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# A New Improved FELICM Based Gray Stretch Method to Segment Images

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***Abstract :*** Image processing and understanding uses segmentation as the major component that subdivides an image into distinct regions of homogeneity. The central idea behind segmenting an image into multiple segments is to achieve an easy and significant approach that will help in image representation. Image segmentation is basically applied to acquire the site of objects or edges or lines in an image. It helps to extract and recognise the objects that are used in the fields of agriculture, forensic, medical etc. DWT based image segmentation make use of waves rather than pixels to segment an image that leads to good segmentation results. To boost the performance of image segmentation further an improved Fuzzy-C Mean with Edge and Local Information (FELICM) based gray stretch approach is proposed that will help to obtain an adaptive threshold to segment an image. Performance of both the existing and the proposed technique is compared using well known performance measures PSNR, MSE and ME.

***Keywords :*** Image Segmentation, Clustering, FELICM, Gray Stretch.

## 1. INTRODUCTION

In the today's world, several areas generally make an efficient use of image processing to satisfy the needs of real world situations. The main element of image processing is image segmentation which forms the necessary condition and foundation for eventual processing involving object extraction and recognition so as to separate out the object that is of keen interest from background. Segmentation sections off or separates an image into easily distinguishable regions with an aim to extract out crucial information from the image [1]. Some of the popular techniques to segment an image include Thresholding, Edge Based, Region Based [2] and Clustering [3]. On the basis of their similarity, the clustering approach (unsupervised classification), clusters the object into meaningful and relevant groups [4]. To obtain the segments of an image, variety of clustering algorithms are conveniently available in image processing. K–mean clustering [5], FCM (Fuzzy–C Mean) clustering, FLICM (Fuzzy–C Mean with Local Information) and FELICM (Fuzzy–C Mean with Edge and Local Information) [6] are some of the popular clustering strategies adopted to segment an image. Clustering can be classified into two main categories: hard and soft. K-mean clustering, the hard clustering technique is that where the neighbour pixels of an image have almost same value. Therefore to group the pixels we use the euclidean distance that exists between the pixels and every pixel in an image is assigned to the unique cluster. Fuzzy clustering that is the soft clustering type uses the partial membership of belonging that is achieved with the help of membership function. It handles the problem of K-mean clustering very efficiently as the data element can belong to more than one cluster [7] making it more favourable choice to achieve clustering.

Image segmentation can easily be attained by clustering but the major drawback in this is that pixels of an image are assumed to be an isolate samples and also spatial relationship among pixels is disregarded, making it

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more delicate towards noise. To handle clustering, smooth filters can be applied or texture description can be used that reduces the difference among pixels in the regions. Whenever such preprocessing strategies are applied, they may possibly result in losing essential image details and eventually the robustness of clustering is compromised. This drawback of FCM was efficiently handled by FLICM that took into consideration both the spatial and gray level relationship between pixels to boost the clustering efficiency. But it somehow resulted in degradation or degeneration of edges. To prevent this degradation, FELICM that remains unaffected for isolated regions was suggested that incorporates weights of the pixels within nearby neighbouring windows, eventually resulting in more precise edges as compared to FLICM [8]. To increase the visibility of pixels so that users can easily differentiate between objects and background gray stretch is applied. In the layman language gray stretch increases the visibility of foreground pixels and at a same time decreases the visibility of background pixels so that segmentation can be more efficiently achieved.

## 2. LITERATURE SURVEY

By adopting various methods much work has been done in the field of image segmentation. Depending on the requirement many researchers have suggested different methodologies and algorithms to segment an image.

Akila et al. [9] suggested a new technique to segment an image named an iterative thresholding based on 2-D improved otsu method that utilized novel threshold value recognition function which helped in well spotting of objects and provided better anti-noise capability.

Zhonghua et al. [10] considered a technique that combined double thresholding with fuzzy set theory to segment cracks in the weld. The new approach is quite simple and highly efficient.

Pranita et al. [11] discussed the spatial FCM approach to detect brain tumor using MRI images that provided better accuracy and chances of errors to occur also reduced.

Xiaolu et al. [12] found that original Otsu method does not provide so efficient segmentation results if the histogram was non bi-modal, so they proposed an improved median based thresholding algorithm that helped to obtain much accurate threshold.

M.Sridevi et al. [13] has reviewed different edge detection and threshold segmentation approaches that can be applied to segment monochrome images. They described the characteristics and drawbacks of each strategy to segment an image.

