

# Video Segmentation using FCM Algorithm

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**Abstract** – Now days, video information plays a crucial role. Storage of video data has become significant for wide variety of applications such as in Forensic, Medical, Navy and Military, Multimedia applications. The miracle happens when there is a appropriate indexing method for the stored video content and proper retrieval method for accessing the stored information from the databases. Video Segmentation is the major issue involved in retrieving and storing the video data. In this paper we use SLIC and FCM algorithm for video segmentation. First of all SLIC algorithm is used for tracking of an object from the video. Tracking is usually performed in the context of higher-level applications that need the location and/or shape of the object in each frame. Then FCM algorithm is used for the segmentation. The advantage of FCM technique is that it yield regions which are more homogeneous also it reduces spurious blobs. Further it was less sensitive to noise. In this paper both algorithms are used. The result shows that the proposed method used for segmentation enhances the image quality.

**Keywords** — Clustering, Motion Detection, Object tracking, SLIC, Video Segmentation.

## I. INTRODUCTION

Segmentation can be specified that it is a process of partitioning data into groups of potential subsets that share homogeneous characteristics. It has become a technique for semantic content extraction and plays an important part in pattern recognition, digital multimedia processing and computer vision.

### IMAGE SEGMENTATION:

Image segmentation is a necessary but challenging problem. It is a necessary first step in image analysis. Because it is used in high-level image interpretation and understanding such as object recognition, robot vision, geographical imaging and medical imaging. In general, image segmentation is a task of partitioning an image into non-overlapped, consistent regions that are uniform with respect to some characteristics like intensity, color, tone or texture, and more. There are different techniques for image segmentation e.g. thresholding, clustering, classifications, artificial neural networks (ANNs), region growing, edge detection etc. [3]

### Motion Detection:

Motion detection is essential in many fields, such as pattern recognition, traffic surveillance, object tracking. At present, the existed approaches of moving target detection are optical flow, background difference, and time difference (frame difference). Motion detection algorithm operates in a specific area to observe the change of image for detecting the dynamic object. However, the change in the environment disturbs the motion detection seriously: illumination, noise, shadow and so on. [5]

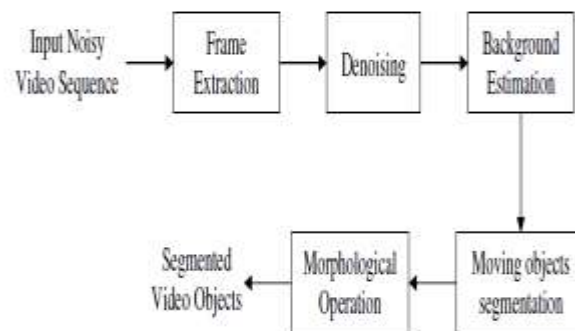


Fig. 1 Block diagram of the proposed video object segmentation approach [8]

### OBJECT TRACKING:

In order to extract useful information of an object of interest from a video scene and keeping track of its orientation, motion, occlusion etc. is defined as object tracking. The goal is to review the state-of-the-art tracking methods, identify new trends and classify them into different categories. Object tracking, in general, is a challenging problem. Due to abrupt motion of object, changing appearance patterns of the object and the scene, object-to-scene and object-to-object occlusions, camera motion and non rigid object structures, there are many difficulties arise in tracking of objects.

The object tracking can be complex, due to camera motion, loss of information caused by the projection of the 3D world on a 2D image, variations of target scale, partial occlusions, real-time processing requirements, clutter, and so on.

### CLUSTERING:

An unsupervised learning task is clustering, where the pixels are classified in to a finite set of categories

known as clusters or groups. It is an unsupervised classification because there is no available data to train the pixels. A similarity criteria is defined between pixels such as distance, intensity and colour, and then similar pixels are grouped together to make clusters. The grouping of pixels is done based on intra class similarity and enhancing the inter class similarity. Where intra cluster similarities is measured between the pixels in a cluster and inter cluster similarity is measured between the clusters. Clustering is useful in several exploratory decision making, pattern analysis, and machine learning situations, document retrieval, including data mining, image segmentation, and pattern classification.[6]

