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Automatic Process with Real Time Fire Detection in Close Surrounding Environment

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Abstract

The digital video recording (DVR) closed circuit television (CCTV) system is quickly becoming one of the most accepted security, surveillance documentation, and monitoring in service today. In proposed image processing technique for automatic real time fire, smoke and temperature detection in closed surrounding environment. To avoid the large scale of damage of fire occurred in the closed surrounding environment, it is necessary to have a system to minimize and to discover the incident as fast as possible. However it is impossible to keep the human observation of Closed-Circuit Television (CCTV) in closed surrounding environment for 24 hour. So if the fire, smoke and temperature detection system through image processing can warn fire state, it will be very convenient, and it can be possible to minimize damage even when people is not in front of monitor. Current fire detectors are prone to errors because smoke detectors can be set off even with the smoke from a cigarette and other types of smoke that isn't produced by fire. Fire detection is very crucial for the safety of the humans. By using different image processing techniques fire detection can be possible. Smoke is the good identifier of fire. By analyzing the features and other characteristics at present in a smoke, temperature detection of fire is done. Currently now a day's closed circuit television systems (CCTV) are already installed in many public places for survey purposes. The feedback time is faster as the camera does not need to wait for the smoke or heat to dispose. The CCTV system can recognize a large area to create a higher possibility of fire identification faster as possible. As fire accident makes great disposes to our life and regions, fire flame detection is an important issue of modern security sensing system.

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introduction

Fire detection is very crucial for the safety of the humans. By using different image processing techniques fire detection can be possible. Smoke is the good identifier of fire. By analyzing the features and other characteristics at present in an image, detection of fire is done. [1] The paper specifies different fire detection techniques. (1) The required equipment

used in this technique has less cost. Currently now a day's closed circuit television systems (CCTV) are already installed in many public places for survey purposes. (2) The feedback time is faster as the camera does not need to wait for the smoke or heat to dispose. (3) The CCTV system can recognize a large area to create a higher possibility of fire identification faster as possible. (4) Analysis of direction of fire is done directly, only the radiant's does not comes from its general vicinity. [2] As fire accident makes great disposes to our life and regions, fire flame detection is an important issue of modern security sensing system. In image processing image is taken as input and the output may either an image or parameters of an image. Various tasks like extracting its features, detect various or different patterns are performed with the image processing. Using technique like image processing the features of fire can be extracted. By using techniques the accidental situations caused due to fire can be avoided. This paper specifics various fire detection techniques and their comparison. [1]

I**mage processing** is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. Image Processing forms core research area within engineering and computer science disciplines too. The two types of methods used for Image Processing are analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing.

Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre- processing, enhancement and display, information extraction.

In the last years several methods have been proposed, with the aim to analyze the videos acquired by traditional video surveillance cameras and detect fires or smoke, and the current scientific effort focused on improving the robustness and performance of the proposed approaches, so as to make possible a commercial exploitation. Although a strict classification of the methods is not simple, two main classes can be distinguished, depending on the analysed features: colour based and motion based. The methods using the first kind of features are based on the consideration that a flame, under the assumption that it is generated by common combustibles as wood, plastic, paper or other, can be reliably characterized by its colour , so that the evaluation of the colour components (in RGB, YUV or any other colour space) is adequately robust to identify the presence of flames. This simple idea inspires

several recent methods: for instance, in fire pixels are recognized by an advanced background subtraction technique and a statistical RGB colour model: a set of images have been used and a region of the colour space has been experimentally identified, so that if a pixel belongs to this particular region, then it can be classified as fire. The introduction of the HSI colour space significantly simplifies the definition of the rules for the designer, being more suitable for providing a people-oriented way of describing the colour . A similar approach has been used in [4], where a cumulative fire matrix has been defined by combining RGB colour and HSV saturation: in particular, starting from the assumption that the green component of the fire pixels has a wide range of changes if compared with red and blue ones, this method evaluates the spatial colour variation in pixel values in order to distinguish non-fire moving objects from uncontrolled fires.

