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Research Article

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Research on online monitoring and cause identification system of building electrical fire

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Abstract. Frequent building electrical fire accidents have brought great harm to life and property. In order to prevent the occurrence of accidents and reduce the losses to the greatest extent, it is necessary to take effective measures for building electrical fires. Based on the Internet of things (IoT) technology, a system for online monitoring and cause identification of building electrical fire is proposed in this paper. For both hardware and software, this paper introduces the overall structure, component units and system functions in detail. According to the characteristics of arc fault and fire, the complete scheme of online monitoring is given, and the system workflow is also described to realize the cause identification. Finally, the effectiveness of this system is verified by practical testing. The results show that the proposed system is helpful to solve the problems in monitoring and cause identification of building electrical fire, which can not only provide decision-making basis for firefighting, but also provide strong technical support for improving the safety of low-voltage power grid.

Keywords: Building electrical fire / Internet of things (IoT) / online monitoring / cause identification / safety of low-voltage power grid

1 Introduction

With the rapid development and application of science and technology, all kinds of electrical and electronic devices in the buildings are becoming more complex, which also bring more potential fire hazards [1,2]. According to the statistics in recent years, building fires caused by electrical factors account for approximately half of the total and the proportion is still on the rise [3–5]. Because of the high frequency, complex causes and dense personnel, the losses from building electrical fires are particularly heavy. Therefore, it is necessary to build the system for online monitoring and cause identification of building electrical fire, which is of great significance to ensure life safety, reduce the losses and prevent the occurrence of similar fire accidents to the greatest extent.

Nowadays, many scholars have conducted relevant researches on the monitoring of building electrical fire. The monitoring method based on the fusion of multi-sensor information is often mentioned, which can conduct the fusion of main characteristic signals to achieve real-time monitoring of electrical fire [6–9]. Sridhar presented autonomous detection of electrical fire based on computer vision techniques, and used yolo v2 to extract the features of electrical fire [10]. Zhao suggested to apply intelligent power monitoring system to the prevention of electrical fire, and also provided a new idea for electrical fire monitoring and fire safety, which could offer assistance to emergency rescue of accidents [11]. Yang combined an application example of system for electrical fire monitoring in urban commercial buildings, and introduced the function and working principle of system [12]. Based on the JenNet protocol of wireless sensor network, Zhao took wireless low-power embedded processor as the core and designed the early monitoring system of building electrical fire [13]. Zhang designed a monitoring system based on the use of ZigBee, and the experiments showed that the system can play an effective role in prevention, reducing the complexity of projects and intensity of maintenance work [14].

However, all these reports did not effectively use the relevant information of faults, which limited the effect in the monitoring of electrical fire. In addition, the cause identification of electrical fire is still mainly based on the empirical methods, thus the accuracy of identification is inevitably affected [15,16].

Based on the Internet of things (IoT) technology, this paper proposes a system for online monitoring and cause identification of building electrical fire, and introduces the

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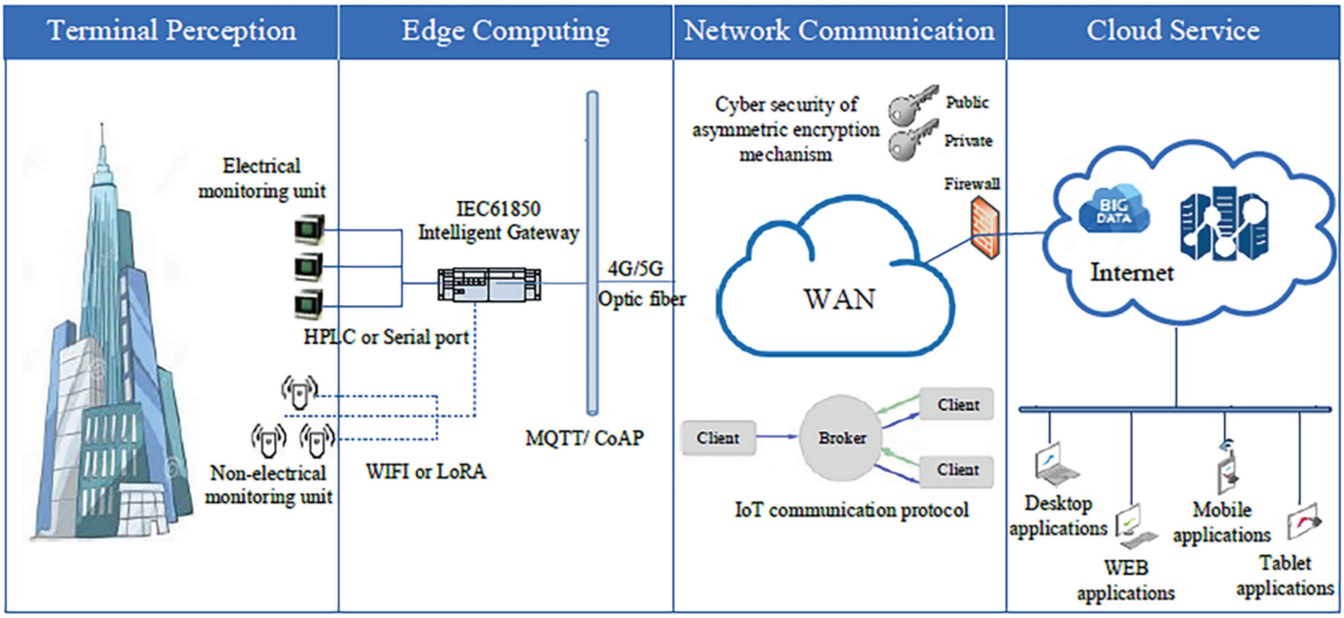

Fig. 1. Overall structure of system.

overall structure, component units and system functions in detail. The system uses the information collected by the electrical monitoring units in the building to realize the detection of arc fault. In addition, the system can also realize online fire monitoring according to the information collected by non-electrical monitoring units. By analyzing the information of arc fault and fire, the cause identification of electrical fire is realized according to their information coincidence degree in temporal logic and spatial area. This system makes full use of IoT technology, which can reduce the workload of construction and maintenance management [17]. The actual testing and analysis prove that the system can realize the online monitoring and cause identification of electrical fire with an effective result.

2 System structure and composition

2.1 Overall structure

Figure 1 shows the overall structure of system. Based on the use of IoT technology, the system is mainly composed of terminal perception layer, edge computing layer, network communication layer and cloud service layer. In addition, the information interconnection is carried out through the communication system based on IEC 61850 standard.

Terminal perception layer has the functions of data collection, upload and communication, its hardware mainly includes various monitoring units. The electrical monitoring unit is used to collect the electrical information such as current and voltage. The non-electrical monitoring unit is used to collect the non-electrical information such as smoke concentration and ambient temperature.

Edge computing layer is composed of intelligent gateway, which is used to realize the giving time service, data reception and storage. Based on IEC 61850 standard and edge computing technology, it realizes the standardized upload of information and the execution of visual system control operation.

Network communication layer can adopt wired, WiFi, 4G/5G and other communication modes to realize the interworking between intelligent gateway and management services.

Cloud service layer mainly uses the technologies of B/S architecture and big data analysis. Based on the cloud platform, the role of cloud service layer is to realize the visual display of online monitoring, cause identification and data statistics.

2.2 Component unit

2.2.1 Electrical monitoring unit

The electrical monitoring unit has the main functions of fault detection, electrical data collection and upload. The electrical monitoring unit is mainly installed in the low-voltage electrical meter box, which is used to measure the analog quantity and status quantity of distribution lines.

Figure 2 shows the hardware composition of electrical monitoring unit. A core MCU is used as the data collection module, and the time synchronization module is composed of an independent MCU, signal conditioning module and signal generator.

