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Research on Cable Trench Fire Extinguishing Technology based on Multi-feature Intelligent Perception

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Abstract

The cable trench fire has strong concealment, and the damage area is large after the fire occurs, which can easily lead to serious economic losses and casualties. This paper studies from the perspective of multi-feature intelligent sensing system and cable trench fire-extinguishing system. The system conducts real-time monitoring through different fire detectors, including environmental information such as temperature and smoke. After considering various signal information and overall assessment of fire risk, fire alarm information is issued before the fire situation expands. Through strict screening of fire extinguishing systems, it can meet the actual needs of cable trench fire extinguishing. The combination of the two means can prevent the occurrence and expansion of the cable trench fire accident in advance and put out the fire in time when the fire occurs.

Keywords

Multi-feature Intelligent Perception; Cable Trench; Fire Extinguishing System.

1. Introduction

The conventional monitoring method of the cable trench is generally manual inspection by the on-duty personnel, but the manual inspection method is difficult to directly observe the internal situation of the cable trench, and it is difficult to eliminate the fire risk in time. The fire point of the fire in the cable trench is hidden, the scope of influence is large after the fire expands, and the repair and recovery time of the personnel is long in the later period. A cable fire in a cable trench not only damages the cable, but also has a high probability of tripping and powering off important lines. The toxic smoke generated by the fire will also cause serious consequences such as injury to surrounding personnel. The economic losses caused by cable trench fires are serious and have a significant impact on social production and life. Therefore, the research on online monitoring equipment for heating and discharging faults in cable trenches is in urgent need of development.

The multi-feature intelligent perception system is mainly based on the various feature information transmitted by a variety of sensors, and is processed in the central processing unit in an overall manner, so as to make all-round judgments. Applied in the cable trench fire extinguishing system, the temperature sensor and smoke sensor and other sensors are used to comprehensively judge the cable trench condition, issue an early warning and start the fire extinguishing device when a fire occurs.

In this paper, the research is carried out from the perspectives of the multi-feature intelligent sensing system and the cable trench fire extinguishing system.

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2. Multi-feature Intelligent Perception System

2.1. System Structure

The main structure of the multi-feature quantity sensing system for cable trench fire consists of the following parts: monitoring platform, central processing server, temperature detection equipment, smoke detection equipment, and fire-fighting linkage equipment including direct linkage equipment and bus linkage equipment. The specific structure is shown in Figure 1. shown. Based on the principle of multi-feature monitoring, this system can monitor cable temperature, smoke online and give early warning. The lower-level distributed detection modules mainly use fixed-point temperature and smoke detectors and recoverable temperature-sensing cables distributed throughout the cable trench. In order to overcome the common defects such as false alarms of the previous monitoring system and misoperation of the fire linkage system, the monitoring system can coordinate the environmental information sent by the temperature and smoke sensors to make an overall judgment on the fire risk degree of the cables in the cable trenches, thereby reducing labor costs. Under the circumstance of ensuring the fire safety of the cable trench and maintaining the stable work of the power facilities.

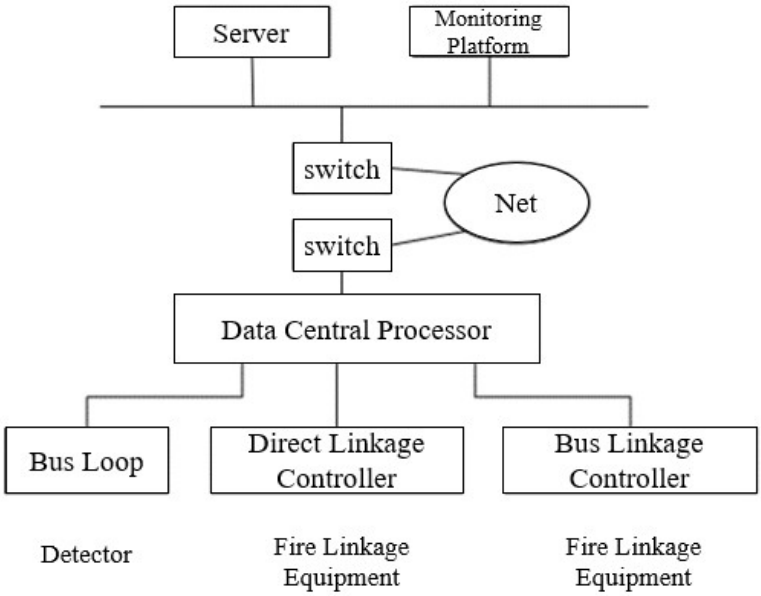

Figure 1. Multi-feature intelligent perception system structure

2.2. Perceptual Unit

In order to ensure the accuracy of fire early warning detection, the system adopts a sensing unit design that combines single-point measurement and overall measurement, as follows:

1) The smoke detectors are installed in the cable trenches at equal intervals, and the installation distance is kept at 15 meters. The focus is on the cable joints and turns where fires are most likely to occur. The type of smoke detectors is explosion-proof ion smoke detectors.

