

The Five Floor Elevator Control System Design Based on S7-300 PLC

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Abstract. This paper describes the situation of China’s elevator industry. And apply technology of programmable logic controller to control system for five floor elevator. This technology not only improves the elevator reliability, maintainability, and flexibility while greatly extending the life of the elevator, shortens the development cycle of the elevator.

This paper in-depth analyzes the working principle of the elevator based on introducing the basic structure of the elevator. It describes advantage and disadvantage of PLC, focusing on analysis of hardware design and software design of the elevator. Studied and proposed the scheme of realization of elevator control system design based on PLC, and finally summarized and discussed the research content of this paper.

1. Main design ideas of the system

1.1 The signal control system

The elevator signal control basically realized by PLC software implementation. The elevator signal control system is shown in FIG 1.

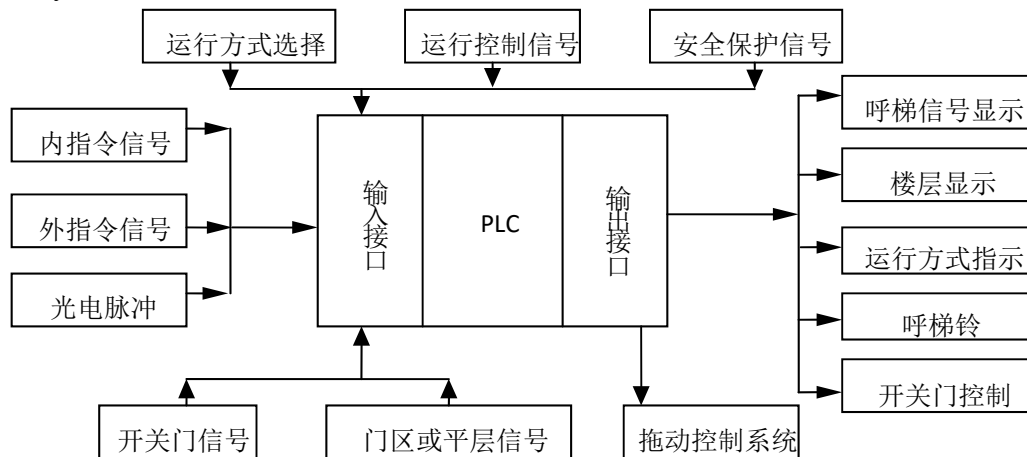


FIG 1. Elevator PLC signal control system block diagram

运行方式选择	Operation mode selection
行控制信号	Operation control signal
安全保护信号	Security protection signal
内指令信号	Internal command signal
外指令信号	External command signal
光电脉冲	Photoelectric pulse
呼梯信号显示	Elevator call signal display
楼层显示	Floor display
运行方式显示	Operation mode display
呼梯铃	Elevator call bell
开关门控制	Door control
拖动控制系统	Electrical towage control system
门区或平层信号	Door and leveling zone signals
开关门信号	door opening & closing signal
输入接口	Input Interface
输出接口	Output Interface

1.2 Deceleration and leveling control

Working characteristics of the elevator is frequent starting and braking, In order to improve the work efficiency and improve the comfort, requiring elevator can smoothly decelerate to zero speed, accurate leveling, namely "no speed parking brake", do not appear crawling phenomenon or low speed brake, namely stop directly. As shown in FIG 2.

