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Comparative Result Analysis of Novel Algorithm based on RBF Network for Image Enhancement

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Abstract

Image Enhancement is for Improving Visibility and can also be used for different task, It is also important to provide a better representation for further automated image processing such as image analysis, detection, segmentation, recognition and data hiding which can be gain by image enhancement technique there are various method are available for the enhancement like histogram equalization etc in this paper we discuss the proposed algorithm for image enhancement based on RBF network and wavelet transform and also in this paper a comparative study has also done with cascaded SOM Network, HE, and MHE. The RBF Network is a local approximation three-layer feed forward neural network using a supervised training algorithm. It is much better than the regular BP network in approximation ability, classification ability and learning speed due to this reason the processing of network is very fast in compression of another artificial neural network method. And the combination of wavelet and RBF network has great advantage over conventional method.

Keywords

Image Enhancement, Wavelet, Neural Network, AMBE, PSNR, SOM, RBF, Histogram.

1. Introduction

Image enhancement is a process that involves changes in the pixels intensity of input image, so that output image should look better then input Image. The main purpose of the image enhancement is improve the interpretability or perception of information contained in the image for human viewers or to provide an enhanced input for other automatic image processing systems. There are many image enhancement methods have been developed a very popular technique for image enhancement is histogram equalization (HE) [8].

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Histogram equalization belong to spatial domain method which operate directly on pixels for image enhancement, Some Example of spatial domain operation are Grey scale manipulation, Histogram Equalization, Discrete Formulation, Image Smoothing, Image sharpening and etc is a common technique for enhancing the appearance of images. Suppose we have an image which is dominantly dark. So that its histogram will be moved towards lower end of the grey scale and all the image detail are compressed towards the dark end of that histogram. If we could stretch out' the grey levels at the dark end to produce a more uniformly distributed histogram then the output image would become much clearer. Histogram equalization involves finding a grey scale transformation function that creates an output image with a uniform histogram or nearly so [2, 3].HE is a broadly accepted in image contrast enhancement technique because of to its effectiveness, and simplicity. However, it often changes the mean brightness of image to the middle level of gray-level range which is not desirable for consumer electronic products like television. In addition, HE method tends to introduce unnecessary visual deterioration including saturation effect. Preserving the input brightness of the image and keeping PSNR in the desired range are required to avoid the generation of non-existing artifacts in the output image. To surmount this drawback multi histogram equalization is used [7].

Multi-HE, which consists of decomposing the input image into several sub-images, and then applying the classical HE process to each one. This methodology performs a less intensive image contrast enhancement, in a way that the output image presents a more natural look [9]. In process of wavelet transform it decomposes image in different layers, which are approximation and detail layer, the decomposed layer are differentiate by horizontal, vertical and diagonal. Wavelet thresholding developed first by Donoho and John stone .This method removes the noise in an image by removing the wavelet coefficients that are too noisy and preserving or shrinking the coefficients that contain important image signals. The success of the method depends heavily on the choice of the threshold

parameters. Various wavelet thresholding methods different approaches to determine the threshold parameters, Wavelet transforms are multiresolution representations of signals and images. Artificial neural network play important role in image enhancement and for preserving brightness and contrast of digital image. The nature of neural network is adaptive and variant; this nature sustained a pervious value of image pixel and set the desired target for enhancement of image. Self-organized map network (SOM) artificial neural network used for the process of image enhancement in frequency domain of digital image. RBF (radial basis function) network is a local approximation three-layer feed forward neural network using a supervised training algorithm. RBF is better than the traditional BP neural network in the approximation capability, classification ability and learning speed. They are typically configured with a single hidden layer of units whose activation function is selected from a class of functions called basis functions. While similar to back propagation in many respects, radial basis function networks have several advantages. They usually train much faster than back propagation networks. They are less susceptible to problems with non-stationary inputs because of the behaviour of the radial basis function hidden units. The hidden units in RBF networks use a Gaussian or some other basis kernel function .Every hidden unit work as locally tuned processor which can compute a score for the match between input vector and its connection weights or centres. In effect, the basis units are highly specialized pattern detectors. The weights connecting the basis units to the outputs are used to take linear combinations of the hidden units to product the final classification or output [6, 10, and 11].The rest of paper is organized as follows. In section 2 discuss proposed method for image enhancement, section 3 experimental result analyses, section 4 conclusion and future work.