2) The temperature detectors are installed in places where there are many cable stacks such as joints and turns of the cables in a way that targets the parts where discharge heat often occurs. The temperature sensor adopts a one-line temperature sensor in type. In order to meet the anti-

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interference and expandability, the interface uses the "one-line bus" type. This interface transmission method has the advantage of strong anti-interference, which can greatly improve the anti-interference of the information acquisition unit, so as to ensure the measurement accuracy of the temperature measurement field in the poor environment. This method does not require a signal conditioning circuit, enhances transmission reliability, and facilitates system expansion. The implementation method is more convenient, and multiple sensors can be connected on a single cable.

3) The temperature sensing cable is wrapped around the outside of the cable in a wave shape, and the length covers the entire object cable to ensure a complete monitoring range. In terms of type, a recoverable cable-type fixed temperature sensor is selected. The result of the temperature detection will transmit the signal to the power amplifier circuit, and drive the alarm device to issue an alarm signal when a fire warning is required.

2.3. Data Processing Unit

As the core unit for overall assessment of fire risk, the central processor can provide overall analysis results according to the signals of the lower-level sensing units and send signals to the upper-level server equipment through the network. When the transmitted information exceeds the preset limit, it will be mobilized The lower-level fire-fighting equipment will put out the fire. The front-end computer can check the temperature and smoke information uploaded by the server through the network at any time, and the SMS server can also send the triggered warning information to the security personnel in time by sending short messages, and check the fault warning line before the real fire occurs, so as to eliminate the fire risk. Quickly call the police when a fire has occurred so that the fire can be put out in time.

2.4. Alarm Processing

For the alarm information, it is necessary to combine various detection signals to judge. In addition to judging the temperature signal of the cable itself of the temperature sensor, the detection information of the smoke sensor and the environmental temperature information should also be considered.

1) The cable temperature sensor issues an alarm;

2) The smoke sensor issues an alarm;

3) The ambient temperature sensor issues an alarm, that is, the ambient temperature detected in the cable trench is greater than the artificially specified value; the temperature measured on the cable surface is the primary basis, and the ambient temperature is the secondary basis to judge the fire alarm information; in order to prevent the expansion of the fire With the development, when dealing with fire, it is necessary to control the information that the fire is about to occur before the fire has occurred, and remove the fire risk in advance.

3. Cable Trench Fire Extinguishing System Optimizations

3.1. Cable Trench Fire Characteristics

The cable trench cable itself is structurally arranged in the cable tray, which leads to the fact that the fire is easily blocked and easy to reignite in the early stage of the fire. After the fire occurs, the smoke corrodes the outer insulating layer, which leads to the expansion of the cable fire, and it is difficult to detect the fire in time from the occurrence of the fire to the large-scale fire. While the hidden danger is great, the conventional fire extinguishing methods are inconvenient. Suppress fire. Most of the current preventive fire fighting methods for cable trenches are ineffective and cannot achieve automatic monitoring and fire extinguishing without manual intervention.

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3.2. Fire Extinguishing System Optimizations

Table 1. Cable trench fire extinguishing system comparison

Contrast items	Ultrafine dry powder (cold aerosol)	High pressure water mist fire extinguishing system
Fire extinguishing mechanism and protection object	Enclosed or partially enclosed spaces, general outdoor spaces Class A, B, C, D, E, F fires	Long-distance cable tunnels and traffic tunnels should use medium-voltage or high-voltage water mist systems
	Alarm device (optional)	Alarm device (optional)
Maintenance operation	Alarm control should use multi-wire equipment to effectively prevent misoperation	ordinary
	Requires dedicated fire-fighting power supply	Requires dedicated fire-fighting power supply
Fire extinguishing performance and safety	High efficiency and fast fire extinguishing	High fire extinguishing performance and safety
	Small particle size, large specific surface area, good fire extinguishing performance, fast decomposition, slow sedimentation, good fluidity, fast dispersion, non-toxic and non-corrosive, green and environmental protection	clean fire extinguishing agent
Cost	Low cost, easy installation and maintenance	high cost

The existing fire extinguishing systems suitable for cable trench fire are mostly the following four: hot aerosol, fire probe type temperature-sensing self-starting fire extinguishing device, high-pressure water mist fire extinguishing system, and ultra-fine dry powder (cold aerosol). Since the fire probe type temperature sensing is not controlled by the general control alarm system, it is excluded first; secondly, the thermal aerosol is mainly suitable for the activation of the thermal line, and it is easy to cause false alarms or failures due to the influence of physical collisions on electronic components, so also exclude it. Next, we will mainly compare the ultrafine dry powder fire extinguishing system with the high pressure water mist fire extinguishing system, as shown in Table 1.

From the above comparison, it can be seen that compared with other fire extinguishing devices, the ultra-fine dry powder fire extinguishing device has the advantages of high fire extinguishing efficiency, automatic fire extinguishing under system control, easy installation and maintenance, and low cost. According to the fire characteristics of the cable trench, it can effectively and timely extinguish the fire.

4. Conclusion

The cable trench fire multi-feature sensing system designed in this paper uses the multi-feature detection, central processing unit control, Internet connection and other technologies composed of a variety of sensor monitoring to form an overall linkage system, which can control the cable trench cable conditions in real time. On the basis of ensuring the fire safety of the cable

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trench, the labor and maintenance costs are reduced. The fire extinguishing device cooperates with the sensing system and adopts an ultra-fine dry powder fire extinguishing system, which can extinguish the fire in time. Make full use of the remote monitoring system to achieve automatic linkage and realize automatic fire prevention and control.

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