

# INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

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**Abstract:** The proposed model in this paper employs different integrated detectors, such as heat, smoke, and flame. The signals from those detectors go through the system algorithm to check the fire's potentiality and then broadcast the predicted result to various parties using GSM modem associated with the GSM network system. The system uses various sensors to detect fire, smoke, and gas, then transmits the message using GSM module. After the message, send by the module the help arrives in 15 minutes. The system is associated with water pump and a sprinkler. The Water system is associated with a water tank and a sprinkler. The water tank uses a Ultrasonic sensor to monitor the level of water level in the tank for refilling the water tank. Once fire is detected, it automatically sends the emergency message and sprinkles the water.

**Key words:** COVID-19, Containment, Convolutional Neural Network & Deep Learning



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## Introduction:

Nowadays, fire incidents have become a critical issue, which must be dealt with on time without any unnecessary delay to avoid the loss in lives and belongings. It is considered a fire situation when the monitored temperature exceeds 50oC. In critical places such as hospitals, schools, and banks, personnel's arrival time to come for help in fire hazards is around 15 minutes. The statistics show that there are 1,291,500 structural fires annually in the United States, causing 2,950 civilian deaths, 16,600 civilian injuries, and 14.8 billion in direct property damage. According to the national fire protection association (NFPA), two-third of U.S. household fires occur in premises with no working smoke alarms, alarms with no proper maintenance, or misplaced alarms. The appropriate allocation of fire alarms with a proactive

warning could save lives and reduce property losses. Particularly, there are many types of fire alarms as heat detectors and smoke detectors studying these types helps to decide which type is more suitable for home or store. For instance, heat detectors are classic options when the temperature reaches a certain level. Thus, it is more suitable for applications that rapid response is not required or in an environment where smoke detectors cannot be placed like frozen areas. Heat detectors have a lower false alarm rate but still slower in response because the temperature rises slowly. With all these lacks, smoke detectors remain better than heat detectors. Smoke alarms will more likely detect fires before it really starts. Smoke comes when the energy of an object is consumed due to the loss of carbon dioxide (CO<sub>2</sub>) from heat. Smoke detectors are classified into three types: ionization, photoelectric, and combination. All these types can be studied further in instruments and measurement books. In this study, we will highlight a brief description of ionization. In brief, ionization is a radioactive material that receives radiation from the fire. It enters the ionization chamber, which is an air-filled space between two electrodes and permits a small, constant current between the electrodes. This type is the best for fast fires or fires caused by bombs or accidents.

The concept of internet of things (IoT) nowadays is applied in many applications ranging from the smart industry, smart agriculture to smart healthcare, and smart home application. Home automation is an area where IoT has several advantages. In the case of remote plant locations, for example, technology enabling remote operation and maintenance will benefit; autonomous inter appliance such that devices are mutually aware of the information exchange, thereby minimizing engineering costs in handling all devices involved. Nowadays, fires can get out of control because people intend to save money rather than installing proper fire alarm systems. Some problems are still on, such as affordability, effectiveness, and responsiveness. Previous related works such as network-based real-time integrated fire detection and alarm (FDA) system with building automation have been done to overcome these problems.

Considering the aforementioned challenges, this study focuses on building an advanced fire alarm using heat and smoke alarms. The system reads the flame, heat, and smoke data using IoT, analyzes these data, and then quickly triggers the automatic water sprinkler. Thus, this study's importance is to provide a low-cost fire alarm system considering the affordability, effectiveness, and responsiveness.

Many studies have been conducted to address these issues like; however, fire detection issues are not addressed properly since these systems rely on machine vision, where the algorithms need more images to train, and the detection rate is not satisfactory. Other approaches like [36, 37] suffer from some limitations, mainly slow time responses and low accuracy. Thus, this paper aims to minimize false alarms, provide faster response, and a new IoT approach than previous studies that used mostly Node-Red. The contribution is as: i) To determine which combinations and algorithms of sensors can accurately and quickly detect fires;

ii) We have designed and then developed a system that detects fire and activates the fire alarm; iii) the proposed system evaluates the situation and initiates an automatic water sprinkler where the water unit was designed separately; and iv) the system analyses the collected data using Ubidots platform which results in a faster response. Thus, the highlighted four points make the proposed system superior in terms of affordability, effectiveness, and responsiveness.

