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Survey On Various Fire Detection Methods

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Abstract - *Every year a large number of fires in the world burn forest, buildings which causes economic and social impacts. There are different methods for detecting fire using sensors, which are not sufficient to detect fire as early as possible. Hence video based fire detection has importance in security systems. This paper refers the fire detection methods based on the analysis of videos. There is different method which focuses on various properties of fire like, color, shape, movement, spatio-temporal features etc. For real-time identification of fire from videos simple and accurate method is proposed as multiexpert system, which uses color, shape and movement evaluation for detecting fire. The study refers different methods for fire detection and prefers integration of smoke analysis for early identification of fire.*

Key Words: Fire detection, spatio-temporal, smoke detection, MES, Multiexpert evaluation.

1.INTRODUCTION

Since the fire causes serious damages, fire detection has been an important study to protect human life and surroundings. As the economy develops, number of large buildings also increases. If fire happens in these buildings then there will be a bad social impact, major property damage and heavy casualties will be easily caused. So fire should get detected early for extinguish and evaluation. In large buildings, rooms and outdoor places, fire detectors can hardly detect fire characteristic parameters like temperature, vapour and flame in the early time.

First step to prevent the serious damages from fire is to detect the event properly. Various methods are there to detect fire which uses different properties of fire. An- other difficulty is to properly identify the characteristics of fire. The fires properties like color, shape, temporal energy, spatial characteristics are identified in different methods. The traditional methods use sensors to detect the fire which cannot be used for early detection. So video based or computer vision based methods are more appropriate for analysis. The fire properties can be identified effectively while analyzing videos. One of the most common problems found in the area of video technology for fire detection is that early identification of fire and its properties. The main causes of fire may be burning things, wildfire, and accidents so on. To detect these fires an efficient methodology is needed as early fire detection system.

Fire detection is a key point in security systems. As the system performs, it must detect the fire as early as possible. Early detection of fire in a large area is a difficult task. To identify the properties of fire is also one of the important steps. The fire and fire coloured objects are to be distinguished properly. Thus, the identification may face some difficulties like; it is sensitive to the changes in brightness, presence of shadows or to different tonalities of the red. Another important fact is that smoke identification can be included as early warning system. Smoke is an indication of fire and the proper smoke identification can prevent fire. To differentiate smoke from smoke coloured objects (like fog, cloud, etc.,) is a difficult task.

In this paper different method for fire identification is studied. Initially the candidate region is to be identified to reduce the computation. From the analysis candidate region identification can be done based on background subtraction. The background subtraction gives a better result for identifying the moving object in the scene. Then the next step is to identify the fire region based on the candidate image block. From different methods studied color analysis gives almost true result for identification of fire region.

2. LITERATURE SURVEY

In [1] Paulo Vinicius Koerich Borges, and Ebroul Izquierdo, proposed a new identification metric based on color for fire detection in videos. Also identified important visual features of fire, like boundary roughness and skewness of the fire pixel distribution. The skewness is a very useful descriptor as the frequent occurrence of saturation in the red channel of fire regions is identified (figure 1). For newscast videos, model the probability of occurrence of fire as a function of the position, yielding an efficient performance.

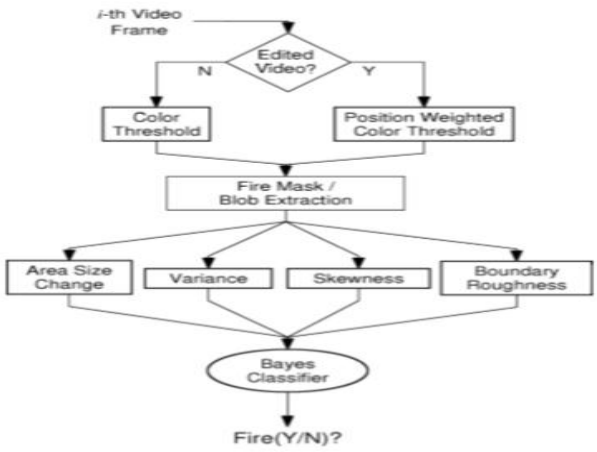

Fig -1: Fire detection process for each frame i, including the PFM generation, the extraction of features and the classification according to the Bayes classifier [1].

