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An Improved Approach towards Image Segmentation Using Mean Shift and FELICM

Amanjot Kaur Randhawa*
CSE Department, GIMET
Amritsar, India

Dr. Rajiv Mahajan
CSE Department, GIMET
Amritsar, India

Abstract— Image Segmentation is dividing the image into the segments. There are various algorithms available for segmentation but clustering approach is considered to be best. The study shows that there are various gaps which are not covered by the researchers so an improved approach towards image segmentation using mean shift and FELICM has been proposed. HSV color space is considered to be better approach than RGB. In the proposed method input image in RGB form is converted into HSV further mean shift and FELICM is applied separately on Hue, Saturation and Value Components. So the final images obtained from mean shift and FELICM is fused together. The method shown in this paper has shown better results on various parameters and different segment results can be analyzed correctly.

Keywords— Image segmentation, Clustering, FELICM, Mean Shift , HSV

I. INTRODUCTION

An image can be referred as a two-dimensional function, f(x, y), where x and y represents are spatial coordinates, and the amplitude of at any pair of coordinates is called the intensity of the image at that point very particular point. When the intensity of f and the value of x ,y are finite then the image is called digital image.[11]

Digital Image Processing is the use of computer algorithms to perform image processing on digital images. The very first application of digital image processing was its first introduction in the newspaper industry and the digital images were sent through submarine cable between London and New York. The applications of digital image processing involves space applications, medical imaging , industries and many more. The color image processing is divided into two fields one is full color on which images are captured with full color sensors such as color television camera or color scanner and the second type is pseudocolor processing. A color model is the specification of the coordinate system within which each color is represented by a single point. The RGB Color Model which an additive color model in which color appears in primary spectral components of red, green and blue. HSV model considered to be better model as it is more nearer to human interpretation. Hue describes the color attribute for a pure color, saturation represents the intensity of the specific hue and value represents the brightness of color.

Image Segmentation is an important process of image processing and understanding. Basically it is defined as the process of dividing the image into different parts of homogeneity. The aim of image segmentation is to simplify the representation of an image into something that is more meaningful and easier to understand. There are many methods available which are used for image segmentation to better understand the image processing and they are Histogram thresholding-based methods, Edge detection-based methods, Graph Partioning Methods, Region-based methods.

II. CLUSTERING

Clustering method is a process in which a data set or say pixels are replaced by cluster, pixels may belong together because of the same color, texture etc. There are two types of clustering that is hierarchical clustering and partional clustering.[5] The various clustering methods are K-means Clustering Method, Fuzzy C-means Clustering Method, FELICM and Mean Shift Segmentation. The two important methods which has been used in the proposed method is as follows:

A. FELICM

It stands for Fuzzy C-Means with Edge and Local Information, which introduce the weights of pixels within local neighbours windows to reduce the edge degradation. Image Clustering is considered to be very effective method but usually it ignores the spatial relationship among the pixels due to which it becomes very sensitive to the noise. An adaptive FCM method was also proposed to suppress the nose and try to remove certain ambiguities. Further Dulyakarn and Rangsanseri add priori knowledge to FCM to work over remote images. Basically FELICM method has somehow tried to overcome the isolated distribution of pixels inside segments of image. The basic process of FELICM is that in this method firstly the original image is being converted into gray image and then the principal components analysis is taken. Then in the next step edges are obtained by adjusting two threshold values that is a high threshold value and low threshold value in canny edge detection algorithm. After analyzing the edges , different weights are set to the neighbours

within the local windows. Then the clustering is done with the FELICM method by using the spatial and spectral information.[1] The following is the illustration of steps involved in this clustering method

Step 1: The grey image is obtained from original image using principal component analysis

Step 2: Number of edges are obtained by adjusting threshold values that is a high threshold value and a low threshold value using Multi-Otsu method. Basically edges are extracted using Canny Edge Detection Method in which first of all noise is reduced using Gaussian filter and intensity gradient is calculated. Instead of Sobel operator Scharr operator is used because of its better rotational symmetry.

Step 3: With the help of edges different weights are assigned to neighbors within local windows. Then the clustering is done using FELICM using spectral and spatial information.

B. Mean Shift Segmentation Algorithm

It is an advanced technique for clustering based segmentation. It is a non parametric iterative technique which do not need prior knowledge of the number of clusters and it is a density of gradient estimation using a generalized kernel approach..It is implemented through kernel density estimation which is a non parametric way to estimate the density of a random variable.[4] It is somehow popular method for estimating probability. For each data point, mean shift defines a window around it and computes the mean of data point. Then it shifts the center of window to the mean and repeats the algorithm till it converges. This method is suitable in over segmentation, multiple segmentation ,tracking ,clustering and filtering applications. The basic mean shift algorithm is discussed in following points.

