Indian Journal of Science and Technology, Vol 8(35), DOI: 10.17485/ijst/2015/v8i35/77238, December 2015
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

The New Approach for Medical Enhancement in Texture Classification and Feature Extraction of Lung MRI Images by using Gabor Filter with Wavelet Transform

Harpreet Singh*, Shekhar Verma and Gaganpreet Kaur Marwah

Department of Electronics and Communication Engineering, Lovely Professional University
Phagwara - 144411, Punjab, India; Harpreet.17377@lpu.co.in, shekharverma05@gmail.com
gaganpreet.marwah@lpu.co.in

Abstract

Magnetic resonance imaging is most widely used radiographic technique in diagnosis, clinical research and studies as well as treatment planning of major diseases. Generally GLCM and PCA technique are used for the feature extraction and classification but this technique increased the complexity and it's robust in nature. In this paper we used the Gabor filter with wavelet transformation classification technique for analyzing Magnetic response images. In this paper, the detection of abnormality in the patient's image is automatically recognized using texture analysis. The hybrid technique may work as an automatic classification of abnormalities in lungs MRI images, which can help radiologist in performing an in-depth examination. The texture analyses of both the normal and abnormal images are done. On the bases of the values of abnormal images, the range is calculated and further it is compared with the texture features of normal image. So, to determine the whether the abnormality is there or not in the image, its texture features are observed and the feature lying outside the range finally concludes that image is normal. Five cases are observed, on the bases of their comparison, the result is obtained at the end indicating the whether the presence of abnormality in the image.

Keywords: Gabor Filter, Feature Extraction, Magnetic Response Images, Texture Classification

1. Introduction

For diagnosis of various medical fettle, medical image direct to a numbers of techniques and process that can be used for looking inside the body. The body doesn't have to be opened up surgically for medical practitioners to look at various organs and areas inside the body. It can be used to assist diagnosis or treatment of different medical conditions.

1.1 Meaning of MRI Image

MRI image stands for magnetic resonance imaging that is medical image. It is most widely used radio graphic techniques in diagnosis clinically studies and clinical studies and treatment planning. The technique is widely used in hospitals for medical diagnosis, staging of disease and follow up without expose to ionization radiation. In this paper, the details provider of automated classification and methods of abnormalities in context of MRI images of lungs[1].

It is a non-bacterial test that utilizes a powerful magnetic field, radio frequency and a computer to produce detailed images of organs, soft tissues, bones or all other internal body structure for diagnosis and treatmen[2]. The basis MRI is the directional magnetic field, or moment that associated with charged particles in motion. MRI based on electromagnetic effect of rotating protons in hydrogen of water and organic material. With magnetic field and high frequency electromagnetic pulses, MRI generates data sets to be reconstructed as two dimensional

* Author for correspondence

cross sectional images are three dimensional volumes of anatomic structures with excellent soft tissue contrast. So MRI techniques dramatically reduced acquisition time and motion artifacts. Figure 1 shows the overview of concept of medical imaging.

Examples of Uses:

MRI can be used to view, monitor, or diagnose:*spine, joint or muscle problems

*abdominal tumors and disorders

*Brain tumors and abnormalities

*breast cancer

*heart or blood vessel problems.

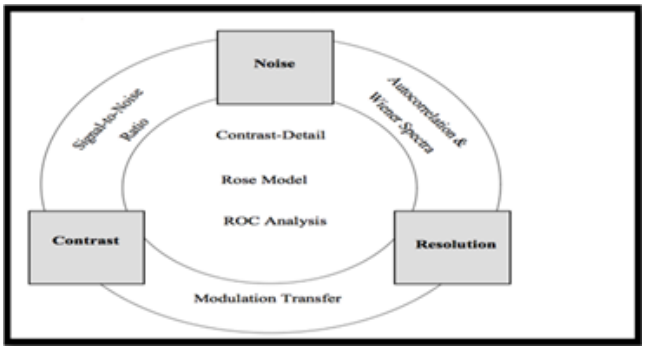


Figure 1. Medical imaging concept overview.

