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A Four C Object Detection Framework for Surveillance

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Abstract: ***This paper proposes a real time object detection system for surveillance. Four C method mainly concentrates on real time and accurate object detection framework which use only one processing thread. Through four C method the special hardware like GPU has been restored. The first step of object detection is contour capture. Secondly, the image is processed using best contour based object detection method, that is CENTRIST visual descriptor and using a linear classifier. . Above step avoid feature extraction and image processing, which made the system less complex and increases detection speed. This paper check 5 cases of security, that include slow moving object detection, check for object crossing boundary, check whether moving object presence exceed time limit, check whether camera is covered by any material and also check whether camera is working properly. This has been applied to detect moving object in a room or a restricted area.***

Keywords: image processing; object detection; real time; classifier; CENTRIST.

I. INTRODUCTION

Surveillance is an important issue faced by the current world. When technology improves the insecurity also widen. In the current world we use different techniques for ensuring security. Wide range of application uses object detection in image and video. Many intellectual challenges and application of object detection have attracted and influenced researches and developers in the early age itself. The main goal of this paper is to introduce the software that detect object from a greyscale image in real time. By the introduction of CENTRIST visual descriptor to the security system, the process has been made less complex.

The main problem faced during object detection, is feature extraction, better classifier, detection speed and occlusion handling. There are many object detection systems available, that detect object type such as face[1][2] and pedestrian[3][4]. But in all cases an important issue faced during real time object detection is speed and accuracy. To improve the detection accuracy appropriate feature choice is done. This feature computation is the main speed bottle neck in existing object detections.

The main contribution of this paper is a less complex object detection framework and 5 cases of surveillance. The less complex object detection frame work has been developed using contour capturing, CENTRIST visual descriptor[5] and linear classifier.

The first step of contour capturing is done to define the outline of an object. This is an essential step in object detection. In this paper the contour capturing is done through the sign of comparison among the neighboring pixel. While the contour capture the magnitude if such comparisons are not considered since here sign of comparison of neighboring pixels are critical.

In the next step, the image has been made to greyscale image through CENTRIST and a linear classifier for object detection. By using CENTRIST visual descriptor and linear classifier, I avoid image processing and feature vector normalization in this paper. Here the feature extraction has been avoided by embedding that to the classifier evaluation. In order to increase the detection accuracy cascade classifier could be used. In this paper I mainly to use linear classifier, this is to

increase the detection rate but to reduce the false positive or to increase the quality of detection nonlinear classifier could be used. This paper is named as four C since here I use contour capturing, CENTRIST visual descriptor and cascade classifier for object detection.

II. Literature Survey

There are hundreds of work already done in object detection and surveillance. Let go through few closely related works among them.

In case of object detection, main focus is on accurate detection with high detection rate and less false positive. This has been achieved main through features and classifiers. Various features are used for object detection such as Haar features for face and pedestrians. HOG (Histogram of Oriented Gradient) used main for pedestrian detection, in which we use edge strength in various direction to detect the object. LBP (Local Binary Pattern) is another method used for object detection, this method shows high potential. The recent trend of detection is by combining more than one method, such as HOG-LBP. There are also methods that combine multiple information such as color, local texture, edge, motion, etc.

In case of classifiers, linear SVM is widely used due to its fast testing speed. In order to achieve high accuracy HIK SVM (Histogram Intersection Kernal) is also used. Sophisticated machine learning algorithm is also used object detection system. If more than one object has been detected in such case more than one classifier are used. For that we call as cascade classifier. In such case, we select small number of feature and construct cascade classifier. Cascade classifier is also used in case to improve object detection accuracy of the system. In order to improve the speed of object detection extra hardware has been used such as GPU that to distribute computing task to hundreds of GPU cores in parallel.

III. Proposed System

A. *Conjectures*

In this paper, sign of comparison among the neighbouring pixel are the key to encode the contour, so here magnitude of comparison has no importance.

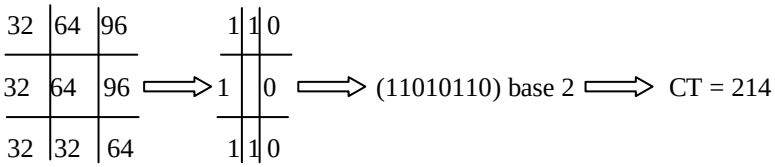
$$I: \begin{pmatrix} 32 & 2 & 8 \\ 38 & 96 & 64 \end{pmatrix}$$

$$I': \begin{pmatrix} 1 & 0 & 1 \\ 2 & 3 & 2 \end{pmatrix}$$

Let us consider I as the image whose contour has to be captured, and I' is the new image created from I. from the above you can view that 96 is converted to 3 because by comparison it's clear that 2> 32>38>96. So in this case, the magnitude of comparison in I is ignored in I', the spatial relationships among multiple comparisons in I will enforce a "pseudo-magnitude" in I'.