In actual working, the electrical information from distribution lines is collected by the electrical monitoring unit, and then the data can be uploaded to the intelligent gateway. GPS time signal can be received by the electrical monitoring unit to realize the time synchronization. In addition, it can also cooperate with the intelligent gateway to realize the topology identification of power network.

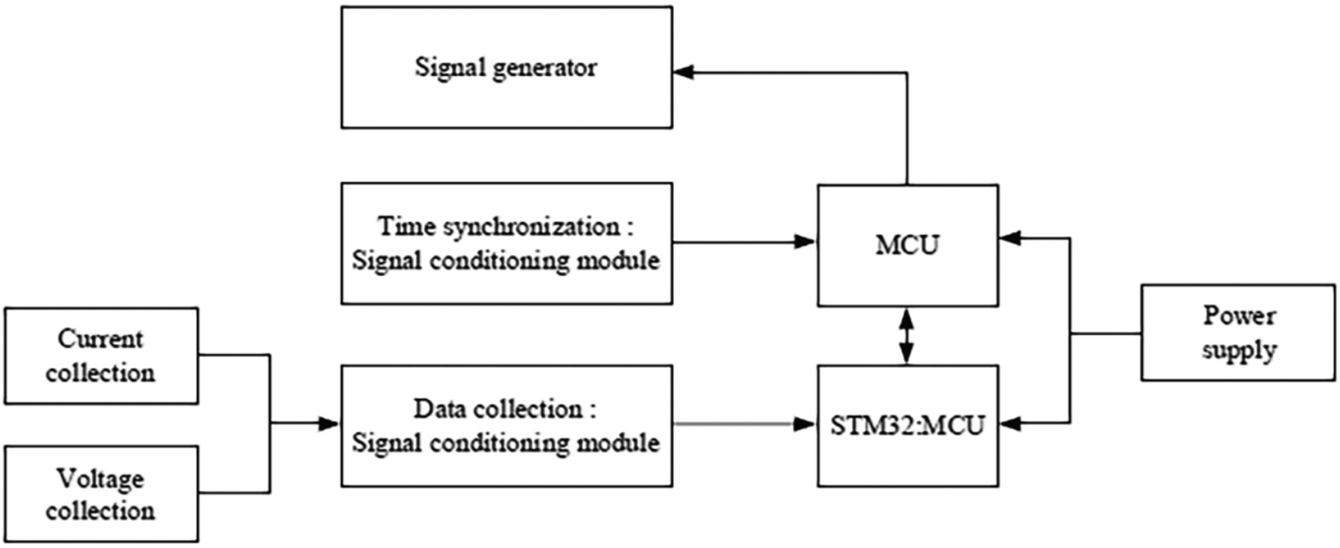

Fig. 2. Hardware composition of electrical monitoring unit.

2.2.2 Non-electrical monitoring unit

The non-electrical monitoring unit has the main functions of fire detection, non-electrical data collection and upload, which should also have good real-time performance and reliability. To reduce the cost of layout, the non-electrical monitoring unit should be able to simultaneously monitor the fire characteristic physical quantities of smoke and temperature.

Figure 3 shows the hardware composition of non-electrical monitoring unit, which is mainly composed of MCU control module, information transmission module, smoke monitoring module, temperature monitoring module and warning module. The non-electrical signals can be converted into digital signals by the monitoring modules, and then transmitted to MCU control module to analyze.

Under normal conditions, the monitoring modules are working all the time while the information transmission module is closed. Once the smoke concentration or ambient temperature reaches the warning value, the information transmission module can be waked up to upload the non-electrical data and device information to the intelligent gateway, so as to realize the fire warning and location.

2.2.3 Intelligent gateway

The data output by various monitoring units is received and processed by the intelligent gateway. To realize the online monitoring and cause identification of electrical fire, the data of fault and fire can be transmitted by the intelligent gateway to the cloud platform as the input.

In addition, the intelligent gateway can also cooperate with the electrical monitoring units to realize the topology identification of power network, which is the prerequisite for fault location [18]. The process of topology identification is shown in Figure 4. Through injecting characteristic disturbance pulses into the power network, the topological relationship of electrical monitoring units can be automatically generated by the intelligent gateway, and then transmitted to the cloud platform to form a network structure.

2.2.4 Cloud platform

From the perspective of function requirements, three aspects of application content should be satisfied in the cloud platform, as shown in Figure 5.

On the one hand, the data sent by the intelligent gateway can be received and displayed by the cloud platform. On the other hand, the cloud platform is responsible for the implementation of algorithms, including fault monitoring, fire monitoring and cause identification. In addition, the cloud platform also needs to have the function of system management to facilitate user operation and device maintenance.

2.3 Information model and communication model

In the distribution network, the construction of IoT needs to solve the problem of interconnection and interoperability between large-scale devices. The existing method is to adopt IEC 61850 standard to establish the standardized information model and communication mapping, which can improve the interoperability of devices and reduce the workload of installation. Since most of the information of low-voltage distribution has been already uniformly modeled, the use of IEC 61850 standard is conducive to the data fusion of monitoring data and existing automation system, so as to avoid the formation of information island.

Based on the function and performance requirements of IoT communication, the information model is completed by various logical nodes. As shown in Figure 6, for the establishment of information model, the application scenarios of IoT communication system should be collected first. Then, the function list and performance requirement are proposed after analyzing the application scenarios, and the communication content of each application scenario is

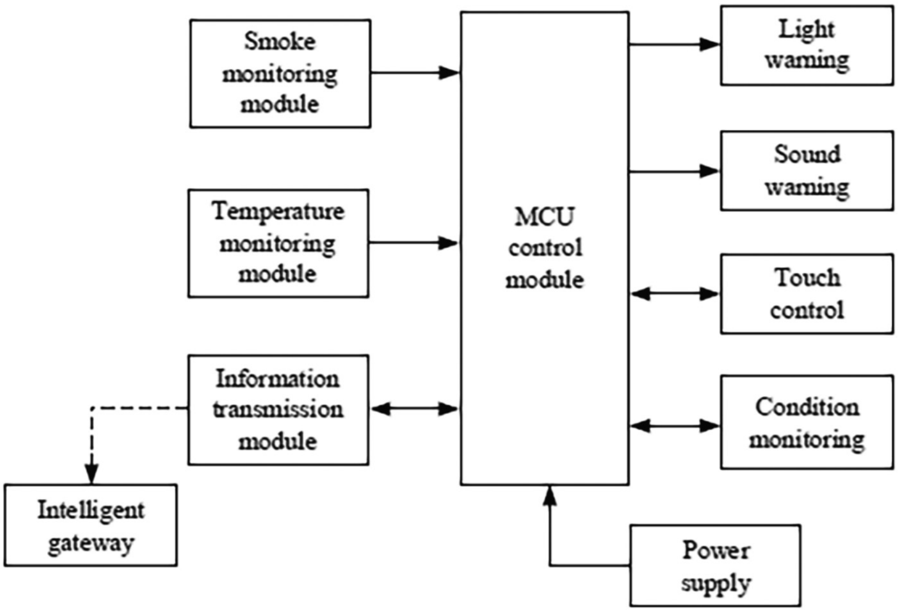

Fig. 3. Hardware composition of non-electrical monitoring unit.

