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Need of Computerized Early Fire Detection System

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Abstract: Every year, fire is a common calamity that claims thousands of lives and causes incalculable material damage. As a result, early fire detection has become increasingly vital in order to defend against this hazard.In 2015, 17,700 people died in fires, a number that has steadily decreased each year, with just 10,915 people dying in fires in 2019. In the recent year, different computerized systems are developed, which is very useful to control the deaths due to the fire accidents. This paper provides the important of computerized fire detection system and also gives the theoretical survey on the systems which are developed in the recent year.

Keyword:Fire Detection System, Hazard, Computerized.

I. INTRODUCTION

In the industrial and process industries, vision-based fire detection and automated suppression (VFDAS) systems are one of the most significant mechanisms. It is especially important in businesses that rely on oil, gas, and petrochemicals as fuels. To avert fire accidents and loss of life and property, a quick automated detection system must be available.VFD (vision-based fire detection) system has a number of advantages over traditional fire detection technologies, including quick response, non-contact detection, and no installation restrictions. Sensors are currently used in the majority of fire detection systems to detect smoke, temperature changes, and other events [2].It is vital to build a monitoring system that can detect early flames in order to prevent fires and slow their spread. The rapid development of urban monitoring systems provides the framework for camera-based fire detection, and establishing a camera-based automatic fire monitoring algorithm may achieve 24/7 automatic fire monitoring without interruption, which considerably decreases personnel expenses.

II. NEED

In 2019, there were 11,037 fire accidents registered across the country, according to the ADSI-2019 data. In comparison to 2018, the number of such recorded fire accidents decreased by roughly 16 percent. The reduction was more pronounced than the year before, when it was roughly 2%.In addition, the number of people injured in fires has decreased by more than half, from 1193 in 2015 to 441 in 2019. During this time period, however, the least number of people were harmed as a result of fires.According to the statistics presented in ADSI reports, the overall number of fire accidents has decreased over the last five years in all locations of occurrence. Figure 1 shows the Fire Accidents in India (2015-2019).

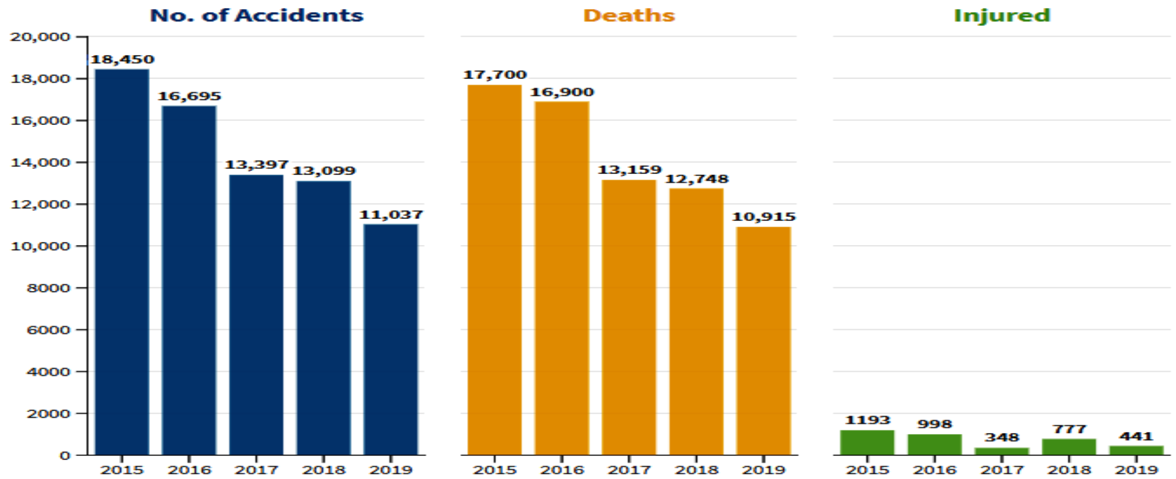

Figure 1Fire Accidents in India (2015-2019)

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III. LITERATURE SURVEY

Several approaches for detecting fire in videos or photos captured by typical video security cameras have been proposed in recent decades. All forms of fire detection use some form of color evaluation.Color information can be recovered using chromatic segmentation techniques that use numerous color spaces. Manjunatha K.C. et al. [2] describe computer vision-based automated fire detection and suppression system for manufacturing businesses and it plays a critical part in the Onsite Emergency System (OES), which can help the industry avoid accidents and losses. The exact placement of fire pixels in the image frame is determined using a Neuro-Fuzzy algorithm. Based on the region of the fire and the intensity values of the fire pixels, fuzzy logic is proposed once more to determine the valve to be controlled.

