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Integrated Fire Protection System Based on IoT Detection Sensor

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Abstract. In this paper, the problems of integrated disaster prevention systems such as traditional temples, hanok houses, and cultural heritages, which are vulnerable to theft and fire, were improved. The existing disaster prevention systems for traditional temples and cultural heritages transmit the data of the detection sensors to the control server through wired communication due to the geographical reasons. When a disaster occurs, this method cannot perform communication because the cable is cut off or the power is turned off, and the integrated control of various sensors is impossible. Considering this point, the proposed integrated disaster prevention system transmits all the detected data to the integrated disaster prevention module first. The integrated disaster prevention module manages various data from IoT-based sensors, intelligent distribution boards, and IP cameras. In addition, it transmits the emergency state information to the control server using the protection circuit even when the communication is cut off and the power is turned off. Through this, an integrated disaster prevention system that can solve the problems of the existing disaster prevention system and can respond early to the accident is implemented.

Keywords; Cultural Heritage; Disaster Prevention; Crime Prevention; Integrated emergency management system; CCTV

1. Introduction

Currently, most of the cultural heritages are made of wood rather than stone, and they have been damaged by fire almost every year [1]. Accordingly, the interest in disaster

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prevention in the cultural heritage sites as well as its importance have been escalating, and the existing cultural heritage preservation and management paradigm focused on corrective maintenance has been pointed out as a problem. To address this problem, it is necessary to establish a disaster prevention management system capable of detecting abnormal condition in an early stage and performing swift and accurate initial response. Therefore, in this paper, the development and implementation of an integrated disaster prevention system that can manage and process various detection signals in real time are described [2].

2. System Structure

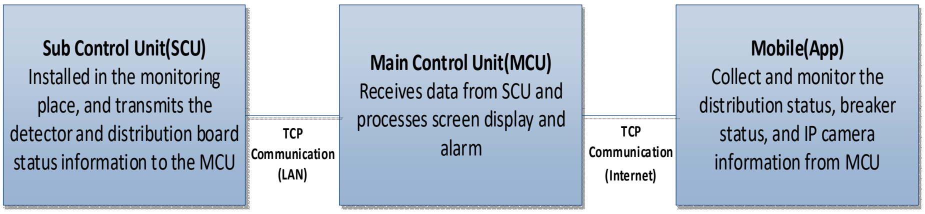

Fig 1. Integrated disaster prevention system configuration

The main control unit (MCU) receives the sensor and distribution board status information from the sub control unit (SCU) using TCP communication (LAN), displays it on the screen, and generates an alarm. When data is requested from a mobile app in real time, it transmits the data using TCP communication (internet). In addition, when an event occurs in MCU, an alarm is transmitted to the mobile application with a push message.

The mobile application receives the distribution board status, IP camera information, and alarm data from MCU. Using the received data, it displays the status of the distribution boards, breakers, and sensors on the screen. Furthermore, it receives the URL addresses of the IP cameras and shows the real-time videos of the cameras installed in the main places [3].

SCU consists of a crime prevention sensor, a flame sensor, a smoke sensor, a differential temperature sensor, a boundary indicator, an intelligent distribution board, and a built-in voice amplifier. SCUs installed in major facilities send event information to MCU. The power circuit selects the optimized AC-DC converter by analyzing the voltage and power consumption, and designs the power protection circuit for low voltage and overcurrent.

3. Experimental Results

Fig 2. Main and setting screens of MCU

The main screen of MCU used the GUI screen configuration and design based on the location and appearance of the actual cultural heritage to be monitored. The screen consists of a building object list, an emergency contact list, a text message transmission list, a complete event list, a voltage/current/temperature display, and a control window. When an event occurs, the corresponding building is displayed in red, and an alarm notification is displayed in the main window and event display. At the same time, a notification message is sent to the contacts registered in the emergency contact list. When the administrator detects the event, the inside of the corresponding building can be viewed in real time through the CCTV screen linkage technology. In the setting screen, the user can easily change parameters such as building registration, sensor setting, camera position setting, and alarm inquiry.