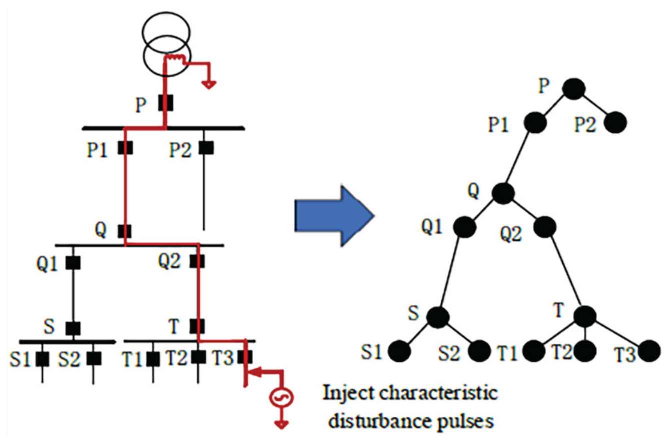

Fig. 4. Process of topology identification.

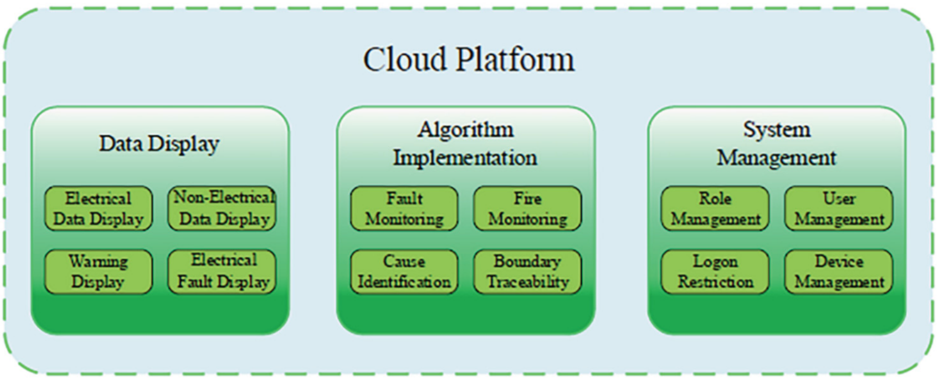

Fig. 5. Functional framework of cloud platform.

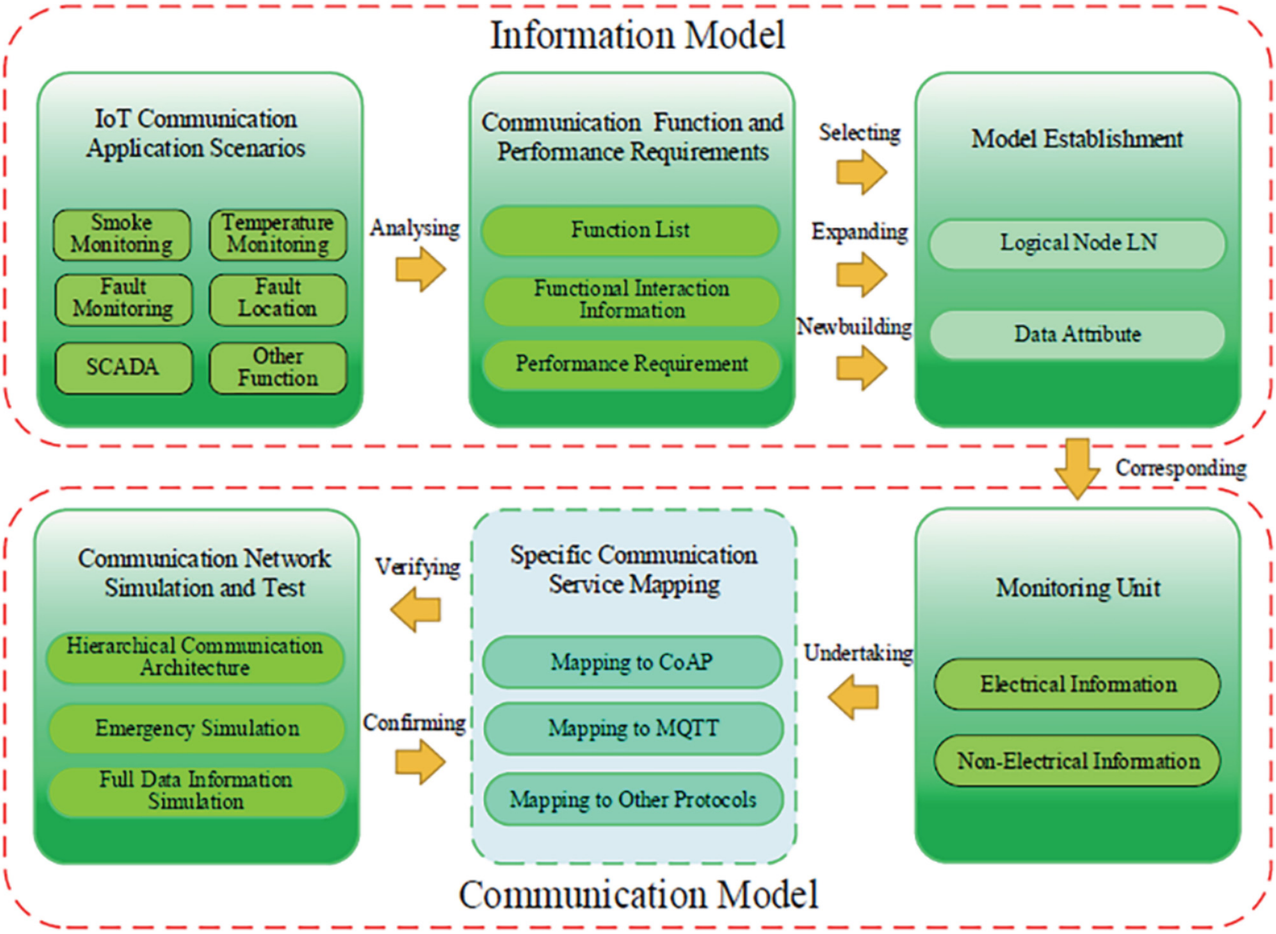

Fig. 6. IoT model based on IEC 61850 standard.

confirmed through the UML modeling method. Finally, the work of selecting, expanding and newbuilding logical nodes are finished according to the communication content.

Due to the difference in collected information, it is necessary to define logical nodes for electrical information such as voltage and current, as well as logical nodes for non-electricity information such as smoke and temperature. In order to realize the location of arc fault and fire, the logical nodes for spatial information are defined to obtain the spatial locations of monitoring units. In addition, it is also important to model devices such as various monitoring units and intelligent gateway. Finally, the information model is formed based on IEC 61850 standard, which is used for data exchange in the system.

In order to form the communication model based on IEC 61850 standard, it is necessary to map information models to Constrained Application Protocol (CoAP), Message Queuing Telemetry Transport (MQTT) and other protocols. The data collected by monitoring units are transmitted to the intelligent gateway via CoAP, and then the intelligent gateway can communicate with the cloud platform via MQTT.

3 System function and basic principle

3.1 System workflow

Once the monitoring unit goes into operation, the register information is actively sent to the cloud platform, including the device information and unique identification name. Based on IEC 61850 standard, the cloud platform and intelligent gateway can receive the operating information collected by various monitoring units, and control the monitoring units through corresponding commands.

Under normal conditions, the monitoring units are collecting data in real time, while the intelligent gateway is in a waiting state and maintains contact with the cloud platform.

When the monitoring unit is found to have failed and needs to be replaced, the cloud platform can automatically issue saved device information to new monitoring unit. According to the device information and topological relationship of electrical monitoring units, real-time topology analysis algorithm is used to realize the function of plug and play.