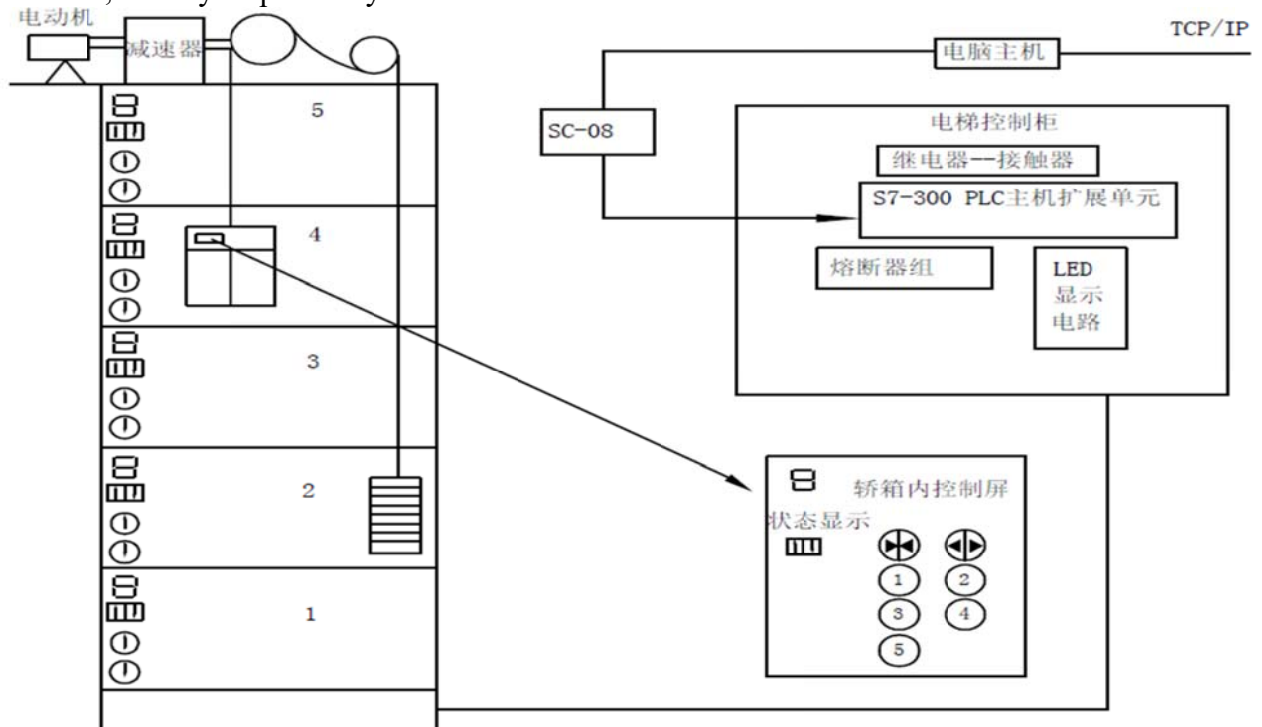


FIG 2. Five Floor Elevator controlled by PLC & Network control schematic

电动机	Motor
减速器	Decelerator
电脑主机	Host computers
电梯控制柜	Elevator control cabinet
S7-300 PLC 主机扩展单元	S7-300 PLC Host Extension Unit
熔断器组	The fuse group
LED 显示电路	LED display circuit
轿厢内控制屏	Car control panel
状态显示	Status display

1.3 For speed change and leveling sensor device

Leveling sensor is generally used magnetic sensors, which is the same structure of permanent magnetic sensor. Permanent magnetic sensor is composed of the spring tube and the permanent magnets. Spring tube is a vacuum tube with contacts, which movable contact 2 is made of a magnetic reed, between contacts 1-2 is equivalent to a set of dynamic break contacts and contacts 2-3 is equivalent to a set of dynamic open contacts. Because of the spring tube mounted beside the permanent magnet, Under the influence of a magnetic field of the reed movement, and dynamic break contacts 1-2 open, then dynamic open contacts 2-3 open. With permanent magnetic sensors for position control of the main electric equipment, not only has the advantage of quick and reliable operation, and there is no mechanical wear defect just like limit switch.

Issued for speed change, floor and leveling signal sensor device are installed on the car, the sensor moves up and down with the car, while magnetic isolation plate fixed in the shaft, each floor of a magnetic isolation plate and those should also be installed in a precise position. When the car reaches the speed change position, speed change magnetic isolation plate inserted in the middle of speed change sensors and makes the motor slowdown. When car reaches parking floor, leveling magnetic isolation plate inserted in the middle of leveling sensors and car bottom is exactly flush with the floor. Floor signal sensor is the same principle.