1.2 Types of MRI Images: TI and T2

The key technique of MRI of lungs is based on resonant high frequency signal of protons in tissue and liquids so called proton MRI or H-MRI. The MRI of lungs is challenging because of low proton density, respiratory and cardiac motion at air tissue interface. RI of lungs is recommended in a number of clinical indications. So MRI is a multimodal imaging approach for staging of lung cancer. Figure 2 shows the types of MRI images T1 and T2. It is being advanced from a technological niche to the doorsteps of clinical routine imaging. The MRI image is of two types[3] T1 and T2. By the intensity of fluids of weighted images able to differentiate between the T1 and T2 image. In T2 weighted images water appears as a white where in T1 appears as a dark. This two types of MRI scan helps to differentiate between abnormalities in soft tissue injury and solid organ. The injury resulting in surrounding edema looks white on T2 weighted images and reverse is true in T1 weighted images. T1 is used to look for solid organ pathology like liver, spleen. T2 used to look for soft tissue injury e.g. in par vertebral muscles in back injury. T2 is a transversal relaxation time where T1 as a longitudinal relaxation time.

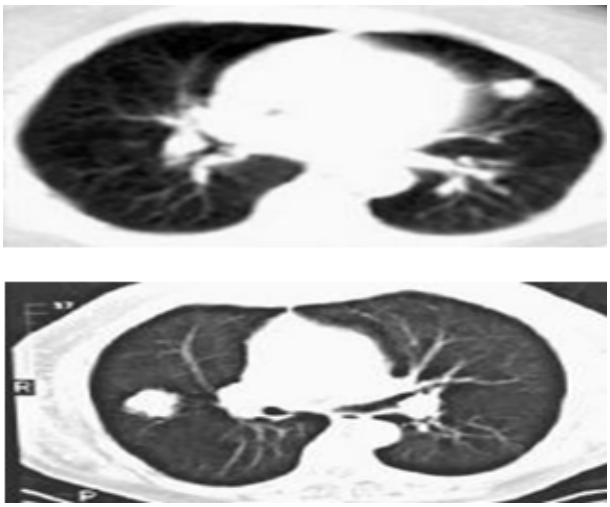


Figure 2. T1 and T2 weighted image.

2. Methodology

2.1 Method for Proposed Work

Figure 3 shows the proposed work which first takes MRI Image, selects its particular features for extraction, classification and then final decision and then the modified output waveform.

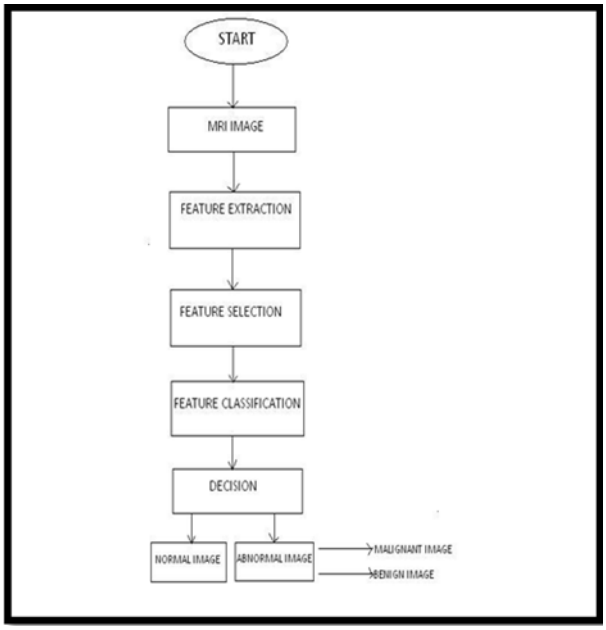


Figure 3. Flow chart for proposed work.

2.2 Feature Extraction Methods

There are various feature extraction methods in image processing which can used for texture classification

problems. Among these we will work on some selected methods that will give us correct result. So, following are various methods for feature extraction.

2.2.1 Gabor Filters

Gabor filters generally used for edge detection of images. It includes the standard deviation, radial center frequency and orientation. In this method decide a set of radial center frequencies and orientations which may changes and to cover all possible orientations mainly used 180° in terms of direction[4].

2.2.2 Grey Level Co-Occurrence Matrices (GLCM)

It is an old method used for texture extraction which was widely used for many applications and is still the most commonly and widely used method. In this method we used statistical analysis which works for the relationship between the different pixels pairs of the image. In other methods textural features will be calculated by the generated GLCMs, e.g. correlation, energy, contrast, entropy and homogeneity. But trends have changed now; GLCM is used with different extraction methods and is rarely used individually[5].