3.2 Fault monitoring and location

3.2.1 Parallel arc fault

From the perspective of fire conditions, there are two main causes of building electrical fire. The first type is the short-circuit fault caused by the contact between conductors, and the second type is the arc fault with arc as the conductor path. The current generated by short-circuit fault is very large, so that the circuit breaker can promptly detect the short-circuit current and cut off the power supply, which can prevent the occurrence of fire [19]. Because of the influence of resistance, the current generated by arc fault is too small to make the circuit breaker act to cut off the power supply. Once the arc fault exists for a long time, the combustibles near the arc can be easily ignited to cause the electrical fire. Therefore, the arc fault is considered as a main cause of electrical fire [20,21].

The phase-to-N parallel arc fault is a fault that occurs between the phase line and neutral line. In order to achieve effective protection, it is necessary to use the composite characteristics of fault voltage and current for monitoring. For the upstream and down-stream monitoring units near the fault point, the characteristics of voltage and current are different.

For the upstream monitoring unit, the upstream current can be expressed as:

$$I_{PN1} = \frac{U_0}{Z_L + Z_{PN}} \tag{1}$$

where I_{PN1} is the upstream current, U_0 is the power supply voltage, Z_{L} is the line impedance from fault point to power supply, Z_{PN} is the arc impedance.

Due to the increase of upstream current, the voltage of upstream monitoring unit decreases slightly, as shown below:

$$U_{PN1} = U_0 - I_{PN1} Z_{\mathrm{L1}} \tag{2}$$

where U_{PN1} is the voltage of upstream monitoring unit; Z_{L1} is the line impedance from upstream monitoring unit to power supply.

For the downstream monitoring unit, the voltage can be expressed as:

$$U_{PN2} = U_f - I_{PN2} Z_{L2} \tag{3}$$

where I_{PN2} is the downstream current, U_{PN2} is the voltage of downstream monitoring unit, U_{f} is the fault point voltage, Z_{L2} is the line impedance from fault point to downstream monitoring unit.

Since the downstream current is greatly reduced, the product of downstream current I_{PN2} and line impedance Z_{L2} can be ignored. Thus, the voltage of downstream monitoring unit U_{PN2} is almost equal to the fault point voltage U_{f}, which is significantly lower than before the occurrence of fault. According to the difference of arc resistance at the fault point, the fault point voltage and the voltage of downstream monitoring unit are distorted to different degrees. If the arc resistance is very small, the voltage of downstream monitoring unit is similar to the rectangular wave. With the increase of arc resistance, the voltage of downstream monitoring unit gradually changes from rectangular wave to sine wave.

The phase-to-phase parallel arc fault is a fault that occurs between the phase line and another phase line. Compared with the phase-to-N parallel arc fault, when the A phase-to-B phase parallel arc fault occurs, two fault phases have synchronous fault characteristics.

For the upstream monitoring unit, the fault currents of two fault phases are equal, which can be expressed as the ratio of line voltage to line impedance and arc impedance, as shown below:

$$I_{PP} = \frac{U_L}{Z_{LA} + Z_{LB} + Z_{PP}} \tag{4}$$

where I_{PP} is the fault current, U_{L} is the line voltage, Z_{LA} is the impedance from A phase fault point to power supply, Z_{LB} is the impedance from B phase fault point to power supply, Z_{PP} is the arc impedance.

Due to the increase of fault current, the voltage of upstream monitoring unit decreases slightly, as shown below:

$$\begin{cases} U_{PPA1} = U_{PPA0} - I_{PP} Z_{LA1} \\ U_{\mathrm{PPB1}} = U_{PPB0} - I_{PP} Z_{\mathrm{LB1}} \end{cases} \tag{5}$$

where U_{PPA1} is the A phase voltage of upstream monitoring unit, U_{PPA0} is the A phase voltage of power supply, Z_{LA1} is the line impedance from upstream monitoring unit to power supply, U_{PPB1} is the B phase voltage of upstream monitoring unit, U_{PPB0} is the B phase voltage of power supply, Z_{LB1} is the line impedance from upstream monitoring unit to power supply.

For the downstream monitoring unit, the fault voltage presents the characteristic of sine wave, which is different from the phase-to-N parallel arc fault. The equations are as following:

$$\begin{cases} U_{PPA2} = U_{\mathrm{PPA0}} - I_{PP} Z_{LA} - I_{PPA2} Z_{LA2} \\ U_{PPB2} = U_{\mathrm{PPB0}} - I_{PP} Z_{LB} - I_{\mathrm{PPB2}} Z_{LB2} \end{cases} \tag{6}$$

where U_{PPA2} is the A phase voltage of downstream monitoring unit; I_{PPA2} is the downstream current of A phase fault point; Z_{LA2} is the line impedance from A phase fault point to downstream monitoring unit; U_{PPB2} is the B phase voltage of downstream monitor-ing unit; I_{PPB2} is the downstream current of B phase fault point; Z_{LB2} is the line impedance from B phase fault point to downstream monitoring point.

According to equations (5) and (6), it can be seen that the voltages of downstream monitoring unit are lower than the voltages of upstream monitoring unit. In addition, the voltage drop of downstream monitoring unit is also related to the arc resistance.

Through the above analysis, the characteristics of parallel arc fault can be obtained. For the upstream monitoring unit, the voltage decreases while the current increases. For the downstream monitoring unit, the voltage decreases while the current does not increase. Therefore, when the voltage collected by the electrical monitoring unit decreases, relevant data is uploaded to the intelligent gateway. According to the change of current and topological relationship of electrical monitoring units,

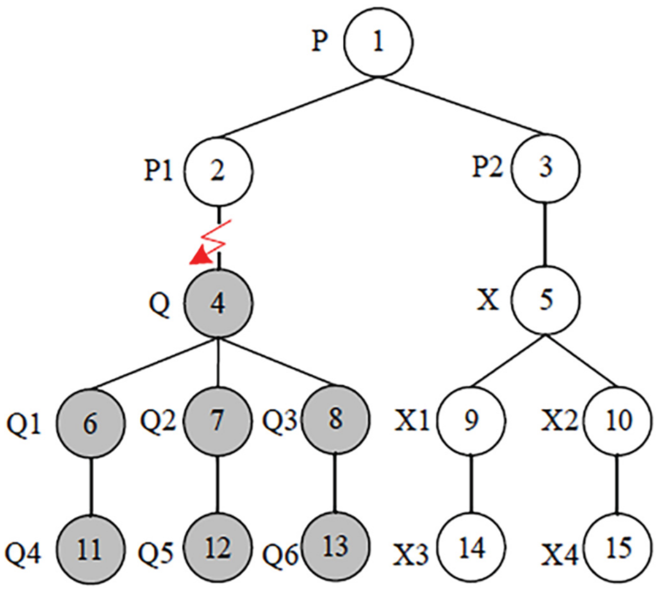

Fig. 7. Topological structure of electrical monitoring units.

the most downstream electrical monitoring unit with increased current can be found, then the fault point can be determined on its downstream line.

The topology of electrical monitoring units is shown in Figure 7. Assuming that the parallel arc fault occurs on the line P1-Q, the voltage collected by the monitoring unit P1 decreases and the current increases, showing the upstream characteristics. The voltages collected by the monitoring units Q, Q1, Q2, Q3, Q4, Q5 and Q6 decrease and their currents do not increase, showing the downstream characteristics. The data uploaded by the monitoring unit is detected in the order of 20 to 1 from the most downstream. When the process is executed to the monitoring unit P1, it is detected that the monitoring unit P1 has the upstream characteristics, so it can be determined that the fault occurs on the line P1-Q.

3.2.2 Series arc fault

Due to the appearance of series arc fault voltage, the voltage of monitoring unit is changed before and after the occurrence of fault. Therefore, the monitoring of series arc fault can be realized by the differential characteristics of voltage.

