

An Efficient Tracking of Multi Object Visual Motion using Hungarian Method

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Abstract— The tracking by detection method used to track the multiple objects visual motion by detecting the objects in the frames and observing the tracklets throughout the entire frame. To the contrary of previous work, this method gives high efficient tracking and considers longer term connectivity between pairs of detections and models similarities as well as dissimilarities between the objects position, color and visual motion. In this paper we have presented the Hungarian method which gives a better performance and solves the problem of occlusion occurred between individuals.

Keywords— *Tracklets; Multiple objects; Visual motion; Occulsions; Blob; Filters; Frames*

I. INTRODUCTION

Video Surveillance systems [7] have long been in use to monitor the security sensitive areas. The automated tracking of multi-objects in the given input video is a centralized problem because of the changing backgrounds, noise, occlusions or overlapping between individuals.

Tracking by detection is a method which becomes popular in video surveillance system [6], [8], [12]. Across the frames it automatically associates human detections. However the previous detections based approach produces false alarms and misdetection of objects across the frames. This leads to the failure of the approach.

Several approaches which are already exist cover these issues by initially linking detection with high confidence to build track fragments [8], [10], then by finding optimal associations of such fragments. But these approaches rely on low-level association and are limited to neighboring time period. By comparing to previous approach this method gives more robust performance to moving camera and changing continuous background.

This paper gives an alternative approach that relies on high level associations between the pairs of detections for multi-objects tracking. We formulate a framework which assigns labels for individual objects in the input video frames.

The important advantages of our modeling scheme are; it provides a connecting detection pairs not only between adjacent frames but also between frames with long time interval within a temporal window and this scheme also allows us to re-label the objects which are lost by the high occlusions.

To Summarize, the paper addresses the problem of tracking multi-object in video surveillance is given below:

- Tracking of visual motion object in the given video is initially done by the background subtraction method which uses Gaussian mixture model to extract the moving object.
- Preprocessing is the second stage where noise is removed with the help of erosion and dilation filters.
- Prediction of new location of the object is done by the kalman filters which uses output of the blob analysis.
- Finally, Hungarian algorithm which connects all the prediction to tracks and produces the tracking results of multiple objects.

The organization of the paper is as follows. Section II tells about the Literature Survey. Proposed Technique is detailed in Section III. Section IV tells about the Implementation Part. Finally the Experimental result and Conclusion are detailed in Section V and VI.

II. A BRIEF SURVEY ON EXISTING SYSTEM

There are a lot of surveys about object detection and tracking. This section discusses some of the methods which are in the same context of this study [1]-[5].

Temporal Differencing method is one such method, where this approach attempts to detect moving regions by making use of the pixel-by-pixel difference of consecutive frames, this covers around two to three frames at a time. It is highly adaptive to dynamic background changes. But it fails to detect the whole relevant pixels of some types of moving objects.

Next method is Optical flow method which makes use of flow vectors of moving objects over time to detect the moving regions in an image. Also they detect motion in video sequences even from a moving camera. The drawback of this approach is they are more computationally complex and cannot be used in real time video.

Shape-based classification method depends on assumption that human are smaller than vehicles and have complex shapes. If other than the object appears that leads to false assumption.

The above disadvantages can be overcome by the proposed approach.

III. PROPOSED TECHNIQUE

This section provides a brief description about the proposed approach. The technique helps us to track the multi-objects in the given video. The step by step approach is explained below in detail.

