Automatic Multiple Object Detection and Tracking System in Real-Time Video Sequences for Moving Objects

Ratnadeep K. Waghmare¹, Hemant. A. Tirmare²

¹Student, Department of Technology, Shivaji University, Kolhapur, India,
²Assistant Professor, Department of Technology, Shivaji University, Kolhapur, India,
¹ratnadeepwaghmare@gmail.com, ²tirmarehemant@rediffmail.com

Abstract

Object detection is challenging task in computer vision. Single object detection can be achieved by different techniques. When multiple objects appear in the videos, detection and tracking of these objects further increases the complexity of the algorithm. In this project we propose the well-known Kalman filter technique for tracking and detection of multiple objects. Kalman filter is used for detection of moving object in many applications like video surveillance and security systems, law enforcement, biometrics, human-computer interaction, video indexing and retrieval, medical imaging, augmented reality and robotics. It has got less complexity as compared to other logics used for the object detection. Application of this algorithm for multiple object detection is challenging task. In our project we will develop the modification for general Kalman algorithm and apply it for multiple object detection. Testing will be carried out on traffic videos available on different sites. Performance evaluation and reliability will be calculated based on precision and recall.

1. Introduction

Moving object detection and tracking is a challenging computer vision task consisting of two closely related video analysis processes. The first one, object detection, involves locating an image object in the frames of a video sequence, while video tracking performs the monitoring of the video object spatial and temporal changes during sequence, including its presence, position, size, shape, etc. [1]. Any object tracking technique must solve the temporal correspondence problem that is the task of matching the target object in successive frames. Usually, the tracking process starts with detecting the initial instance of the moving object, then identifying that image object repeatedly in subsequent frame sequence. Video tracking is often a difficult process, due to factors such as abrupt object motion, object occlusions and camera motion [2]. Thus, object detection has been approached using methods based on background subtraction, frame differences, Histograms of Oriented Gradients (HOG), Partial Least Squares Analysis, Haar Wavelets with SVM, SIFT descriptors, Hough transforms and Active Contour models. Also, various object motion tracking techniques have been proposed. Most popular approaches use Kalman filtering, Mean-Shift algorithms, Optical Flow, HMM, contour tracking and human matching. In this project we propose an automatic multi moving object detection and tracking system for static camera videos. We will develop computer vision system which identifies only the moving objects, not all objects from video frames. It is mainly intended for moving object detection and tracking in fixed camera movies, therefore being very useful for video surveillance applications. Our novel detection and tracking approach consists of the following steps. A video pre-processing step, consisting mainly of image de-noising and restoration operations, is performed first. Then, a moving object identification technique is applied on the filtered video sequence. The multiple video object detection that is described in the next section uses an improved temporal differencing method and several morphological operations.

2. Related Work

Pramod Sharma and Ram Nevatia in their paper [3] discussed efficient techniques to detect objects from video. They have worked on human detection as object from videos. Obtained detection responses, are tracked by applying a simple tracking by-detection method, which only considers the association of detection responses in consecutive frames based on the size, position and appearance of the object. Computational efficiency is compared with other methods.

KhinThandarLwin, Dr. Than Htike and Dr. Zaw Min Naing.in their paper [4] demonstrated the multiple object detection from video. Multiple objects like vehicles are detected for speed detection of vehicles on a highway. Multiple object problems and noisy in data are also considered for performance calculation.
Osama Masoud and Nikolaos P. Papanikolopoulos [5] used multiple object detection for pedestrian tracking and counting. The system outputs the spatio-temporal coordinates of each pedestrian during the period the pedestrian is in the scene. There are three levels for the processing, first at raw image, second at blobs and third at pedestrian. The pedestrian parameters are calculated/estimated using the Kalman filter algorithm. System robustness is tested for outdoor and indoor videos.

Young-Kee Jung, Kyu-Won Lee, and Yo-Sung Ho in their paper [6] propose an object segmentation and tracking algorithm for visual surveillance applications. From dynamic background scene, to detect moving object they have advise method of adaptive background update and rule of motion classification. A two-dimensional token-based tracking system using a Kalman filter is designed to track individual objects under occlusion conditions.

3. Methodology

3.1. Methods of data collection:

Datasets we will use which are available publicly from web. Two different datasets we will use for experiments: CAVIAR [9] and Mind’s Eye [11]. Two sequences: OneShopLeave2Enter (CAVIAR1) and WalkByShop1front (CAVIAR2) from CAVIAR dataset. These sequences have 1200 and 2360 frames respectively of size 384 x 288. Ground-truth (GT) is available at [9]. CAVIAR1 has 290 GT instances of the human, whereas CAVIAR2 has 1012 GT instances of the human.

Two video clip sequences ME1 and ME2, we will use for from Mind’s Eye dataset. These sequences have 425 and 300 frames respectively, each of size 1280 x 760. We manually annotated the ground-truth for these sequences. ME1 has 641 GT instances of the human, whereas ME2 has 300 GT instances of the human.

3.2. Probable methods of data analysis:

After collecting the videos of multiple objects we will follow following steps for detection and tracking of the objects.

1. Take current image and previous image.
2. Take difference between them.
3. Apply minimum threshold for rejection of small objects and random noise.
4. Difference of image is greater than threshold objects detected.
5. Apply object detection algorithm to find centroid of detected objects.
6. Take coordinates of objects detected.
7. Store objects coordinates in object_table for all objects in frame.
8. If objects new coordinates > max value and new coordinates < min values of frame then delete the entry of object.
9. Check end of video length.
11. Else go to step 1.

Step 1 to 4 actually to separate stationary objects from moving objects. Moving objects appear as foreground while all other is treated as background. To separate foreground pixel from background we will use Kalman filter technique. A Kalman Filter is an optimal recursive data processing algorithm. In image sequence processing kalman filtering is used for adaptive background estimation, in order to separate the foreground from the background. The modification suggested in step 7 will help in tracking multiple objects.

Performance evaluation and reliability will be calculated of the above algorithm based on precision and recall.

3.2. Block diagram:

Figure 1 System Block Diagram.

4. Conclusion and Future Work.

In this phase we have develop detection and tracking system for single object. Video sequences captured from Mind’s Dataset are converted in gray scale images. Kalman filtering is used to estimate...
objects parameters. At the images level, we will perform background subtraction and thresholding to produce difference images. Once objects are detected, we extract their outline and track their centroids across the image plane using separate linear Kalman filters to estimate their x and y coordinates. The Kalman filter provides a general solution to the recursive minimized mean square linear estimation problem.

The future work will consist of the modification for general Kalman algorithm and apply it for multiple object detection. Testing will be carried out on traffic videos available on different sites. Performance evaluation and reliability will be calculated based on precision and recall.

5. References


[2] N. A. OGALE, A survey of techniques for human detection from video, Department of Computer Science, University of Maryland, College Park [link]


