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Review of Abandoned Object Detection Techniques

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Abstract- In recent years due to various kinds of social activities such as theft, bomb attack and other terrorist attack preventive security measures at public places has gained lot of importance. Abandoned Object detection is most crucial task in visual surveillance system. Many Public or open areas are facilitated with cameras at the multiple angles to monitor the security of that area for keeping citizens safe. This is known as the surveillance system. In this paper a new algorithm is proposed for object tracking in video, which is based on image segmentation. With the image segmentation all objects in video can be detected whether they are moving or not by using segmentation results of successive frames. This approach definitely provides security and detects the moving object in a real time video sequence and live video streaming. Attempt of this paper is to study all the different techniques available for abandoned detection and to find out the research possibilities available in this area.

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

1. Introduction

In Recent years we have seen that 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, its out of the hands of human operators. Recent studies have brought into for 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. Public places are being investigated with cameras but modern technologies cannot fully prevent such attacks[1].To prevent from luggage bomb attacks, a fully automatic efficient and effective intelligent surveillance system is required. The intelligent surveillance system can detect stationary object which are alone in the public places and produce an alarm or message to alert the guards for removing such type of abandoned object.

Security of public places is a considerably burning issue. Though the CCTV have installed at the places but the footage is only used after incident had taken place. Those CCTV cams can be used to prevent such incidents from happening. Hence we are proposing a best way in this project. The processing the live feed of the CCTV cam with the image processing[2]. If a person is dropping off some bag or any such suspicious thing and leaving it and 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[3]. Minimum time span probability stays 50-50, but as time span increases the probability of that thing are being abandon or hazardous increases.

2. Literature Review

This particular section deals with review at different papers related to different techniques available for abandoned object detection.

Kevin Smith, Pedro Quelhas, and Daniel Gatica-Perez [4] presented a temporal consistency model is combining 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-term and

long-term background models, which can accurately identify static foreground objects. Their back-tracing algorithm tracks the luggage owner by using spatial-temporal windows to efficiently verify left-luggage events.

Fatih Porikli,Yuri Ivanov and Tetsuji Haga[5] 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, author adapt the dual background models using Bayesian update, and aggregate evidence obtained from dual foregrounds to achieve temporal consistency. This method does not depend on object initialization and tracking of every single object, hence its performance is not upper bounded to these error prone tasks that is usually fail for crowded scenes. It accurately outlines the boundary of items. Since it will executes pixelwise operations, it can be implemented on parallel processors.

Rajesh Kumar Tripathi, Anand Singh Jalal [6] proposed a framework for abandoned object detection in real-time from surveillance video. Author utilized running average method for background modeling which is more suitable for real-time surveillance video. Proposed features are more sensitive to the changes and 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 and it is effective to detect object of different size. False detection has been handled through the generated score.

In [7], A. Singh, S. Sawan, M. Hanmandlu have presented an abandoned object detection system based on a dual background segmentation scheme. The background segmentation is adaptive in the nature and based on the Approximate Median Model. It consists of two types of the reference backgrounds, Current background and Buffered background, each with the different time interval. A Blob analysis is done on the segmented background and a dynamic tracking algorithm. A device is used for tracking the blobs even under the occlusion. Detection results show that the system is robust to variations in lighting conditions and the number of people are in the scene. In addition, the system is simple and computationally less intensive as it avoid the use of extensive filters while achieving better detection results.

In [8], YingLi Tian, Rogerio Schmidt Feris, Haowei Liu, Arun Hampapur, and Ming-Ting Sun have presented a new framework to robustly and efficiently detect the abandoned and removed objects in complex environments for real-time video surveillance. The mixture of Gaussians background subtraction method is employed to detect both background and static foregrounds by using the same Gaussian mixture model. Then static foregrounds were classified into abandoned or removed objects by segmenting and comparing the surrounding area of the background model and the foreground image. Method can handle occlusions in the complex environments with crowds. Besides this, in order to reduce false alarms, author has employed tracking information in to a small temporal window to provide an additional cue to filter out the impact of spurious and noisy trajectories for abandoned object detection.

