NOVEL METHOD OF REAL TIME FIRE DETECTION AND VIDEO ALERTING SYSTEM USING OPEN-CV TECHNIQUES

M. Karthikeyen, N. Ramya, M. Sai Priya and C. Yuvalakshmi

ABSTRACT

Fire detectors play a very important role. It helps in detecting fire at an early stage. Commercial fire detecting systems usually have an alarm signaling, with the help of a buzzer. In this paper, computer vision-based fire detection is used. In the proposed model a webcam is used as an alternative of surveillance camera for monitoring the interiors of buildings. The video is processed using open CV techniques using fire detection (Hue, Saturation, Value (HSV)) algorithms and if a fire is detected, a short duration of the live video is sent to the security or the higher officials followed by an alert message. Thus the number of peoples stuck in the fire blazing area can be rescued. In the existing system, MATLAB tool is used for processing. While in the proposed system, Open CV techniques are used for processing. Open CV has more functions for computer vision and its processing time is less. Using this project, fire can be detected at early stage without any false alarming strategies and peoples can be rescued thereby.

Index Terms- Open CV, Capturing the video, Fire detection, Alert to the user.

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[I] INTRODUCTION

The purpose of the project is to solve the existing problem of unreliable fire detection systems. The project is aimed at using surveillance cameras in order to detect and monitor the occurrence of fire. This system is aimed at diminishing the disadvantages of false alarm, making the system cost effective and fast method of detecting fire. The system uses Open CV technique, it is an open source freeware. In warehouses, a surveillance network consisting of cameras exist due to security and insurance needs, these devices cause plenty of false alarms due to cigarette smoke or incense smoke etc. This led us to developing an algorithm which could be using the already existing surveillance system so as to detect fire from a live video feed by processing it. Our proposed system provides fire detection using a simple algorithm. The image frame is acquired from the live video feed. The RGB color model is then applied to the frame. The resultant RGB frame is then converted to a HSV frame, and then, the process of yellow separation is done, in order to identify the fire, which is a combination of red , yellow and orange. Once the process of yellow separation is made, the substance which are in yellow are converted to white for easier identification. After conversion, the other areas are removed thereby and then it is converted to grey scale, once it has been wholely converted, the fire alone is clearly detected thereby and finally it is alerted to the user through mail followed by a message.

[2] EXISTING METHOD

Existing systems include Fire and Hazard Detection systems which employ heat sensors or temperature sensors or smoke sensors or a combination of these. These are installed at heights which are usually floor level (or ceiling level). These contain individual sensors which are not lined together, which leads to unpredictability and nonsynchronous behavior of alarm. A smoke detector is a device that senses smoke, typically as an indicator of fire. Fire alarm system known as smoke alarms, generally issue a local audible or visual alarm on detection of smoke. Generally, fire alarm consists of smoke detectors with a basic assumption that smoke will be generated by the fire. If we detect smoke, then the fire is detected. Even if there is any fire, the smoke may be generated quite later after burning the surroundings. For some fires, smoke may not be generated or it takes long time for the smoke detectors to detect the smoke.

Limitations of existing systems are:

1. Only after detection of smoke, the fire is detected.
2. Even if there is any fire, the smoke may be generated quite later after burning the surroundings.

For somefires, smoke may not be generated.

3. It takes long time for the smoke detectors to detect the smoke.
4. Surrounding materials will be burnt till the next precautionary measure is taken.

[3] PROPOSED SYSTEM

In the existing system, the sensors such as smoke, fire and gas are used ,which may cause false alarm which panics people thereby, In this proposed system concentration on sensors are omitted with the usage of HSV algorithm, which identifies the fire with the help of the Hue, Saturation and the value

of the color obtained from the live video .In the proposed system, a webcam is used instead of a surveillance camera for convenience .

The process involved in proposed system is as follows.

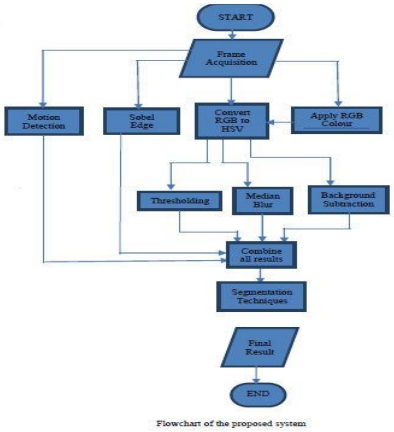


Figure 1. (a) Flow chart of proposed system (b) Camera

[4] STUDIES AND FINDINGS

A. WEBCAM

A Webcam is installed at locations where inventory has to be monitored. It is connected to the computer via a USB 2.0 Cable where image processing of frames is done in open CV. It takes the snapshot from the captured video where further processing such as background Subtraction, Segmentation, etc. is done. It has to be positioned properly so as to capture the entire area under observation.

