IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 18, Issue 3, Ver. V (May-Jun. 2016), PP 116-119
www.iosrjournals.org

Object Detection & Tracking in Moving Background Under Different Environmental Conditions

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Abstract: *Object detection and tracking has been a widely studied research problem in recent years. Currently system architectures are service oriented i.e. they offer number of services. All such common services are grouped together and are available as a domain called as service domain. One such service domain of our interest is LBS (location based service). The service of our interest is tracking. Tracking of moving objects is done in applications like surveillance systems, human computer interactions, object recognition, navigation systems etc. In real world, 3D, the object which we want to track is called as object of interest (OOI). Tracking has been a difficult task to apply in congested situations due to erroneous segmentation of objects. Common reasons of inaccurate segmentation could be long shadows, partial and full occlusion of objects with each other and with stationary objects in the scene. Difficulties in tracking objects can arise due to appearance change of object as well as scene, unexpected object motion, non-rigid object structures, partial or full occlusions, and camera motion. In this paper we propose algorithm to detect and track objects in indoor or outdoor environment under various conditions such as high illumination, low illumination and hue.*

Keywords: *Multiple moving object tracking; background modeling; morphology; target localization and representation.*

I. Introduction

Digital image processing is among the most researched fields nowadays. The growing need of surveillance systems has further on increased the importance of this field. Surveillance systems have many applications in the field of security, intelligence gathering, traffic control and people tracking. Object detection and tracking is one of the main steps in these systems. Availability of high definition videos, fast processing computers and exponentially increasing demand for highly reliable automated video analysis has created a new and great deal for object detection and tracking algorithms [1].

The detection and tracking of the Object Of Interest (OOI) in a video or video sequence is a very important task in the automated video surveillance; In order to monitor the happenings in a particular area, to detect and recognize moving objects and to detect unlikely events and to report suspicious, criminal activities applications are developed in computer vision system. Some of the other major applications of object tracking are:

- **Robot Vision:** for navigation of robot, different obstacles in the path are identified by the steering system in order to avoid collision. In case the obstacles are itself in motion then we need a real time object tracking system.
- **Monitoring of Traffic:** Highway traffic can be continuously monitored using moving cameras. The vehicle breaking any type of law or involved in any illegal activities can be detected and tracked using a object tracking system
- **Animation purpose:** Animation can be supported by using object tracking algorithm
- **Human computer interaction:** it can be used for automatic attendance system in many areas and to record the in and out time of the object.

II. Litrature Survey

Object Detection and Tracking System consists of following steps:

- Object Detection
- Object Tracking

A. Object Detection

This is essentially the first step of any tracking system. Every tracking method requires an object detection mechanism either in every frame or when the object first appears in the video. Detecting a moving object handles segmentation of moving objects from stationary or moving background objects.

If the camera is fixed then the surveillance scene will remain unchanged leading to method called static background detection method. If camera is not static then camera and scene of surveillance will have some relative movement and the method is called as moving background detection method. In static background detection method position and size of pixels in the background will remain same in different frames of an image sequence .Thus it can use method of difference of the pixels in term of intensity or color value to determine moving region and extract moving object at the same previous position in the different frames. While detection and tracking in case of moving background detection method i.e. dynamic background is more complex due to dynamic environmental conditions such as illumination changes, shadows and waving tree branches in the wind, appearance change caused by pose, illumination, occlusion, and motion, among others.

B. Object Tracking

Object Tracking is among the leading areas of research and quite important in the field of video surveillance. Availability of high definition videos, fast processing computers and exponentially increasing demand for highly reliable automated video analysis has created a new and great deal for object detection and tracking algorithms.

C. Optical flow

Optical flow refers to the visible motion of an object in an image and the apparent 'flow' of pixels in an image. The optical flow can be used as an estimation of object velocity and position of object in the nest frame. It falls under kernel tracking category of object tracking and is referred to as KLT algorithm.

In optical flow method we have studied the latest L1-tracker algorithm [3] they have used sparse representation where an object is modelled by a sparse linear combination of target and trivial templates. However, latest L1 –tracker algorithm efficiently addressed all the major challenges of the object tracking but the computational complexity of this tracker is rather high, thereby limiting its applications in real-time scenarios. Despite much demonstrated success of these generative tracking algorithms, several problems remain to be solved.

The drawbacks of L1 tracker algorithm are:

1. Numerous training samples cropped from consecutive frames are further required in order to learn an appearance model. Since there are only a few samples at the outset, most tracking algorithms often assume that the target appearance does not change much during this period. However, if the appearance of the target changes significantly at the beginning, the drift problem is likely to occur.
2. When multiple samples are drawn at the current target location, it is likely to cause drift as the appearance model needs to adapt to these potentially mis-aligned samples that degrades the performance of appearance model.
3. These generative algorithms do not use the background information which is likely to improve tracking stability and accuracy.

D. Existing work in Dynamic Background

A. Black et al. [4] propose a tracking algorithm based on the subspace constancy assumption. They construct a subspace model offline with some collected target observations, and keep the model fixed during tracking. However, for most tracking applications, it may be difficult to obtain such target observations in advance. As a result, this method has limited application domains and may fail when the target undergoes a different view from the ones used for constructing the model

B. Shafie et al. [5] presented motion detection using optical flow method. Optical flow can arise from the relative motion of objects and the viewer so it can give important information about the spatial arrangement of the objects viewed and the rate of change of this arrangement. Discontinuities in the optical flow can help in segmenting images in to regions that correspond to different objects.

