AUTOMATED SYSTEM FOR SMOKING DETECTION

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Abstract
It has been noticed that in many countries citizens are suffering because of second-hand smoking and this problem is increasing rapidly. This paper will provide a solution to the problem of smoking in public areas by using the concept of Image Processing. Initially the moving objects are detected in the captured video frame by using background estimation method. Then person's face in the captured frame is detected using Haar classifier and the presence of cigar is determined using template matching. By using the features of smoke and Gaussian blur is applied on the frame for noise removal and for smoothening, the presence of smoke in a frame is identified.

Index Terms: Background Estimation, Haar classifier, Template Matching.

I. INTRODUCTION

The government of India has prohibited smoking in public areas because many citizen of India are suffering from causes of second-hand smoking. Second-hand Smoke has the same harmful chemicals that smokers inhale and it also causes cancer. Many women and children are suffering because of smokers in public areas like railway station, Bus stand etc.

According to World Health Organization (WHO) more number of non smokers die every year because of second-hand smoke. But the government has not automated the process for detecting the person responsible for smoking. Even after bringing awareness among the citizens about the effects of public smoking, the Government is still struggling to stop smoking in public areas. Hence, the citizens of India especially under the age of 18 are facing the effects of second-hand smoking. So, there is a need for a system which can give the information about the smoker in public areas. In this paper we propose an automated system for smoking detection in public places.

Image processing is a technique to perform operations on the image to get an enhanced image or to extract some useful information.

II. LITERATURE SURVEY

The main idea of our proposed method is to detect the smoking persons in public areas by recognizing their actions.

Turgay et al [1] has done fire detection using statistical color model in video sequences, Toreyin et al [8] has done real-time smoke detection.

III. PROPOSED SYSTEM

Our proposed system is as shown in Fig. 1. The system consists of five major steps and explained in the further sections.

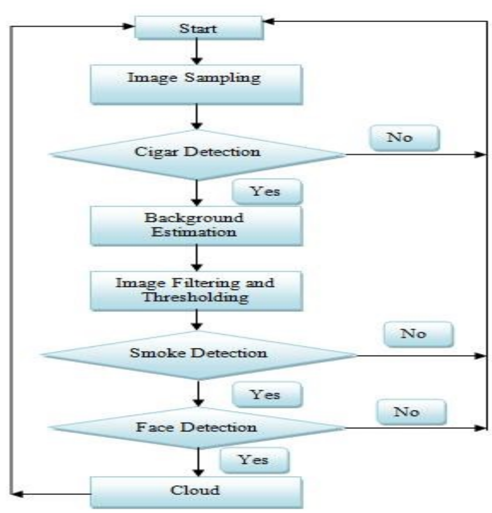

Fig.1 Proposed system

A. *Image Sampling*

Image sampling is the first step in which we access the image frame from the video sequence. Image from RGB color space will be converted to Gray color space as shown in Fig. 2. Gray scale image is also known as black-and-white, and will be composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest [1].

Fig. 2 Examples RGB and GRAY images

B. Cigarette Detection

Different methods for finding a match between two images can be found in Scale-Invariant Feature Transform (SIFT), Speeded Up Robust Features (SURF) and Binary Robust Invariant Scalable Keypoints (BRISK) [2]-[3]-[4]. [2] uses a key-point detector and descriptor to detect the match between two images. On the other hand [3] uses the same technique as that of [2] but, it is computationally faster than [2]. But for real-time image matching both [2] and [3] are not suitable, since they impose a large computational burden. So for detecting cigar in an image this paper uses BRISK technique [4] which basically extracts the key features from the image for matching. [4] extracts key features from the image by first identifying the point of interest across both the image and then scales the dimensions using a saliency citation. Secondly, it creates a sampling pattern consisting of points on scaled concentric circles. Since, BRISK key points are binary in nature it makes a better computational speed. Since, computational speed of the matching algorithm makes a big difference when it comes to videos this paper uses BRISK algorithm for finding cigarette in an image [5]. The result of detection of cigar is as shown in Fig. 3.