B. Padmapriya et al. [14] discussed the automatic edge based image segmentation technique to detect and estimate urinary bladder wall thickness. The proposed technique was simple, much accurate, less chances of errors caused due to human negligence, easy implementation and less time costly.

Gurjinder et al. [15] proposed a new approach to obtain vehicle plate number by adopting neural network that would help in automatic supervision of vehicles to achieve security.

Er. Sakshi et al. [16] proposed improved median filter to handle noise in images and also conserve edges. It compresses the image by a technique that utilizes DCT so as to enhance the speed of proposed methodology.

S. Zulaikha et al. [17] proposed FCM with some variations in order to segment medical images that have been highly corrupted by noise that proved out to be an efficient approach to segment them in more efficient way.

Zhiwei et al. [18] proposed a method combining otsu method along with an approach that relies on fuzzy technique to obtain a threshold to segment an image. The proposed approach helped to obtain better image details and produced much better results for images that have low contrast.

Mengxing et al. [19] suggested an improved threshold strategy to segment an image that uses otsu technique. Experimental results clearly proved that the new technique gives improved accuracy results and also high processing speed.

Si Jun-shu et al. [20] considered an adaptive threshold technique comprising otsu and fuzzy approach to segment traffic lights in a complicated background. The results obtained using proposed approach gave better accuracy.

## 3. PROPOSED METHODOLOGY

**Step 1 :** Start the algorithm.

**Step 2 :** Take any input image on which proposed approach will be applied.

**Step 3 :** Apply one level 2D-DWT so as to obtain the high and low wavelet coefficients that basically expresses the features of an image more effectively.

**Step 4 :** First apply FELICM on the low frequency wavelet coefficients also known as smooth variations that describe the basic figure of an image and then apply gray stretch on it so as to increase the visibility of pixels.

**Step 5 :** On the high frequency wavelet coefficients also known as sharp variations that describes edges with detail, directly apply edge enhancement on it.

**Step 6 :** After applying FELICM and gray stretch on low frequency wavelet coefficients and edge enhancement on high frequency wavelet coefficients, apply wavelet inverse transform so as to reassemble the high and low components into one constructed image.

**Step 7 :** Again apply FELICM so that an optimal segmentation can be achieved.

**Step 8 :** The resultant image is the output image with improved method of segmentation.

**Step 9 :** Stop the algorithm.

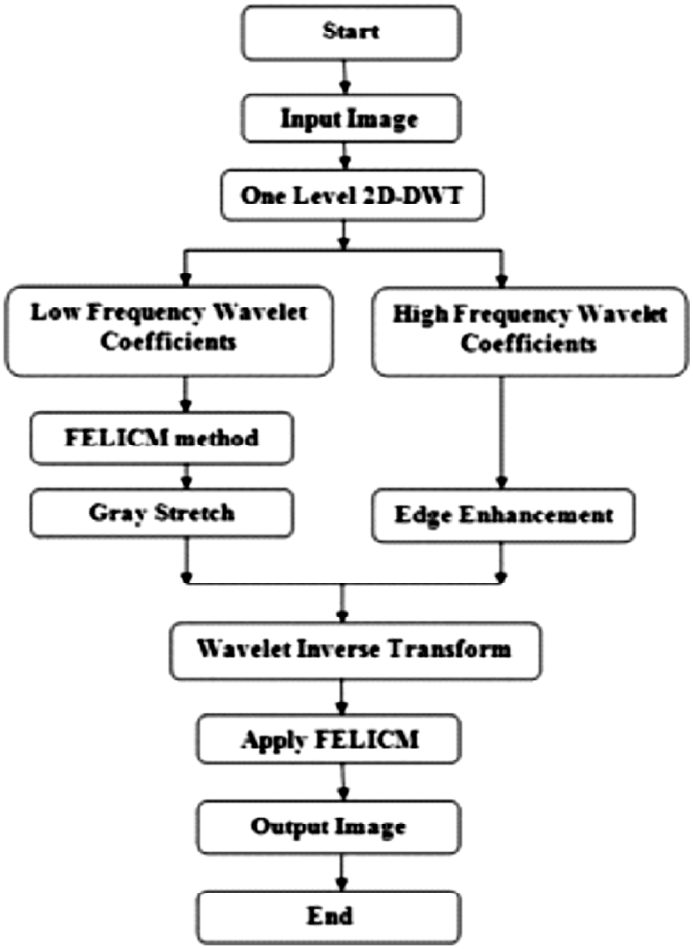
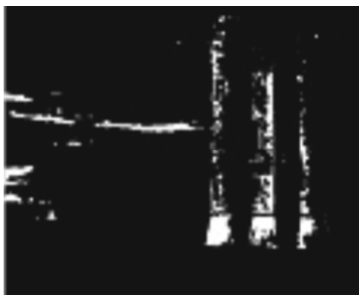



**Fig. 1. Flowchart of proposed methodology.**

## 4. RESULTS AND DISCUSSIONS

To assess the productiveness of the proposed technique, it is implemented in the matlab. Images from the various websites have been used to carry out the experiment.

