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RESEARCH ARTICLE

BRAIN TUMOR DETECTION USING LEVEL SEGMENTATION AND K-MEANS CLUSTERING

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Abstract

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The unchecked growth of strange tumors of brain cells is known as a brain tumor. Tumor cells are extracted from the tumor using an input magnetic resonance imaging (MRI) scan. Pre-processing techniques are applied to minimize noise. After applying K-means clustering to the image, the skull has been eliminated from the clustered image. Quickly finding tumor cells by looking at their shape.Last, this image is cleaned up using segmentation and thresholding, which get rid of the tumor cells.To evaluate the accuracy of our findings, recall, consistency, false positives(FP),true negatives(TN),true positives (TP), and true negatives (TN) are analyzed.

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Introduction:-

One of the areas of computer science and engineering that is expanding quickly is image processing. Due to their affordability, flexibility, and ease of use, digital systems are gradually replacing analog imaging in all fields. Image processing is used in a lot of different fields, including medicine, photography, remote sensing, desktop publishing, film and video production, military target analysis, and manufacturing automation and control. Many of these applications need bright and clear photos, so corrupted or degraded images need to be fixed so that they can be identified and used in the future.Depending on the kind of interference that caused the degradation factor, the image is processed using techniques like image enhancement, object detection, and filtering. Any signal processing system must include filtering, which entails estimating a signal that has been deteriorated by impulse noise, which is typically brought on by errors made when an analog signal is converted to a digital signal using an analog-to-digital converter. Over time, numerous filtering methods have been created for a range of uses.MRI offers the benefit of being a non-invasive technique that enables tissue examination of the cerebrum. Through appropriate treatment, patients can save their lives when a cerebral tumor is discovered early. The pRI image is a result of the expansion of medical knowledge in clinical diagnosis. In addition, the tumor's placement in an image is advantageous for medical professionals and can be used for a number of purposes, including 3D replication.The precise location of a tumor makes it possible to perform various tasks in a Mea'spreprogrammed location, which makes the tumor area easy to measure and identify. Because MRI offers more accurate information on tumor location and size, it is used to detect cerebrum tumors.Radiologists utilize MRI to take pictures of how the body works and what it looks like. MRI scanners use powerful magnetic fields, magnetic field gradients, and radio waves to make pictures of organs. Unlike CT and PET scans, MRI doesn't use X-rays or ionizing radiation. Nuclear magnetic resonance (NMR) is used in MRI. NMR spectroscopy can also use NMR to take pictures.

Clustering:-

Cluster analysis is the process of using clustering algorithms to uncover patterns that aren't obvious in a dataset. People often use it for exploratory data analysis, preparing data for supervised learning, and finding outliers. Data in a cluster is more alike than data in other clusters.Numerous similarity metrics, such as correlation, cosine distance, probabilistic, and Euclidean distance, can be applied. Cluster analysis is used in the majority of unsupervised learning techniques.

There are two main types of clustering algorithms:

Like k-means, hard clustering puts all the data points in one group.

Soft clustering, like Gaussian mixture models, enables data points belong to more than one cluster. For example, genes and speech phonemes are both made up of basic sounds. K-means clustering puts data into groupings. The stars (2) depict the average of each member, which is the centroid of the group.

The Gassian mixing model groups data into two clusters.

Cluster analysis looks for patterns and sequences in many areas:

In data compression, clusters can take the place of raw signals.

Clusters are used in image and lidar point cloud segmentation algorithms.

Bioinformatics employs sequencing and genetic classification.

Semi-supervised learning employs clustering to make labeled and unlabeled data more comparable. This is because initial models are generated with only a small amount of labeled data and are then used to label unlabeled data. Semi-supervised clustering makes use of information about the clusters, such as whether certain observations belong to the same cluster or whether some clusters are linked to a specific outcome variable.

MATLAB used the imsegkmeans program, which uses the k-means technique, to divide the tissue into three groups: white, black, and gray.

