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BRAIN TUMOR DETECTION USING ADVANCED CLUSTERING ALGORITHMS

Mohit Jain[1],Chandrakant Raut[2],Siyona Rahane[3],Shreya Mandlecha[4],Prof. Anita Mahajan[5]

Computer Engineering, G.H.Raisoni Institute of Engineering And Technology, Pune, INDIA

mohitdesarda123@gmail.com, craut358@gmail.com,rahanesiyona@gmail.com,shreyamandlecha123@gmail.com, anita.mahajan@raisoni.net

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Abstract: The present method employs a number of algorithms for recognising the size and form of tumours in brain MR images and estimating the tumour stage based on the tumour area given. Tumors are uncontrollable tissue growths that can appear anywhere in the body. Following considerable study and statistical analysis of persons affected by brain tumours, certain general risk factors and symptoms have been identified. The advancement of research at all hours of the day and night strives to give new treatment techniques. This imaging is examined by the doctor in order to discover and diagnose a brain tumour. However, this method accurately predicts the stage and size of the tumor, as well as the stage of the tumor from the tumor's location. The k-means and fuzzy c-means algorithms were employed to segment brain tumours in this investigation. This technique allows for precise and reproducible tumour tissue segmentation, similar to hand segmentation. Additionally, it reduces analysis time and diagnoses tumour stage from a specific tumour area.

Keywords: *Brain tumor, Pre-processing, K-means, fuzzy c-means, Thresholding.*

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I INTRODUCTION

The anatomy of the brain is routinely examined using MRI or CT scans. Using an MRI scanned image, the complete procedure is detailed in this paper. An MRI scan is more comfortable than a CT scan for diagnosis. It has no negative consequences on human health. Radio waves and the magnetic field are used to power it. Various algorithms have been developed for the identification of brain cancers. However, in terms of detection and extraction, they may have certain limits.

In this work, two methods are used for segmentation. K-means clustering method with fuzzy C mean algorithm As a consequence, an accurate tumour segmentation result is obtained. Uncontrolled tissue development in any part of the body causes tumours. There's a chance the tumour is either primary or secondary. If it has an origin, it is referred to as primary. When a part of a tumour travels to another place and develops on its own, it is called secondary cancer. Brain tumours are known to influence CSF (Cerebral Spinal Fluid). Strokes are caused by it. The doctor focuses on the strokes rather than the malignancy. As a result, early detection of a tumour is crucial for effective therapy. A person's life expectancy will be prolonged if a brain tumour is discovered early. This will add 1 to 2 years to your life expectancy. Tumor cells are usually classified into two groups. They're huge and malignant at the same time. The identification of a malignant tumour is more difficult than that of a benign tumour. In this study, we concentrated on identifying brain cancers utilising brain MRI scans and estimating tumour stage from the provided tumour area. The shape and stage of a brain tumour, as well as its size and location, as well as your overall health and medical history, all influence treatment. The majority of therapies aim to completely eliminate or eradicate the tumour. If discovered and treated early enough, the majority of brain tumours can be cured.

A person who has had any type of brain tumour has a greater chance of developing another type of brain tumour. If a person has two or more close relatives (mother, father, sister, brother, or child) who have had brain tumours, his chances of developing one are enhanced. A genetic condition that makes the brain more sensitive and increases the chance of developing a brain tumour can be passed down through generations. About 5% of brain tumours may be linked to hereditary (genetic) factors or conditions. The objective of this project is to develop a tool that can inform individuals about their risk of developing a brain tumour, including if they are at danger and how much they are at risk. The detection platform is built with Java. Finally, we provide technologies that can detect cancers and their forms, as well as determine the stage of a tumour from a specific tumour location.

II. RELATED WORK

For MR image segmentation, the proposed system of image registration and data fusion theory has been changed. Propose a technique for segmenting MR images that uses image registration and data fusion theory. A brain tumour may be diagnosed quickly and accurately with this method. The K-means approach, which is utilised in this system, is a rapid and effective way to detect a brain tumour [1].

Meena and Raja developed a Spatial Fuzzy C Means (PET-SFCM) clustering technique for Positron Emission Tomography (PET) scan image datasets. To update each cluster's goal function, the proposed method integrates geographic neighbourhood information with traditional FCM. A huge data set of individuals with neurodegenerative disorders of the brain, such as Alzheimer's disease, was used to develop and test this approach. It has been proven effective after being tested on real-world patient data sets. [2].

