An Integrated Approach of SOM Segmentation and Multi-wavelet for Classification of Brain-Stem

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Abstract— MRI-based medical image investigation for brain stem studies is ahead attention in topical times due to an amplified need for proficient and objective valuation of large amounts of data. While the original approaches applying mechanized methods for the analysis of brain stem images date back approximately two decades, the modern methods became proficient and coming nearer to routine clinical purpose. Early diagnosis of Parkinson’s disease (PD) is of massive significance, since clinical symptoms do not happen until substantial portion of the Substantia Nigra (SN) neurons in the brain stem have been irreparably spoiled. In this paper we have proposed an approach which is integration of Multiwavlet based image preprocessing and SOM based image classification that will significantly increase the accuracy which help to diagnose SN in brain-stem.

Key words: PD, SN, SOM, MRI, SOPCA

I. INTRODUCTION

Diagnostic imaging is a useful tool in medical science these days. Magnetic resonance imaging (MRI), computed tomography (CT), digital diagnostic technique, and different imaging modalities offer a good means for noninvasively mapping the anatomy of a subject. These technologies have greatly increased knowledge of normal and diseased anatomy for medical research and are a critical component in diagnosis and treatment planning. With the increasing size and number of medical images, the use of computers in facilitating their processing and analysis has become necessary.

A range of approaches has been proposed for semi-automatic detection of various structures in the head. These approaches usually require manual interaction, even in most practical implementations, to perform the required segmentation and detection. The fully automated segmentation, however, is still under research. Image processing in modern medicine is very helpful to diagnosis. In our case we work with set of MRI images of brain-stem to potential diagnosis of Parkinson’s disease (PD), which is chronic disease depending on production of dopamine. In ultrasound images is characterized by defects in substantia nigra (SN) area in brain-stem.

The goal of this paper is to show an application which has been developed for ROI SN and searching these defects by thresholding and area comparison followed by statistical analysis. This application is helpful for classification of patients who have PD or not. For analysis of these images we are using a two-stage neural network system The first stage is a self-organizing principal components analysis (SOPCA) network that is used to project the feature vector onto its leading principal axes found by using principal components analysis. This step provides an effective basis for feature extraction. The second stage consists of self-organizing feature map (SOFM) which automatically clusters the input vector into different regions.

Fig. 1: The position of SN in brain

In brain stem Substantia nigra (SN; in English “black substance”) is a brain structure[14] which is located in the mesencephalon (midbrain) that plays an important role in reward, addiction, and movement. SN produces an important dopamine for correct function of CNS (Central nervous system).

II. LITERATURE SURVEY

Actual modern medicine is focused on new progressive technologies for image processing and we encounter with these technologies in many areas of medicine. Modalities US, CT, MRI, X-Rays, PET are nowadays common but indispensable in medicine. This work also well shows interdisciplinary character between medicine and computing. The neural networks are very applicable for image processing problems. Thus we have the different approaches to comparison.


This paper shows how to solve the recognition of ultrasound brain-stem images. Our work is based on PCA method that is very useful and known method for image processing. This paper uses artificial neural networks (ANN) for this problem and we will compare a results. The ANN is generally very usable for image processing. It has been demonstrated with Neuro Solutions software that is very sophisticated simulator of ANN with PCA multilayer (ML) NN topology.

2) Image processing of medical diagnostic neuro son graphical images in MATLAB[14]

This paper presents a processing of medical ultrasound images with MATLAB. This processing is useful to potential diagnosis of Parkinson’s disease in brain-stem area. Furthermore introduces DICOM standard for medical imaging and modern 3D/4D scanning for high level and accuracy of diagnoses that is higher than traditionally 2D scanning.
3) SOM Segmentation of Gray Scale Images for Optical Recognition[20]
This paper describes a clustering technique using Self Organizing Maps and a two-dimensional histogram of the image. The two-dimensional histogram is found using the pixel value and the mean in the neighborhood. This histogram is fed to a self-organizing map that divides the histogram into regions. Carefully selecting the number of regions, a scheme that allows an optimum optical recognition of texts can be found. The algorithm is especially suited for recognition application where a very high degree of confidence is needed.

