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Efficient object tracking on complex environment based on active contours

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Abstract

Over the last decade the object tracking has become an important area for researcher. It took its major part in real time applications such as the video surveillance and monitoring, perpetual user interfaces, smart rooms and video compression. The efficient tracking of visual features in complex environments is a challenging task for the vision community. Object tracking includes single object tracking and multi object tracking based on the color, deformable template models, and active contours. In this study, the implementation of active contours for object tracking on complex environment is discussed with issues such as irregular illumination and the frame-to-frame deviations of the object.

Keywords: Object tracking, Video Surveillance, Active contours, Eigen model and Camshift Algorithm

The increasing use of video surveillance and monitoring the moving objects from a moving airborne platform. The increasing use of video sensors, with Pan-Tilt and Zoom capabilities or mounted on moving platforms in surveillance applications, have increased researchers attention on processing arbitrary video streams.

This high level description of a video stream relies on accurate detection and tracking of the moving objects, and on the relationship of their trajectories to the scene. During the early period the detection of object was based on stationary camera with fixed background.

To track an object in an image sequence, we use such a criterion which combines two terms: the frame-to-frame deviations of the object shape and the fidelity of the modeled shape to the input image. The deformable template model was used to track the object. Real-Time Tracking of Non-Rigid Objects from a moving camera was the next challenging work in field of sports and monitoring the traffic. Then comes the color based object tracking, this includes a color is an efficient and robust visual cue for characterizing one object from the other objects.

Color segmentation is, however, suffered from color variations induced from irregular illumination variations and the viewing geometry of a camera.

Related Works

A research on object tracking on deformable templates [1] proposed a novel method for object tracking using prototype-based deformable template models. The image information that was gathered in one frame was used as input to another frame to model the shape of the image. The advantage of the model is Flexibility in combining multiple sources of information. The disadvantage of the method was not applied for inter frame motions and regions corresponds to track objects in sequence. Objects moving very fast and longer view point are not applied.

Joint audio-video object tracking was done by Spors et at al [2]. A face tracking algorithm and a microphone array are used to compute two single-modality speaker position estimates. Kalman filter is used to decentralize the position. This approach yields more robust results for audio-visual object tracking than either modality by itself. Object localization for both audio and video tracking.

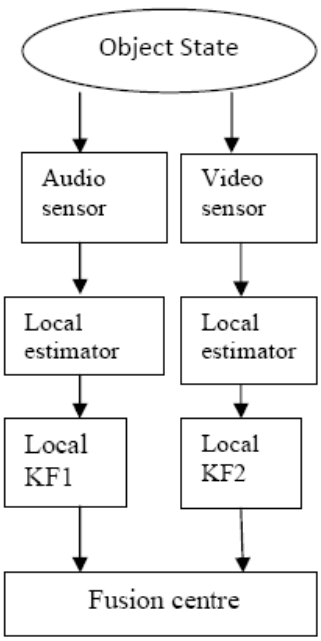

Fig. 1: Audio-Video Object Tracking

G. Tsechpenakis et al [3] has proposed a method for tracking the moving objects. In this work a most known method active contours, the Snakes were modified and they proposed motion-based utilization of it. The snake energy minimization procedure is approximated by a force-based curve evolution approach, inside the extracted uncertainty regions. Finally, a motion estimation scheme is used to help handling problems related to object occlusion. The object's motion history, along with a robust motion estimation scheme, provide the snake initializations for the next frames of the examined sequence, as well as uncertainty regions around these initializations, indicating the possible/allowable snake deformations.

Dan Schonfeld [4] introduced fast object tracking algorithm for motion vector information. An adaptive block based approach for detecting motion. Covered and uncovered regions are estimated from the displaced frame difference. An adaptive block matching with occlusion / disocclusion detection (forward/backward motion) was detected. Occlusion and disocclusion are viewed as dual events. Time consumption was very less for computation and detection.

A novel object tracking algorithm in video sequences was proposed by Dorin Comaniciu et al [5] to track a robust video object by using an active contours. Here region and boundary information cooperate for object boundary localization by using active contours. the segmentation of the objects in the first frame is required for initialization.

The evolution of the object contours on a current frame aims to find the boundary of the objects by minimizing the Kullback-Leibler distance of the region features distribution in the vicinity of the contour to the objects versus the background respectively. This method was applied to find on the fast moving multiple, non rigid objects in the image sequence. The objects can be recognized on the dim light.

