Design of Intelligent Surveillance System for Cable Connector

Hongguang Li*, Xinhua Feng, Deming Wu and Lifeng Liang
Nansha Power Supply bureau of Guangzhou Power Supply Bureau co., Ltd.
Guangzhou, Guangdong Province, 511458, China

*Corresponding author e-mail: Lhg9159@yjbys.com

Abstract. Cable connectors may fail after long-term use, causing serious economic losses. Modern technology has developed rapidly, and research and development of an intelligent surveillance system has been carried out under the background of big data and Internet to monitor each connector of the cable in real time, and make timely adjustments before failures to avoid the occurrence of failures, which is of great significance to modern residents and enterprises. The author analyzes the hardware required for intelligent surveillance of cable connectors, followed by the design of an intelligent surveillance system for cable connectors, and finally summarizes the operation results.

Keywords: Cable Connectors, Intelligent Surveillance, Test System, Software Design, Operation Results

Introduction
The connector of the cable may be overheated, which may gradually cause collapse and cause a large-scale power outage. Such a power outage cannot be restored within a short period of time, which will cause huge economic losses to enterprises and inconvenience to residents. There are relatively many connectors in the cable tunnel. In the case of long-term operation, coupled with the influence of the external environment, cable connectors will collapse due to overheating. In order to better prevent the occurrence of faults, or to do a good job of maintenance in the early stage of collapse, an intelligent surveillance system can be developed in conjunction with modern technology. Real-time monitoring enables workers to have a clearer understanding of cable connectors. Once an overheating situation occurs, the load can be adjusted in time, and preparations for emergency repair plans can be made. Even if a collapse occurs, the repair can be completed faster. The intelligent surveillance can shorten the maintenance time [1-3].

1. Hardware Required for Intelligent Surveillance of Cable Connector
Cable connectors are relatively distributed in various places, and the distance between connectors is relatively long. According to the actual environment, some are distributed around 50 meters, others are distributed at 100 meters or 200 meters, and the farthest is even a few hundred meters. When carrying out intelligent surveillance, we have to consider the actual situation of the distribution distance, and to use advanced communication technology, digital temperature sensing technology and micro-processing technology. The system bus must have two important features. One is low
temperature resistance, and the other is strong electric field resistance. In the system, it is necessary to consider the remote monitoring of the surface condition of cable connector and the temperature of the environment and internal environment. Each intermediate connector surface of the cable should be set with a temperature sensor, and each sensor and system that can display the temperature number in real time should be connected in a unified way, and then be connected with the host computer, so as to form a complete set of data monitoring. As a result, the staff can monitor the fault while observing the system [4-6].

The designed system has a good man-machine interface, and the cable routing channel is suitable. The temperature sensor can transmit the real-time temperature, and can show the actual position where it is, the type of the cable, the length of the cable, and the position of the intermediate connector in detail. Therefore, when the temperature of the intermediate connector exceeds the preset value during work, an alarm will appear, and the staff can obtain the danger information and make the corresponding plan in time, which can effectively avoid the occurrence of accidents. The schematic diagram of the system that can monitor the temperature of the cable connector intelligently is shown in Figure 1. The entire online monitoring system of temperature fault selects a fully digital network mode. After the intelligent temperature controller is connected to the host computer, digital temperature sensors are connected to each other, and the listener can well realize the function of the detection and control system [7-10].

![Schematic diagram of the system that can monitor the temperature of the cable connector intelligently](image)

Figure 1. Schematic diagram of the system that can monitor the temperature of the cable connector intelligently

According to Figure 1, the hardware includes intelligent temperature controller, digital temperature sensor and monitor. The intelligent temperature monitor is mainly used in the cable tunnel to test every cable connector, which can well complete the data collection and fault monitoring, and this equipment can automatically verify, the overall results can be transmitted to the operation platform on the basis of bus transmission, and the operation platform can automatically carry out basic processing according to the data. The whole intelligent temperature controller will be set with four times of CPU structure, which can complete the information exchange and data collection more quickly and efficiently. In addition, it can guarantee its own security, and can have certain self repair ability in the face of failure. The power supply and bus will also choose double isolation measures. When the isolation voltage reaches 10kV, it can achieve a good isolation effect. DC voltage is selected for the power supply with a range of 12-48v, and wide voltage can effectively meet the actual demand. In addition, the cable connector may cause damage to the equipment and the staff may also cause damage on site, so the double isolated floating bus technology will be used in the bus design, which can well avoid the high voltage in the cable from entering into the operating platform, ensure the safety of the equipment and the safety of the staff.
As a kind of temperature sensor and digital series, digital temperature sensor can achieve integration effect well after connecting bus interface. The size of the sensor is small, but its anti-interference ability is very strong. The sensor can operate between -55 °C and 155 °C, even in winter in North China. The measuring speed of the sensor can reach 50 points / second, and the measuring error is 0.3.

