Automatic Hemorrhage Classification System Based On Svm Classifier

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Abstract *- Brain hemorrhage is a bleeding in or around the brain which are caused by head trauma, high blood pressure and intracranial tumors. Precised identification of location and classifying the type of the hemorrhage on CT image is a challenging task. In this paper, an automatic identification and classification of brain hemorrhage is proposed to saves the lives of the patients in an early stage and also improve the physicians' decision making process. To accomplish this, Canny Edge Detector is to detect and segment the wide range of hemorrhage region in an image. After that the valuable information of features (shape, position and area) of the hemorrhage are extracted by using Weighted Histogram Analysis. In feature selection, Hough Transform is used to find the imperfect instance of objects within a certain shapes. Finally, Support Vector Machine (SVM) is proposed to classify the type of hemorrhage such as Epidural hemorrhage (EDH), Subdural hemorrhage (SDH), Subarachnoid hemorrhage (SAH), Intracerebral hemorrhage (ICH) and Intraventricular hemorrhage (IVH).*

Index Terms **- Brain hemorrhage and classification, Canny Edge Detector, Weighted Histogram Analysis, Hough Transform, Support Vector machine (SVM).**

I. INTRODUCTION

Medical images are obtained from different modalities like MRI, CT, Ultrasound, PET are the tool used for extracting information by the radiologist. As compared to other modalities, Now-a-day CT modality has been preferred to apply in clinical diagnosis such as tumor, hemorrhage etc., because of low cost, easily available and high contrast. CT scan helps physicians to detect and locate Pathological changes with more accuracy. CT scan images uses a computer that takes data from several x-ray images of structures inside a human's or animal's body and converts them into pictures on a monitor. Computed tomography images can be able to distinguish different tissues inside a solid organ [1].

In present-day, cerebrovascular disease are the first cause of death in the world and the third after cancer and heart diseases. A common cerebrovascular disease is brain hemorrhage i.e., bleeding which is caused by busting of one or more blood vessels within brain. Several factors can cause brain hemorrhage such as high blood pressure and trauma. There are five many types of brain hemorrhage such as: Epidural, Subdural, Subarachnoid, Intracerebral and Intraventricular hemorrhage as shown in Figure1. The different types affirmed differ in many aspects such as the size of the hemorrhage region, its shape, and its location. Bleeding within the brain itself is known as an Intracerebral hemorrhage (ICH).

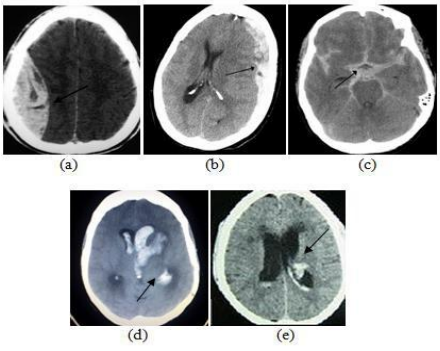


Fig 1 Types of brain hemorrhage (a) EDH (b) SDH (c) SAH (d) ICH (e) IVH

Bleeding can occur between the covering

of the brain and the brain tissue itself, referred to as a Subarachnoid hemorrhage (SAH). If a blood clot occurs between the skull and the brain is known as Subdural (SDH) or Epidural hematoma (EDH) depending on whether it is below or above the tough covering of the brain. If the bleeding into the brain ventricular system is referred as Intraventricular hemorrhage (IVH) [2].

II. METHODOLOGY

The proposed method is for identifying and classifying the type of hemorrhage in the brain.

Fig 2 Phases in Proposed Method

The proposed method contains multiple phases such as Image Preprocessing, Image Segmentation, Feature Extraction and Selection, Hierarchical classification as shown in Figure2 and Figure3 describes the complete method in detail.

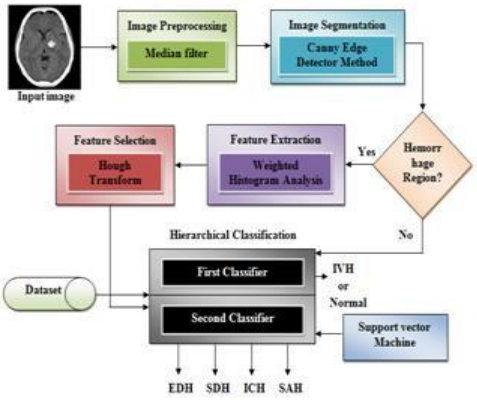
The main objective of the proposed system is

1. To extract the noises in an image with preprocessing for better understanding of an original image.
2. To propose Canny Edge Detection method for accurate and improve the Segmentation.
3. To develop Weighted Histogram Analysis for Feature (shape, size and position) Extraction.
4. To propose Hough Transform for Feature Selection.

To classify the brain hemorrhage by using the Support Vector Machine (SVM).

A. Preprocessing

Preprocessing is the initial step for detecting the anomaly in the brain CT scan image. It involves removing low frequency background noises. It improves quality of the image while converting the original image information into the grayscale image and remove noise**.**



. Fig 3 Proposed Method for Identifying and Classifying the Brain Hemorrhage

This part that may reduce segmentation performance such as the skull, brain ventricles and noises are removed by using some functions and median filter are used.

