

The research and application of communication board in Beijing Subway

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Abstract: It's a common problem to reform the old device in many projects, and this paper introduces a case that rebuilds the signal convert board for lift in Beijing metro. Under the problem caused by the lack of documents, the new solution imported according to the analysis of the old device. This project solved the trouble that the lift can't be integrated into the BAS of metro, even more, provided a reference for reform of old device in other fields.

1. Introduction

Elevators are the most closely related to the public life of the special equipment, occupying more than half of the special equipment share, the safety of the elevator is directly related to the safety of each person's life, and each time the elevator safety accident also can cause the huge negative effect in the society. Beijing Metro Line 4, a retrograde accident occurred in the accident led to 1 death and 30 injured July 5th in 2011, message came, shocked the whole country. On the elevator safety issues from the perspective of the community and the media also entered.

Different places with other applications of the elevator, the use of various types of elevators in the subway more frequently, the load is greater, the maintenance time is shorter, especially in the morning and evening rush hour. The crowd gave a higher challenge and stable operation of the elevator. For Beijing Metro Line 1, the challenge is not just people from day to day, more from the growing old equipment brings hidden trouble. From 2006, the Beijing Metro Line began to have a hidden transformation project, today, BAS, FAS and other systems have been completed, but how to realize the control of the new system to take over the old elevator and other equipment is a major contradiction of the reform personnel.

In the new control system, the bus type is used to realize the communication of each device, for example, through the Modbus to monitor air conditioning unit, but in old equipment, generally rely on traditional switch signal transmission information, and the signal type is not the mainstream, this is one of the contradictions; on the other hand, due to the lack of appropriate equipment support, most of the elevator control is the manufacturer's own development, there is no uniform standard, no way to maintain the replacement of spare parts, this is the contradiction of the two, is also due to the lack of standardization and the prevailing market limitations, many of the old elevator control panels are not formed on the scale of the product, many of the technical details have been lost, this is the contradiction of the three. It is in this context, how to find an available scheme to re-access the old elevator to the new control system, refer to the agenda of the renovation project.

In this paper, the phase of the Beijing Metro Line 2 of the control interface this paper introduces the process of analysis and implementation, of the direct control of the project, for other projects in the old equipment and new control system of a certain reference role.

2. Functional analysis of old signal processing board

In the existing control strategy, the operation control of the vertical ladder is in charge of the main control board, the current state of operation is provided to the control of the digital signal by a processing plate. The new BAS cannot do any changes after the use of the input, direct reception of the dry contact signal provided by the straight ladder signal processing board, after the completion

of the program in their own interlocking, or display the current running state of the straight ladder in the picture, specific processes are shown below:

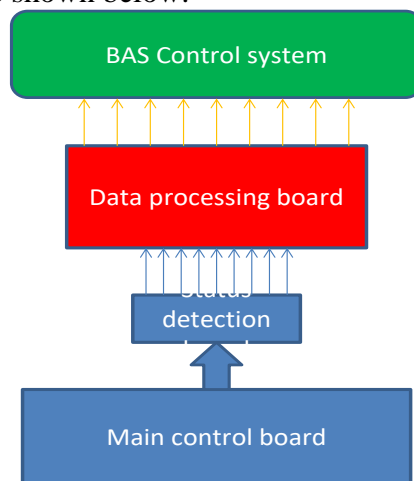


Figure 1 Existing control and state data processing scheme

The status detecting board of the straight ladder is obtained from the main control board, and provide a data processing board. The data processing board is an interface board, can be state signal processing output of several dry contact, to control the upper control system.

But the current line of direct ladder, most of the signal processing board has been damaged, and the time is long, manufacturers have no way to provide spare parts, this means that the current can be normal work of the board once the error, the straight ladder was cut off from the whole BAS, middle control and operation center cannot read the state of the straight ladder, after an error, it can be triggered by the interlocking protection in BAS.

This, the function of the old data processing board is analyzed, and replace with new interface device, become a top priority.

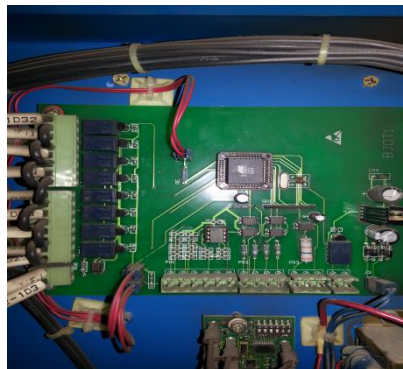


Figure 2 Old straight lift signal processing board

As shown above, 9 state signals from the control board are connected to a pin type slot at the bottom of the processing board, after logical processing, output from the left side of the terminal to 9 dry contacts.

To analyze the function of the processing board, there are two aspects of the problem:

- How to enter the 9 original signal of the processing board?
- How to deal with the process in the processing board?