2. Proposed Method for Image Enhancement

Cascading of neural network model plays an important role in image classification and image enhancement. In this section we discuss cascaded model of RBF network for gray scale image enhancement. The great advantage of RBF network is single layer processing unit and target output independent with input data. In the process of cascading input image passes through wavelet transform, wavelet transform function decomposed image into layers such as approximation and details in frequency domain. The part of approximation used as input in cascaded model. Here we show block diagram of process of cascading model of RBF network See figure 1. We proposed a novel methodology for image enhancement based on wavelet transform and radial biases neural network. Initially the discrete wavelet transform function is applied into input image. Now input image decomposed in to layer structure form. After that we calculate horizontal, vertical and diagonal coefficient of input image, after that we apply soft transform technique and generate trained pattern using ACP algorithm. In RBF network we used Gaussian based kernel function. The ACP algorithm generates a trained pattern for the removal of noise. In that process the variance factor of noise is increase and the target PSNR value is achieved.

Proposed Cascaded Radial Basis Function Network Algorithm:

Input raw image

1. Perform wavelet transform and image decomposed in layers.
2. Find horizontal, vertical and diagonal coefficient of wavelet.
3. Apply soft transform of wavelet
4. Check value of coefficient of wavelet
5. Decide the size of vector input 3*3
6. Trained the network with constant learning rate.
7. Apply target value of activation Gaussian function
8. Apply cascaded second stage RBF network
9. Find PSNR and AMBE of enhanced image.
10. Image enhanced result.

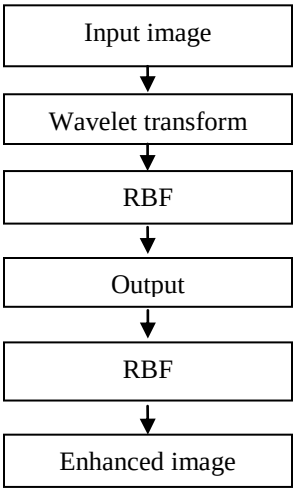


Figure 1: shows that process block diagram for RBF cascading model

3. Experimental Result Analysis

The performance calculation of image enhancement technique already existing and the proposed cascaded model the MATLAB software package is used. And some standard images are used for experimental process. Calculation of the performance is calculated by the Peak Signal to Noise Ratio (PSNR), and by Absolute Mean Brightness Error (AMBE) values these are standard parameters for the result analysis. For the Performance evaluation of proposed cascaded RBF method for some images like Lena, Baboon, Boat, Barbara and Lichtenstein Castle etc. The images used are gray scale images of size of the image are 512 X 512 pixels the images are still image, and image are having 2d information only are considered, The analysis is performed For JPEG, TIF, PNG, and BMP Type of images. Proposed cascaded RBF is a neural network based method for image enhancement. Comparative analysis of Cascaded RBF has done with Cascaded SOM model for image enhancement using wavelet transform [1], MHE, and HE.

The Figure numbered 2 shows the input image of a Lichtenstein Castle and its histogram map of given image. Then in figure number 3 shows that enhanced image by Cascaded RBF method and equalized histogram map with PSNR value 38.7432 and AMBE IS 15.2076. After that in Table number 1 show that value of PSNR, AMBE on the basis of method HE, MHE, SOM, and RBF for the Different images and for different type of images. After these we did a comparative study of PSNR and AMBE values for the image of Lichtenstein Castle on the bases of HE, number 1 and in figure 4 some of the image are MHE, Cascaded SOM, and Cascaded RBF in graph displayed which are used while analysis.

As per our experimental result analysis we came to know that our proposed Cascaded model on RBF is working better as compare to the other model histogram equalization, Multi histogram equalization models, and Cascaded SOM. The result values of proposed model for PSNR are going higher as compared to other and the value of AMBE is going down.

