Analysis of electrical fire monitoring system with LoRa wireless communication technology

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Abstract: LoRa wireless communication technology with its ultra-low power consumption, long-distance communication ability and high efficiency data transmission, is being widely used in various fields, including electrical fire monitoring system. The electrical fire monitoring system based on the technology is an advanced and dynamic fire warning and monitoring solution, which can effectively monitor and prevent the occurrence of electrical fires and protect people's lives and property safety. This paper first analyzes the characteristics and advantages of LoRa technology, the composition and principle of electrical fire monitoring system, and then discusses the design of electrical fire monitoring system based on LoRa wireless communication technology combined with the safety needs of electricity in the new era, in order to provide reference for the development of electrical fire monitoring work.

Key words: LoRa; Wireless communication technology; Electrical fire monitoring system; Design; Analysis

Introduction

Most of the traditional electrical fire monitoring systems rely on wired connections, which are complex and vulnerable to damage, and it is difficult to meet the safety needs of modern electricity use. In recent years, the rise of LoRa wireless communication technology has brought revolutionary changes to the electrical fire monitoring system. LoRa wireless communication technology has low power consumption, can achieve long-distance transmission, and its unique spread spectrum technology ensures anti-interference performance, making data transmission more stable and reliable. In the electrical fire monitoring system, the application of LoRa wireless communication technology has epoch-making significance.

I. LoRa technical characteristics and advantages

In the era of Internet of Things (IoT), low power wide area network (LPWAN) technology is developing rapidly, among which LoRa technology stands out with its unique characteristics and advantages. LoRa is a long-distance communication protocol based on spread spectrum technology, which has the advantages of long distance, low power consumption and strong anti-interference ability, and is widely used in intelligent cities, intelligent manufacturing, intelligent agriculture and other fields.

LoRa technology has the following characteristics:

1. Long-distance communication: LoRa uses spread spectrum technology and has long-distance communication capabilities, and the farthest communication distance can reach several kilometers, meeting the needs of most Internet of Things application scenarios.

2. Low power consumption: the power consumption of LoRa equipment is extremely low, and it can work for a long time, solving the problem that many iot devices are limited in power.

3. Strong anti-interference ability: LoRa technology has excellent anti-interference ability, and can work stably in complex environments, avoiding many interference problems of other wireless communication technologies.

4. High security: LoRa technology uses advanced encryption algorithms to ensure the security and privacy of data.

The advantages of LoRa technology are mainly reflected in the following aspects:

1. Wide range of application: LoRa technology is suitable for a variety of scenarios, such as smart cities, intelligent manufacturing, intelligent agriculture, etc., and has a wide range of applicability.

2. Low deployment cost: The deployment cost of LoRa equipment is low, reducing the overall cost of Internet of Things applications.

3. Strong scalability: the LoRa network can expand the number of devices and communication distance as needed to meet the needs of larger scale applications.

4. Easy maintenance: The maintenance of LoRa equipment is relatively simple, the failure rate is low, and the operation and maintenance cost is reduced.

In short, LoRa technology has the characteristics of long-distance communication, low power consumption, strong anti-interference ability, high security, has a wide range of application scenarios, and low deployment cost, scalability, easy to maintain, its application in the electrical fire monitoring system will bring more security to our lives.

II. The composition and principle of electrical fire monitoring system

With the development and progress of science and technology, electrical fire monitoring system has become an indispensable part of modern buildings. The system can monitor the running status of electrical equipment in real time, discover and deal with electrical fire hazards in time, and effectively protect the safety of buildings and personnel. It is mainly composed of monitoring equipment, detectors and communication devices. Among them, the monitoring equipment is the core of the system, which is responsible for receiving and analyzing

the data uploaded by the detector. When abnormal data is found, the monitoring device will immediately start the alarm program and send the alarm information to the management through the communication device for timely investigation and processing.

The working principle of the electrical fire monitoring system is through real-time monitoring of the current, voltage, temperature and other parameters in the electrical equipment. When there is an anomaly in these parameters, the detector will immediately sense and upload to the monitoring device. For example, when the temperature of the wire rises due to aging or overload, the detector is able to quickly sense and upload the alarm information to the monitoring device. After receiving the alarm information, the monitoring device will immediately start the alarm program and send the alarm information to the manager through the communication device. At the same time, the system can also record and analyze the historical data, so that the managers can grasp the running state of the electrical equipment in time and prevent the occurrence of fire accidents. The electrical fire monitoring system plays an important role in ensuring the safety of buildings and personnel. It can detect and deal with electrical fire hazards in time to avoid the occurrence of fire accidents.

III. Electrical fire monitoring system design based on LoRa wireless communication technology

1. Wireless communication network design

When designing a wireless communication network, we need to consider the following key factors. First, the network architecture. According to the application requirements and the actual environment, choose the appropriate network architecture. Common network architectures include star, tree, and mesh, each with its own advantages and disadvantages. In the electrical fire monitoring system, we usually choose the tree or network architecture to achieve multi-point monitoring and information interaction. Second, node layout. Reasonable layout of monitoring equipment and sensors to ensure that the entire monitoring area covers no dead corners. Increase sensor density in key areas to improve monitoring accuracy. Third, communication protocol. Choose the appropriate communication protocol, such as LoRa, Zigbee, NB-IoT, etc. In the electrical fire monitoring system, LoRa protocol is the ideal choice because of the high requirements on data transmission distance and power consumption. Fourth, the data transmission rate. According to the actual demand, choose the appropriate transmission rate. For electrical fire monitoring systems, it is often necessary to transfer data in real time, so you need to choose a device that supports a higher transfer rate. Fifth, equipment power consumption and life. Considering that the monitoring system needs long-term stable operation, equipment with low power consumption and long life should be selected. This can not only reduce system maintenance costs, but also help improve the availability and reliability of the system. Sixth, data security. In order to ensure the security of monitoring data, necessary security measures should be taken, such as data encryption, access control, etc. In the actual design process, also need to be combined with the actual situation for comprehensive consideration. For example, according to the building structure, electromagnetic environment and other factors to adjust the equipment model and parameters; According to user needs and technical conditions to determine the best networking scheme.

