counting the holes. The PLC can vary the motor speed so that the car slows down gently as it reaches each floor. This ensures a smooth ride for the passengers. In a multi-storeyed building, the PLC strategy is to keep the elevator box run efficiently. Traditionally, the strategy was to abstain from reversing the elevator's direction. That means, the elevator box will move up till there are people on the floors above that want to go up. It makes sure to only answer "down calls" after it has taken care of all the "up calls" (intelligent mode). But once it starts coming down, it won't pick up anybody who needs to go up until and unless there are no more down calls from the lower floors.

This ladder language program speedily does a satisfactory job of placing everybody to respective floor. More advanced programs take density of passengers for each floor patterns into account. They know which floors have the highest demand, at what time of day, and direct the elevator box accordingly. In one end of the system, the elevator lobby works like a train station. Instead of simply pressing up or down, people waiting for an elevator can enter a request for a specific floor. Based on the location and course of all the boxes, the PLC tells the passengers which box will get them to their destinations the fastest.

Figure3: Pictorial view of elevator design

IV. FUNCTION OF A PLC

In the automated system through the PLC controlling the whole program with a control application, program (stored within the PLC memory) while executing, the scan cycle continuously scanning the program of the system through the field input devices and output devices. Based on the programming logic will determine the action to be carried out at the field output devices.

The PLC are using for controlling and repetition of the ladder logic program, which may be interconnected together with other host controllers through a sort of communication network cable for integrating the control of a complex process.. Soft wiring makes changes in the control system easy for identifying the faults in the wiring.
If we wish a device for a PLC system to behave differently or to control a different process element, all you have to do is change the control program. In a traditional system, changing the wiring between the devices, a costly and time-consuming endeavour.

ADVANTAGES OF PLC

- Higher reliability
- Compact size so requires less space
- Great capabilities of computing
- Cost Effective
- Flexibility
- Abundant Expansions

V. XINJE Model : XC1- 24R-E PLC

By means of the huge choice of components now available, the engineers can frequently obtain parallel systems from OEM abbreviated as Original Equipment Manufacturers. These manufactures give different ratings of input/output devices and, definite types of controller functions [5]. As a result, it is possible that one arrangement from a single firm repute out as more superior or cost efficient than the other; but usually this is hardly ever the situation. To decide the most appropriate PLC to be selected in the automation task, there are several basic concerns to be made:

• Essential input/output capacity;
• Types of I/O required;
• Amount of memory required;
• Speed and power required of the CPU and instruction set

• Manufacturer's support and endorsement.

Figure 4: XC1- 24R-E

Figure 4 shows the picture of XC1-24R-E type of PLC in which R represents that it is of relay type & 24 give the total number of Input & Output points available with the PLC.

CPU Description	Specification
Power Supply	AC POWER (230V)
Programming mode	Instruction, ladder Diagram
Operation speed	0.5μs
Data register(D)	150
Digital I/O	12/12
Analog I/O	None
Timer	80
Counter	48

XC Series PLCs because of highly scalable design provides flexibility and diverse CPU units enable to match cost and functionality. The CPUs and Expansion Units provide design flexibility. Moreover, the Expansion Units ensure expansion of I/O and communications.

The software required to program the PLC units is Windows or MAC based and developed for ease of use depending on plug and play principle. Many functions are built-in and follow a tick-box selection protocol to enable settings and functionality; together with wireless capability, programming and setup could not have been made simpler.

XC series and models are been designed with different function blocks to give the user with a cost effective unit based on the application.

A. Faster Operation

The time required for basic operation instruction is 0.2～0.5μs; the scan time needed is 10,000 steps per 5ms, and availability of up to 160K program space.

B. Support Expansions

CPUs can include up to 7 different expansions and a BD card.

C. Numerous Communication Ports

CPUs carry 1to4 communication ports, will support recommended standards232, recommended standards485, CAN - Bus and can facilitate peripheral devices such as, instruments, inverters etc.

D. Interruption Function

Interruption functions of XC Series PLCs includes external interruption, time interruption and higher speed counter interruption; permitting them to meet various requirements.

E. Switch I/O points freely

A special switch I/O point function has been provided in XC Series PLCs which works on condition of damaged terminals, so that program need not be changed.

F. C language function block

To improve the program efficiency and security the user is permitted to write function block in C language.

