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IMPROVE QUALITY OF GEOGRAPHICAL IMAGES USING DISCRETE WAVELET TRANSFORM BASED EDGE ENHANCEMENT AND FUZZY CONTRAST ENHANCEMENT TECHNIQUE

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ABSTRACT

Picture improving could be a strategy to support the nature of an image. The aim of image enhancement process is to Enhance the interpretability or perception of information in images for human viewers, or to give better input for other automated image processing techniques. in this paper we are displaying very surprising procedures for satellite picture enhancement. For removal of noise and blur different instinctive procedure suggested in this paper that pre-processes poorly concentrated or degraded remote sensing images by composing numerous consecutive autonomous processing phases which overturn noise and increase contrast of the image. Contrast Enhancement are being aided by the universal data content of an input image by enlarging the dynamic variety of intensity levels, utilized by Conversion functions. For edge enhancement DWT based algorithm is applied where high level component which contains the edge information of image are extracted using DWT and enhanced using sharpening filter. Finally, using inverse DWT operation enhanced image is generated. Fuzzy contrast enhancement is also applied for setting contrast level at last stage. Finally output of each stage is compared by using PSNR parameters.

INDEXTERMS: Preprocessing, Satellite images, Fuzzy Contrast Enhancement, DWT Image Enhancement, PSNR.

I. INTRODUCTION

Transform techniques are used to Enhance the edges, contrast and visual appearance of an image. Image resolution is moreover an important constraint for enrichment of images; this can be carried out by means of interpolation in which number of pixels in an image is increased. Various techniques for image enhancement are classified as spatial/pixel-based approaches which are-linear contrast adjustment, histogram equalization and adaptive filtering. Here, we are talking about some past papers from which creators see and proposed techniques. P. Suganya, N. Mohanapriya et. al.[1] in this work creator proposed strategy for satellite picture improvement which incorporates Haar channel for pre-handling, Multi Wavelet Transform, Interpolation Process, Inverse Process of Multi Wavelet Transform for the low goals picture. The Multi Wavelet Transform and Interpolation strategy used to deliver less ancient rarities. Constraint of this technique isn't powerful strategy to decrease twisting and for losing of high recurrence content.

Abdullah-Al-Wadud et al., 2007[2] proposed one strategy which utilizes worldwide histogram alteration technique. By and large nearby histogram change strategy performs balance over little fixes with the goal that the little scale subtleties turn out to be clear. Anyway it can make a few antiquities. Histogram Equalization and determination A decent differentiation enhancement technique ought to explicitly address a few huge properties, some of which are recorded underneath. (1) Noise resistance: The difference enhancement strategy should display suitable clamor invulnerability. (2) Uniform differentiation: The difference enhancement technique should give uniform complexity of the whole picture. (3) Brightness conservation: The difference advancement procedure should upgrade the complexity of the picture without losing brilliance. (4) Convenient usage: The differentiation enhancement strategy ought to have the capacity to be set up rapidly and dependably.

II. LITERATURE SURVEY

Pavithra C, Dr. S. Bhargavi,[3] author proposed a method for fusing two dimensional multi-resolution 2-D images using wavelet transform by using the combine gradient and smoothness criterion. Basically it decomposes each registered image into sub-images by using forward wavelet transform which have same resolution at that same level and different resolution at different levels. Image fusion is performed based on the high frequency sub-images and final image is obtained using inverse wavelet transform. Using the inverse wavelet transform it can reconstruct the image. This reconstructed image has information gather from all the different images sources so this is more informative.