While comparing with other methods which extract complicated features, the features discussed here allow very fast processing, making the system applicable not only for real time fire detection, but also for video retrieval in news contents, which require faster than real-time analysis.

In [2] Osman Gunay, Behçet Ugur Toreyin, Kivanc Kose, and A. Enis Cetin, an EADF is proposed for image analysis (figure 2). In this work assumed that several subalgorithms are combined to get the main algorithm for a specific application. Each of the subalgorithm yields its own decision to representing its confidence level. Decision values are combined with weights, updated online by using nonorthogonal e-projections onto convex sets describing sub-algorithms. This framework is applied to a real time problem of wildfire detection. The proposed adaptive decision fusion method uses the feedback from guards of forest which is a limitation for the system.

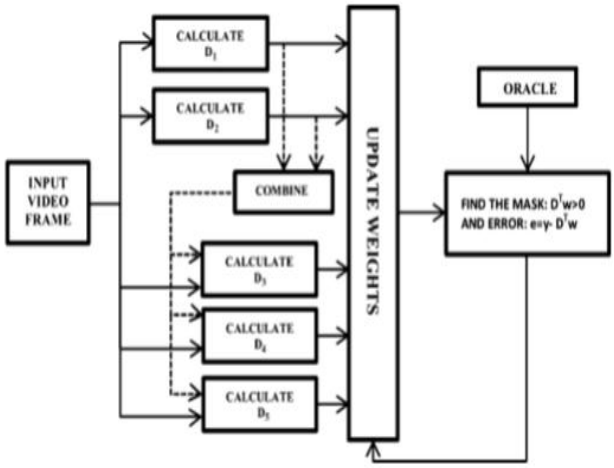

Fig -2 : Flowchart of the weight update algorithm for one image frame[2].

In [3] Martin Mueller, Peter Karasev, Ivan Kolesov, and Allen Tannenbaum proposed two novel optical flow estimators, optimal mass transport (OMT) and Non-Smooth Data (NSD). The dynamics of fire have motivated the use of motion estimators to differentiate fire from other non-fire object. The obtained moving region provides useful space on which to define motion features. These features reliably detect fire and reject non-fire motion, on a large dataset of videos. There is a chance for false detections in the presence of significant noise, partial occlusions, and rapid angle change.

In [4] Kosmas Dimitropoulos, Panagiotis B armpoutis and Nikos Grammalidis, proposes a fire-flame detection to be used by an early fire detection and warning system (figure 3). The first step is to identify candidate fire regions using background subtraction and color analysis. Then the fire features are modelled by using various spatio-temporal features such as color, flickering, spatial and spatio-temporal energy. Dynamic texture analysis is used in each candidate region. The robustness of algorithm can be increased by estimation spatio-temporal consistency energy of each candidate fire region by comparing current and previous frames. The last step is to classify candidate region using SVM classifier.

