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K-MEANS CLUSTERING OF SPINAL CORD MRI ABNORMALITY FEATURE EXTRACTION

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Abstract:

Research on Medical Image presents an efficient platform for automated analysis and identification of any deformations in a given medical image data collection, particularly in the Spinal Cord, for more effective and better comprehension of the diagnosis. Tumors, disc hernias, fractures, edoema, and other abnormalities of the spinal cord may be discovered using a variety of medical imaging modalities, including MRI, CT, and fMRI. Fast and reliable analysis of the MRI imaging of the spinal cord using an Automated Decision Support System (ADS) is shown in this study. There are two stages to this process: preparation and execution. Using histograms, the first step is to determine whether any abnormality characteristics or distortions are present in the provided picture. This is the second phase, in which the MRI picture is clustered to determine the depth at which the calcification is present. The algorithm's performance and the amount of time it takes to finish each cluster phase are examined. To further demonstrate its complete accuracy, the algorithm's efficiency is being monitored.

INTRODUCTION

The spinal cord is a vital part of human anatomy. The significance of the spinal cord is often overlooked. It is the primary conduit via which all of the information flowing from the brain is sent to the rest of the body. It moves data from one part of the body to another. The vertebral column, disc, and spinal canal all form part of the spinal cord. In all, the vertebrae of the spinal cord are divided into four categories: cervical, thoracic, lumbar, and sacral. The cervical vertebrae regulate the neck and hand, while the thoracic vertebrae care for the rib muscles to above the waist, and the lumbar vertebrae care for the hip and leg. A total of 150 joints may be counted from the neck to the sacrum, where movement can occur. Injuries to the spinal cord are prevalent worldwide. A spinal injury may be classified as either an incomplete or a full damage. Trauma, prolonged standing, poor sleeping posture, and heavy lifting all contribute to this. Even if an injury is only partially healed, it might still result in more damage. Tumors in the brain and elsewhere in the body have been found in prior research, but not in the spinal cord. Tumors of the spinal cord vertebrae are becoming more prevalent these days. If you have a spinal anomaly, there is no age restriction. No one knows why the spinal vertebrae have calcified. Cervical and thoracic-lumbar vertebrae are the most often affected by calcification. Disputes that are both full and incomplete might exacerbate pain. Symptoms such as numbness, swelling, weakness, and a different gait might be noted in the early stages. Pre-operative treatment is usually preferable than post-operative treatment. An MRI seems to be the best method for diagnosing a potential problem or location. An automated decision support system will be created in this study to help make the area visible or understood more clearly. In order to avert more serious consequences, this study employs a variety of diagnostic methods to catch an unsafe scenario early on. Clustering is one of the most often utilised methods of data splitting by academics. It distinguishes between medical data items that are connected and those that are not. K-Means MRI Spinal Cord Tumour is utilised to create the well-known and widely used process known as clustering. Clusters of data from a variety of age groups have been analysed. The optimum outcome can be achieved with this technique. The parts of this document are as follows: There are related works in both the same and separate disciplines, which are described in Section II. Section III explains the proposed work's theoretical and mathematical representations. Images are used to illustrate the results and discussion of the work done. Section V wraps off the project.