For the images interpolation Hasan Demirel & Gholamreza Anbarjafari,[4] suggested a DWT procedure. However, as equated to other procedures, the images acquired from DWT and IDWT procedure have low PSNR and are not sharp. Hasan and Gholamreza,[4] enclosed the Discrete & stationary wavelet decomposition method based on interpolation of high frequency sub band images resulting from DWT. In this technique, Stationary wavelet transform are utilized for enhancement of the high frequency image components. Comparatively great results are produced by this technique. Remote sensing images are needed to be upgraded both in terms of resolution and edges so that the quality of Enhanced image looks enhanced than original image. In image processing Complex Wavelet Transform (CWT)is utilized which gives two complex-valued sub-band images of low frequency and six complex valued sub-band image so high frequency of original image. MSE and PSNR of the super resolved image also Enhanced. Image enrichment procedures are applied for the modification of band intensities and lessening the noise which cover substantial information, about contrast-based feature extraction from remote sensing images of high resolution. Wavelet transform, Fourier decomposition, and discrete cosine transform are alternative approaches that belong to the frequency-domain techniques,[6,7] Intricate diffusion methods similar to normalized shock filter for the Enhancement of image and a ramp maintaining de-noising process were utilized.[8] A nonlinear technique for noisy data Enhancement is utilized by F. Russo which accepts fuzzy webs for combining contrast enhancement and noise reduction.[9] A method in which three different edge detection approaches based on search, zero-crossing, and fuzzy logic is equated.[10] Dr. G. Sudhwani proposed three enhancement techniques namely fuzzy rule based contrast enhancement, contrast enhancement using intensification (INT) operator, and contrast enhancement using fuzzy expected value (FEV) for the low contrast gray scale images.[11] Nutan Y.Suple, Sudhir M. Kharad proposed Fuzzy image enhancement based on grey level mapping into membership function. The aim is to generate an image of higher contrast than the original image by giving a larger weight to the grey levels that are closer to the mean grey level of the image than that are farther from the mean.[12]

In most of the image processing applications, there is a need of expert knowledge to overcome the difficulties (like object recognition, scene analysis). Fuzzy set and fuzzy logic offers a powerful tool to process and represent human knowledge as fuzzy if-then rules. Because of the data uncertainty due to randomness, ambiguity and vagueness many difficulties arise in image processing. Fuzzy method can manage ambiguity and vagueness efficiently.[13] Most of the mentioned techniques target the betterment of the visual inspection of the image and commonly involves manual parameter tuning.

In,[15] remote sensing images are firstly enhanced by using DWT-SVD method and then segmentation is applied on the enhanced using MRR–MRF Model. 3-level DWT method for image enrichment has been implemented in.[16]

Thriveni R. et. al. they propose a DWTPCA based fusion and Morphological gradient for enhancement of Satellite images. The input image is divided into small sub bands using DWT. PCA based fusion is applying on the low-low sub band, and input image for contrast enhancement. IDWT is used to reconstructs the enhanced image. To achieve a sharper boundary discontinuities of image, an intermediate stage estimating the fine detail sub bands is required. This is done by the success of threshold decomposition, morphological gradient based operators are used to detect the locations of the edges and sharpen the detected edges.[17] Jadhav B. D. et. al. proposed a satellite image enhancement algorithm based on interpolation of the high-frequency sub bands obtained by discrete wavelet transform (DWT) and the low resolution input image is proposed. This method uses a DWT and high frequency sub band image interpolation into the low resolution input images. The sharpness of picture is gained through high frequency sub band. Inverse DWT is performed to reconstruct the resultant image.[18] Sharma A. et. al. proposed a technique which decomposes the input filtered image into the four frequency sub-bands by using DWT and then the high frequency sub band images and input image have been interpolated along with this the technique also estimates the singular value matrix of the low– low sub band of histogram equalized image and input filtered image then normalize both singular value matrices to obtain brightness enhanced image.[19]

