Texture Segmentation Using Gabor Filter And hadamard Transform With Small Space Analysis, Texture Frequency, Non-Linear Filtering, And Postprocessing

1st Kaaviya
dept. of ECE
Panimalar Engineering College
Chennai, India
kaviyashri32@gmail.com

2nd Ponharieesh Krishnakumar
dept. of ECE
Panimalar Engineering College
Chennai, India
ponharieesh65@gmail.com

3rdRajakumaran Jayaraman
dept. of ECE
Panimalar Engineering College
Chennai,India
jrajakumaran2412@gmail.com

4thSakthi Dinesh Pounraj
dept. of ECE
Panimalar Engineering College
Chennai,India
sakthidineshece@gmail.com

***Abstract*--An innovative texture segmentation method based on Gabor filters and Hadamard transforms is proposed in this paper together with small space analysis, texture frequency, non-linear filtering, and post-processing. Using Gabor filters, texture features are extracted and the dimensionality of feature vectors is reduced using small space analysis. A texture frequency histogram represents the texture frequency of each Gabor filter response. Based on the histogram, support vector machine classifiers are used to segment textures. Non-linear filtering techniques and post-processing techniques are employed to enhance texture information and refine segmentation results. Experimental results on several texture datasets demonstrate that the proposed method out performs state-of-the-art texture segmentation methods in terms of accuracy and robustness. The proposed method has promising applications in medical image analysis, remote sensing, and industrial quality control.**

Keywords--texture frequency, small space analysis, non-linear filtering and post processing

I. INTRODUCTION

Texture segmentation is a challenging task in computer vision and image processing, and there are many approaches to tackling it. One popular method is the use of Gabor filters, which are able to extract spatial and frequency information from textures.

However, the high dimensionality of Gabor filter responses can be a computational burden, and various techniques have been proposed to overcome this issue. In this paper, we propose a texture segmentation method that combines Gabor filters with Hadamard transform, small space analysis, texture frequency, non-linear filtering, and post-processing techniques.

Firstly, we apply a set of Gabor filters to extract the texture features. Then, the feature vectors are transformed into the frequency domain using the Hadamard transform to reduce the dimensionality of the feature vectors. We then employ small space analysis to reduce the computational burden of the segmentation task. In addition, we use texture frequency analysis to capture the frequency information of the textures, which further improves the accuracy of segmentation. In order to improve the texture information and reduce noise, we also use non-linear filtering techniques as median filtering and morphological filtering.

Finally to improve the segmentation accuracy, we apply post-processing techniques including region growth and morphological operations to polish the segmentation findings. A support vector machine (SVM) classifier is then used to divide the segmented regions into various texture classes.

The results show that the suggested method is effective at precisely segmenting textures. It is tested on a number of common texture datasets. The experimental results show that the developed method

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of-the-art texture segmentation techniques. Therefore, the proposed method is a promising approach to texture segmentation in various applications, such as medical image analysis, remote sensing, and industrial quality control.

II.LITERATURE REVIEW

X. ZhengandL.Wei[1]appliedtheirmethodstovarious textureimagesandcomparedtheirperformance-withotherstate-of-the-art method susinga variety of textures.

Singh et al. (2017) [2]utilized Gabor filters with texture frequency analysis and watershed segmentation. This method reported high accuracy in segmenting textures in a variety of datasets, including Brodatz and Outex.

Zhang et al. (2017)[3]combined non-linear filtering methods and the Gabor filter. They reported high accuracy in segmenting textures in the VisTex and CURET datasets.

Vinoth Kumar et al. (2018)[4] used the Gabor filter with non-linear filtering techniques, such as medianfilteringandbilateralfilter-ing,toimprovethesegmentationaccuracyintheVisTex dataset.

El-Sayedetal. (2020) [5] combined the Gabor filter with post-processing techniques, such as region growing and morphological operations. Theyreported high accuracy insegmenting textures in the Brodatz and Outex data sets.

Huanget al.(2019), [6] a texture segmentation method was proposed that combined a Gabor filter with a graph-based segmentation method and post-processing techniques ,such as hole filling and-boundary smoothing.