Many schemes of clustering are categorized based on their special characteristic, such as the hard clustering scheme and the soft (fuzzy) clustering scheme. The conventional hard clustering scheme restricts each point of the data set to entirely just one cluster. As a consequence, with this approach the result of segmentation is often very crisp, i.e., every pixel of the image belongs to just one class exactly. In fuzzy (soft) clustering, data elements can belong to more than one cluster. The fuzzy set theory described by a membership function. [3]

#### VIDEO SEGMENTATION

The term video segmentation refers to decomposing a video data into meaningful elementary parts that have strong correlation with the actual world contained in the video data. The result of video segmentation is a set of segments that collectively cover the real entire video data. The major difference between image signal and video signal is that a video signal keeping of temporal information, which introduces the object motion and includes camera motion concept, therefore Video has both temporal nature and spatial (static) nature. Segmentation of video can thus be temporal, spatial or spatio-temporal. In a video, segmenting a frame in spatial domain is just like a static image. Segmenting a sequence of video frames in temporal domain is known as temporal segmentation and shot detection. For video data temporal segmentation is used for considering boundary of shots may operate both in uncompressed and compressed domain. Temporal segmentation can identify dynamic objects since moving objects have coherent motion that is distinct from the background. Spatial segmentation can examine object boundaries correctly if underlying objects have a different visual appearance from the background. [9]

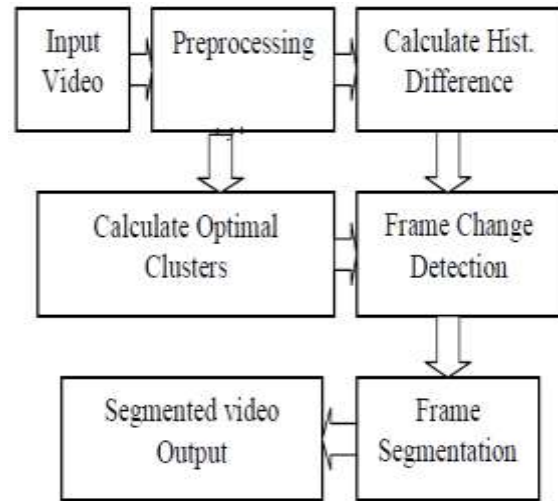


Fig. 2 Block diagram of Video Segmentation.[12]

## II. RELATED REVIEW WORK

At present we found that many researchers had done work towards the video segmentation, object tracking and motion detections and in the meantime, few research reports are published recently & tried to solve the problem associated with them. Many of the journals and research papers published during the above span 2013-2016 have been studied.

**Shaoping Xu et. al (2013)** In the paper author propose an algorithm i.e novel cluster number adaptive fuzzy c-means image segmentation algorithm (CNAFCM), for naturally grouping the pixels of an image into different similar regions when the cluster number is not known beforehand. To calculate the cluster number as initialization parameter of the following FCM clustering, the author utilize the Grey Level Co-occurrence Matrix (GLCM) feature selection at the image block level instead of at the pixel level.[1]

**Meenakshi M. Devikar et. al (2013)** Histogram based skillful fuzzy c-means algorithm is proposed in this paper for the segmentation. Given image is clustered with this proposed Improved Histogram based Spatial FCM algorithm . Robustness against noise is enhanced by using the spatial probability of the nearby pixel. The medical images are denoised with effective denoising algorithm before to segmentation. [3]

**Sudhanshu Sinha et. al (2014)** In this paper, simplified mean-shift filter and K-Means clustering both are used in modeling the background. The most common models are mixture of Gaussian (MOG), Kernel Density Estimation (KDE), etc. used for background estimation. With some of the aforementioned models comparison of the proposed approach have been made. [2]

**RAJASEKHAR NALABOLU et. al (2014)** This paper proposes a motion detection system based on background subtraction using morphological processing and fuzzy color histogram. In dynamic texture scenes, morphological process and filtering are used effectively for pixel removal from the background that are unwanted. The background subtraction algorithm use a clustering-based feature, called fuzzy color histogram (FCH), having an ability of extremely attenuating color variations generated by background motion. [4]