1.0 Existing Method

Commonly used techniques like Histogram comparison, Temporal based method, and Rule based method to detect smoke are quite reliable [5]. Histogram method could show several parameters such as luminance level, gray level and RGB ratio. For example, image was grabbed every second, and then by comparing the first and second image; the difference number of pixels could be counted, and this data is one block in the Histogram. After several iterative comparisons, a tendency curve could be tracked. If smoke is produced, there would be a great difference in the number of pixels, and the data bar would be higher than the normal one. This simple idea inspires several recent methods: for instance, fire pixels are recognized by an advanced background subtraction technique and a statistical RGB colour model: a set of images have been used and a region of the colour space has been experimentally identified, so that if a pixel belongs to this particular region, then it can be classified as fire.

The common limitation of the above mentioned approaches is that they are particularly sensitive to changes in brightness, so causing a high number of false positive due to the presence of shadows or to different tonalities of the red.

2.0 Proposed Method

Flame detectors are generally only used in high hazard areas such as fuel loading platforms, industrial process areas, hyperbaric chambers, high ceiling areas, and any other areas with atmospheres in which explosions or very rapid fires may occur. Flame detectors are "line of sight" devices as they must be able to see" the fire, and they are subject to being blocked by objects placed in front of them. However, the infrared type of flame detector has some capability for detecting radiation reflected from walls. In this paper we propose a method able to detect fires by analyzing the videos acquired by surveillance cameras. Two main novelties have been introduced: first, complementary information, respectively based on colour, shape variation and motion analysis, are combined by a multi expert system. The main advantage deriving from this approach lies in the fact that the overall performance of the system significantly increases with a relatively small effort made by designer. Second, a novel descriptor based on a bag-of-words approach has been proposed for representing motion.

To develop a robust fire detection system, we need to understand the nature of fire. When the fire temperature is low range changes from red to yellow and when the fire temperature is high range changes to white. The shape of the flame also changes rapidly. Thus, the fire region exhibits a structure of nested rings of colour s changing from white at the core to yellow, orange and red. [2] Depend on this knowledge; the proposed colour edge detection algorithm is composed of the following four components: At first, the image is smoothed by median filter to suppress unwanted noise in image. Secondly, maximum directional differences of sum of gray values i.e. Red+ Green+ Blue are calculated. In the third step, image is threshold and finally the detected edges are thinned to get the proper edge map. Lastly, after the edge is mapped fire is detected and it send alert to fire brigade.

3.0 Methodology

Another parameter is plotting a characteristic curve of Pixel counts verses the Gray level. In the case of 8-bit gray-scale images, there are 256 gray-scale levels, Black colour pixel has a gray-scale of 0 and White colour pixel has a gray-scale of 255. If there is an obscuration or smoke showing in the screen, the gray level would be changed and there would be a great number of pixels counted in the low luminance portion (between 20 to 75) of the histogram.

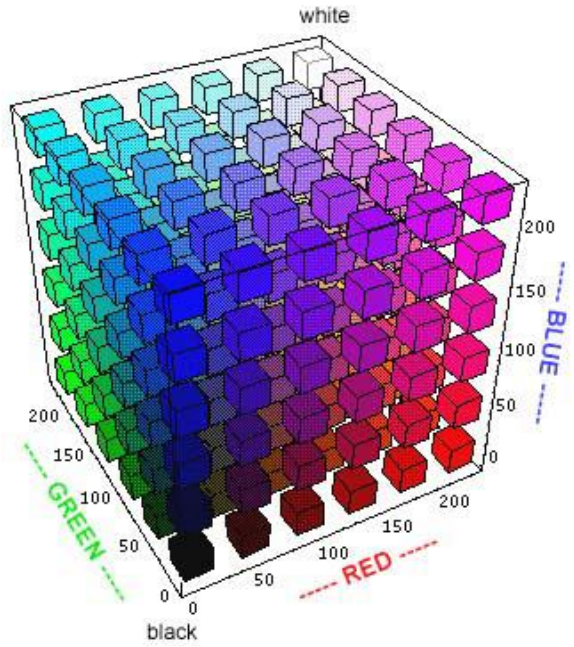

Fig. 1: Colour component of a graphic pixel [7]

If there is a fire occurred, there would be a high luminance portion between (200 to 250) in the histogram. [6] But for a 24-bit RGB image as shown in Fig. 1, the pixel of the image could be described: Red (255, 0, 0) or Yellow (255, 255, 0), a different form of histogram could be shown; the data may be based on the occurrence of Red, Green and Blue or R/G ratio. [7]

At first, the image is smoothed by median filter to suppress unwanted noise in image. Secondly, maximum directional differences of sum of gray values i.e. Red+ Green+ Blue are

Table 1: Comparison of traditional smoke detection system and VSD system

Detection	Heat	Smoke	Flame	Particle	Gas	Video smoke
Response speed	Slow	Fast	Very fast	Fast	Medium	Very fast
False alarm rate	Low	Medium	High	Medium	Medium	Low
Cost	Low	Medium	High	High	High	Variable
Application	Confined spaces	Open or confined spaces	Highly flammable material storage	Open spaces-high value	Controlled spaces high value	Large and open spaces

calculated. In the third step, image is threshold and finally the detected edges are thinned to get the proper edge map. Lastly, after the edge is mapped fire is detected and alert send.