B. *CENTRIST Visual Descriptor*

In the CENTRIST visual descriptor the Census Transform image has been created. The CT image is designed for establishing corresponding between local patches. So the in the CT image creation, the intensity value of each pixel has been compared with eight neighbouring pixel.



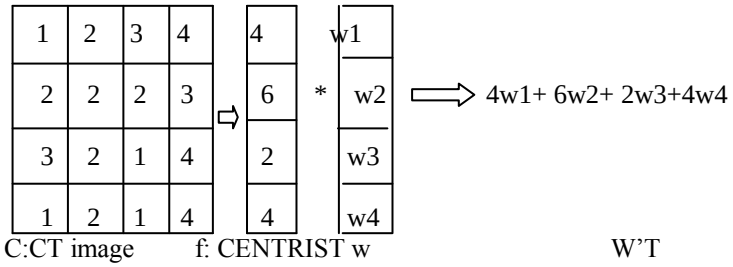
Here the CT value of each pixel has been calculated. For that, a pixel intensity value is compared with eight neighboring pixel intensity value such as to get the CT value of center pixel 64. First compare value 64 with eight neighboring pixel value. If those pixel value less than 64 is set as bit 1 and value greater than 64 set as bit 0. Now the eight bit generated from intensity comparison can be put together in any order that is from left to right or from top to bottom, which is consequently converted to a base-10 number that is 0 to 255. This is the CT value for the center pixel 64. So in this way we find the CT value of each pixel in an image and then we form the CT image. The CENTRIST descriptor is a histogram with 256 bin, that is a histogram of CT value in an entire image or a rectangular block of image.

C. Linear Classifier

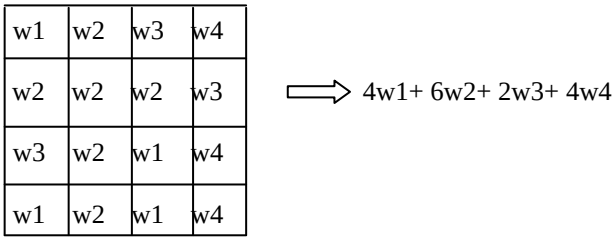
In this paper, linear classifier has been used to classify the object of interest from the background, this is because linear classifier with CENTRIST form an algorithm whose complexity is very less with extreme efficiency. This is because only constant numbers of operations are needed for a pixel.

Here holistic case are focused more, this is because through this work a better surveillance software is put forward and mainly concentrating on room or more secure area. So that fast rejection for the holistic case is discussed here.

This is a paper focus on real time, so for each frame, its corresponding sobel and CT image has been created. In early case, from the CT image the feature vector has been extracted and object detection is done. But since the feature vector extraction is a bottle neck problem faced in real time object detection, here a linear classifier.



(a) By computing feature(f)



A: Auxiliary image built from CT image W'T (sum of values of A)

(b) The proposed system: avoid computing f

Fig 1: Illustrating the computation from 4 CT value

In this method the linear classifier w is directly combined with the CT image to form an auxiliary image. Now by doing summation of all values of auxiliary image the object has been detected. So through this a step of feature extraction has been avoided here. This step has been made in practical by creating a classifier that can classify the object from its background on the CT image. In order to reduce the false positive more than one classifier could be used. The output of linear classifier is not

enough accurate in object detection. If any window consider as the background is rejected immediately by the linear classifier. And the window that passes the linear classifier test will be considered for further testing. This will help to reduce the false positive and increase the detection accuracy

D. Surveillance Cases

In this paper 5 surveillance cases has been considered. Those are slow moving object detection, check for object crossing boundary, check whether moving object presence exceed time limit, check whether camera is covered by any material and also check whether camera is working properly. If any illegal activity among these 5 is detected alert is provided. The alert can be email or message through mobile or an alarm ring.

Slow Moving Object Detection

There is a chance of slow moving object in a room, in such case each time the current frame has been checked with the first frame. If a large pixel change that exceed the threshold value then an alert is proved.

Check for Object Crossing Boundary

In this case, the user has been asked to select the more important area of that room. If an moving has been identified in that area, then alert is provided.

Moving Object Presence of Time

If a moving object has been detected and its presence of time exceed threshold value then an alert is proved. This is checked by setting a count when object is detected and if that count that is number of frame the object present exceed threshold the alert provided.

Check Camera Covered or Not

Camera covered has been detected by converting the image to black and white image. If image is converted to black and white and more than 95 percentage of the black and white image is black or white, then alert is provided.

