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Survey Paper of Approaches for Real Time Fire Detection

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Abstract-Accidental fire always causes great loss. If that fire is detected in time, then loss can be minimized. Hence there should be more efficient systems to avoid losses. Most of the fire detection systems are based on sensors. These sensors give false alarms in case of cigarette or essence sticks are burnt and these systems are also quite costly. By using fire detection system through video surveillance cameras the cost of system can be reduced. The videos achieved by popular surveillance cameras are analysed and different topologies of information, respectively based on colour and movement are united into a multi expert system in order to increase the overall accuracy of the approach, making it possible its usage in real time applications. The systems use HSV, HSL, YUV models. In these systems, the models are based on colour, motion and shape. The approaches have been tested on a wide database with the aim of assessing its performance both in terms of sensitivity and specificity.

Keywords: *Background Subtraction, HSV Model, Video surveillance, Fire Detection, Multi Expert System, Fire morphology, YCbCr model.*

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I. Introduction

Several methods have been presented, with the aim to examine the videos acquired by traditional video surveillance cameras and detect fire or smoke, and the current scientific effort focused on improving the robustness and performance of the proposed approaches, so as to make attainable a commercial exploitation. It can be observed that the methods using color information, although being intrinsically simple to configure, can be successfully used only in sterile areas, where no objects normally move inside. In fact, their main constraint concerns the number of false positives when used in normal populated areas: persons with red clothes or red vehicles might be wrongly detected as fire only because of their dominant color. In order to face this issue, morphology structure has been considered, a flame continuously changes its shape and the disordered movement of red colored regions can help in differentiating it from rigid objects moving in the scene. The physical properties of the fire are used to build a feature vector based on an enhanced optical flow, able to analyze in different ways both the dynamic texture of the fire and its saturated flame. Dynamic textures have also been used in; where a two-phase texture detection process has been suggested in order to speed-up the segmentation step. In the irregularity of the fire over time is handled by combining the capabilities of finite state automata with fuzzy logic: variations in wavelet energy, motion orientation and intensity are used to generate probability density functions, which determine the state transitions of a fuzzy finite automaton. In frame-to-frame changes are analyzed and the evolution of a set of features based on color, area size, surface coarseness, boundary roughness and skewness is evaluated by a Bayesian classifier. Adapting the color and appearance variation increases the reliability in the fire detection. In the thresholding on the color, performed in the RGB space, is improved by a multi resolution two-dimensional wavelet analysis, which evaluates both the energy and the shape variations in order to further decrease the number of false positive events.

Section II describes literature survey. Section III describes System Design. Section IV describes overall conclusion.

II. Literature survey

In [1] author has implemented a novel method for detecting fires in both indoor and outdoor environments. The videos acquired by traditional surveillance cameras are analyzed and different topologies of information, respectively based on color and movement, and are combined into a multi expert system in order to increase the overall reliability of the approach, making it possible its usage in real applications. The proposed algorithm has been tested on a very large dataset acquired in real environments and downloaded on the web. The obtained results confirm a consistent reduction in the number of false positive detected by the system, without paying in terms of accuracy.

The paper [2] describes the fire detection algorithm in video sequences on wireless sensor network. The proposed fire detection algorithm processes visual information acquired through static camera that lets us incorporate the algorithm to CCTV surveillance system, and therefore does not require an additional expanses on conventional fire sensors. Fire detection method based on motion information, any input image, is compared to background in order to identify foreground. Background is statistically modeled by mixture of Gaussians. To detect the foreground of video sequences, the proposed color detection algorithm was performed in RGB space. The procedure of algorithm eliminates all objects that do not fulfill color requirements without fire-like objects. And the change map and blob's area are computed, change map shows temporal variation of pixel between two consecutive binary frames, and percentage area increase or decrease characterizes a fire property for swinging.

The paper [3] describes a set of motion features based on motion estimators. The key idea consists of exploiting the difference between the turbulent, fast, fire motion, and the structured, rigid motion of other objects. Since classical optical flow methods do not model the characteristics of fire motion (e.g., non-smoothness of motion, non-constancy of intensity), two optical flow methods are specifically designed for the fire detection task: optimal mass transport models fire with dynamic texture, while a data-driven optical flow scheme models saturated flames. Then, characteristic features related to the flow magnitudes and directions are computed from the flow fields to discriminate between fire and non-fire motion. The proposed features are tested on a large video database to demonstrate their practical usefulness. Moreover, a novel evaluation method is proposed by fire simulations that allow for a controlled environment toanalyze parameter influences, such as flame saturation, spatial resolution, frame rate, and random noise.

The paper [4] presents a computer vision-based approach for automatically detecting the presence of fire in video sequences. The algorithm not only uses the color and movement attributes of fire, but also analyzes the temporal variation of fire intensity, the spatial color variation offire, and the tendency of fire to be grouped around a central point. A cumulative time derivative matrix is used to detect areas with a high frequency luminance flicker. The fire color of each frame is aggregated in a cumulative fire color matrix using a new color model which considers both pigmentation values of the RGB color and the saturation and the intensity properties in the HSV color space. A region merging algorithm is then applied to merge the nearby fire colored moving regions to eliminate the false positives. The spatial and temporal color variations are finally applied to detect fires. The extensive experimental results demonstrate that the system is effective in detecting all types of uncontrolled fire in various situations, lighting conditions, and environment. It also performs better than the peer system with higher true positives and true negatives and lower false positives and false negatives. Video fire detection, cumulative time derivative matrix, cumulative fire color matrix, spatial color variation, temporal color variation. Many researchers are being involved in fire detection using camera images as information data. However earlier researches have not paid attention to the determination of the type of fire.The paper [5] elaborates a fire detection method based on the image features that are taken as a feed to a rough set information system (RSIS) in order to not only determine the type of the fire but also to minimize the false alarm signals from the methods based on physical aspects of fire (temperature, smoke sensors, etc.) and other frequency based image features WMF (Wavelet-based model) and FDS (Fire detection based on discrete cosine coefficients) proposed earlier. Keywords are: Image processing, fire detection, computer vision, information system.

