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Short Communication

A NOVEL APPROACH FOR DIAGNOSING LIVER LESION IMAGES IN TELEMEDICINE MODE

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Abstract:
In this article, a novel approach for diagnosing liver lesion using ultrasound image in telemedince mode is attempted. Liver cancer is a one of the neoplastic diseases. It has a high rate of mortality. The low quality of clinical ultrasound image limits the success of early detection and diagnosis based on the images. Filtering the spcekle noise to enhance the quality and segment the ROI from the ultrasound image are carried out. Wavelet-based texture descriptors are calculated and classification has been done using support vector machine. Telemedicine is the ability to provide interactive healthcare utilizing modern technology and telecommunications. In this telemedicne mode based diagnostic classification system, a client at remote location can submit the ultrasound B-scan liver image using the Internet and after analysis in the web server, the client at remote location will receive the diagnostic result.

I. Introduction :

Telemedicne may be defined as the use of electronic information and communications technologies to provide and support health care when distance separates participants. Telemedicine is an upcoming technology which is intended to minimize the gap between medical professionals and patients[1]. The services of the medical fraternity can be extended to the rural sector through telemedicine.

In some cases of ultrasound diagnosis, only subtle differences in images are seen as in certain liver lesions, where existing B-scan methods are inadequate. Ultrasound has been extremely valuable in differentiating a simple liver cyst from other liver masses and is therefore the first study obtained in the evaluation of a suspected liver mass. In some cases, when diagnosing remains obscure, aspirational biopsy and/or exploration are often required. Texture properties of image carry useful information for discriminating purposes. Texture is a commonly used feature in the analysis and interpretation of images. A number of approaches to solve texture classification problem have been developed over the years. Early research work was based on the first and second order statistics of texture [2], [3], [4].

First and Second order statistics of the wavelet detail coefficients provide texture descriptors that can discriminate contrasting intensity properties spatially distributed throughout the image, according to the various level of resolution [5], [6]. Second order statistical measures can be evaluated on the output of the 2D wavelet transformation in order to create a more reliable framework for the generation of the textural descriptors [8].

Features extracted from ultrasound images of the liver can discriminate usefully between normal and diffuse disease by taking advantage of the underlying changes in structure, as manifest by patterns of scatter [10].

Support vector machine (SVM) have been extensively used in the last few years for medical applications, including a variety of data classification and pattern recognition problems in medical imaging, achieving encouraging results due to their capability to address problems by learning from examples and their capability of simultaneous processing large amounts of information. Considering the great difficulties in ultrasound diagnosis due to the limited sensitivity of this technique and the great complexity of ultrasound images, which require a long training for their interpretation, it has been felt that the use of SVM is specifically worthwhile in this field.

The applications of tele-medicine are innumerable, but the most important and successful applications are tele-radiology, tele-cardiology and tele-pathology. Home healthcare is an application rapidly developing in the field of telemedicine. Promising new technologies will help to deliver healthcare into the homes using telephone lines and existing home cable television distribution networks [9]. In this idea, diagnosis of liverlesion using wavelet-based texture descriptors, machine learning technique and telemedince mode has been attempted.

II. Materials And Methods

A. Wavelet Texture Descriptors

There are various methods applied towards the study of characterization of texture within medical images including run-length encoding, discrete wavelet transform and two-dimensional co-occurrence matrices. The co-occurrence matrix is a function of two parameters: relative distance measured in pixel numbers (d) and their relative orientation θ. Cooccurrence matrices signify the spatial distribution and the dependence of the gray levels within the area. Each and every entry of the matrices represents the probability of going from one pixel to another pixel with gray levels under

a predefined distance and angle. For building different textural model, statistical measures with these matrices have been computed.

In our system, we have measured four angles, namely 0°, 45°, 90° and 135° as well as predefined distance of one pixel in the formation of the cooccurrence matrices. Therefore, we have formed four Cooccurrence matrices. According to our work, second order statistical gray level measures, originally proposed by Haralick [3], [16], provide high discrimination accuracy that can be only slightly amplified by adding more measures in the feature vector.

The preprocessed image is decomposed using 2D wavelet transform into 4 subbands: low-low (LL) band, low-high (LH) band, high-low (HL) band and high-high (HH) band. Daubechies 2 level wavelet filter is used with 3 pixel resolutions. The LL-band texture is a smoothed version of the input texture, while the LH-band texture, the HL-band and HH-band textures are high pass filtered textures in the x direction, y direction, and both x and y directions respectively[11].

The ultrasound B-scan images are collected from the scan centres for training and testing. After the preprocessing of the ultrasound liver image, the region of interest (ROI) was calculated and the histogram of each of the detail coefficient matrix was obtained. The final texture descriptor vector had 11 elements per resolution level.

