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Particle Filter Algorithm for Object Tracking in Video Sequence Based on Chromatic Information

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***Abstract:** In this paper, an idea for tracking an object in a video sequence using particle filer is proposed. The process is performed in two parts i.e. identifying the object to be tracked and actual tracking process. This paper deals with object detection by different methods including K-means clustering and seeded region growing and merging approach to derive the object features and object tracking by color based particle filter algorithm. The algorithm estimates the position of objects from the initial state of particles which is derived from the object features. The tracking process satisfactorily handles the scale and rotation variance issues by using object color as a tracking feature.*
***Keywords:** Object tracking, K-means clustering, region growing, particle filter, scale and rotation invariance*

I. INTRODUCTION

Object tracking in the videos presents a challenging filed in area of image processing, surveillance and human computer interaction. The term object tracking refers to estimate the trajectory of an object of interest in a video sequence. The process of object tracking can be subdivided as object detection for deriving the object features and using particle filter based on these features in order to estimate current position of object.

Object detection can be done in every frame or when the object first appears in the video. Detecting object in every frame leads to increased accuracy but it also increases the computational cost as well as time consumed for tracking process. Detection of object can be performed by using various methods, which include point detectors, background subtraction, segmentation techniques, supervised learning, etc. [1]

Two basic approaches for object tracking are deterministic method and stochastic method. The deterministic method is based on target representation and localization. The stochastic method is based on filtering and data association techniques [2]. Various features like color, edges, optical flow, texture, etc. can be considered for object tracking. The Particle filtering approach is a probabilistic approach where state space model is used and the tracking process is considered as state estimation problem based on posterior probability density.

Initial state of particles represents the position of pixels in the object to be tracked. The initial state is updated and weights are assigned to the particles depending on the value of the likelihood distance. Likelihood is computed based on color similarity with target region. The process leads to particle degeneracy and it is handled by using resampling stage. In conventional particle filters the latest observation from the current frame in the image sequence is only used in the weighting step and not in the sampling step. As a result, a large number of particles are often required to approximate the posterior probability density properly. Large number of particles improves the tracking accuracy but increase computational requirement. This limitation is overcome in particle filter algorithm which requires less number of particles and thus computations get reduced [3].

Section II describes the object detection process while section III deals with object tracking using particle filter. The experimental results and conclusion are given in sections IV and V respectively.

II. OBJECT DETECTION

Object detection involves separation of target object (foreground) from background in the video frame. Segmentation techniques are widely used for this purpose. Segmentation of image refers to identification of homogeneous regions in the image. Image segmentation can performed based on similarity and discontinuity [4]. Here, CIELab and HSV color spaces are used in order to separate luminance components from chromatic information [5] [6].

The different methods of image segmentation used here are:

A. K-means clustering

K-means algorithm is an unsupervised learning algorithm which tries to classify a given dataset into a certain number of clusters. The K-means algorithm can be summarized as:

1) Initialization (defining number of clusters or prototypes)
2) Assign each data point to the closest prototype. That data point is now a member of the class identified by that prototype.
3) Calculate the new position for each prototype (by calculating the mean of all the members of that class).
4) Observe the new prototypes' positions. If these values have not significantly changed over a certain number of iterations, exit the algorithm. If they have go back to step 2. [7]

B. Color distance based method:

Color distance based method is a hybrid method used for segmentation of color images using neighbourhood information. This method selects seed pixels automatically. Then seeded region growing approach is used followed by region merging based on similarity and size to achieve efficient segmentation results. The algorithm for segmentation using color distance method can be summarized as:

1) Convert an image from RGB to required color space.
2) Compute mean values of color components over 3×3 mask for every pixel.
3) Compute the color distance ΔE.
4) Calculate the value of edge threshold TE.
5) Select the initial seed pixels satisfying ΔE ≤ TE.
6) Assign same label to the connected initial seed pixels which have same mean color component values.
7) Compute similarity distance between each unlabelled pixel and its neighboring regions.
8) Assign the label of most similar neighboring region to the unlabelled pixel.
9) If no similar neighboring region is formed, the unlabelled pixel is assigned with a new label.
10) Repeat the process till all the pixels in the image get labelled.
11) Calculate similarity distance between neighboring regions.
12) If the distance between two neighboring regions is less than threshold, they are merged to form single region.
13) Repeat the process till all the similar regions are merged.
14) Merge the regions having size less than the threshold size (eg. 1/100 of the image size) with its most similar neighboring region.
15) Continue the process till no region is smaller than the threshold size [5].