Step1: Choose kernel and bandwidth clustering

Step 2: For each point

a. Center a window on that point.
b. In the search window , mean of data is computed.
c. The search window is centered at the new location.
d. Repeat (b, c) until convergence

Step 3: Assign points that lead to nearby modes to the same cluster

III. RELATED WORK

FELICM decreases the edge degradation by adding the weights of pixels within local neighbour windows. The canny edge detection is used for [1] edge extraction, adaptive threshold values. The FELICM based method could be directly applied without using the filters. The FELICM approach has delivered the better results with respect to fuzzy c means clustering method and mean shift approach. Researchers have also implemented the FELICM method along with K-means clustering. [3] The benefits of Spatial Fuzzy C-means (SFCM) [2]is that it overcomes the limitation of conventional FCM towards noisy image have been discussed. Thresholding by Fuzzy C-means (THFCM) [2] approach has solved the problem of existing method to determine a threshold for excellent segmentation Different versions of Fuzzy C-means Clustering are improved FCM, Bias Corrected Fuzzy C-means and many more.

Mean Shift Method is is an advanced technique for clustering based segmentation. It is a non parametric iterative technique which do not need prior knowledge of the number of clusters and it is a density of gradient estimation using a generalized kernel approach.[9] It preserved the discontinuity characteristic of image. The recursive mean shift procedure converges to the nearest stationary point of the density function and it is used in detecting various kinds of modes of the density.[4]

From the observations it has been proved that the RGB, CMY and other similar are not practically useful for human interpretation. So HSV model considered to be better model as it is more nearer to human interpretation. Hue describes the color attribute for a pure color, saturation represents the intensity of the specific hue and value represents the brightness of color. In the research it has been shown that HSV color model is more useful in representing than RGB model. [8]

IV. PROBLEM FORMULATION

A. Problem In Existing Work

The survey has shown that of the existing techniques have focused on the complex regions. Therefore not much work has been done for the images with mixed regions .The effect of the regions on the segmentation has been neglected by many researchers. The effect of the color on the segmentation results has also been neglected.

B. Problem Definition

Segmentation of image is still an important task for digital image processing. The basic process of image segmentation is to divide the image into segments for deeply analyzing the image.The proposed method use hsv space over segmentation is done.

V. PROPOSED ALGORITHM

After analyzing and going through the literature survey. There are various gaps in study have been found So to overcome those kind of problems following methodology have been proposed.

The following steps are involved in proposed methodology

Step 1: First of all take the input image.

Step 2: Convert the input image from rgb to hsv plane.
Step 3: In this step Mean Shift and FELICM Algorithm are applied separately and further FELICM involves the PCA analysis used along with otsu thresholding for canny edge detection. The output obtained from canny edge method will be used by FELICM for clustering.
Step 4: After getting the separate images from Mean Shift and FELICM Algorithm Variance based fusion is done over the two images that means the segments which has least variance among the two images will be taken together.
Step 5: All pixels are assigned to their nearest clusters and hence proposed segmentation method will be achieved.
Step 6: Color Labeling is done after obtaining the desired results.

VI. EXPERIMENTAL SETUP

In order to implement the proposed algorithm the MATLAB has been used. The proposed technique has been compared with existing technique which is FELICM using the tools available in the MATLAB. Basically over ten images the algorithm has been implied and the results will be discussed in next section. The table 1 shows the information of the images used.

TABLE I: INFORMATION OF IMAGES

Sr.No.	NAME	FORMAT	SIZE IN KB
1.	image1	JPEG	11.2
2	Image2	JPEG	24.2
3	image3	JPEG	32.8
4	image4	JPEG	34.4
5	image5	JPEG	14.7
6	image6	JPEG	38.4
7	image7	JPEG	24.6
8	image8	JPEG	219
9	image9	JPEG	10.2
10	image10	JPEG	165

VII . RESULTS

Figure 1 shows the input image which will be used for the proposed algorithm over which rgb to hsv conversion is done and FELICM and Mean Shift Algorithm is applied separately.

Figure 1 original Image

Figure 2 shows the image obtained from the existing technique that is FELICM.

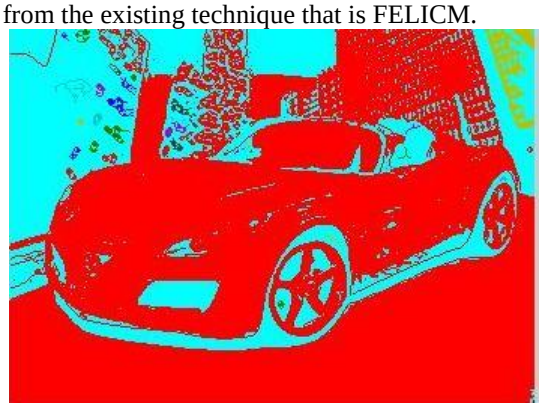

Figure 2 Image from existing technique

Figure 3 represents the image obtained from proposed method that is achieved after mixing the image obtained from mean shift and FELICM method and from figure it can easily be seen that segmentation is better in proposed method.