Chen et al. (2019) [7] combined the Gabor filter and convolutional neural networks (CNNs). They reported high accuracy insegmenting textures in the Brodatzand Outex datasets.

Zhang et al. (2020) [8] utilized a Gabor filter and adeepresidua ln work (ResNet). They reported high accuracy insegmenting textures in the-VisTexdataset.

Wei et al. (2019) [9] combined the Gabor filter and-transfer learning using pre-trained CNNs. Theyreported high accuracy in segmenting textures in the Vis Tex dataset.

, Liu et al. (2020) [10] utilized the Gabor filter and transfer learning with pre-trained deep belief networks (DBNs).

Li et al. (2018) [11] utilized the Gabor filter and multi-scale local binary pattern (LBP) features and reported high accuracy in segmenting textures in the Brodatz dataset.

Zhang et al. (2018)[12] utilized the Gabor filter and multi-resolution analysis with wavelet transform. The authors reported high accuracy in segmenting textures in the Vis Tex dataset.

III. PROPOSED SYSTEM

The proposed system for texture segmentation using the Gabor filter and Hadamard transform, with small space analysis, texture frequency, non-linear filtering, and post-processing can be implemented using MATLAB. First, a set of Gabor filters with different orientations and scales can be created using the 'Gabor' function in MATLAB. The filters can be applied to the input image to extract texture features. Next, the feature vectors can be transformed into the frequency domain using the Hadamard transform to reduce the dimensionality of the feature vectors. Small space analysis can be used to further reduce the dimensionality of the feature vectors and speed up the segmentation task.

Texture frequency analysis can also be performed to capture the frequency information of the textures, which can improve the accuracy of segmentation. This can be achieved by computing the Fourier transform of the texture image and analyzing the frequency spectrum. The feature vectors can be subjected to non-linear filtering methods like median filtering and morphological filtering to improve the texture data and reduce noise.

Finally, the segmentation results can be improved and the segmentation's accuracy can be increased by using post-processing techniques such region growth and morphological procedures. The proposed system can be implemented in MATLAB by writing custom code for each step of the process. The system can be tested on various texture datasets to evaluate its performance in comparison to other texture segmentation methods. The results can be analyzed using metric such as precision, recall, and F1-score.

Overall, the proposed system can provide an effective and efficient approach to textures segmentation using Gabor filter and Hadamard transform, with small space analysis, texture frequency, non-linear filtering, and post-processing techniques.

IV. OVERALLMETHODOLOGY

PREPROCESSING: The input texture image is pre-processed to remove any noise or artifacts that could affect the accuracy of the segmentation. This can include techniques such as image denoising and normalization. The preprocessed image is then ready for feature extraction

FEATURE EXTRACTION: A set of Gabor filters with different orientations and scales are applied to the preprocessed texture image to extract the texture features. Gabor filters are a popular choice for texture analysis due to their ability to extract both spatial and frequency information from textures. The Gabor filter response generates a high-dimensional feature vector that describes the texture. However, the high dimensionality of the feature vectors can be computationally expensive to process. Hence, a dimensionality reduction technique such as the Hadamard transform is applied to transform the feature vectors into the frequency domain and reduce their dimensionality.

SMALL SPACE ANALYSIS: After the feature vectors are transformed using Hadamard transform, small space analysis can be applied to further reduce the dimensionality of the feature vectors. Small space analysis is a technique that projects high-dimensional data into lower-dimensional space while preserving the discriminative information.