Three picture segmentation methods are compared and contrasted in the given system: K Means clustering, Expectation Maximization, and Normalized cuts. This research looks at the problem of segmenting a picture into several sections. We examine two unsupervised learning algorithms, K-means and EM, and compare them to the graph-based Normalized Cut method. K-means and EM are clustering methods that split a data set into groups based on a specified distance metric [3].

The Fuzzy K-C-means technique, introduced by Funmilola et al., combines the Fuzzy C-means and K-means characteristics. Clustering techniques, particularly k-means and fuzzy c-means clustering algorithms, have been the focus of this study. These techniques were combined to develop the fuzzy k-c-means clustering algorithm, which has a higher time utilisation result. MRI (Magnetic Resonance Imaging) images of the human brain were used to design and test the algorithms. The results have been investigated and recorded [4].

Wilson and Dhas used K-means and Fuzzy C-means, respectively, to detect iron in the brain using the SWI method. A accurate evaluation of iron buildup is required for the diagnosis and treatment of iron overload in many neurodegenerative diseases. Susceptibility Weighted Imaging (SWI) offers data on any tissue that has a susceptibility that differs from that of its surrounds. [5].

Several sorts of diagnostic techniques are described in this in-depth look at brain tumours. This study offers a systematic Type-II fuzzy expert system for detecting human brain cancers using T1-weighted Magnetic Resonance Images with contrast (Astrocytoma tumours). The proposed Type-II fuzzy image processing technique has four separate modules: pre-processing, segmentation, feature extraction, and approximate reasoning. [6].

Because of the importance of human perception and the inability of traditional mathematics to cope with its intricate and ambiguously defined system, many fuzzy approaches have been used as an acceptable alternative in the field of pattern recognition [7].

The proposed work offers a synergistic and effective strategy for the detection of brain tumours based on median filtering, K Means Segmentation, FCM Segmentation, and ultimately threshold segmentation. In this suggested approach, we utilise approximation reasoning to determine the size of the tumours after improving the quality of the tumour pictures collected with the use of MRI. [8].

The author of the paper investigates the various approaches for colour, text, and grayscale pictures. Picture segmentation produces a set of segments or contours from the image that together cover the entire image. Each pixel in an area is similar in terms of some characteristic or calculated property, such as colour, intensity, or texture [9].

In this work, k-means and C-mean clustering methods were employed to extract features from brain images and identify tumours [10].

III.PROPOSED SYSTEM

The proposed approach employs a combination of two clustering methods. The proposed system's four main modules are preprocessing, segmentation, feature extraction, and approximation reasoning. As a pre-processing phase, image filtering with a median filter is utilised. The pictures are then segmented using the K-means and Fuzzy C-means methods. To recognise the tumour area and location in an MRI image, as well as to identify the stage of the tumour from the result area of a brain tumour, image thresholding is performed to extract features, and then approximation reasoning is employed. I.e., develop a simpler, less costly, and time-saving method for identifying tumour stage.

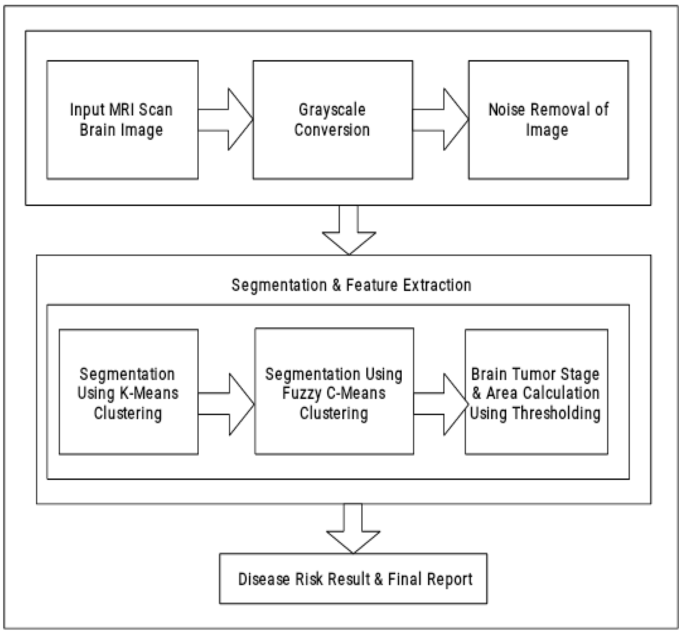

Figure 1: Proposed System Architecture

IV. MATHEMATICAL MODEL

Mathematical equation in K-means clustering

1. $M = \frac{\sum_{i:c(i)=k} Xi}{Nk}$,

where , k=1, 2,…… K.

