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Original Article

"Automated Disease Diagnosis In Medical Images"

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ABSTRACT

Medical imaging is a vast and important application of image processing. Medical images are characterized by very high resolution and very band sensitive images.

There are medical images associated with various tests like the CT-Scan, MRI, X-Ray, Mammography, Ultra Sonography, Angiography, Endoscopy etc. Each test is performed for specific set of disease diagnosis, for example Mammograms are taken to analyze the breast cancers, sonographic images are taken for analyzing the kidney stone and so on. Generally the analysis of such images required expert radiologists or specialists. Sometimes the unavailability of the specialists causes significant delay in the diagnosis of such cases which proves fatal for some subjects. Our objective is to carry out a research on automated disease diagnosis for various medical imaging in order to classify the abnormalities in the image of the subject, if it is present. Even though content based image retrieval systems and pattern classification is quite old research areas, the standard mechanisms applicable for such areas are not applicable to medical images because of diversity in the abnormalities and because of the dependency of the images on the physical attributes of the subject like the amount of fluid flow or the blood pressure etc. Hence the research will open a door for automated disease diagnosis which may further integrated with a Medicinal data warehouse system for an automated medicine suggestion also.

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I. PROPOSED STAGES

A. Data Collection

Initially we would collect data for following tests.
i) MRI ii) CT Scan iii) X-Ray iv) Mammogram v) Intenstinal
vi) Endoscopy

B. Denoising

As the clarity of the images may not always be good because of various physical or technical problems we would propose methods for denoising/restoration for each types of images. For denoising we would research mainly on three domains.

Wavelet, Spatial and Frequency domain Filtering, Also anisotropic diffusion for region of interest can be adopted for denoising.

c) Segmentation

Medical images are very high resolution images. The images contain many smaller and broader details in a section of inner anatomy. The abnormalities are difficult to track over the entire image. Therefore in the first step an appropriate segmentation needs to be adopted which can separate region of interest from the rest of images. Therefore pattern classification over the ROI segmented image becomes more efficient than the classification over non segmented images.

d) Feature Extraction

Once the images are perfect for analyzing it requires an appropriate mechanism for feature extraction. The feature extraction may be global or local. A local feature extraction will be only a area specific which interns requires a relevant area to be segmented out from the main image. Hence methods must be developed relevant to segmentation, specific to the type of imaging.

Types of features may be effectively categorized into following major category.
i) Color ii) Texture iii) Shape iv) Sub band v) Frequency domain vi) Invarient viii) GLCM etc.

D) Classification and Recognition

Once the features are extracted, they must be analyzed for abnormalities. It requires a set of training images, w.r.t which the analysis will be performed. It requires different classifiers which may be statistical or non statistical. Accordingly we may select any or combination of following classifiers.

1. Neural Network
2. Fuzzy Classifier
3. Self Organizing Maps
4. Support Vector Machines
5. Nearest Neighbor Classifier

Once the classification is performed, further specialized class detection or pattern recognition for the images is required which can be further performed by re cascading the classifier.

I. Related Work

[1] present a methodology to improve optical quantification by utilizing the ability of Dixon MR imaging to quantitatively estimate water and fat; this technique effectively reduces optical crosstalk between water and oxyhemoglobin.

[2] present a novel algorithm to detect suspicious lesions in mammograms. The algorithm utilizes the combination of adaptive global thresholding segmentation and adaptive local thresholding segmentation on a multiresolution representation of the original mammogram. The algorithm has been verified with 170 mammograms in the Mammographic Image Analysis Society MiniMammographic database.

[3] present a supervised approach for automatic detection of micro-calcifications. The system is based on learning the different morphology of the micro-calcifications using local features, which are extracted using a bank of filters. Afterwards, this set of features is used to train a pixel-based boosting classifier which at each round automatically selects the most salient one.

[4] proposed a detailed method to identify cancer parts just using simple technique of isolation of insignificant portion of slide by color polarization. The simplicity of algorithm is leads to less computational time. Thus, this approach is suitable for automated real-time breast cancer diagnosis tool.