2.2.3 Wavelets and Other Transform Methods

There is another approach for signal processing known as wavelets transform which is used for pattern recognition in various signal processing applications. It is the most commonly used feature for texture classifications. The most popular wavelet transforms is Discrete Wavelet Transforms (DWT) that include the Haar wavelet and Daubechies wavelets[6]. These methods are used in frequency domain of the images; frequency domain information is more stable than the time domain. Hence, they produced much better results despite having slower and complex in nature.

2.2.4 Local Binary Patterns (LBP)

Local Binary Patterns gives a value that makes a comparison inside a 3 × 3 neighborhood to a maximum neighborhood value, which is manifold with corresponding binomial weights. It is the most popular method for texture classification and is often used to calculate local features of the image.

2.2.5 Principle Component Analysis (PCA)

The PCA technique of feature extraction had been used for many past years, mainly used in starting stage of feature analysis also called it as factor analysis tool. The main function which can be performed by PCA is derived non redundant data, compression of data extraction of features, or prediction, etc. It is very important if there is a need of dimensions reduction. PCA can be best fit only in that domain which is linear or have a linear combination like image processing or signal procession control theory etc[7]. It reduced a large dimensional data into small discreet dimensions. Among the given variables or observed features, or indirectly compress the large amount of data into non redundant data. This dimensional reduction is possible if there is strong correlation between the observed data or data space we have. This dimension space of feature space is less than original space of image. The first principle component is chosen on the behalf of variance, component which has maximum variance chosen as first principle component. In principle component analysis two dimension matrix of image space is represented as one dimensional feature vector. First feature is corresponding to first principle component. This feature space is called as Eigen space that is calculated from co-variance matrix or after picking the Eigen vectors of co-variance matrix PCA is suitable for finding the local or global features. These features are related to image feature directly or not.

2.2.6 Independent Component Analysis (ICA)

It is a method which is used for separating the signal into its additive subcomponents which is done by assuming the subcomponents which are non-Gaussian signals and are independent from each other[8]. This method is not the popular method used for texture classifications.

2.2.7 Region Covariance Matrices

To calculate the covariance between values in statistical method generally covariance matrix is used. To generate a covariance matrix from different image features used a Tuzelet an approach. This generated matric are two dimensional with identical sizes. The other image features can also be used in the texture by the same approach, e.g. Gabor filters.

3. Feature Extractions

In this part of the paper, Gabor filters and wavelets have been popularly used. Moreover in frequency domain required more computation for these methods and the accuracy obtained by these methods is also very good. The old methods like GLCM are still remembered because of its working and its style. But it still remains to be a baseline algorithm for comparative studies, especially used for texture classification. The major aspect of the today research is feature extraction for texture classification and it should be highly accuracy oriented, however, usually the newer approach algorithms gives a better accuracy but it include more number of calculations that may effect on the speed of the algorithm. In texture classification new approach is used known as region covariance matrix. Its major advantage it's fast computational and integral image. So, among from all we will work on some hybrid methods selected that will give us more accurate results.

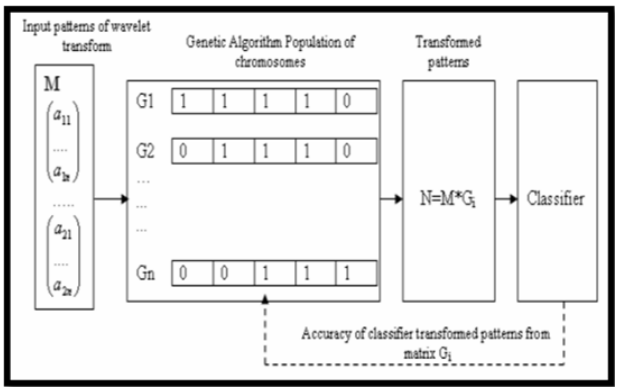


Figure 4. Classification accuracy using GA based features extractor.

