Identification and Tracking of Players in Sports Videos

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Challenges

To develop an automatic basketball video analysis system is difficult for several key reasons. First, collisions between players occur frequently. Second, players on the same team (and thus in the same uniform) can look similar. And, third, players frequently perform complicated motions and may move outside the field of view of the camera. Most existing basketball video analysis systems can recognize players only in fairly close-up shots in which facial features are clear or jersey numbers are easily legible. Those criteria, however, are not commonly met in recordings of basketball games. Usually, videos of basketball games are acquired from a single pan-tilt-zoom camcorder at court level. Under these circumstances, faces of players are usually indistinguishable and jersey numbers can also be difficult to recognize. Moreover, since players change their poses and orientations frequently, both face and jersey number are recognizable only in limited cases. Last but not least, since players of the same team wear identically colored jerseys and in many cases may even have similar skin and hair colors, retrieving information from colors is challenging.

Player Tracking and Identification

In this work, we propose a novel framework to automatically perform player tracking and identification for basketball videos filmed by a single pan-tilt-zoom camcorder from court view. The proposed scheme is composed of four steps. The first step is to detect players by a deformable part model (DPM). Fig. 1 shows an example of player detection using DPM. DPM estimates locations and sizes of players, which are represented by red bounding boxes in the figure (Fig. 1).

Basketball video analysis has many commercial applications and has attracted great attention in recent years. With the assistance of advanced object-detection and tracking techniques developed in the past few years, efficient and effective player tracking and identification have become a reality. Under these circumstances, to develop a fully automatic basketball video analysis system that can analyze the interaction among players or the scoring process becomes possible. An automatic basketball video analysis system has many potential applications. For example, it can provide better services by automatically generating some video segments that highlight star players. In addition, the coaching staff of a team can employ such techniques to calculate the statistics of players, to analyze the strength and weakness of competitors, and to review the team itself.
After executing the above four steps, our experimental results demonstrate the efficacy of the proposed system. Fig. 3 shows some results detected by the proposed automatic multi-target tracking and identification system. The text inside a bounding box is the track’s ID.

Contributions

In this work, we propose an automatic player tracking and identification framework for basketball videos filmed with a single pan-tilt-zoom camera from the court view. The proposed framework is based on use of a single uncalibrated pan-tilt-zoom camera, which avoids the expensive and often impractical installation of a calibrated camera network.

Moreover, our framework can be used to analyze any sport videos acquired by uncalibrated moving cameras, e.g., sports videos distributed over the Internet. We will further advance our framework to perform event detection and mining based on what we get in the process of player detection and identification.

Application-Aware Graph Search

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be interested in getting acquainted with a high-value potential customer in the hope of making a business pitch.

Addressing this desire, we are making a grand suggestion for social-networking service providers to support active friending. The service providers, eager to explore new tools to increase revenue, may consider charging users for the active friending service. Our sketch is as follows. By iteratively recommending a list of candidates who are friends of existing friends of the initiator, a social-networking service provider may support active friending — and do so without violating the current practice of privacy preservation in recommendations. Consider an initiator who specifies a friending target. The social-networking service, based on its proprietary algorithms, recommends a set of friending candidates who may likely increase the chance for the target to accept the eventual invitation from the initiator. The aforementioned step is repeated until the friending target appears in the recommendation list and an invitation is sent by the initiator. It is clear, however, that the recommendations made for passive friending may not work well because active friending is target-oriented.

To support active friending, the key issue is the design of the algorithms that select the recommendation candidates. To select suitable users, we study a new optimization problem, called Acceptance Probability Maximization (APM), for active friending in online social networks. Given an initiator $s$, a friending target $t$, and the maximal number $r$ of invitations allowed to be issued by the initiator, APM finds a set $R$ of $r$ nodes, such that $s$ can sequentially send invitations to the nodes in $R$ in order to approach $t$. The objective is to maximize the acceptance probability at $t$ of the friending invitation when $s$ sends it to $t$. The parameter $r$ controls the trade-off between the expected acceptance probability of $t$ and the anticipated efforts made by $s$ for active friending $t$.

We prove that calculating the acceptance probability in the Independent Cascade (IC) model is #P-hard and that APM in the IC model is NP-hard; thus, we approximate the acceptance probability by the Maximum Influence Arborescence (MIA) model. To tackle the APM problem in the MIA model, we propose the Selective Invitation with Tree and Node Aggregation (SITINA) algorithm, which aims to systematically select the nodes for recommendation. SITINA is designed with dynamic programming to find nodes that may result in a coordinated friending effort to increase the acceptance probability of the target, which obtains the optimal solution for APM in polynomial time.