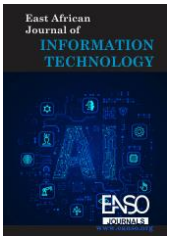

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Original Article

Fire Blackbox Control for Public Marketing

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Fire Safety, Public Marketing, Fire Black Box Control, Predictive Analytics, Temperature Sensor, Flame Sensor.

ABSTRACT

This paper presents the system for Fire Blackbox control in Public Marketing. When information is required following a fire incident, investigators or police might use the smart black box system to collect information. The black box system is used to continuously record, temperature, smoke, and other data. The information is then stored in a storage device. We are able to examine, track, and evaluate fire situations. In this paper, we propose a novel concept termed "Fire Black Box Control" (FBBC) tailored specifically for public marketing spaces. FBBC integrates cutting-edge sensing technologies, data recording, and data analytics. We present a comprehensive framework for implementing FBBC, encompassing sensor deployment strategies, data processing techniques, decision-making algorithms, and performance evaluation methodologies. Through extensive simulations and analysis, we demonstrate the effectiveness of the proposed FBC approach in mitigating fire risks and ensuring regulatory compliance in public marketing spaces.

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INTRODUCTION

In recent years, there has been a growing emphasis on the integration of technology into various aspects of public safety and marketing strategies. One of the technological innovations that holds promise in this regard is the Fire black box. Originally was developed for aviation to record

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flight data and cockpit conversations in the event of an accident, in this paper, we propose a groundbreaking concept called Fire Black Box Control (FBBC) tailored specifically for public marketing environments and store data related to the fire incidents. It consists of sensors, detectors, and control mechanisms that collect data on the environmental conditions, such as temperature, smoke levels, or other relevant factors to help investigators understand the dynamics of a fire.

The project aims to implement a fire black box control system in public marketing spaces for the purpose of minimizing the potential damage caused by fires in marketing areas. Therefore, the implementation of this system in public market spaces will significantly enhance public safety also, will mitigate the risk of fire-related incidents, protecting both individuals and property.

The present data shows a concerning trend in fire incidents within a public marketing space, with a notable percentage attributed to preventable causes such as electrical faults, and overheating and statistics reveal the significant financial losses and human casualties associated with these incidents. Example of fire incidents data trends; in 2018: 1,200 incidents and in 2019: 1,350 incidents. The causes of fire: Electrical faults 40% and Cooking related accidents: 25%. The affected areas; Residential: 60%, commercial: 25%, public spaces :5%

This paper involves the installation of a fire black box in public marketing, which works with the help of sensors and these sensors are strategically placed throughout a specific public marketing area to detect potential fire hazards. These sensors continuously monitor environmental conditions such as flame level, heat level, and smoke level. When potential fire risks are detected, the information is sent to the Black box for being recorded and stored.

LITERATURE REVIEW

The Blackbox concept is derived from the aviation industry, a data recorder, colloquially known as a Blackbox. Now, Fire Blackbox systems assist in determining the cause of accidents and provide information about those accidents that are necessary for both accident investigations and informing family members. In this paper, the system suggests an intelligent black box method for capturing safety information associated with fire incidents, which has not been addressed by other systems. The papers surveyed may not reflect the exact same system as the current paper, but they have many similarities in terms of the devices used and the way they are connected. They also provide the same concept of smart black box activities with different specifications, and the implementation of these projects will be investigated in this section. There are many possible applications for smart black boxes; therefore, finding the exact same project idea that measures the exact same parameters couldn't be achieved.

Therefore, what the systems reviewed here have in common is that they all attempt to provide smart black-box systems. The review will be in terms of the provided features, the main microcontroller used, sensors and another tools system equipped to achieve the expected outcome.

A Smart Blackbox using Raspberry Pi proposed the idea that involved leveraging mining algorithms to develop an intelligent system capable of analysing data and extracting valuable insights. This approach aims to enhance the functionality and effectiveness of black box systems in various applications.[1].

According to the study of communication, the system is capable of collecting and analysing data related to vehicle safety parameters. This approach lacks comprehensive data collection mechanisms [2]. A Review on Implementation of Evidence Collection System For Vehicle involved utilizing embedded technology to develop a robust and efficient Black box system of recording and storing data related to vehicle operations and performances [3].