2. D (i) = arg min$||X_i - M_k||^2$,

where i=1, 2,….., N.

Mathematical equation in Fuzzy-C means clustering

$$Ym = \sum_{i=1}^{N}\sum_{j=1}^{C} Mij^{m} \; \|X_i - C_j\|^2$$

Where,

m= any real number greater than 1,

M_{ij}= degree of membership of X; in the cluster j,

X_i= data measured in d-dimensional,

R_j= d-dimension center of the cluster,

The update of membership Mij and the cluster centers R are given by:

1. $M_{ij} = \frac{1}{\sum_{K=1}^{C} \left(\frac{||Xi-Cj||}{||Xi-Cj||}\right)^{\frac{2}{m-1}}}$

2. $R_j = \frac{\sum_{i=1}^{N} \; Xi.Mijm}{\sum_{i=1}^{N} \; Mijm}$

V. ALGORITHMS

K-means clustering

Steps:

1. Give the value to k for no of cluster.
2. Randomly choose the k cluster centers
3. Calculate mean or center of the cluster
4. Calculate the distance b/w each pixel to each cluster center
5. If the distance is near to the center then move to that cluster.
6. Otherwise move to next cluster.
7. Re-estimate the center.
8. Repeat the process until the center doesn't move.

Fuzzy C-Means Algorithm

Fuzzy logic is a data processing approach that assigns a partial membership value to each pixel in an image.

The fuzzy set's membership value varies from 0 to 1.

Participants of one fuzzy set can also be members of other fuzzy sets in the same picture using the fuzzy clustering approach, which is essentially a multi-valued logic that allows for intermediate values. Between full membership and non-membership, there is no clear transition.

The membership function is used to describe the fuzziness of a picture as well as the information it contains.

VI. RESULT

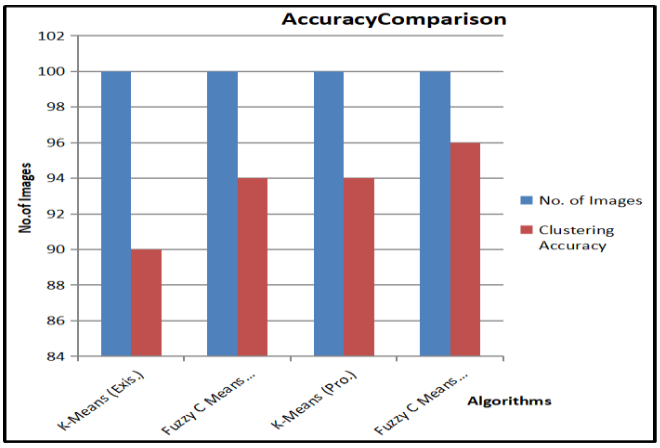

Fig.7Brain Image Clustering Accuracy Graph

Table: Brain Image Clustering Accuracy

Algorithm	No. of Images	Clustering Accuracy (Exis.)	Clustering Accuracy (Prop.)
K-Means Clustering	100	90%	94%
Fuzzy C Means Clustering	100	94%	96%

VII.CONCLUSION

The segmentation of brain tumours is done in this article. The picture is first pre-processed with the median filter method. If there is any noise in the MR image, it is removed before applying the K-means algorithm. Using the noise-free image as an input to the k-means method, the tumour is retrieved from the MRI image. Then, segmentation using Fuzzy C means is utilised for accurate tumour shape extraction of malignant tumours and output thresholding in feature extraction. Finally, approximate reasoning is utilised to compute the size and location of the tumour, as well as to determine the stage of the tumour based on the size and location of the tumour. i.e. identifies stage of tumour in a way that is simpler, less expensive, and faster.

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