Design and Research of Elevator Group Control System Based on PLC

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Abstract. This paper is based on the research of elevator group control system based on PLC, aiming at the phenomenon of elevator in the running process of long time elevator phenomenon, on the basis of improving the utilization of elevator, put forward the overall design structure of elevator group control system, through the communication and control between group control and single elevator, to achieve the unified coordination of elevator scheduling. Considering the riding comfort of passengers, the shortest waiting time of passengers is shortest, and the algorithm of elevator group control scheduling system is analyzed according to the time delay algorithm. At the same time, the elevator control system is analyzed in detail, using PLC to achieve the hardware circuit design, complete the elevator control signal processing, through the inverter control motor operation, to achieve the elevator uplink and downlink. In the design of elevator control software, the overload detection and the delay treatment of the switch door are set up to improve the safety of the elevator, so that the elevator can develop in the direction of intelligent.

1. Introduction
At present, there are many types of elevators, including escalators and vertical elevators. Especially, the car lift has become an indispensable important construction equipment in various shopping malls and building groups, which has played a certain role in promoting the improvement of people's life quality and quality of life. With the development of society, in large buildings, a single elevator can not cope with all the passenger flow, so it is necessary to set up several or more elevators, and ensure that multiple elevators can realize the linkage of control system of single elevator.

With the introduction of AC voltage regulation and speed regulation technology, the upgrading technology of domestic elevator mainly adopts microcomputer control and PLC control. The microcomputer processing is simple and reliable. It is mainly used in high-end elevator control system, but its anti-interference ability is relatively weak. Using PLC to control the elevator, combining with frequency conversion speed regulation technology, combining microcomputer control technology with PLC technology, the overall control of elevator group control system is realized, so that the elevator system can better meet the needs of people[1].

2. Design of Elevator Group Control System

2.1. Introduction of Elevator Group Control System
Group control elevator is a elevator with multiple elevators arranged in a centralized way, with a button outside the elevator and centralized scheduling and control according to the prescribed procedures. The elevator group control system is a group of elevators which run independently in a
building. According to the actual function of the building and the densely populated floors, the elevator group is managed and distributed by the microcomputer control system. The most optimal elevator dispatching scheme is realized according to the traffic state algorithm set by the system. In addition to the single elevator control function, the group control elevator should also have the functions of minimum waiting time, calling of a certain floor when the waiting time does not exceed the specified value, calling by the elevator that has received the instruction in the floor, and centralized control of the special floor[2].

In the elevator group control system, when the call information of a certain layer appears, the signal will not be directly transmitted to the central host computer, but through the algorithm analysis of the host computer of the group control system, select the most suitable elevator from the elevator group, and send the command to the host of the elevator to execute the response, improve the operation efficiency of the elevator and save the waiting time of the elevator waiting personnel. For the external call signal of the same floor, the group control software will dispatch according to whether there is an external call signal on a certain floor, so pressing the button of any elevator on the same floor can get the same result.

2.2. Design Scheme of Elevator Group Control System

In the group control elevator system, we should try our best to keep the independence of the added elevator system in the control logic and isolate the electrical signal from the original elevator system to avoid mutual interference and ensure the reliability of the elevator operation. The elevator system does not deal with any internal processing, only the interception of external call signal and communication equipment are installed to realize the two-way communication between each elevator and the group control host.

Group control system consists of group control host system, communication system and signal acquisition system and electrical control system. The group-controlled elevator common hall calls out the button, and the group-controlled host system centrally dispatches and controls the response of the elevator. On the basis of single elevator, it mainly adds network communication function and software program algorithm. For different elevator models, the interface layer receives the signals from different elevators, encodes them and sends them in the same information format, then the group control terminal will receive the same format of signals, so as to realize the control of different elevators. The Structure Block Diagram of Elevator Group control system is shown in Fig. 1

The elevator group control host is the core part of the whole control system. It is mainly responsible for the coordination and control of the whole system as well as the optimization of scheduling. Through the single elevator system, it completes the collection of various elevator signals and sends them to the main control system for analysis and generation of scheduling commands. Then the commands are sent to the corresponding elevator control system for elevator execution response. The monitoring host and the command system of the group control system jointly realize the monitoring of the status of each elevator system in the elevator group, so as to timely discover the hidden dangers of the system and eliminate the faults [3-4].