A. Skull and brain ventricles removal

In CT scan image, the skull and brain ventricles are in the white and black color, respectively as shown in Figure3. It can be removed by setting zero to any pixels that are below α_1 and above α_2. After fixing the limits the algorithm automatically change for different image. α_1 and α_2 are defined by

$$\alpha_1 = \beta * m_1 \quad (1)$$

$$\alpha_2 = m_1 - m_2 \quad (2)$$

where β is constant, m_1 is the maximum value of the image and m_2 is obtained by the following equation:

$$m_2 = med - mean \quad (3)$$

where med is the median of the image and mean is the mean of the image. Finally, removing skull and brain ventricles by the following relations:

$$I_2(i,j) = \begin{cases} 0 & P(i,j) < \propto_1 \ or \ P(i,j) > \propto_2 \\ 1 & o.w \end{cases} \quad (4)$$

where I_1 and I_2 are the original image and the image after removing the skull and brain ventricles, respectively. *P(i, j)* is the pixel in *i*-th row and *j*-th column of the image.

1.2 Noise removal

After removing the skull and the brain ventricles, the noises are arises in the image. To solve this problem noises are removed by using the median filter. The median filter is the nonlinear and effective filter for the noise reduction for preserving edges in the image.

It works by moving the image pixel by pixel, while replacing each value with the median value of the neighbouring pixel. It is calculated by

1. First sorting all the pixel value from the neighbou
2. Replacing the pixel being considered with the median pixel value.

5.

2. Image Segmentation

Segmentation is the process of partitioning the image into multiple segments (set of pixels). The main goal of segmentation is to simplify or change the representation of the image into somewhat that is more meaningful and easier to analyze. It is used to locate the objects such as lines, curves, etc. Image segmentation are helpful in the area of medical imaging for locate the tumors, diagnosis and other pathologies. Numerous general-purpose algorithms and techniques have been developed for image segmentation. Here Canny Edge detector is used to detect and separate the wide range of hemorrhage region in an image.

3. Feature Extraction and Selection

3.1 Feature Extraction

Feature extraction is the process of defining a set of features (characteristics) such as position, shape, size and texture which will more efficiently or meaningfully represent the information that is important for analysis and classification.

Weighted Histogram Analysis is defined to give the valuable information from shape, position and area of the hemorrhage are analyzed with the grayscale histogram of hemorrhage region. The histogram of each hemorrhage region is weighted with the information of the hemorrhage such as the hemorrhage position in the brain, the distance of hemorrhage region from the brain center.

In this algorithm, the Histogram of hemorrhage (H) for all observation of different hemorrhage types is weighted by a novel weighted scheme is Weighted Histogram (h). It is defined as,

$$h(\quad) = \quad(\quad)^{*}\quad(\quad); \tag{5}$$

where $j = 1,2,\ldots N_i$ *and* $i = 1,2,3,4,$ $(\quad)$ is the weight of sample o_{ij} of the i-th hemorrhage class, N_i is the number of hemorrhage sample in the i-th hemorrhage class such as EDH, ICH, SDH and SAH.

(i) The Axes Ratio (AR) is defined as,

$$AR = A \quad / A_{a} \tag{6}$$

where 摩 and A_{a} are the major and minor axis length of the hemorrhage region, respectively.

(ii) The ratio of the hemorrhage region area to perimeter (AP) that is defined as,

$$AP = 4\pi A / (e)^2 \tag{7}$$

where A and e are the area and perimeter of the hemorrhage region, respectively.

(iii) The distance of hemorrhage region from the brain is defined as,

$$r = \min(D_{ce}\ (x, y)); \quad (8)$$

$$D_{ce} = \sqrt{(\quad - \quad)^2 + (\quad - \quad)^2} \quad (9)$$

where r is the radius, D_{ce} is the distance of hemorrhage boundary points (x, y) from the center of hemorrhage region

(,).

3.2 Feature Selection

The Feature selection is the process of selecting the subset of most convenient feature in an image. To improve the classification performance of the hemorrhage region, it's very important to select the best feature by using Hough transform. This Hough transform is used to find the imperfect instance of objects within a certain class of shape.

Hough transform offers some advantages

1. Conceptually simple.
2. Easy implementation.
3. Handles missing and occluded data.
4. Can be adapted to many type of form (shapes) such as line, circle, etc.

4. Hierarchical Classification

A hierarchical classifier is a classifier that maps input data into defined subsumptive output categories. The classification first occurs on the low-level with high specific pieces of input data. The classification of the individual pieces of data are then combined systematically and classified on a higher level iteratively until one output is produced. The proposed hierarchical classification is developed by the two classifiers. After segmentation step, the hemorrhage region is belongs with any one of this two classifiers.

4.1 First classifier

If no hemorrhage region is detected in an image segmentation process, it belongs to the IVH or normal. If the hemorrhage is occur inside the brain ventricles then it is belongs to the IVH. This IVH is detected before removing the brain ventricles; otherwise it belongs to be normal. For achieve this, we try to find the pixels are inside the brain ventricles and the intensity values are more than α_2.

4.2 Second classifier

If hemorrhage region is detected in an image segmentation process, it should belong to EDH or ICH or SDH or SAH. For that classification purpose, we use Support Vector Machine (SVM) classifier.

IV. CONCLUSION

In this paper, an automatic identification and classification of brain hemorrhage is proposed. The main goal is to improve the physicians' decision making process and to save the life of the people earlier. Median filter is used to remove the noises for better understanding of the original image. In segmentation, canny edge detector is used to segment and identify the hemorrhage region. If the hemorrhage region is detected, weighted histogram analysis is used to extract the features (shape, area and position) of the hemorrhage region. Feature selection Hough algorithm is used to select the most convenient features. Finally, Support Vector Machine (SVM) is used in hierarchical classifier to classify which type (EDH, ICH, SDH or SAH) of hemorrhage in it. If the hemorrhage is not detected in the segmentation process, it belongs to either IVH or normal. The proposed work is applied in a real CT scan brain image.

V. REFERENCE

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