Black Box will give us instant feedback for any physical anomalies, and will also give the command centre access to the data on the Black

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Box. Because the Black Box is designed to withstand a large impact, it will also secure the data in the Black Box [4]. It records the data and provides an analysis as feedback to the driver and control room [5]. An improved Blackbox construction of compassable secure computation presented the Blackbox is secure computation and its significance to secure protocol design [6].

Journal of Law and Technology presented that the Backbox is an advanced system capable of collecting and analysing data related to vehicles [7]. Investigation on black box for vehicles finds that black box system can play a major role in solving problems. Like flight data recorders in aircraft “Black Box” technology can now play a key role in motor vehicle crash investigations [8]. According to Wireless Blackbox for cars using sensors and GPS, the black box is torn and displays its parameters such as temperature, location, and vibration [10].

Mohmoody “Blackbox, Incorporated” The Backbox is an advanced system capable of collecting and analysing data related to vehicles [12]. A System for Automobiles Event Data recorder presented how data can be retrieved by using serial transmission of EEPROM [13].

According to a research paper on upgraded black box for automobiles, "Black Box” technology plays a key role in vehicle crash investigations [14]. A paper titled “A Black Box with SMS Alert for Road Vehicles” presented that Complete accident prevention is unavoidable but at least repercussions can be reduced [15]. Evidence Collection from Car Black Boxes using Vehicular Digital Video Recorder System released that black boxes or Digital Video Recorders (DVRs) for vehicles are being widely used to store accident circumstances [16]. A Black-box testing mobile applications using sequence covering arrays presented the idea of finding bugs that are activated only after a specific sequence of events [17].

As per the black box for vehicles, "Black Box” technology can now play a key role in motor vehicle crash investigations [18]. Development of Black Box Alert System for Accident Detection stated that the "black box" may record vital information in the event of an accident or crime while the car is in motion [19]. Blackbox System for Automobiles presented need to reduce automobile accidents and to improve the overall safety in vehicles and roads [20]. An intelligent Vehicle Black Box Using IoT presented that, Wireless Black-Box is basically a device that will collect all the parameters regarding vehicular accidents [21].

A paper by Mariammal et al. presents that a Smart Blackbox system is important when information is required following an accident or crime [22]. The Blackbox records data regarding the various aspects of flight, like elevation level, the distance travelled, and the position of the wing flaps and rudder [23].

HARDWARE COMPONENTS REQUIREMENTS

The hardware part consists of the components and the sensors used in the black box system. This part mainly collects the status of the sensors and stores it in the microcontroller’s EEPROM

Smoke Sensor

This can be an Ionization smoke sensor or a photoelectric smoke sensor. For, the ionization sensor, use a small amount of radioactive materials to ionize air with a sensing chamber. When smoke enters the chamber, it disrupts the ionization process. A photoelectric smoke sensor, uses a light source and a photosensitive receiver, when smoke enters a chamber, it scatters light, causing the receiver to detect the scattered light.

Plate 1: Smoke sensor

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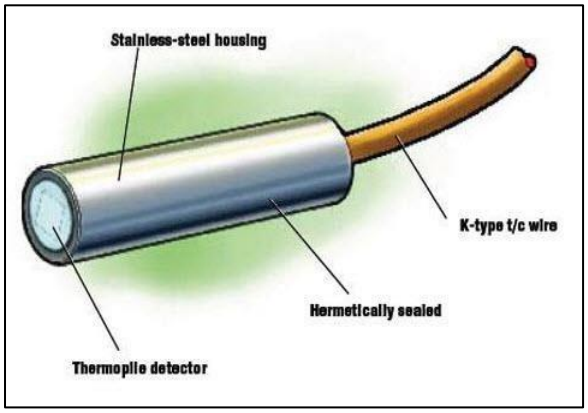
Heat or Temperature Sensor

This sensor is mainly used to detect the heat of the surroundings of the fire. This can be the rate of rise heat detector or a fixed temperature heat detector. In rate of rise heat detector, triggers an alarm when the temperature increases rapidly within a short period typically around 15-20 °F (9-11 °C) per minute. And, fixed-temperature heat detector triggers an alarm when the ambient

