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Abandoned Object Detection Based on Blob Analysis

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***Abstract* — Abandoned object detection is vital & necessary in many video surveillance context. In this paper a new framework to efficiently detect abandoned object in surveillance videos based on background subtraction & foreground analysis is presented. The blob analysis technique is applied on the foreground object pixels represented by binary images. Blob Analysis calculate statistics for labeled regions in a binary image. The statistical quantities such as the area, centroid, bounding box, label matrix, and blob count are returned by the block. On the binary images of the foreground pixels the morphological operations are done. From the blob statistics, the blobs are tracked to find for how many frame it remains stationary. If the blob stays stationary for predefined number of frames, it is declared as an abandoned object & the alarm is raised. Very small abandoned objects in the low quality surveillance videos can be detected. Proposed method can even detect the abandoned objects in the presence of varying illuminations and dynamic background.**

Keywords—object detection, background subtraction, foreground analysis, blob analysis.

I. INTRODUCTION

In recent years we have seen a stark growth in terrorist outbreaks on crowded open places such as airports, train stations and subways, nightclubs, shopping malls, markets, etc. Many investigation tools have been working in the fight against terror. Although video investigation systems have been in action for the past two decades. The analysis of the CCTV recording has rarely guessed out of the hands of human operators. Current trainings have taken into fore the bounds to human effectiveness in examining and handling crowded scenes, particularly in video surveillance systems consisting of several cameras. Fig 1 Sample images of detected abandoned object.

Fig 1 Sample images of detected abandoned object

Nowadays, the demand for computerized video-surveillance systems is developing resulting from growing worldwide safety concerns. Traditionally, the tracking task is performed by human operators who've to simultaneously examine data from one-of-a-kind cameras. A reduction of performance is expected as operators must manner large amounts of visible records generated through these cameras. For this reason, real-time automated video interpretation is rising as a solution to aid operators in focusing their interest on particular protection-related events. In this situation, the detection of abandoned and stolen items has end up one of the most promising studies topics especially in crowded environments such as educate stations and buying malls. For instance, a useful application of deserted item detection could be to detect unattended applications in a subway station. For stolen object detection, an interesting software may be the tracking of specific items

in an workplace, showroom or museum. This detection ambitions to provide a continuous supervision of the data captured by using the camera in order that the ideal moves can be taken.

II. PROBLEM STATEMENT

After evaluating the existing condition and other social problems, the problem can be defined as:

"Develop a user-friendly method which is able to detect abandoned object in public transportation and surroundings by using the videos captured as an input of the system. When the abandoned object is detected, the system must trigger the alarm signal to the user"

III. LITERATURE REVIEW

After studying different IEEE paper, I have collected some related papers and documents & some of the point are discussed here:

1. **Detection & Tracking In The IBM People Vision System" IEEE International conference on multimedia & Expo(ICME) 2004.**

   AUTHORS- J. Connell, A.W.Senior, A. Hampapur, Y. L. Tian, L. Brown, S. Pankanti

   In this paper they have developed a system for detection & tracking of people in application of computer vision .They have developed a background subtraction system for detection of moving objects in various scenarios. The method is also implemented for detection of object moving in front of moving background. They have implemented tracking system to track the detected foreground regions which can initiate real time alarm & generates a smart surveillance index which includes information about tracks, their size, position, type & appearance etc.

2. **An Abandoned Objects Management System Based on the Gaussian Mixture Model" International Conference on Convergence and Hybrid Information Technology 2008**

   AUTHORS -Chih-Yang Lin and Wen-Hao Wang

   In this framework they have considered the two cases whether the object is abandoned or it is removed. Here the two adaptive abandoned object detection (AOD) methods are designed. One is for high efficiency and the other is for high roughness. Instead of using single Gaussian method, both the methods are based on the Gaussian mixture model for real environments. To adapt to the changes in the real environment, the mixture of adaptive Gaussian is used to construct the background image. The probability of false detection is reduced by using counters only to the candidate static object instead of all foreground objects. The experimental results proved the efficiency & roughness of the proposed method.