The equivalent circuit of series arc fault established by the *RL* model is shown in Figure 8. According to the KVL theorem, equation after the occurrence of fault can be got as follow:

$$\begin{cases} R = R_1 + R_2 \\ L = L_s + L_1 + L_2 \\ U_0(t) = U_{ac}(t) - RI_{arc}(t) \end{cases}$$
$$-L\frac{dI_{arc}(t)}{dt}U_{arc}(t) \quad (7)$$

where $U_0(t)$ is the terminal voltage, $U_{ac}(t)$ is the power supply voltage, $U_{arc}(t)$ is the arc fault voltage, $I_{arc}(t)$ is the fault current, L_S is the system impedance, R_1 is the line resistance from fault point to power supply, L_1 is the line inductance from fault point to power supply, R_2 is the line resistance from fault point to terminal, L_2 is the line resistance from fault point to terminal.

Before the occurrence of series arc fault, the terminal voltage $U_0(t)$ can be expressed as:

$$U_0(t) = U_{ac}(t) - RI(t) - L\frac{dI(t)}{dt}. \quad (8)$$

It can be seen that the terminal voltage $U_0(t)$ before the fault is the negative superposition of power supply voltage and line voltage. Moreover, the terminal voltage $U_0(t)$ can be regarded as the voltage collected by the downstream monitoring unit. Therefore, the differential voltage $\triangle U_0(t)$ before and after the fault collected by the downstream monitoring unit can be got as follow:

$$\begin{aligned} \Delta U_0(t) &= [I_{arc}(t) - I(t)]R \\ &+ \left[\frac{dI_{arc}(t)}{dt} - \frac{dI(t)}{dt}\right]L + U_{arc}(t) \\ &= \xi(t) + U_{arc}(t) \end{aligned} \quad (9)$$

$\xi(t)$ in equation (9) reflects the influence of upstream current on the differential voltage. Since the current is dominated by power frequency components, $\xi(t)$ appears as the sinusoidal fluctuations of differential voltage on the waveform. Therefore, the voltage collected by the downstream monitoring unit can well reflect the fault information. The voltage waveform of arc fault can be identified by the voltage difference $\triangle U_0(t)$, which is the basis for detecting the series arc fault.

According to the topological relationship of electrical monitoring units, the breadth first search algorithm is used to locate the series arc fault. When the electrical monitoring unit detects the series arc fault, fault information can be uploaded to the intelligent gateway. In actual working, information collected from the monitoring units is checked level by level until the monitoring unit with fault information is found, and the position of series arc fault can be determined on the upper level line above this monitoring point.

As shown in Figure 7, if the series arc fault occurs on the line P1-Q, the fault information can only be detected by the monitoring units Q, Q1, Q2, Q3, Q4, Q5 and Q6, showing the downstream characteristics. The information uploaded by the monitoring unit is detected in the order of 1 to 20 from the most upstream. When the process is executed to the monitoring unit Q, it is detected that the monitoring unit Q has the fault information, so it can be determined that the fault occurs on the line P1-Q.

3.3 Fire warning and cause identification

In the cloud platform, fire warning can be realized by the input of smoke concentration and ambient temperature collected by the non-electrical monitoring units in the building. The threshold value W_S of smoke concentration and the threshold value W_T of ambient

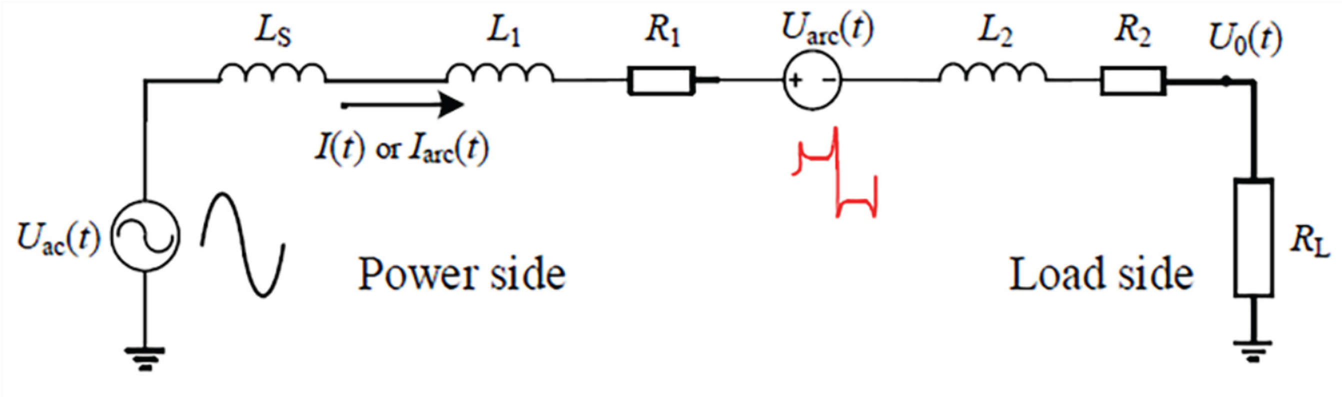

Fig. 8. Equivalent circuit of series arc fault.

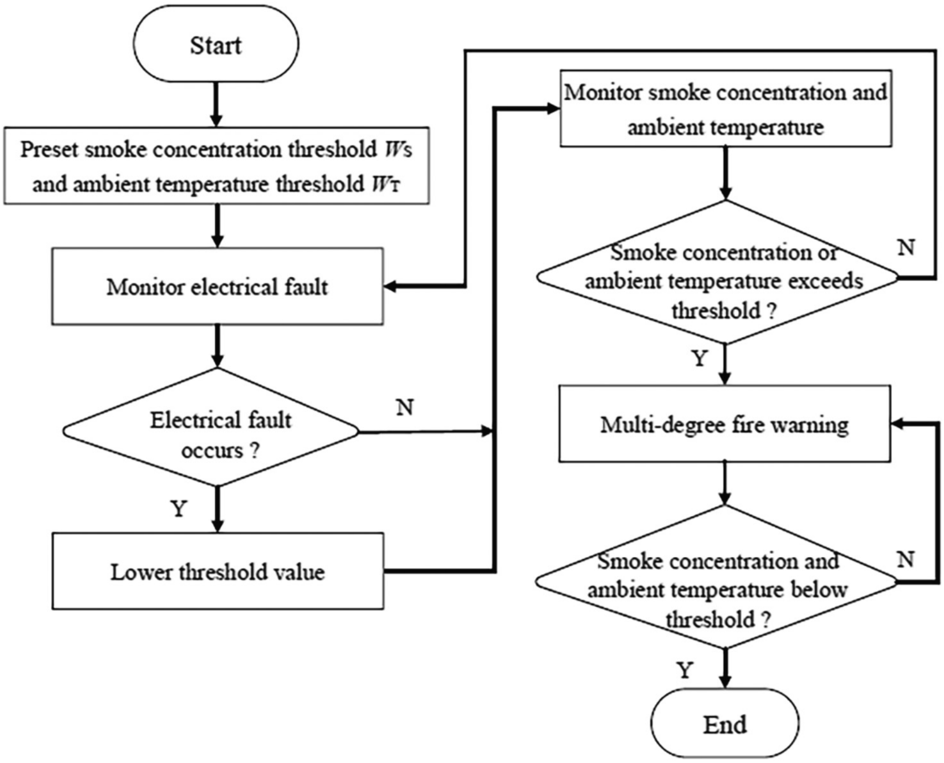

Fig. 9. Flow chart of fire warning.

temperature are preset at the beginning. The setting basis for threshold value is the relevant standards in different places and environments, and the threshold value can be set as instantaneous value or change rate. Once the information collected by the non-electrical monitoring units exceeds the threshold value, the transmission module in the monitoring unit can be waked up to upload the information to the cloud platform through the intelligent gateway, including the non-electrical information, time information and device information. To ensure the timeliness of electrical fire warning, an instruction from intelligent gateway is sent to the non-electrical monitoring units to lower the threshold value after the arc fault has been detected.