#### **Sending Alert SMS to User:**

This project's main objective is to help the Authority to automatically monitor the industry by providing them with access to a web app that lets them monitor variables like temperature, gas and flame on the industry. They also intimate the nearest fire station for help and automatically switch on the motor to sprinkle water on fire. The fields of Fire accident prevention and Fire accident alarms are the subject of substantial research by numerous academics and professionals. In order to increase safety and prevent Fire accidents, many different techniques are applied. For ease of reference, stand-alone, cooperative, and hybrid strategies are separated in the Fire accident detection and avoidance literature. While stand-alone approaches use sensors for Fire accident avoidance and detection, such as Flame sensor, Temperature sensor and Gas sensor.

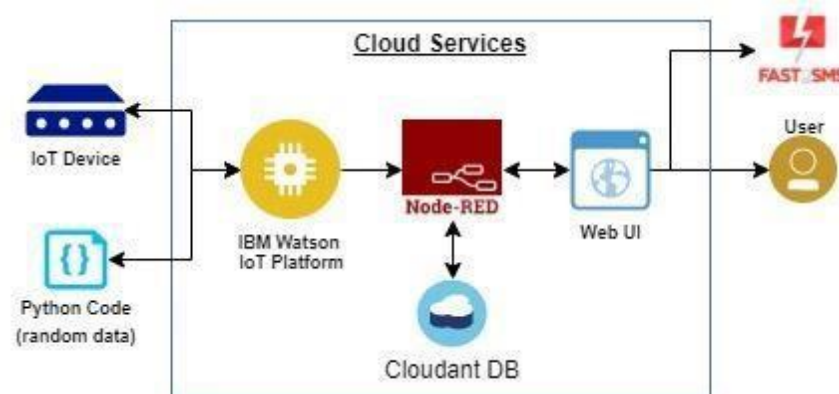
#### **Gets Alert notification through website:**

Fire is a very dangerous situation, and it is very much necessary to monitor and give warning before anything untoward happens. In many developing countries, houses do not come fitted with fire alarm system as seen in developed countries like Singapore, USA etc. This results in fire being unattended and leading to lot of losses like property, human. This is the IOT (internet of things) based fire monitoring and controlling system which not only gives the real time information about the situation on the monitor but also takes the corrective action as per the need. In this system the sensors transfer data wirelessly with the help of MQTT (message queuing telemetry transport) networking protocol which is designed for constrained with low bandwidth. MQTT allows us to send commands to control output, read and publish data from sensors nodes and much more. The first concept is the publish and subscribe system. In a publish and subscribe system, a device can publish a message on a topic, or it can be subscribed to a particular topic to receive message. Also, it is perfect solution for internet of things application. Due to this all data can be stored in server and this data can be access by the Application program interface which we can display on the monitor and with the help of software the operator can visualize the condition at the time of fire accident.

#### **Logic for a process in the application:**

The problem of gas leakage and fire is often encountered in our day-to-day life. LPG, Liquefied Petroleum Gas, is highly flammable gas used as fuel in heating appliances. Leakage of this gas

raises the risk of building fire, suffocation or an explosion. The mentioned problem can be solved with the development of reliable techniques to detect gas leakage. As soon as gas leakage will be detected, user will be notified via SMS and call so that he/she can turn off gas valve from anywhere in his workplace. The issue of flame and fire at kitchen can be monitored with the help of fire sensor. The buzzer starts beeping whenever fire is detected. In addition to these, it is often found that a person forgets to book gas cylinder due to his/her busy schedule. The main aim of this paper is to design an IOT based Smart Gas Management System that will be able to detect gas leakage and fire. With the help of load sensor, automatic booking of a gas cylinder is also facilitated. Notification is sent to the booking agency to book a gas cylinder whenever load cell detects that the weight of gas cylinder has reached below a threshold value. At the same time, user will be notified about gas cylinder going empty.