3. **An abandoned object detection system based on dual background and motion Analysis" International Conference on Computer Science and Service System 2012.**

   AUTHORS -Liu Xiya, Wang Jingling, Zhang Qin

   In this paper, a method is proposed for the detection of abandoned objects and its owner. The proposed method combines the stationary foreground detection which uses modified pixel level dual background method & motion analysis algorithm for detecting the owner. There are two steps for static foreground detection. In the first step the dual foreground is obtained by constructing & updating a pixel based dual background. In the second step a register is carried for the evidence frame in order to trigger the alarm. The features of foreground blobs between the

successive frames are matched for labeling the objects & record their states & characteristics. When the desired target is found by static foreground detection part, the owner is estimated by the result of motion analysis. By this system the best results of object detection are obtained in occlusion situation between steady & moving objects.

4. **Robust Detection of Abandoned and Removed Objects in Complex Surveillance Videos.**
AUTHORS- Ying Li Tian, Rogerio Feris, , Haowei Liu, Arun Humpapur, and Ming-TingSun
This system proposes that Tracking-based approaches are not reliable for abandoned object detection in complex surveillance videos due to occlusions, lighting changes, and other factors. They have presented a new frame work to robustly and efficiently detect abandoned and remove the objects in complex environment for real time video surveillance. In this system, the back ground is model by three Gaussian mixtures. The mixture of Gaussian background subtraction method is used to detect both background & static foregrounds. Furthermore, the types of the static regions (abandoned or removed) are determined by segmenting & comparing the surrounding areas of the background model & the foreground image. A person-detection processes so integrated to distinguish static objects from stationary people. . In order to reduce the false alarms, they have employed tracking information.

5. **A Localized Approach to Abandoned Luggage Detection with Foreground-Mask Sampling.**
AUTHORS- Huei-Hung Liao, Jing-Ying Chang, and Liang-Gee Chen

In this paper they have proposed a completely unique method for the detection of abandoned object in video surveillance. They have used foreground mask sampling Technique to detect & localize the candidate left luggage items. This method can handle the luggage pieces of various colors & shapes without any prior knowledge. This method has given the successful results for crowded scenarios & heavily cluttered scenes. The localization of candidate abandoned object allows them to concentration attention & successive processing only on their neighborhood. They even have tracked the owner of the luggage. They have used a probability model by using the MAP principle to compute the posterior confidence score for the object abandoned incident & the alarm is raised after detection of the abandoned object. For testing the results they have used AVSS 2007 & PETS 2006 Datasets.

IV. PROPOSED SYSTEM

The recorded video of abandoned object detection scenario is given as a input to the proposed system. This input video is converted to separate RGB frames. The Region Of Interest (ROI) is defined for the frames so as to eliminate the areas which are unlikely to contain the abandoned object. Then these frames needs further processing. The first process is conversion from RGB color space to YCbCr color space. The computation for YCbCr image is simpler than the color RGB image. Then the foreground detection is done by using the background subtraction algorithm which results in binary images, with the white portion representing foreground (blobs). The background subtraction is done by considering the first frame of the video as a background frame & all the successive frames are subtracted from the background frame to get the foreground blob. For the good accuracy in the result, background subtraction is done separately on the luminance & chrominance parts of the YCbCr frame.The binary image is divided into number of blobs. Each blob represents an object. Further the binary images of foreground pixels undergoes through the morphological close operations to fill the small gaps. Then the blob analysis is carried on the candidate foreground pixels. Blob block returns the statistical quantities for the blob such as area, centroid, bounding box etc. By tracking different candidate blobs using the blob statistics the abandoned object is detected. The alarm is triggered for the Corresponding abandoned object. Figure 2 shows the block diagram of the proposed system.

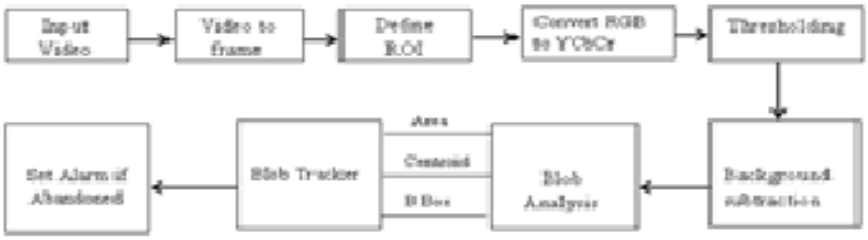

Fig 2. Block Diagram

V. SYSTEM IMPLEMENTATION.

For the implementation of the system MATLAB R2013a is used. Various functions from computer vision system toolbox are used. The detailed explanation is given below.

