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Dual Background Segmentation Based Abandoned Object Detection in Video Surveillance Systems

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Abstract: Detection of unattended object is one of the important tasks in video surveillance system. This paper describes the unattended object detection based on dual background segmentation approach. The proposed system consists of preprocessing model which includes background segmentation, shadow removal and brightness balancing techniques. The system uses two sets of background i.e current background and buffered background for the detection of foreground blob. The framework of the system is based on approximate median model. The stationary object is detected and based on the threshold value the alarm is raised after detecting the unattended object. The system is tested on a video of resolution 320×240 pixels containing all types of objects. i.e. moving objects, static objects and abandoned/unattended objects.

Keywords: Video Surveillance, Image Pre-processing, Dual Background Subtraction, Tracking, Abandoned Object.

I. INTRODUCTION

The advent of smart cameras with higher processing capabilities has now made it possible to design systems which can possibly detect suspicious behaviors (in general) and abandoned objects (in particular). A common approach is to perform background subtraction, which identifies moving objects from the portion of a video frame that differs significantly from a background model. There are many challenges in developing a good background subtraction algorithm. First, it must be robust against changes in illumination. Second, it should avoid detecting non-stationary background objects such as moving leaves, rain, snow, and shadows cast by moving objects. We present an abandoned object detection system based on a simplistic and intuitive mathematical model which works efficiently at QVGA resolution which is the industry standard for most CCTV cameras. The proposed system consists of a novel self-adaptive dual background subtraction technique based on the Approximate Median model framework [1].

The purpose of this project is to develop an automated system for detecting and raising an alarm in presence of an unattended/abandoned object. Thus preventing hazardous events from taking place.

In the past, many approaches based on background subtraction were proposed. Such methods differ mainly in the type of background model and in the procedure used to update the model. Among them, a mixture of Gaussian distributions has been used for modeling the pixel intensities in [3]. In [4] the authors proposed a simple background subtraction method based on logarithmic intensities of pixels. They claimed to have results that are superior to traditional difference algorithms and which make the problem of threshold selection less critical. A prediction-based online method for modeling dynamic scenes is proposed in [5]. The approach seems to work well, although it needs a supervised training procedure for the background modeling, and requires hundreds of images without moving objects. Adaptive Kernel density estimation is used in [6] for a motion-based background subtraction algorithm, the detection of moving objects to handle complex background, but the computational costs is relatively high. In [7] different background subtraction techniques are used such as single Gaussian, temporal median filter, mixture of Gaussian, kernel density estimation. This provides a review of comparison mainly based on three factors speed, memory requirements and accuracy but these background subtraction techniques have limitations in terms of noise and illumination change. In this work, a new background subtraction technique, dual background subtraction algorithm is used which dynamically updates two sets of background. Having two backgrounds has an added advantage that the user can adjust the time interval between the update of reference background frames to suit different needs and environments.

The rest of the paper is organized as follows: In section II, we describe an overview of the proposed system. In section III, we describe dual background segmentation method for stationary region detection. The classification procedure of detected object types is presented in section IV. Section V covers some experimental results. Finally, concluding remarks and discussions are presented in section VI.

II. SYSTEM OVERVIEW

To develop an intelligent system for detecting unattended object and raise alarm for the same.

The methods proposed in this system consist of following modules:

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- Input(Video Sequence)
- Frames Extraction
- Background Modelling
- Blob Detection
- Feature Extraction
- Stationary Object Detection
- Monitoring Objects
- Alarm and Display

The overall system is modular in nature and has different blocks acting as discreet processing units. First of all a video stream is initially segmented into individual images by frame extraction.

III.MATERIALS AND METHODS

A. IMAGE PRE-PROCESSING

In the preprocessing part we apply the several preprocessing steps on each frame like denoising to remove the noise from images, smoothing, erosion etc. The noise and error free image frames are given as input to the background substraction model.