3.1 Feature Selection and Optimization using GA and SVM

In classification problem some features are redundant and relevant. In order to reduce the large number of features to a smaller in numbers, we still use GA based global search method, which is an efficient method of processing and analysis the behavior of evaluation process. It's an initial population of individuals fittest person survival is a high chance of in such a way that evolves through natural selection and maintains a population of competing feature transformation matrices.

4. Classification of Methods

In the data classification there are three groups of classifiers which are closest neighbors, Support Vector Machines (SVM), Artificial Neural Networks (ANN) .Other than these classifiers are less popularly used classifiers.

4.1 Nearest Neighbors

They act as simple classifiers for selecting the nearest distance training samples for the query sample and it will find the distance and gives results from the query to every sample and selects the nearest sample with a shorter distance. The most commonly implementation is a k-Nearest Neighbor (k-NN) where k is number of best selected neighbors and among the best number of votes from the k neighbors will decide the nearest neighbor winning class. These are simple and easier to be implemented. This approach more useful when there is a small dataset available that may not effectively trained by using other machine learning methods. The major disadvantage of these algorithms is the speed of computing distance will increase depending on the number of training samples available.

4.2 ANN (Artificial Neural Network)

These are the most popular learning algorithms which are widely used. In training duration back-propagation is used for updating the weights of neural network. This method is slowly losing popularity and is taken over by other method which is SVM (Support Vector Machine).

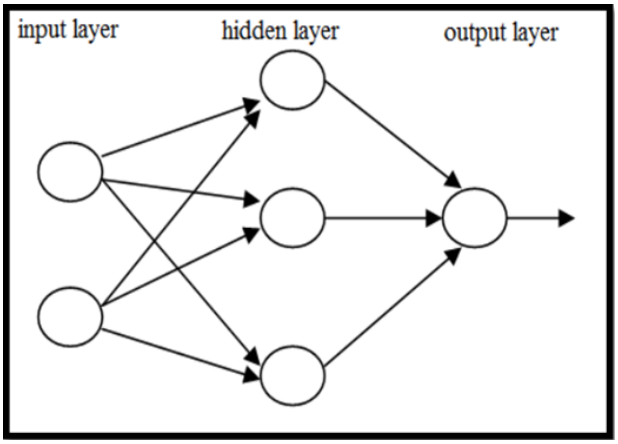


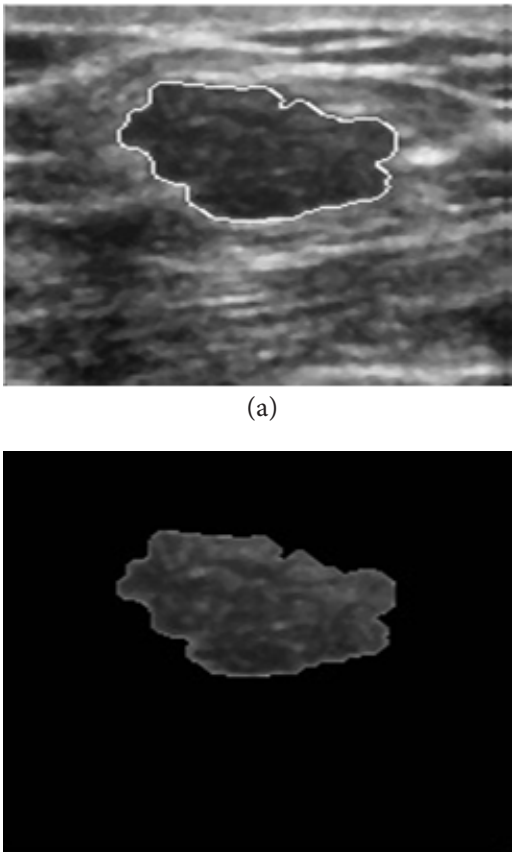
Figure 5. Basic structure of ANN

4.3. SVM (Support Vector Machine)

For solving the texture classification problem generally Support Vector Machine is used. It is designed to maximize to solve problems in recent years, including texture classification. SVM is designed to maximize the marginal distance between classes with decision boundaries drawn using different kernels. It is also designed to work with only two classes by finding the hyper plane to divide two classes which can be done by maximizing the margin from the hyper plane to two classes. The samples closest to the margin that were selected to determine the hyper plane is known as support vectors. The winning class is then determined by the highest output function or the maximum votes respectively. It is still the most powerful classifier which was replacing the ANN and has become the most widely algorithm in the research of texture classification.