The paper [6] narrates an early fire-alarm raising method based on video processing. The basic idea of fire-detection is to adopt a RGB (red, green, blue) model based chromatic and disorder measurement for extracting fire-pixels and smoke-pixels. The decision function of fire-pixels is mainly deduced by the intensity and saturation of R component. The extracted fire-pixels will be verified if it is a real fire by both dynamics of growth and disorder, and further smoke. Based on iterative checking on the growing ratio of flames, a fire-alarm is given when the alarm-raising condition is met. Experimental results show that the developed technique canachieve fully automatic surveillance of fire accident with a lower false alarm rate and thus isvery attractive for the important military, social security, commercial applications, and so on at a general cost.

The paper [7] elaborates a run-based one-scan algorithm for labeling connected components in a binary image. The algorithm is different with conventional raster-scan label-equivalence-based algorithms in two ways: (1) to complete connected component labeling, all conventional label-equivalence-based algorithms scan a whole image two or more times, our algorithm scansa whole image only once; (2) all conventional label-equivalence-based algorithms assign eachobject pixel a provisional label in the first scan and rewrite it in later scans, our algorithm does not assign object pixels but runs provisional labels. In the scan, the algorithm records all run data in an image in a one-dimensional array and assigns a provisional label to each run. Anylabel equivalence between runs is resolved whenever it is found in the scan, where the smallest label is used as their representative label. After the scan finished, all runs that belong to a connected component will hold the same representative label. Then, using the recorded run data, each object pixel of a run is assigned the representative label corresponding to the run without rewriting the values (i.e., provisional labels) of object pixels and scanning any back- ground pixel again. Experimental results demonstrate that our algorithm is extremely efficienton images with long runs or small number

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of object pixels. Keywords are: Labeling algorithm, connected component, label equivalence, run-length encoding, raster scan.In a video surveillance system, moving object detection is the most challenging problem especially if the system is applied to complex environments with variable lighting, dynamic and articulate scenes, etc. Furthermore, a video surveillance system is a real-time application, sodiscouraging the use of good, but computationally expensive, solutions.

The paper [8] presents a set of improvements of a basic background subtraction algorithm that are suitable for video surveillance applications. Besides presenting a new performance evaluation scheme never usedin the context of moving object detection algorithms.

In paper [9], the author present a system for movie segmentation based on the automatic detection of dialogue scenes. The system processes the video stream directly in the MPEG domain: itstarts with the segmentation of the video footage in shots. Then, a characterization of each shot between dialogue and not-dialogue according to a Multi-Expert System (MES) is performed. Finally, the individuated sequences of shots are aggregated in dialogue scenes by means of a suitable algorithm. The MES integrates three experts, which classifies a given shot on the basis of very complementary descriptions; in particular an audio classifier, a face detector and a camera motion estimator have been built up and employed. The performance of the system have been tested on a huge MPEG movie database made up of more than 15000 shots and 200 scenes, giving rise to encouraging results. The paper [10] proposes a videobased fire detection system which uses color, spatial and temporal information. The system divides the video into spatiotemporal blocks and uses covariance based features extracted from these blocks to detect fire. Feature vectors take advantage of both the spatial and the temporal characteristics of flame colored regions. The extracted features are trained and tested using a support vector machine (SVM) classifier. The system does not use a background subtraction method to segment moving regions and can be used, to some extent, with non-stationary cameras. The computationally efficient method can process 320* 240 video frames at around 20 frames per second in an ordinary PC with a dual core 2.2 GHz processor. In addition, it is shown to outperform a previous method in terms of detection performance. Keywords are: Fire detection, Covariance descriptors, and Support vector machines.

III. System Design

In fire detection three methods are applied on the fire are following:
1) CE (Expert Color Evaluation)
2) SV (Expert Shape Variation)
3) ME (Expert Motion Evaluation)

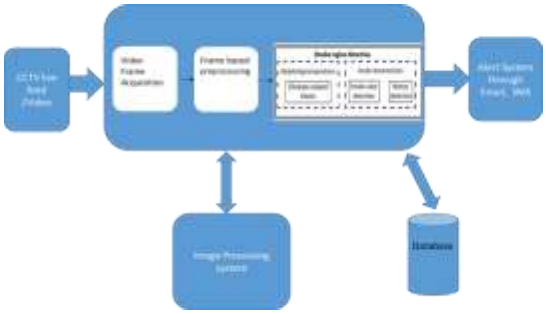

Fig.1. System Architecture

The system shown in Fig.1 is processing simultaneously at the same time i.e. parallel processing. If all the system runs one by one in serial manner then it will take long time to detect individual system. And result takes longer time which cannot be affordable in real time system. All system process parallely and make individual result and all this result value is collected and optimized in multi expert system i.e. MES. MES analyze all the data and give proper output. It makes note on each frame and stored it into database. After analyzing data in database the fire is detected if fire is hazard it will alarm as well as sent mail and message to admin/owner else it will show not hazard fire.

IV. Conclusion

In this survey fire detection is done by using an expert based on information about color, shape and flame movements. Detecting real time fire using image processing is been very tempting and interesting topic as it reduces the hardware cost and this can be implement in both indoor and outdoor places. This paper puts light on many of the past systems and also other methodologies to yield better output accuracy in the fire detection process that will be coming in our future edition paper. Select the proper frames to avoid the false fire.

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