B. BACKGROUND SEGMENTATION

In background subtraction, however we are using dual background subtraction, it requires the two reference background images namely “Current background” and “Buffered background”. In this, both backgrounds are updated dynamically. The first one is updated frequently while the second one has a slower update rate. The first frame of the incoming video is initialized as Current Background. Subsequently, the intensity of each pixel of this current background is compared with the corresponding pixel of the next frame (after every 0.4 seconds). If it is less, then the intensity of that pixel of current background is incremented by one unit, otherwise it is decrementedby one unit. In case of equality, the pixel intensities remain unchanged. This way, even if the foreground is changing at a fast pace, it will not affect the background but if the foreground is stationary, it gradually merges into the background. Since we are interested in all those objects which are stationary for a long period of time (and thus have gradually merged into the background), we maintain another set of background images called Buffered Background. Here, all those pixels which do not belong to the prospective abandoned objects set are made equal to that of Current Background. This is done at an interval of every 20 seconds. Difference of the two backgrounds is represented as a binary image with the white portion representing foreground (blobs)[1].

C. ALGORITHM

The blob analysis takes as an input a binary image, applies an algorithm and returns various properties of the detected blobs like bounding box, area, centroid position, etc.

The algorithm is as follows:

1. Create a region counter.
2. Scan the image from left to right and from top to bottom.
3. For every pixel check the north and west pixel (4-connectivity) or the northeast, north, northwest, and west pixel (8-connectivity) for a intensity value of 1 in the binary image (termed as criterion of blob analysis).
4. If none of the neighbours fit the criterion then assign to region value of the region counter. Increment region counter.
5. If only one neighbour fits the criterion, assign pixel to that region.
6. If multiple neighbours match and are all members of the same region, assign pixel to their region.
7. If multiple neighbours match and are members of different regions, assign pixel to one of the regions and indicate that all of these regions are the equivalent.
8. Scan image again, assigning all equivalent regions the same region value.

D. OBJECT DETECTION

Once the blob analysis is carried out the feature extraction is done from which the stationary object is detected. The features to be extracted are:

1. Centroid of Blob
2. Area of Blob
3. Height of Blob
4. Velocity of Blob

These features are fed into the classifier to come up to a conclusion on whether the particular object is an abandoned object or not [2].

1.Centroid Of Blob

To calculate the centroid of a binary image you need to calculate two coordinates:

$$\text{centroid} = \left(\frac{\mu 1{,}0}{\mu 0{,}0}, \frac{\mu 0{,}1}{\mu 0{,}0}\right) \quad (1)$$

Consider the first moment

$$\text{sum}_x = \sum\sum x f(x, y) \quad (2)$$

The two summations are like a for loop. The x coordinate of all white pixels (where f(x, y) = 1) is added up.

Similarly, we can calculate the sum of y coordinates of all white pixels:

$$\text{sum}_y = \sum\sum y f(x, y) \quad (3)$$

To get the average, we need to divide each by the number of pixels. The number of pixels is the area of the image the zeroth moment. So we get:

$$\mu_{1,0} = \frac{\text{sum}_x}{\mu_{0,0}} \quad (4)$$

$$\mu_{0,1} = \frac{\text{sum}_y}{\mu_{0,0}} \quad (5)$$

2. Area Of Blob

To calculate the area of a binary image, you need to calculate its zeroth moment:

$$\mu_{0,0} = \sum_{x=0}^{\omega} \sum_{y=0}^{h} f(x, y) \quad (6)$$

Now, in a binary image, a pixel is either 0 or 1. So for every white pixel, a ’1’ is added to the moment - effectively calculating the area of the binary image. Once

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the features are extracted then the rule based classifier is used to distinguish the unattended object and the still-standing persons.

IV. CLASSIFICATION

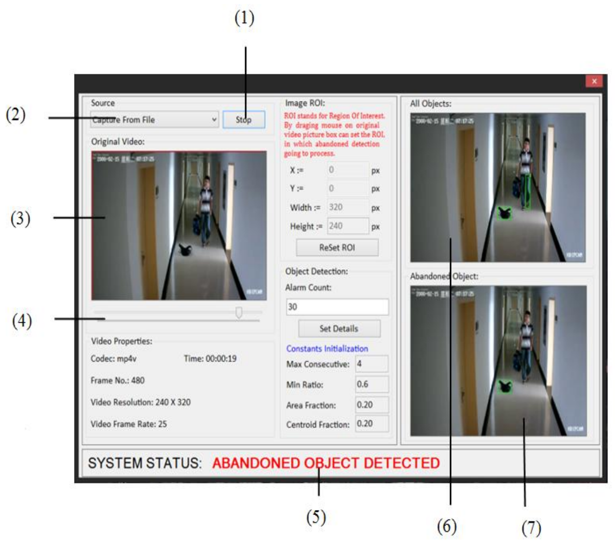
To distinguish the unattended or removed object from still person, we subdivide extracted objects moving object was classified into one of four types, Temporary Static Object (TS), Moving Person (MP), Still Person (SP), Unattended Object (UO), and Unknown (U), using a simple rule-based classifier for the real-time process. It uses features such as the velocity of a blob, area of blob etc.
To classify, we used three critical assumptions:

