

A Study on K-Means Clustering and Morphological Operations to Spot Brain Tumors

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ABSTRACT:-A brain tumour is an intrinsically severe and life-threatening disorder because of its location in the limited area of the cerebral cavity where it develops. Because brain tumours are one of the most common kinds of brain illness, the diagnosis and treatment of these conditions are of the utmost significance. The computed tomography (CT) scan is the procedure that is used to produce aImage of the interior of human tissues using a computer. A mass of abnormal tissue that develops due to the uncontrolled development of cells is referred to as a neoplasm. The anatomical structure of the brain may often be seen via CT scans. It does not pose any risk to the health of a person. Because it uses no radiation, in this study, we propose the segmentation of brain CT scan images by using the K-means clustering algorithm followed by morphological filtering to prevent the formation of misclustered regions after the segmentation of the brain. Specifically, we are interested in determining the effects of this method. Images were obtained from a CT scan to pinpoint the location of tumours.

KEY WORDS: Feature,Extraction,Tumor, Preprocessing.

1. INTRODUCTION

Image processing entails converting an image to a digital format and then performing operations on it to improve it or extract information. Digital image processing is another name. Image processing helps diagnose diseases in agriculture and medicine. This work aims to construct a computer system that can detect and properly define brain tumours in digital brain images.Our primary focus is determining which of the several potential courses of action will provide the best results. Tumours of the brain are abnormal growths of cells that occur inside the bone¹.

In most cases, the growth may originate in brain cells, blood vessels, or nerves branching out of the brain. Malignant tumours are the opposite of benign tumours, which are those that do not spread malignancy to other parts of the body (cancerous). The first kind of

tumour is characterised by a sluggish rate of growth and the fact that they exert negative pressure while not spreading to neighbouring brain tissue. On the other hand, the latter may be separated from the former due to its rapid development and readiness to create a brain. Tumours will harm normal brain cells because they cause inflammation, “pressure parts of the brain, and increase the pressure within the skull surrounding the brain”¹. The CT SCAN is a procedure that is very helpful in identifying cases of brain cancer¹. Imaging of the brain may be obtained without the use of radiation, thanks to this technique. Image processing methods are used to analyse the image that was not inherited. Image segmentation and clustering are presented as new approaches for measuring global growth.

2. STRUCTURE OF BRAIN

Brain and spinal cord make up what is called the central nervous system. The os, a cushion of protective fluid, and the blood-brain barrier all work together to keep the brain from being exposed to its surroundings. External causes, such as physical trauma or a viral or bacterial infection, may still cause harm to the brain despite this². The human brain may be roughly divided into three regions, each responsible for a distinct set of functions.

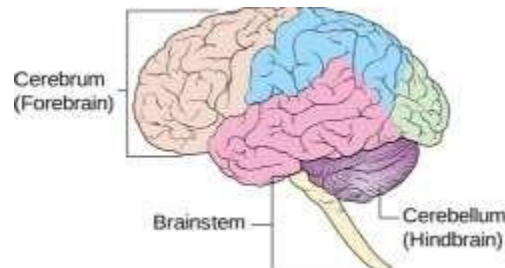


Fig-1.1 Brain Structure

Cerebrum

The brain stem is the connecting tissue between the neuronal structure and the rest of the brain and nervous system. The pons and the bulb are neuronal structures that compose the brain stem together. Learning, thinking, emotions, communication, identifying disadvantages, reading, and writing are all controlled by the brain's structure². Separation of the brain's right and left hemispheres. Muscles on the left side of the body are under the control of the left hemisphere of the brain and vice versa for the right side of the body.

Cerebellum

Standing, walking, and maintaining your balance are all under the control of the brain's architecture. Pairs of tracts go from one part of the brain to another. Laughter is generated and dispersed inside the brain's four linked ventricles, known as the "cavity system".

Brainstem

Like a stalk, the brain stem enters and leaves the nervous system. The brain stem is made up of two different types of neuronal structures: the pons and the medulla. The cerebellum is located behind the brainstem. The brain stem is the part of the brain that communicates with the spinal cord. Essential bodily processes including heart rate, body temperature, and respiration are all under the brain stem's watchful eye. Explain the structure of the brain in Fig.1.1.