Preliminaries:

K Means Clustering:-

k-means clustering is a method from signal processing that divides n observations into k clusters, with the nearest mean (cluster centers or cluster centroid) as the prototype. This divides data into Voronoi cells. Unlike the more difficult Weber problem, k-means clustering minimizes within-cluster variances (squared Euclidean distances). The mean optimizes squared errors, while only the geometric median minimizes them. For example, k-medians and k-medoids improve Euclidean solutions. Though computationally complex (NP-hard), efficient heuristic algorithms quickly reach a local optimum. These are similar to the expectation-maximization algorithm for Gaussian mixtures via iterative refinement used by k-means and Gaussian mixture modeling. Both use cluster centers to model data, but k-means clustering finds clusters of similar spatial extent, while expectation-maximization allows varied cluster shapes.

Level Sigmentation:-

This tutorial covers the level set method's basics.I was apprehensive about level sets for a while.Why I was terrified is still a mystery.The level set approach is simple: a surface intersects a plane, forming a contour.Image segmentation refreshes the surface with image-derived forces.In this document, I explain the problem, how it was addressed, the limits, and the miracle solution with nice illustrations.

Tracking interfaces:-

First, picture water falling from the top of a hill. The goal is to follow the water down the hill. The map below shows how red water moves in a V pattern.

Explicit contours:-

One way is to follow a few areas, shift them normally to the front (red arrows), and then predict where the front ends upThe picture below shows a step in the process.It may seem like a good idea to change the front with a collection of points, but there are some problems with it. In our last example of a V-shaped spreading front, the corners can become unclear.Below is what this status looks like after one iteration.

Proposed work:-

There are two types of visual representations: (1) photo graphic images of things and (2) electronic images on TVs and computers.The lens, mirror, or electronic gadget makes an exact copy of an object that looks the same.Image noise occurs when the brightness or color changes randomly, mostly because to electrical noise.It can be made by the electronics and image sensor of a scanner or digital camera.Film grain and perfect photon detector shot noise can also make images noisy.Noise from taking pictures hides critical information. "Noise" used to indicate "unwanted signal" since AM radios picked up electrical changes that weren't wanted and made sound ("static"). "Noise" is the term for unwanted electrical changes.

The way kmeans algorithm works is as follows:

- Choose how many clusters (K) there will be.
- After shuffling the dataset, pick K data points at random for centroids without putting them back.
- Keep going until the centroids stay the same. The way data points are grouped together stays the same.
- Add up all the squared distances between the data points and the centroids.
- Put data points in the cluster that is closest to them (centroid).
- Find the cluster centroids by averaging all the data points in each cluster.

Working:-

Expectation-Maximization is the strategy k utilizes to solve problems.The E-step puts data points in the cluster that is closest to themThe M-step finds the center of the cluster. We can find a numerical solution like this.So, E-step:

$$\frac{\partial J}{\partial w_{ik}} = \sum_{i=1}^{m} \sum_{k=1}^{K} \|x^i - \mu_k\|^2$$

$$\Rightarrow w_{ik} = \begin{cases} 1 & \text{if } k = argmin_j \|x^i - \mu_j\|^2 \\ 0 & \text{otherwise.} \end{cases} \qquad (2)$$

Experimentation and results:-

On doing filtering, we get the image when the noise is removed using median filter. Noise can be of different types, but when we use median filter, it removes the unwanted disturbances irrespective of the color of the image.

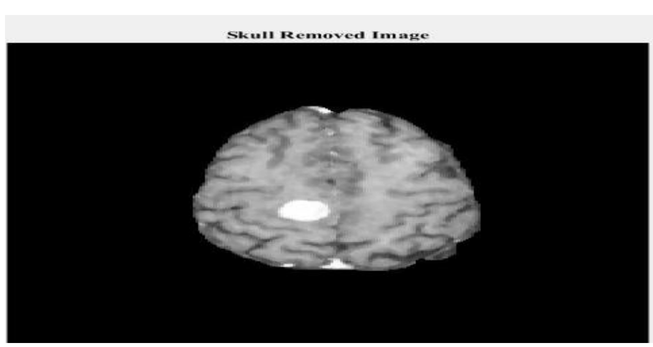

Fig.4. Filtered Image

Here, the preprocessed image is subjected to K-Means clustering in which the same intensity pixels are grouped and formed centroids for which others pixels have different values.