1. Smoothing by Adaptive Median filter

A traditional median filters based upon moving a window over an image and computing the output pixel as the median of the gray values within the input window. If window is J x K in size then we can order the J*K pixels from smallest to largest in the gray level values. If J*K is odd then the median will be: (J*K+1)/2..... (1) And this entry in the list of ordered gray values. Note that the value selected will be exactly equal to one of the existing gray values so that no round off error will be involved if we want to work exclusively with integer gray values. For random types of noise, they provide excellent noise reduction capabilities and which helps to preserve edges because of this median filters are popular. In this method we have used an adaptive median filter. One main reason for using adaptive median filter is that it seeks to preserve detail of the image while smoothing the non-impulse noise, something that the "traditional" median filter does not do [3].

2. Directional Colour Difference Calculation

In the proposed method, colour image is analyzed from RGB colour space. In each colour pixel there are three colour channels known as RGB component. The range lies between 0 - 255. Edges exist in a colour image where changes of RGB values occur. So for detecting proper edges, firstly colour differences in an image must be pointed-out in four directions and they are 0o, 45o, 90o and 135o. For reducing the computational overhead we have calculated a transformed value for each pixel which converts three component valued pixels into a single attribute. This type of transformation is simply a weighted addition of three components.

i,j	i,j+1	i,j+2
i+1,j	i+1,j+1	i+1,j+2
i+2,j	i+2,j+1	i+2,j+2

Fig. 2: 3X3 Mask with coordinates

Pixel(i,j)=2*red(i,j)+3*green(i,j)+4*blue(i,j).....(2)

For images like figure 1, check box we can see that the image consists of three fundamental colour s. So if we compute the sum of three channels for each pixel it will be 255. Because, for the red regions, the value of the red component is 255 and values of green and blue components are 0. Similarly, for blue regions value is 255 and for red, green pixels will be 0. Same problem will arise for green regions. Using the weighted sum technique we can calculate exact colour differences.

3. Threshold Technique

Threshold technique is very important task in edge detection algorithms. The accuracy of an algorithm is dependent on threshold parameters. A foremost criterion of thresholding is that the program should be efficient enough to automatically compute the optimum threshold parameter. Criteria of selection of a parameter as given below [3]: 1. It should contain most of the prominent edges; 2. It should not contain too much spurious edges; 3. It should be meaningful and visibly pleasing; the proposed scheme suggests a method of parameter selection that works on various images. So that we calculate the maximum colour difference using (˜f (i+1, j+1) | max) for each pixel. Average value of the maximum colour difference is computed: row col

t = (˜f|avg) =™ ™ [˜f (i, j) / (row*col)] i=0 j=0..... (3)

The proposed method uses single threshold value T. For that several ways to obtain a fixed value of parameter. The simple way to observe the edge maps for a set of selected images and take that value which is producing acceptable edge maps for all the selected images .The various kinds of images it produced edge maps which is acceptable at 1.2t.Then Threshold value (T)=1.2t.

4. Edge thinning

Edge map produced in this way contains thick edges. So a thinning technique is applied to create more thin edges which will be more accurate and visibly soothing.

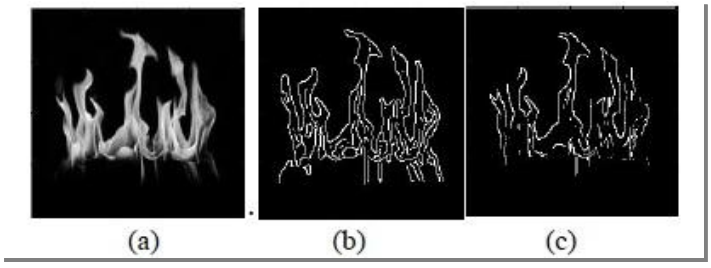

Fig. 3 (a) Fire image, (b) multi pixel thick edge map after threshold, (c) Final edge map after using thinning masks.