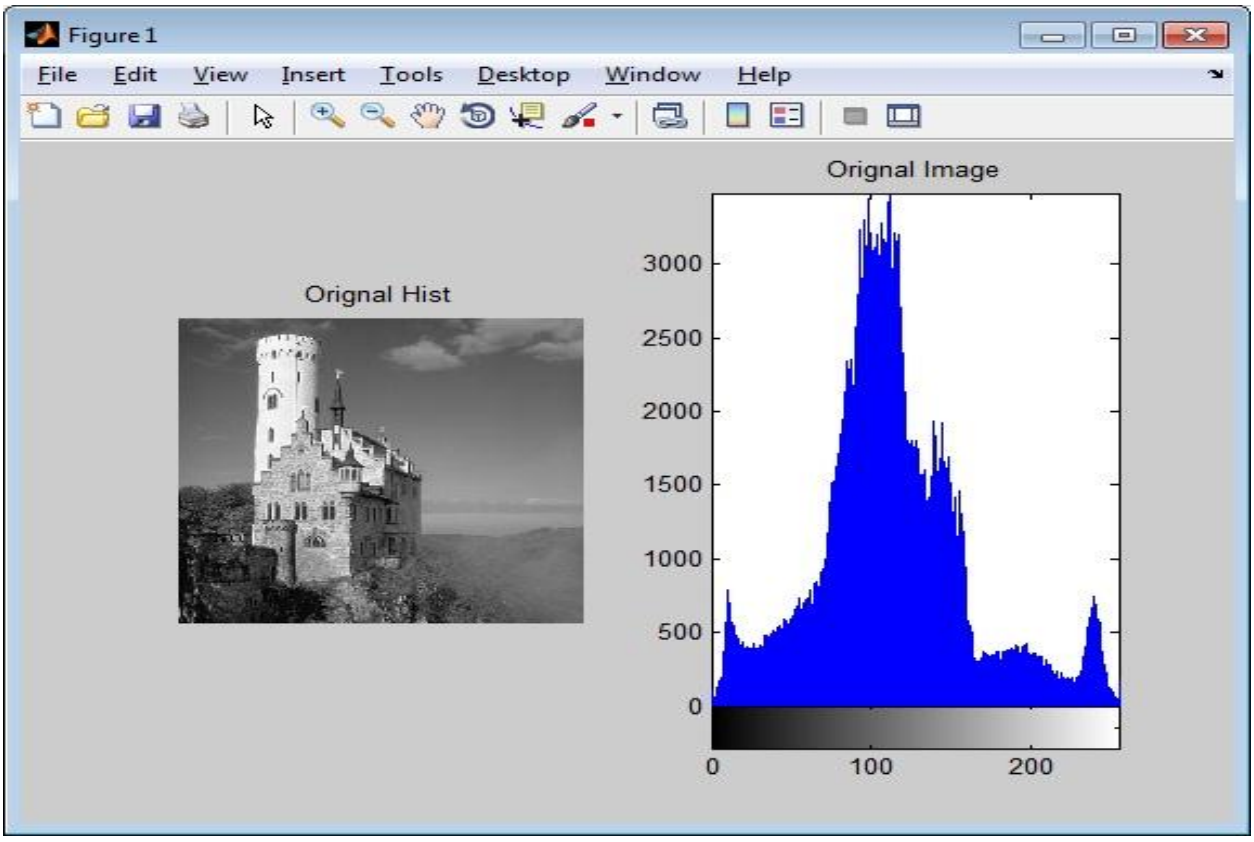


Figure 2: shows the input image of a Lichtenstein Castle and its histogram map of given image.