Vision Toolbox

Computer Vision System Toolbox delivers functions, algorithms, & apps for the designing and simulating computer vision and video processing schemes. The various functions performed by vision toolbox are object detection and tracking, feature finding, extraction & matching, video processing & motion estimation. For 3-D computer vision, the system toolbox supports camera calibration, stereo vision, 3-D reconstruction. You can train object recognition, object detection, & image retrieval system using machine learning based framework. Algorithms are available as MATLAB functions, System objects, and Simulink blocks.

Input Video:

The recorded video of abandoned object detection scenario is given as an input to the proposed system. The video stream is initially segmented into individual RGB frames. The ROI is then defined for the frame.

RGB to YCbCr Conversion:

Human eye perceives more information from luminance part than that of chrominance. RGB Color system is less efficient for storage & transmission. In case of YCbCr color system we can separate luminance & Chrominance parts. So that the more useful information is stored with high resolution & transmitted with a large bandwidth using luminance part to get rid of unnecessary color information. For displaying the results, again conversion is done into RGB clor system.

Thresholding:

Thresholding converts intensity image to binary image. The simplest approach to segment an image is using thresholding.

If f (x, y) > T then f (x, y) = 0 else f (x, y) = 255

For thresholding Otsu's method is used in this system. In this system use the Thresholding operator parameter to specify the condition the block places on the input values. If you select > and the input value is greater than the threshold value, the block outputs 1 at the BW port; otherwise, it outputs 0.

Background subtraction:

To obtain the foreground blobs, a background subtraction algorithm is employed in this system. The background subtraction is performed for both luminance & chrominance part separately where each successive frame is subtracted from the background frame to get the foreground blob.

Morphological Close System:

The Morphological Close object performs morphological closing on an intensity or binary image to fill the gaps & obtain the connected region. The Morphological Close System object executes a dilation process followed by an erosion operation using a predefined neighborhood or structuring element. This System object uses flat structuring elements only.

Blob Analysis Technique:

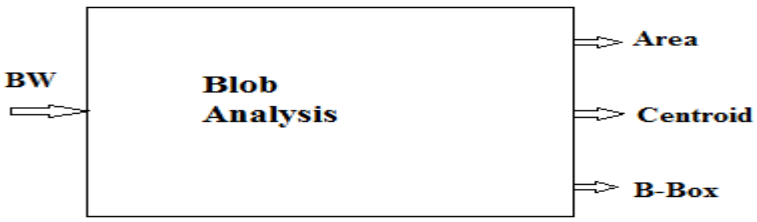

Figure 3 Blob Analysis Block

For the obtained foreground blobs from background subtraction, the blob analysis algorithm is applied. The block of blob analysis is shown in figure 3. The blob takes the input binary blobs BW & computes the blob statistics. The block returns the statistical quantities such as area, centroid, bounding box etc. for the further tracking of the blobs for object detection.

Blob Tracker:

From the obtained statistics of the blob by blob analysis block, all the blobs are tracked to find for how many frames the blob remains stationary & it outputs the number of detected abandoned objects (outcount) & also the bounding box coordinates of the detected abandoned objects (Outbox). The abandoned object tracker is shown in figure 4

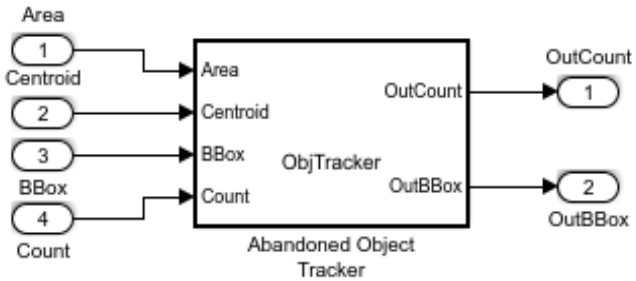

Figure 4 Block of Blob Tracker

Alarm:

If the blobs remains stationary for the predefined number of frames (45 frames for this system), the detected object is declared as an abandoned object & the alarm is triggered to indicate the detection of the object.

Display Results:

The results are displayed in three GUI windows. For displaying the objects detected, a vision shape inserter system is used. The Shape Inserter object can appeal numerous rectangles, lines, polygons, or circles in a 2-D grayscale or truecolor RGB image. Using this system the rectangles are drawn around all the detected blobs & around the detected abandoned object.

VI. RESULT ANALYSIS.

The effectiveness of the proposed method is tested on various scenarios including indoor scenes, outdoor scenes, railway station etc. Even the results are also tested on ABODA dataset [1]. It is found that for all the scenarios, the system has detected all the abandoned objects with very few false positives.