2. System control requirements analysis

This elevator model is total five floors. Each floor of elevator has indicator light for lifting and car standby floor. 1-5 corresponding indicator light indicates floor number, each of floor hall were input (ascending and descending) button to call the elevator. Through the analysis of the above control requirements, the elevator control needs to achieve the following functions:

- a. Initially, the elevator at any floor.
- b. When there is hall call signals arrival elevator response to the call, and elevator stops at the floor, elevator stops running and door opens, and then closed automatically after three seconds delay.
- c. Where is car call signals arrival elevator response to the call, and elevator stops at the floor, elevator stops running and door opens, and then closed automatically after three seconds delay.
- d. During the elevator in the process of ascending (or descending), any descending in the opposite direction (or ascending) of hall call signal does not respond.
- e. Elevator should have the farthest reverse response function for hall call signals.
- f. The elevator has synthetic interception function
- g. When the elevator is not leveling or running, startup button and shutdown buttons are ineffective.

3. PLC control system I/O points calculation and allocation table

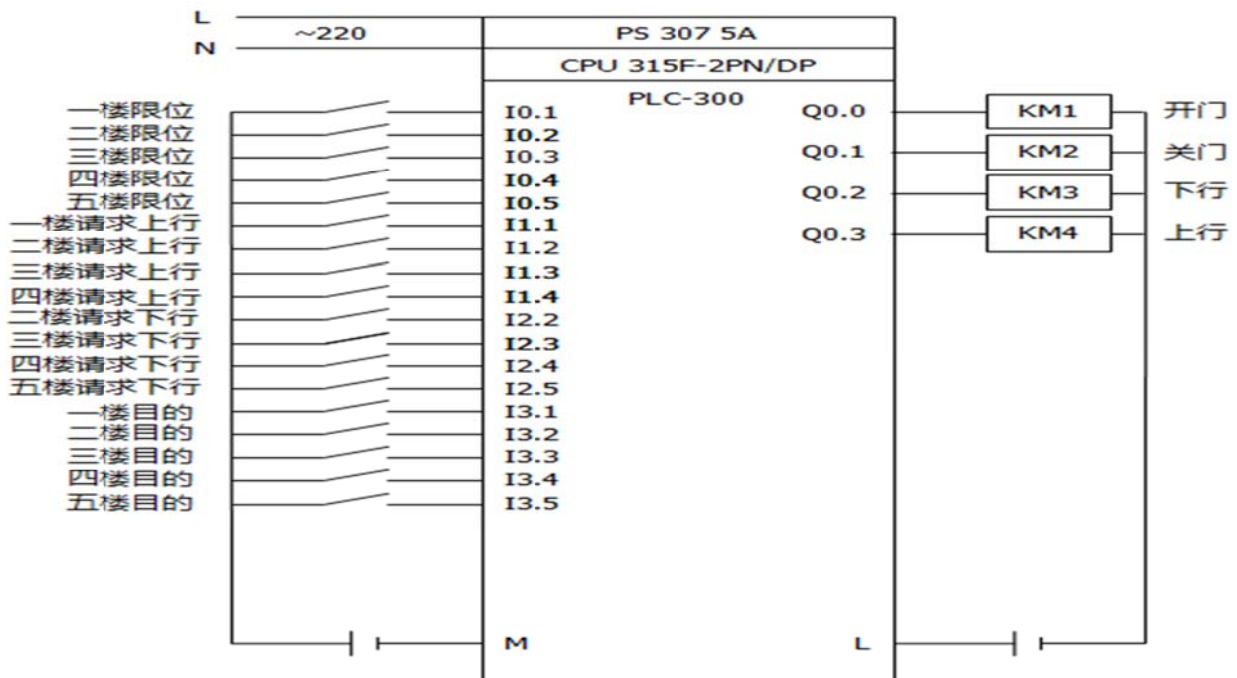
According to the characteristics of the elevator control system, the input signal should include the following components:

- a. Car and hall call button of each floor. There are 1-5 five numeric keys selection buttons in the car.
- b. Position signal. Position signal is generated by five sensors mounted the elevator stop position of each floor.

