Chapter 4
IoT-Based Economic Flame Detection Device for Safety

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ABSTRACT

Mainly fires are of three types (i.e., ground, surface, and crown fire), which occur as wild land/forest fire, residential fire, building fire, and others. The number and effect of fires are an outcome of global warming, extinction of species, and climate change. To battle against these parameters/disasters, it is important to take on an exhaustive and complex methodology that empowers nonstop situational mindfulness and moment responsiveness. The outcome is unrecoverable and dangerous to the climate, environment, people's lives, and causes economic losses. The issues/barriers in the detection of fire are discussed here. For that, the authors have identified and ranked those challenges by using the best worst method. They have designed an automatic fire alarm detector at sensitive sites as one of the preventive steps to avoid the hazard. It can detect heat in a specific environment, raise an alert, turn off the building's mains, and even spray water to minimize the intensity of the fire.

1 INTRODUCTION

With the rapid expansion of urbanization across the world, the numbers of exceptionally long-term inhabitants in urban areas, as well as the population, are expanding. There are circumstances where natural elements, non-natural factors, or human factors interrupt people's lives and livelihoods and result in fatalities, environmental harm, property losses, and psychological effects. Every fire process always produces smoke and heat, and the temperature will rise when there is a fire (Ehsan et al. 2022). Flammable substances chemically react with oxygen to start flames through combustion. A high oxygen content will increase the likelihood of a fire starting. Fire disasters have historically occurred in densely populated areas. When a fire erupts, it endangers people's lives and results in enormous financial damage. So, fire detection has grown to be a major problem in recent years because to the significant damage it has caused, including the loss of human lives. These incidents can occasionally become more destructive if the fire

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spreads to the nearby area. One efficient technique to prevent loss of life and minimize property damage is early fire detection. The fire needs to be detected early on to be evacuated from a burning location and put out the fire source. The simplest option to see a fire early and stop damage is to install a fire alarm system (Saeed et al. 2018). Fire alarms are made up of numerous interrelated parts that may detect fire and inform people via visual and audible ways. The alarm could include horns, mountable sounders, or bells. According to a research from the National Crime Records Bureau's Accidental Deaths and Suicides in India (ADSI) database, fire-related mishaps killed 35 people on average every day between 2016 and 2020. Even though the number of these accidents has been continuously diminishing, this still occurs.

According to incomplete statistics, there were 312,000 fires in India in 2016, with 1,582 people killed and 1,065 wounded, and $3.72 billion-dollar immediate property damage. There were multiple large-scale fires throughout the world in March and April of 2019, including forestry fires in Liang Shan, China, the Notre Dame fire in France, woodland fires in Italy, and a meadow fire in Russia, all of which caused substantial damage to people's lives and property. Alkhatib (2014) have summarized all the technologies that have been used for forest fire detection with exhaustive surveys of their techniques/methods used in this application. Current techniques for urban identification rely on a variety of sensors for detection, such as smoke alarms, temperature warnings, and infrared beam warnings. Iqbal et al. (2021) mention that, even though these safeguards can help, they have serious drawbacks. To begin, an exact convergence of visible particles all around must be achieved to set off an alert. When an alarm is triggered, a fire may already be too large to even attempt to put out, undercutting the goal of early notice. Second, in a restricted environment that is incapable of a broad space, such as outside or public settings, the bulk of the notifications must be utilitarian. Third, there may be incorrect warnings. Sharma et al. (2020) state that when the non-fire molecular focus approaches the caution fixation, the alert is automatically heightened. People are unable to intervene and receive up-to-date data in a timely manner.

As per the Accidental deaths & suicides in India (ADSI, 2019) report, the number of people injured in fires has more than quadrupled, with 441 injured in 2019 compared to 1,193 in 2015. Regardless, most people were injured as a consequence of fires during this time period in 2017 (ADSI, 2019).

While the decrease in the number of fire-related occurrences, as well as deaths and injuries, is positive, the much higher number of deaths in relation to injuries is alarming. This greater mortality rate might be attributed to difficulties with clinical and crisis management in dealing with such situations, which could have resulted in a lower loss of life. Other variables, such as the severity and nature of the fire occurrences, may also contribute to higher mortality. According to_ADSI data, the total number of fire disasters has reduced during the last five years.

have explained that the Node MCU micro controller has an inbuilt Wi-Fi to acquire internet signals and provides a constant bridge between the sensor unit and the server end for remote data maintenance. The proposed logic is helpful in identifying the fire signals and informing the respective person to take appropriate action to prevent forest fires. Due to their role in preserving the stability of the universe's whole ecology, forests are important for both human survival and societal advancement (Ahmad et al. 2019; Ahmadi et al. 2017; Alkhatib 2014). Regrettably, certain unchecked human activities and unpredictable climatic conditions frequently result in forest fire scenarios (Avazov et al. 2021; Alqourabah 2021). Such fires are by far the most harmful to both human ecology and environmental assets (Arana-Pulido et al. 2021; Ajith et al. 2018; Bhoi et al. 2018; Faroudja et al. 2020). Due to global warming, increased mortality, and other factors, forest fire scenarios have considerably grown in frequency in this condition (Zope et al. 2020; Sinde et al. 2020).