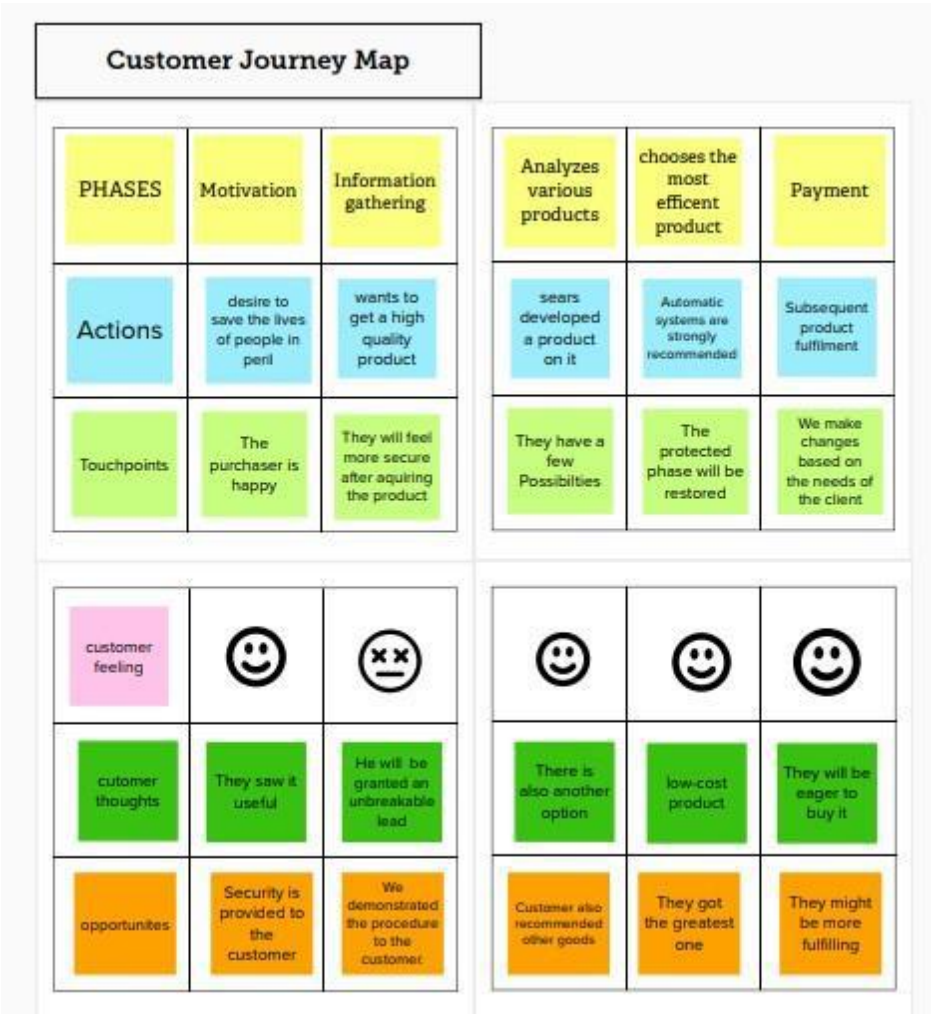


**Fig.1. Solution Architecture:**

### **IOT Based Smart Gas Management System:**

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NB-IoT refers to a cellular-based narrowband Internet of Things, which has become an important part of the Internet of Things. NB-IoT is a new technology emerging in the field of Internet of Things in recent years. It has obvious advantages in technology and application. In addition, the application of narrowband Internet of Things (NB-IoT) technology in the field of fire protection can fundamentally enhance the combat capability of fire fighting forces, avoid fire and reduce the loss of life and property of the people. This thesis analyses and introduces an intelligent fire-fighting system based on the new industry standard, and a smoke-fire detection and alarm device based on the Internet of Things (IoT) platform and Nb-IoT technology. It also puts forward corresponding solutions to the problem of smart smoke, such as the value, advantages and future expectations of the solution.