1. Unattended object does not move by itself.
2. Unattended object has an owner and
3. The size of the unattended object is probably smaller than a person.

If objects were detected, they were initially classified as Unknown. Then, using the velocity of the moving object, the Unknown was classified as Person. That is to say, if Unknown moved at a velocity higher than that of the threshold value, then for several consecutive frames, it was identified as a Moving Person. If Unknowns velocity was below the threshold velocity, it was classified as Temporary static object. If Unknown is identified as Temporary Staic, Unattended Object and Still Person were distinguished by using the Exponent Running Average (ERA). If ERA is greater than a predefined threshold value Then, the Temporary Static object is classified as still person and otherwise it will be unattended object [2].

E. ALARM
The time span is given to the system. If the object is stationary for a time greater than the defined time span then the object is considered as unattended. We used the raise-alarm flag and highlight that part of the vide for which the alarm has been raised.

V. RESULTS AND DISCUSSION



1: The start/stop button.
2: This section is used to choose between capturing video from camera/file.
3: Original video playback area.
4: Interactive video track-bar
5: This section displays whether the abandoned object is detected or not.
6: This section tracks and displays all the new objects that is being added to the background.
7: This section displays all the abandoned object detected by the system.

VI. CONCLUSION

We have presented robust and computationally efficient method to detect unattended object in public places. This method uses dual background segmentation scheme for the detection of foreground blob. The background segmentation is adaptive in nature. It consists of two types of reference backgrounds current and buffered background, each with a different time interval. Blob analysis is done on the segmented background. The results show that the system is robust to variations in lightning conditions and the no of people in scene. In addition, the system is simple and computationally less intensive as it avoids the use of expensive filters while achieving better detection results. Finally if the object is found to be unattended then the alarm is raised to alert the authorities. Future scope will focus on training the system with objects. For that we will be using feature extraction part which consists of rotation, translation and scale (RTS) invariant features [8].

REFERENCES

[1] A. Singh, S. Sawan, M. Hanmandlu, V.K., B.C. Lovell, “An abandoned object detection system based on dual background segmentation”,2009.
[2] ThiThi Zin, Member, IEEE, Pyke Tin, Hiromitsu Hama, Member, IEEE,TakashiToriu, Member, IEEE, “Unattended Object Intelligent Analyzer for Consumer Video Surveillance”, 2011.
[3] Medha Bhargava, Chia-Chih Chen, M. S. Ryoo, J. K. Aggarwal, “Detection of object abandonment using temporal logic”, 2009.
[4] G. Mallikarjuna Rao, Dr.Ch.Satyanarayana, “Object Tracking System Using Approximate Median Filter, Kalman Filter and Dynamic Template Matching, I.J. Intelligent Systems and Applications”, 2014, Vol 05, 83-89.
[5] C. Lakshmi Devasena, R. Revath , M. Hemalatha, “Video Surveillance SystemsA Survey”, IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 4, No 1, July 2011.
[6] M. Elhamod and M. D. Levine, “A real time semantics-based detection of suspicious activities in public scenes”, in Proc. 9th Conf. CRV, Toronto, ON, Canada, 2012, pp. 268275.
[7] Manojkumar Gawali and D.R.Pawar, “Background Subtraction Techniques”, International Journal of Engineering Technology and computer Research, vol. 2, no. 6, pp. 50-56, 2015.
[8] Dipti Pawar, “Fuzzy Min-Max Neural Network with Compensatory Neuron Architecture for Invariant Object Recognition”, IEEE IC4, pp. 639-643, 2015.