**FireScout**

A Portable Device for Real-Time Classification of Common Fires

**Abstract**

This paper presents FireScout, a portable, box-shaped device developed to address the critical danger of misidentifying common fires. Incorrectly classifying a fire can lead to the use of the wrong extinguishing agent, a mistake that can significantly escalate the danger to life and property. FireScout provides a solution by performing real-time analysis of a fire scene. The device uses an integrated fan to draw in ambient air, which is then analysed by a multi-sensor array. An embedded AI model processes this data to classify the fire as either Class A (combustible organic materials) or Class B (flammable liquids). The classification is then displayed on an on-device dashboard, providing first responders with the essential data needed to make a safe and effective decision.

**Introduction & Problem Definition**

In emergency firefighting scenarios, the inability to quickly and accurately identify a fire's source is a significant challenge. Different types of fires require different extinguishing agents. The application of the wrong agent—for instance, using water on a flammable liquid fire—can be ineffective and dangerously counterproductive, leading to the exacerbation of the blaze and a compounded loss of life. FireScout is designed to solve this problem for common fire types by providing immediate, on-site classification, enabling a safer and more effective response.

**The FireScout Solution**

In its current form, FireScout is a portable, rectangle-shaped device designed for easy placement near a fire. Its operational workflow is focused on simplicity and speed:

1. **Deployment:** The device is placed in the vicinity of the fire.
2. **Air Intake:** A 4010 fan actively draws ambient air into the device's enclosure.
3. **Sensor Data Acquisition:** The airflow passes over a suite of integrated sensors that acquire data on airborne particulates and chemical composition.
4. **ML-Based Fire Classification:** The sensor data is processed by an embedded AI model that classifies the fire as Class A (fires involving organic materials like wood or paper) or Class B (fires involving flammable liquids).
5. **Dashboard Display:** The classification result is displayed on a real-time, on-device dashboard, providing clear and immediate feedback to the user.

**Technical Foundation**

FireScout’s design leverages proven sensor technology and edge computing principles to create a functional and portable prototype.

* **Mechanical Design:** The system is housed in a rectangular box. Air sampling is achieved using a simple and effective active intake system powered by a 4010 fan.
* **Sensing and AI:**
  + **Multi-Sensor Fusion:** FireScout uses a combination of sensors (such as the PMS7003, MQ-9, and BME680) to gather comprehensive data about the fire's characteristics. This approach of fusing data from multiple sensors is validated by research as a method to improve accuracy and reduce false alarms.
  + **Edge AI Deployment:** The classification is performed by a machine learning model deployed directly on the device's embedded hardware. This allows for real-time analysis without needing a connection to the cloud, a methodology supported by literature on modern fire detection systems.
  + **On-Device Dashboard:** The device hosts its own web server to display the real-time data dashboard. This architecture is based on established practices from similar IoT detector prototypes.

**Conclusion**

FireScout, in its current iteration, successfully addresses the core problem of fire misclassification for common Class A and Class B fires. By integrating a simple fan-based air intake with a multi-sensor array and an embedded AI model, the device serves as a practical and portable solution for real-time analysis. While simplified from its original concept, the prototype effectively provides first responders with crucial data to select the correct extinguishing agent, thereby enhancing operational safety. This functional device represents a significant foundational step in creating accessible smart tools for emergency response.