In paper [9] Q. Fan, P. Gabbur, and S. Pankanti have proposed a novel approach to the abandoned object detection using the framework of relative attributes. Specifically, they design three physically interpretable attributes (staticness, foregroundness and abandonment) to characterize different kinds of alerts raised by various objects in the scene. They learn ranking functions for each of the attributes to rank under the alerts based on their strengths on the corresponding attributes. The attributes are used as input to an alert prioritization method which performs a ranking using alert importance.

H.-H. Liao, J.-Y. Chang, and L.-G. Chen [10] have proposed a novel approach to left-luggage detection in surveillance video. Through the use of foreground-mask sampling, authors are able to emulate the human vision capability of limiting and focusing on solely the object of interest to them, while filtering out all other irrelevant, interfering agents. They are therefore able to apply tracking in a selective and more localized manner. Authors have also proposed an improved implementation of the Hough Transform for detecting the human upper-body contour from the video frames. And they have incorporated a probabilistic framework and employed the MAP principle in their modelling of the luggage-abandonment event and subsequent reasoning.

In paper [11], Kahlil Muchtar, Chih-Yang Lin, Li-Wei Kang and Chia-Hung Yeh have proposed an automatic system for abandoned object detection. The main contribution of the method is to provide a comprehensive solution, which can identify the status of an object, abandoned, removed or partially occluded. He employs the combination of background modelling based on mixture of Gaussian Mixture Model (GMM) and Markov Random Field (MRF). Furthermore, he employs a cast-shadow approach to enhance the shape of abandoned object. By combining these two approaches the abandoned object detection can perform well and obtain accurate results. The Gaussian Mixture Model (GMM) was proposed by

Grimson and Stauffer. The authors presented pixel-based method to the model each pixel (regarded as background) into a mixture of Gaussians. In addition, each Gaussian has its own weight to represent its portion of the data accounted for corresponding distribution.

3. Methods and Descriptions

In [1] Kevin Smith, Pedro Quelhas and Daniel Gatica-Perez proposed a temporal dual-rate foreground integration method for static foreground estimation for single camera video images. Their approach involves constructing both short-term and long-term background models learned from an input surveillance video on-line. Subsequently, they introduce a simple pixel-based finite-state machine (PFSM) model that uses temporal transition information to identify the static foreground based on the sequence pattern of each object pixel. Because this proposed approach involves using temporal transition information, they can reduce the influence of imperfect foreground extractions in the double-background models, thereby improving the accuracy of the constructed static foreground inference. An owner-tracking procedure is also employed in their method to semantically verify the abandoned object event. The proposed methodover previous methods are follows:-

1) They introduce a dual-rate background modelling framework with temporal consistency. It performs considerably better than the single-image-based double background models .
2) They develop a simple spatial-temporal tracking method for back-tracing verification.Compared to the frame-by-frame tracking approaches.

Table 1.Abandoned Object detection Methods/Technique

Authors	Methods	Description
Kevin Lin, ShenChi Chen,[1]	Dual Background, Subtraction, PFSM	Dual subtraction is used to identify current and background image. Then a Pixel based finite state machine method is applied to that image and the static object can be detected.
F. Porikli, Y. Ivanov, and T. Haga,[2]	Dual Foreground, Bayesian Update	Each pixel as layers of 3D multivariate Gaussians. Each layer corresponds to a different appearance of the pixel. Using Bayesian approach, they are not estimating the mean and variance of the layer, but the probability distributions of mean and variance.
Rajesh Kumar Tripathi, Anand Singh Jalal[3]	Contour feature, Edge based object recognition	Extract two consecutive binary foreground frames and find the contours of both the frames. The area and length of a contour from both frames are calculated and then, area ratio, length ratio and center position of the contour is calculated to determine static object into the frame.
A. Singh, S. Sawan, M. Hanmandlu[4]	Dual background segmentation, Blob detection	Technique requires two reference background images, namely, 'Current Background' and 'Buffered Background'. This technique of storing two backgrounds can be considered as a dual background method. The blob analysis takes as an input binary image, applies an algorithm and returns various

