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RESEARCH ARTICLE OPEN ACCESS

Control the Stability and Steady State When the Elevator Reached the Requested Level
(PLC (LOGO) Control for4-level elevator system)

Abstract
This paper presenta project on design and implementation of a PLC-based controller for a 4-level elevator Feedback system. The PLC used is a Siemens with 24 inputs and 16 outputs. The design incorporates an intelligent controller that solving the stability and balance, based on algorithm and PID software solution. Some farthersuggestions on how to extend the program for control the system are offered.
Keywords: Elevator control; PLC control; Siemens LOGO; Feedback elevator system.

I. Introduction

Many industrialproducts and systems including elevator systemsare nowadays controlledby (PLCs) programmable logic controllers.Due to PLCs reliability and efficiency the industriesare reliance on implementing these PLCs in their systems. This paperdiscusseda design and implementation forfour-level elevator system controlled by a small PLC.

The PLC may be considered as a special-purpose computer with a basic architecturesimilar to that of any other known computer such as a central processing unit(CPU). It is based on a memory and a number of input and output terminals. Theladder diagram is one choice of special programming language softwaremethodsthat could be used for a running the PLC system. The ladder diagram is an easy software programming language since it is based on Boolean logic functions. This makes the task of modifying any systemmuch easier and more cost-effective.

The size of the PLC is one of the factors that should be consideredwhen it is selected to control a process or a machine. PLCs come in a variety of sizes anddifferent capabilities; the sizes range from small controllers with limited inputs andoutputs used for controlling small processes, to very large ones with more inputsand outputs provided which are used to control much larger processes and operations.The required number of inputs and outputs could identify based on analysing the process or operation to be controlled.The PLC has many advantages over other control systems. It is known for its flexibility,lower cost, operational speed, reliability, ease of programming, security, andit is easy in implementing changes and correcting errors (Warnock,1988;Webb,19898) .

Elevator control systems are one of the PLCs applications. A simulation of such control was successfullytested in a diploma-project control course in the Electrical Power Departmentat Kuwait High Institute of Power, where anSiemens…..-input and ….-outputLOGO PLC was used. This paper presentsboth the hardware and software aspects of the successful design and operationof this PLC-based controller.

II. Objectives of the project

The objective of the project is to design and implementa 4-level elevatorsystem control by a Siemens LOGO (PLC) Programmable Logic Controller and to solve the problem of the stability and the steady state when the elevator reached the needed level. The design waslimited to 4-levels due to the design of the system provided by the Feedback elevator; more details on this will begiven in the section ‘Software design’.Some suggestions are given later as to how to expand the elevatorsystem to more than oneelevator.

III. Hardware design

The Elevator is dispatched from the factory with the counter balance weight for the car, at the rear panel an IEC mains input connector is provided that will require a suitable power lead for the available supply outlet. Using the LOGO-PLC Siemens with modules (……) with Feedback 34-150 Elevator see Figure 1.1 included an advanced application.