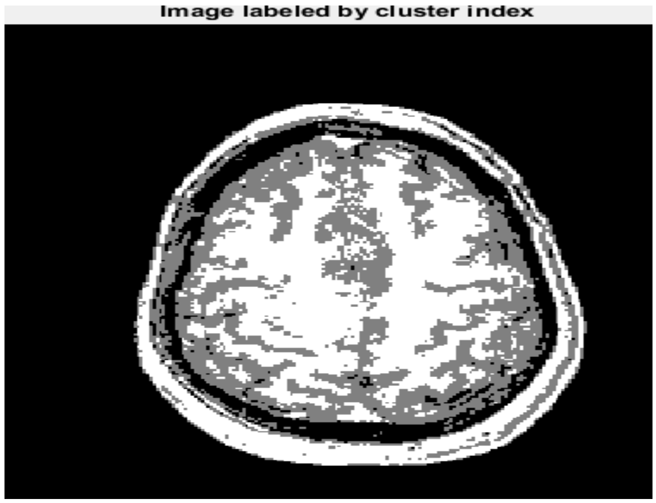

Fig.5. Cluster Image

Fig. 1. MRI Machine

Level set Segmentation is used to detect a contour, which is like a layer formation for the particular image. When the contour is formed, we can observe a green line formed around the brain region

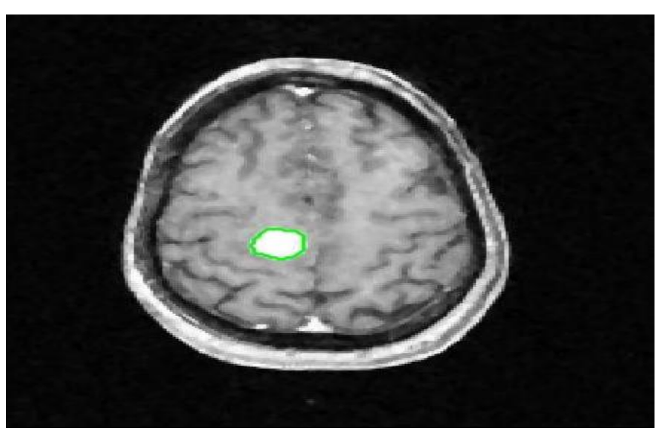

Fig.13.contour formation

After this whole process, tumour position is located and shown in a separate image using thresholding technique.

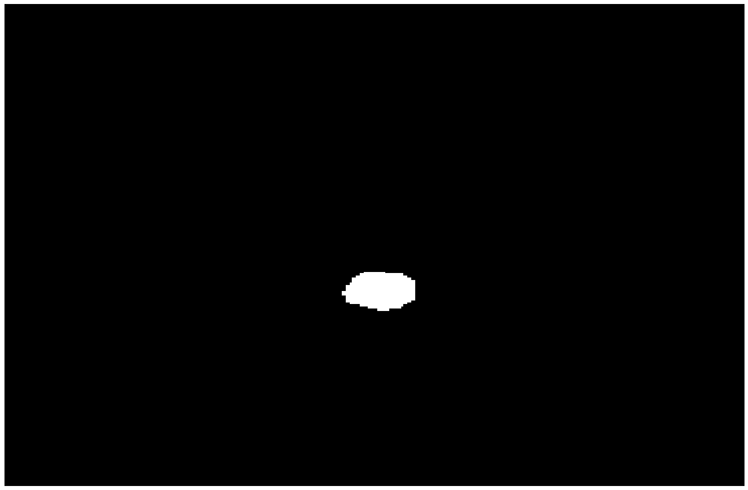

Fig.14.tumor detection

Performance Evaluation Matrices:

Performance Measurements	Data Set 1	Data set 2	Data Set 3
TP	99.483	99.4247	99.4247
TN	1.0781	1.2539	2.1406
FP	0	0	0
FN	62	56	59
Accuracy	99.05	99.9	99.9
Precision	100	100	100
Recall	99.90	99.91	99.99

CONCLUSION:-

K-means Clustering and Level-set segmentation are the most accurate and exact ways to find brain tumors. Experimental findings indicate that this method can identify and delineate abnormal cells in MRI images, notwithstanding tumor complexity.Various characteristics, such as comparison, correlation, in potential work possible to add additional data which included in the method of extraction of features to render the process more adaptive to the texture and multiple other variables.

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