G. Sequential Function Block

It enables users to control instructions conveniently in a sequential manner. This function is suitable with: ON pulse output; motion control; communication; inverters read/write etc. It reduces program editing.

VI. WIRING OF XC1- 24R-E:

Figure 7 depicts the wiring of PLC XC1 24 RE. The terminals COM in the input side and terminal from COM0 to COM2 in the response side describe the common points where any one of the terminals of either the load or the supply has to be connected.
Each & every input of the PLC should be 24 V DC but it will be activated by a voltage anywhere in between 20 Volt DC and 30 Volt DC. The initial output Y0 is a DC but the other responses are connected with relay so both the DC and AC sources can be used based on our necessities.

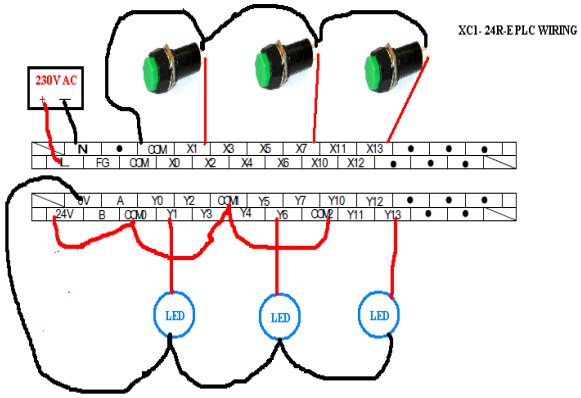

Figure 5: PLC Wiring

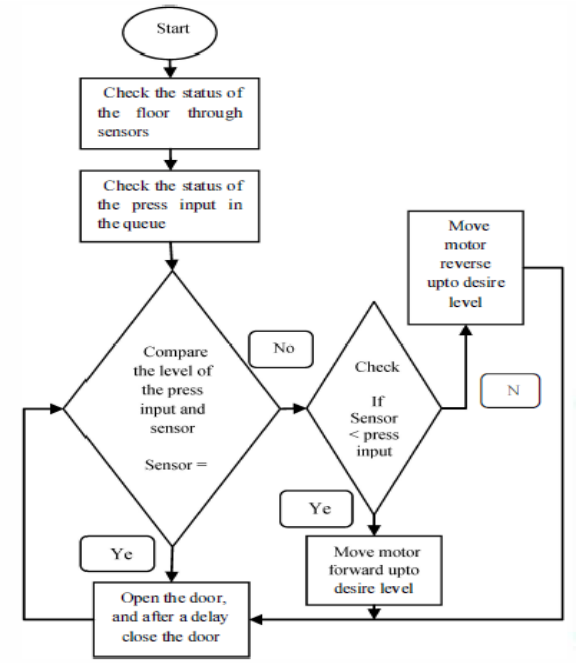

Figure 6: Flow Chart

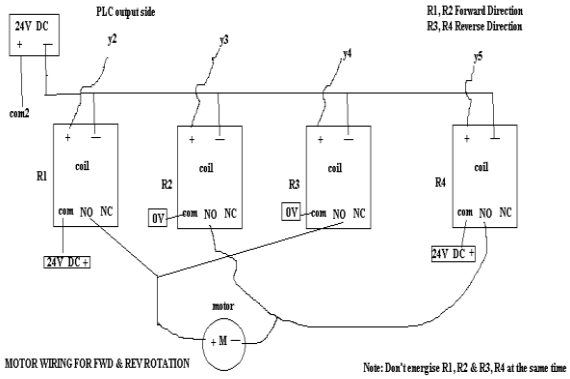

Figure 7: DC Motor Wiring

Figure 7 depicts the wiring of DC Motor for rotating both in forward as well as reverse ways. Relays R1, R2 are used for forward way of motor & Relays R3, R4 are used for reverse way of Motor. All the relays are not to be energized at the same time.

VII. LADDER LOGIC/ LADDER DIAGRAM

Ladder logic is a graphical language very familiar for programming Programmable Logic Controllers (PLCs). It was originally invented to describe logic made from relays. The name is based on the observation that programs in this language resemble ladders, with two vertical "rails" and a series of horizontal "rungs" between them. A program in ladder logic, also called a ladder diagram, is similar to a schematic for a set of relay circuits. An argument that aided the initial adoption of ladder logic was that a wide variety of engineers and technicians would be able to understand and use it without much additional training, because of the resemblance to familiar hardware systems. (This argument has become less relevant given that most ladder logic programmers have a software background in more conventional programming languages, and in practice implementations of ladder logic have characteristics — such as sequential execution and support for control flow features — that make the analogy to hardware somewhat imprecise.)