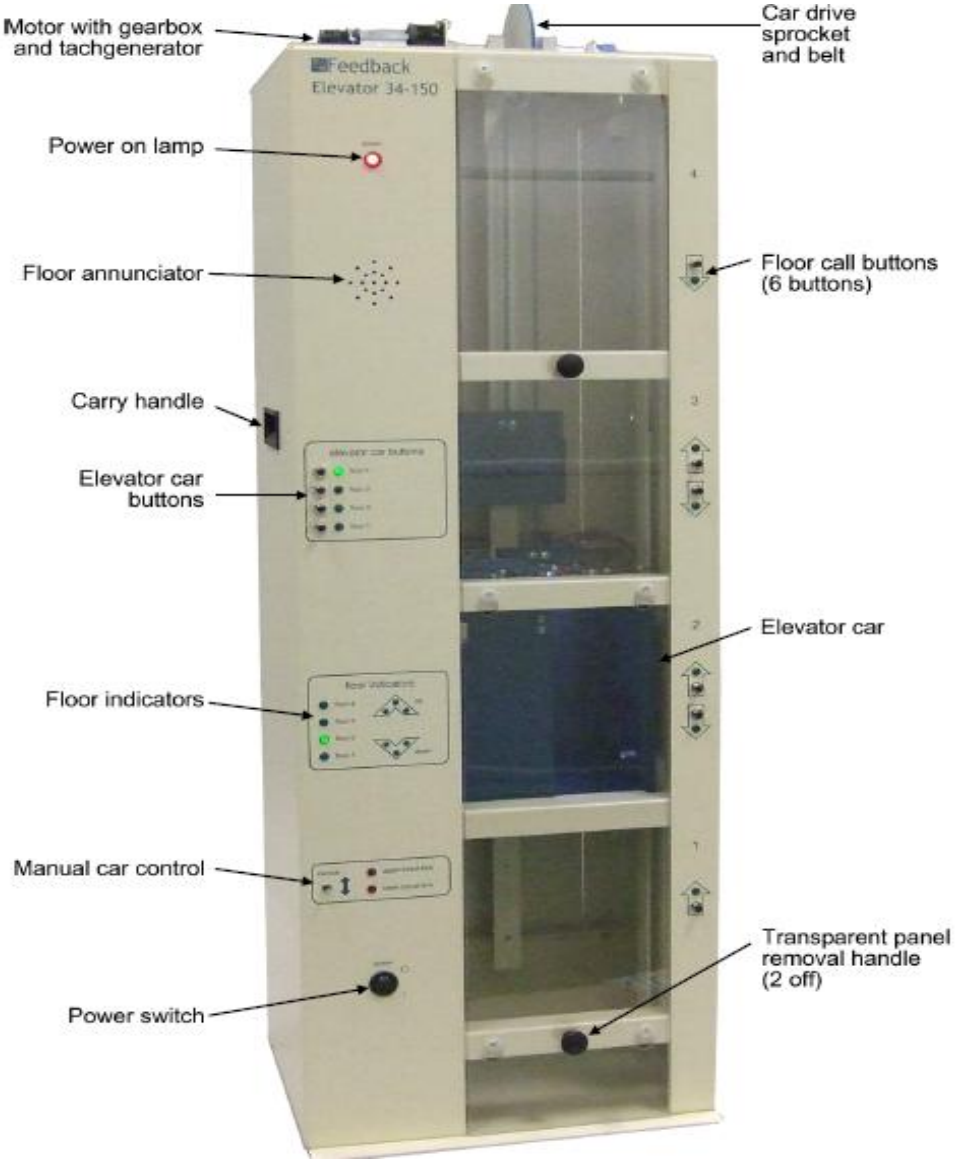


Figure 1.1: Feedback 34-150 Elevator

The system possible to use PLCs from other manufacturers that have the minimum digital I/O as listed in this report.The required process need to be converted using the ladder diagrams or other PLC languages to run on those alternative units. The 16 dc PLC inputs should be of the current sink type and 16 outputs dc source transistor or Relay type.The elevator is connected to the external PLC controller via a set of connectors located on the rear panel, see Figure 1.2.