B. BACKGROUND STRUCTURE

1. BACKGROUND STRUCTUREMOG1()

It is a Gaussian Mixture-based Background/Foreground Segmentation Algorithm. It uses a method to model each background pixel by a mixture of K Gaussian distributions (K = 3 to 5). The weights of the mixture represent the time proportions that those colors stay in the scene. The probable background colors are the ones which stay longer and more static. While coding, we need to create a background object using the function, cv2.create Background SubtractorMOG(). It has some optional parameters like length of history, number of Gaussian mixtures, threshold etc. It is all set to some default values. Then inside the video loop, use background sub tractor. Apply () method to get the foreground mask.

2. BACKGROUND STRUCTURE MOG2()

It is also a Gaussian Mixture-based Background/Foreground Segmentation Algorithm One important feature of this algorithm is that it selects the appropriate number of Gaussian distribution for each pixel. It provides better adaptability to varying scenes due illumination changes etc.

3. BACKGROUND STRUCTURE MOG3()

This algorithm combines statistical background image estimation and per-pixel Bayesian segmentation. It uses first few (120 by default) frames for background modelling. It employs probabilistic foreground segmentation algorithm that identifies possible foreground objects using Bayesian inference. The estimates are adaptive; newer observations are more heavily weighted than old observations to accommodate variable illumination. Several morphological filtering operations like closing and opening are done to remove unwanted noise. You will get a black window during first few frames. It would be better to apply morphological opening to the result to remove the noises.

C. CONTOUR DETECTION

Contours can be explained simply as a curve joining all the continuous points (along the boundary), having same color or intensity. The contours are a useful tool for shape analysis and object detection and recognition. For better accuracy, use binary images. So before finding contours, apply threshold or canny edge detection. Find Contours function modifies the source image. So, if you want source image even after finding contours, already store it to some other variables. In Open CV, finding contours is like finding white object from black background. So, remember, object to be found should be white and background should be black. At the left-hand corner presence or absence of fire in captured video frame is given. See, there are three arguments in cv2. Find Contours() function, first one is source image, second is contour retrieval mode, third is contour approximation method. And it outputs the image, contours and hierarchy. Contours is a Python list of all the contours in the image. Each individual contour is a Numpy array of (x, y) coordinates of boundary points of the object.

D. COLOR DETECTION

The input is in RGB form, and then RGB form is converted to HSV form. Then the range representing HSV form of fire is applied to detect only fire characteristics. Fire in HSV form is then displayed. HSV color space is chosen purposely because it has ability to differ illumination information from chrominance more effectively than the other color spaces. Threshold values for the fire are loaded in to the system, as par the threshold values color detection system display result only if the fire is detected.

E. HSV COLOR MODEL

The HSV stands for the Hue, Saturation, and Value based on the artists (Tint, Shade, and Tone). The coordinate system in a hexacone in Figure 2. (a). And Figure 2.(b) a view of the HSV color model. The Value represents intensity of a color, which is decoupled from the color information in the represented image. The hue and saturation components are intimately related to the way human eye perceives color resulting in image processing algorithms with physiological basis. As hue varies from 0 to 1.0, the corresponding colors vary from red, through yellow, green, cyan, blue, and magenta, back to red, so that there are actually red values both at 0 and 1.0. As saturation varies from 0 to 1.0, the corresponding colors (hues) vary from unsaturated (shades of gray) to fully saturated (no white component). As value, or brightness, varies from 0 to 1.0, the corresponding colors become increasingly brighter.

Figure 2. (a) HSV coordinates system *b) HSV color model*

F. MOTION DETECTION

There Motion detection method for fire is used to detect occurrence of any movement in a video. It is done by analyzing the difference in images of video frames. The most common approach used for motion detection is background subtraction which can identify any movement in the video frame. There are three main approaches used in background subtraction for motion detection in a continuous video stream.

G. SEGMENTATION

In computer vision, image segmentation is the process of partitioning a digital image into something sets of pixels known as (sub pixels). The goal of segmentation is to simplify and/or change the representation of an image.

