IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 5, Issue 9, September 2018

Abandoned Object Detection via Temporal Consistency Modeling and Back-Tracing Verification for Visual Surveillance

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Abstract: Security of public places is a considerably burning issue. Day by day the issues of mass killing due to bomb explosions are increasing. These bombs are mostly disguised in bags, luggage, etc. The common strategy of sleeper cell is to leave bags or belongings in public area. The security in charge cannot be always vigilant over Camera's footage, hence if an automation is given to Camera itself; that will lessen the chances of such risk. For that the proposed system is processing the video with the image processing using Open CV on .NET platform. If a person is dropping off some bag or any such suspicious thing and leaving it running away, the system will catch this activity and if such bag is immobile for certain time span decided by analyzer, then it will give notification to authority as abandon object using Image processing. Abandoned object detection is an essential requirement in many video surveillance contexts. We introduce an abandoned object detection tool based on a set of possible events and on a set of rules to act upon those events. This implementation is simple and reusable unlike existing techniques. It is implemented using a simple logical reasoning upon textual data, in contrast to image centric processing.

Keywords: Abandoned luggage detection, abandoned object detection, object detection and tracking, video surveillance, left baggage detection, background subtraction.

I. INTRODUCTION

Public places are being investigated with cameras but modern technologies cannot fully prevent the such attacks. To prevent luggage bomb attacks, a fully automatic efficient and effective intelligent surveillance system is required. The intelligent surveillance system can detect stationary object which is alone in the public place and produce an alarm or message to alert the guards for removing such type of abandoned object. Security of public places in a considerably burning issue. Though the CCTV have installed at the laces but the footage is only used after incident had taken a place. Those CCTV cams can be used to prevent such incidents from happening. Hence we are proposing a best way in this project. We are processing the live feed of the CCTV cam with the image processing. If a person is dropping off some bag or any such suspicious thing and leaving then it running away, the camera will catch this activity. And if such a bag is untouched for some time span decided by analyzer after it will give notification to authority.

Recent years have seen there are rise in terrorist attacks on crowded public places such as train stations and subways, airports, market, nightclubs, shopping malls, etc. Many surveillance tools have been employed in the fight against terror. Although video surveillance systems have been in operation for the past two decades, the analysis of the CCTV footage has not often put in risk so it's out of the hands of human operator. Recent studies have brought into fore the limits of human effectiveness in analyzing and processing crowded scenes, particularly in the video surveillance systems consisting of multiple cameras. The advent of smart cameras with higher processing capabilities has now made it possible to the design systems which can possibly detect suspicious behaviours and abandoned objects. Nowadays, terrorists come to public places such as railway stations, airports, bus stations and leave the luggage bomb for explosive attacks.

It is very challenging to watch over the public places with crowds by security guards and identify the abandoned objects that have been left by a terrorist. In the visual surveillance research, detecting abandoned luggage is referred to as the problem of abandoned-object or left-luggage detection. It is a crucial task for public security, particularly for identifying suspicious stationary items.

1. Problem statements

Given a video sequence captured by a static uncalibrated camera in a mid-field setting, our objective is:

- To develop a reliable system that detects abandoned objects in a crowded scene. An abandoned object as an entity which is absolutely static in the scene for more than a time period T and the perceived owner of the object is not present within a radius of r.
- To implements a systematic method for segmenting the foreground and background in the scene based on a comprehensive background model.
- To make the background model adaptive, so the system adapts to changes which are persistent and does not have to be restarted periodically.

2. Objectives

- To provide security systems for social monitoring.
- To stop the terrorist activity in public places.
- To increase the level of security.

II.LITERATURE REVIEW

In paper [1] A temporal consistency model is described which is combination a back tracing algorithm for abandoned object detection. The temporal consistency model is described by a very simple FSM. It exploits the temporal transition pattern generated by short- and long-term background models, which can accurately identify static foreground objects. Their back-tracing algorithm iteratively tracks the luggage owner by using spatial temporal windows to efficiently verify left-luggage events. presented a robust method that uses dual foregrounds to find abandoned items, stopped objects, and illegally parked vehicles in static camera setups. At every frame, autor adapt the dual background models using Bayesian update, and aggregate evidence obtained from dual foregrounds to achieve temporal consistency.