C. Ho et al. [6] propose a subspace learning method based on uniform L2 optimization. During tracking, they divide the most recent observations of the target into several batches and use the means of these batches for appearance modeling. However, this method only preserves the most recent appearance information of the target, and is sensitive to the chosen size of batches. When the batch size is not appropriate, the learned subspace model will be inaccurate and the resulting tracking may be in danger of drifting.

D. Boris Babenko [7] proposes an algorithm called MILtrack, which uses a MIL based appearance model. He argued that using Multiple Instance Learning to train the appearance classifier results in more robust tracking, and presented an online boosting algorithm for MIL. He presented empirical results on many challenging video clips where he measured quantitative performance of tracker compared to a number of competing state of the art algorithms; these results show that tracker is, on average, the most robust with respect to partial occlusions, and various appearance changes.

E. Amit Adam and Ehud Rivlin [8] presented a novel approach ("FragTrack") to tracking. The approach combines fragments-based representation and voting known from the recognition literature,with the integral histogram tool. The result is a real time tracking algorithm which is robust to partial occlusions and pose changes.

F. 6.Grabner [9] considered the tracking problem as a binary classification problem .His proposed method does both - adjusting to the variations in appearance during tracking and selecting suitable features which can learn any object and can discriminate it from the surrounding background. The basis is an on-line AdaBoost algorithm which allows to update features of the classifier during tracking. Furthermore the efficient computation of the features allows to use this tracker within real-time applications.

G. Sam Hare [10] presents a framework for adaptive visual object tracking based on structured output prediction. The method uses a kernelized structured output support vector machine (SVM), which is learned online to provide adaptive tracking. To allow for real-time application, he introduce a budgeting mechanism which prevents the unbounded growth in the number of support vectors which would otherwise occur during tracking.

Despite much demonstrated success of these tracking algorithms, several problems remain to be solved.

1. Numerous training samples cropped from consecutive frames are further required in order to learn an appearance model. Since there are only a few samples at the outset, most tracking algorithms often assume that the target appearance does not change much during this period. However, if the appearance of the target changes significantly at the beginning, the drift problem is likely to occur.
2. When multiple samples are drawn at the current target location, it is likely to cause drift as the appearance model needs to adapt to these potentially mis-aligned samples that degrades the performance of appearance model.
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III. Proposed Algorithm

A typical tracking system consists of three components [2]: (1) an appearance model, which can evaluate the likelihood that the object of interest is at some particular location (2) a motion model, which relates the locations of the object over time; and (3) a search strategy for finding the most likely location in the current frame.

In this paper, we focus on the problem of tracking an arbitrary object with no prior knowledge other than its location in the first video frame (sometimes referred to as “model-free” tracking). Our goal is to develop a more robust way of updating an adaptive appearance model; we would like our system to be able to handle partial occlusions without significant drift, and for it to work well with minimal parameter tuning. To do this, we turn to a discriminative learning paradigm.

Algorithm

1) For each Frame
2) Each frame is divided into number of blocks each of size 45X45 pixel.
3) Find the block with tracking location at (t-1)th frame.
4) Find the feature of the block.
5) Extract the features with low dimensionality using Random Gaussian Matrix Method.
6) Use Gaussian Classifier to each feature vector and get the tracking location with the highest classifier response.
7) For incremental learning of the Gaussian Classifier, extract mean and standard deviation of nearby block features and update the classifier.
8) Sample two set of patches as positive samples which are near to current target location and negative samples which are far away from the object centre to update the classifier.
9) To predict the object location in the next frame, we draw some samples around the current target location and determine the one with the maximal classification score.
10) Based on these two sets classifier classifies and update the parameters.
11) Get the next frame and repeat the steps till the last frame.

IV. Result And Discussion

The proposed NT algorithm is better than the latest existing L1-tracker algorithm [3]

1. L1-tracker algorithm is generative models that encode an object sample by sparse representation of templates using 1-minimization. Thus the training samples cropped from the previous frames are stored and updated, but this is not required in our algorithm due to the use of a data-independent measurement matrix.
2. Our algorithm extracts a linear combination of generalized Haar-like features but the existing L1- trackers use the holistic templates for sparse representation which are less robust.

3. Existing L1-tracker algorithms need to solve numerous time-consuming and computationally complex problems but our Proposed NT algorithm is efficient as only matrix multiplications are required.

Accuracy table (Precision and Recall)

Table 1: accuracy comparision table

ALGORITHM	TP	FP	TN	FN	PRECISION		RECALL	
					Ps = TP/(TP+FP)	Pn = TN/(TN+FN)	Ƞs = TP/(TP+FN)	Ƞn = TP/(FP+TN)
Existing Optical Flow(L1-tracker)	55996	3996	19946	379916	0.93	0.05	0.13	2.34
Proposed Optical Flow(NT-tracker)	98949	999	9957	389297	0.99	0.02	0.2	9.03

V. Conclusion

Thus we conclude proposed algorithm, detects moving objects in indoor and outdoor environments under changing illumination conditions and in the presence of background dynamics. Proposed NT algorithm which deals with the appearance model, which can evaluate the likelihood that the object of interest is at some particular location.

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