Faming Gong et al. [3] have developed a novel detection method based on flame multifeature fusion. As a fire preprocessing stage, we merged the motion detection and color detection of the flame. In screening the fire candidate pixels, this strategy saves a significant amount of computing time. Second, despite its irregularity, the flame has a considerable resemblance to the image's sequence. In order to acquire the spatiotemporal information of the flame centroid, we calculated the centroid of the flame region in each frame of the image and included the temporal information. Then, to improve recognition accuracy, we retrieved information such as spatial variability, shape variability, and area variability of the flame. Finally, we trained using a Support Vector Machine (SVM), finished analyzing candidate fire photos, and accomplished automatic fire monitoring. According to the results of the experiments, the proposed method's right rate is close to 95.29 %, demonstrating that it is more accurate and stable.

A video-based early fire detection system is presented by Pedro Santana et al. [4]. The obstacles associated with the actual deployment of the vision system are highlighted. Most importantly, background subtraction is done in a windowed manner for better accuracy, an attentive mechanism is used to focus a computationally expensive frequency analysis of potential fire regions, and interaction with people detection and tracking system is included to allow model-based false alarm rejection. The camera-world mapping is approximated using a GPS-based learning calibration technique, and new color-based models of fire's look as well as a new Wavelet-based model of fire's frequency signature are presented. The model's applicability to real-life applications is demonstrated by a 92.7 percent average success rate at a processing rate of 10 Hz.

Mohammad Sultan Mahmud et al. [5] describe a smart fire detection system that can alert the appropriate authorities even before the fire breaks out. A signal processing unit, an image processing unit, and a GSM module unit have been combined in a model. To gain more accurate detection, a machine learning approach is adopted and compared to the result. A multi-level approach for fire detection that examines chromatic information patterns, shape randomization, and fire optical flow estimation proposed by Arnisha Khondaker et al. [6]. To extract the regions of interest, the decision function of fire pixels based on chromatic information first employs majority voting among state-of-the-art fire color detection algorithms. Finally, an upgraded optical flow analysis technique evaluates turbulence to establish the existence of fire. We use videos from the Mivia and Zenodo datasets to assess the proposed model's performance. These datasets offer a varied collection of scenarios, including indoor, outdoor, and forest fires, as well as videos with no fire. For our test dataset, the proposed model has an average accuracy of 97.2 percent.

K.K. Wong et al. [7] use video flame detection analyses to offer segmentation and recognition methods. The Otsu multi-threshold approach can provide clear flame only images when used with Rayleigh distribution analysis. To detect specific image types, the Nearest Neighbour (NN) method can be utilized. In the segmentation of flame photos, Otsu's method's multi-threshold algorithm and the Rayleigh distribution analysis method (modified segmentation algorithm) can be employed. The updated segmentation technique, on the other hand, can be improved to extract pool fire photos using the best threshold values. Following this segmentation, the Nearest Neighbor (NN) method can be utilized to recognize pool fire photos using the centroid analysis technique. The table 1 gives the literature survey on Methods, Algorithm or Techniques used for fire detection system in the recent year.

Table 1 Methods, Algorithm or Techniques used for fire detection system.

Sr. No.	Reference	Method/Algorithm/Technique Used	Accuracy
1	Manjunatha K.C. et al. [2]	Neuro-Fuzzy algorithm	99 %
2	Faming Gong et al. [3]	Support Vector Machine (SVM)	95.29 %,
3	Pedro Santana et al. [4]	Wavelet-Based Model	92.7 %
4	Arnisha Khondaker et al. [6].	Enhanced LKT Optical Flow Analysis Algorithm	97.2 %
5	Jareerat Seebamrungsat et al. [8]	HSV and YCbCr Color Models	90 %
6	Pedro Gomes et al. [9]	Wavelet-Based Model	93.1 %
7	Kumarguru Poobalan and Siau-Chuin Liew [10]	Segmentation Technique	80.64 %

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8	Turgay Çelik et al. [11]	Fuzzy Logic	99.00 %
9	Raam Pujangga Sadewa et al. [12]	Convolutional Neural Networks (CNN)	92 %
10	Sally Almanasra and li Alshahrani [13]	Alternative Image-Based Algorithm	95.10 %
12	B. Triveni et al. [14]	RGB color model Algorithm	80.64 %
13	S. Sree Southry et al. [15]	Supervised Multi-Model Image Classification Algorithm (SMICA)	98.38 %
14	John Adedapo Ojo and Jamiu Alabi Oladosu [16]	Support Vector Classifier	99.30 %
15	Bo-Ho Cho et al. [17]	statistical color model	85 %

IV. Conclusion

One of the changeable risks that cause property destruction is fire. Many academics are working on early warning systems that help to reduce the effects of fire damage. Many existing image-based fire detection systems, on the other hand, can perform effectively in a certain field. Different computerized technologies have been created in the last year that are highly useful in reducing the number of deaths caused by fire accidents. This study discusses the significance of computerized fire detection systems and provides a theoretical overview of systems that have been created in the last year.

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