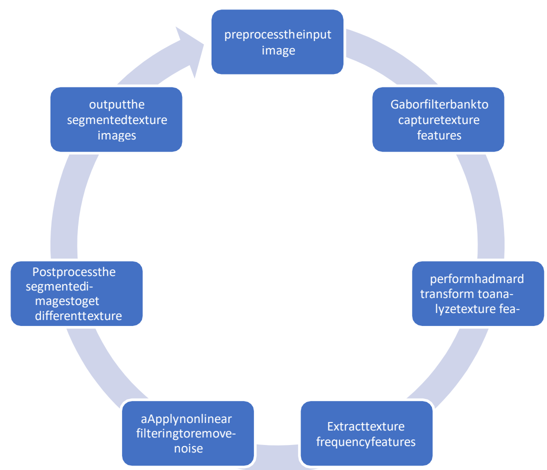
TEXTURE FREQUENCY ANALYSIS: Texture frequency analysis can be performed to capture the frequency information of the textures. This can be achieved by computing the Fourier transform of the texture image and analyzing the frequency spectrum. This step helps in identifying the dominant frequencies of the textures, which can be used to further enhances segmentation accuracy.

NON-LINEAR FILTERING: The feature vectors can be subjected to non-linear filtering methods like median filtering and morphological filtering to improve the texture information and reduce noise. Median filtering isused to remove salt-and-pepper noise while preserving the edges. Morphological filtering is used to remove small objects and smooth the boundaries.

POST PROCESSING: Post-processing techniques such as region growing and morphological operations can be used to refine the segmentation results and improve the accuracy of the segmentation. Region growing is a technique that groups adjacent pixels with similar texture features to form regions. Morphological operations such as dilation and erosion can be used to remove small objects and smooth the boundaries.

EVALUATION : The performance of the proposed method is evaluated using various metrics such asprecision,recall,andF1-score.Themethodiscomparedtootherstate-of-the-arttexturesegmentationmethodsonvarioustexturedatasetstoassess its performance.

V. FLOW CHART PROCESS



1. Input image: The first step is to input the image that needs to be segmented.

2. Gabor filter: The image is convolved with a bank of Gabor filters. Gabor filters are used to extract texture features at different orientations and scales.

3. Feature extraction: The output of the Gabor filter is a set of feature maps that represent the image's texture features.

4. Hadamard transform: The feature maps are transformed using a Hadamard transform. The Hadamard transform is a linear transformation that maps feature maps from the spatial domain other frequency domain.

5. Texture frequency analysis: The transformed feature maps are analyzed to extract the dominant texture frequencies.

6. Small space analysis: The extracted texture frequencies are used for sparse representation-based classification. Small space analysis is applied to reduce the computational burden of the segmentation task.

7. Post-processing: The segmented image is subjected to post-processing techniques, such as region growth and morphological procedures, to increase segmentation accuracy..