II.RELATED WORK

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Numerous applications of K-Mean Clustering may be found. In this study, the K-mean Clustering idea is examined and the work of several writers is analysed and implemented. A new approach for manually identifying a spinal column's vertebral column was provided by Mohamed Amine Larhmam et.al.[2]. They employed a contrast and edge detection approach to pre-process the picture, and then Generalized HT was used to manually indicate the alignment. Finally, k-means clustering seems to have found the area. Alignment of the vertebrae is determined. Automating their job and improving their learning models and segmentation processes will be a priority in the coming years. On a variety of medical photos, Piyush M. Patel utilised the K means method to identify a particular area of the image. Automatic image processing utilising K-Means and modified seed-based region-growing algorithm has been suggested by Nor Ashidi Mat Isa[4] (MSBRG). To begin, the threshold value is determined using K-means clustering, and then MSBRG is utilised to identify edges. After comparing the results with those of other algorithms, it seems to have produced superior results. To segment the brain picture, Selvamani.K et.al [5] used the K-means method. The MRI brain tumour is segmented using k tissue values, which is how this project is completed. Estimated average intensity for each tissue type at each site. The algorithm's performance is evaluated on a variety of large-scale patient datasets. It's a long-term goal of ours to segment the coronary vessels in angiographic images while maintaining their topology. FMRI images may be segmented using a novel model established by K. Vijay and K. Selvakumar [6]. To begin with, it is used to prevent any issues that may arise during segmentation. Clustering is done on the FMRI using K mean clustering after this interaction. Shows that it performed effectively and supplied the correct answer. A color-based technique to segment the brain MRI was suggested by Ming-Ni Wu1 et al [7]. A clustering algorithm is utilised to accomplish this goal. This k-means first converts the grayscale picture to a colour space image before separating the tumour from the provided image; it is not often seen. The histogram clustering approach is compared to this result. The results suggest that this strategy works well and, as said, it is the simplest way for segmentation. There are two approaches to apply the k means in Shiv Ram Dubey et al's work [8]. The first step was to group the pixels into groups based on their colour and location. Second, a region value is created by combining all of the clustered items. Rather of having to extract the features of each each pixel in the picture, they reasoned that this would boost computer efficiency. According to the results, the method is promising. Medical pictures may be segmented using the watershed algorithm and the k means clustering approach, according to H.P. Ng1 and S.H. Ong3 [9]. Due of oversegmentation and sensitive erroneous edge detection, the watershed segmentation method has certain drawbacks. The K means clustering technique was used to solve these problems. In the segmentation maps of 50 photos, the number of partitions is compared. B. Ramamurthy [10] describes shape-based feature extraction employing canny edge detection approaches, which yielded segmentation maps with 92% fewer divisions than the classic watershed procedure. Images sorted according to k-means clustering. Finding a specific photograph in the vast medical database is the task at hand. Edge detection is used to obtain the shape feature. K means classification is utilised for the retrieval of images for diagnosis. NameirakpamDhanachandra et al [11] used K means clustering and subtractive clustering to segment the medical picture. To divide up the items in a picture, an unsupervised method known as the K-means algorithm is utilised. Feature improvement was previously employed as a pre-processing approach before this clustering. Clusters are created using subtractive clusters to establish initial centres. In the k means clustering procedure, these centres are employed. Finally, the segmentation has been completed. Using median filtering, the undesired regions are removed from the segmented picture. It performed better than before. Use morphological operations and other clustering algorithms with this subtractive clustering approach to achieve the notion. A clustering method called k means clustering was used to identify the tumour area in the brain by Meenakshi S R et al [12]. Dilation and erosion are the two methods used in morphological segmentation. This k-means clustering is the first step in locating and defining the study area. For RSI Images, the same principle was used.

III THEORETICAL AND MATHEMATICAL REPRESENTATION OF THE PROPOSED WORK

There are two stages to the suggested technique. Pre-processing of Spinal MR medical pictures is done in the beginning to increase the flexibility of the images for later processing. To make the decision-making process more automated First Image Enhancement method histograms are used to look for anomalous characteristics in the given data. Those who are in good health don't need to be processed. If there are anomalies in the data, it moves on to the

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Second Process, where the k means technique is used to the clustering in order to extract the features. Fig. 1 depicts the methodological framework. In the next step, the anomalies' depths will be determined.

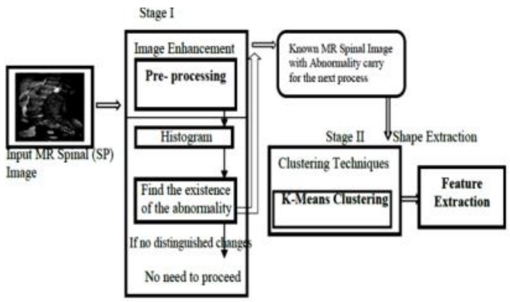

Fig 1: Over view of the different steps of the proposed framework.