To detect 9 original signals, simply use the oscilloscope to read directly. Test results show, these 9 original signals have a normal level signal, there is also a pulse signal frequency of about 2HZ, but no matter what kind of signal, the high level of the amplitude is “-38V”, low level of the amplitude in the “-15V” or so, without any signal, voltage around 0V. This is quite different from the standard 24V signal.

And to detect the control logic of the processing board, can only use the experimental method. Data processing board to receive the signal from the control board of the straight ladder, after processing the output of 9 state signals in the form of dry contact, and these 9 state signals are

known, such as emergency stop 、 up、 down, etc. The process of the experiment is to make the straight ladder in a certain state, signal combination for recording data processing board, the following state corresponding table is formed:

Table 1 Signal processing board status signal corresponding table

| | | Input signal of the state of the input | | | | | | | | |
|---------------------------|--------------------|--|-------|-----|-----|---|-----|-------|-------|-------|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Output dry contact signal | Normal stop | Light | Light | | | | Out | Flash | Flash | Flash |
| | Lift up | | | Out | | | Out | Light | Flash | Flash |
| | Elevator down | | | | Out | | Out | Light | Flash | Flash |
| | Safe return signal | | Out | | Out | | Out | | | Flash |
| | Trouble parking | | Out | | | | Out | | Flash | Flash |
| | Platform | | | | | | Out | Flash | | |
| | The station hall | | | | | | Out | Flash | | |
| | Emergency stop | Out | | | | | Out | | | |
| | Exit (First layer) | | | | | | Out | Flash | Flash | Flash |

On the table, “Light” indicates that the signal is “-38V” in the reverse high state, “Out” means that the signal is in the “-15V” around the reverse low state, “Flash” indicates that the signal is at the level of 2Hz and the level of the switch is switched on.

signal processing board of the state signal “translation” mechanism through a period of time to run the process of the test radio, to prove that the relationship is clear and correct. At this point, analysis of the working mechanism of the old board, but meanwhile, these analysis results also give a new challenge to the reconstruction project:

- How to deal with the non standard signal of “-38V”?
- How to deal with the use of state translation?

This is also a new data conversion program to focus on the answer to the question.

3. Functional design of new data conversion link

According to the owner's requirements, the new direct ladder state data conversion equipment should meet the requirements of easy maintenance, can be upgraded, full-featured. The state signal of the straight ladder is connected to the BAS system, the existing interface is dry contact, the new conversion device is also supposed to provide a dry contact state signal, to avoid causing the BAS side of the program to modify; because the new conversion device will be used in the entire subway line, so from the point of view of maintenance convenient, products that need to be formed, in order to facilitate the reserve of spare parts; in addition, regardless of whether the old conversion board function analysis is correct or not, this “black box” type of analysis may be a potential risk, this, the new conversion device should be able to upgrade to complete its data conversion algorithm.

The general switch signal acquisition module only supports the following voltage signal received by 30V, for “-38V” the non-standard signal is not readily available in the acquisition module. For this can only and related products manufactures to communicate, common development of new acquisition module. These acquisition modules should have the following characteristics:

- Standard products based on existing standards;
- The internal signal processing chip changes as small as possible to reduce the overall cost;
- Specific modifications to the program to share, in order to solve the problem of production of spare parts in the future;
- Allows the high voltage to reach the minimum 40V, while the isolation voltage of each channel to exceed 5000VDC;

- Signal acquisition board to support Mod bus communications, in order to prepare for the subsequent communication between devices.

In accordance with these requirements ,and product manufactures to develop a special signal to support the acquisition of a special signal module, these modules have been tested in detail, fully able to meet the high speed signal acquisition capability.

For the old process board in the state of the “translation ”function, formulated the following plan:

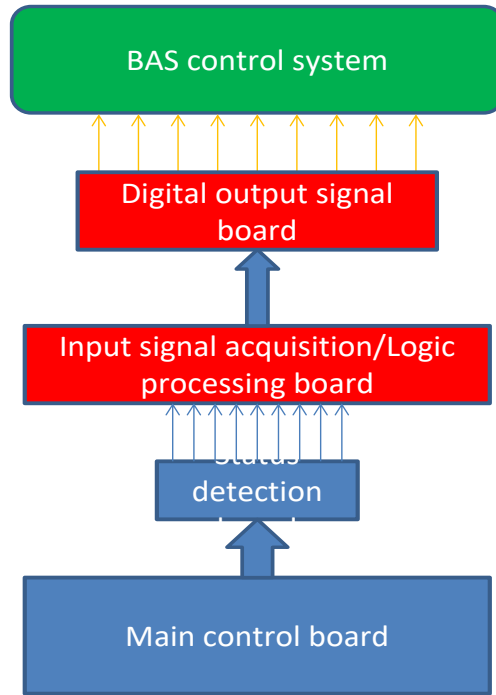


Figure 3 Plan one

In the above scheme, in the signal acquisition module, while is developed by the manufacturer and the signal acquisition module, a programmable chip is added, the corresponding relationship shown in Table 1, write to the chip in a logical way. Late if there is a need to update, then brush the chip, this will give debugging and future maintenance in convenience, therefore, on the basis of this, second schemes are put forward:

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IF IN02 = 0 AND IN_T = 0 THEN
Data03 = 1
ELSE
Data03 = 0
ENDIF

IF IN03 = 0 AND IN_T = 0 THEN
Data04 = 1
ELSE
Data04 = 0
ENDIF

IF IN03 = 0 AND IN01 = 0 AND IN_T = 0 THEN

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Figure 4 Plan Two

In the second program, output and output signal board is not integrated logic processing chip, instead of using an independent device to run the logic program, it can also be the result of the logical operation is presented in the panel.

