VLSI IMPLEMENTATION FOR IMAGING BASED CLASSIFICATION OF NEURODEGENERATIVE DISEASES

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***Abstract*: Neurodegenerative diseases are mainly occurs due to the deterioration of myelin sheath of neurons, brain spinal cord, and peripheral nerves. The economic and social burden of the diseases is massive and rising too rapidly. There are several kinds of neurodegenerative diseases in that the present work is focused Alzheimer's diseases. The aim of this work is to automatically classify patients as probable Alzheimer's diseases (AD) subjects or normal subjects and to find the severity of the diseases condition. In this work a fusion strategy is proposed to mix together bottom-up and top-down information flows to find the presence of the diseases. Bottom up stage includes a multiscale analysis of different image features, top-down flow includes learning and a fusion strategy which is formulated as max-margin multiple kernel optimization problems. Support Vector Machine (SVM) is used to classify and to find the severity of the disease.**
***Keywords*: AD, SVM, VBM, Visual saliency, MRI**

I. INTRODUCTION

Neurodegenerative diseases are a debilitating condition where progressive degeneration or death of nerve cells takes place which causes problems in mental functioning, or with movement. It basically affects neurons of human body, neurons are the building blocks of nervous system that includes brain, spinal cord, peripheral nerves. Neurons neither reproduce nor replace themselves so once when they are damaged or die they cannot be replaced by human body. Neurodegenerative diseases comprise variety of mental symptoms which cannot be evolved by the visual analysis made by radiologists. World wide it is estimated that approximately 20-30 million people suffer from neurodegenerative diseases. Many researchers have suggested that neuroimaging may become one of the valuable tool in the early detection and diagnosis of neurodegenerative diseases.

Biochemical, clinical, neuropsychological analysis against neuroimaging remains to be demonstrated for large population, but still there exists sufficient evidence of patients suffering with different states of neurodegenerative diseases. The main aim of analysing structural brain MR images is to find anatomical changes, either local or global, that is related to functional disturbances. In particular radiologists examine images by looking at unique regions and compare them by searching differences [1].In existing method the morphometric brain analysis method consists of a set of strategies which is aimed to extract and quantify anatomical differences between groups of subjects. Voxel-based Morphometry (VBM) [2] and Deformation-based Morphometry (DBM) [3] are the most used techniques to compare populations. In this work we propose an automatic image analysis method inspired by the radiologist visual perception. The method is built on a visual saliency model and is extended to involve a learning process that imitates the adaption of a radiologist visual perception.

II. METHODOLOGY

In this work, MIRIAD (Minimal Interval Resonance Imaging in Alzheimer's disease) dataset of normal and abnormal MR images of the patients is used for the analysis. MIRIAD is raw dataset which is not readable by the processor therefore encoding scheme is used. The images are pre-processed to separate the information in the form of pixel content that represents the brain image and its header represents the data type of each pixel in an image.

The dataset has 0 to 255 planes, where the middle three planes are selected for the analysis, since brain would have reached to maximum expansion during these planes and the tumour identification becomes easy. For the pre-processed MR images Visual Saliency features such as edges, intensity and orientation are calculated. The salient features of all the three planes are fused using bottom-up fusion approach for whole brain volume. The dissimilar pixels are extracted by using Local Binary Pattern (LBP) the process is known as feature extraction. All the features of three planes are fused together in Bottom-Up Fusion thereby we get a single tumour region.

Also the presence of unwanted, irrelevant, noisy features and computational time is reduced by using dimensionality reduction technique (DOG). Further the features are trained in training phase and is temporarily stored in RAM and fed to Support Vector Machine (SVM) classifier [4-7]. In testing phase the query image is selected and the same procedure is followed to obtain the features [8,9]. The features are fed to SVM classifier, that classifies the image into normal or abnormal image also the severity of the disease condition is obtained. The proposed system is implemented using MATLAB and VLSI domain. The block diagram of the proposed work is shown in fig.1