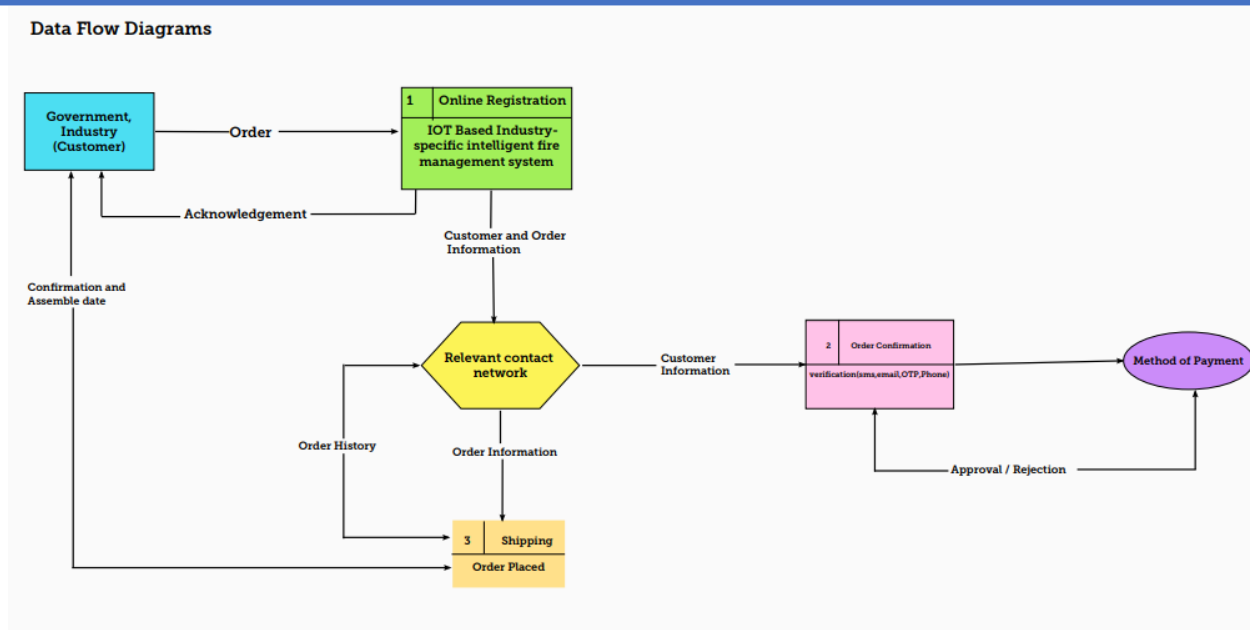


**Fig.2. Customer Journey Map:**

**A Smart Fire Detection System using IoT Technology with Automatic Water Sprinkler:**

Implemented to provide the fire department with the necessary data. Finally, the main feature of the proposed system is to minimize false alarms, which, in turn, makes this system more reliable. The experimental results showed the superiority of our model in terms of affordability, effectiveness, and House combustion is one of the main concerns for builders, designers, and property residents. Singular sensors were used for a long time in the event of detection of a fire, but these sensors cannot measure the amount of fire to alert the emergency response units. To address this problem, this study aims to implement a smart fire detection system that would not only detect the fire using integrated sensors but also alert property owners, emergency services, and local police stations to protect lives and valuable assets simultaneously. The proposed model in this paper employs different integrated detectors, such as heat, smoke, and flame. The signals from those detectors go through the system algorithm to check the fire's potentiality and then broadcast the predicted result to various parties using GSM modem associated with the system. To get real-life data without putting human lives in danger, an IoT technology has been responsiveness as the system uses the Ubidots platform, which makes the data exchange faster and reliable.

Many fire situations have represented the loss of lives and material costs due to the lack of early fire detection through smoke or gas sensing, which can become complex and critical. Meanwhile, engineers worldwide develop and test multiple systems for smoke and gas detection, commonly based on sensor networks, digital image processing, or computer vision. Furthermore, the detection system must work thoroughly with alarms and warnings that aware of a risk situation for prompt evacuation of the population in the surroundings based on a reliable data network topology with adequate device deployments that will let us know the moment a fire outbreak. This paper presents a low-cost Internet of Things (IoT) prototype for fire detection in outdoor environments based on sensors and Low Power Wide Area Network (LPWAN), focused on the accuracy in the temperature and gas measurement at the moment a fire starts. For its achievement, we integrated wireless components, development boards, and electronic devices, following the management of information updates through a database schema for the alarm settings based on the data gathered from the Sensors.



**Fig.3. Flow Architecture:**

### Conclusions:

The World won't change by itself, but we can make it's safer, better and less harmful. The fire detection systems proposed in the literature served fire stopping with no care of the responsiveness. Thus, this study considers the existing issues and build an efficient and effective fire detection system based on IoT technology, gas, temperature, and smoke sensors to collect the data accurately and rapidly. The continuous readings sent over WIFI modules to the central unit to analyze the data and trigger the water sprinkle. This system structure enhances the efficiency and effectiveness of fire detection. Moreover, using the Ubidots platform in this system made the data exchange faster and reliable. However, this study's proposed approach obtained an average response of 5 seconds to detect the fire and alert the property owner. Meanwhile, the water pump activated to suck water from the tank and release it into the water sprinkler to minimize the fire until the property owners and emergency services reached. Hence, the proposed system overcame the challenges of the issues of affordability, effectiveness, and responsiveness. The proposed system still needs further enhancements. Thus, one of the enhancement directions is integrating machine learning with the system to predict the potentiality of fire based on the collected data from different sources. Machine learning may help the operators find and overcome the vulnerabilities in their building to prevent fire instead of detection only.

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