M. Ekta et. al. compare lots of enhancement techniques for satellite image enhancement.[20]

III. METHODOLOGY

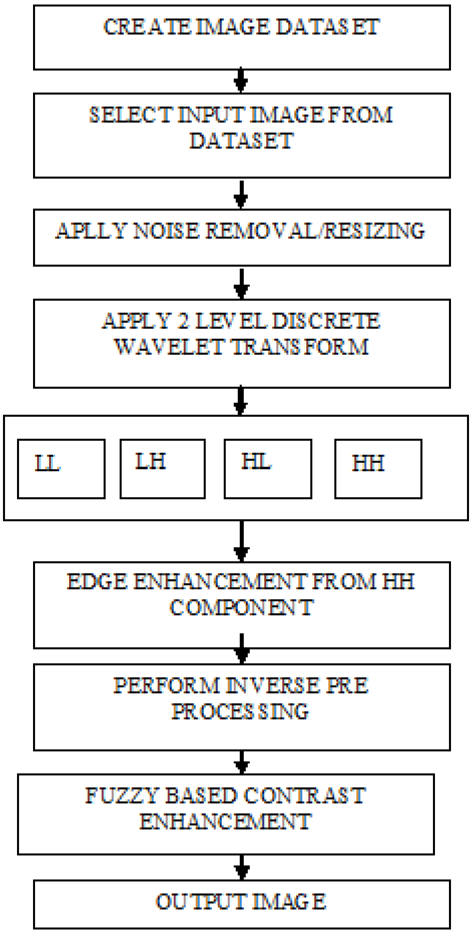


Figure 3.1: Flowchart of Methodology.

3.1 Image Database

Image database used in this study is taken from National Aeronautics & Space Administration (NASA) website www.nasa.gov. then images are converted into same size, same data type by applying following steps

The database preparation steps are as follows:

- Input Images from various sources.
- Resize all the images into 512*512 sizes
- Convert all the Images into same Format (.JPG)
- Store into Database

3.2 Pre Processing

A. Noise Removal

Here, for preprocessing we are applying median filter. It is a nonlinear filtering technique, which is used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to Enhance the results of later processing. Median filtering is very commonly applied in various image processing tasks because, under certain conditions, it preserves edges while removing noise.

Median filter can be applied by following equation

$$F(x,y)=median(g(s,t) \quad \ldots.(1)$$

Here, f(x,y) is output gray value ,were as g(s,t) is input gray value.

B. Contrast Enhancement

pixels with lower pixel value than a particular value are shown as dark, though the pixels having higher pixel value are shown as white, and pixels having pixel value in the middle of these two qualities are shown as tint of dim. For best yield diverse upper and lower limits are analyzed. The differentiate extending calculation is utilized by extending the scope of the shading values to utilize every single conceivable incentive to improve the difference. For safeguarding the precise shading extent when the complexity extending calculation is utilized, comparable scaling is connected for extending all channels. Then, PSNR is calculated by using equation (3). PSNR is well-defined simply via the mean squared error (MSE). Noise free m×n monochrome images I and its noisy approximation K is given then MSE is defined as:

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

The PSNR (in dB) is defined as:

$$PSNR = 10.\log_{10}\left(\frac{MAX_1^2}{MSE}\right) \qquad (3)$$

Here, MAX1 represents the extreme probable pixel value of the image. If the pixels are characterized by using 8 bits per sample, it is 255, and m, n is the number of rows and columns of input image respectively. Higher value of PSNR shows good results.

The PSNR values are higher for upper limit near about 0.96 and lower limit 0.04.

3.3 Enhancement Using Discrete Wavelet Transform

2-D Discrete Wavelet Transform (DWT) Wavelets have been used pretty commonly in image processing. Images can be represented both in terms of local spatial and frequency contents using wavelet transforms. The Fourier transform and DCT gives global frequency characteristics of an image, but they be unsuccessful to give local frequency characteristics. This drawback is overcome in wavelet transforms. A discrete wavelet transforms (DWT) for which the wavelets are discretely sampled for numerical analysis and functional analysis. This is overcome by DWT, it captures both frequency and time information. Discrete wavelet transform (DWT) decompose signals into sub-bands with smaller bandwidths and slower sample rates namely Low-Low (LL), Low-High (LH), High-Low (HL), and High (HH). With this, it is obtained four sub-bands from one level of transform – first low pass sub-band having the coarse approximation of the source image called LL sub-band, and three high pass sub-bands that exploit image details across different directions – HL for horizontal, LH for vertical and HH for diagonal details.

The 2-D wavelet decomposition of an image is performed by applying 1-D DWT along the rows of the image first, and, then, the results are decomposed along the columns. The luminance component (V) from HSV is used here for obtaining the wavelet transform. The frequency components of those sub-band images cover the frequency components of the luminance components value (V) is as shown in Fig. 2. Hence, discrete wavelet transform (DWT) is a suitable tool to be used for designing an image enhancement system.

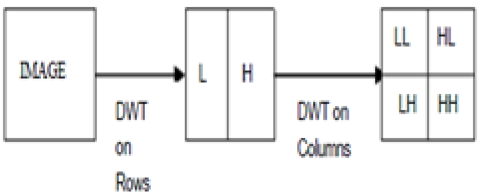


Figure. 1: DWT Operation on Image.