III. OBJECT TRACKING

As discussed in above section, the object is detected from the video frame. Here object is detected only once in the video sequence when it first appears in the video. Once the object region is detected, different parameters like minimum and maximum X and Y coordinates, coordinates of centroid and mean color component values for the cluster are computed and used as input features for tracking process.

The color based particle filter is used for the tracking of the detected object. It provides advantages like tracking in nonlinear and non-Gaussian conditions, providing scale and rotation invariance and dealing with partial occlusion.

The steps of color based particle filter object tracking are: Initialization, State update, Weighing and Resampling.

A. Initialization

First step of particle filter is to assign initial state to the particles. The particles are initialized using the parameters derived from detected object. Particle filter algorithm uses state transition model. Thus initial state S can be defined as $S = [X \quad Z]^T$.

Here X represents the state vector and Z represents the observation vector. State of the particle indicates the position of the particle in terms of coordinates.

B. State update

In this step, new state is set for each particle using proposal distribution. The particle state is updated by using standard deviations of noise distribution.

C. Weighing

The important step in particle filter algorithm is weighing in which each particle is assigned a weight according to value of likelihood function for that particle. For color based particle filter the color similarity of the particle with the initially selected object region is used as measure to compute likelihood.

The color parameter is used for tracking objects as it is easier to be detected and the processing time to obtain color information is much less as compared to other parameters. The similarity measure to compute likelihood function can be determined by using both CIELab as well as HSV color spaces. The likelihood distance for the updated particles is computed using degree of similarity (D) with the help of equation (3.1) [8].

$$\pi = \frac{1}{\sqrt{2 * pi *}\ \sigma} * e^{(-\frac{D^2}{2*\sigma^2})} \tag{3.1}$$

It is observed that the value of deviation σ depends on the number of particles used for tracking purpose. If the number ofparticles is small then larger value of σ must be used in order to track the object accurately.

D. Resampling

The particle filtering process described above is repeated for each frame in the video. After a few iteration of the process, many low weight particles are generated. This is known as particle degeneracy. This problem can be solved by using resampling process where small weight particles are removed and new set of particles is generated.

If the particle degeneracy has occurred, only the weakest or lowest weight particles are replaced with higher weight particles while the particles of acceptable weight are stored for tracking process [9]. This leads to the faster resampling process.

IV. RESULT AND ANALYSIS

In the previous sections, different algorithms for object detection using segmentation and color based particle filter using CIELab and HSV color spaces are described and experimental results have been obtained. Successive frames of a video sequence showing the tracking of an object are shown in fig. 1 and 2. The green rectangle shows the position of the object region, blue color shows position of the particles and the red line denotes the path followed by the object up to the current frame. The trajectory of the object is also extracted and shown separately.

