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Research paper

Evolutionary Algorithm Based Extreme Learning Machine for Retrieval of Images

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Abstract*:*

In the present days, the importance of digital media or images has been improved. All the fields are utilizing these services at their maximum levels. It is because of easy acquisition, easy transmission, easy saving, easy retrieving, easy error correcting, etc. The cost of the storage devices also has been reasonable. Different storage or data servers are maintained to store these digital images. The storage capacity basically depends on image type, number of pixels of the image, number of grey levels of the image, number of dimensions of the image, number of features available in the images, etc. This paper presents an adaptive methodology for medical image retrieval.

Keyword: *Local Binary Patterns, Rotation, Dominant, Features, Image retrieval.*

1. Introduction

Over the decade, advancements in the imaging technologies and information storing have paved the way for the formation of vast image datasets. The acquired images are stored in one's personal computer or huge databases. In case the image data is stored in one's personal computer, then one can manually annotate each image and store similar images in a folder so that, the images can be retrieved for future usage. The most commonly followed method is to look all the images in the gathering until the desired image is discovered. Despite the fact that, this is a cumbersome procedure and requires tremendous effort, it causes little annoyance as the number of images stored in one's personal computer is not that high.

The objective to locate a comparative image from extensive accumulations or remotely appropriated databases is shared by scientists, instructors, and experts as well as by general users [1]. However, image retrieval is an extremely tedious job when the image dataset is very large and deals with particularly medical images. Querying on several thousands of images to find desired images is troublesome and time consuming. In vast image databases, literary comment of images ends up illogical and wasteful for image depiction and recovery [2]. It is therefore desirable to have an effective and efficient system that is much faster than manual searching and retrieving of images. In such a situation, it is essential to create a suitable framework to productively deal with these large image datasets. To manage the problem, quite a few methods have been put forth by the researchers that make use of the alleged content based image retrieval method.

Image retrieval based on image content aims at depicting the complex object information of computerized pictures by non-textual features, which are pertinent for proficient query handling [3]. There are several application areas, which would benefit from content-based image retrieval system, includes defence organizations, engineering-based applications, healthcare, journalism and advertising, education and training, geographical information and remote sensing, etc. Medical imaging is one field which would immensely benefit from content-based image retrieval. Medical imaging procedures are very popular as those facilitate accurate diagnosis, monitoring drug responses and have almost negligible side effects. The usage of imaging techniques in medical application is also frequent for being a non-invasive procedure. As medical imaging is an indispensable tool for the medical practitioners for diagnosis of health hazards, thousands of medical images are produced on a daily basis. These images include X-rays, magnetic resonance images (MRIs), computed tomography (CT) scans, ultrasound (US), mammograms, etc. Physicians used to rely upon these images in hardcopy image formats to diagnose health hazards. With the advancement of data storage technology, the problem of storing and retrieving medical images in hardcopy format is circumvented. The medical image data stored in softcopy form paves the way for their usage in various cases. The stored digital images and their efficient retrieval are used to aid in diagnostics, as physicians can compare the image under investigation to that of healthy organs, or search for similar cases for prognosis. The feature content of images is an effective and straightforward query which can be utilized to look for different images containing comparable substance [4].

2. Proposed Method

This method involves all possible features of the medical query image to retrieve from a database. Combination of so many features is maintained as a final feature set to compare with database feature set. Image statistical feature extraction can be possible by calculating the features like contrast, correlation, energy, and homogeneity. Simple image texture feature extraction can be possible by calculating the features like mean, kurtosis,

standard deviation, entropy, variance, smoothness, skewness, and root mean square. Inverse difference movement of pixels can be calculated from the pixel values. Geometrical features like area, perimeter, circularity, a centroid of different regions and centroid mid-point of an image can be extracted [5-7].

All the features that are calculated from above techniques are in thousands. The total number of features, that can come out depending on the size of the image, the shape of the image, grey level distribution of the image, etc. Curvature, histogram and BLP features are more in number. A limited number of these features is considered for retrieving purpose and those considered features are dominated and important features. Finally, 253 features are obtained by limiting them in a meaningful way. These 253 features have to be compared with 253 features of all the images of a database. It again creates a problem to compare. The number has to be reduced further. In this process, local linear embedding method can reduce the feature set to a nominal feature set by considering the importance of all the features. Evolutionary algorithm based extreme learning machine is used for comparing feature set.

