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Detection of Foreground Object for Video Surveillance Applications

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Abstract: This paper describes the simplest and efficient method to find the foreground objects in less computation time. Initially the video is converted into frames. Those frames are compressed by eliminating the redundant frames by extracting more informative frames. The correlation coefficient is used to find similar frames which are to be eliminated. The first frame is set as the background of the image. The background image is subtracted from all subsequent compressed frames so that we obtain foreground of the image. The morphological operation is performed on the foreground objects to obtain boundary of objects. The noise is removed by applying the median filter. Moore neighborhood algorithm is applied to the image to obtain objects. Those objects can be used for further processing in various applications.
Keywords: Video Surveillance, Foreground Object Detection

I. INTRODUCTION

Video surveillance systems run 24 hours a day and seven days a week create a large amount of data including videos, extracted features, alerts, etc. There are thousands of surveillance cameras in a typical city. These numbers are continuing to increase. Robustness and efficiency are the two key factors for successful video surveillance systems due to the large scale data processing and complex video analysis.

The detection of foreground objects is a common stage and has widespread applications in video surveillance. It is used in advanced, automated video surveillance, traffic monitoring systems, UAV (Unmanned Aerial Vehicle) and driver assistance systems, where the robust segmentation of peoples or vehicles is essential to perform reliable tracking. The foreground of the image consists of all the objects that are not in background frame. Those foreground objects are used in various applications for further processing.

The following figure-1 depicts the overall process involved in the proposed work

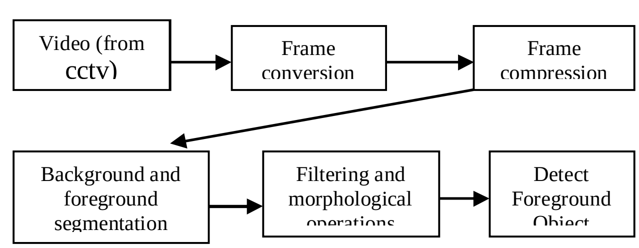

Figure-1: Architecture Diagram of the Proposed Work

This paper is organized as follows. The next section describes previous work. In Section 3 proposed method is discussed. Section 4 describes experiments to evaluate the robustness of the proposed method. Section 5 presents conclusions and future work.

II. RELATED WORKS

The vast amount of research is going on this foreground object detection which provides significant improvement in surveillance application. One of the conventional techniques used in foreground detection is background subtraction [1-12]. Stauffer and Grimson [13] modeled each pixel as a mixture of Gaussians and used an on-line approximation to update the model. Their system can deal with slow lighting changes and introducing or removing objects from the scene.

Wang et al. [14] proposed a unified framework to address detection and tracking simultaneously to improve the detection results. Taycher et al. [15] proposed an approach that incorporates background modeling and object tracking to prevent stationary objects fading into the background. Pnevmatikakis and Polymenakos [16] overcame the problem of stationary targets fading into the background by combining background subtraction and a Kalman tracker in a feedback configuration.

By analyzing some of the previous work it is clearly evident that the fading of the foreground into the background and time complexity are the major problem. The proposed work overcomes that by giving more importance to the following.

A. The processing time is reduced significantly by considering only the informative frames. That is the redundant frames are eliminated by finding the similarity.

B. The frame differencing method is used for background identification. And the morphological operations, median filter, and moore-neighborhood algorithm used for blob detection to avoid false detections.

III. PROPOSED METHOD

A. Preprocessing

The input video is converted to frames initially. Generally from a CCTV footage video 25 to 30 frames per second had been generated. Since processing of all frames are not necessary. So there is a need to extract frames with useful information by eliminating redundant frames. These frames are designated as informative frames. For the detection of redundant or similar frames, the correlation technique is used here. First the frames are converted in to two dimensional gray scale images.

A correlation coefficient is a number that quantifies a type of correlation and dependence, meaning statistical relationships between two or more values in fundamental statistics. The correlation coefficient is a measure that determines the degree to which two variables' movements are associated. The range of values for the correlation coefficient is -1.0 to 1.0. While the correlation coefficient measures a degree to which two variables are related, it only measures the linear relationship between the variables.

