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Survey On Diagnosis Of Brain Hemorrhage By Using Artificial Neural Network

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ABSTRACT
Brain hemorrhage is bleeding in or around the brain tissues caused due to ruptured artery, which is a form of stroke known as hemorrhagic stroke. CT scan enables the accurate diagnosis of brain hemorrhage. The aim of this project is to help radiologist as well as medical students in diagnosis of brain hemorrhage in more refined manner by feeding CT images & identify the type of brain hemorrhage using watershed algorithm along with artificial neural network (ANN).

***Keywords** - Artificial Neural Networks (ANN), Computed tomography (CT).*

I. INTRODUCTION

Brain hemorrhage is a type of stroke, which occurs due to the bleeding in or around the brain tissues as result of ruptured artery. The factors responsible for brain hemorrhage are trauma, high blood pressure, smoking habits, alcohol usage, aneurysm, blood disorders like hemophilia, sickle cell anemia etc. Approximately more than 80% of people who are being born with weak spots in their major brain arteries are at the risk of brain hemorrhage [1]. When blood from trauma irritates the brain tissues, it develops swelling that is cerebral edema. This edema pooled blood from surrounding tissues and accumulates to form a mass known as hematoma in brain. This will results in increasing pressure on brain tissues, thus decreases the vital blood flow and kills brain cells. Bleeding may occur inside the brain or in between brain and its covering membranes or in between layers of covering. Accordingly, brain hemorrhage is categorized as:

- Intracerebral hemorrhage (ICH),
- Subdural hemorrhage (SDH),
- Extradural hemorrhage (EDH),
- Subarchnoid hemorrhage (SAH).

The main technique which helps in diagnosis of brain hemorrhages in human being is through Computed Tomography (CT) scan. CT scan is combination of x-rays. During CT imaging an x-ray tube rotates around the patient's head which captures multiple images. This captured images are analyze through computer. CT image allows radiologist and other physicians to identify internal structure of body mass, also observed its shape, size, density and texture. CT scan technique is suitable for claustrophobic patients as well as those patients having metallic or electrical implants in their body. It is also suitable for those who are too large in size. CT scan is effective in diagnosing bleeding and fractures in inner parts of body.

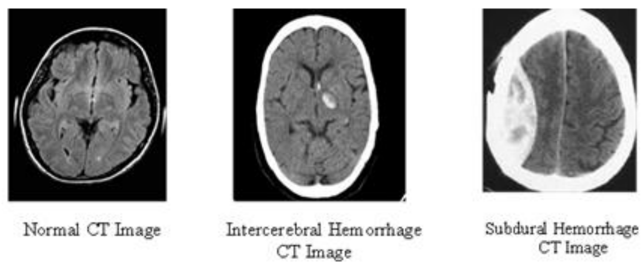

Fig. 1 Types of brain hemorrhage

The purpose of this research paper is to do diagnosis of brain hemorrhage by feeding CT images and classify the type of hemorrhage using watershed algorithm along with artificial neural network (ANN).

II. RELATED RESEARCH

With the advancement in technologies in neural networks, image processing etc. all around the world and other researchers started doing research on integrating medical expertise with computer-aided system. Thus a lot of research was done in segmentation of brain image using MRI and CT scan images to diagnose brain hemorrhages in past three decades.

In each year, brain hemorrhages are affecting 220 people out of every 100000 in Asia while 7 people out of every 100000 in West [1]. The statistical data shows that women are affected more than men by ratio of 3:2.

R. Ganesan and S. Radhakrishnan (2009) had proposed segmentation of CT brain image using Genetic Algorithm. In study, original images are enhanced by using Selective Median Filter and the Genetic Algorithm is used to segment image. The performance is evaluated using receiving operating characteristics (ROC) curve analysis. ROC curve is a popular tool in medical and imaging research. The area under ROC curve is an important criteria for evaluating diagnostic performance that referred as Az index. The value of Az is 1.0, when diagnostic detection has perfect performance which means that true-positive (TP) rate is 100% and false-positive (FP) rate is 0%. In this work, suspicious region extracted from proposed algorithm is overlapped with true abnormality provided in ground truth of image called true positive detection. An overlap means that at least 85% of region extracted lies within the circle indicating true abnormality. If an overlap is less than 85% of specified region, then image is considered as false positive image. The area under ROC curve was found to be 0.93 [2].