5. An Action performed and Alert system activate

In this system has learned to identify fire it can easily detect the fire on its own and turn on the alert. Moreover in this, we would be also training the system in such a way that can identify the direction in which there is fire break out. Also the system would check the intensity & volume of fire break and accordingly would sent alert to the fire brigade which currently has to be done manually.

In this system we would be placing camera at various location in the close surrounding environment. Using camera we would be detecting the fire using image processing. The input from camera is in terms of frames. So the camera is not an intelligent. So we are come up with an intelligent system which would be detecting fire. For doing this, first we need to train the system to recognize or identify the fire. By using advance colour recognition algorithm we would be training the system to detection of fire. Once the system has learned to identify fire it can easily detect the fire on its own and turn on the extinguisher on its own. Moreover in our system we would be also training the system in a way to identify the direction in which the fire raised and with the help of conventional sensor such as smoke and temperature detector. It will make help to turning on the extinguisher on its own in specific direction. The system will also identify the intensity & volume of fire break and accordingly would sent alert to the fire brigade whom will get an alert from system.

In this system specifies about colour edge identification algorithm. Detection of edge is one of the operations which are used most commonly used in image processing and pattern recognitions. An edge is the boundary in between an object and its background and defines the boundary within all objects. So the edges present in fire image can be identify efficiently and effectively, the various objects can be located and its basic features as shape, area and perimeter are recognized and measured. As computer aims to include the identification and classifying of objects in fire image, edge detection is required and essential tool. Accurate and Efficiency in edge detection will lead to increase the performance of subsequent image processing techniques, does image segmentation, object-based image coding, and image extraction. Maximum colour difference value is used to predict the value for thinning and for image which is colour ed technique is applied to extract appropriate edges is the threshold value. Edge detection in image which is colour is far more challenging task than gray scale images as colour space is considered as a space of vector. Almost 90% of edge specification in a colour image can be found in the gray scale image as per correspondence. Thus, 10% can still be vital in certain computer vision tasks. First, the cost of technology is low and mostly systems are based on CCTV cameras, which are found being already installed in many public places for surveillance purposes. Second, the response how fire and smoke detection is faster, as the camera does not require predicting for the diffusion of heat. Third, thus the camera also work as a volume sensor, as distinct from all other traditional sensors, it may check a specific area, defining a high probability of fire detect in an early stage.

4.0 Feasiblity Study

The objective of feasibility study is not only to solve the problem but also to acquire a sense of its scope. During the study, the problem definition was crystallized and aspects of the

problem to be included in the system are determined. Consequently benefits are estimated with greater accuracy at this stage. The key considerations are:

- Economic feasibility
- Technical feasibility
- Operational feasibility

Economic Feasibility

Economic feasibility studies not only the cost of hardware, software is included but also the benefits in the form of reduced costs are considered here.

Technical Feasibility

Technical feasibility evaluates the hardware requirements, software technology, available personnel etc., as per the requirements it provides sufficient memory to hold and process.

Operational Feasibility

This is the most important step of the feasibility study this study helps to predict the operational ability of the system that is being developed. This study also helps to analyze the approach towards which the system must be developed by which development effort is reduced. Proposed system is beneficial only if they can be turned into information systems that will meet the organization requirements.

5.0 Conclusion

In this paper, we have analyzed the static and dynamic features of fire flame and proposed a detection algorithm based on the integration of spatio-temporal information in the image. It shows that detection algorithm can locate the position of flame accurately and can be applied to complex environment. Vision-based fire detection approaches offer several advantages, including relatively inexpensive equipment, a rapid response time, and fast confirmation through the surveillance monitor.

From a geometric perspective of image, we have derived a boundary constraint on the transmission from the radiance cube of an image. Although the boundary constraint imposes a much weak constraint on the process, it proves to be surprisingly effective for the most natural images, after combined with the contextual regularization. More generally, one can employ a tighter radiance envelop, not limited to a cubic shape, to provide a more accurate constraint on the transmissions. This may help to further reduce the ambiguity between colour and depth, and avoid many erroneous enhancements on the image.

6.0 List Of Symbols & Abbreviations

CCTV: Closed Circuit TV

DVR: Digital video recording

VSD: Video Smoke Detection

7.0 Acknowledgement

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