In paper [2] "A survey on visual surveillance of object motion and behaviours" describes by Man, Cybern. Proposed contour features are more sensitive to the changes, to distinguish the static objects and moving objects. An edge based object recognition method applied to classify human and non-human static objects either it is full or partial visible. Experimental results demonstrate that proposed approach detect abandoned object even in bad illumination, crowd scene, occlusion and effective to detect object of different size. False detection has been handled through the generated score. An abandoned object detection system based on a dual background segmentation scheme.

Chuan-Yu Cho and Wei-Haoin in 2008 developed a crowd-filter for detection of abandoned objects in crowded area [3]. The video surveillance scenarios into three categories of Occasional, Normal and Crowded based on the pedestrian traffic in surveillance videos. For occasional and normal cases, only few pedestrians appear in a video, the video background could be separated using simple background modeling methods. The detection schemes mentioned are all able to deal with these two scenarios well. However, for the crowded scenario, there is still no effective way to filter out crowded pedestrians for identifying the possible suspicious objects.

Huiyuan Fu and Mei Xiang in 2011 developed [4] Abandoded object detection in highway scenes. Gaussian mixture model (GMM) is used to model the background, but it is not updated every frame for keeping the abandoned objects in the foreground. To erase the noise caused by sunshine or wind, we bring an edge statistics feature based approach into the framework.

Shin-ichi Ito and Minoru Fukumi in 2013 [5] implemented Abandoned Object Detection by Genetic Algorithm with Local Search. In this objects with security camera, there are infinitely various sizes and orientations of the object to be searched. Therefore, they propose an object search method which is adapted to transformation of the object. they use a template matching using Genetic Algorithm (GA) for detection of abandoned objects.

III.SYSTEM IMPLEMENTATION

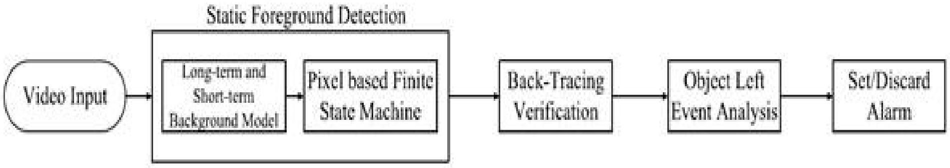

Figure.1 Block diagram

The proposed abandoned-object detection method is based on background modeling and subtraction The following subsection provides a conceptual review of background sub-traction and the associated learning rates for updating a background model. Subsequently, the remaining subsections introduce our algorithm for identifying static fore-ground regions.

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

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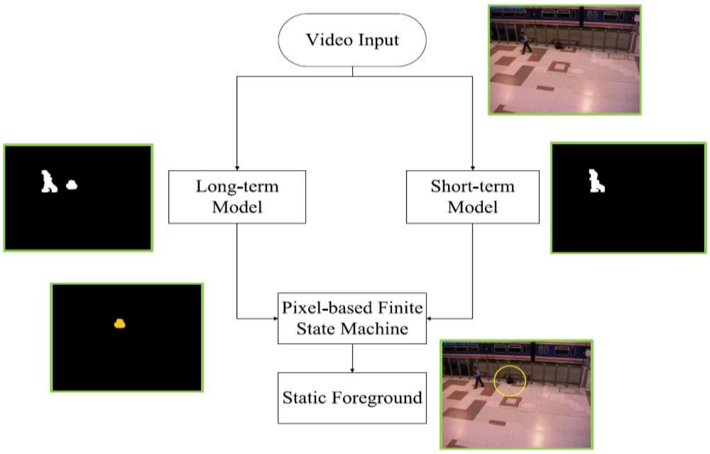

Figure.2 System design

- **Long-Term and Short-Term Integration Background Modeling**

Figure shows an overview of the integrated background modeling method proposed in this study. First, describe the long- and short-term models built in our approach for static foreground detection. The proposed algorithm starts from a generic background modeling method operated at two learning rates. Without loss of generality, we select the MOG method in as background modeling method; however, other methods equipped with learning-rate mechanisms for updating background models can be used in our framework as well. As aforementioned, a small learning rate S updates the background model at a faster speed. The model that learns at this small rate is called the short-term background model BS, where FS denotes the binary foreground image obtained via the short-term model. By contrast, a large learning rate L yields the model that is updated at a slower speed.