		properties of detected blobs like bounding box, area, centroid position etc.
Y. Tian, R.S.Feris, H. Liu,[5]	Background subtraction with Gaussian Mixture Model	The mixture of Gaussians BGS method is employed to detect both background and static foregrounds by using the same Gaussian mixture model. Then, the static foregrounds were classified into abandoned or removed objects by segmenting and comparing the surrounding areas of the background model and the foreground image.
Huiyuan Fu1, Mei Xiang[6]	Gaussian Mixture Model to framework	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
Takako Ikuno, Momoyo Ito, Shin-ichi Ito and Minoru Fukumi [7]	Genetic Algorithm with Local Search	In this topic searching 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.
Chathuranga Hettiarachchi, and Asitha Nanayakkara[8]	Detection with Logical Reasoning	In this research present implemented using a simple logical reasoning upon textual data, in contrast to image centric processing. Objects foreign to a usual environment are extracted using background subtraction. Results of blob detection and tagging process are passed to an abandoned object detector in a textual format.
Tiantian Zha and Jinghan Li[9]	Detection Basedon Tachograph Videos	A novel abandoned object detection based on tachograph is proposed. Firstly, this is use the HarrisSIFT features and particle filter to achieve object tracking. After that, the VIBE

		algorithm is applied to detect the abandoned object with background modelling frame by using both background subtraction method and frame difference method.

4. Gap of Research Identified

The application was tested on a large number of publicly available as well as custom made videos and was found to give accuracy comparable to most contemporary systems, while still managing to run in real time on a fairly modest setup. One particularly noteworthy aspect of its performance was that the very low rate of false positives that were obtained. Also, these results were obtained by using virtually the same methods and parameter values across all the videos with only minor changes for some cases. Significantly better results can be obtained if exhaustive testing and adjustments are carried out for each scenario. Finally, and perhaps most importantly, the methods that have been presented and tested in this paper are those that are part of the initial implementation of this system. These were specifically chosen to be relatively simple methods, both to implement and to execute, due to limitations of time and computational resources. However, owing to the modular nature of this system, it is quite easy to add more sophisticated methods to any of its module. This system can, therefore, be considered as the foundation for a truly robust framework that only requires a bit of calibration to perform well in practically any scenario.

The already developed system where carrier is being tracked with the abandoned object and shows alarm when the carrier leaves the frame. But we still need more work to be done in our system.

a) Would like to track the carrier with his/her face.
b) Create a database and try to track and capture a terrorist by face Recognition.
c) The upgrade our work and implement it on a moving camera.
d) The system to work in very dull light environment.
e) The develop system to detect suspicious activities.
f) Suicide bomber never abandons any package but stick the bomb in their body.
The implement facial structural recognition to track the motive of any person. The target is not only to stop here but to implement more of these add-on to our system in near future and make it more efficient and accurate security surveillance system.

5. Problem Formulation

By identified above gaps in abandoned object detection techniques the problem can be formulated 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.

6. Conclusions

1) There are different techniques that can be available for abandoned object detection out of Background subtraction, Blob Detection and Tracking, Morpho-logical Processing which are useful.
2) There are different techniques of abandoned object detection by using short term and long term parameters.
3) Problem formulation can be done by identifying various methods\techniques such as Background Modeling and Subtraction, Foreground Analysis, Blob Extraction etc.
4) The temporal consistency model is described by a very simple FSM. It exploits the temporal transition pattern generated by short-term and long-term background models, which can accurately identify static foreground objects.
5) The back-tracing algorithm tracks the luggage owner by using spatial-temporal windows to efficiently verify left-luggage events.

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