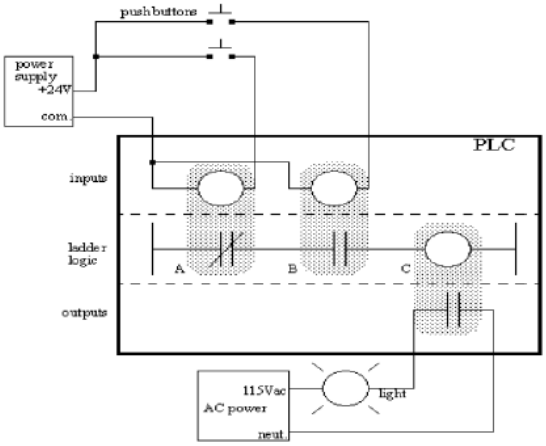

Figure 8: PLC Illustrated With Relays

In the proposed system PLC program using Ladder Diagram is developed in XC pro to analyze the result analytically & in XC series programming tool to analyze practically.

INPUT	TITLE
X0	Ground floor push button
X1	First floor push button
X2	Second floor push button
X3	Third floor push button
X4	Ground floor limit switch
X5	First floor limit switch
X6	Second floor limit switch
X7	Third floor limit switch
X10	Sensor
X11	Forward test
X12	Reverse test
X13	Toggle switch Automatic/manual mode

Table 1: Input Addressing

Output	Title
Y0	Ground floor indicator
Y1	First floor indicator
Y2	Second floor indicator
Y3	Third floor indicator
Y4	Buzzer
Y10	Forward motoring
Y11	Forward motoring
Y12	Reverse motoring
Y13	Reverse motoring

Table 2: Output Addressing

VIII. LADDER PROGRAMMING SIMULATION

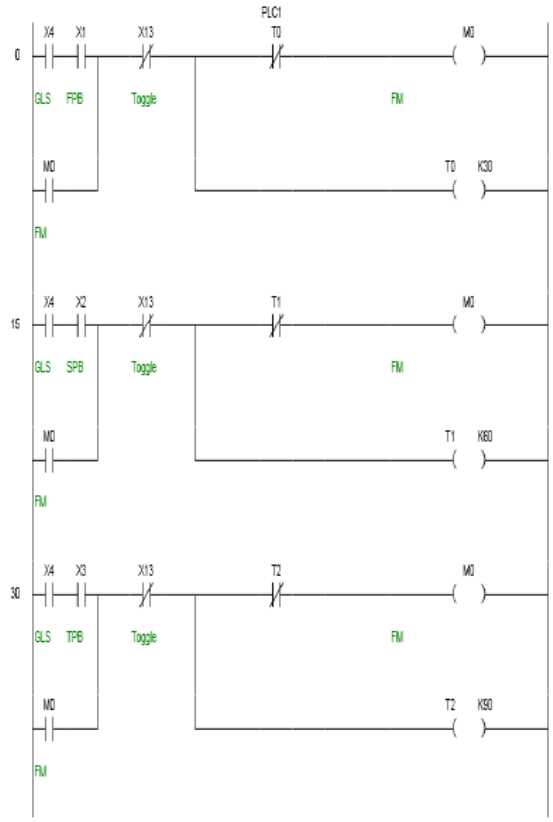

Figure 9: Ladder Programming

IX. CONCLUSION

Following execution of the beyond, a number of conclusions are made as follows: PLC can simply manage the performance of the elevator. It is experiential that PLC dependent elevator works superior than all further control system. It do not offer the sufficient power to generate the torque in the motor so we need to provide the internal power and we have to use relays / contactors to supply the controlling through PLC and power through outside source[10]. It can be simply programmed and program can be altered online i.e. in process we can modify program according to our necessity. SCADA is providing the best supervision of the functioning of elevator and also provide the supervision of the internal module. It also provides the close supervision on the inconsistent changes in the elevator method and, provides alarm as well as comments so that fault can be alarmed and suitable solution comments provided on the alarm. In addition to that CCTV camera, Fire alarm system and additional safety equipments can be clubbed together with elevator system & monitored via Building management system emergency stop function can be operated remotely through control room.

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