Fig 3. Fig. 3 Main and CCTV screens of the mobile application

The mobile application receives the distribution board and breaker status information from MCU and displays it on the screen. The screen consists of distribution board status display and control, alarm confirmation, and video viewing. When an event occurs, the screen is automatically switched to the corresponding building. In the same way as MCU, the event building is displayed in red, and the real-time image is displayed in a full screen or in quad screens by receiving the URL address of the IP camera. In places other than the control tower, the administrator can remotely set and control the main items of the disaster prevention system.

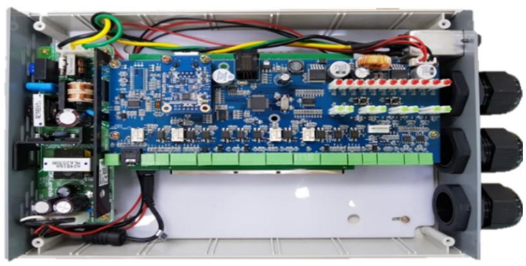

Fig. 4 Sub Control Unit

SCU's sensor interface consists of a crime prevention sensor, a flame sensor, a smoke sensor, a boundary indicator, and an intelligent distribution board. The room sensor, theft sensor, flame sensor, smoke sensor, temperature sensor, and boundary indicator use four input/output ports. The differential temperature sensor uses two input/output ports, and the intelligent distribution board performs RS485 communication. DC 24V input power was selected for the system power circuit after determining the voltage and power consumption used for each module. A power protection circuit for low voltage and overcurrent was designed, and PCB quality stabilization through the SMT process was performed.

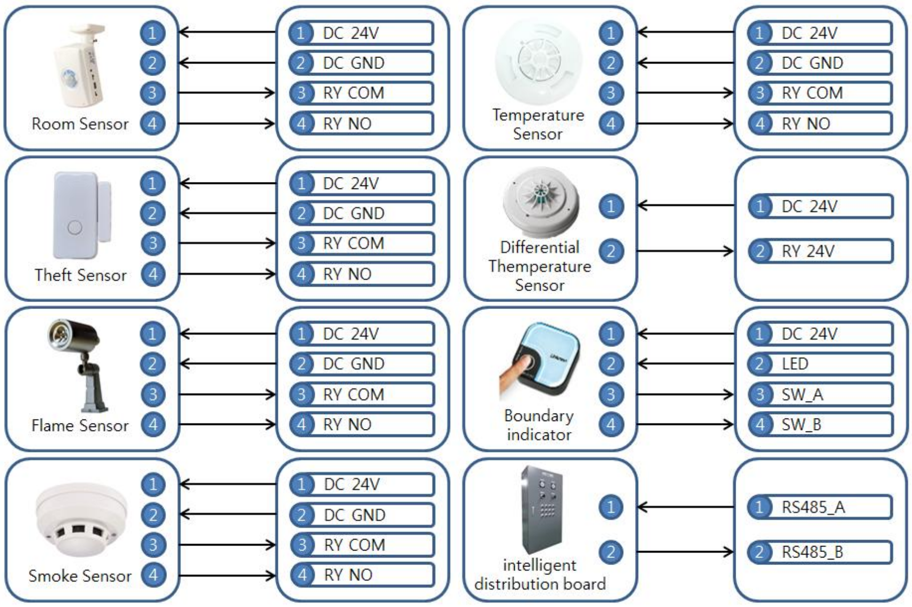

Fig 4. Fig. 5 Sensor Interface Circuit

4. Conclusion

This paper described the implementation of an integrated disaster prevention system based on IoT sensors. Recently, the market for disaster prevention systems that use IoT has been growing rapidly of late, but the existing disaster prevention systems that are used in actual disaster sites are vulnerable to disasters. In addition, there is no system that can integrate and manage various sensors such as theft, movement, flame, smoke, and differential temperature sensors. It is expected that the integrated disaster prevention system, which can transmit the emergency status and manage various detection signals in real time even when communication is cut off or the power is turned off, will be highly utilized.

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