Extraction of HoG features on Corner Points for Visual Tracking

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ABSTRACT

Instead of using HoG feature on cell or blob ,the extraction of HoG features on corner points is proposed for multiple object visual tracking system in which single or multiple moving objects could be tracked. This work intends to solve the challenging problem of appearance changes and object deformation in visual tracking. Although fusion approach of local features for efficient target representation have been proposed in recent years, but how to effectively combine them for visual tracking is still an open problem. Firstly, moving objects will be detected in the form of regions from background subtracted frame. The strongest features points on corners will be extracted for each moving objects by the Features by Harris Corner Detector and gradient of each point via HOG are quantized into bins. These features will be represented with histograms as template matching and classification for the targets localization in the consecutive frames.

Keywords: Harris Corner Detector, Histogram of gradient (HOG)

INTRODUCTION

Object tracking is the process of tracing the location of an object of interest. The main application of object tracking comes in the field of automatic video surveillance. Nowadays almost all buildings and roads are provided with closed circuit television (CCTV) security cameras. The visuals from these CCTV cameras serve a great deal in monitoring human activities. Thus these become very much helpful in prevention of crime, theft, etc. The main problem associated with this is that a lot of human workforces are required for the monitoring of these video sequences. It is in this context that the need for an automatic surveillance system arises. Success in object tracking relies heavily on how robust the representation of target is against the variation challenges. There exists no single tracking approach that can successfully handle all challenging scenarios. Several factors, such as illumination variations, partial occlusions, and background clutter and shape deformation complicate the problem of tracking. If a robust target representation can be developed that can adaptive with variations, the accuracy of tracking result can improve significantly. This challenge becomes matter of primary interest for robust online tracking in the recent researches. Most existing tracking systems are based on color feature distribution; target object is represented by means of color. The efficiency of color representation is degraded when several objects move together in image sequence or sudden illumination changes or background color is similar with the target. So, the new type of image feature needs to be utilized to find the corresponding region between the consecutive frames by means of feature point detection.

FRAMEWORK OF VISUAL TRACKING SYSTEM

The framework of multiple objects tracking via local features on corner point is presented in figure1. In the intended tracking system, as the first step, moving objects will be detected in the form of regions from background subtracted frame with the help of Gaussian Mixture background Modeling. The strongest features points on corners will be extracted for each moving objects by the Features by Harris Corner Detector. Comparing with other blobs detectors ,Harris a corner based detector with high speed with can get more feature points. One drawback of blob detector is that the object region can contain the background pixels that may reduce the discriminative power of features. Among the corner point detectors, Harris detector could produce the strongest corner points with the acceptable rate for tracking system. These HoG features on corner points will be used in matching objects between consecutive frames of tracking sequences.

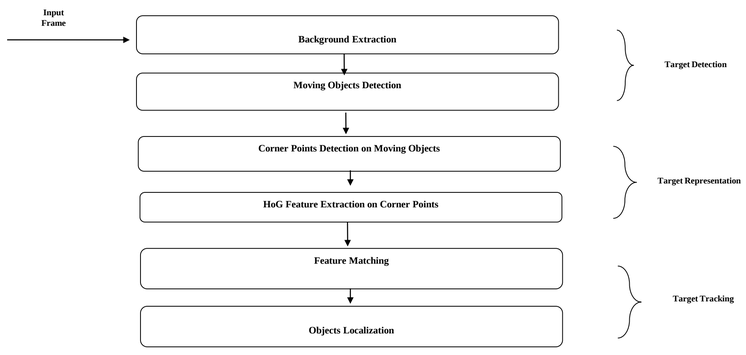

Figure 1. Overview Architecture of Tracking System

TARGET DETECTION

The core and first step in tracking is also the object segmentation or object detection in which the foreground is separated from the background. All the moving parts in video sequence are regarded as the foreground parts to be tracked through the video sequence. Target Detection was done by help of MoG foreground detector . The probability of being foreground was accessed by the stability of individual pixel. With 288*352 sized subway dataset was used and the target frame rate of video is 30fps. The detection result of subway dataset can be seen in figure 2.

Figure 2. Object Detection and Labeling Moving Parts

PROPOSED HoG FEATURE EXTACTION

Edge detection aims to localize the boundaries of objects in an image and significantly reduces the amount of data to be processed. Corner point is the intersection of two edge point. In general, pixels located at the joint of two edges might be the possibility of strong feature points. Corner based detectors are widely used in classification and recognition task because of their computational properties . As in Figure 3, the HOG method tiles the detector window with a dense grid of cells. Each cell contains a local histogram over orientation bins. At each pixel, the image gradient vector is calculated. The angle of the vector is used as a vote into the corresponding orientation bin and the vote is weighted by the gradient magnitude. Votes are accumulated over the pixels of each cell. The cells are grouped into blocks and a robust normalization process (HOG normalization) is run on each block to provide strong illumination invariant.

In our proposed feature extraction, firstly corner point is extracted from detected ROI moving objects via Harris Corner Detector. For a pixel p, use its neighborhood (e.g. 7x7) to form the following matrix.

$$C = \begin{bmatrix} \sum I_x^2 & \sum I_x I_y \\ \sum I_x I_y & \sum I_y^2 \end{bmatrix}$$

where Ix, Iy are image gradient components. If the smaller Eigen-value of this matrix is larger than a certain threshold, it is considered a corner.

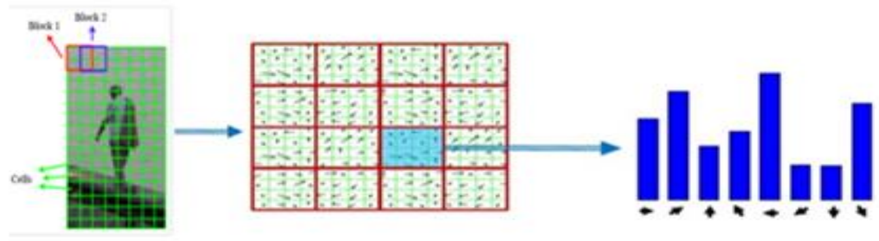

Figure 3. Cell Based HoG Feature Representation (one histogram per cell)

The strongest features points on corners will be extracted for each moving objects by the Features by Harris Corner Detector and gradient of each point via HOG are quantized into bins as shown in figure 4. These features are represented with histograms as template matching and classification for the targets localization in the consecutive frames.

Figure 4.Proposed Corner Point Based HoG Feature Representation (one histogram per object)

TARGET TRACKING

The core of tracking algorithm is the computational paradigm to find the best location or best state of the target in the new frame. As a first stage, object detection performed using foreground estimation by Gaussian of Mixture model . Once detected a foreground objects, the object array was created to store the individual objects as a moving objects to be tracked. The HoG feature on corner points of the detected objects will be counted and stored in object buffer for the whole sequence. In the proposed system, the parallelized feature of PSO search ability will be applied in the dynamic form. The number of detected objects in the current frame will be the iteration of PSO algorithm. In each iteration, the number of particles will be dynamically decided depends on the number of objects in the buffer. Localization of targets will be decided on the value of similarity of feature histograms (fitness value) over each parallelized particles. Calculate the histogram correspondence between target and candidate objects by means of Bhattacharyya distance calculation.

CONCLUSION

This proposed work is intended to solve the challenging problem of appearance changes and existing homogeneous color blob in visual tracking. Discriminative features and compact object representation will be proposed to handle the large amount of local feature for correspondence matching. The extraction of HoG on corner points is presented as the main theme of this paper. These features will be used in matching objects between consecutive frames of online benchmark challenging sequences as one of the contribution features of my intended research work.