Evolutionary algorithm (EA) based Extreme learning machine (ELM) has been used in the process to compare the reduced feature set of medical query image with database of reduced feature set [8-9]. Extreme learning machine algorithm consists of two classification algorithms, neural network architecture and discriminant analysis. It is having the benefits of both algorithms. Evolutionary algorithm is having an advantage of using the process up to reaching, either maximum of iterations or minimum error value. The proposed method is having benefits of both the methods, EA and ELM. After comparing both the sets, the images in the database are assigned ranking numbers to the database images based on the relevance of the image features of database images with query image features. The best relevant image is ranked as 1, next relevant image is ranked as 2, and so on. Based the required count number (N), the relevant images to query image are retrieved. The image details are also displayed for the query image. The statistical report will be given after retrieving process. If the query image is not available in the database, it will ask for the addition of the new query image into the database. It is up to the user, to take the decision of adding it to the existing database images or not.

3. Results and Discussion

A suitable and noisy medical query has been considered for retrieving process. The image has been enhanced with pre-processing techniques. As discussed above, the statistical, texture and area features have been evaluated. Dominant direction has been evaluated by rotating with different suitable angles. Figure 1 is showing query, speckle noisy, denoised with denoising algorithm and post processed image. The post processed image is taken as query image. As discussed earlier, the feature set of query and database images are compared. Based on the similarity the ranking is given. Based on the required number of retrieval images the output is shown and parameters are calculated. Table 1 is calculated for a given query as discussed and database of 300 images. Based the rankings of the images of three categories of the images the confusion matrix is formed. The producer, user and overall accuracy are calculated and given in table 2. Other quality parameters like precision, F1 measure, sensitivity or recall and specificity for the proposed are calculated and formulated in table 3. These values are compared with different existing models to get better analysis and given table 4. The error rate of 0 and normalised average rank of retrieval of 0.04 are obtaining for the given method. These values are depending on the number of required retrieved images.

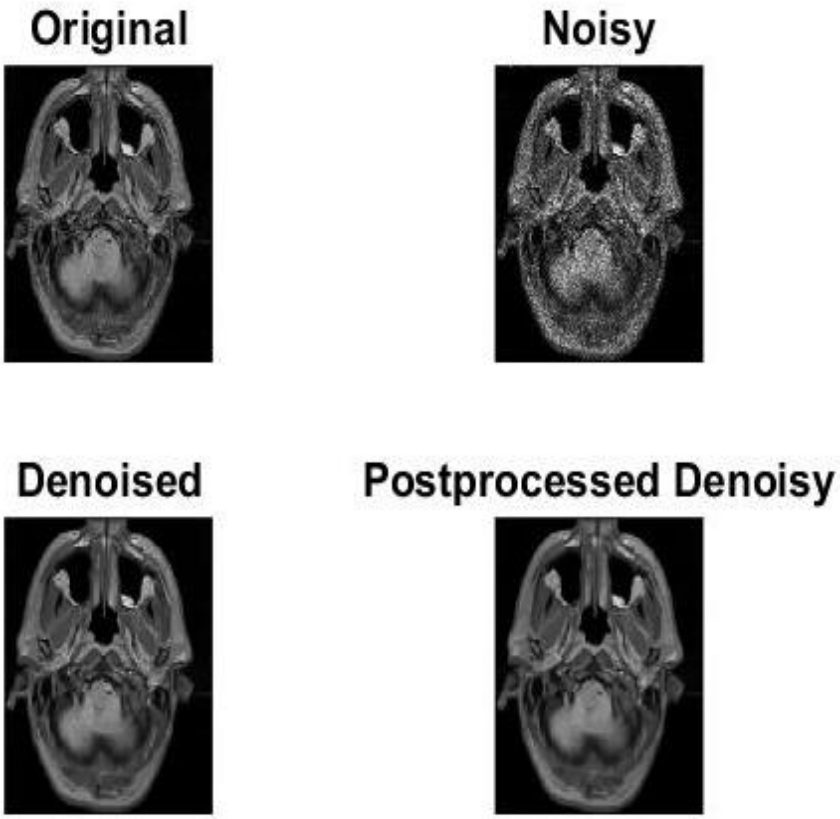

Figure 1: Input, speckle noisy image, denoised image and post processed image of query Image