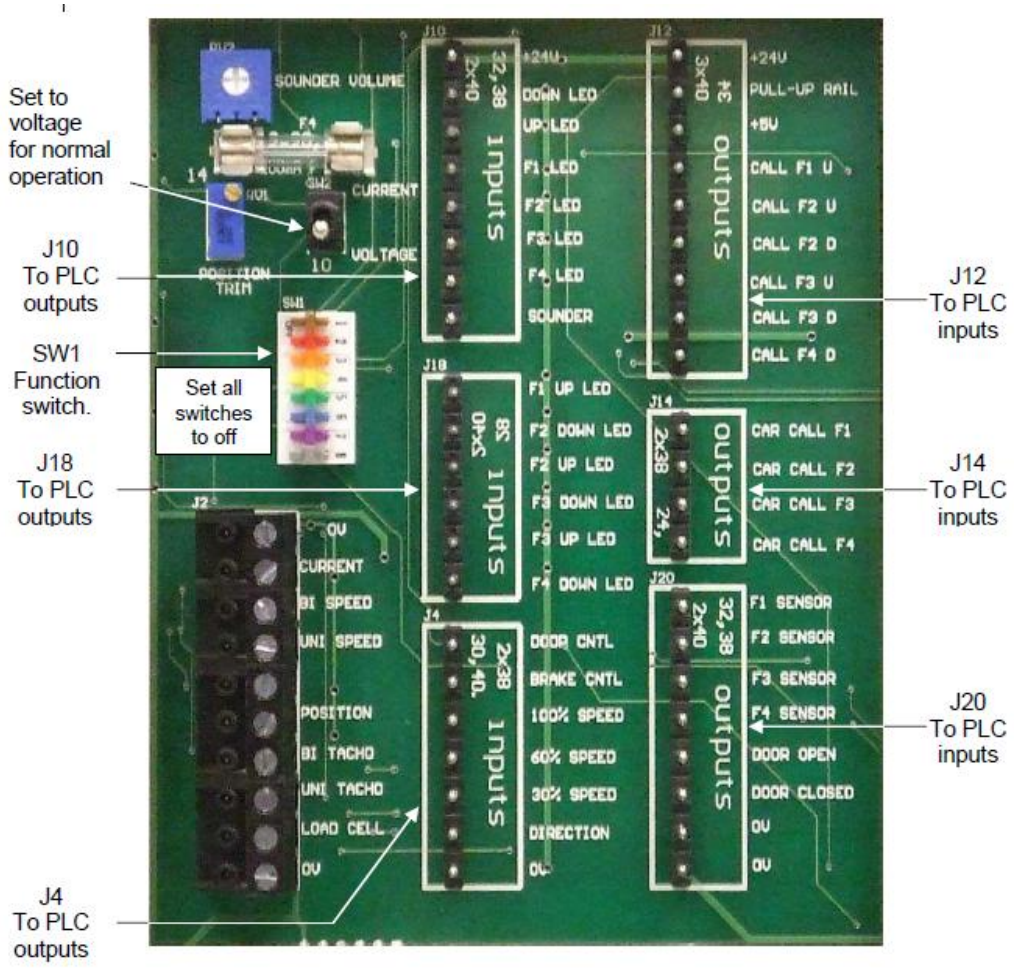
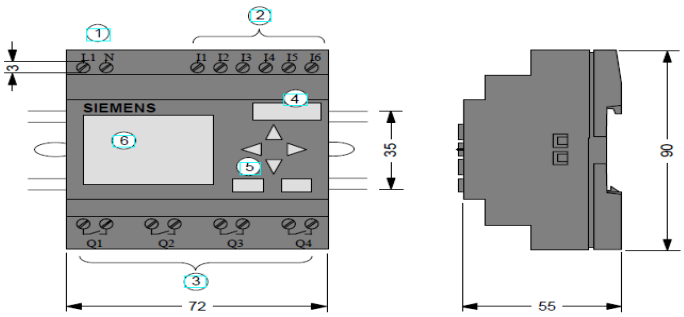


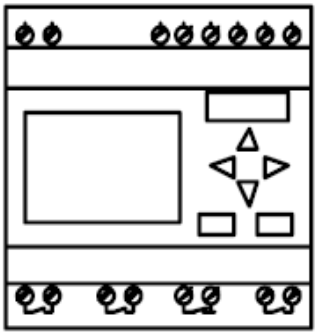
Figure 1.2: set of connectors located on the rear panel

IV. Description of the interface circuit

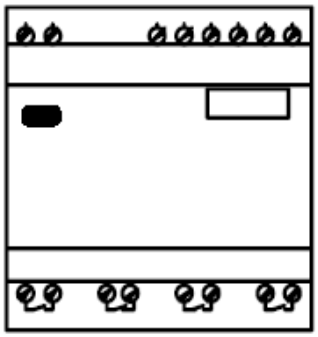
The Elevator outputs will interface directly with Siemens LOGO-PLC 24v dc current sink input modules. Model …… see Figure 1.3, is required in this case.



1Power supply
2Inputs
3 Outputs
4 Module shaft withcover
5 Control panel (not with RCo)
6 LCD (not with RCo)
7 ASinterfaceconnection (only with LB11)



Standard variant with 6 inputs and 4 outputs with dimensions of 72 x 90 x 55 mm



Variant without display with 6 inputs and 4 outputs with dimensions of 72 x 90 x 55 mm
Figure 1.3: Siemens PLC-LOGO! Standard variant

The PLC terminals labeled COM or DC COM should be connected together and connected to the elevator 0 V. The elevator outputs need a pull-up voltage wich is supplied by the elevator 24 V dc supply output from connector J12 on block P1.The elevator inputs will interface directly with Siemens LOGO-PLC 24 V dc sourcing output modules e.g. ……The terminals labeled COM or DC COM should be connected together and connected to the elevator 0 V. The terminals labeled VDC should be connected to the elevator 24 V dc supply. The connections in Table 1.1 given in the elevator to power PLC switched outputs.