The detection results are displayed in three windows. First window displays the input video with the detected abandoned object highlighted in red rectangle. Second window shows all the detected foreground blobs (objects) bounded in green boxes. The ROI is shown in yellow box. Third window displays the segmented result where all detected objects are bounded in green boxes.

Figure 5 shows the snapshot of detection of abandoned object at railway station scenario, where detected abandoned object is highlighted in red box in first window. All detected blobs are shown in green boxes in second & third window.

Figure 6 shows the snapshot of detection of abandoned object for indoor environment. The detected object is shown bounded in red box.

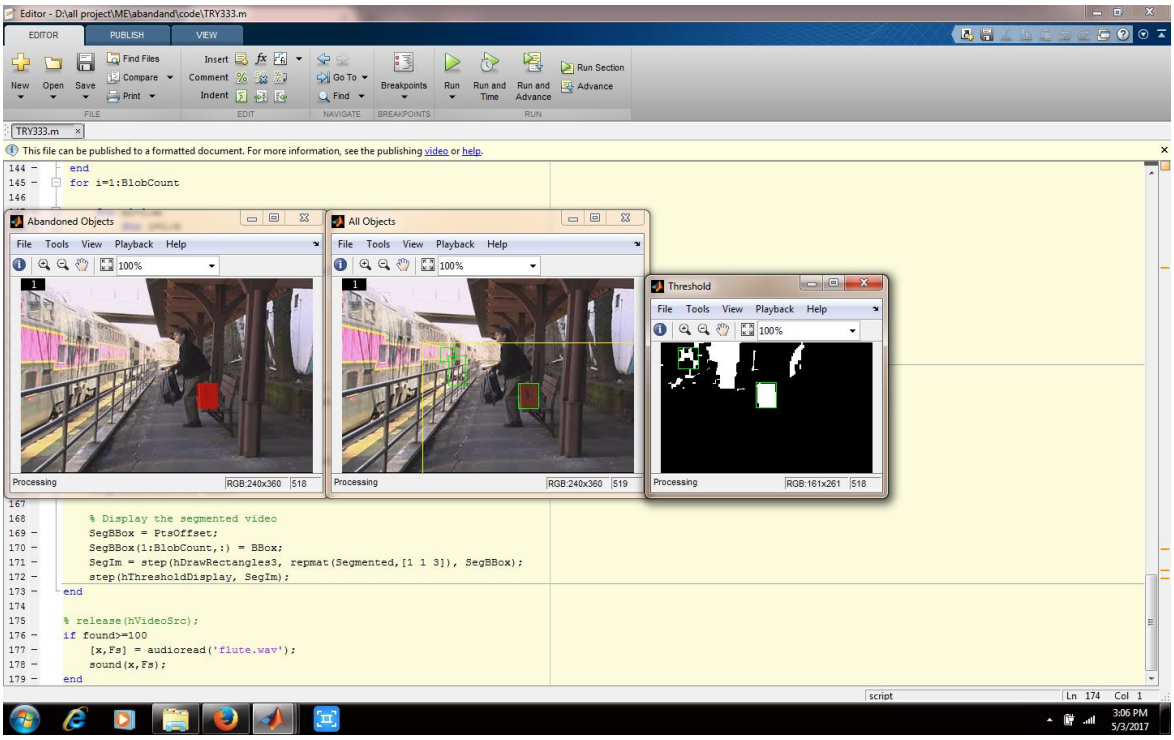

Figure 5 Result of Detection of abandoned object at railway station scenario

Figure 6 Result of Detection of object Indoor scenario:

VII. CONCLUSION

In this paper, the system for automatic detection of abandoned object based on blob analysis is proposed. The video of abandoned object detection scenario is given as the input to the system. The video is divided into number of frames & ROI is defined for the frame. Then conversion from RGB to YCbCr is performed for accuracy in the results. The foreground blobs are detected by using background subtraction algorithm. Morphological close operation is done on the detected foreground blobs to fill the gaps. Using blob analysis algorithm, the blob statistics are computed. From the obtained blob statistics, the detected blobs are tracked by blob tracker block. The blob tracker finds for how many frames the blob remains stationary & if it is stationary for predefined value (45 frames for this system), then the blob is declared as an abandoned object & the alarm is triggered. The results of system are tested on various scenarios & it is found that all the abandoned objects are successfully detected with very few false positives.

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