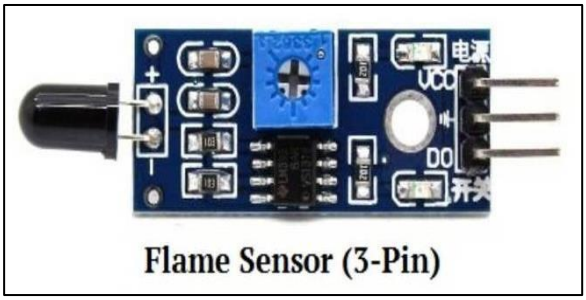
Plate 2: Heat sensor



Flame Detectors

These can be either Ultraviolet (UV) Flame detectors or Infrared (IR) flame detectors. In UV flame detectors detect the ultraviolet radiation emitted by flames. They are particularly effective for detecting fires involving hydrocarbon fuels. Infrared flame detectors detect the infrared radiation emitted by flames. They are effective in detecting fires across a wide range of fuels and are less prone to false alarms compared to UV detectors.

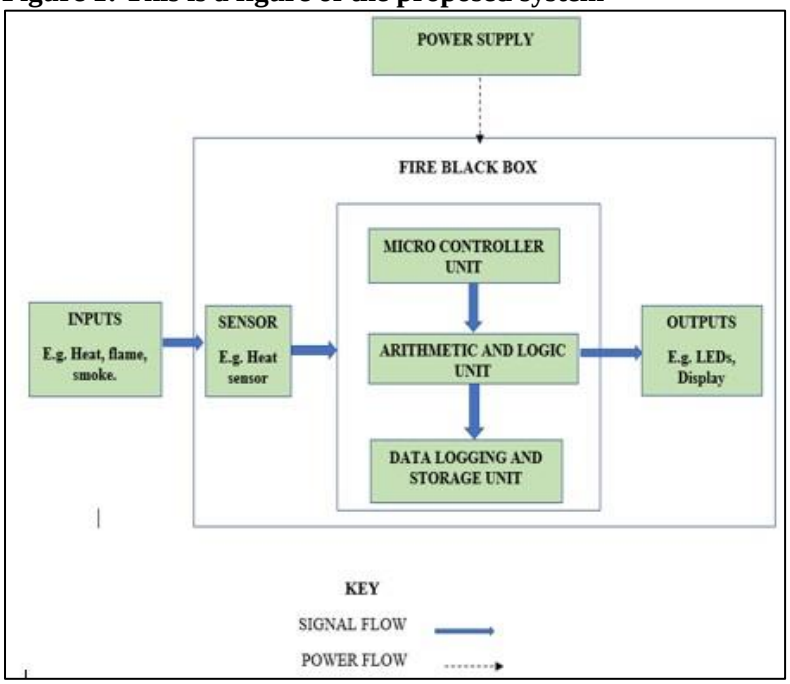
Plate 3: Flame sensor



PROPOSED SYSTEM FOR FIRE BLACKBOX CONTROL

Our system's black box houses a smoke sensor, together with a temperature and flame sensor. This is well shown in the following block diagram. The block diagram of the fire Blackbox control system in public marketing environments encompasses several interconnected components that work together to enhance fire safety and compliance as indicated in the following block diagram.

Figure 1: This is a figure of the proposed system



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The block diagram system has the following essential parties as explained below.

Sensing Infrastructure

Environmental sensors, including smoke detectors, and temperature sensors, form the backbone of the sensing infrastructure. These sensors are strategically deployed throughout the public marketing space to continuously monitor key parameters related to fire risks, such as air quality, temperature variations, and the presence of combustible gases.

Data Acquisition

The data acquired from the environmental sensors are transmitted to a central data acquisition unit for processing and analysis. The unit acts as the interface between the sensing infrastructure and the data analytics platform collecting real-time data from multiple sensors across the public marketing space.

Data Analytics Platform

This analyses the incoming data using advanced algorithms and techniques. Machine learning algorithms are employed to identify patterns anomalies and potential fire hazards in the collected data. The platform continuously learns from historical data and adapts its algorithms to improve the accuracy of fire hazard detection and prediction.