CTScan

A CT or CAT scan may provide cross-sectional Images of the body using a computer and spinning X-ray equipment. Compared to regular X-ray Images, these show a lot more detail. "They can show the muscles, tendons, ligaments, blood vessels, and bones of different body regions. With a CT scan, you may see brain, spine, heart, abdomen, thigh, and chest images".

3. LITERATURE REVIEW

Segmentation of brain CT SCAN images for tumour site identification was given by M.Manekandan. They used the K-means clustering approach, followed by morphological filtering, to reduce the number of misclustered areas. Opening and closing are only two morphological strategies employed in this research to eliminate those pesky misclustered areas. Pre-processing, k-means/fuzzy c-means segmentation, and approximation reasoning are all explained by Alan Jose, S.Ravi, and M.Sambath.

Filtering is used for preprocessing, while an improved K-means method and a fuzzy c-means algorithm are used for segmentation. An approximate reasoning technique called edge detection is used to determine the size, location, and form of a tumour in a CT SCAN Image. In order to locate the border pixels of tumours, this method first transforms the RGB or grayscale Image to binary using a binarisation algorithm. Additionally, the number of white pixels (digit 0) in the binary Image is used to calculate the size of the tumour. MsSoniChaturvedi, offer a novel approach for segmenting images using the k-means algorithm.

A quick overview of the various feature selection methods for brain image detection was provided by M. Sasikalal and N. Kumaravel. This article provides an overview of feature selection methods for detecting brain tumours and makes some comparisons between them³. Space-based grey level dependency techniques and a revolving ridge remodel are used to assemble texture alternatives from both the original and expanded ROI. This study uses a GA to search for optimal feature configurations.

4. BASIC SYSTEM

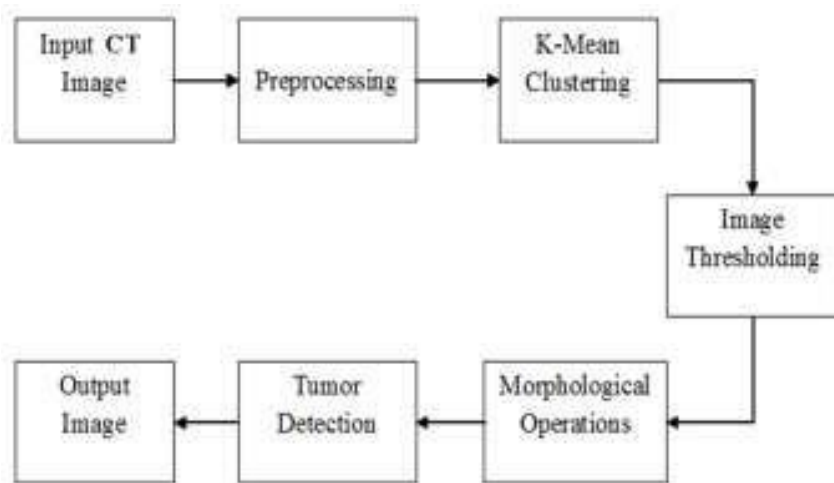


Fig-3: Basic Block Diagram of System

Input CT Scan Image:

Only white and grey tones were used to create the CT SCAN Image. Cancer cells are represented by white data points, whereas grey data points show healthy cells. This Image, generally in RGB format, has been converted to grayscale. Tumour anatomy is often analysed. A CT scan may accurately show the anatomical structure of tissues⁴.

Feature Extraction-

During the feature extraction procedure, the cluster is gleaned. The cluster is extracted and accompanied by an edge technique. The whole thing is masked in binary. In approximation reasoning, the neoplasm space is calculated using binarisation. Because of this, the black part becomes darker, and the white part becomes brighter⁴.

SobelOperator-

A method for finding edges in photos using algorithms is the Sobel operator. It is essential to find things in Images and figure out what is there. Edge detection techniques, to put it. Educate North Americans on how to tell foregrounds and backgrounds apart in images⁴. The Sobel operator uses convolution with a pair of 3x3 filters to approximate the visual gradient at each pixel. The magnitude of the gradient is just the sum of the estimates from the horizontal (x) and vertical (y) filters.