**Table 1. Segmentation Results on Images**

| *Images* | *Original Image* | *Existing Technique* | *Proposed Technique* |
|---|---|---|---|
| **1.** |  |  |  |
| **2.** |  |  |  |
| **3.** |  |  |  |

The column 1 shows an original image. Second column describes an image that has been segmented by applying wavelet domain gray stretch. To segment complex background images the proposed methodology of improved FELICM based gray stretch was applied that has been incorporated in column three that has improved the segmentation accuracy further.

## 5. PERFORMANCE EVALUATION

Both the existing and the proposed techniques have been evaluated using three evaluation measures namely PSNR, MSE and ME. These parameters will help to prove that the proposed strategy is better in performance as compared to existing.

### 5.1. MSE (Mean Square Error)

MSE basically depicts how much an output image diverges from the input image. It is basically a risk function.

$$\text{MSE} = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[\text{I}(i,\ j) - \text{K}(\text{i},\ j)]^2 \qquad (1)$$

where $m \times n$ is any monochrome image I.

**Table 2. MSE.**

| *Image No.* | *Existing Technique* | *Proposed Technique* |
|---|---|---|
| Img_1 | 0.0523 | 0.0083 |
| Img_2 | 0.0437 | 0.0317 |
| Img_3 | 0.0695 | 0.0027 |
| Img_4 | 0.1427 | 0.0913 |
| Img_5 | 0.0306 | 0.0019 |
| Img_6 | 0.0914 | 0.0090 |
| Img_7 | 0.0971 | 0.0032 |
| Img_8 | 0.0083 | 0.0012 |
| Img_9 | 0.1051 | 0.0016 |
| Img_10 | 0.0183 | 0.0015 |

The above table shows the comparison of both the existing and the proposed technique. Less the value of MSE, better the technique is.

### 2.2. PSNR (Peak to Signal Noise Ratio)

PSNR basically determines the quality of an image.

Generally,
$$\text{PSNR} = \frac{\text{Maximum attainable power}}{\text{Corrupting Noise}}$$

$$\text{PSNR} = 10 \times \log_{10} \frac{(\text{MAX}_1)^2}{\text{MSE}} \tag{2}$$

where I represents an image that is free from noise, MAX gives the maximum value that a pixel can hold, MSE is Mean Square Error.

**Table 3. PSNR**

| *Image No.* | *Existing Technique* | *Proposed Technique* |
|---|---|---|
| Img_1 | 60.9796 | 68.9937 |
| Img_2 | 61.7626 | 63.1592 |
| Img_3 | 59.7477 | 73.8742 |
| Img_4 | 56.6201 | 58.5586 |
| Img_5 | 63.3023 | 75.2757 |
| Img_6 | 58.5541 | 68.6117 |
| Img_7 | 58.2928 | 73.0534 |
| Img_8 | 68.9804 | 77.2895 |
| Img_9 | 57.9483 | 76.0046 |
| Img_10 | 65.5452 | 76.2637 |

The table mentioned above shows the comparison of both the existing and the proposed technique. More the value of PSNR for the proposed approach, better the technique is.

### 2.3. Measures of Entropy

Entropy is a statistical measure that specifies the information contained within an image.

$$E = \text{sum}(p \times \log_2 p) \quad (3)$$

where the histogram count is represented by '*p*'.

**Table 4. ME**

| *Image No.* | *Existing Technique* | *Proposed Technique* |
|---|---|---|
| Img_1 | 0.2265 | 0.4976 |
| Img_2 | 0.2611 | 0.4943 |
| Img_3 | 0.2737 | 0.4969 |
| Img_4 | 0.3323 | 0.4904 |
| Img_5 | 0.2510 | 0.4961 |
| Img_6 | 0.1018 | 0.4933 |
| Img_7 | 0.0140 | 0.4965 |
| Img_8 | 0.0862 | 0.4993 |
| Img_9 | 0.1759 | 0.4982 |
| Img_10 | 0.2099 | 0.4984 |

The table above depicts the comparison of both the existing and the proposed technique. More the value of entropy, more efficient the technique is.