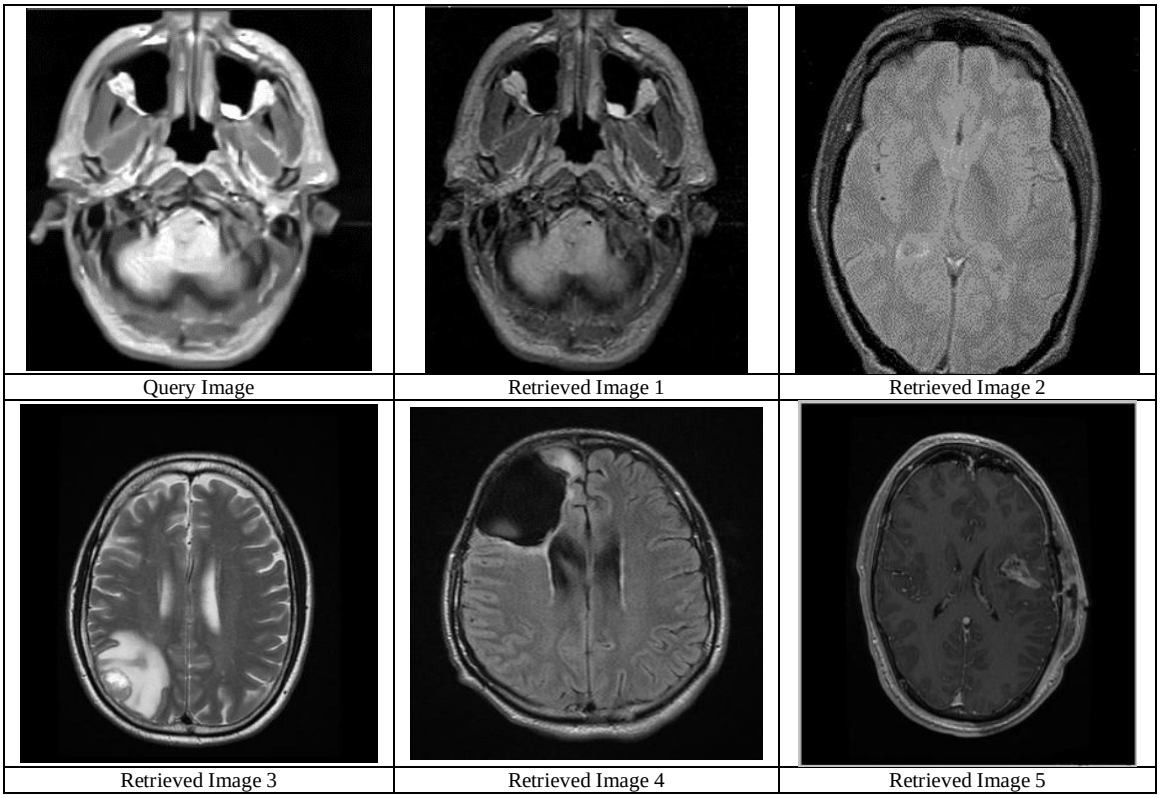

Figure 2: Query and its five retrieved images

Table 1: Confusion matrix for query image with extreme learning machine

		PREDICTED			
	CLASS	**A**	**B**	**C**	**Total**
ACTUAL	**A**	98	2	0	100
	B	0	97	3	100
	C	1	0	99	100
	Total	99	99	102	300

Table 2: Accuracy measurements for query image with extreme learning machine

Class	**Reference Pixels**	**Classified Pixels**	**Matching**	**Accuracy type**	
				Producer	**User**
A	99	100	98	98.99%	98.00%
B	99	100	97	97.98%	97.00%
C	102	100	99	97.06%	99.00%
Total	300	300	294		
Overall Classification Accuracy				98%	

Table 3: Different parameters calculated for query image with extreme learning machine

	Accuracy	**Precision**	**Recall**	**Specificity**	**F1 score**
A	0.98	0.9899	0.9800	0.9950	0.9849
B		0.9798	0.9700	0.9900	0.9749
C		0.9706	0.9900	0.9850	0.9802
Over all		0.9701	0.9800	0.9900	0.9800

Table 4: Different parameters calculated for query image with different methods

	Accuracy	**Precision**	**Recall**	**Specificity**	**F1-score**	**Error Rate**	**NARR**
LDEP	95.3333	95.3333	95.3333	97.6667	95.3333	0.1	0.2611
SR-EMD	90	90.3677	90	95	90.0821	0.5	0.1167
GS	93.3333	93.3297	93.33	97.6675	93.333	0.1	0.2611
CNN	97.337	97.33	93.33	98.667	97.337	0.1	0.05
Proposed	98	98.0365	98	99	97.99	0	0.04

4. Conclusion

The proposed method has been developed by considering different features like basic statistical features, geometrical features, inverse difference movement feature, dominant rotated local binary pattern features, curvature features, tamura features, and histogram of gradient features. All the texture features have been fused into one set and considered as a feature set. This feature set has been reduced with locally linear embedding algorithm. Evolutionary algorithm based extreme learning machine was used for comparing the feature set to retrieve the query image from a database. The existing methods cover only some of the features like color features, local features, global features, statistical features, geometrical features, rotated local binary pattern features, histogram of gradient features, etc. The proposed method is

developed, based on all the possible features of medical images available, that leads to better retrieving of the images.

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