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Brain Stroke Detection System using Machine Learning

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Abstract - **Currently, the different algorithms for detecting stroke range and shape in brain MR images are being implemented and it is now possible to find out the degree of stroke with regard to the given stroke area. The information was gathered via research of various statistical analysis methods which are all based on those individuals who have been diagnosed with brain strokes, and then risk factors and symptoms that appear for all individuals diagnosed with brain strokes were discovered. The advancement of research in medicine day and night aims to provide modern therapeutic approaches. The surgeon physically examines this image in order to identify and diagnose brain strokes. However, this procedure accurately measures the stage and scale of the stroke and accurately distinguishes the stage of the stroke based on the location of the stroke. This dissertation employs k-means and fuzzy c-means algorithms to segment brain strokes and classify stroke cells This approach enables the accurate and reproducible segmentation of stroke tissue equal to manual segmentation. Additionally, it decreases research time and accurately determines the stage of stroke from a given region of stroke.**

Keywords - ***Clustering, Segmentation, Thresholding, Magnetic Resonance Imaging, Brain-Tipped Stroke.***

I. INTRODUCTION

MRI or CT scans are usually used to image the brain's anatomy. The entire procedure is recorded in this paper using an MRI scan. For diagnosis, an MRI scan is more convenient than a CT scan. It has no adverse effect on the human body. It works by the use of magnetic fields and radio waves. Numerous algorithms have been created for the diagnosis of brain strokes. However, they may have some disadvantages in terms of identification and extraction.

Two algorithms are used in this work to perform segmentation. Algorithms for clustering K-means and Fuzzy C-means. As a result, it produces a correct stroke segmentation result. Strokes are caused by excessive tissue growth in every portion of the body. Main or secondary strokes are likely. If it is a source, it is referred to as primary. If a portion of the stroke spreads to another location and grows independently, this is referred to as secondary. Normally, a brain stroke has an effect on the CSF (Cerebral Spinal Fluid). It contributes to strokes. The surgeon treats the strokes rather than the stroke. Thus, early identification of strokes is crucial for successful treatment. When a brain stroke is diagnosed at an early stage, the patient's life expectancy may be extended. This will add about one or two years to the lifespan. Typically, stroke cells are classified into two groups. They are classified as Mass and Malignant. It is somewhat difficult to detect a malignant stroke in a bulk stroke. In this post, we will explore how to diagnose brain strokes using brain MRI images and how to assess the stage of the stroke depending on the given region of stroke. Treatment for a brain stroke is determined by the stroke's form and level, its size and location, as well as the general health and medical records. In the majority of cases, the aim of therapy is to totally eliminate or kill the stroke. The majority of brain strokes are curable if detected and treated early.

An individual who has been diagnosed with some kind of brain stroke is at an elevated risk of having another form of brain stroke. An individual who has two or more close relatives (mother, father, sister, brother, or child) who have developed brain strokes has an increased chance of developing his or her own brain stroke. Occasionally, family members will inherit a mutation that makes the brain more vulnerable and raises the chance of developing a brain stroke. Around 5% of brain strokes are thought to be caused by inherited (genetic) causes or disorders. The aim of this work is to develop a method that can inform people about their estimated risk of developing a brain stroke, whether they are at risk or not, and by how much. Java is used to build the detection platform. Finally, we have systems that detect the stroke and its form, as well as the stage of the stroke, from a given region of the stroke.

II. LITERATURE SURVEY

For magnetic resonance imaging, the method of image registration and data fusion theory presented here has been modified for the segmentation of the magnetic resonance images. This research aims to propose an image registration and data fusion method that is optimal for segmentation of magnetic resonance images. This method enables the accurate and rapid detection of brain strokes. This device utilises the K-means algorithm to provide an effective and rapid tool for diagnosing brain strokes [1].

Meena and Raja demonstrated how to use the Spatial Fuzzy C Means (PET-SFCM) is used for PET scan image datasets to cluster data in 3D. To better assist the clustering process, a proposed algorithm incorporates spatial neighbourhood information into the FCM, and modifies the objective function of each cluster simultaneously. This algorithm has been applied and validated on a large data set of patients with neurodegenerative disorders of the brain, such as Alzheimer's disease. It has been shown to be efficient in real-world patient data sets [2].

In this case, the presented framework features three image segmentation algorithms, namely K-Means clustering, Expectation Maximization, and Normalized Cuts. The main objective of this project is to find a solution to the issue of cutting up a picture into separate regions. When we compare the two unsupervised learning algorithms, K-means and EM, to a graph-based algorithm, the Normalized Cut, we equate them to each other. Clustering algorithms that divide a data set into clusters based on a given distance measure, such as K-means and EM, are two common methods for clustering [3].

Funmilola et al. introduced the Combining the properties of Fuzzy C-means and K-means, the fuzzy K-C-means form can be used. While most of this work has focused on clustering algorithms like k-means and fuzzy c-means, this portion has done much of the work on both approaches. The k-c-means clustering algorithm was constructed by utilising these separate algorithms. This allowed the algorithm to provide a more effective result in terms of computational time. the algorithms have been put to the test and proven correct by comparing them to human brain MRI images Results have been thoroughly investigated and reported [4].