Correlation computes the correlation coefficient r between A and B, (eq-1) where A and B are matrices or vectors of the same size. Thus after applying correlation, the redundant frames are eliminated and informative frames are extracted.

$$r = \sum m \sum n(\bar{A}_{mn} - \bar{A})\ (B_{mn} - B)/\sqrt{(\sum m \sum n(-A_{mn} - \bar{A})^2 \sum m \sum n(B_{mn} - B)^2}\ \text{(eq-1)}$$

The following table (Table-1) shows the results of various videos and the number of frames after eliminating the redundant frames.

Table-1: Results after eliminating the redundant frames

Video	Total no of frames	Frames after compression
1	865	37
2	1674	62
3	1001	49

B. Foreground Object Detection

After performing the compression and extracting the informative frames. The first step is background detection.

In this the first frame is and set as a background image (eq-2).

$$BG(x,y)= firstf(x,y)\ \forall x,y\ \text{---(eq-2)}$$

1) *Foreground of the Image:* The foreground of the image can be obtained by subtracting the background image (eq-3) with all those compressed frames.

$$FG(x,y)=currf(x,y)-BG(x,y)\ \forall x,y\ \text{–(eq-3)}$$

Once the foreground image is obtained it is fine-tuned by applying the following operation

2) Morphological Operation: The Morphological operation is performed on the foreground of the image obtained. Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image. The most basic morphological operations are,

a) Dilation: The value of the output pixel is the maximum value of all the pixels in the input pixel's neighborhood. In a binary

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image, if any of the pixels is set to the value 1, the output pixel is set to 1. After applying dilation we get the boundaries of the object.

b) *Erosion:* The value of the output pixel is the minimum value of all the pixels in the input pixel's neighborhood. In a binary image, if any of the pixels is set to 0, the output pixel is set to 0.

The next step is noise removal and it is done by applying the median filter. Median filtering is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges.

c) *Object Detection:* Once the noise had been removed from the foreground then blob analysis can be performed to detect the object. The area, perimeter, centroid of those blobs can be calculated which can be used for various purposes in many applications. The Moore neighborhood tracing algorithm is used for blob detection. The edges of the object can be determined by this.

IV. EXPERIMENTAL RESULTS

The proposed work had been implemented using MATLAB 2013 and the results are validated on the standard data set i-Lids 2007, PETS 2006, and real-time scenario captured in railway station R-Video. The following fig-2,3,4,5,6,7 shows the experimental results of the proposed work.

Fig 2.Input video

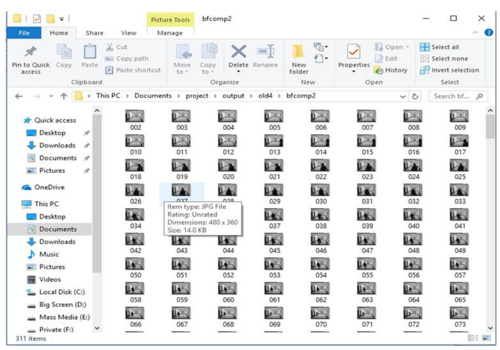

Fig 3.After extraction of frames

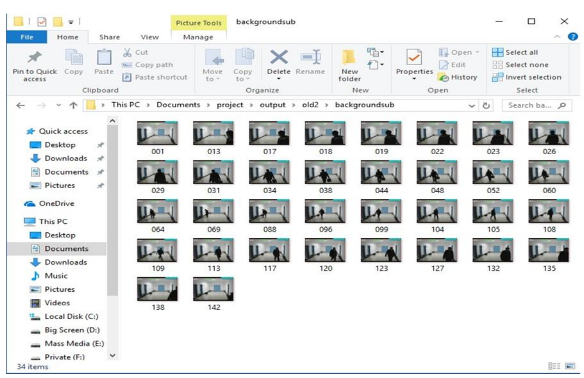

Fig 4.After compression of frames

Fig 5.Backgrounds of the image

Fig 6.Foreground of image

Fig 7.Result after object detection

V. CONCLUSION AND FUTURE WORKS

In our paper the video is converted into frames and compressed those frames efficiently and foreground is obtained by subtracting the background. Then morphological operations, median filters are applied and determined the blobs in foreground objects with boundaries which provides better results compare to other methods. In future this can be extended to determine the suspicious objects.

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