2. Monitoring module design

The monitoring module is an important part of the electrical fire monitoring system, which is responsible for real-time monitoring of the fault and abnormal situation of the electrical line, and timely sending alarm signals. When designing the monitoring module, we need to consider the following 4 aspects. First, the selection of monitoring parameters. The parameters that the electrical fire monitoring system needs to monitor include current, voltage, temperature, smoke, etc. These parameters can reflect the running state and fault of the electrical line, and provide an important basis for the subsequent fire warning and prevention. Secondly, the choice of sensor. In order to obtain various parameters of the electrical line in real time, it is necessary to choose the appropriate sensor. For the monitoring of current and voltage, current transformers and voltage transformers can be used; For temperature and smoke monitoring, you can use temperature sensors and smoke sensors. When choosing a sensor, it is necessary to consider aspects such as its measuring range, accuracy, stability and reliability. Thirdly, it is LoRa wireless communication technology. LoRa is a low-power, long-distance wireless communication technology, which is suitable for monitoring systems with high requirements for power consumption and transmission distance. By combining the monitoring module and LoRa wireless communication technology, long-distance data transmission and real-time monitoring can be realized. Finally, it is processing and alarm. The monitoring module needs to process the collected data and issue an alarm signal according to the processing results. In terms of data processing, it is necessary to carry out data filtering, denoising and other processing to improve the accuracy and reliability of the data; In terms of alarm, it is necessary to set an alarm threshold, when the collected data exceeds the threshold, an alarm signal is sent and uploaded to the monitoring center.

3. Design of signal data processing module

Signal data processing module is an important part of electrical fire monitoring system. It is mainly responsible for processing, analyzing and judging the signal collected by the front end, so as to provide accurate basis for early warning and alarm. The design of this module includes data acquisition, data preprocessing, data transmission and data processing. Among them, data acquisition is the first step of signal data processing module, which obtains the state data of electrical equipment through wireless communication technology, such as temperature, humidity, current, voltage and so on. Taking into account the parameters of different devices and the actual environment, it is necessary to choose the appropriate sensor and equipment for data acquisition. Data pre-processing is mainly to clean, filter and convert the collected data. Since the original data may have noise, outliers and other problems, it is necessary to pre-process the data to improve the accuracy and reliability of the data. Commonly used data preprocessing methods include mean filtering, median filtering, differential filtering, etc. Data transmission is the transmission of the pre-processed data to the data processing module or other related systems. Considering the communication distance and reliability requirements in practical applications, we use LoRa wireless communication technology to achieve

data transmission. LoRa has the advantages of long distance, low power consumption, strong anti-interference ability, etc., which can meet the requirements of electrical fire monitoring system. Data analysis and processing is the core part of signal data processing module. It is mainly responsible for in-depth analysis and processing of the transmitted data. According to different data characteristics and early warning requirements, we use different algorithms and models to process and analyze the data. For example, for electric signals such as current and voltage, we use Fourier transform (FFT) and other methods for spectrum analysis; For temperature, humidity and other signals, we use regression analysis, support vector machine (SVM) and other methods for anomaly detection and classification. In practical applications, the signal data processing module also needs to consider the timeliness, accuracy and reliability of early warning and alarm. Therefore, the module needs to have real-time processing capabilities, and can quickly respond to abnormal situations and conduct early warning and alarm.

4. Design of fire warning module

In the traditional electrical fire monitoring system, the sensor and the monitoring center are usually connected in wired mode, which requires a large number of cables, high installation cost, and is not easy to maintain. The design of the fire warning module based on LoRa wireless communication technology can make use of its advantages of long distance and low power consumption to realize the wireless connection between the sensor and the monitoring center, saving the laying and maintenance cost of the cable. The main function of the design of the fire warning module is to monitor the temperature, smoke, electric spark and other parameters in the electrical line in real time. When these parameters exceed the set threshold, the alarm signal is quickly issued. In the design of the fire warning module based on LoRa wireless communication technology, the data collected by the sensor is transmitted to the monitoring center through LoRa wireless signal to realize the real-time transmission and storage of data. Specifically, the design of the fire warning module based on LoRa wireless communication technology should include the following 4 parts. First, it is the sensor part. We should choose a sensor with high sensitivity and high stability, which can monitor the temperature, smoke, electric spark and other parameters in the electrical line in real time, and convert it into an electrical signal that can be transmitted. Secondly, it is the LoRa wireless communication module. We should choose the LoRa wireless communication module with long distance, low power consumption, strong anti-interference ability and other advantages to achieve wireless data transmission between the sensor and the monitoring center. Third, the data processing and control module. We should process and analyze the data collected by the sensor, and compare it with the set threshold. When the set threshold is exceeded, an alarm signal is issued. Finally, it is the power module. We should provide a stable power supply for sensors, LoRa wireless communication modules, data processing and control modules.

Epilogue

In general, the electrical fire monitoring system based on LoRa wireless communication technology is an efficient, intelligent and flexible fire monitoring solution. In today's increasing emphasis on building safety and environmental protection, this system has a wide range of application prospects, and will bring more convenience and safety to our lives. We expect this technology to bring more possibilities to our lives in the future!

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This paper is funded by the research project of Luzhou Vocational and Technical College (KB-2221) : The research achievement of forest fire remote integrated detection system based on LoRa wireless technology.