Wilson and Dhas, respectively, The SWI technique was used to detect iron in the brain by first using K-means and then using Fuzzy C-means. accurate assessment of iron stores is needed in a number of neurodegenerative diseases because of the relationship between iron accumulation and the aetiology of these diseases a susceptibility the weighted imaging SWI (SWI weighted for sensitivity) assists in getting an accurate depiction of a tissue's properties which are different from the structures under which it is located [5].

The overview of various brain stroke diagnostic techniques provided here contains a full examination of their various types. The main purpose of this article is to provide a comprehensive Type-II fuzzy expert method for diagnosing human brain strokes (Astrocytoma strokes) with T1-weighted Magnetic Resonance Imaging (MRI) with contrast. four distinct modules make up the proposed Type-II fuzzy image processing method: pre-processing, segmentation, feature extraction, and approximate reasoning [6].

Human intuition plays a key role in pattern recognition, and mainstream mathematics cannot accurately accommodate this complicated and ambiguously defined system. This, coupled with the inadequacy of fuzzy mathematics to fully embrace these ideas, has led to the implementation of various fuzzy approaches [7].

This paper presents a technique that offers an efficient and synergistic algorithm for brain tumour diagnosis, utilising median filtering, K Means segmentation, FCM segmentation, and a final threshold segmentation. in this method, we aim to improve the accuracy of stroke images obtained via MRI and to use that increased accuracy to guide estimations on the size of the strokes [8].

The author of the presented work is conducting an examination of various algorithms that can be used to color images, text, and gray scale images. When image segmentation is done, the resultant collection of segments or contours will take up the whole image, or a collection of segments and contours will be derived from the image. A pixel in a particular region can be identical in some way, such as color, strength, or texture [9].

This thesis showed how to isolate features from brain images and detect strokes using k-means and C-mean clustering techniques [10].

III. PROPOSED SYSTEM

The proposed work is a combination of clustering algorithms and classification algorithm, which have been combined to create a new algorithm. The system currently in use has four main modules: preprocessing, segmentation, feature extraction, and classification. This image pre-processing procedure involves applying the median filter to the images. Once Image Segmentation has been completed, K-means and Fuzzy C-means are used to carry out the process. Feature extraction is performed by thresholding images to extract features, and then classification steps are followed to recognize the stroke area and position in MRI images and to identify stage of stroke from the result area of a brain stroke.

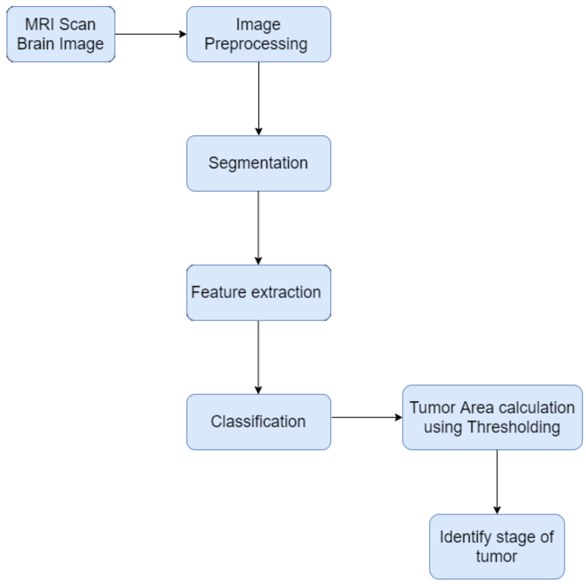

Fig 1: Proposed System Architecture

3.1 Pre-processing

In this step, we first removed the noise from an image using the median filter, and then we also got rid of any unwanted images or defects within the image, as well as sharpening the image's edges. This location includes RGB to gray scale conversion and reshaping as well. The algorithm includes a median filter for noise removal. Most modern MRI scans have virtually no noise from transit noise entering the scanner. It is likely that the shipment will show up because of the thermal effect. The main purpose of this project is to detect and identify the stroke cells. But the system itself needs the process of noise removal for complete operation.

3.2Segmentation

Steps:

1. To specify the number of k clusters, give the cluster value as k.
2. Using a random number generator, select the k cluster centers
3. The third step is to calculate the mean or the center of the cluster
4. We must first calculate the distance between each pixel and each cluster center.
5. In a situation where the distance is near to the cluster's center, you should head in that direction.
6. Otherwise, if this cluster does not fit, please choose the next cluster.
7. Use new data to re-estimate the center.
8. Expand by repeating the process until the center does not move.

3.3 Convolution neural network:

Convolution Layer

Convolution is the first layer to extract features from an input image (image). Convolution preserves the relationship between pixels by learning image features using small squares of input data. Convolution of an image with different filters can perform operations such as edge detection, blur and sharpen by applying filters i.e. identity filter, edge detection, sharpen, box blur and Gaussian blur filter.