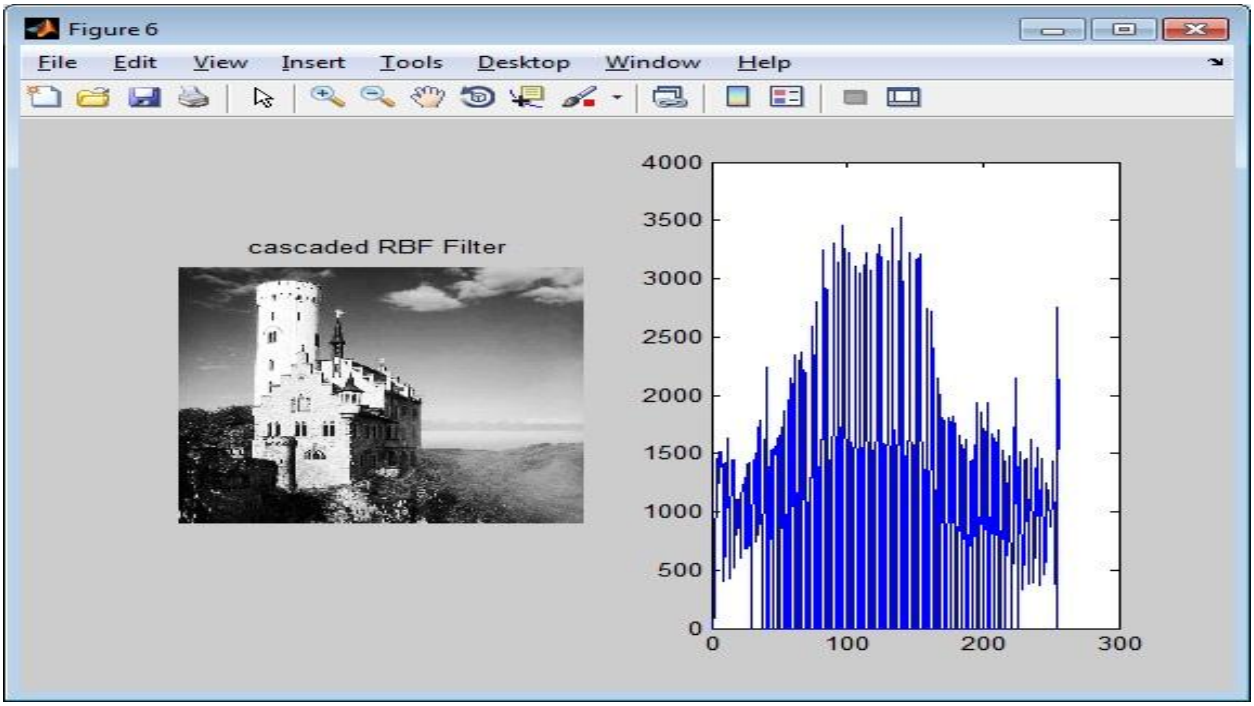
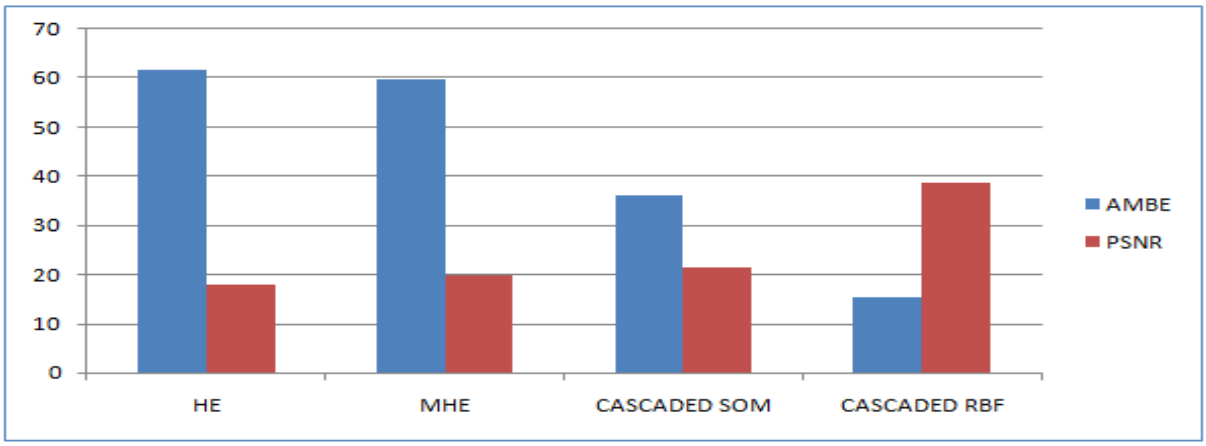


Figure 3: shows the enhanced image by Cascaded RBF method and equalized histogram map with PSNR value 38.7432 and AMBE IS 15.2076

Table 1: shows thee value of PSNR, AMBE on the basis of method HE, MHE, SOM, RBF for different images and Image Type.