5. Result and Discussion

The research work is being carried out experimentally using the brodatz texture dataset which applied on the different five images of abnormal images and one normal image of different part of brain. Texture analysis of the 5 different images of each case is done by finding their contrast, correlation, energy, homogeneity and entropy, and then their range is obtained as mention in Table 1 by using the SVM classifier. In detection process the digital image is portioning into multiple images i.e. set of pixels. So, detection is basically partitioning an image into several constituents' components. Detection of an image is subdivided images into its constituents region or object as shown in Figure 6(a) and 6(b). The detection is stopped when objects of next in applications have been isolated. The texture value of particular normal is compared with the range of that particular case. If the value outside the range concludes the normality of the image.

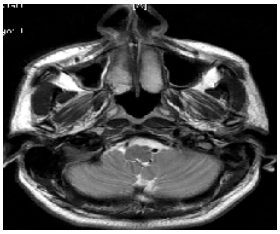


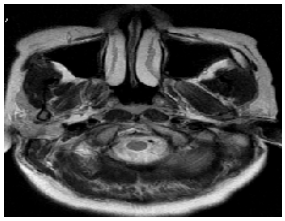
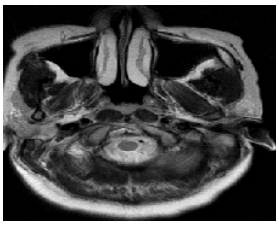
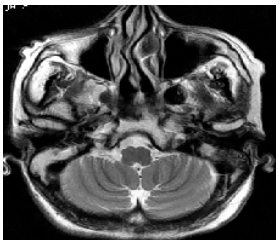
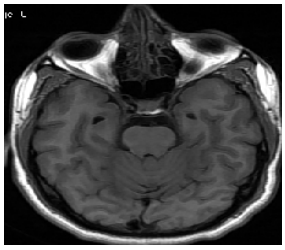
(a)

(b)

Figure 6. (a) Detection of Cancerous part. (b) Cancerous part detected.

Table 1. Texture features analysis of different MR image

Case	Image type	image	Texture features	
I	Normal	I		Contrast: 2.223 Correlation: -0.0042 Energy: 1.690 Homogeneity:0.0249 Entropy : 6.597
	Abnormal	II		Contrast: 2.0134 Correlation: -0.0034 Energy: 1.584 Homogeneity:0.0277 Entropy : 6.580

	Abnormal	III		Contrast: 2.1638 Correlation:-0.0035 Energy:1.639 Homogeneity:0.0268 Entropy:6.663
	Abnormal	IV		Contrast:2.0840 Correlation: -0.0029 Energy: 1.6241 Homogeneity:0.0271 Entropy :6.876
	Abnormal	V		Contrast:1.8478 Correlation: -8.0489 Energy: 1.6949 Homogeneity:0.0284 Entropy :6.7175
	Abnormal	VI		Contrast:1.8928 Correlation: 1.9322 Energy:1.5644 Homogeneity:0.0287 Entropy :7.0244
II	Normal	VII		Contrast: 2.5099 Correlation: -0.0051 Energy:1.4734 Homogeneity: 0.0249 Entropy:6.5689

6. Conclusion

From the above stated various methods of proposed work we can say that the hybrid technique is used for image extraction, selection and classification. The texture analyses of both the normal and abnormal images are done. On the bases of the values of abnormal images, the range is calculated and further it is compared with the texture features of normal image. So, to determine the whether the abnormality is there or not in the image, its texture features are observed and the feature lying outside the range finally concludes that image is normal. It is seen that 5 different cases are taken and each case consists of 5 abnormal images and 1 normal image of a particular part of the brain. Texture analysis of the 5 different images of each case is done by finding their contrast, correlation, energy, homogeneity and entropy, and then their range is obtained. Finally, analysis of the normal image of each case is performed. The texture value of particular normal is compared with the range of that particular case. If the value outside the range concludes the normality of the image. So, from the above theory, it is clear that the present methods may work as an automatic classification of abnormalities in lungs MRI images. Which can help radiologist in performing an in-depth examination and moreover, in future work we will implement this technique to compare results with other researches clinically and accuracy will check out thoroughly.

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