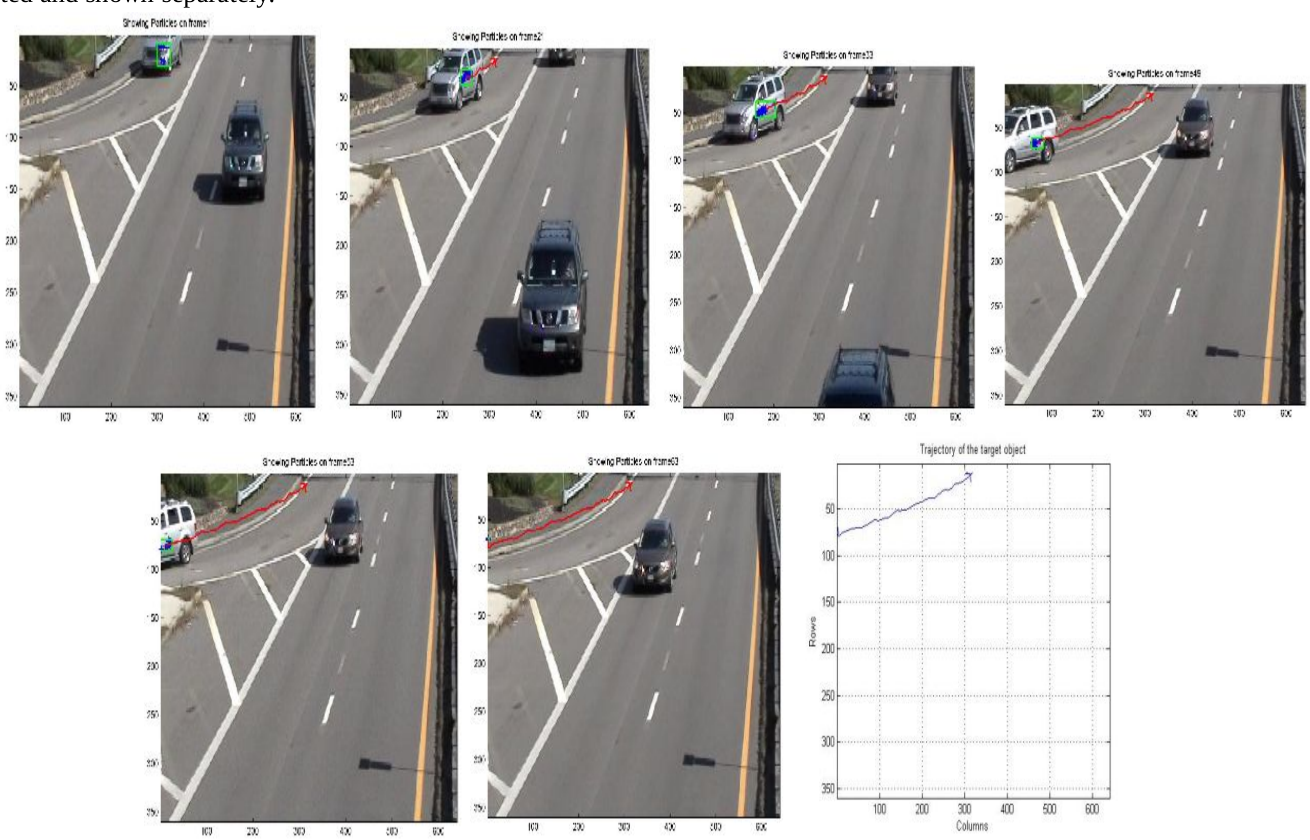

Fig. 1 tracking results using CIELab color space and Trajectory of the object

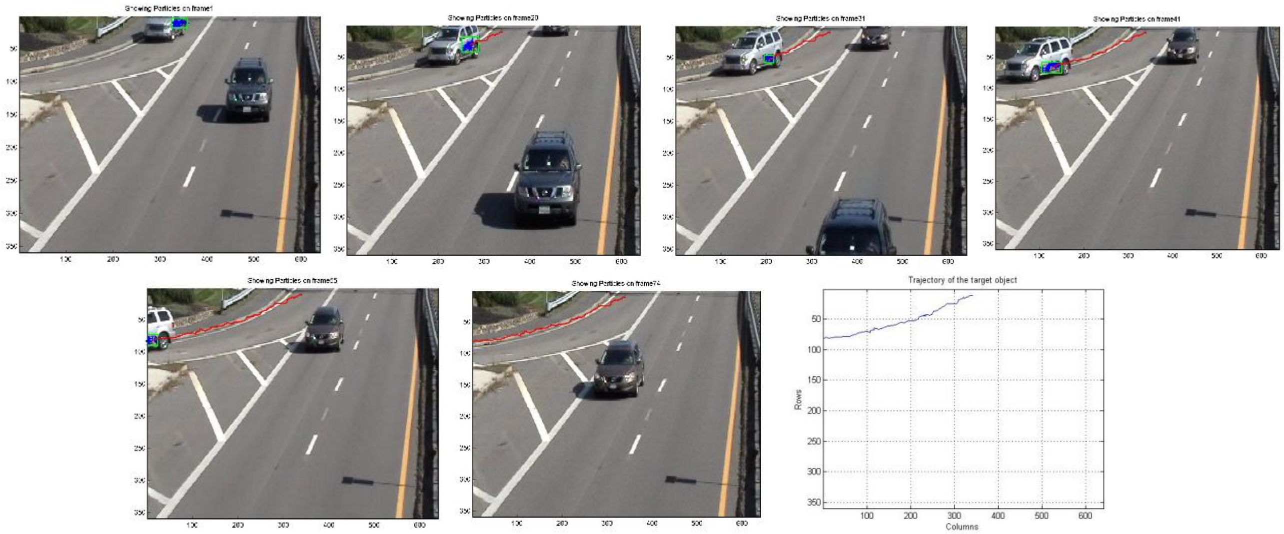

Fig. 2 Tracking results using HSV color space and Trajectory of the object

Object detection using K-means clustering provides advantage of less computational cost and larger speed of operation but has basic limitations like The clusters obtained by using this method are not guaranteed to include connected regions and accuracy is dependent on number of bins provided by the user.