S. NO.	IMAGE NAME	TYPE OF IMAGE	PARAMETERS	VALUE OF HE	VALUE OF MHE	VALUE OF CASCADED SOM	VALUE OF CASCADED RBF
1	BABOON	BMP	PSNR	6.8865	7.7023	8.2644	**15.0361**
			AMBE	23.9929	23.171	14.0479	**5.902**
2	BARBARA	BMP	PSNR	11.9638	13.3809	14.3575	**26.1217**
			AMBE	41.6821	40.2542	24.405	**10.2534**
3	BOAT	BMP	PSNR	12.3107	13.7689	14.7739	**26.8792**
			AMBE	42.8907	41.4214	25.1126	**10.5507**
4	CAMERAMAN	BMP	PSNR	13.0493	14.595	15.6603	**28.4919**
			AMBE	45.4642	43.9068	26.6194	**11.1838**
5	LICHTENSTEIN CASTLE	BMP	PSNR	19.5662	21.8839	23.4811	**42.7209**
			AMBE	68.1692	65.834	39.9133	**16.769**
6	PEPPERS	BMP	PSNR	18.6454	20.854	22.3761	**40.7104**
			AMBE	64.9611	62.7357	38.0349	**15.9798**
7	BABOON	JPEG	PSNR	6.8866	7.7024	8.2646	**15.0363**
			AMBE	23.9933	23.1714	14.0481	**5.9021**
8	BARBARA	JPEG	PSNR	11.9638	13.3809	14.3575	**26.1217**
			AMBE	41.6821	40.2542	24.405	**10.2534**
9	BOAT	JPEG	PSNR	11.5536	12.9221	13.8653	**25.2261**
			AMBE	40.2531	38.8741	23.5683	**9.9019**

10	CAMERAMAN	JPEG	PSNR	15.602	17.4501	18.7238	**34.0655**
			AMBE	54.3578	52.4957	31.8267	**13.3715**
11	LICHTENSTEIN CASTLE	JPEG	PSNR	17.7444	19.8463	21.2948	**38.7432**
			AMBE	61.8221	59.7042	36.197	**15.2076**
12	PEPPERS	JPEG	PSNR	17.5494	19.6282	21.0609	**38.3175**
			AMBE	61.1428	59.0482	35.7993	**15.0405**
13	BABOON	PNG	PSNR	7.3913	8.2669	8.8703	**16.1383**
			AMBE	25.7517	24.8695	15.0777	**6.3347**
14	BARBARA	PNG	PSNR	11.9638	13.3809	14.3575	**26.1217**
			AMBE	41.6821	40.2542	24.405	**10.2534**
15	BOAT	PNG	PSNR	11.5587	12.9279	13.8715	**25.2373**
			AMBE	40.2709	38.8913	23.5787	**9.9063**
16	CAMERAMAN	PNG	PSNR	13.0493	14.595	15.6603	**28.4919**
			AMBE	45.4642	43.9068	26.6194	**11.1838**
17	Lichtenstein Castle	PNG	PSNR	19.5662	21.8839	23.4811	**42.7209**
			AMBE	68.1692	65.834	39.9133	**16.769**
18	peppers	PNG	PSNR	18.6454	20.854	22.3761	**40.7104**
			AMBE	64.9611	62.7357	38.0349	**15.9798**
19	BABOON	TIF	PSNR	6.8865	7.7023	8.2644	**15.0361**
			AMBE	23.9929	23.171	14.0479	**5.902**
20	BARBARA	TIF	PSNR	11.9638	13.3809	14.3575	**26.1217**
			AMBE	41.6821	40.2542	24.405	**10.2534**
21	BOAT	TIF	PSNR	11.5538	12.9224	13.8656	**13.8656**
			AMBE	40.2538	38.8749	23.5687	**23.5687**
22	CAMERAMAN	TIF	PSNR	15.6016	17.4496	18.7233	**34.0646**
			AMBE	54.3564	52.4943	31.8258	**13.3711**
23	LICHTENSTEIN CASTLE	TIF	PSNR	17.7583	19.8618	21.3115	**38.7735**
			AMBE	61.8704	59.7509	36.2253	**15.2195**
24	PEPPERS	TIF	PSNR	17.5618	19.642	21.0757	**38.3445**
			AMBE	61.1858	59.0898	35.8245	**15.0511**



Graph 1 shows the comparative analysis of Lichtenstein Castle mage for three image enhancement method HE, MHE, SOM, and RBF.