**A Pugazhenthii et. al (2015)** It removes the limitations associated with Fuzzy C-means clustering algorithm such as choosing of number of clusters initially by selecting from the co-occurrence matrix. As the co-occurrence matrix produced the repetition of adjacent gray levels, the proposed algorithm choose centroids as the gray levels correlating to the diagonal elements of the co-occurrence matrix. To the resultant image some morphological actions were done. The proposed algorithm consistently removes the background pixels and the performance of the proposed algorithm is evaluated quantitatively. [6]

**Deepak Kumar Panda et. al (2016)** In this context, author describe a robust background subtraction technique with three contributions. First, in the background subtraction algorithm, the use of color difference histogram (CDH). This is done by evaluating the color difference between a pixel and its neighborhood pixels. The use of CDH reduces the number of false errors due to the moving background and illumination variation. Secondly, the color difference is fuzzified with a Gaussian membership function. A novel fuzzy color difference histogram (FCDH) is finally proposed by using fuzzy c-means (FCM) clustering and performed the CDH. The function of FCM clustering algorithm in CDH minimize the large dimensionality of the histogram bins in the evaluation and also lessens the intensity effect variation generated due to the change in illumination of the background or fake motion. [7]

**Radhakrishna Achanta et. al (2010)** The author introduce a novel algorithm that use clusters pixels in the integrated five-dimensional color and image plane space to productive originate compact, nearly uniform superpixels. The simplicity of this technique makes it extremely easy to use - a lone parameter describe the number of superpixels and it makes this algorithm very practical due to the efficiency. Experiments show that this approach produces superpixels at a minimum computational cost while achieving quality of segmentation equal to or greater than four state-of-the-art methods, as estimated by boundary recall and under-segmentation error. [10]

### III. PROPOSED WORK

#### SLIC Algorithm:

Superpixels are becoming popular for work in computer vision applications. However, there are few algorithms that output a compact and desired number of regular, superpixels with a low computational overhead. A novel algorithm called SLIC (Simple Linear Iterative Clustering) in which clusters pixels are integrated in the five-dimensional color and image plane space to effectively generate compact, nearly similar superpixels. The simplicity of our technique makes it extremely easy to use - a lone parameter identifies the number of superpixels - and the efficiency of the algorithm makes it very practical. Furthermore, it is more memory efficient and faster than existing methods.

#### Fuzzy C Means Algorithm:

The clustering algorithm, FCM was introduced by Dunn in 1973 firstly and later extended by Bezdek in 1981. For image segmentation in pattern recognition this algorithm has been used as one of the famous clustering techniques. In the FCM, each image pixel has certain membership degree corresponding with each cluster centroid. These membership degrees have values in the range, showing the strength of the association among the pixel and a particular cluster centroid. The FCM algorithm attempts to division every image pixel into a collection of the fuzzy cluster centroids using minimizing the weighted summation of squared error objective function  $J_m(U, C)$ ,

$$J_m(U, C) = \sum_{i=1}^N \sum_{j=1}^K u_{ji}^m d_{ji}^2 \dots\dots\dots (1)$$

Subject to

$$\sum_{j=1}^K u_{ji}^m = 1, 1 < j < k$$

$$\sum_{i=1}^N u_{ji}^m < N, 1 \leq i \leq N \dots\dots\dots (2)$$

In image N is the total number of pixels,  $u_{ji}$  is the membership degree of  $i$ th pixel  $x_i$  to  $j$ th cluster centroid  $c_j$ ,  $m$  is the exponential weight of membership degree that controls the fuzziness of the

resulting partition, and  $d_{ji} = \| x_i - c_j \|$  is the distance between  $x_i$  and  $c_j$ .

$$u_{ji} = \frac{1}{\sum_{k=1}^K (d_{jk}/d_{kj})^{2/m-1}}$$

..... (3)

Where  $1 \leq j \leq K$  and  $1 \leq i \leq N$ . It should be noted that if  $d_{ji} = 0$  then  $u_{ji} = 1$  and set another membership degrees of this pixel to 0.

$$c_{ji} = \frac{\sum_{i=1}^N u_{ji}^m x_i}{\sum_{i=1}^N u_{ji}^m}$$

..... (4)

Where  $i \leq j \leq K$  and  $X_i$  is the multidimensional feature vector of  $i$ th pixel  $x_i$ .

