Improved Object Tracking Using Radial Basis Function Neural Networks

Alireza Asvadi
MohammadReza Karami-Mollaie
Yasser Baleghi
Hosein Seyyedi-Andi

Babol University of Technology

Abstract

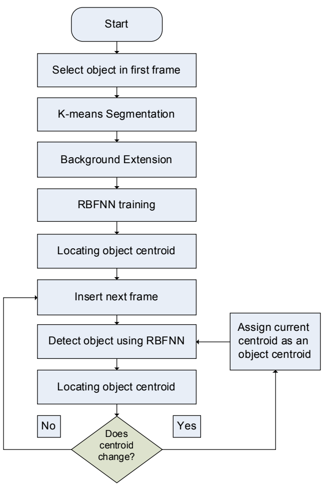
Here, an improved method for object tracking is proposed using Radial Basis Function Neural Networks.
The Pixel-based color features of object are used to develop an extended background model. The object and extended background color features are then used to train RBF Neural Network. The trained RBFNN will detect and track object in subsequent frames.

Introduction

Tracking is basic task for several applications of computer vision. In its simplest form, tracking can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. Some of important challenges encountered in visual tracking are non-rigid objects, complex object shapes, occlusion and scale change of the objects and real-time processing.
In the last few decades, neural networks have been successfully used in a number of applications such as pattern recognition, remote sensing, dynamic modeling. In [2] a global approach is proposed for adapting the neural networks for tracking purpose. In [3] and [4] neural networks are used for object tracking too, but these methods are computationally expensive. Here a fast algorithm of tracking is proposed.

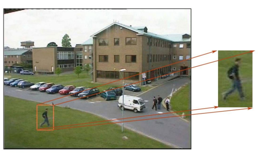
Proposed algorithm

The process of the presented method is shown in here:



Object tracking starts with selecting object approximately in the first frame manually.

selecting the object manually.



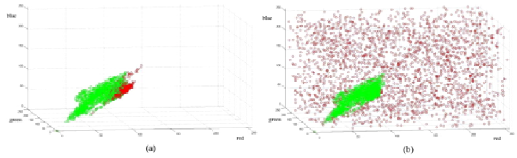
Next, k-means color segmentation is separating the object from background this results in a binary image. The features used for k-means segmentation are simple R-G-B value of pixels.

(a) Manually selected object.
(b) K-means color segmentation result.

(a) (b)

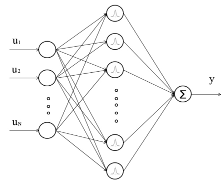
After segmenting first frame and detecting an object, color features of object and background is extracted. Whereas background may be changed in consecutive frames then extracted background features from first frame could not be reliable alone. In presented work a new approach proposed. In presented work points distributed randomly in the whole feature space except in object feature points. We call this process background extension.

(a) Object and background color features in R-G-B color space.
(b) Object features and extended background features.



(a) (b)

Then, both of the object and extended background features are used to train the RBFNN. For the NN input, we use R-G-B value of pixels of the segmented object as foreground features and random R-G-B value of pixels as extended background pixels. The weights between the hidden layer and the output layer are calculated by using Moore-Penrose generalized pseudo-inverse.



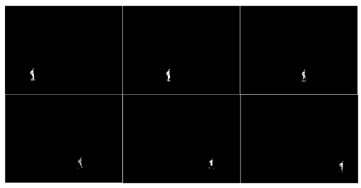
The structure of Radial Basis Function Neural Networks.

Finding the object location starts at the center of segmented object. The displacement of the object is given by the shift in centroid of the object pixels. Object location in a given frame, is achieved by iteratively seeking the object centroid estimated by the RBFNN. The iteration is terminated when centroid location for any two consecutive iterations remain unchanged .

Experimental Results

The tracking result for the PETS 2001 sequence is shown in here. Here, the object walks such that his body undergoes partial occlusion, as well as, appearance and illumination and background changes, over time. One advantage of the NN is that if an object is temporarily occluded, it will not adversely affect the Ultimate classification. A further advantage of this method is that it is robust with regard to background clutter . It is observed that the proposed tracker is able to track the object when background changes or the object undergoes partial occlusion.

Tracking result of proposed system.



Tracking result of proposed system in binary format.

Conclusions

We have proposed an improved object tracker using k-means color segmentation and radial basis function neural network. The k-means color segmentation is used to detect object in the initial frame. Background extension is used to improve RBF neural network performance when background colors change during tracking. RBF neural network is trained in offline stage by result of background extension. Trained RBF neural network is used for classifying object and non-object pixels in other frames. Object localization is achieved by estimating object in each of the frames by using RBF neural network.
Our method is able to track the detected moving objects in a scene. Since the k-means color segmentation and RBF neural network incurs very low computational load, the proposed algorithm is suitable for real-time applications.

References

[1] A. Yilmaz, O. Javed, M. Shah, "Object Tracking: A Survey," ACM Computing Surveys, vol. 38, no. 4, pp. 1-45, 2006.
[2] M. Bouzenada, M.C. Batouche, Z. Telli, "Neural network for object tracking," Information Technology Journal, vol. 6, no. 4, pp. 526–533, 2007.
[3] R.V. Babu, S. Suresh and A. Makur, "Online adaptive radial basis function networks for robust object tracking," Comput. Vision Image Understanding, vol. 114, no. 3, pp. 297–310, 2010.
[4] J. B. Kim and H. J. Kim, "Unsupervised moving object segmentation and recognition using clustering and a neural network," in Proceedings of the International Joint Conference on neural networks (IJCNN '02), pp. 1240-1245, 2002.
[5] S. Haykin, "Neural Networks, A Comprehensive Foundation," 2Edition, Pearson Education, 1999.