This paper presents a method for color image segmentation which uses classification to group pixels into regions. The chromaticity is used as data source for the method because it is normalized and considers only hue and saturation, excluding the luminance component. The classification is carried out by means of a self-organizing map (SOM), which is employed to obtain the main chromaticities present in the image. Then, each pixel is classified according to the identified classes. The number of classes is a priori unknown and the artificial neural network that implements the SOM is used to determine the main classes. The detection of the classes in the SOM is done by using a K-means segmentation.

III. PROBLEM IDENTIFICATION
After study of various literature we got that image classification can be done by following process as shown in fig.

Much work carried out in this field still accuracy is less henceforth to increase the accuracy we can use some different Neural Network tool for image classification so that detection of defects in SN ROI (Region of Interest) by region growing method with automatic detection of ROI from whole image to more exact PD diagnose and furthermore we can use some filtering methods. If we will use some good image preprocessing technique like GHM multiwavelet filter then accuracy will increase.

<table>
<thead>
<tr>
<th>Input</th>
<th>Classification Method</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI Images</td>
<td>PCA</td>
<td>80%</td>
</tr>
<tr>
<td>Ultrasound Images</td>
<td>PCA</td>
<td>80%</td>
</tr>
<tr>
<td>MRI Images(*)</td>
<td>Neuro Fuzzy Model</td>
<td>60%</td>
</tr>
<tr>
<td>Color Images(*)</td>
<td>SOM</td>
<td>90%</td>
</tr>
</tbody>
</table>

Table 1: Comparison of Image Classification Technique

IV. PROPOSED METHODOLOGY
From section III we came with some conclusion.

1) If we apply any good image preprocessing technique on input image then accuracy will increase in next phase i.e. Image classification.

2) From Table 1 we can conclude that SOM provide great accuracy in image classification.

A. Image Pre-Processing:
At the primary step for every processing is suitable preprocessing for successful application. Thus, the first step is cropping of images to window with stem area and removal of noise. For removal of noise we are using GHM multiwavelet. The idea of Multiwavelet originates from the generalization of scalar wavelets. Instead of one scaling and one wavelet function, multiple scaling and multiple wavelet functions are used. This leads to more degree of freedom in constructing Multiwavelets. Therefore, opposed to scalar wavelets, properties such as orthogonality, sym-metry, higher order of vanishing moments, compact support can be gathered simultaneously in Multiwavelets. Multiwavelets are of mainly two types: 1) Orthogonal type such as Geronimo-Hardin-Massopust (GHM).

B. Feature Extraction:
The feature extraction [19] is used to reduce the dimension of the input data and minimize the training time taken by the classifier. Multiple features which include geometrical moments, statistical moments and texture moments are extracted from the region of interest (ROI). The features are represented by their chromaticity values, which express colors hue and saturation, avoiding the luminance component. The chromaticity is obtained by normalizing the RGB components of the image, named the r, g and, b components.

C. Classification:
The proposed segmentation utilizes a self-organizing map to detect the main features present in the image.

```
somcluster(im)
//im - input samples
map=8;
//map size
//[p1,p]=size(im)
mw=rand(map,map,1); //initialize map;
[m,n]=size(im);
wx=0;wy=0;sigma=0.0;update_lrate=0.99;
update_radius=map/3;radius_decay=0.999;
i=1
for t=1:10000 //iteratio
```
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V. RESULTS

For implementation of our project we have used Matlab 2013 and open access PD affected MRI brain images.

VI. CONCLUSION

Identification of Parkinson’s disease is thought-provoking problem and there is still a lot of work has been done in this area. Finished the past few years, recognition of SN in brain-stem has expected substantial attention from scientists in neurology communities.

As we have discussed in section III to increase the accuracy we can use some different Neural Network tool for image classification so that detection of defects in SN ROI by region growing method with automatic detection of ROI from whole image to more exact PD diagnose. From comparison provided in section V we can conclude that SOM provide more accuracy.

REFERENCES


An Integrated Approach of SOM Segmentation and Multi-wavelet for Classification of Brain Stem (IJSRD/Vol. 3/Issue 03/2015/228)