General Architecture

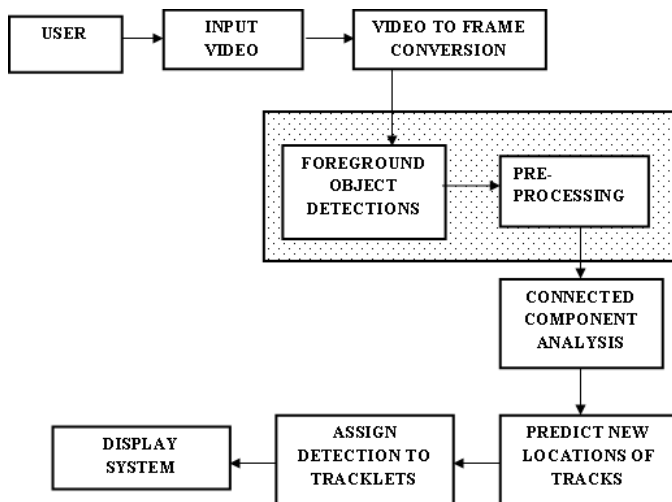


Fig 1: The architecture of multi-object tracking system

The figure 1 shows the architecture of the proposed system the user inputs the video, where multi-object should be tracked. The video as it is cannot be processed. So video is converted into frame by frame.

Every frame need not to be compared to detect the motion objects. It undergoes frame selection process, where some of the frames are skipped. This will be given as input to the Background model [11] which produces the foreground object along with removal of noisy disturbance.

Next step is to find the connected object in the foreground model. Blob analysis did this job by assigning unique label to every individual objects.

Now the task is to predict the new location of the object in the next sequence frame. Kalman filters were used to make this process easier.

Kalman filter is not actually the filter, they are the predictors. This predicts the new locations of objects. In case, if any of the noise is present at that stage it works like a filter and removes noisy disturbance.

Predicted object has to be assigned to tracks, this is achieved by using Hungarian Algorithm, which uses matrix method to solve assignment detection to tracklets problem.

Finally the output is returned to the user, which produces the tracking results. This uses video player application to display the result.

IV. IMPLEMENTATION

MODULE DESCRIPTION

1. Object Detection
 - Foreground object detection
 - Preprocessing
 - Blob Analysis
2. Object Tracking
 - Kalman Filter
 - Hungarian Algorithm

1. Object Detection

Motion recognition is very important in automated surveillance system. It is the process of recognition of moving objects on the video source.

Foreground object detection

The stationary objects are getting separated from the motion object by using Gaussian mixture background subtraction model. Where the background pixels are label as 0 and foreground objects are label as 1.

This is how the separation process is done, but the problem arises in the form of noisy disturbance. It can be solved by preprocessing, which uses morphological operations to remove it.

Preprocessing

Morphological operations [9] such as erosion and dilation are used to remove noise from the pixels.

Blob Analysis

For image processing, a blob is a region of connected pixels. After detecting foreground moving object and applying preprocessing operations, the filtered pixels are need to be grouped into a connected regions and are uniquely labeled.

To solve this problem we use a simple two pass algorithm.

On the first pass:

1. Iterate through each element of the data by row, then by column.
2. If the element is not the background
3. Get the neighboring elements of the current element
4. If there are no neighbors, uniquely label the current element and continue
5. Otherwise, find the neighbor with the smallest label and assign it to the current element
6. Store the equivalence between neighboring labels

On the second pass:

1. Iterate through each element of the data by column, then by row
2. If the element is not the background
 - Re-label the element with the lowest equivalent label

2. Object Tracking

This section is to describe about the prediction and assignment to prediction process.

Kalman Filter

After the blobs (object) are detected the next step is to associate detection to the same object (track). This filter is used to predict the new detection in the consecutive frames and to associate those predictions to the location of a track in each frame.

Kalman filter uses predict and correct method to do so and sometimes they also used as high-pass filters and low-pass filters to remove noisy disturbance.

Hungarian Algorithm

Assign detections to tracks in the process of tracking the multi-objects using James Munkers's variant of the Hungarian assignment algorithm. It also determines which, are all the tracks that were missing and which detection should begin a new track. This method returns the indices of assigned tracks.

Based on indices of assigned tracks the cost matrix decides the cost of the tracklets. If the cost is less, then the assignment is more and if the cost is more the assignment is less.

