Hardware Design and Web-based Communication Modules of a Real-time Multi-Sensor Fire Detection and Notification System using Fuzzy Logic

ABSTRACT

Fire is a phenomenon combustion manifested in light, flame, and heat. There are three main elements required for fire to exist, these are; oxygen, heat and fuel. The proportion of each of these elements determines the nature of the fire. This paper presents the design and development of a fuzzy logic based multi-sensor fire detection system and a web-based notification system. Until recently, most consumer grade fire detection systems relied solely on smoke detectors. The protection provided by these have been established to be limited by the type of fire present and the detection technology at use. The problem is further compounded by the lack of adequate alert and notification mechanisms. A typical system relies on the physical presence of a human being to act on the alert. In developing countries, poor planning and addressing negatively affects the fire and rescue crew's response time. To address this problem, a fuzzy logic system was implemented using an Arduino development board with inputs from an MQ2 smoke sensor, a TMP102 temperature sensor and a DFRobot flame sensor. The output of the detection system is sent over SMS (Short Message Service) using a SIM900 Global System for Mobile Communication (GSM) module to the web-based system and the house owner or caretaker in real-time. With access granted to the web-based system, the fire and rescue crew also get notified in real-time with location information. A comparison between the efficiency of the notification system employed by standard fire detectors and the multi-sensor remote based notification approach adopted in this paper showed significant improvements in the form of timely detection, alerting and response.

EXISTING SYSTEM

Fire is a phenomenon combustion manifested in light, flame, and heat. There are three main elements required for fire to exist, these are; oxygen, heat and fuel. The proportion of each of these elements determines the nature of the fire. Due to lack of our attention many deaths are occurred due to fire. Prior to the introduction of technology, fire detection was done mainly by visual inspection and confirmation. This however changed during the late 1930s when Walter Jaeger accidentally discovered a sensor which capable of detecting smoke thereby paving the way for research into modern smoke sensors . Smoke detectors are broadly categorized into photoelectric based and ionization based detectors. Photoelectric based detectors employ the light scattering ability of smoke particles to detect the presence of smoke whereas the ionization based detectors are designed with an ionization chamber containing a radioisotope (usually Americium-241). In the absence of smoke particles the ionized air molecules within the chamber allow the passage of a small electrical current between the charged electrodes in the chamber . The presence of smoke particles leads to a drop in the current between the electrodes. The need to produce a more reliable fire detection system devoid of false alarms has led to the adoption of a multi-sensor approaches. Unlike fire detection approaches relying solely on smoke, this approach relies on the detection of more than one fire signature. Due to the effectiveness and efficiency of multi sensor based fire detection systems, current research on fire detection is largely focused on developing better algorithms and processing techniques based on the data received from the sensors, thereby reducing false alarms.

DRAWBACKS

- There may be a chance to get false alarm.
- It requires manual actuation of the fire alarm using a button or a break glass station.
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PROPOSED SYSTEM

This paper presents the design and development of a fuzzy logic based multi-sensor fire detection system and a web-based notification system. In developing countries, poor planning and addressing negatively affects the fire and rescue crew's response time. To address this problem, a fuzzy logic system was implemented using an Arduino development board with inputs from an MQ2 smoke sensor, a TMP102 temperature sensor and a DFRobot flame sensor. The output of the detection system is sent over SMS (Short Message Service) using a SIM900 Global System for Mobile Communication (GSM) module to the web-based system and the house owner or caretaker in real-time. With access granted to the web-based system, the fire and rescue crew also get notified in real-time with location information. A comparison between the efficiency of the notification system employed by standard fire detectors and the multi-sensor remote based notification approach adopted in this paper showed significant improvements in the form of timely detection, alerting and response.

ADVANTAGES

- It reduces of getting false alarms.
- It easier to analyze the often noisy sensor data.
- Rescue operation is done quickly.

SYSTEM EQUIREMENTS
H/W System Configuration:-

- Processor   -   Pentium –IV
- RAM   -   4 GB (min)
- Hard Disk   -   20 GB
- Key Board   -   Standard Windows Keyboard
- Mouse   -   Two or Three Button Mouse
- Monitor   -   SVGA

S/W System Configuration:-

- ➢ Operating System　　　:　Windows 7 or 8 32 bit

- ➢ Application Server　　　:　Tomcat5.0/6.X

- ➢ Programming Language　:　Java

- ➢ Java Version　　　　　:　JDK 1.6 and above