The communication of the group control system mainly refers to the communication between the external call control board and the group control host.
Group control system

Figure 1. Structure Block Diagram of Elevator Group control system

The signal acquisition circuit mainly includes three parts: the photoelectric encoder is installed on the top of the car and coaxial with the traction wheel of the elevator to ensure the positioning control of the elevator for the floor; the weighing sensor is used to detect the weight of the car to prevent the phenomenon of overweight; the light curtain sensor, installed on the car door, is used to prevent the occurrence of door closing and clamping accidents, and the three sensors will detect After AD conversion, the signal is sent to PLC for processing, so that the elevator can respond in time[5].

In addition, the signal processing part of the elevator mainly refers to the external call signal and internal call signal processing of the elevator. Each elevator collects the internal call and external call information in real time, and sends these data to the external call control board. The external call control board directly communicates with the group control host, and the host carries out corresponding processing.

The external call panel and external call control board are added on the basis of the original elevator system to collect the collected data of each elevator, send the data to the group control host for processing, and send the processing results to the external call board of each elevator. The external call control board is a data processing board controlled by an independent CPU. After the external call board of the elevator collects the signal, and after the external call control board sends the processing results of the host computer, the key signal of the external call board really plays a role. When the group control system fails, the external call control board only plays the role of signal transmission, and no longer receives the dispatching signal from the group control host.

The internal call control board and the state control board are respectively responsible for collecting the internal call signal and real-time operation status information of the elevator. After receiving the command from the group control host, the elevator signal is sent to the bus. They only collect the signal and do not receive the control of the host.

3. Hardware Design of Control System

The group control elevator system is realized by adding an external call control panel to each independent elevator to realize the unified dispatching of external call signals to the group control host system for unified dispatching. The optimal waiting algorithm is used to realize the shortest waiting time of passengers or other control systems. However, the functions and control methods of any independent elevator control system are basically the same. For the elevator operation control system realized by combining PLC and frequency converter, the hardware system control structure is shown in Fig. 2.
The whole hardware control system is mainly composed of PLC host, motor, frequency converter and corresponding signal acquisition circuit and display device. The signal acquisition circuit uses the corresponding sensors to monitor the real-time environmental parameters and working conditions of the elevator, such as the load-bearing and leveling signals of the elevator, and transmits the data to the PLC host for information analysis and processing through the necessary conversion. Through the analysis and calculation of elevator operation data, reasonable control instructions are sent to the elevator in time to ensure the normal and stable operation of the elevator.

Use the motor to realize the traction of the elevator car, realize the elevator up and down, use the elevator frequency division PG card to connect the motor encoder, and realize the determination of the speed and position of the feedback motor. The inverter is used to improve the current impact of the elevator at the moment of start and stop, which makes the elevator system run more smoothly, and also improves the economic benefits of the elevator operation. As the core processing equipment of the elevator control system, PLC sends the external detection signal to PLC through the input interface, carries out calculation and processing according to the program stored in the PLC, and then sends out the display signal and control signal through the output interface[8-9].

4. Software Design of Group Control System
The core part of group control elevator control system is the design of system software program. The software program design mainly includes two parts, one is the software design of host control system, the other is the design of single elevator operation program. The software program of host control system shall complete the elevator dispatching algorithm of group control elevator[8-9], analyze the received external call signal of elevator, and realize the shortest average waiting time of passengers by delay dispatching selection algorithm. The flow chart of software program design is shown in Fig. 3.
Figure 3. Software design flow chart of host control system
For a single elevator control program flow chart is shown in Figure 4.

Figure 4. Flow chart of operation software design for single elevator control system
In the process of elevator operation, the elevator in the group control system is controlled by the group control signal, and it also has its own control system to control the running state of the elevator. Including up, down, parking, alarm and the control of each indicator light. For the purpose of
intelligent optimization of the elevator operation, the state parameters in the elevator operation process are detected, and the elevator operation is adjusted in real time [10-12].

5. Conclusion
Based on the analysis of the elevator group control system, this paper puts forward the design structure diagram of the group control system, and makes a detailed analysis of the overall design of the group control system and the communication between the elevator calling signals in the group control system. In order to realize the centralized control and coordinated distribution of elevators, improve the utilization ratio of elevators, and ensure the comfort of passengers, a delay optimal dispatching algorithm is proposed to minimize the average waiting time of passengers. In addition, for the group control system, through the group control software program and the data communication between the elevator and the group control host, the group control host can obtain the running state parameters of each single elevator in time, so as to carry out unified scheduling of the elevator, and make the elevator design develop towards a more intelligent direction.

Based on the research of group control elevator system, the detection and signal processing of elevator control signal are deeply studied. In the following design and research of elevator control system, considering the advantages of FPGA technology in digital signal processing, FPGA is applied to the elevator control system To reduce the structure of the hardware circuit.

6. References
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