Here, high level component which contains the edge information of image are extracted using DWT and enhanced using sharpening filter. Finally, using inverse DWT operation enhanced image is generated.

3.4 Fuzzy Contrast Enhancement

Gray scale transformations, with the image contrast enhancement as a main application, are among the most frequent areas in which fuzzy techniques for image processing are applied. This rule based approach includes the following steps.

Step 1: Specifying the input membership functions.
Step 2: Specifying the output membership functions.
Step 3: Obtaining the fuzzy system response function F using following rules.

IF a pixel is dark, THEN make it darker
IF a pixel is gray, THEN make it gray
IF a pixel is bright, THEN make it brighter
Step 4: Construct the intensity transformation function T using fuzzy system response function F. Step 5: Transform the intensities of input image using T.

Fuzzy Inference System Tools for Image Enhancement: We can use five GUI tools for building, editing and observing fuzzy inference systems, which are as follows:
1. Fuzzy inference system editor
2. Membership function editor
3. Rule editor
4. Rule viewer
5. Surface viewer

Fuzzy Inference System

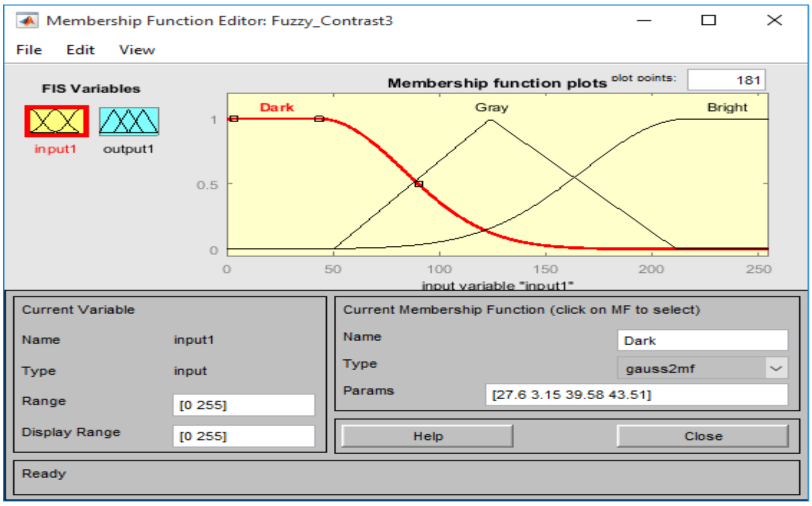


Figure 2: Input FIS Membership function for contrast Enhancement.

Figure2 shows FIS editor, which displays the general information about a fuzzy inference system. The names of each input variable are on the left, and those of each output variable are on the right. Input variable is Gray Level Image and output variable is Enhanced Image.

Output Membership Function

Figure3 shows the Surface Viewer. Surface Viewer presents a two dimensional curve that represent the mapping from gray level image to enhanced image.

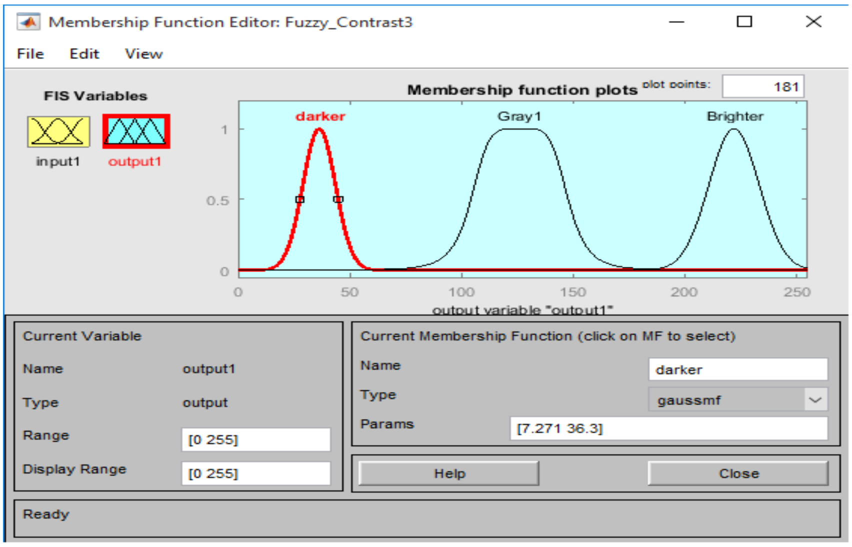


Figure 3: Output membership function.