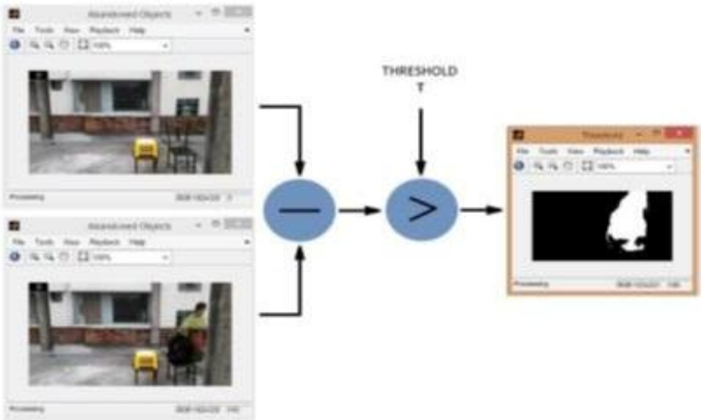

Figure 3: foreground regions obtained using the long- and short-term background model

Figure 3. shows an example of the foreground regions obtained using the long- and Short-term background models; the assembly of long- and short-term background models is suitable for detecting stationary objects.

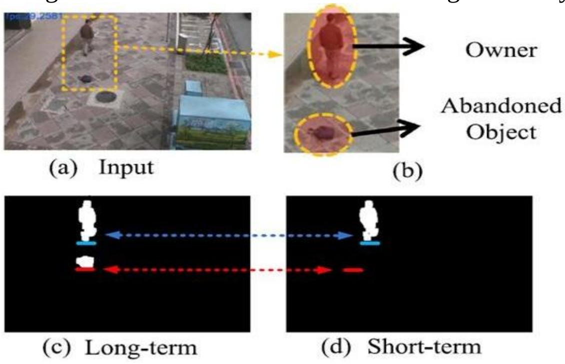

Figure 4: shows an example of an abandoned-object event

- **Pixel Based Finite State Machine (PFSM)**

Instead of recognizing the status of each pixel based on only a single frame, we use temporal transition information to identify the stationary objects based on the sequential pattern of each pixel. A pixel is associated with only one state at a time. Based on long-and short-term background models, the state of pixel i can be changed from one state at time t to another state at time t + 1.

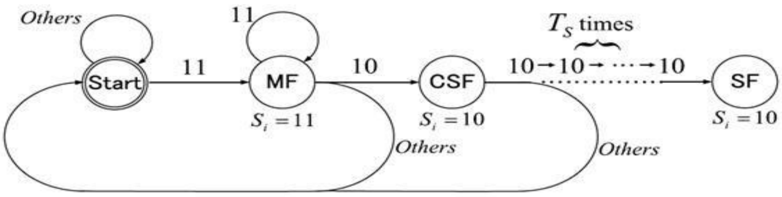

Figure 5: PFSM for Static foreground detection

As shown in Figure 5, the transition pattern describes the static foreground in an object-abandoned event. Starting from an initial state, the system is triggered by Si = 11, indicating that pixel i is currently occluded by a foreground region. Hereafter, when a person abandons their luggage, the short-term method soon updates the luggage into its background model, whereas the long-term method does not; thus, the status of this site is changes to Si = 10. Finally, when the status of Si = 10 persists for a certain duration of time (i.e., for Ts times), we then conjecture that pixel I has become a part of the static foreground. During this procedure, only those pixels associated with this particular transition pattern are considered static foreground pixels. Otherwise, the state of pixel i would return to the initial state and restart until the initial state Si = 11.

- **Abandoned Object Event Analysis**

Once the trajectory of owner is obtained, a warning is issued that the luggage has been abandoned in accordance with the following two rules, as defined by PETS2006.

1. Temporal rule: The luggage is declared an unattended object when it is left by its owner, and the luggage is not attended within time T= 30 seconds.
2. Spatial rule: The unattended luggage is declared an abandoned object when it is left by its owner. When the distance between the owner and luggage is greater than a prede ned distance D= 3 m, then an alarm event is triggered.

According to the PFSM, the temporal rule is satis ed by letting Ts = 30 f frames, where f is the frames per second (fps) at which the video is captured. The spatial rule is veri ed by examining the trajectory of owner. We create a luggage-centered ROI with a radius of D = 3 pixels (where denotes the scaling factor to convert pixels into real-world distances), and investigate whether the owner is within and then left the ROI. An alarm is raised when both the spatial and temporal rules are satisfied.