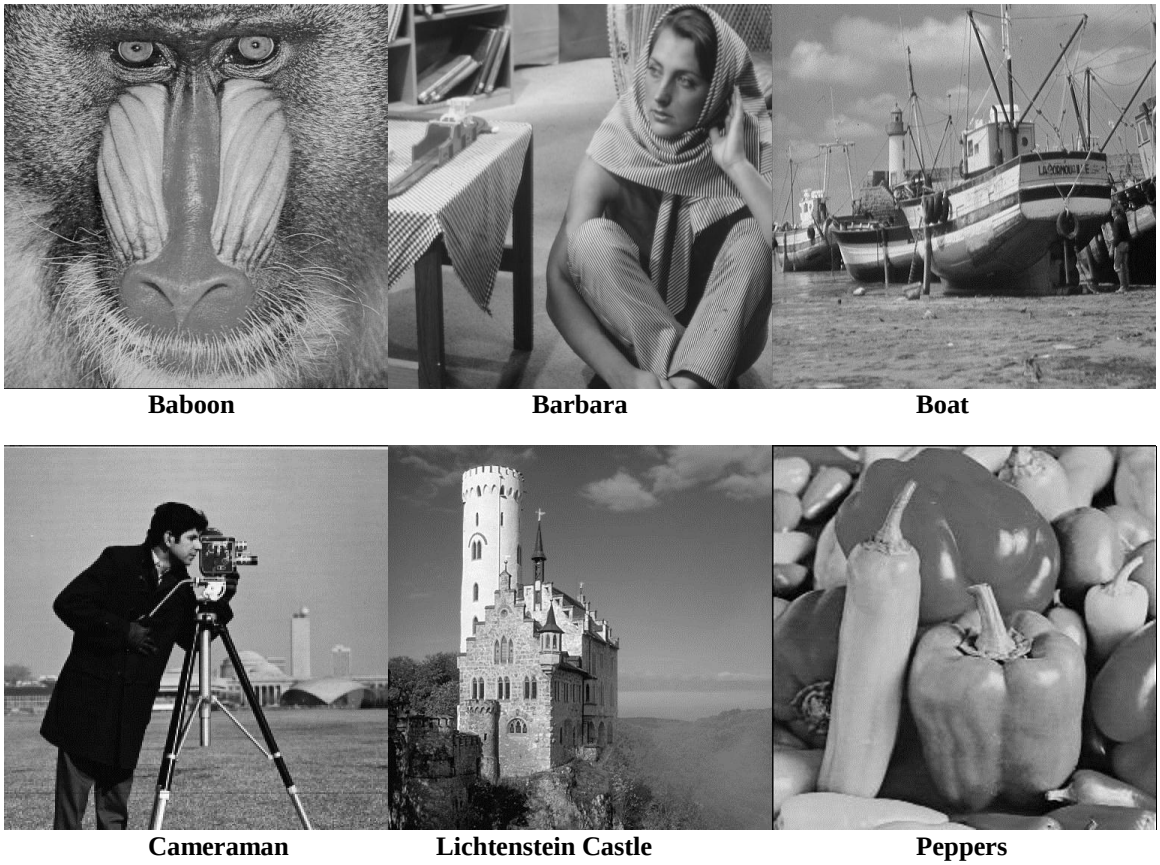


Figure 4: shows Some Different Image Used While Result Analysis

4. Conclusion and Future Work

The image enhancement is versatile field of research using ANN. The application of image in different field such as medical diagnosis, satellite image and user application are needed denosing and enhancement technique of image. The conventional technique such as histogram equalization and multipoint histogram equalization not perform up to mark. Cascading of neural network model plays a great role for enhancement of image. In this paper we proposed cascading model of neural network, RBF. The cascaded model of RBF network performs better in compression of H.E, M.H.E, and cascaded SOM method for image enhancement. We have analysed the performance on the bases of PSNR and AMBE values, As per our result analysis we the value of PSNR for CSOM is Highest in comparison to other techniques and value of AMBE is lowest for CSOM as compared to other techniques by which the quality of greyscale image is improved so that we can conclude that the Cascaded model on RBF is comparatively working efficiently. In feature work the work can be extended for colour image and the image having 3d data and even for non static images.

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