Intelligent Detection and Prediction of Indoor Fires Based on Gamma Distribution Models for Long-Term Care Facilities

Abstract

Early detection of fire incidents can greatly improve the efficiency of disaster control and reduce the risk of losing life and property. Recognition of development patterns of main causes of fire casualties closely correlates to determining strategies needed for associated rescue actions. Long-term care facilities usually provide services to individuals relying on assistance in daily living. Automated and intelligent fire detection and prediction systems can greatly help when emergency situations arise. This work aims to investigate such an intelligent system. An intelligent fire incident data perception and analysis system was designed to analyse fire incidents. We conducted two combustion experiments and collected data within designated spaces simulating the environment of long-term care facilities. In the first experiment, data were collected and models of several attributes were built to approximate fire development using various techniques. The gamma distribution-based models, related to entropy function in the second law of thermodynamics, most closely approximated the actual trajectory, especially in the early stages of the fire. The models derived were then used to predict the fire development of the second combustion. The prediction results were compared with data of the actual experiment. The comparison concludes that the prediction can effectively estimate the fire development and thus can help in reducing life-threatening risk during fires.

Keyword: Intelligent systems, fire detection and prediction, indoor fires, gamma distribution, Internet of Things