Pooling Layer

Pooling layers would reduce the number of parameters when the images are too large. Spatial pooling also called subsampling or down sampling which reduces the dimensionality of each map but retains important information.

Fully Connected Layer

In this layer Feature map matrix will be converted as vector (x1, x2, x3, …). With the fully connected layers, we combined these features together to create a model.

Softmax Classifier

Finally, we have an activation function such as softmax or sigmoid to classify the outputs

III. RESULT AND ANALYSIS

We can consider the brain stroke image depicted in figure 2, which is an MRI of a stroke with the stroke in figure 2. Median filtering is applied on the images that have already been acquired to get rid of the noise. In the graph, you can see the results displayed (See Figure 3).

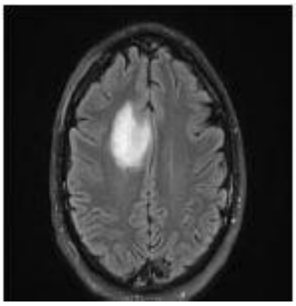

Fig. 2 Brain Stroke Image

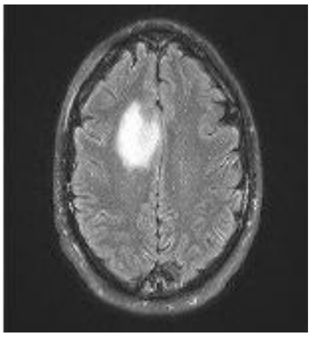

Fig. 3 Median Filtering Outcome

K means algorithm is implemented on such noise filtered images containing brain strokes. In figure 4, a white spot is seen, which is outcome of threshold segmentation on the input image. This region is the area having higher intensity values compared to the defined threshold. Areas with higher intensity values mostly contains ulcer. The outcomes of thresholding segmentation are shown below in figure 4.

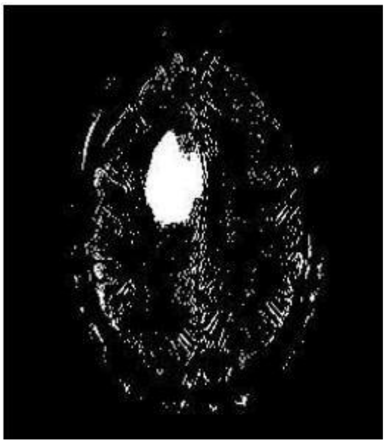

Fig. 4 K Means Clustering

Once the K Means Clustering gets over, Fuzzy C-Means segmentation is eventually implemented on the resulted image procured from K Means segmentation. The region affected by ulcer is highlighted in this process. The outcome of the watershed segmentation is shown below in figure 5.

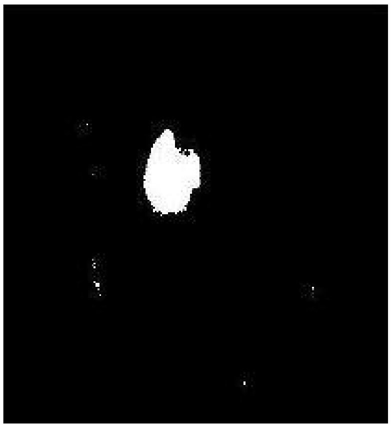

Fig. 5 FCM Segmentation

Eventually, the thresholding segmentation is implemented, once the FCM segmentation is completed. The outcomes are spectacular and intended approach is efficacious in nature to an extent. Figure 6 shows the resultant image procured after the implementation of thresholding segmentation.

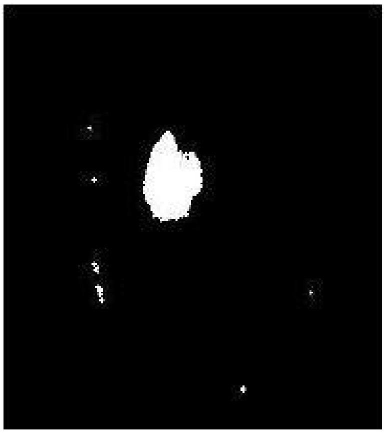

Fig. 6 Thresholding Segmentation

Fig. 7 Output Images of Stroke Area Estimation

The output is displayed above in figure 7. Additionally, the proposed system is very sensitive to errors because even a small error will lead to the system producing a result in a state of ambiguity, which is not helpful for diagnosing stroke. Further, it should be noted that both the FCM method and the k-means algorithm are employed to compare each individual performance level to the proposed system and the result of all are compare and we find that the proposed system has less errors in the system.

CONCLUSION

Segmentation of brain strokes is done in this presented work. To start, the image is pre-processed using the median filter technique. If noise is detected in the MR image, it is extracted prior to the K-means phase. The noise-free image is fed into the k-means algorithm, which extracts the stroke from the MRI image. Eventually, estimated logic is used to calculate stroke area and location, and finally, the resulting area of the stroke is used to identify the stage of the stroke, which is simpler, less expensive, and faster.

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