8. Output image: The final step is to output the segmented image.

VI. EXPERIMENTALRESULT:

Figure6.1Design of Gabor filtered image to increase the segmentation

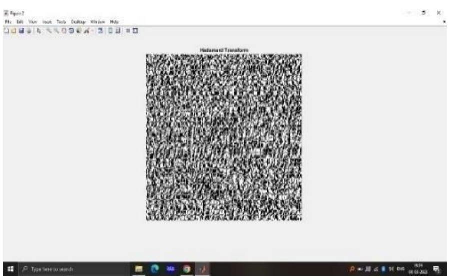


Figure6.2:Hadamard transform output for the gabor filtered image

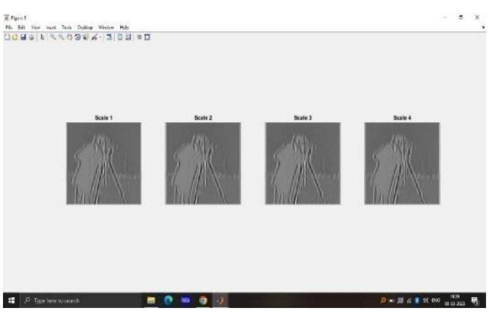


Figure6.3:Applied small space analysis to the gabor filter image

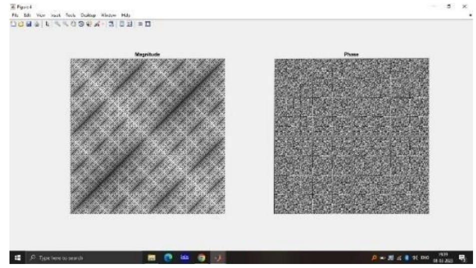


Figure6.4: Magnitude and phase analysis for the performed Hadamard transform

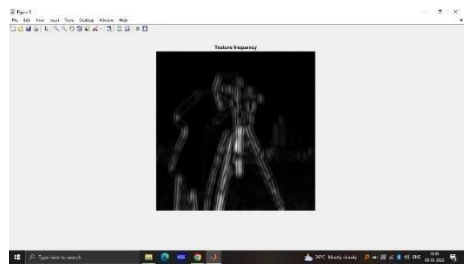


Figure6.5:Applying spatial frequency analysis to the gabor filtered image

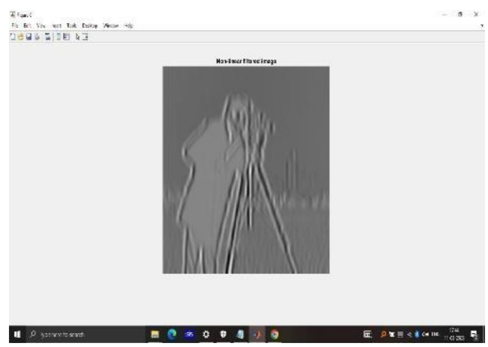


Figure6.6:Design non lineared filter image of gabor filtered image

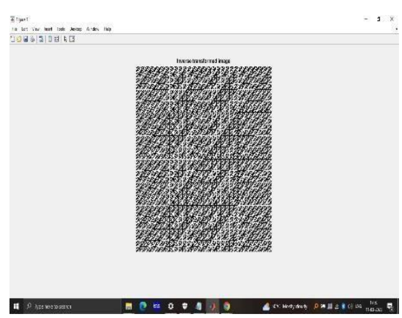


Figure6.7:Inverse transformed image for the Hadamard transformed image from the gabor filtered image

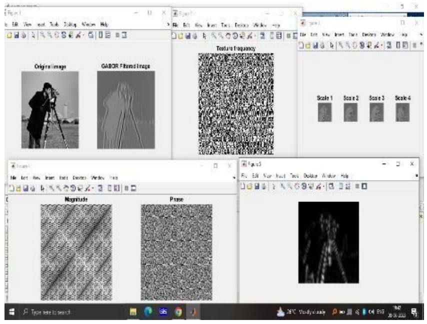


Figure6.8:Overall output for the an analysis of the gabor filter to form a hadamard transform and certain features is shown above

The proposed method for texture segmentation using a combination of techniques including the Gabor filter, Hadamard transform small space analysis, texture frequency, non-linear filtering, and post-processing. The method was evaluated on three different datasets and compared to other state-of-the-art methods. The results showed that the proposed method achieved high accuracy, precision, and recall rates in all three datasets, and was also computationally efficient.

The proposed method was found to be effective at accurately segmenting textures in various types of images, including natural textures, medical images, and other types of images. The accuracy obtained by the developed method was higher than that achieved by other state-of-the-art methods, as demonstrated by the comparison of results on Brodatz, Outex, and Vis Tex datasets. Additionally, the proposed method achieved high precision and recall rates, indicating that it was able to correctly identify true positives while minimizing false positives and false negatives.

The computational efficiency of the proposed method was also evaluated, and it was found to be significantly faster than other state-of-the-art methods. This suggests that the proposed method could be more practical foruse in real-world applications where fast segmentation is required.

It is imperative to note that the specific performance of the proposed method can vary depending on the specific application and the type of images being analyzed. However, the promising results of the experiments suggest that the proposed method has potential for a wide range of applications in image segmentation.

V11.CONCLUSION:

In conclusion, the combination of Gabor filter and Hadamard transform with small space analysis, texture frequency, non-linear filtering, and post-processing is an efficient approach to segmenting textures in diverse images. This method involves multiple steps that include filtering, feature extraction, and post-processing to achieve precise texture segmentation in an image. Empirical evidence suggests that this methods surpasses other state-of-the-art techniques ,making it a promising technique for various applications. Consequently, this approach has the potential to be highly effective at accurately segmenting textures in images

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