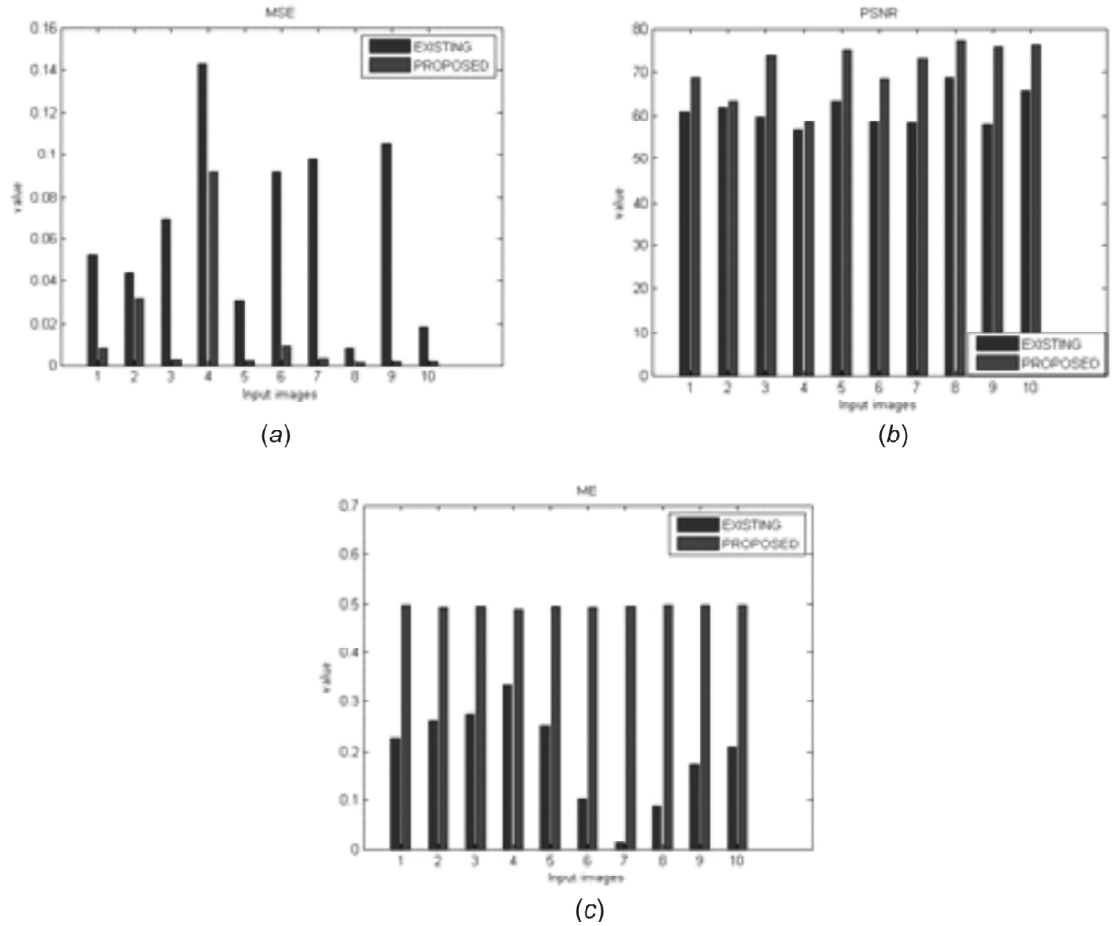



**Fig. 2. (*a*) MSE Analysis (*b*) PSNR Analysis (*c*) ME Analysis for Wavelet Domain Gray Stretch and Improved FELICM Based Gray Stretch.**

The above plot (*a*), (*b*) and (*c*) clearly shows that the MSE has decreased, PSNR and entropy values have increased for the proposed technique thereby proving its efficiency.

## 6. CONCLUSION

The motivation behind the proposed approach (*i.e.* a new improved FELICM based gray stretch) is quite simple and effective. The use of improved FELICM based gray stretch helped to find an adaptive threshold that enabled to segment complex images in more effectual manner. This paper has compared the proposed technique with the existing based upon the following parameters: Entropy, Peak Signal to Noise Ratio and Mean Square Error. The proposed technique that is improved FELICM based gray stretch gave better results than the existing technique of Wavelet domain gray stretch that is clearly visible from the graphs shown above.

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