Design of Intelligent Flame Detection System

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Abstract. This paper uses SCM as the control core to design an intelligent flame detection system based on flame sensor R2868. This system consists of 100 flame detection nodes and one hand-held terminal. Each flame detection node includes flame sensor and its driver module, step motor and its driver module, clock module, sound and light alarm, wireless transmission module, and display circuit and keyboard. The flame sensor can acquire the flame condition and direction within 5 meters in real time, and the node sends the flame information and the detection time to the hand-held terminal. The flame sensor is not affected by fluorescent lamp. The hand-held terminal with wireless transmission module, display circuit and keyboard can inquire the information of the flame detection nodes in automatic and manual modes. After multiple trials, the system works stability, which has a certain theoretical significance and practical value on the intelligent fire alarm.

Introduction

Every year in China and other countries, the fire accidents cause great economic losses and casualties. Flame detection is vital to preventing fires. Flame detection has two solving methods of introducing flame detection sensors and using image processing technology.

Flame detection module is one of the key modules of indoor fire detection system. The quality flame detection module is directly related to the performance of the system. Therefore, designing high accurate measurement of flame direction and the distance between the fire and the test point is critical [1]. The collected flame signal is transmitted by photoelectric device through multi-amplifier to the control unit, obtaining the accurate flame frequency and intensity by computational procedure, and displaying the current working status of the system by the digital tube and relay output [2]. The wireless network HD real-time monitoring system is designed and realized, and the flame detection algorithm is integrated which is suitable for the embedded system [3]. Aiming at residual flame detection after fire, proposing a kind of hand-held fire detection system which combines UV sensor technology and ZigBee wireless network technology. The detection system is designed to realize the accurate flame detection through hardware, software and topology structure in a variety of complex environment [4]. In order to monitor flames effectively, and meanwhile reduce the false alarm rate, the theory of UV flame detective sensors and infrared flame detective sensors are studied [5]. Communication system for coal-flame detection is proposed based on freescale [6]. Voronoi-based coverage improvement approach for wireless directional sensor network is studied [7].

Image processing technology in the flame detection increases the research cost, and needs the better software algorithm. While the system with the flame detection sensors can decrease the cost and need not the high software support.

Overall System Framework

The intelligent flame detection system includes one hand-held terminal and 100 flame detection nodes. The hand-held terminal can gain the flame information from flame detection nodes. The overall system framework is shown in Fig. 1.

Each detection node with a flame detection sensor is driven by the step motor to search the flame and record the flame information, such as the direction and state of the flame, and the time for

finding the flame. When the flame is found, the node gives sound and light alarm, and sends the flame information to the hand-held terminal. And the hand-held terminal can inquire the flame information in the automatic or manual way. The node with the its sole address can be 100 meters away from the hand-held terminal, between them, wireless communication can be used (via wireless module NRF905). Fig .2 and Fig .3 shows the sketches of the hand-held terminal and nodes respectively. They uses STC89C58 as their control core. The hand-held terminal consists of DS1302 clock module, keyboard, NRF905 wireless transmission module and displaying screen from Fig .2. Here, the user can use the keyboard to change the visiting addresses of the detection nodes in the manual way. And the detection node has several parts more than the hand-held terminal, these are, sound and light alarm, step motor and its driving module, and flame sensor and its driving module. The hardware schematic and software flow diagrams are given in the following.

Fig. 1 The overall system framework

Fig. 2 The sketch of the hand-held terminal

Fig. 3 The sketch of the detection node

Fig. 4 Hardware schematic diagram of the Hand-held Terminal

Hardware Design of the Hand-held Terminal and Detection Nodes

As shown in Fig .4 and Fig .5, the hand-held terminal and detection node have their own SCM minimum system. The clock module adopts DS1320 with only 8 pins. The displaying screen uses LCD12864 which can display 4 lines of letters or characters. NRF905 is chosen as the wireless communication device with transmission distance 100 meters. The step motor can rotate the flame sensor to look for the flame.

Fig. 5 Hardware schematic diagram of the detection node

Fig. 6 Program flow chart of the hand-held terminal

Fig. 7 Program flow chart of the detection node

Program flow charts of the hand-held terminal and detection node

Fig .6 and Fig .7 shows the program flow chart of the hand-held terminal and detection node respectively. The user may set manual or automatic inquire way through keyboard from Fig .6. In the manual inquire way, the visiting address from 1 to 100 can be set and the flame information can be inquired. In the automatic way, the visiting address pluses one automatically and the responding information can be shown. From Fig .7 the flame detection monitors the flame all along and sends the flame data to the hand-held terminal when requested for the node information.

Conclusions

This paper designs an intelligent flame detection system based on SCM STC89C58, and the flame sensor R2868 not affected by fluorescent lamp is used. This system includes one hand-held terminal and 100 flame detection nodes, between them, wireless communication modules NRF905 are used to transmit the address and the flame information. This paper gives overall system framework, the sketches of the hand-held terminal and detection nodes, hardware schematic diagrams and program flow charts. This design can be embedded in the internet of things and play an important role in the intelligent fire alarm.

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