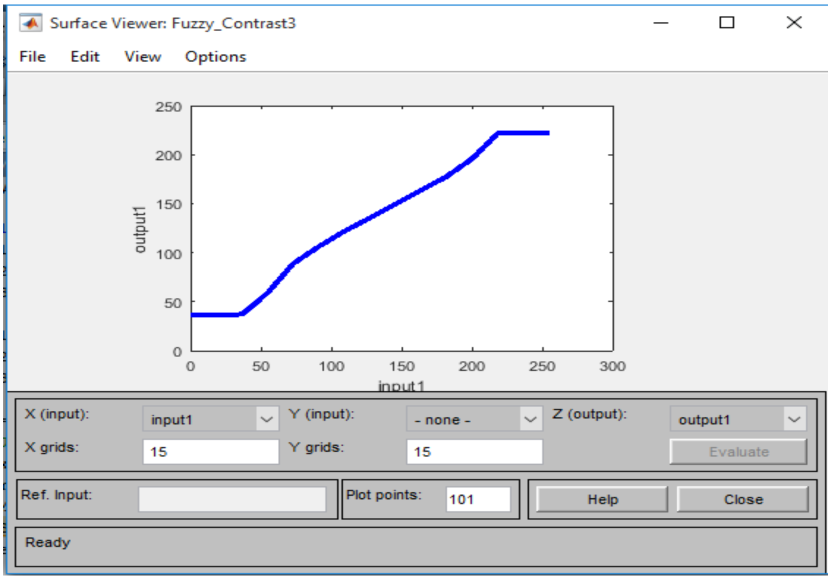


Figure 4 Input-Output Relationship.

Figure4 shows the input output relationship x-axis shows the input gray value and y-axis shows the corresponding output gray values.

IV. RESULT ANALYSIS

Output of all the above mentioned techniques is compared on the basis of their corresponding PSNR values and following figures and table show the output after applying following operations:

First input image is selected from database. The preprocessing is done through noise removal filter and contrast setting algorithm. Then DWT based edge enhancement method is applied where high level component is extracted from image and edge enhancement is done.

Finally, fuzzy contrast enhancement is applied to enhance the contrast of image and it is observed that it gives better results for image enhancement rather than other techniques.

Table 1: Output Comparision After Each Steps.

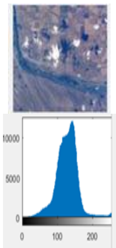
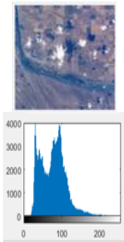
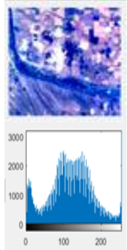
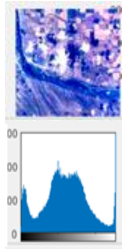
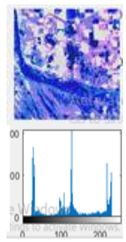
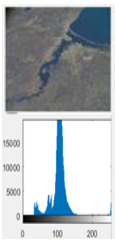
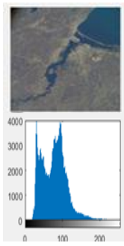
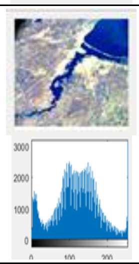
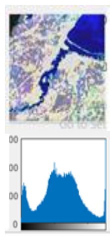
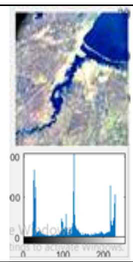
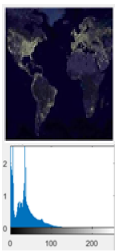
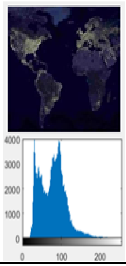
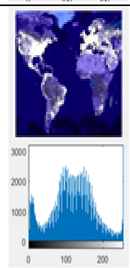
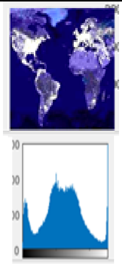
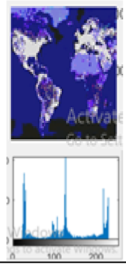
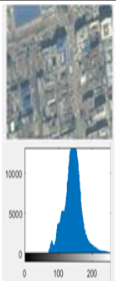
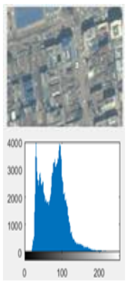
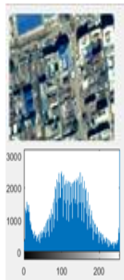
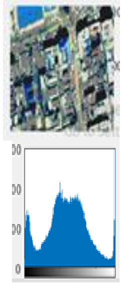
Input Image	Pre Processing	Contrast Setting	Wavelet Based Enhancement	Fuzzy Contrast Enhancement
				