According to the change of collected information, multi-degree fire warning is set to reflect the development of fire. The flow chart of fire warning is shown in Figure 9, and the specific warning algorithm logic is as follows:

– If the smoke concentration measured by a non-electrical monitoring unit exceeds the threshold value W_S, it is considered that the fire has occurred and the third-degree warning is displayed in the cloud platform.
– If the ambient temperature measured by a non-electrical monitoring unit exceeds the threshold value W_T, it is considered that the fire has developed to the flashover stage with the temperature rising and the second-degree warning is displayed in the cloud platform.

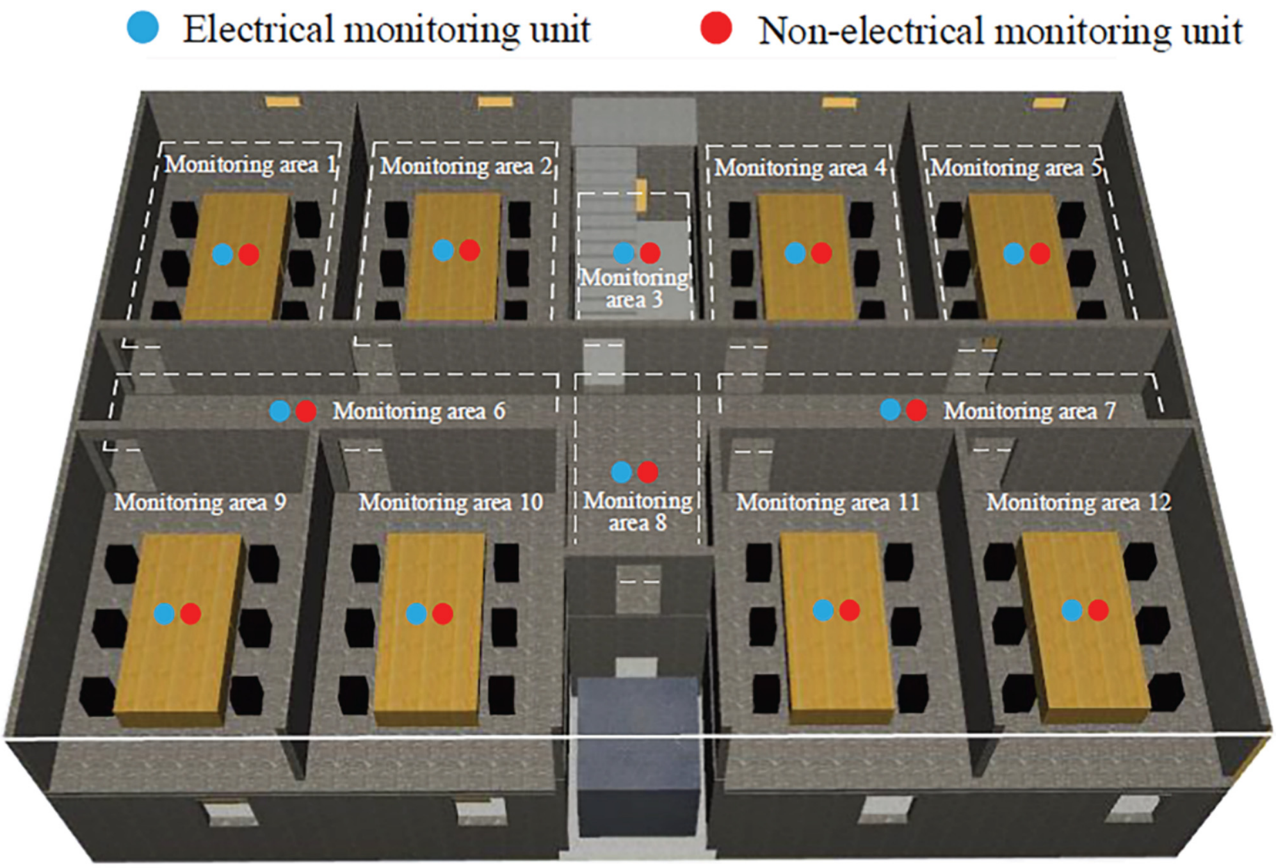

Fig. 10. Building plan layout.

– If the ambient temperature measured by three non-electrical monitoring units exceed the threshold W_T, it is considered that the fire has spread with the fire area expanding and the first-degree warning is displayed in the cloud platform.

For the electrical fire, the law of fault propagation is closely related to the law of fire development, and the combination of two aspects can be conducive to the cause identification of electrical fire. Based on the temporal and spatial information of fault and fire, the problem of insufficient physical evidence can be solved to improve the accuracy of cause identification.

As shown in Figure 10, the monitoring areas are divided by the wall according to the plane structure of building, and the electrical monitoring units and non-electrical monitoring units are arranged in each area. Under normal conditions, the electrical monitoring unit is installed in the low-voltage electrical meter box to measure the voltage and current. Meanwhile, the non-electrical monitoring unit is installed above the ceiling of room and corridor to monitor the smoke concentration and ambient temperature. In the cloud platform, each monitoring unit is mapped to the corresponding monitoring area. When the arc fault or fire is detected in the building, its occurrence time and monitoring area can be recorded and sorted by Sequence of Event (SOE) in the cloud platform.

Through the fault information and fire information, the type of fire can be distinguished according to the coincidence degree of their temporal and spatial information. The conditions identified as electrical fire are as follows:

– According to the information collected by electrical monitoring unit, it is judged that there is an arc fault has occurred in the building.
– According to the information collected by non-electrical monitoring unit, it is judged that there is a fire has occurred in the building.
– According to the temporal information of fault and fire, it is judged that the moment of fire occurrence is later than that the moment of arc fault occurrence, and two moments are close enough.
– According to the spatial information of fault and fire, it is judged that the arc fault location area overlaps with the fire location area.

If the above conditions are all met, it can be identified as the electrical fire. Otherwise, it can be identified as the non-electrical fire. In addition, based on the result of fault location, it can also be judged that the arc fault is on the upstream or downstream line of the low-voltage electrical meter box, so as to realize the boundary traceability. The flow chart of cause identification is shown in Figure 11.