In case of color distance based method, as the neighborhood based techniques are used, the part selected as object region is a connected region and is actually a part of the object to be detected.

Hence color distance based method is prefers over K-means clustering algorithm for detecting the object to be tracked. In case of color distance based segmentation, the accuracy of algorithm basically depends on value of similarity threshold and size threshold.

A color based particle filter is used to track the object. Using color as a feature for object tracking can provide scale and rotation invariance in tracking process. Also obtaining and processing color information requires less computational cost and provides increased processing speed of the algorithm.

If the size of object to be tracked is very small or the number of particles used for tracking is less, then the possibility of losing the track in the tracking process is increased. Using larger value of system variance can provide better tracking results in such case

V. CONCLUSIONS

In this paper, the hybrid method for segmentation of color images using automatic seed pixel selection using edge information and seeded region growing is used. Region merging technique based on color similarity and size is utilized in order to reduce over segmentation. The accuracy of the segmentation results can be enhanced if the information about object size in image is available according to which the threshold can be set.

A color based particle filter is used for object tracking in video sequences using CIELab and HSV color spaces. Use of CIELab and HSV color spaces enables to separate color information from luminance component in order to obtain reasonably good results. Using color feature for tracking can provide scale and rotation invariance, flexibility in the partial occlusion, background clutter and reduced computational cost and reduced processing time. The accuracy of the tracking algorithm increases as the number of particles used is increased.

There is scope to modify the algorithm by using multiple object features in order to handle situations like full occlusion and multiple object tracking.

REFERENCES

[1] M.Mary Synthuja Jain Preetha, L.Padma Suresh, “An Integrated approach for Color Image Segmentation using Edge and Color Information”, IOSR Journal of Computer Engineering (IOSR-JCE), ISSN: 2278-0661, p- ISSN: 2278-8727, Volume 14, Issue 6 (Sep. -Oct. 2013), PP 07-13

[2] Kun Wang, Xiaoping P. Liu, “Visual Object Tracking Based on Filtering Methods”, Instrumentation and Measurement Technology Conference (I2MTC), 2011 IEEE.

[3] Jan Valiska, Stanislav Marchevsky and Rastislav Kokoska, “Object tracking by Color-Based Particle Filter Techniques in Video Sequences”, Radioelektronika, 24th International Conference, IEEE, 2014

[4] Nikita Sharma, Mahendra Mishra, Manish Shrivastava, "Color Image Segmentation Techniques and Issues: An Approach", International Journal of Scientific & Technology Research Volume 1, Issue 4, May 2012, PP 09-12.

[5] Prachi R. Narkhede and Aniket V. Gokhale, "Color Image Segmentation using Edge Detection and Seeded Region Growing Approach for CIELab and HSV Color Spaces" 2015 International Conference on Industrial Instrumentation and Control (ICIC), College of Engineering Pune, India. May28-30,2015, pp. 1214-1218.

[6] Shamik Sural, Gang Qian and Sakti Pramanik, "Segmentation and Histogram Generation using the HSV Color Space for Image Retrieval", in IEEE ICIP 2002 pp. 589-592.

[7] Faten Abu Shmmala and Wesam Ashour, "Color Based Image Segmentation using Different Versions of K-Means in two Spaces." Global Advanced Research Journal of Engineering, Technology and Innovation (ISSN: 2315-5124) Vol. 1(9) pp. 030-041, January, 2013.

[8] Kun Wang, Xiaoping P. Liu, "Visual Object Tracking Based on Filtering Methods", Instrumentation and Measurement Technology Conference (I2MTC), 2011 IEEE.

[9] W. L. Khong, W. Y. Kow, Y. K. Chin, I.Saad and K. T. K. Teo, "Enhancement of Particle Filter for Vehicle Tracking via Adaptive Resampling Algorithm", in Third International Conference on Computational Intelligence, Communication Systems and Networks, 2011, pp. 259-263.

[10] Prachi R. Narkhede and Aniket V. Gokhale, "Color Particle Filter Based Object Tracking using Frame Segmentation in CIELab* and HSV Color Spaces", in IEEE ICCSP 2015 Conference, pp. 804-808.