Several computer aided methods have been came for segmentation and quantification of brain tumors ranging from manual or user-assisted outlining performed by medical expert to fully automatic methods. Prastawa et al. (2003) has presented a approach for automatic segmentation of tumors and adjoining edema from non-enhancing multichannel MRI [3].

Loncaric et al. (1997) described a method for quantitative analysis of CT images, in particular for determining volume of Intracerebral brain hemorrhage (ICH) which is based on fuzzy clustering, expert system labeling and enables automatic determination of volume of ICH region. To verify the system for automatic measurement of ICH regions, the scans of five patients was measured using conventional planimetric method. Each patient had three CT scans: baseline, 1-hour scan, 24-hour scan. Statistical significance t-tests was performed on these measurements to evaluate the significance of the difference of this algorithm with respect to planimetric method. The correlation coefficient among these two methods was 0.92 [4].

Liu et al. has presented an automated detection of CT scan slices which contain hemorrhages. The detection method consists of two parts. The first part splits the scan slices into encephalic region and nasal cavity region. The second part focuses on encephalic region and detects abnormal slices. In both parts, he had applied method by using Wavelet and Haralick texture model. In study, the data consists of 493 patients brain CT scans. CT slices contains various situations such as rotation, displacement and motion blur. Each patient has 20 to 30 slices. The total number of images is 11011. The testing on over 10 thousands CT scans, the splitting accuracy and recall reaches 96% and 89%. The detection has accuracy 80% and recall 88% [5].

Myat Mon Kyaw (2013) introduced an automated method for detection and classification of an abnormality (hemorrhage) or stroke in brain CT images. The image is initially pre-processed to remove film artifacts and skull region. The image is subdivided into four regions to find region that has possibility of inclusion of abnormal areas. Thus there is no need to search and segment unnecessary regions [6].

Alyaa Hussein Ali et al. (2015) had proposed the detection and segmentation of hemorrhage stroke from brain CT images using textural analysis. In study, the thresholding segmentation process used to extract stroke region from CT image of brain. The median filter was used to remove noise from image and the statistical feature calculated using first order histogram. The first order histogram represents estimation of probability distribution function (PDF) for selected neighbourhood. The results as mean value represents white color in image. The higher mean gives indication that there is an abnormal part in brain. The energy gives indication about number of grey-level in image. When its value is low, this means that there is low number of grey-levels and study area is not homogeneous. Entropy is inversely proportional to energy. So the higher entropy means un-homogeneous texture. The skewness represents symmetry of texture around mean. So for the abnormal part, its value has more symmetry than normal part. The kurtosis is parameter that depicts the shape of histogram. The variance and standard deviation are higher for abnormal parts [7].

Vishal R. Shelke, Rajesh A. Rajwade, Dr. Mayur Kulkarni presented a approach for classification of intracranial hemorrhage. In study, the image enhancement tools and medical filtering was used. The thresholding technique is used to separate out suspicious hemorrhagic region of interest (ROI). The various morphological operations are applied before hemorrhage detection to get to get uniform ROI. Geometrical and textural features used as input to neural network and support vector machine (SVM). This algorithm is tested on different classifiers like support vector machine and neural network. By using support vector machine technique, precision value shown is 0.913 and accuracy is 0.88. [8]

The new use of dual energy CT scanner which uses two x-ray energy levels simultaneously for clinical applications has potential of redefining role of CT imaging for soft tissue segmentation (Ying et al., 2006) allowing radiologist to better differentiate and isolate body tissues and fluids. [9]

Mayank Chawla et al. (2009) presented an automated method to detect and classify an abnormality into acute and chronic infarct, and hemorrhage at the slice level of non-contrast CT images. The method consists of three main steps: image enhancement, detection of mid-line symmetry and classification of abnormal slices. A windowing operation is performed on intensity distribution to enhance the region of interest. Domain knowledge about the anatomical structure of the skull and brain is used to detect abnormalities in a rotation and translation invariant manner. A two-level classification scheme is used to detect abnormalities using features derived in the intensity and the wavelet domain. The performance of this method has been evaluated on a datasets. The dataset consists of volume CT data of 15 patients (6 normal and 9 abnormal- 6 infarct, 3 hemorrhagic) cases. Number and thickness of slices vary across patients: 18-31 slices and 4.8-6mm. There are total 347 slices belonging to four main categories: 223 normal, 40 chronic infarct, 49 acute infarct and 35 hemorrhagic. The method gives 90% accuracy and 100% recall in detecting abnormality at patient level and achieves an average precision of 91% and recall at the slice level [10].