Data Storage and Retrieval

The black box always monitors and stores the informational data from sensors for further use. After a fire incident, the investigating team can actually use this data to get a clear picture of the accident scene with the logged data stored in the data storing device. This makes fire incidence investigation efficient and accurate. Black box stores the data from various sensors in a pen drive with the help of a USB module from Sunrom Technologies. This will help to maintain the data about the vehicle in a logged manner. From this data driving habits of drivers could be found and that is an important lead in crash investigations. The logged data is retrieved by connecting the pen drive/hardware storage device to the computer. The pen drive will contain a file named BLACK.txt which is in .txt extension format. This file contains all the informational data needed. The black box stores data because of the program written in the PIC microcontroller. Microcontrollers take different inputs in their pins and produce output through different pins to store the data in a pen drive and show the data in real-time in an LCD.

A Microcontroller

(sometimes abbreviated µC, uC, or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash, or OTP ROM is also often included on the chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general-purpose applications.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys, and other embedded systems.

Data Storage Device

A data storage device is a device for recording (storing) information (data). Recording can be done using virtually any form of energy, spanning from manual muscle power in handwriting to acoustic vibrations in phonographic recording, to electromagnetic energy modulating magnetic tape and optical discs. A storage device may hold information, process information, or both. A device that only holds information is a recording medium. Devices that process information (data storage equipment) may both access a separate portable (removable) recording medium or a permanent component to store and retrieve data.

The design of the Fire black box control system will be implemented with the help of a

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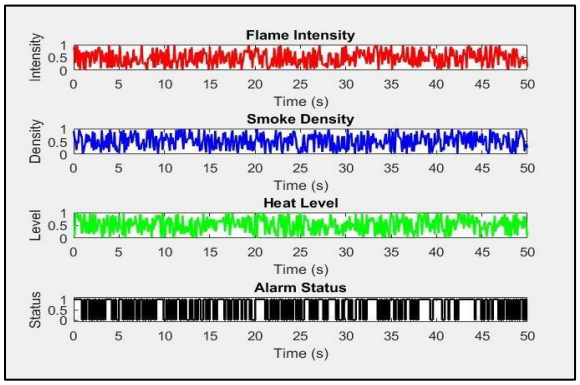
Microcontroller as a control unit. All the parameters of the system such as temperature, smoke, fire, accidents, etc., are controlled with the help of sensors like those proposed in the initial design of the project. All sensors are interfaced with the microcontroller unit. All this information about the fire incidents that occurred can be directly monitored and controlled by the system, in addition to being immediately displayed on a shared cloud application for more convenient actions. The system proposes a set of monitoring and controlling features, mainly focusing on monitoring fire.

SIMULATION RESULTS

Simulation results were conducted to assess the scalability and robustness of the FBC system under different scenarios. Results indicate that the FBC system can adapt to varying occupancy levels, environmental conditions, and fire scenarios, maintaining high performance across diverse public marketing environments.

Figure 2: Simulation results



DISCUSSION

The fire Black box control (FBC) approach offers a proactive solution for addressing fire risks in public marketing spaces. Challenges include optimizing sensor placement, refining predictive models, and integrating with existing control systems. Future research will focus on addressing these challenges to facilitate broader deployment of the FBC system for public marketing. The fire Blackbox addresses a crucial market need for enhanced fire safety in residential and commercial buildings. Unlike traditional fire safety devices, the fire Blackbox offers unique capabilities such as data recording on fire origins and spread. These features provide significant benefits, including detailed incident reports for insurance claims and insights for improving building design and fire prevention strategies. Future prospects include technological advancements and continuous innovation driven by market feedback, ensuring the product's long-term success and global impact on fire safety.

CONCLUSION

This paper has presented a new vision for public marketing, which is the Black Box system used for fire. This paper has also offered a brief description of the suggested component to be used in the system design. In addition, the development approach and technology between the two parts of the system, are hardware and software. In this project, we suggested a smart black box device for capturing safety data. The project on fire black box control in public marketing has yielded substantial advancements in safety, risk mitigation, compliance, and operational efficiency within commercial environments. Through the implementation of innovative fire black box control systems, the project has effectively enhanced safety levels by proactive identifying and addressing potential fire hazards in real-time, thus minimizing and severity of fire-related incidents.

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