VerticalGradient-

By removing the mask, the image's vertical edges become apparent. It is a simple first-order derivative that finds the contrast between Image elements along the edges. Since 0 appears in the centre column, it is used to determine the difference between the values of the corresponding elements on the right and left sides of the Image at that particular edge. Aside from that, the middle numbers in the first and third columns are 2 and -2, respectively⁴. Therefore, the values of the Image elements along the boundary are more critical. As a result, the overall intensity of the edge will increase, making it more robust in contrast.

HorizontalGradient-

The horizontal edges of aImage may be brought into focus using this mask. It uses the same premise as the higher-than-mask algorithm and attempts to assess the dissimilarity between an edge's component intensities⁴. Instead of using the image's pre-calculated edge values, it measures the disparity between the edge's non-zero and non-negative component intensities. as a result, the sudden increase in intensity and the resulting sting are amplified.

MedianFilter-

To clean up aImage, one may use a median filter. "Median filtering is a noise-reduction strategy that makes use of nonlinear digital filtering"⁴. Median filtering is widely used in digital image processing because it can preserve edges while simultaneously decreasing noise. Median filters, like mean filters, are often used to reduce Image noise⁴. For proper operation, the median should correspond to a neighbouring pixel's value, and the median filter should not introduce illogical new components at edge crossings.

k-meansclustering-

A CT SCAN Image of a brain tumour is segmented using k-means clustering. We cluster the information using a k-means algorithm after first sorting it by selecting its median value. However, in situations when the grouping data are included in another data set, the fuzzy and c-means techniques do not accommodate this⁴. We use k-means clustering rather than fuzzy

c-means or the c-means clustering technique. As a method of categorization, it is quite effective.

Image Thresholding-

Non-contextual segmentation may be accomplished with minimum effort using image thresholding. It uses a single threshold to convert a colour or grayscale. The binary map is divided into two parts: the first includes pixels whose input file values are below a certain threshold, while the second contains pixels whose input file values are at or above the threshold⁴. It is common to practice using the symbols 0 and 1 to denote the beginning and end of the range.

Morphological Operations-

The primary concerns of morphology are the object's shape and underlying architecture. As a result, this is the norm regarding tasks like object extraction, noise cancellation, etc⁴. For the same reasons, we often use these methods to clean up images and fortify item borders.

Tumour Detection-

When it comes to modern medical treatment, a brain tumour diagnosis is one of the leading causes of mortality. Magnetic resonance imaging (also known as CT SCAN) has developed into an effective tool for diagnosing brain conditions and other organs via imaging⁴. When a tumour is discovered, this is the first step. Malignancy in brain CT SCAN images is detected using K-means clustering and morphological operation.

Output Image-

The output image represents the “CT SCAN input image” that demonstrates the outcome of the given input.

Doctors undertake analyses of brain tumours; however, their grading of these tumours might lead to subjective assessments that may differ from one practitioner to the next. The research was done utilising the software's segmentation techniques, so doctors can easily access the brain section and tumour data.

5. CONCLUSION

The K-Means Algorithm in MATLAB has been used to estimate tumours' presence and location. The proposed K-Means algorithm outperforms state-of-the-art methods and has the potential to optimise computation time, leading to improved accuracy and quality in image segmentation. Since this method reduces the time spent on computations while still producing adequate results, we have concluded that it is worth adopting. Thanks to Image segmentation, it is easy to see exactly where the damage occurred. The efficacy of

chemotherapeutic therapy highly depends on the tumour's size and location. The MATLAB GUI design process is shown. This approach makes it simple to identify tumours in CT SCAN Images. A graphical user interface (GUI) simplifies using a system so that anybody may do it. Area estimates for tumour staging may be included in this research in the future. It will help doctors and radiologists make more accurate diagnoses. That way, medical professionals can tell what kind of transformation their Patient is facing. Estimating the presence and location of tumours is possible using suggested MATLAB K-Means techniques. Compared to other approaches, the K-Means algorithm has shown to perform better because of its ability to optimise computation time, improving image segmentation's efficiency and precision. This method reduces the processing time required while still producing accurate results. The segmented Image shows the damaged parts as they are. The efficacy of chemotherapeutic therapy highly depends on the tumour's size and location. We have created a graphical user interface in MATLAB. This approach makes it simple to identify tumours in CT SCAN Images. A graphical user interface (GUI) simplifies the usage of a system so that anybody may use it.

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