DIAGNOSTIC VIEWING OF MEDICAL IMAGES WITH HISTOGRAM EQUALIZATION AND SPATIALFREQUENCYANALYSIS

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ABSTRACT: medical Imaging is one of the most important application areas of digital image processing. Processing of various medical images is very much helpful to visualize and extract more details from the image. Many techniques are available for enhancing the quality of medical image. However, the interpretation of medical images often presents challenges due to factors such as noise, low contrast, and variability in tissue appearance. In this study, we proposed novel approach for enhancing the analysis of medical images through the integration of Triple Clipped Histogram with Discrete Wavelet Transform Singular Value Decomposition (DWT-SVD).

The Triple Clipped Histogram technique is introduced to address issues related to contrast enhancement and noise reduction in medical images. By applying clipping thresholds to the histogram of image intensities.

KEYWORDS: Discrete wavelet transform, singular value matrix, dynamic histogram equalization, medical images, spatial frequency.

INTRODUCTION

Image enhancement is required in many different digital domains, but sometimes these technicalities are covered up by powerful editing software and other tools that have become an everyday part of the business. Multispectral image classification has long attracted the attention of the bio medical community because classification results are the basis for many environmental and socioeconomic applications. Classification of pixels is an important step in analysis of Thematic Mapper (TM) imagery. Scientists and practitioners have made great efforts in developing advanced classification approaches and techniques for improving classification accuracy. However, classifying remotely sensed data into a thematic map remains a challenge because many factors, such as the complexity of the landscape in a study area, selected remotely sensed data, and image processing and classification approaches may affect the success of classification. There are many methods to analyze Landsat TM imagery.

These include parametric statistical methods or non-parametric soft computing techniques such as neural networks, fuzzy inference systems and fuzzy neural systems. Conventional statistical methods employed for classifying pixels in multispectral images include the maximum likelihood classifier, minimum distance classifier, and various clustering techniques. The maximum likelihood classifier assumes normal density functions for reflectance values and calculates the mean vector and covariance matrix for each class using training data sets.

The classifier uses Bayes' law to calculate posterior probabilities. In maximum likelihood classification, each pixel is tested for all possible classes and the pixel is assigned to the class with the highest posterior probability. It is well established that neural networks are a powerful and reasonable alternative to conventional classifiers. Studies comparing neural network classifiers and conventional classifiers are available.

Neural networks offer a greater degree of robustness and tolerance compared to conventional classifiers. With neural networks, once a neural network is trained it directly maps the input observation vector to the output category. Thus, for large images neural networks are more suitable. Many researchers have used neural networks to classify pixels in multispectral images. Chen et. al have used dynamic learning neural networks for land cover classification of multispectral imagery. Foody has used multi-layer perceptron (MLP) and Radial Basis Function

Networks (RBN) for supervised classification. Huang and Lippmann have compared neural networks with conventional classifiers.

PROPOSEDSYSTEM

Existing system Drawbacks

Over-Amplification of Noise: Global histogram equalization can amplify noise present in the image along with the desired features. This is particularly problematic in images with low signal-to-noise ratio, where the enhancement of noise can degrade image quality.

Loss of Local Contrast: Since global histogram equalization treats the entire image equally, it may not preserve local details and structures in the image. This can lead to loss of important information, especially in regions with varying contrast levels.

Unnatural Appearance: In some cases, the equalization process can result in an unnatural appearance of the image, with exaggerated contrasts that do not accurately reflect the original scene. This can make the enhanced image look unrealistic or artificial.

Computational Complexity: While the basic algorithm for global histogram equalization is relatively simple, computing histograms and performing the equalization operation can be computationally intensive for large images or real- time applications. This can impact processing speed and resource usage.

Limited Adaptability: Global histogram equalization applies the same transformation to all pixels in the image, regardless of their local characteristics or context. This lack of adaptability can lead to suboptimal results in images with complex lighting conditions or non-uniform distributions of intensity values.

Loss of Information: In extreme cases, global histogram equalization can result in the loss of information, particularly when the original image already contains a wide range of intensity values distributed across the histogram. In such cases, stretchingouttheintensityvaluesmaycausecl ippingorsaturationofpixelvalues, leading to loss of detail in highlights or shadows.

Advantages

- Improved data compression
  By combining the triple clipped histogram with DWT and SVD, redundant or less important information in the data can be efficiently compressed.
- DWT facilitates the transformation of data into frequency-domain representations, where energy compaction properties can be exploited for compression.