				
				
				

Table1 shows the output of image with their histogram after each step

Table 2: Psnr Comparision After Each Steps.

Image	PSNR Values			
	Pre Processing	**Contrast Setting**	**Wavelet Based Enhancement**	**Fuzzy Contrast Enhancement**
11.jpg	42.06	48.47	48.48	48.71
15.jpg	47.95	48.50	48.51	48.77
23.jpg	49.0	46.15	46.15	46.3
37.jpg	48.43	50.04	50.04	50.14
41.jpg	50.64	50.53	50.54	50.91

Details of PSNR comparison are shown in Table 4.2.

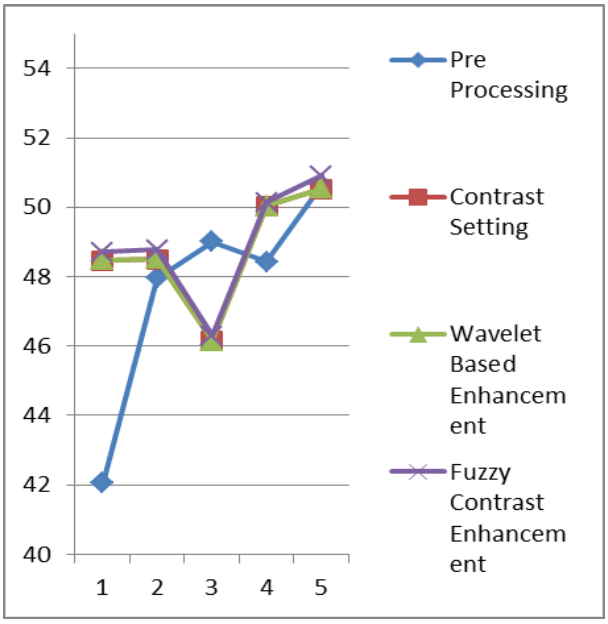


Figure 5: PSNR Comparison after each steps.

From table 1, 2 and Figure 5 it is very clear that PSNR values are increasing after each step of enhancement and fuzzy based contrast enhancement of input image generates highest PSNR i.e. best result.

From table 1,2 and Figure 5 .it is very clear that PSNR values are increasing after each step of enhancement and fuzzy based contrast enhancement of input image generates highest PSNR i.e. best result.

IV. CONCLUSION

Different Image Enhancement algorithms produce many different methodologies for image amendment to attain visually accepted images. The techniques of Contrast enhancement are utilized broadly for betterment of visual quality of low contrast images. Here, after taking the image database, we applied Median filter for noise remove as it gives highest PSNR than others. Contrast enhancement is done by using auto contrast method where upper limit is set to 0.96 and lower limit is set to 0.04 concluded as best. For edge enhancement DWT based edge enhancement method is applied. Finally, fuzzy base contrast enhancement is applied and from table 1.2 and Figure 4.it can be easily observed that PSNR values are much greater after fuzzy fiction. Most of the present techniques do not give adequate results in low contrast and light variation areas. Table 2 also shows that after all steps average PSNR value is near to 49 which shows good for enough for enhancement algorithm. The method proposed in this paper is very effective for image contrast enhancement with a membership function that recovers both the brightness and fine details of the input image.

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