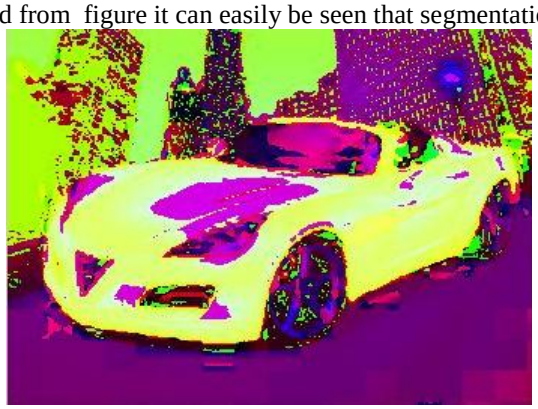

Figure 3 Image from proposed technique

VIII. PERFORMANCE EVALUATION

The table 2 and figure 4 shows the results of proposed method on the basis of Peak Signal To Noise Ratio. Basically (PSNR) is the ratio between maximum possible power of a signal and the corrupting power. The algorithm which has high PSNR value performs better so the main goal is to have high psnr value .As PSNR need to be maximized so our goal is to increase PSNR as much as possible.

TABLE II: PSNR VALUES

Images	FELICM	Proposed
1	32.7164	36.4394
2	31.3466	38.5742
3	32.2437	46.1832
4	32.3441	36.4728
5	33.1501	39.5208
6	31.3608	33.2777
7	33.1275	37.6749
8	32.1024	47.0489
9	33.5161	36.5907
10	32.5550	37.6353

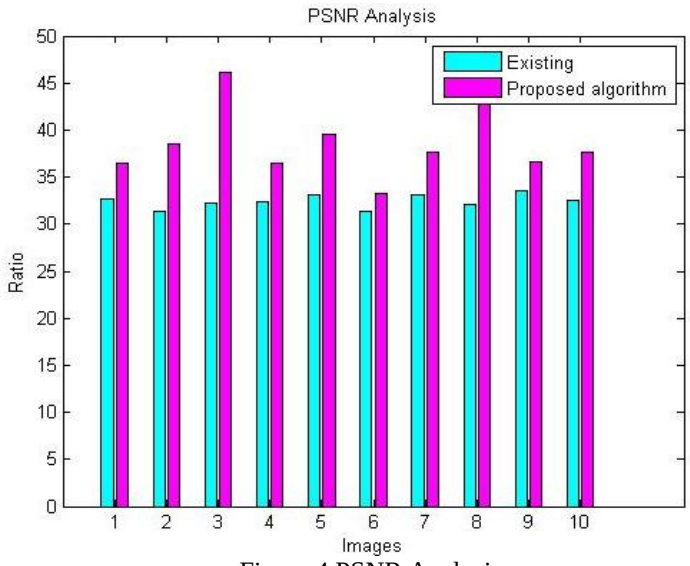

Figure 4 PSNR Analysis

The table 3 and Figure 5 shows the result for Mean Square Error (MSE). MSE is better than the existing algorithm which is FELICM as the value of MSE has been decreased in proposed algorithm

TABLE III: MSE VALUES

Images	FELICM	Proposed
1	35.0619	14.8779
2	48.0644	9.1004
3	39.0944	1.5789
4	38.2009	14.7639
5	31.7303	7.3181
6	47.9074	30.8112
7	31.8952	11.1942
8	40.3870	1.2930
9	29.1656	14.3685
10	36.3894	11.2967

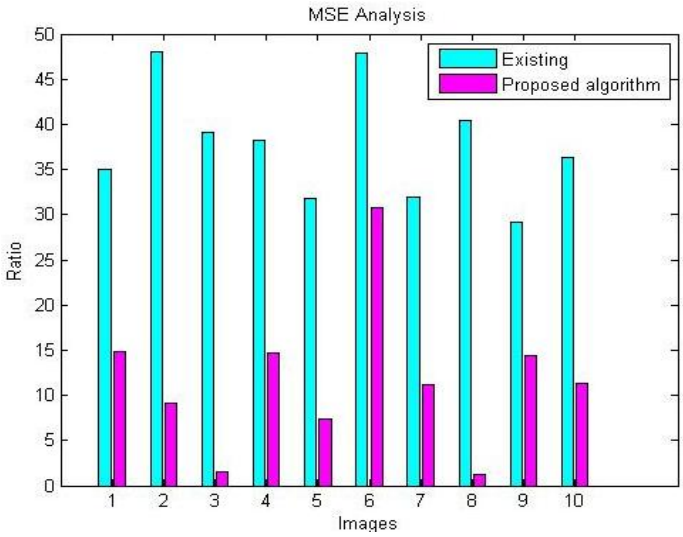

Figure 5 MSE Analysis

IX. CONCLUSION & FUTURE SCOPE

Segmentation is the process of partitioning the image into segments. There are well known segmentation methods like Fuzzy C-Means Clustering method, Bias Corrected Fuzzy C-means and many more. For the success of any algorithm PSNR should be high and MSE should be low, so the scenario is same for proposed method. So from the overall process it can be concluded that the improved approach towards image segmentation using mean shift and FELICM has shown better performance level than the previous algorithms. The main strength of the algorithm is seems to be the HSV plane and advantages of both the integrated method which has been taken together for the superior outcome.

In the near future modified proposed method can be implemented along with neuro fuzzy approach. The performance of the proposed method can be evaluated with more parameters and different kind of images.

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