The monitor can monitor the external environment. For example, in the tunnel, a monitor is placed at every turning place to enable people to grasp the situation inside the tunnel in time, so that people have a good understanding of other emergencies. The change of external environment will also have a certain impact on the cable connector. The external monitor can help the staff to evaluate the connector from external environment and internal temperature, so that the evaluation is more accurate.

2. Design of Intelligent Surveillance System for Cable Connector

The system of intelligent surveillance of cable connector by temperature in this paper is suitable for Windows 7 operating system. The development software is implemented by VC++. The whole system is designed with asynchronous serial communication technology and related hardware to meet the actual needs of the function. This kind of software system can complete the configuration offline, realize online system monitoring and maintenance, and the human-computer interface is also good. The function diagram of system software of the specific intelligent surveillance of cable connector by temperature is shown in Figure 2.

![Function diagram of system software of intelligent surveillance of cable connector by temperature](image-url)

**Figure 2.** Function diagram of system software of intelligent surveillance of cable connector by temperature

The display screen can realize the dynamic monitoring, the static picture and the dynamic picture can be well displayed, and the real-time animation of the online monitoring of cable operation can also realize the dynamic description, which can accurately display the specific location and temperature of digital sensor. When using it, users can set their windows, browse the corresponding icons, and select the serial number they want to operate according to the form of dialog box. The serial number represents the corresponding parameter, and then the real-time updated status and monitored values are displayed.

The man-machine interface is the interface operated by the staff, which can operate the system well and evaluate whether the whole system is monitored in real time. In addition, the man-machine interface can show operating status of the system, fault alarm screen, switch window screen, historical parameter, data analysis, and data storage, as well as online parameter modification or reports printing.

The function of monitoring occupies an important position in the entire system, which mainly includes the following four functions: (1) The configuration can be modified online. The configuration
including the upper limit setting value can be modified online in time, so that the monitoring conditions can be adjusted according to the external environment. In addition, the online modification of the configuration can also be operated remotely for a certain monitoring point or multiple monitoring points, which can save time and effort. (2) The function of monitoring and controlling system running state. The running system can monitor the real-time operation of digital sensors and networks. The system can take corresponding measures in time to be repaired or adjusted if it shows abnormality. (3) The function of automatically tracking the ambient temperature. The system can track the ambient temperature very well. According to the temperature alarm parameters set automatically, all cable connectors can be detected automatically in a few seconds. (4) Both the early warning temperature and the alarm temperature can realize the function of temperature gradient change and automatic setting. After the cable is energized, it is in a running state, and various temperature changes may occur. The system automatically sets the warning temperature of the cable connector and sets the alarm temperature. That the temperature is increased by 5 °C per minute is considered to be a gradient, which can better monitor the temperature.

According to the actual needs, the GSM voice prompt function, SMS alarm function, and SMS temperature query function are also set in the design of the program. These small programs are built into the entire temperature system after they are completed, and can better meet the actual needs of the staff.

3. Operation Result of Intelligent Surveillance System of Cable Connector

The temperature sensor is a key device in the entire system, so the temperature monitoring range and the accuracy of the sensor are measured before operation. Compared with the thermometer and combined with the measured values of the system, the specific results are shown in table1. After measuring the temperature of the first to ninth sensor, it is found that measurement accuracy of the sensor is high. The measurement range basically meets the actual needs and meets the results of the setting.

| Name         | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
|--------------|----|----|----|----|----|----|----|----|----|
| Thermometer  | -10| 0  | 10 | 20 | 40 | 60 | 80 | 90 | 105|
| Sensor       | -10.3| 0.2| 10.2| 20.2| 40.2| 60.3| 80.2| 90.3| 105.4|
| Error        | 0.3| 0.2| 0.2| 0.2| 0.3| 0.2| 0.3| 0.3| 0.4|

In addition, the sensitivity of GSM short message alarm system needs to be measured. Based on the actual measurement on site, the sixth temperature sensor is set to be more than 60 °C, that is, short message reminder. After the temperature exceeds the alarm set value, the mobile phone can receive the alarm message in time. The message content will show the location and alarm time of the temperature point. Through the operation of mobile phone, the current real-time temperature can be queried in time, and the upper limit of alarm temperature can be modified on the mobile phone in time when the authority is obtained. It meets the expected results of the design.