Mahmoud Al-Ayyoub et al. has presented an approach to detect and classifying the hemorrhage in CT scan of the brain. This approach consists of several stages includes image preprocessing, image segmentation, feature extraction and classification. In segmentation stage, Otsu method is used to extract hemorrhage region from image. In next step, discriminative features of region of interest are extracted. Finally, the image is classified based on computed features of ROI. In study, the dataset consists of 76 CT images of brain. Out of these, 25 images are for normal brain while the remaining images represent the brain that suffers from one of three type of brain hemorrhage. A recognition rate of 100% is attained for detecting whether brain hemorrhage exists or not. For the hemorrhage type classification, more than 92% accuracy is achieved [11].

C. Amutha Devi and Dr. S. P. Rajagopalan has proposed a method for classifying the brain MRI images into stroke and non-stroke images. This method extracts features from MRI images of brain using watershed segmentation and Gabor filter. Feature reduction is accomplished by using information gain. The top 20, 40, 60, 80, 100, 120, 140 and 160 features are used for classification. Multilayer perception (MLP) is used for classifying the extracted features. This method consists of a dataset of 52 DWI scan images. Out of 52 images, 25 images are of positive stroke images. The best classification performance is achieved by Sigmoidal function with 80, 100 and 120 features. The classification of 88.46% was achieved with low root means square error (RMSE). [12]

Anju Bala has described an improved watershed image segmentation technique. Watershed transformation is a powerful tool for image segmentation in mathematical morphology. Watershed transformation was based on edge detection algorithms and used gradient operators. But it suffered from over segmentation. To avoid over segmentation image enhancement and noise removal techniques with Prewitt's edge detection operator was introduced. This method showed more accurate segmentation results and reduced the problem of over segmentation [13].

Fatima et al. has presented an approach to detect brain hemorrhage in CT scan of human beings and classified types of Brain hemorrhages. Otsu's method is used to extract hemorrhage region from image in segmentation then discrimination features of ROI extracted. In classification images are classified based on computed feature of ROI. Weka tool was used for classification and testify parts. The rate of diagnosing brain hemorrhage in detection is 100% and achieved accuracy is 92% in classification of brain hemorrhage. [14]

T Gong et al focused on dividing brain CT images in to region where each region can either be normal brain region or hemorrhage region. For images containing hemorrhages, the regions which do not include hemorrhage are treated as normal regions resulting in a highly imbalanced dataset. In this study, the researcher had utilized an image segmentation scheme that uses ellipse fitting, background removal and wavelet decomposition technique. The weighted precision and recall value for this approach is almost 83.6% and 88.5% [15].

Kailash et al described classification of brain tumors using neural network. Classification of MRI images was a challenging task because of variance and complexity of brain lesions. Two neural network techniques were used for classification of MRI brain images. Features are extracted using discrete wavelet transformation (DWT). Then the numbers of features were reduced by using principles component analysis (PCA) to the more essential features. During classification two classifiers were based on supervised machine learning used. One was feed forward artificial network and second classifier was back propagation neural network the classifier were used to classify the subjects as normal or abnormal MRI brain images [16].

In this paper, we present a method to detect and classify the type of brain hemorrhage from given CT image. This method consists of several stages: image preprocessing, image segmentation, feature extraction and classification. The watershed algorithm is used to segment the image. The features are extracted by using Grey Level Co-occurrence Matrix (GLCM). The feed forward Back Propagation Neural Network is used to classify the type of hemorrhage.

III. CONCLUSION

Brain images can be detected by MRI, CT scan etc., but they are not suitable for the proper diagnosis of brain hemorrhage. Various diagnosis techniques for brain hemorrhage were invented. Some of them required high segmentation, noise removal, accuracy, etc. In this project, these problems are overcome by using neural network which are advanced in terms of accuracy, speed and robustness. This paper includes the survey of applications of intelligent computing techniques for diagnostic sciences in biomedical image classification. The various features using the computing techniques have been detected with their advantages and limitations and hence it provides a better framework for development of emerging medical systems, enabling the better delivery of healthcare with cost effectiveness.

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