[5] compared various MLP activation functions for classification problems. The most well-known (Artificial Neural Network) ANN architecture is the Multilayer Perceptron (MLP) network which is widely used for solving problems related to data classifications. Selection of the activation functions in the MLP network plays an essential role on the network performance. This paper investigate the activation functions in MLP networks in terms of the accuracy performances. The activation functions under investigation are sigmoid, hyperbolic tangent, neuronal, logarithmic, sinusoidal and exponential. Medical diagnosis data from two case studies, thyroid disease classification and breast cancer classification, have been used to test the performance of the MLP network.

[6] introduce a variational image segmentation method for assessing the aberrant crypt foci (ACF) in the human colon captured in vivo by endoscopy. ACF are thought to be precursors for colorectal cancer, and therefore their early detection may play an important clinical role. The paper enhances active contours without edges model of Chan and Vese to account for the ACF's particular structure.

[7] proposed a frame classification scheme based on statistical textural descriptors taken from the Discrete Curvelet Transform (DCT) domain, a recent multi-resolution mathematical tool. The DCT is based on an anisotropic notion of scale and high directional sensitivity in multiple directions, being therefore suited to characterization of complex patterns as texture. The covariance of texture descriptors taken at a given detail level, in

different angles, is used as classification feature, in a scheme designated as Color Curvelet Covariance.The classification step is performed by a multilayer perceptron neural network.
[8] elaborates a detailed description and comparison of speckle reduction of medical ultrasound, and in particular echocardiography, is presented. Fifteen speckle reduction filters are described in a detailed fashion to facilitate implementation for research and evaluation. The filtering techniques considered include anisotropic diffusion, wavelet denoising, and local statistics. Common nomenclature and notation are adopted, to expedite comparison between approaches. Comparison of the filters is based on their application to simulated images, clinical videos, and a computational requirement analysis.
[9] Finds that Magnetic Resonance Imaging is affected by random noise which limits the accuracy of many quantitative measurements from the data. The coupled partial diffusion equations are introduced for Magnetic Resonance Imaging denoising. One equation contains an anisotropic diffusion term, which controls the diffusion direction, a fidelity term, which assures the filtered image is not far from the initial image, and a diffusion gene, which controls diffusion speed of each pixel and connects with another diffusion equation.
[10] presents A supervised framework for the automatic registration and segmentation of white matter (WM) tractographies extracted from brain DT-MRI. The framework relies on the direct registration between the fibers, without requiring any intensity-based registration as preprocessing. An affine transform is recovered together with a set of segmented fibers.
[11] presents a new supervised method for blood vessel detection in digital retinal images. This method uses a neural network (NN) scheme for pixel classification and computes a 7-D vector composed of gray-level and moment invariants-based features for pixel representation. The method was evaluated on the publicly available DRIVE and STARE databases,
[12] presents techniques to measure the complexity of the developing fetal cortical surface using the concept of FD. As has been done by others, the commonly used box-counting (BC) method was herein extended from 2-D to 3-D to quantify the FD of fetal cortical complexity. The primary theoretical contribution of this work is the modification of the 3-D BC method using a local FD measure to yield an accurate FD that elucidates the fractal characteristics of the cortical surface. The proposed 3-D modified BC (MBC) method was then adopted to estimate the FD to measure the complexity of the cortical surface of 32 normal and six test fetal brains at a gestational age (GA) of 27-37 weeks.

Ultrasonic image segmentation is a difficult problem due to speckle noise, low contrast, and local changes of intensity. Intensity-based methods do not perform particularly well on ultrasound images. [13] proposes a level set propagation to capture the left ventricle boundaries. The proposed approach uses a new speed term based on local phase and local orientation derived from the monogenic signal, which makes the algorithm robust to attenuation artifact. Furthermore, we use Cauchy kernels, as a better alternative to the commonly used log-Gabor, as pair of quadrature filters for the feature extraction. Results on synthetic and natural data show that the proposed method can robustly handle noise, and captures well the low contrast boundaries.

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