And then the temperature of cable connector is measured, and the corresponding chart of changing trend is drawn according to the temperature change of cable connector, and the changing trend is drawn according to the temperature test results of the cable operation environment. Comparing the test results of 3 months, it is found that it can meet the actual needs. When testing the upper computer software, the uninterrupted mode are chosen, and the temperature of each point can be well displayed. The change brought by the temperature rising trend can also form the corresponding alarm processing. As a whole, each performance can be within the set range. The linkage test results show that each performance can be well connected, and it has certain anti-interference ability. This design basically meets the requirements of the experiment. Then the system is contacted with the manufacturer to carry out on-site installation and commissioning experiments. On-site technicians and workers cooperate closely, and after that, the entire equipment can be put into use smoothly. The parameters of each
system can also be set permanently after debugging according to the site environment, and there is no failure within 2 years.

4. Conclusion
Combined with modern technology, the design of intelligent surveillance system for cable connector can reduce the economic loss caused by large-scale power failure. The temperature measurement in cable connector can reflect the changes brought by the temperature, as well as the cable operation environment. It can prevent the collapse caused by over temperature and avoid the breakdown caused by aging insulation. Intelligent equipment can also save labor costs, reduce the probability of safety accidents, and prevent the failure of various equipment. From the test to the practical application, the system operate well.

Acknowledgments
The Guangzhou Power supply co., LTD offers technology project that “The analysis and solution problem why cable contact in 10kV voltage of ring main unit Switchgerar’s has temperature rise “a financial support.

References
[1] Gao Lili, Lv Xiaofang, Zhao Hua. Demand Analysis and Design of the Comprehensive Monitoring System for High-voltage Cable Tunnels [J]. Automation Application, 2019 (01): 59-64.
[2] Shen Zhiguang, Zhang Haiting, Zheng Yunzhao, et al. Research and Design of the Intelligent Linkage Scheme of Tunnel Power Cable Monitoring System [J]. Modern Building Electrical, 2019 (9).
[3] Zhu Yiqun, Zheng Yuansheng, Wang Zhen, et al. Development of an Intelligent Control Drainage System for Monitoring the Water Level and Temperature and Humidity of Cable Trenches [J]. China High-tech Zone, 2018, 000 (024): 33.
[4] Xiaochen Report. "Urban Lighting Craftsman" Casts the Most Beautiful City Night Scene: The Fifth Jiangsu Lighting Industry Maintenance Electrical Skills Competition was held in Wuxi [J]. Urban Lighting, 2018, 022 (004): P.10006 -I0007.
[5] Qi Xingyu, Liu Linxu, Lv Zhipeng, et al. Research on a New Online Monitoring System for Partial Discharge of Cables [J], Power Supply and Use, 2020 (1): 51-56.
[6] Wu Gang, Xiang Minjiang, Bei Taizhou, et al. Application Research on the Intelligent Transformation of the Ring Cabinet and Branch Box in the Power System [J]. Shandong Electric Power Technology, 2019 (9).
[7] Xie Ximing. Preliminary Study on the Use of Intelligent Leakage Switch and Its Application in Street Lamp Power Supply System [J]. Urban Lighting, 2018, 022 (001): P.5-8.
[8] Zhong Xiaohua, Tu Shuanguang, Song Wuxing, et al. Design of STM32-based Photovoltaic Intelligent Water Tower Monitoring and Controlling System [J]. Information Weekly, 2018 (15): 0126-0127.
[9] Song Jiawei, Zhang Chengyu, He Sizhuo. Design of Intelligent Traffic Light Control System with Vehicle Flow Detection Function [J]. Computer and Digital Engineering, 2019, 47 (11): 2930-2934.
[10] Yang Liying. Design of Monitoring System for Solar Intelligent Charging Controller Based on Arduino MCU [J]. Computer Measurement and Control, 2019, 027 (008): 99-103.