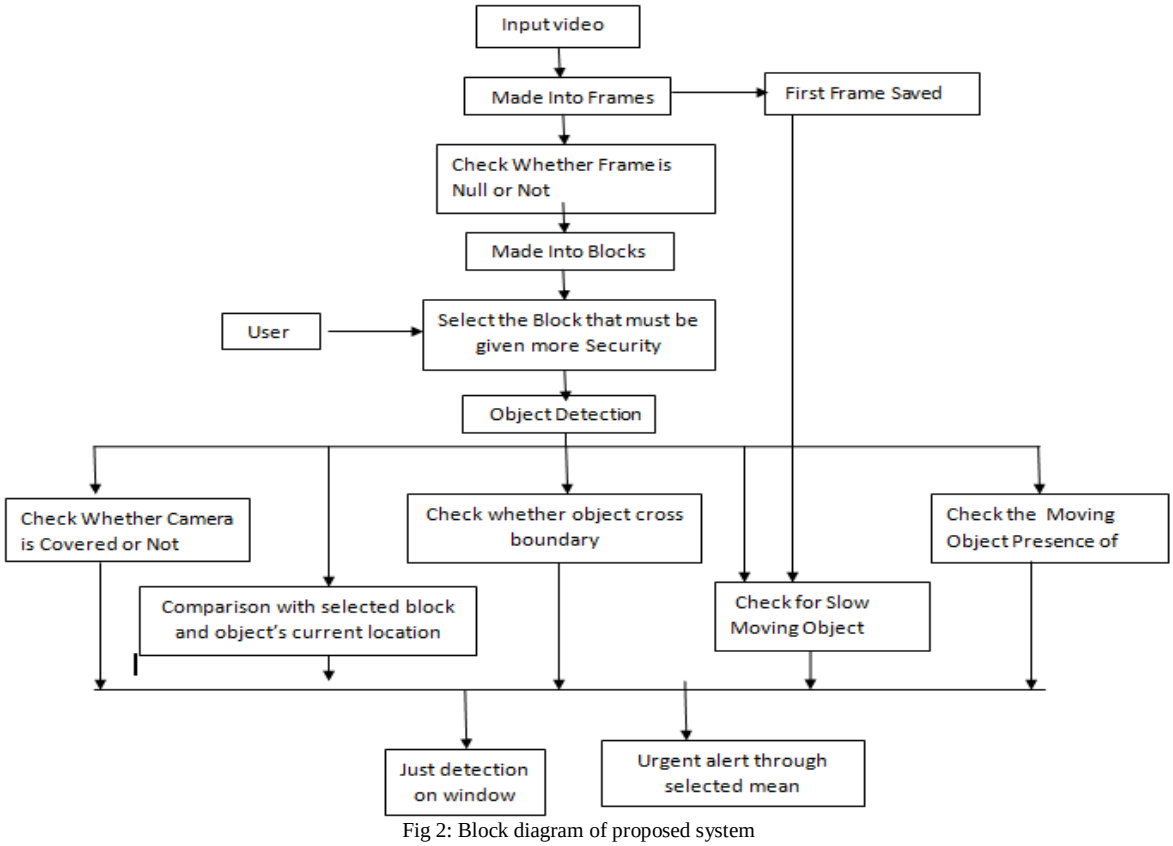


Fig 2: Block diagram of proposed system

Check Camera Working

This is done by checking whether the captured frame is null or not. Once the frame variable has null value then camera is not working, prove alert.

These are the five surveillance cases that have been considered in this paper. By the use of CENTRIST visual descriptor and linear classifier a better system for surveillance has been created. By using cascade classifier even thou detection accuracy increase but speed decreases. So selecting a better classifier make this system work better and adding more information channel help to detect object whose detection not possible using contour.

IV. CONCLUSION

This paper proposes a real time object detection framework for surveillance. In this object detection is done through contour detection, CENTRIST visual descriptor and cascade classifier. Once object detected, 5 case of surveillance is checked.

The first step, contour capturing is done through sign of comparison among the neighboring pixel. CENTRIST for object detection because it succinctly encodes the sign information during neighboring pixel comparison and will capture large scale structure or contours. Linear classifier that reject background window quickly. CENTRIST with linear classifier using only small number of instructions per detection window. The preprocessing and feature vector normalization is not need in this method. In order to improve the detection accuracy and reduce false positive cascade classifier could be used.

Then the output of this object detection has been provided for the surveillance purpose. Here in this paper 5 cases of surveillance are considered. That is slow moving object detection, check for object crossing boundary, check whether moving object presence exceed time limit, check whether camera is covered by any material and also check whether camera is working properly. If any illegal activity among these 5 is detected alert is provided. The alert can be email or message through mobile or an alarm ring. Through this paper better surveillance software has been introduced with better detection speed and accuracy.

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