H. COLOR CONVERSATION

In order to use a good color space for a specific application, color conversion is needed between color spaces. The good color space for image retrieval system should preserve the perceived color differences. In other words, the numerical Euclidean difference should approximate the human perceived difference

I. RGB TO HSV CONVERSION

In the obtainable HSV colors lie within a triangle whose vertices are defined by the three primary colors in RGB space:

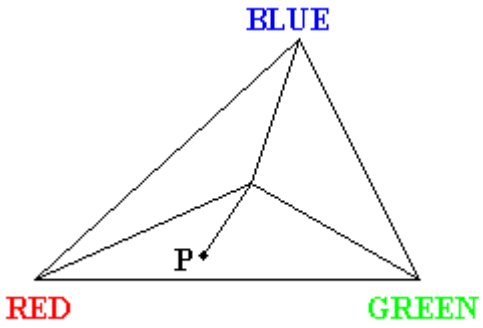


Figure 1. Obtainable HSV color from RGB color space

The hue of the point **P** is the measured angle between the line connecting **P** to the triangle center and line connecting RED point to the triangle center. The saturation of the point **P** is the distance between **P** and triangle center. The value (intensity) of the point **P** is represented as height on a line perpendicular to the triangle and passing through its center.

The grayscale points are situated onto the same line. And the conversion formula is as follows:

$$H = \cos^{-1}\left\{\frac{\frac{1}{2}[(R-G)+(R-B)]}{\sqrt{(R-G)^2+(R-B)(G-B)}}\right\}, \quad S = 1-\frac{3}{R+G+B}[\min(R,G,B)],$$

$$V = \frac{1}{3}(R+G+B) \qquad \text{……..1}$$

J. HSV TO RGB CONVERSION

Conversion from HSV space to RGB space is more complex. And, given to the nature of the hue information, we will have a different formula for each sector of the color triangle.

Red-Green Sector:

$$for \quad 0° < H \le 120°$$

$$b = \frac{1}{3}(1-S), \quad r = \frac{1}{3}\left[1+\frac{S\cos H}{\cos(60°-H)}\right], \quad g = 1-(r+b)$$

Green-Blue Sector:

$$for \quad 120° < H \le 240°$$

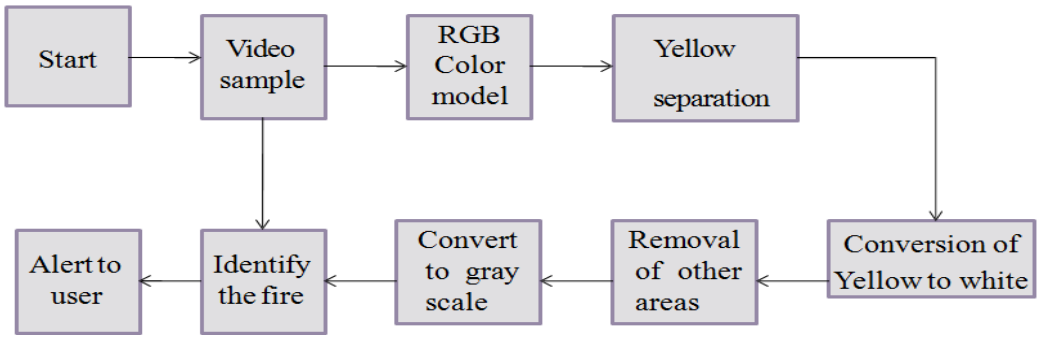
$$r = \frac{1}{3}(1-S), \quad g = \frac{1}{3}\left[1+\frac{S\cos H}{\cos(60°-H)}\right], \quad b = 1-(r+b)$$

Blue-Red Sector:

$$for \quad 240° < H \le 360°$$

$$g = \frac{1}{3}(1-S), \quad b = \frac{1}{3}\left[1+\frac{S\cos H}{\cos(60°-H)}\right], \quad r = 1-(r+b)$$

K. Block Diagram



[5] CONCLUSION

The embedded processing capabilities of smart cameras have given rise to intelligent CCTV surveillance systems. Fire is the most dangerous abnormal event, as failing to control it at an early stage can result in huge disasters, leading to human, ecological and economic losses. This project is used to find the reasonable accuracy for fire detection and localization, its size, and the rate of false alarms, the system can be helpful to disaster management teams in controlling fire disasters in a timely manner, thus avoiding huge losses.

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