In summary, it needs a total of 18 input points. According to the characteristics of the elevator control system, the output signal should include the following components:

- a. Motor indication signal: The elevator car ascending & descending signal, traction motor forward and reverse indication signals, a total of 2 signals.
- b. door opening and closing: Door open motor switch indication, totally needs 2 output points.
- c. Floor display: In general elevator floor display is displayed by the digital display tube, and this design is by the IO domain instead of digital display tube to display the floor

To sum up, it's totally need 4 output points. The hardware wiring diagram of this system is shown in FIG (3) as below.

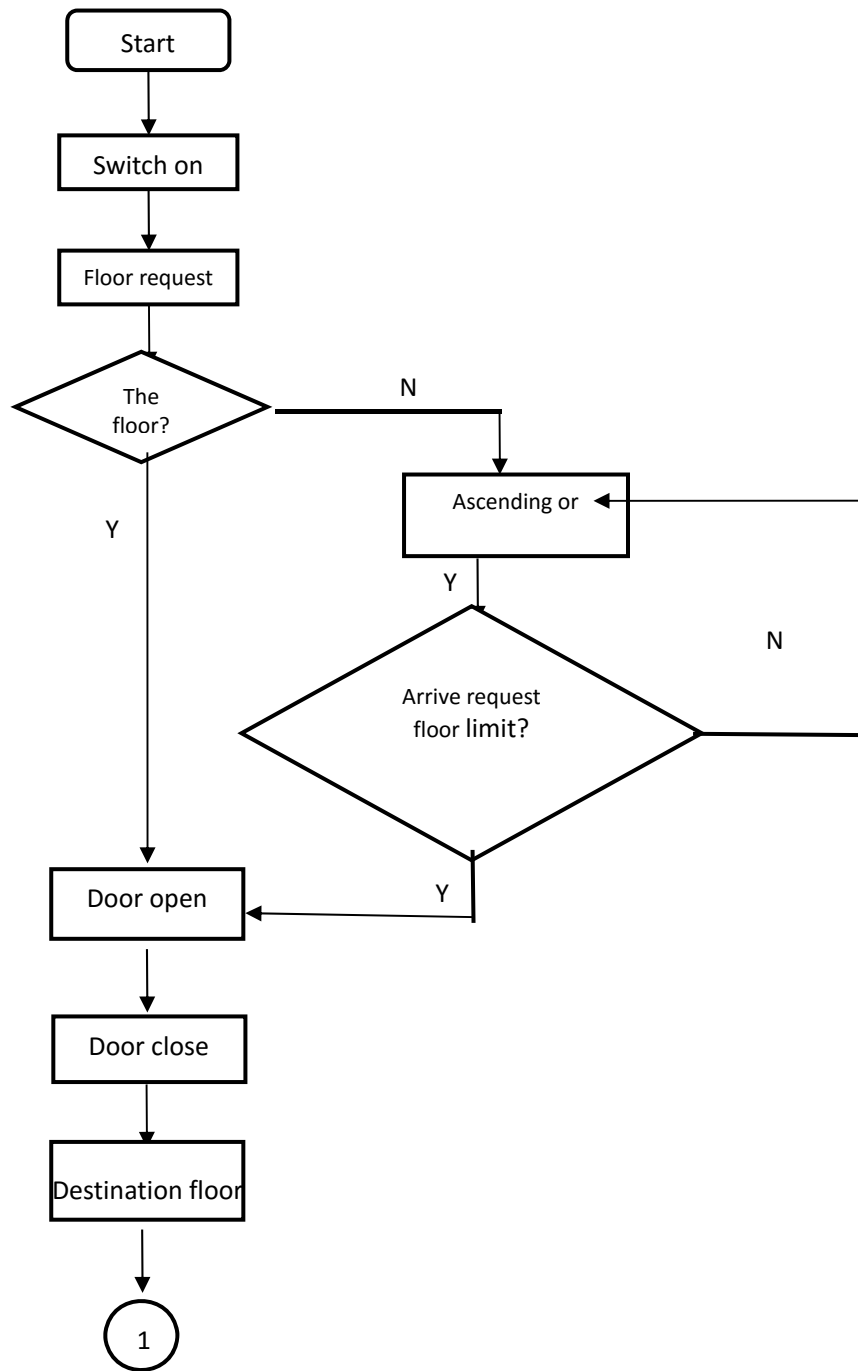


一楼限位	First floor limit
二楼限位	Second floor limit
三楼限位	Third floor limit
四楼限位	Fourth floor limit
五楼县委	Fifth floor limit
一楼请求上行	Ascending request from first floor
二楼请求上行	Ascending request from second floor
三楼请求上行	Ascending request from third floor
四楼请求上行	Ascending request from fourth floor
二楼请求下行	Descending request from second floor
三楼请求下行	Descending request from third floor
四楼请求下行	Descending request from fourth floor
五楼请求下行	Descending request from fifth floor
一楼目的	First floor destination
二楼目的	Second floor destination
三楼目的	Third floor destination
四楼目的	Fourth floor destination
五楼目的	Fifth floor destination
开门	Door open
关门	Door close
上行	Ascending
下行	Descending

FIG (3) PLC external wiring diagram

4. The system software design

The system control by random logic control. That is the elevator control requirements achieved based on the order of basic logic control. Control system design flow chart shown in FIG (4) as below.



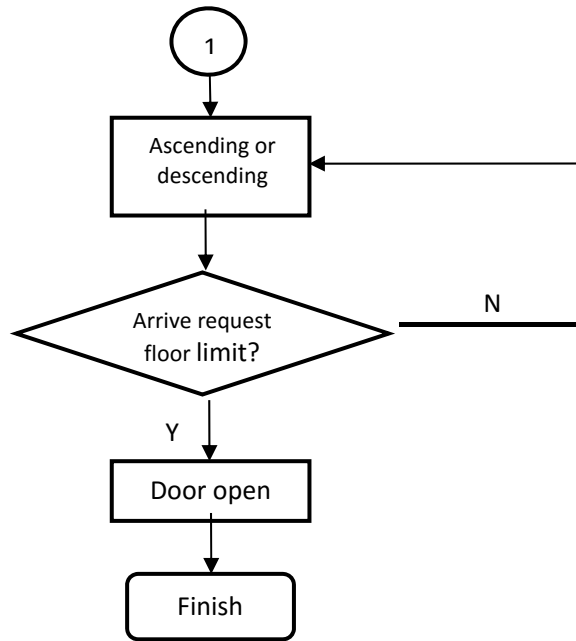


FIG (4) Control system design flow chart

5. The elevator running status