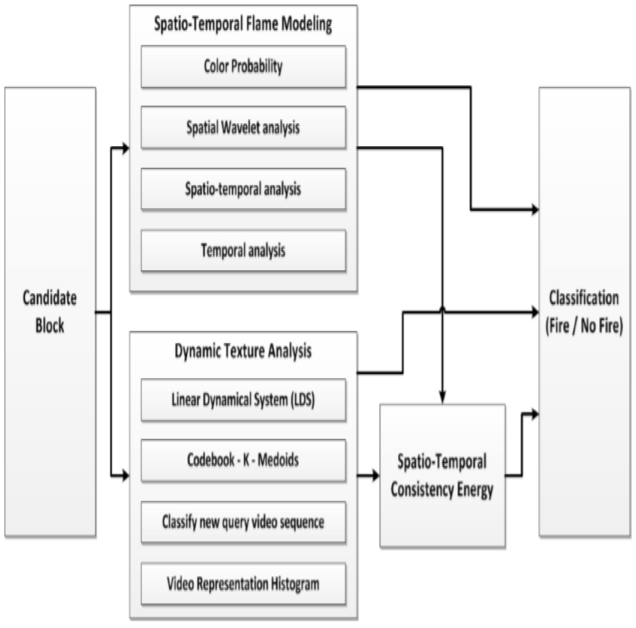

Fig -3: An algorithm for modeling both the behavior of the fire using various spatio-temporal features and the temporal evolution of the pixels' intensities in a candidate image block through dynamic texture analysis[4].

In [5] Pasquale Foggia, Alessia Saggese, and Mario Vento, proposes a method that is able to detect fires by analyzing videos. It introduce complementary information, based on color, shape variation, and motion analysis, and combined using a multiexpert system known as MES. A descriptor

based on a bag-of-words approach has been proposed to represent motion of objects. The method identifies moving objects based on background subtraction which is an effective method as compared to others. Then based on color, shape and movement the multiexpert system works for identifying fire region.

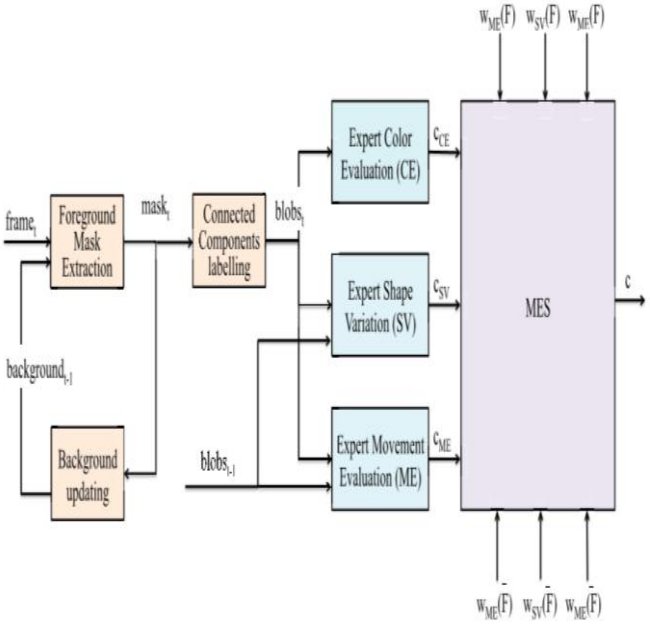

Fig -4: The proposed approach based on color, shape variation, and motion[5].

In [6] Tian Qiu, Yong Yan and Gang Lu, a flame edge-detection method has been developed. The identification of fire edges is the process of determining a boundary between the area where there is thermochemical reaction and those without. First the algorithm detects the coarse and superfluous edges in a fire image and then detects the edges of the fire and removes the irrelevant artifacts. This flame edge-detection algorithm can contribute to the in-depth understanding and advanced monitoring of combustion flames. Also, the algorithm provides a useful addition to fire image processing and analysis in fire safety engineering.

Table -1: The following table illustrates the false positive, false negative and true positive rates for different methods.

Methods	False Positive	False Negative	True Positive
[1]	**0.68%**	**0.028%**	-
[2]	-	**14.70%**	**85.30%**
[3]	**3.19%**	**3.55%**	-
[4]	**4.93%**	-	**91.12%**
[5]	**11.76%**	**0%**	-

3. CONCLUSIONS

Several methods have been studied to analyze the videos acquired by traditional video-surveillance cameras and detect fires. Each method has different functions to analyse the frames and detect different features of fire. From the study recognized that the basic information needed to identify the fire are color and movement. Hence the multiexpert system can be considered as an efficient fire detection system for real time application. But the multiexpert system does not identify the smoke which is an indication for fire. Smoke is generated with a burning object and has many dynamic and static features. These features can be used to identify fire in early stage and prevent the fire.

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