Nicolhs Amezquita et al [6] have introduced a method for tracking object based on regions instead of active contours. An observation model and a velocity motion model for object recognition and tracking was proposed. Tracking of binary images, are determined for each object from the current dynamic recognition probabilities , and the tracking images of the same object in two previous time steps, which contribute to provide a prediction of the object's apparent motion in terms of translation and scale changes. The proposed method is especially suitable in noisy environments where segmented images vary so much in successive frames that it is very hard to match the corresponding regions or contours of consecutive images.

Dai Guojun1, *et al*. [7] Auto-Camshift (Automatic Continuous Adaptive Mean Shift) algorithm was put forward to track moving object without manual intervention, it retrieved the initial track window by difference in frame. Camshift is designed for color distribution which is changing dynamically.

An adaptive particle filter-based Eigen-tracking was proposed for object tracking by Tiesheng Wang et al [8]. The proposed scheme is realized by integrating SURF and RANSAC for estimating consensus point correspondences, and modify an existing particle filter-based Eigen-tracking. It provides more accurate tracking, especially for objects with fast motion or long-term partial occlusions. Particle filters (PFs) have been widely used in Eigen-tracking while the number of particles required is usually large and pre-determined. Used in real time applications and only one object was tracked at a time.

Veronica Vilaplana *et al.* [9] have worked on Face tracking using mean shift algorithm with adaptive object and back ground models. By using color and shape the face was tracked. The result obtained was compared with CAMSHIFT algorithm. It is Very fast and easy method for detecting the face for surveillance, human computer interaction or facial expression recognition.

Multiphase Joint Segmentation-Registration and Object Tracking for Layered Images were done by Ping-Feng Chen *et al*. [10]. It was done by through active contour. A combination of Multiphase active contour method with a joint segmentation-registration technique (which we called MPJSR) carried out in a local moving window prior to a global optimization. Align them for a pair of layered frames and keep track of the objects over time. This was applied on aerial views of a city for traffic monitoring or UAV (Unmanned Aerial Vehicle) airborne image acquisition for surveillance or target recognition purpose.

Proposed Method

Object tracking using Adaptive Active Contour Models, more widely known as *Snakes Model* is proposed here. Segmentation, extraction and verification of faces and possibly facial features from an uncontrolled background can be well handled using contours. This complete facial image processing system can be able to detect faces in the given images, track the face, extract facial features, recognize people and describe facial expression. The proposed face recognition system is composed of three main parts: the face region estimation part, the detection part, the facial feature tracking and extraction part. In the face region estimation part, images are segmented based on human skin color. In the face detection part, the template matching method is used. And, in the facial feature tracking and extraction part, new proposed algorithm called "adaptive color snake" is applied to extract the facial feature points within the estimated face region. It is a fast face detection method. Embedded PC board was equipped for real time robot vision system in order to attain performance accuracy.

Experimental Results

Filter-based Eigen tracking provides more accurate tracking, especially for objects with fast motion or long-term partial occlusions. Particle filters (PFs) have been widely used in Eigen-tracking while the number of particles required is usually large and pre-determined. Used in real time applications and only one object was tracked at a time. Fast template-based tracking could tackle this problem but faces the difficulties like the loss of the optimal matching result and fixed-size template. Template matching is one of the oldest object tracking algorithms. Its main advantage lies on no need for any assumption about the object's motion. Watershed transform is used for the over-segmentation that can be used to find natural boundaries in gray-scale images. The disadvantages of the watershed transform are that the algorithm produces pretty small patches, which makes it harder to decide where the patch belongs since the small patch does not contain much information. Accuracy of 97.3% is recorded.

CAMSHIFT (Continuously Adaptive Mean-Shift) is used for multi object tracking on the basis of the hue, saturation and the value of the color histogram are used to describe the object. For multi object tracking we used separate object tracker for tracking. In this proposed method the object localization, object modeling, color masking, segmentation, histogram back projection and tracking of objects was done to track the objects accurately. Face Tracking rate of 65.1% and face-body tracking of 95.2% was regitered. A color-based particle filter and can track object accurately and robustly even if interfered strongly. Local binary pattern and color histogram was used to define the color and texture.

By applying Contour, the target could be tracked very fast; it deals well with illumination change and shadows, occlusion and targets' changing appearance. The objects in video are detected automatically. This was applied on face-body in human body tracking. Active contours results in 99% accuracy.

Conclusion

The proposed algorithm for object detection and tracking in unknown environment was extensively tested to operate in complex, real world; non-plain and changing background was found to possess remarkable accuracy and precision. Our future works will be improving the methods using Graphical Processing Unit (GPU) or parallel programming in multi-core processor to increase the speed. So, it can achieve real time speed. Implementation of this technique can achieve multiple objects tracking at a given time. It can also improve the robustness of tracking.

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