**IV. RESULT ANALYSIS**

RESULT: First of all we take the frames from the video. Then using SLIC algorithm, track the object for the further segmentation. Then clustering and segmentation is done of that object. Now clustering is done with the help of FCM algorithm. Then calculate the PSNR values of extended and proposed segmentation. We see in the table that the PSNR value of proposed technique is high or better than existing technique.

TABLE 1  
PSNR VALUES OF SEGMENTATION

Sr. No.	PSNR value of Existing segmentation	PSNR value of Proposed segmentation
1	3.8539	4.2073
2	3.7592	4.1447
3	3.7277	4.1160
4	3.7305	4.1374
5	3.7932	4.1520
6	3.7665	4.0985
7	3.7505	4.0647
8	3.8572	4.1691
9	3.8050	4.1603
10	3.7614	4.1025
11	3.6915	4.0531
12	3.7428	4.2603
13	3.6855	4.0862
14	3.5436	3.9356
15	3.9382	4.2907

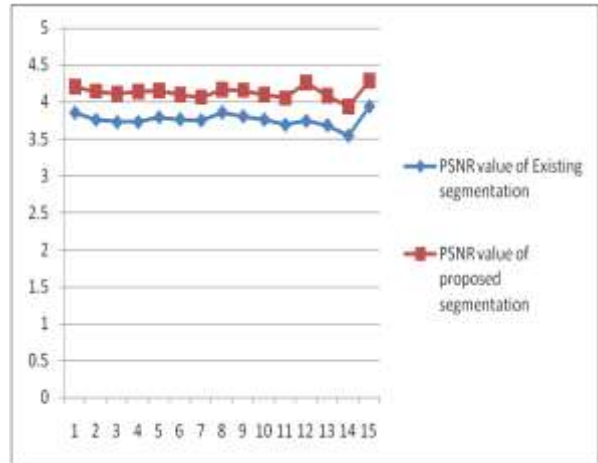


Fig. 3 Graphical Representation of PSNR values

Taking that values we make a graph. Graphical representation shows that we get the better results using FCM algorithm.

Now calculate the average values of both segmentation and make a graph of that calculated values and it show clearly that we achieve better segmentation result.

Avg. PSNR value of Existing segmentation = 3.7604

Avg. PSNR value of proposed segmentation = 4.1318

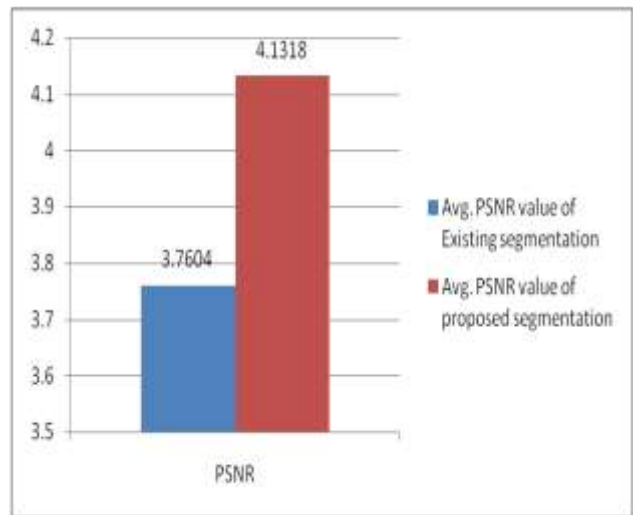


Fig. 4 Graphical Representation of average PSNR values

In this graph it is clearly seen that the proposed technique gives the better result of quality of the video segmentation.

## V. CONCLUSION

In digital video processing and computer vision, one of the most challenging and active research areas is video object segmentation. A significant issue for the successful use of many video sequences is video object segmentation that accentuates partitioning the video frames to semantically meaningful video objects and backgrounds. Video object segmentation is a vital operation for content-based video coding, multimedia content description, intelligent signal processing and more. SLIC is used for object tracking and FCM is used for clustering. FCM clustering is a hard and an unsupervised clustering technique which will be applied to image segments to clusters with spectral properties. FCM use the distance between pixels and cluster centers in the spectral region to compute the membership function. In this paper we calculate the PSNR (peak to signal noise ratio) values of existed segmentation and proposed segmentation. The comparison is based on the PSNR values. The Proposed technique gives the high values of PSNR. Graphical representation of PSNR values shows the better quality of segmentation.

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