B. Support Vector machine

Support vector machines are supevised learning model in machine learning which is used for classification The support vector machine is a machine learning algorithm that generalizes the Support Vector Machine (SVM) classifier. Whereas the SVM classifier supports binary classification, multiclass classification and regression, the structured SVM allows training of a classifier for general structured output labels[12].

The original support vector machine (SVM), introduced in 1992, can be characterized as a supervised learning algorithm capable of solving linear and non-linear classification problems. In comparison to neural networks we may describe SVM as a feed-forward neural net with one hidden layer area [18]. The architecture of SVM is shown in Fig.1.

When an input is presented, the first layer computes distances from the input vector to the training input vectors, and produces a vector whose elements indicate how close the input is to a training input. The second layer sums these contributions for each class of inputs to produce as its net output as a vector of probabilities. Finally a complete transfer function on the output of the SVM as class one to normal and class one as benign and class two as malignant. While Training, the training error was calculated to find the quality of the training. Training and testing were created and tested separately using all images.

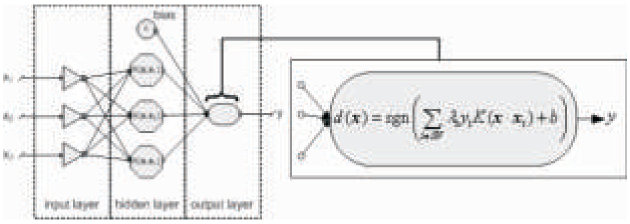

Fig. 1. Architecture of the Support Vector Machine.

C. Web Server

In all the modern hospitals and scan centres, all the radiology department equipment like Ultraounnd, CT scan, MRI etc are connected through Local area networks (LAN) and Internet. Radiology images can now be transmitted from one centre to any part of the world in real-time. The diagnostic system in telemedince mode developed in this work inhibits the typical Internet environment.

The developed web server for diagnostic classifier has been connected to internet leased line connectivity, which is able to receive images submitted by the remote user in JPEG format on the World Wide Web. The web server invokes the MATLAB script intended for computation of the wavelet-based texture descriptors and the obtained descriptors are submitted to a trained support vector machine for classification of liver lesion. The output is the generated result, which is sent back through Internet to the client at distance place.

I. Results :

The Internet Information Server (IIS) is available in windows server operating system. While installing windows server on a system, the IIS also installed automatically with the operating system. The configuration screen of the IIS is shown in Fig. 2. The required data for the IIS are Global IP, Root Directory (Home Directory), Security Level, Web Page Types (extension) and Name of the first Page. These major information's are used to configure IIS.

Global IP is the unique address for web server. Home directory, which enable the user to store all the web pages in it, and the path of the home directory, must locate using IIS. Security level is used to restrict others entering in the system and free from virus, warms, spy's, etc., The type of web page for instance index.html or default.asp must be mentioned in the document part of IIS.

In the development of web-based diagnostic system, whenever a user submits an image from a remote location using Internet, the wavelet-based texture descriptors are calculated in the developed tele mode web server. The wavelet-based texture descriptors of the ultrasound B-scan image are given to the trained SVM and the classification is done in the telemedicine mode web server[19]. The result of the diagnostic result is sent back to the remote location client.

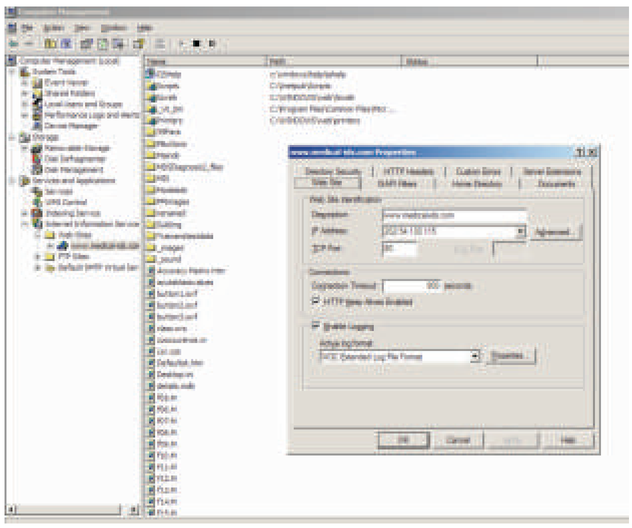

Fig.2. Internet Information Server Setup Screen

I. Conclusion :

The technology and tools of computer and communication is changing the medical practice into a better implementation. There are many research works done in developing non invasive medical devices with the advent of technologies. With the development of networking and Internet facilitates all over the world, the developed telemedicine mode diagnostic classifier can be accessed by user from anywhere in the world. Accessibility for this system has been extended to all people in remote location and even to the rural sector through telemedicine mode.

In this work, we have attempted a novel approach for diagnosing liver lesion using ultrasound B-scan image in telemedince mode. The developed telemedince mode diagnostic classificer provides a second opinion for physician to discriminate the liver lesion from ultrasound B- scan mode image, which can be carried out even from remote location.

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