Dataset

Researchers at Cauvery Hospital in Chennai used MRI Spinal Cord Cervical pictures acquired from normal and aberrant patient images for this study. In medical terminology, DICOM stands for Digital Imaging and Communications in Medicine. For medical pictures and associated information, DICOM prescribes the formats in which they should be stored. It's possible to store any kind of information item in a DICOM file. Patients' ages, sex, gender, modality and study descriptions are all included in these photographs. In this procedure, both normal and aberrant data are analysed. MRI pictures of the Tumor MR Spine with Sagittal t2-weighted are obtained. The suggested Method is put to the test on 20 photos of the patient.

b) Histogram

The histogram is a graphical depiction of the pixel values of a picture at various intensity settings. To get the desired histogram output, you'll need to provide either an image data file or histogram statistics. Figure 2 shows a histogram of the total number of pixels in the dataset. There are 256 potential values for an 8-bit grayscale picture. By comparing the intensity modification values in the picture, it is possible to identify the deformed image. The only method to distinguish between the photographs is by the use of Histogram Modification. Hence The histogram adjustment is necessary for this approach. For example, let Ho be the input image's histogram, and let Hu be a uniform one. Essentially, the goal is to get H c values from the input histogram Ho so that the difference between H c and Hu remains small enough to maintain H c near

$$H' = \alpha H + (1 - \alpha) Hu,$$

Where $0 \leq \alpha \leq 1$.

H. It is now a formalised optimization problem:

Different values and their mapping functions are discussed in the preceding equation. As a starting point, let's choose 1(=1). The most saturated point is reached early in this function's maximum value. As a result,

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the spinal dataset is over-enhanced. When it gets to this point. However, as soon as it reaches a value of 0(=0), values begin to approach their maximum.

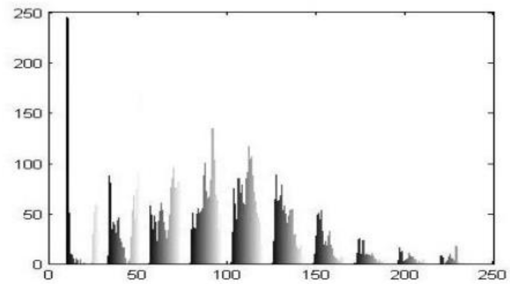

Fig 2: Histogram of MR Spinal Image

c) K-Means algorithm

A clustering technique known as K is the simplest and most widely employed. As the name suggests, this process involves dividing the input data into k clusters and then using those clusters to group objects that are related in some way. The multidimensional values are assigned to a single K cluster in this approach. The cluster index for the given estimate data is returned. Using this method, clusters will have less of a variance in the vectors they're working with. The value of the cluster centre will be altered iteratively after each vector is allocated (reallocated). The same procedure will be repeated for each of the k vectors. Clustering is the unsupervised grouping approach for the cluster or collection in this procedure [13] [14]. There are many uses for clustering in image processing, and it's particularly useful for locating the data's hidden characteristics. In this case, the term "data mining" is A clustering method assigns an input parameter k, and splits n items into k clusters such that one cluster similarity is high and the other cluster similarity is low. If any of the interpretations (x1, x2, x3, x4, x5...xn) are not in the specified dimension, then they should be modified. Each observation is a 2-dimensional real vector. The goal is to reduce the inner cluster sum of squares by partitioning the n observations into k sets (k n) S = S1, S2... Sk.

$$\arg\min_{S} \sum_{i=1}^{k} \sum_{xj \in si} \|X_j - \mu_i\|^2 \qquad (2)$$

Where µi is the Mean value in si.

K-Means Clustering Algorithm was Used The Mean value is used to implement this clustering procedure. n items from the supplied Dataset as input. K is the cluster number. Clusters depending on the K value are generated as output. Method:

1. In the first step, enter the image.
2. The second step is to convert the image's data type.
3. The number of clusters is set to zero in this step.
4. k centre is determined in step four.
5. Figure out the average.
6. For the last step, determine the distance between each cluster's centres.