The car door open can be divided into the following situations: a. Elevator on the first floor leveling, there is first floor hall call for ascending indication or car call indication. b. Elevator on the second floor leveling, there is second floor hall call for descending indication (elevator option descending), hall call for ascending indication (elevator option ascending) or car call indication. c. Elevator on the third floor leveling, there is third floor hall call for descending indication (elevator option descending), hall call for ascending indication (elevator option ascending) or car call indication. d. Elevator on the fourth floor leveling, there is fourth floor hall call for descending indication (elevator option descending), hall call for ascending indication (elevator option ascending) or car call indication. e. Elevator on the fifth floor leveling, there is fifth floor hall call for descending indication or car call indication. f. When elevator on the leveling, pressing the door open button.

References

- [1] PLC application technology. Changchu Liao. Chongqing University Press.
- [2] The programming methods and engineering application of PLC. Changchu Liao. Chongqing University Press.
- [3] PLC ladder diagram program design methods and skills. Changchu Liao. Electrotechnics.
- [4] Electrical and PLC application technology. Zeming Deng, Shuifang Deng, etc. China Machine Press.
- [5] Large PLC System Design. Shaowu Zhou, etc. China Electric Power Press.
- [6] The principle and application of PLC. Xuelin Hu. Publishing House Of Electronics Industry.
- [7] The PLC theory and experiment. Wenhao Zhang. National Defence Industry Press.
- [8] Small PLC practical technology. Zhaoyi Wang. China Machine Press.
- [9] The principle and application of PLC. Zhifeng Wang. University Of Electronic Science And Technology Press.
- [10] li Wu, Yubin Liu Simons S7-300PLC basis and application. China Machine Press.
- [11] Jian Simons S7 PLC—STEP7 Programming Guide [M]. China Machine Press. Beijing (in Chinese)