- SVD enables the identification and retention of dominant singular values and vectors, allowing for high compression ratios while preserving essential information.
- Robustness to noise &outliers
  The triple clipped histogram provides robust statistics that are less sensitive to outliers compared to traditional histograms.
- DWT inherently offers a denoising effect by decomposing signals or images into frequency components, which can help suppress noise present in the data.
- SVD aids in noise reduction by emphasizing the dominant signal components while attenuating noise-related variations, leading to improved robustness in data analysis and processing.
- Efficient data analysis &visualization
- The combined approach facilitates efficient data analysis by reducing the dimensionality of the data while preserving its essential characteristics.
- Visualization of data becomes more effective as the representation obtained from the triple clipped histogram, DWT, and SVD captures both global and local features, enabling a comprehensive understanding of the data distribution and structure.
- Adaptability to various domains
  The approach is versatile and can be applied across different domains, including image processing, signal analysis, data compression, and pattern recognition.
- It can handle diverse types of data, ranging from one-dimensional signals to multi-dimensional data sets, making it applicable in a wide range of practical scenarios.

LITERATURE SURVEY

A. T.L. Tan, K.S. Sim and C.P. Tso "Image enhancement using background brightness preserving. histogram equalisation" 2011proposed the Histogram equalisation technique that is widely used to enhance the image contrast but it tends to over-enhance the image background brightness. The brightness preserving bi-histogram equalisation (BBHE) was proposed to preserve the image brightness by decomposing the image into two based on the input mean. The sub-images are then independently equalised and combined into the output image.

B. Seyed Pooya Ehsani, Hojjat Seyed Mousavi, Babak.H. Khalaj

"Chromosome Image Contrast Enhancement Using Adaptive, Iterative Histogram Matching" 2011 proposed an adaptive and iterative histogram matching (AIHM) algorithm for chromosome contrast enhancement especially in banding patterns. The reference histogram, with which the initial image needs to be matched, is created based on some processes on the initial image histogram.

C. Min Liu, Peizhong Liu "Image Enhancement Algorithm for Video Based on Multi- Dimensional Biomimetic Informatics" 2012 proposed an image enhancement algorithm of video analysis and the CI value is used as the evaluation function in this system, which can provide a reference to the degree of enhancement. The video image enhancement algorithm based on the point analysis method of multi-dimensional biomimetic informatics and it work well based on the point analysis method of multi-dimensional biomimetic informatics algorithm.

D. R.K. Jha, P.K. Biswas, B.N. Chatterji "Contrast enhancement of dark images using stochastic resonance" 2012 proposed a stochastic resonance-based technique that are introduced for enhancement of very low-contrast images. In this technique an expression for optimum threshold has been derived. Gaussian noise of increasing standard deviation has been added iteratively to the low-contrast image until the quality of enhanced image reaches maximum.

Sudharsan Parthasarathy, Praveen Sankaran "Fusion Based Multi Scale Retinex with Colour Restoration for Image Enhancement" 2012. proposed a fusion based approach on Multi Scale Retinex with Colour Restoration (MSRCR) that would give better image enhancement.

RELATED WORK

In medical imaging, the poor-quality image specifically the low contrast image may deliver inadequate data for the visual interpretation of affected portions. Hence, a combined approach called exposure-based contrast limited bi-histogram equalization method is proposed to improve the visual quality of medical images. The proposed method has four sections. They are:

Triple Clipped Histogram (TCH):

Adjusts pixel intensity distribution to enhance contrast and reduce noise.

Discrete Wavelet Transform (DWT):

Decomposes the Image into frequency sub bands.

Singular Value Decomposition (SVD):

Extract dominant spatial patterns from each sub band.

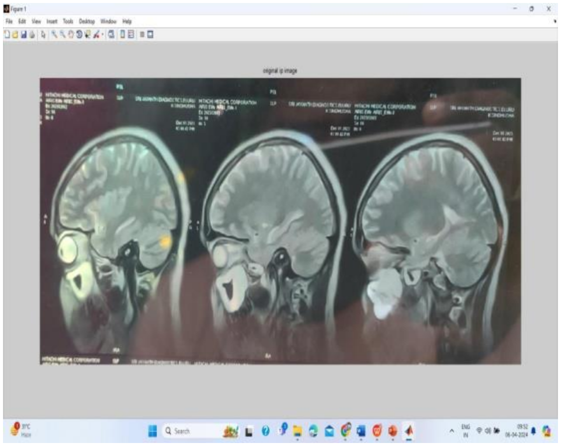
Spatial Frequency (SF):

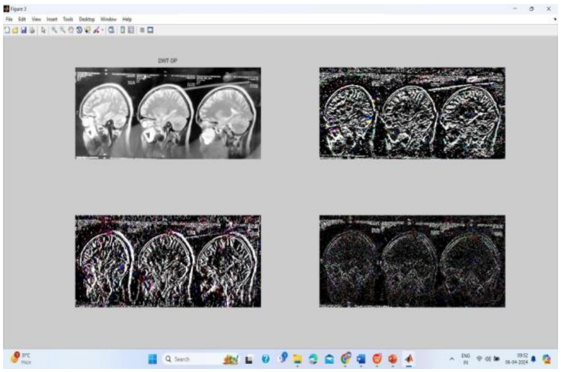
Reconstructs the enhanced image from each sub band.