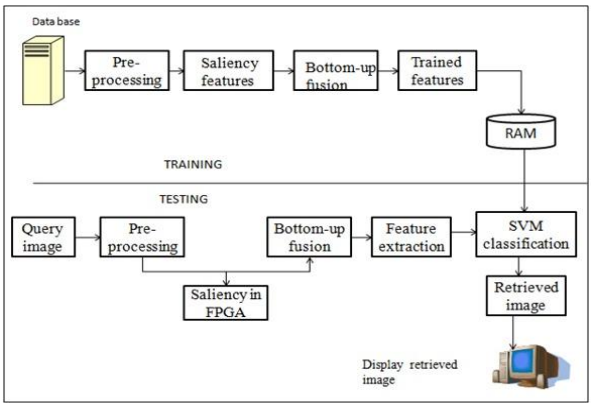

Fig 1. Block diagram of proposed approach

III. RESULTS & DISCUSSION

Fig 2a. and fig 3a. represents the original abnormal MRI image. Fig 2b and fig 3b shows bright region that is obtained using visual saliency technique, the high intensity regions indicates the presence of tumour. In Fig 2c and fig 3c red region indicates the tumour region in Alzheimer's disease and also it gives information about severity of the diseases condition. Fig 2d and fig 3d are Graphical User Interface (GUI) output which shows the severity of the disease. Accuracy of the system is 90%.

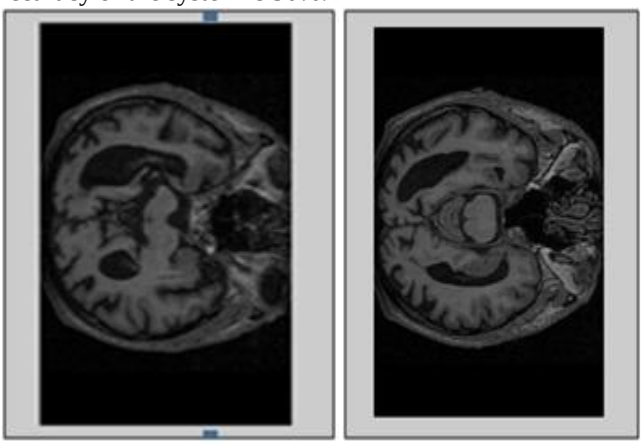

Fig 2a. Original abnormal MRI image
Fig 3a. Original abnormal MRI image

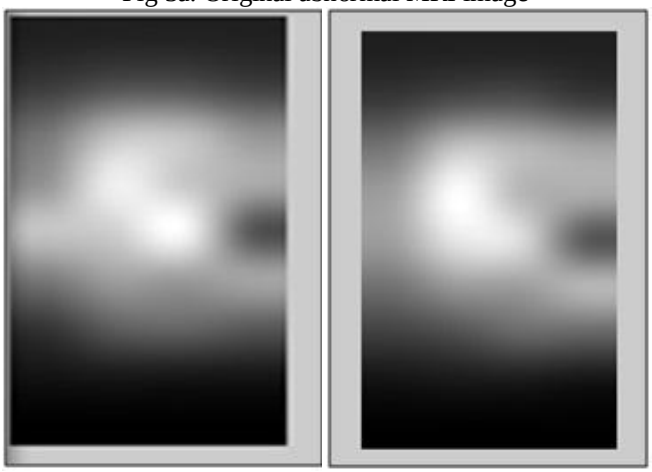

Fig 2b. Saliency map of original image
Fig 3b. Saliency map of original image

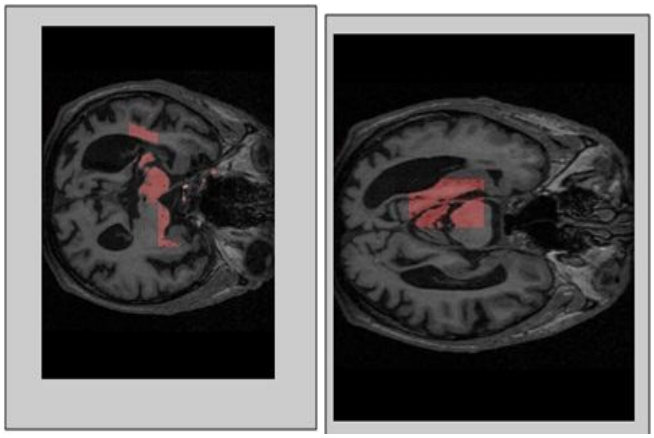

Fig 2c. Reveals the structural brain patterns associated to the presence of the Alzheimer's disease.
Fig 3c. Reveals the structural brain pattern associated to the presence of Alzheimer's disease.

Fig2d. Shows the severity of Alzheimer's disease disease in in fig 2c. as high
Fig3d. Shows the severity of Alzheimer's fig3c as medium.

IV. CONCLUSION

This work is intended to design an automated classification system for the pathological diagnostic of the disease in its infancy stage. SVM classifier is precise and reliable in diagnosis and outcome prediction in varied clinical setting which will ultimately support Clinicians and Researchers, and patients could be treated for such disease prior to commencement of disease helping millions of people to lead their normal life.

V. ACKNOWLEDGMENT

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