Moving Object Tracking using Object Segmentation

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Abstract. Research in motion analysis has evolved over the years as a challenging field, such as traffic monitoring, military, automated surveillance system and biological sciences etc. Tracking of moving objects in video sequences can offer significant benefits to motion analysis. In this paper an approach is proposed for the tracking of moving objects in an image sequence using object segmentation framework and feature matching functionality. The approach is amenable for SIMD processing or mapping onto VLIW DSP. Our C implementation runs at about 30 frames/second with 320x240 video input on standard Window XP machine. The experimental results have established the effectiveness of our approach for real world situations.

Keywords: Object Tracking, Motion Analysis.

1 Introduction

Tracking moving objects over time is a complex problem in computer vision and has many potential applications in the fields of intelligent robots [1], monitoring and automated surveillance [2], human computer interfaces [3], vehicle tracking [4], biomedical image analysis [5], video compression [6], etc [7]. Object tracking has been an active research area in the vision community in recent years. Numerous approaches have been proposed to track moving objects in image sequences. Impressive tracking systems have been developed for some specific applications. We assume, initially, that we just want to track one object in the scene, but there may be other moving objects present in the scene. The basic condition imposed by our method is to maintain the few important features of the object in a sequence of images.

In this algorithm we extract all the objects from an input image by object segmentation. The result of object segmentation is a binary frame containing connected clusters of blocks that represent different objects. To be able to separate and distinguish between these clusters, they have to be labeled. We have used Equivalence Table Based Algorithm for labeling the connected components. Next we

extract simple object features. Then we compare the features of extracted objects in the current frame with that of tracked in the previous frame. The most similar object (best feature matching) between the successive frames is marked as object to be tracked.

2 Proposed Scheme

The proposed tracking scheme involves three major operations: Object Segmentation, Object Labeling, and Object Tracking.

2.1 Object Segmentation

Object Segmentation can be achieved by building a representation of the scene called the background model and then finding deviations from the model for each incoming frame. Any significant change in an image region from the background model signifies a moving object. The various approaches have been presented for segmenting the moving objects from the background [8 - 12]. We have used computationally much simpler object segmentation scheme proposed in [13].

2.2 Object Labeling

After segmentation, a binary frame is produced containing connected clusters of blocks that represent different objects. To be able to separate and distinguish between these clusters, they have to be labeled. Various labeling algorithms have been proposed. A typical label collision occurs in a binary image when a u shaped object is encountered. The method to handle this problem is Equivalence Table Based Algorithms. Equivalence table based algorithm [14] scans through the memory writing every label collision into an equivalence table. In the first label scan each pixel is compared with its neighbors to the left and above. After the first scan all pixels are assigned a label and all collisions have been detected. The second scan resolves all collisions.

2.3 Object Tracking

Features are used to separate the tracking part of the system from the image stream. In this scheme we have two types of features (color centroid and size). Matching is performed between stored object and all new clustered objects. These two types of features are sufficient to perform tracking of moving objects in the video stream. However, they are not reliable to keep track of an object that walks out from the scene and reenters at a later time. If two or more persons enter the scene with similar clothing occlusion handling between those persons becomes unreliable. The solution to these problems is to include more and better features.

3 Results & Discussion

We implemented the proposed method in C. Our implementation runs at about 30 frames/second with 320x240 video input on a standard window XP machine. Figure 1 shows the tracking results of a moving person moving on road. There is no effect of other moving object (person wearing white shirt on cycle) on tracking results. We experimented about 20 video sequences of average length 500 frames (from 350 frames to 1000 frames). Our scheme has tracked about 90% of true objects.

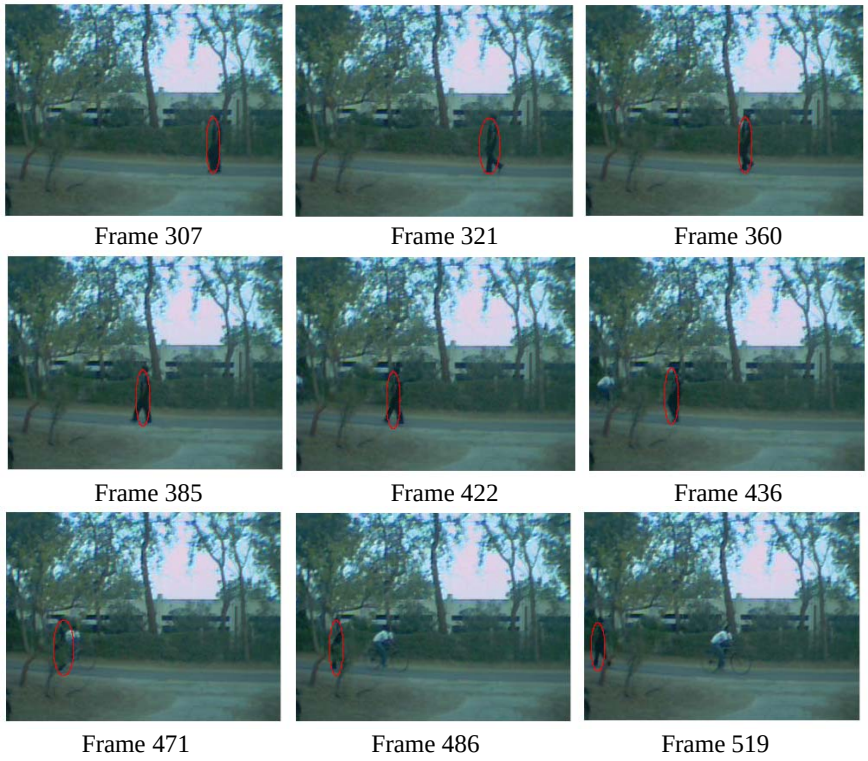

Figure 1: Sequence of tracking a person which shows movement of other object (person wearing white shirt on cycle) in background.

4 Conclusion

In this paper we have presented an approach for the tracking of moving objects in an image sequence using object segmentation framework and feature matching functionality. The computation is structured for easy implementation in embedded environment. Each block can be mapped to a processing element (PE) in VLIW DSP

processor because there exists no dependency between the blocks. The proposed scheme runs in real-time (30 frames/second) for 320x240 video. The intended use of this approach is for our Automated Surveillance System.

Acknowledgments. This work was supported by Ministry of Communications and Information Technology (MCIT) / Department of Information Technology (DIT), Government of India.

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