In terms of mathematics the Euclidean metric is the distance between the two points in Euclidean space. Where the distance is smaller, then the assignment is more.

Finally the tracking result is displayed to the user.

V. EXPERIMENTAL RESULTS

We implemented a video player application to test our algorithms. This player supports the AVI format video and displays it. The player application displays both the video data on the screen and at the same time it feeds the image to our video analyzer algorithms.

In order to test the performance of the object tracking we used sample indoor and outdoor video clips. We especially tested the performance of the occlusion handling the screen.

Table 1 shows the number of true occlusions and the number of cases our occlusion handling algorithm identifies the objects correctly after the split and the error rates.

Figure 2 and Figure 3 shows sample tracking scenes where the occlusions are handled successfully. Where we can observe the occlusions which occurred in figure 2 by overlapping the blue and pink frames, this can be solved in the

Video Clip	Occlusions	Successfully handling occlusions	Success Rate (%)
Movie 1	2	2	100
Movie 2	1	1	100
Movie 3	3	2	67
Movie 4	3	3	100
Movie 5	5	3	60
Total	14	7	80

Table 1 Occlusion handling results for sample clips

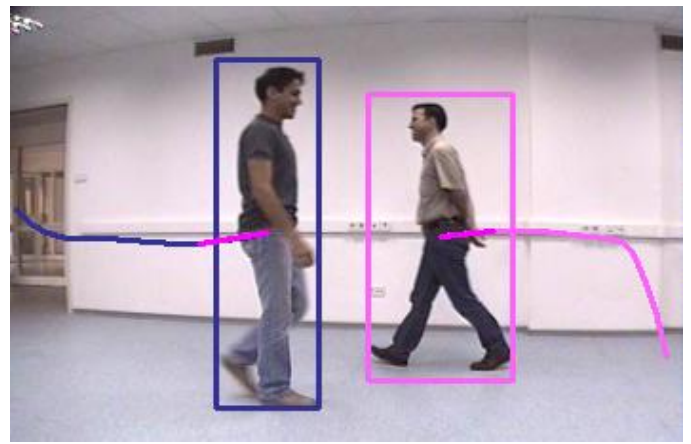


Fig 2: Sample video frames before occlusions

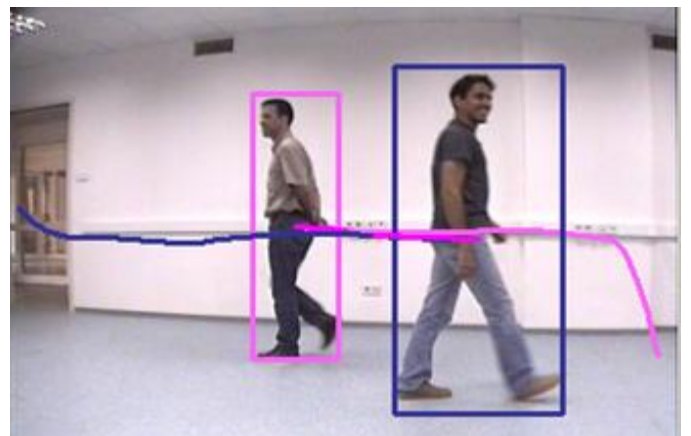


Fig 3: Sample video frames after occlusions

figure 3 where after the occlusion also the frames never get changed.

VI. CONCLUSION

We have proposed a method for “video surveillance contexts “. There are so many different algorithms that do not give a perfect recognition and tracking of multi-object during the occlusion than this approach.

The outcome of this paper will be a tracking of multi-objects in the video which is inputted by the user and display the results. This system recognizes the multiple moving objects and tracking algorithm successfully tracks objects in consecutive frames. It also handles simple object occlusions.

This model exploits the longer-term connectivities between pairs of detections. It also relies on pair wise similarities and dissimilarities factors defined at detection level, based on position, color and also visual motion cues.

The model also incorporates a label for individual objects which make occlusion free.

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