Table 1.1: Siemens LOGO-PLC connection table shown in Table 1.1

PLC I/O Point	LOGO Connector	Function	Detail
	J12 PLC I/P		
	P1[3]	Power rail	+24 V rail output
	P2[3]	Output Pull-up	Output common pull-up point
IN 0.3	P4	Floor call pushbuttons	Floor 1 call pushbutton-UP
IN 0.4	P5		Floor 2 call pushbutton- UP
IN 0.5	P6		Floor 2 call pushbutton- DOWN

IN 0.6	JP7		Floor 3 call pushbutton- UP
IN 1.1	JP8		Floor 3 call pushbutton- DOWN
IN 1.2	P9		Floor 4 call pushbutton-DOWN
	J14 PLC I/P		
IN 1.3	P1	Pushbuttons "inside" car (mounted on panel LHS)	Car panal-select Floor 1 pushbutton
IN 1.4	P2		Car panal-select Floor 2 pushbutton
IN 2.1	P3		Car panal-select Floor 3 pushbutton
IN 2.2	P4		Car panal-select Floor 4 pushbutton
	J20 PLC I/P		
IN 2.3	P1	Floor location sensors	Car at Floor 1 sensor
IN 2.4	P2		Car at Floor 2 sensor
IN 3.1	P3		Car at Floor 3 sensor
IN 3.2	P4		Car at Floor 4 sensor
IN 3.4	P5	Door open switch	Car door open
IN	P6	Door closed switch	Car door closed
DC COM	P7	Power rail	0 V
	J4 TO PLC O/P		
OUT 0.1	P1	Door control	Open/close car door
OUT 0.2	P2	Brake control	Release car brake
	J10 TO PLC O/P		
OUT 0.3	P3	Car going up	Front panel "going up" arrow

OUT 0.4	P2	Car going down	Front panel "going down" arrow
	J18 TO PLC O/P		
OUT 1.1	P6	Elevator "on its way" indicators	Illuminate Floor 4 down indicator LED
OUT 1.2	P5[1]		Illuminate Floor 3 down indicator LED
OUT 1.3	P4[1]		Illuminate Floor 2 down indicator LED
OUT 1.4	P3[2]		Illuminate Floor 1 down indicator LED
OUT 2.1	P2[2]		Illuminate Floor 4 down indicator LED
OUT 2.2	P1		Illuminate Floor 4 down indicator LED
	J10 TO PLC O/P		
OUT 2.3	P7	Elevator destination	Illuminate Floor 4 down indicator LED in car
OUT 2.4	P6		Illuminate Floor 3 down indicator LED in car
OUT 3.1	P5		Illuminate Floor 2 down indicator LED in car
OUT 3.2	P4		Illuminate Floor 1 down indicator LED in car
	J4 TO PLC O/P		
OUT 3.3	P4	Logic motor control	Motor 60% speed demand
OUT 3.4	P5		Motor 30% speed demand
OUT 3.1	P6		Motor direction up/down
OUT 3.2	P7	Power rail	0 V
	J10 TO PLC O/P		
OUT 3.3	P8	Sounder	Bell announce arrival of car at floor
OUT 3.4	P1	Power rail	+24V rail output

Notes:
$P3^1$,$P4^2$ etc. refers to 1,2 etc.
1. Link together to common Floor 3 indicator LEDs.
2.Link together to common Floor 2 indicator LEDs.
3. Link together to connect the elevator output pull-up rail to the +24 V supply terminal on the elevator.

V. Software design

The elevator system may run in different control modes, In order to achieve the complete design, all possible transitions and stages the elevator system has to go through were considered and a complete flowchart was drawn for this.
Description of the operation of the elevator

VI. Expanding the projects

The researcher could starting with progress to more complex control involving the elevator speed control, car direction and floor arrival and departure management. In addition to that achieve more advanced programming sequence involving two or more elevators working in sequence.

VII. Conclusion

In this paper, the successful design and implementation of the smart controlof a 4-level elevator system using only a Siemens PLC-LOGO was discussed. Thedesign includes a program forsolving the steady state/stability for elevator. Some suggestionsas to how to expand the design to handle a larger number of PLCs werealso given. Finally, it is hoped that this work has explain and demonstrated the using of PLC-LOGO, totacklesome industrial control system operations in a smart and clever way.

References

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[2] 4 J. W. Webb, Programmable Logic Controllers: Principles and Applications (Macmillan, New York, 1988).