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Object Detection and Tracking based on Trajectory in Broadcast Tennis Video

M. Archana[a], M. Kalaisevi Geetha[b]

[a]*Assistant Professor, Annamalai University, Chidambaram -608 002, Tamilnadu, India*
[b]*Associate Professor, Annamalai University, Chidambaram -608 002, Tamilnadu, India*

Abstract

Ball, player detection and tracking in Broadcast Tennis Video (BTV) is a challenging task in tennis video semantic analysis. Informally, the challenges are due to the camera motion and the other causes such as the small size of the tennis ball and many objects resembles like ball, while the player, the human body along with the tennis racket is not detected completely. In this paper proposed an improved object tracking technique in BTV. In order to track the ball, logical AND operation is applied between the created background and image difference is performed, from that the ball candidates are detected by applying threshold values and dilated. Finally the ball is tracked. Player detection is performed from AND results by finding the biggest blob and filling the whole detected object by removing the small one and the players are tracked based on the contour. The experimental result shows the proposed approach achieved the higher accuracy in object identification, and their tracking. It is achieved a high hit rate and less fail rate for ball tracking while for player tracking is measured by Multiple Object Tracking Precision (MOTP).

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Keywords: Ball tracking; player tracking; background subtraction; broadcast tennis video; Hit Rate; Fail Rate; Multiple Object Tracking Precision (MOTP).

1. Introduction

An automatic analysis of sports video is an interesting area which attracts many research attentions for several applications, Sports video contains rich audio and video information within a well-organized structure. Owing to increase in the growth of videos on broadcast and internet, there is a need to access semantic events among the full-length videos arises [1]. Instead of accessing the whole lengthy voluminous videos, access of highlights and skipping the less interesting parts of the videos will save not only the viewers time but also the cost. To attract the users the content based views are developed based on their own preferences. Consider the tennis video, the moving object is

* Corresponding author. Tel.: +91 9842897771.
E-mail address: archana.aucse@gmail.com and archana.m.15074@annamalaiuniversity.au

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ball and player around the ground region. Tracking of ball and player in tennis video faces many challenges [2], since the ball focus the attention of viewers and players follows the ball movement in tennis. The main aim of tracking is event detection in Broadcast Tennis Video (BTV) based on the tracking results of ball and player. In tennis the court length is 78 feet, the width is 27 feet for Singles and 36 feet for Doubles.

To track the ball and player some of the challenges are,

1. The target object i.e., the size of the ball is too small in different angles and views. Based on various lighting conditions, the ball may not be visible.
2. Tracking the ball based on trajectory, is little bit complicated because of fast ball and camera movement.
3. The player tracking is considerably easy but dynamic background is a challenge.
4. The size of the players also changes at different angles.

In this context of tracking a tennis ball, noise is a big issue because of the ball size. Due to the quality of the frame, noise appears very frequently among images, which interferes with the process of object detection. Traditional background subtraction approach is not capable of eliminating the majority of noise and they usually require additional operations. A modified background subtraction approach is applied to overcome the limitations due to the bad quality of the captured images [3], [4]. The rest of the paper is organized as follows. Section 2 reviews the related works. The problem analysis is discussed in section 3. The methodology of work and proposed model is discussed in section 4. Experimental results are briefly discussed in section 5 and followed by performance measures in section 6. Finally conclusion and future work are presented in section 7.

2. Related Work

F.Yan, W.Christmas et al. [5] have proposed a tennis ball tracking algorithm for low quality video recorded with a single camera. In this paper a particle filter with improved sampling efficiency is used to track the tennis candidates. Smoothing and observation origin identification are then used to refine the trajectory, to give higher tracking accuracy. Xinguo Yu et al. [8] have proposed a about improving trajectory-based ball detection and tracking algorithm in tennis videos, this algorithm can obtain not only higher accuracy in ball identification, but also ball landing frames and positions with the aid of homography. Yang Wang et al.[11] have proposed about the detection and tracking of player in BTV, this is obtained by support vector classification and court segmentation from that accurate player area is founded. Based on this particle filter tracking of small particles is used to improve the performance of this method.

F.Yan et al. [14] have proposed a ball tracking using automatic annotation of tennis match for low quality video recorded with a single camera. A particle filter is used to track the tennis candidates to achieve better results. It shows the higher accuracy for tracking, while smoothing and observation of origin identification is used to refine the trajectory and it is suitable for tennis annotation. Christmas et al. [9] have proposed about the automatic annotation of tennis video. In this method, proposed an automatic analysis of tennis video which extent the video into individual video shots with accuracy. In some locations, the ball events are wrongly classified and these situations are difficult to realize even by eye. HMM is used for interpreting the play rules in the high level module, which is currently using as input hard decisions made in other modules and for soft decisions, with confidential information.

Min-Yuan Fang et al. [6] have proposed a player tracking of tennis videos using adaptive kalman filter, the parameters of this filter is adjusted based on the detection of players. This improves the tracking accuracy by corrects the detection errors. The success rate of player tracking is well done in singles as well as for double matches. Keni Bernardin and Rainer Stiefelhagen [10] have proposed evaluating metrics i.e., Multiple Object Tracking Performance for any object tracking and also discussed about simultaneous tracking of multiple persons in real-world environments

3. Problem Analysis

Detection and tracking of the ball and player in tennis video face many problems. This section analyses the problems related to tracking. For the purpose of tracking in BTV, the whole tennis court is partitioned into upper and lower half court due to players distinct size. The camera view makes the objects in the upper half much smaller than the lower half and also the background color in the lower half doesn‘t vary in a random manner [12]. So the tracking of the lower half player isn‘t a difficult task. On the contrast the detection and tracking of the upper half player are a real challenge. This is because the upper half background varies in a random manner and possesses additional objects