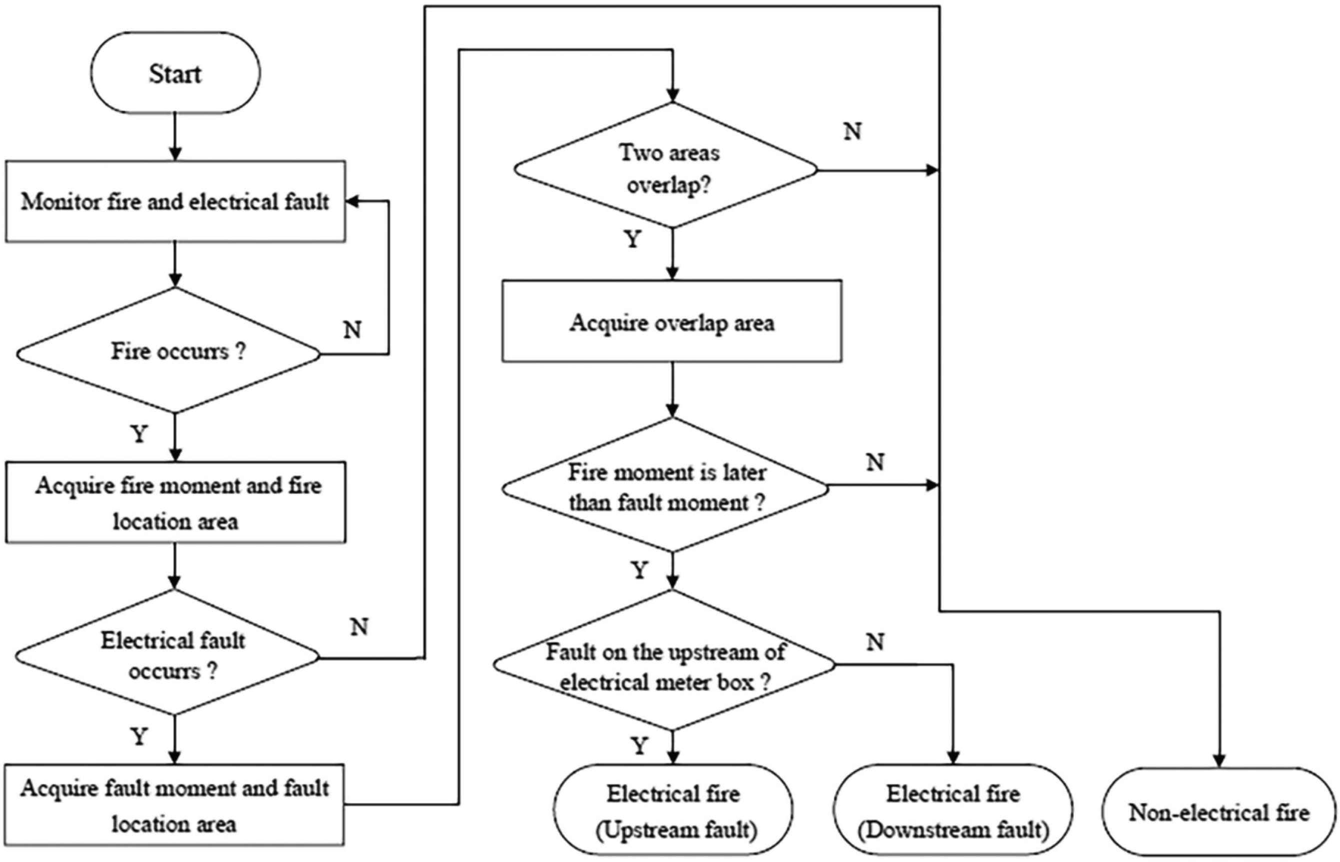

Fig. 11. Flow chart of cause identification.

4 Testing and analysis

In order to verify the effectiveness of proposed system, a laboratory is selected to test the system function in the demonstration building with a complete set of devices. The physical objects of monitoring units in the building are shown in Figures 12a and 12b. The functions of system are tested through the fault test and fire test, then comparing the results with the preset conditions to analyze the accuracy of system operation results.

The fault test is designed as the low-voltage series arc fault generated by the arc fault generator, as shown in Figure 12c. The distance between carbon pole and copper pole is adjusted through the knob, and then the series arc fault can be generated by arc pulling. Considering the actual ignition of arc fault, wire sheath is selected as the combustibles to simulate the ignition. The fire test is designed as the simulated fire generated by the smoke generator, as shown in Figure 12d. The smoke can be added to a non-electrical monitoring unit to simulate the fire. According to the information received by the cloud platform system, the response times of electrical monitoring unit and non-electrical monitoring unit can be recorded, as shown in Table 1. From the analysis of the response times, it can be found that the fault indication is sent out in an average time of 9.6 s, and the fire indication is sent out in an average time of 6.3 s. Therefore, both of response times are within the acceptable.

Table 1. Response times of monitoring units, Unit: s.

Electrical monitoring unit	Non-electrical monitoring unit
10.9	6.5
8.3	7.0
11.4	6.3
9.1	5.8
8.5	6.1

Based on the proposed system, the basic functions are tested, including communication, report query, fault monitoring and fire monitoring. As shown in Figure 13, after the system goes to work, the situation of demonstration building and the plane structure of each floor can be displayed on the browsing interface of cloud platform. In addition, the online rate and layout of each monitoring unit can also be viewed in real time, which indicates that the communication function is qualified.

Details of fault and fire can be recorded in the event list of system. According to the characteristics of series arc fault created in the test, the fault moment and location area can be determined by the upstream and downstream electrical monitoring units of fault point. The development of fire can be described by the non-electrical data imported into the system. With the increase of smoke

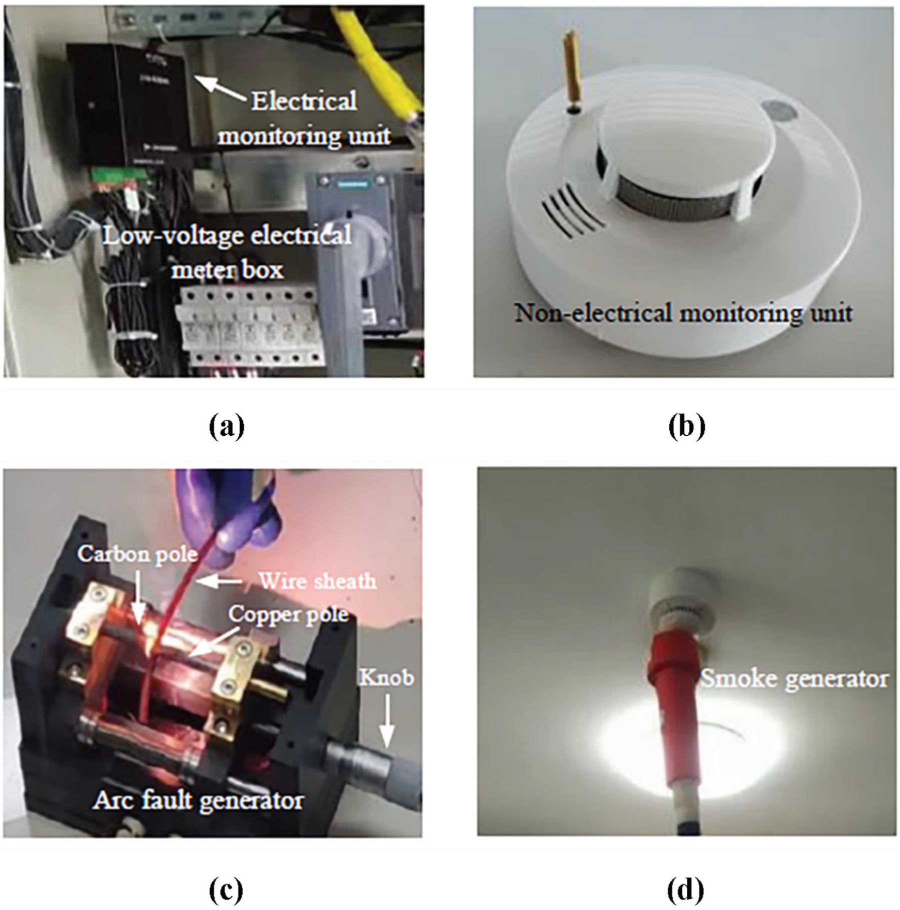

Fig. 12. Physical pictures of test. (a) Electrical monitoring unit. (b) Non-electrical monitoring unit. (c) Fault test. (d) Fire test.