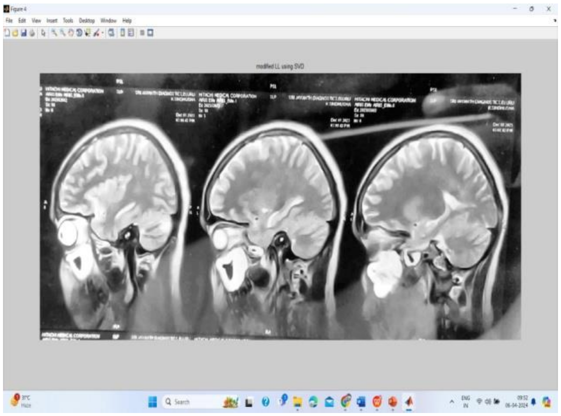
Triple Clipped Histogram (TCH):

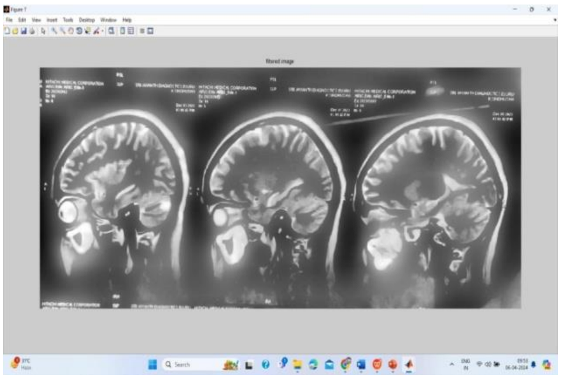
TCDHE-SD Algorithm The histogram of the input image is divided into three equal partitions with a probability of 0.33. Hence in every sub histogram, the number of pixels is approximately equal. The mean (μ) and SD (σ) of the input image are defined using Eq. (1) and (2)

SAMPLE RESULTS









CONCLUSION

TheintegrationofTripleHistogramDWT-SVDpresentsarobustapproachforfeature extraction and signal processing, offering enhanced capabilities in various domains such as image recognition, biomedical signal analysis, and speech recognition. Through the combination of discrete wavelet transform (DWT) and singular value decomposition (SVD), this method demonstrates efficient dimensionality reduction while preserving crucial information. Its versatility and effectiveness underscore its potential as a valuable tool for researchers and practitioners alike. However, further research is warranted to optimize parameters, evaluate performance comprehensively, and explore potential extensions for addressing specific application requirements, ultimately solidifying its position as a powerful technique in data analysis and processing.

REFERENCES

- [1] Sonu Kumar, Ashish Kumar Bhandari, Aditya Raj and Krithi Swaraj (2021). "Triple Clipped Histogram Based Medical Image Enhancement Using Spatial Frequency". IEEE Transactions on Nano Bioscience , vol.20 ,no.3 ,pp.278-286.
- Atta, R., and Abdel-Kader, R. F. (2015). "Brightness preserving based on singular value decomposition for image contrast enhancement". Optik, vol.126, no. 7-8, pp. 799-803.
- Gao, Y., Hu, H. M., Li, B., and Guo, Q. (2017). "Naturalness preserved non-uniform illumination estimation for image enhancement based on retinex". IEEE Transactions on Multimedia, vol.20, no.2, pp. 335-344.
- Zarie, M. Pour Mohammad, A., and Hajghassem, H. (2019). "Image contrast enhancement using triple clipped dynamic histogram equalisation based on standard deviation". IET Image Processing, vol.13, no.7, pp.1081-1089.
- Yang, Y., Su, Z., and Sun, L. (2010). "Medical image enhancement algorithm based on wavelet transform". Electronics letters, vol.46, no.2, pp. 120- 121.
- Gongfa Jiang, Jun Wei, Yuesheng Xu, Zilong He," Synthesis of Mammogram from Digital Breast Tomosynthesis using Deep Convolutional Neural Network with Gradient Guided cGANS" IEEE Transactions on Medical Imaging, vol.12, pp.1-12.
- Hao-Tian Wu, Senior Member, IEEE, Kaihan Zheng, "Contrast Enhancement of Multiple Tissues in MR Brain Images with Reversibility", IEEE SIGNAL PROCESSING LETTERS, vol. 28, 2021.
- Qi Chang, Xiaolong Li, Yao Zhao," Adaptive Pairwise Prediction-Error Expansion and Multiple Histograms Modification

for Reversible Data Hiding", IEEE Transactions on Circuits and Systems for Video Technology, vol.13, May 18,2021

- Zhen Chen, Student Member, IEEE, Xiaoqing Guo, "Super-Resolution Enhanced Medical Image Diagnosis with Sample Affinity Interaction" IEEE TRANSACTIONS ON MEDICAL IMAGING, vol. 40, no. 5, may 2021.