Compare with the two schemes, the advantages of the scheme is to save the cost equipment, but the advantages are also obvious, that is, the preparation of the logic program and the late update is not convenient; while the program two due to the use of a special, with control functions of the device, so the configuration of the logical relationship is very convenient ,at the same time ,it can also show the results of the operation. After weighing, the KunLun Winton MCGS embedded integrated touch screen TPC as the main control and surveillance equipment, the logical relationship can be easily implemented by the VB statement as shown below:

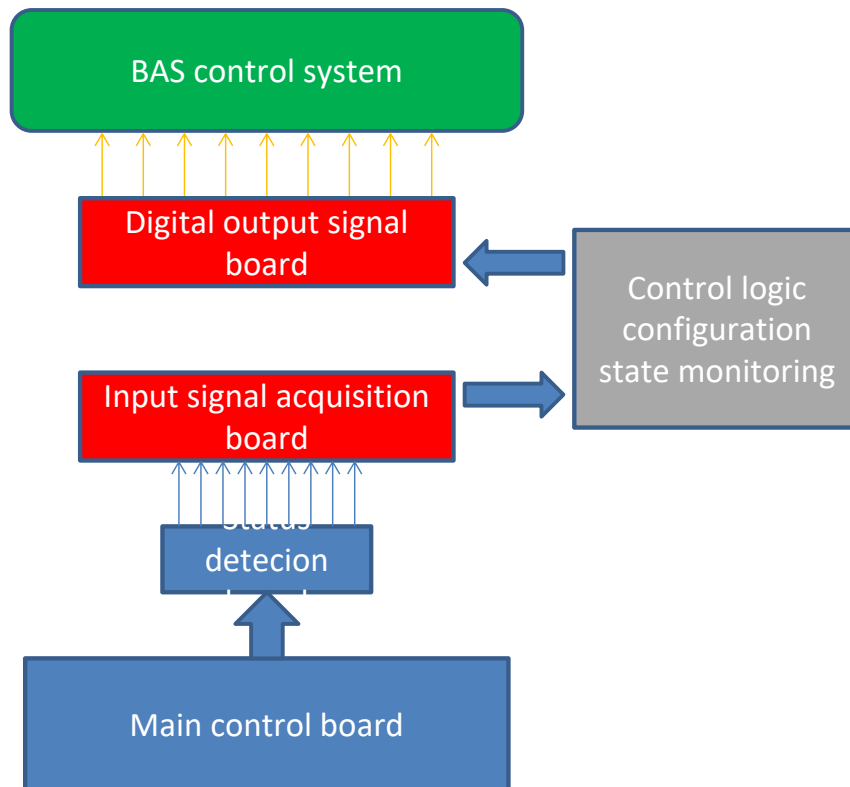


Figure 5 MCGS implementation of the state conversion relationship through VB

After repeated testing, fully realized the relationship between all the States shown in Table 1, at the same time, it also makes the state monitor screen, convenient debugging and late use, related equipment combined case, the control board is connected with the control board:



Figure 6 New signal conversion box in debugging process

Debugging process is progressing smoothly, a direct ladder debugging completed, the signal conversion box can be copied directly, greatly simplify the use of other direct ladder, the state output of the control board is only required to be transferred from the old processing board to the new converter box.

4. Application Summary

The Beijing Metro in the straight ladder signal interface transformation project size is small, but its treatment ideas and solutions for other industries, the transformation of equipment has a very good reference. To meet the current reality needs, also to take into account the future maintenance and upgrading, this is a basic starting point for signal reconstruction project of the straight ladder.

To reproduce a similar signal conversion board is to meet the current needs of a most simple way, but to the future of maintenance adverse. The newly developed signal processing and acquisition card can be used for the acquisition of non standard signal, also provide Mod bus and other communication interface; display with control functions, both to allow the operator to see the state information before and after processing, also to provide the possibility of further functional improvement. A large number of existing mainstream devices, in addition to quality assurance, it can also avoid the future of spare parts procurement.

The transformation project has been successfully completed, signal conversion equipment also continued to work properly, but the “Black box” analysis method for the old signal processing board, is always a kind of emergency response at that time. After all, complete the original signal description file, according to the touch screen in the program that can eliminate the hidden troubles.

Acknowledgements

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