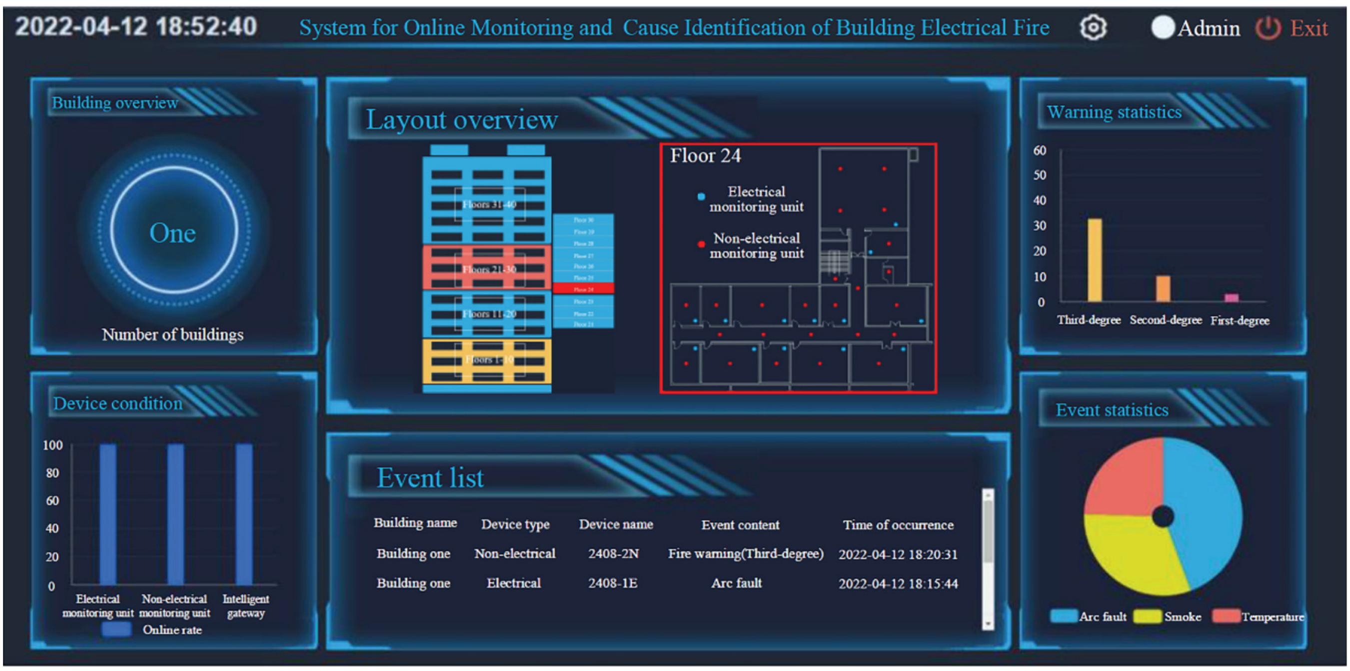

Fig. 13. Interface of cloud platform.

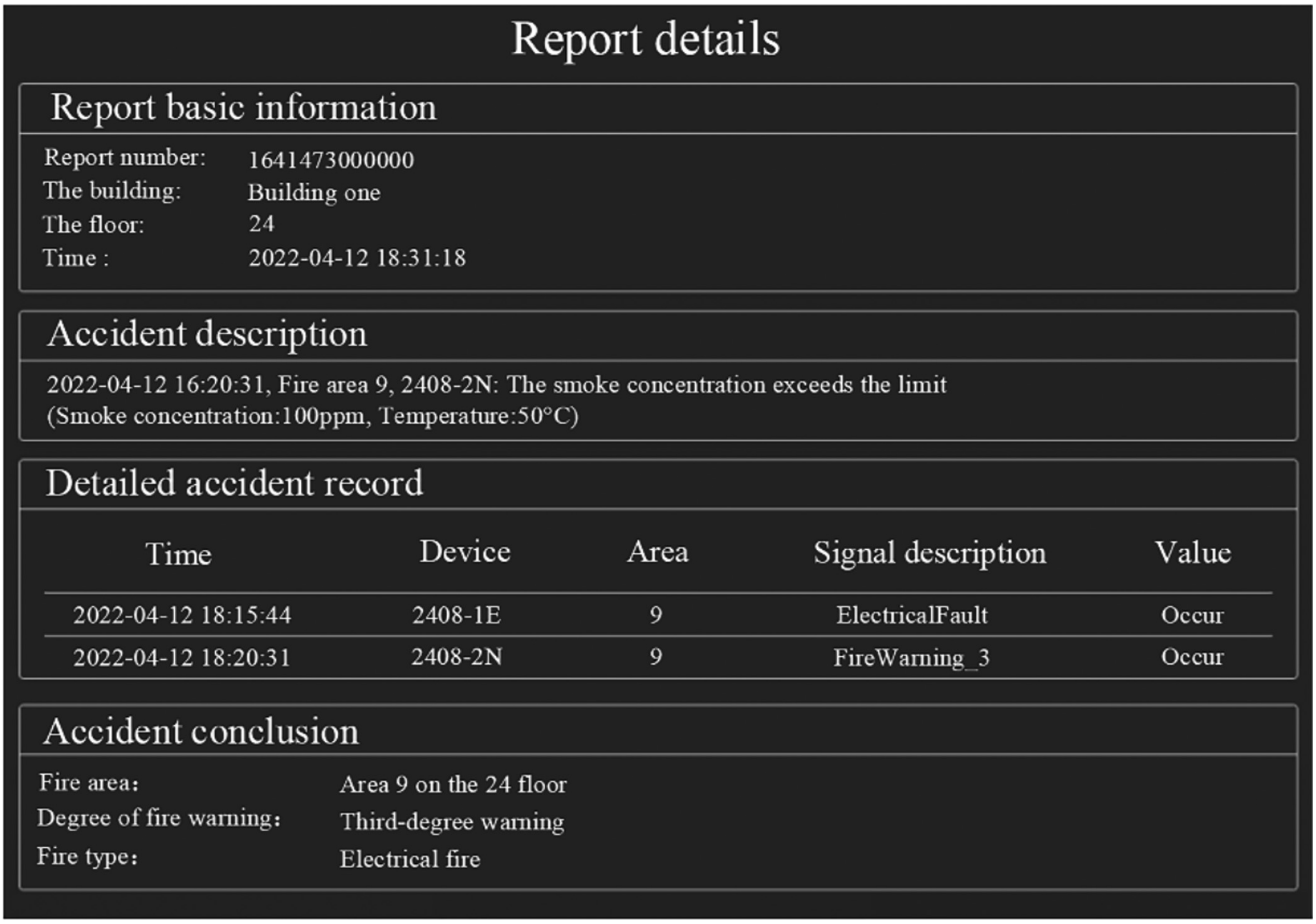

Fig. 14. Report details of accident.

and temperature, the fire moment and location area can be determined by the first non-electrical monitoring unit that exceeds the threshold.

As shown in Figure 14, the accident description of test can be completely displayed on the report query interface. The development process of accident can be reviewed by querying the report, so as to provide the basis for realizing the cause identification of building electrical fire.

Through the above test and analysis, the test results are consistent with the preset conditions. The basic functional requirements can be met by the designed system, which can provide effective help for online monitoring and cause identification of building electrical fire.

5 Conclusion

This paper presents a system for online monitoring and cause identification of building electrical fire. Based on the use of IoT technology, this system can reduce the workload of construction and maintenance management, which is suitable for office buildings, residential buildings and other buildings. The IoT technology can effectively solve the problems of interconnection and interoperability when large-scale devices are connected, and promote the intelligent development of monitoring systems. According to the collected electrical information and topological relationship of electrical monitoring units in the building, the monitoring and location of arc fault can be realized. Similarly, fire monitoring and warning can be realized by the non-electrical information. Finally, through the fault information and fire information, the type of fire can be distinguished according to the coincidence degree of their temporal and spatial information.

The actual testing results show that this system can effectively implement various functions, which can not only provide decision-making basis for firefighting, but also provide strong technical support for improving the safety of low-voltage power grid. Relevant research will continue to be carried out in the next step, the system will be further improved to enhance the ability of monitoring.

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