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7. This cluster should be used for objects that are quite close to the centre value. Instead, leave and move on to the next cluster.

8. Keep going until the centre value is obtained in this step.

V RESULT AND DISCUSSION

The pixel values in MR Spinal are identified and analysed to find tumours in this study. The picture is formatted as DICOM Image for processing. MATLAB is used to write the source code. The following procedure was used to get at this conclusion. Preprocessing is conducted once the original photos are inserted as input. Histogram is used to automate the creation of this final picture. The next step is to sample cluster the photos that have been provided. Tables and figures demonstrate the outcomes of all the aforementioned. As at this point, all quantitative analysis has been completed. Figure 3 calls for DICOM data to be converted to a.JPG format before it can be used for the processes shown there. Noise and ambiguous edges may be present in the picture. Noise in a medical picture makes it harder to do pre-processing, such as clustering or segmentation. As a result, picture preprocessing, such as converting RGB to grayscale and performing sharpening and smoothing, is required. To make a picture more readable, you may use sharpening. The noise in the picture is reduced or eliminated by the use of smoothing. This is an example of an MR Spinal Input picture.

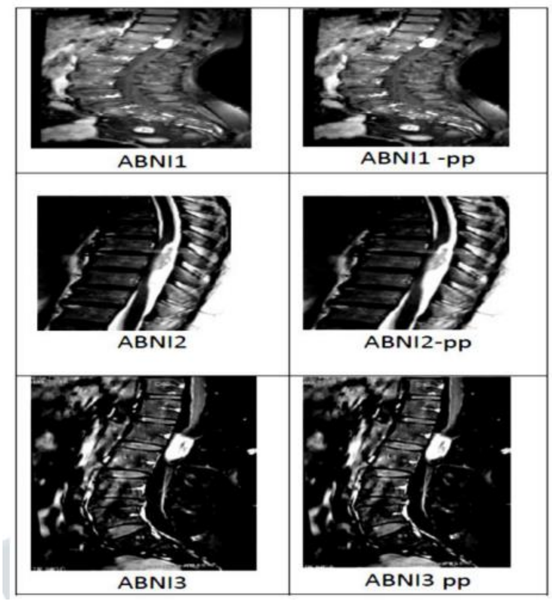

Fig 3: Input image (with pre-processing)

c)Histogram

It is in this step that the scattered histogram pixel values are Identified and Examined to identify the amalgamation. Predicted values for the range are 40-89. Calibration leads to clustering when the pixel distribution reflects the aforementioned values. If there are no errors in the data provided, the procedure will end. In Fig. 4, anomalous values are emphasised by the red rectangular box. There were a total of 50 seeds used in this experiment. The pixel range distribution of the greatest density region (suspicious) in the MR Spinal picture is shown below. As a result, a decision-making method that is less time-consuming has been created. An increased amount of data sets should be examined, as well as the effectiveness of any procedures used.

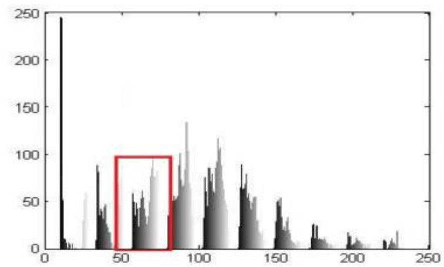

Fig 4: Histogram of MR Spinal Image with suspicious amalgamation.

V CONCLUSION

It is discussed in this article how to use the Histogram and K-Means algorithm to automate a decision support system. This technique is used to group tumours on MR images of the spine. In the clustered analysis, the tumour was represented by the largest centroid. Accuracy and compatibility are evaluated. Automated segmented pictures of the spine will be produced, allowing neurologist to better extract the Spinal-tumor ratio. There are plans to do further testing with other data sets using classification techniques to determine the depth of tumour pictures. This will also help determine the sort of tumour that is there.

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