Fig. 3 Cigar Detection

C. Background Estimation

Identifying the moving objects in the captured video frame is the fundamental task. In order to find the moving objects from the part of a video frame we use the background estimation approach. The moving object detection begins with the segmentation part where foreground or moving objects will be segmented from the background [6]. The simplest way of detecting the moving object is to take an image as background and take the frames obtained at the time t, denoted by I(t) to compare with the background image denoted by B.

$$P[R(t)] = P[I(t)] - P[B] \quad (1)$$

Where, P[B] is pixel value of the background image and P[I(t)] is pixel value of image at time t.

The difference image P[R(t)] as shown in (1) is the intensity for the pixel locations which have changed in the two frames. This approach will suit best only for some cases where all foreground pixels are moving and all background pixels are static [7].

D. Image Filtering and Thresholding

The obtained image from the Background Estimation Technique is subjected to Gaussian Blur algorithm [7] for noise removal and smoothing image. By applying Gaussian blur, it reduces the image's high-frequency components.

$$G(i,j) = \frac{1}{n}\sum_{i=0}^{n} W(i,j) \quad (2)$$

Where G(i,j) represents the Gaussian function, W(i,j) represents the weight of pixels of an image frame, and n represents the number of kernels.

Adaptive Thresholding transforms gray-scale image to a binary image [8]. This method replaces each pixel in an image with a black pixel if the image intensity I(i,j) is less than some fixed constant T (threshold value), or a white pixel if the image intensity is greater than that constant as in (3). After image filtering and adaptive thresholding, the smoke is detected as shown in Fig. 4.

$$dst(i,j) = 0 \text{ if } src(i,j) > T(i,j) \quad \text{otherwise } 1 \tag{3}$$

Where dst(i,j) is destination image, src(i,j) represents the source image, and T(i,j) represents the threshold value.

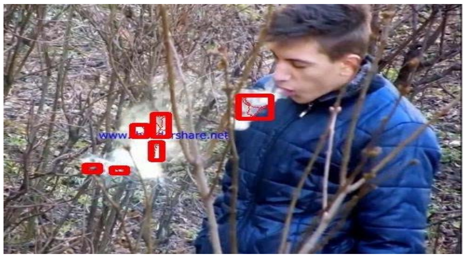

Fig. 4 Smoke Detection after Thresholding

E. Face Detection

Face Detection algorithm focuses on detection of human faces in the captured frame. Instead of using usual image intensities we are using an alternate feature set based on Haar wavelets called as Haar like features proposed by Viola and Jones [9]. The person's face is a rectangular section of the original image called a sub-window which has a fixed size typically 24x24 pixels. This algorithm scans the image frame with the sub-window and represents the respective section of the person's face. The algorithm uses an integral image to process the Haar like features of the person's face at constant time. The integral image is the sum of pixel values of the original image frame. The Haar features will be composed of two or three rectangles. The person's face will be scanned and searched for the Haar features. Each Haar feature has a value which will be calculated by considering the area of each rectangle and multiplying by their respective pixel values and then summing the results. The area of rectangle will be calculated using the integral image [10].

The obtained result is then used to categorize subsections of an image frame. For each subsection of the image the Haar like feature will be computed. By using the Haar classifier features like edge feature, line feature, and Four-rectangle feature we compare each feature of the image. When one of the feature is found in the image then the candidate image will be sent to next stage of detection. This method uses a cascade of stages to eliminate the non-face frame. If the order of the feature appears on the image, then we return the co-ordinates of the image as a face of the person as shown in the Fig. 5 and will be stored in the Google drive.

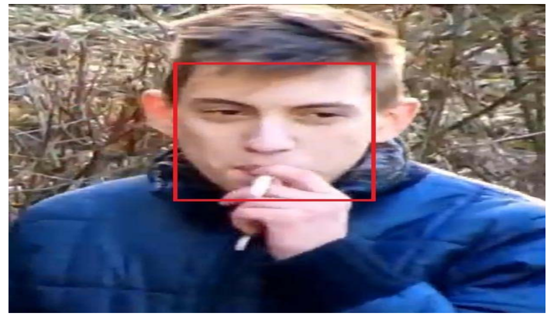

Fig. 5 Face Detection

IV. CONCLUSION

In this paper, we have developed an automated system for smoking detection in public places which helps the people to avoid second-hand smoking. Also this system provides an easy way for the authorities to find the victims of smoking and to take required actions against the victim.

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