Abstract

More and More smart cameras or various types of sensing devices are installed in modern buildings to monitor the state of the environment. These include the smoke sensor and temperature sensor, which use the change in smoke particle density or temperature rise to judge whether there is a fire occurring. However, the various sensing devices and cameras only identify independently whether a fire is occurring or has occurred. Unequal or uncoordinated fire site information often results in misjudgment of fire or inefficient rescue.

This study proposes a novel AIoT-based, real-time fire detection system, named the Hfd-RTFD system, which predicts the probability of an occurrence of a fire by using AI-based model training data from AIoT environments. In the Hfd-RTFD systems, the heterogeneous data includes temperature, multi-gas concentration digital values, and flame images. The temperature and multi-gas concentration digital values, such as CO, CO2, H2S, are collected by multi-sensing detection module devices, and transmitted to the IoT platform. Moreover, the flame images are parallelly received by IP Webcams and transmitted by Real Time Streaming Protocol to a deep-learning based object detection model, which is used to detect the flame position and the recognition rate. An AI-based fire prediction model in the Hfd-RTFD systems processes and trains on the heterogeneous data to predict the probability of a fire occurrence.

Furthermore, the experimental result in this study shows that the accuracy of the integration of multiple perceptions is 92.28%, especially for the extremely early flames. The very early flame detection in this study improves the speed and accuracy of fire identification, and effectively assists fire-fighters in planning for disaster relief operations to avoid misjudgements caused by single information from fire images, temperature,
or gas concentration information respectively.

Keyword: AIoT, deep learning, fire detection, heterogeneous data fusion