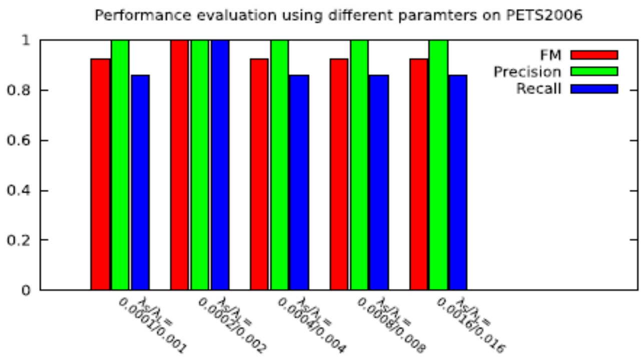

Figure.6. Performance evaluation using different parameters on PETS2006

- **PETS 2006**:

The datasets are multisensor sequences containing the following 3 scenarios, with increasing scene complexity:

1. loitering
2. attended luggage removal (theft)
3. unattended luggage

The results of processing the datasets are to be submitted in XML format.

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Vol. 5, Issue 9, September 2018

Figure.7 detection by PETS 2006

- **The i-LIDS Dataset**

This dataset was created from the pedestrians observed in two non-overlapping camera views from the i-LIDS Multiple-Camera Tracking Scenario (MCTS) dataset which was captured at an airport arrival hall under a multi-camera CCTV network. It comprises 600 image sequences of 300 distinct individuals, with one pair of image sequences from two camera views for each person. Each image sequence has variable length ranging from 23 to 192 image frames, with an average number of 73. The iLIDS-VID dataset is very challenging due to clothing similarities among people, lighting and viewpoint variations across camera views, cluttered background and random occlusions. The i-LIDS video library provides a benchmark to facilitate the development and selection of video detection systems. The evaluation is based on two scenarios: abandoned baggage and parked vehicles.

Figure.8 Detection by The I-LIDS dataset

IV.RESULTS

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a sub category or field of digital signal processing, digital image processing has many advantages over analog image processing.

Figure.9 Simple image output

It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

DOI 10.17148/IARJSET.2018.592

IARJSET

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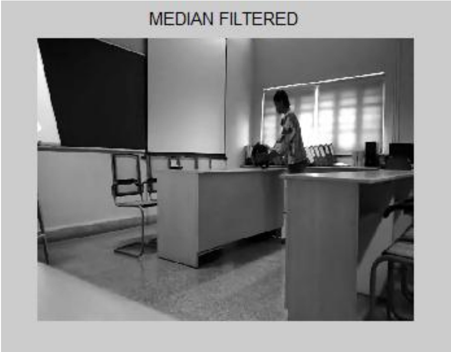

Figure.10 Median Filtered output

The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing.

Figure.11 Foreground image output

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to grey scale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest.

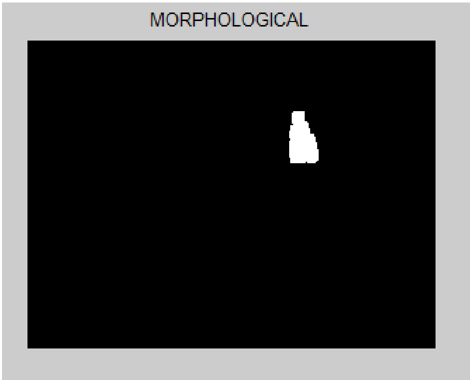

Figure.12 Morphological object output

The identification of objects within an image can be a very difficult task. One way to simplify the problem is to change the gray scale image into a binary image, in which each pixel is restricted to a value of either 0 or 1. The techniques used on these binary images go by such names as: blob analysis, connectivity analysis, and morphological image processing (from the Greek word morphē, meaning shape or form). The system processes video imagery from the cameras and can then detect certain moving objects. The version of the system that uses the Around View Monitor analyzes video signals in an image-processing unit from the four cameras attached to the front, rear and both side-view mirrors of the vehicle.

Figure.13 Moving object output

CONCLUSIONS

1. The abandoned object detection system is based on a Background subtraction, Blob Detection and Tracking, Morpho-logical Processing.
2. It is adaptive in nature and based on the Approximate Median Model it can be use for tracing of blob under occlusion is given.
3. Tracking the blobs under occlusion can be done with the help of background subtraction, Blob Detection and Tracking Morphological Processing algorithm.

Future Scope

1. Further this method can be extended to identify any such suspicious objects in real time by looking for certain pre-defined patterns in the incoming video stream so as to raise an alarm without requiring any human intervention.
2. It is assumed that the data about the scene is available from only one camera and from a fixed viewpoint is approximately done.

Applications

- To detect the theft
- To detect bomb in tiffin or bag
- At airport
- Object detection in crowd places

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