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A Review on Brain Tumor Detection Using Immune System with Imaging Techniques

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Abstract: *The brain tumor is an uncontrolled growth of tissues in human brain. Tumor, when turns into cancer it becomes life-threatening. Medical imaging is necessary to detect the exact location of tumor and its type. There are many techniques to detect brain tumor from medical imaging technique. Recently Magnetic Resonance Imaging (MRI), Positron EmissionTomography (PET) and Computed Tomography (CT) is used. For locating tumor in magnetic resonance image (MRI) segmentation of MRI plays an important role. The people know the awareness of brain tumor and symptoms of brain tumor. In the existing method Convolutional Neural Network (CNN) requires a large number of training samples in order to achieve competitive performance and small dimension images does not provide better results.To overcome these disadvantages, the system has proposed immune system and KFCM algorithm. Using the immune cells, the growth of the brain tumor cells is find. MRI and PET images used to find the tumor location and sizes, for the immune system to analysis the development stage of tumor. The KFCM algorithm is used to identify the small distances in the data point in images. So, the system has discovered that could lead to better treatment for patients suffering from brain tumor. The image technique helps to view the cells in the brain and extract the location of tumor is detected.*

Keywords: *Computed Tomography (CT),Convolutional Neural Network (CNN),Fuzzy c-means, Immune Cells, Kernel Based fuzzy c-means (KFCM), Magnetic Resonance Image (MRI), Positron Emission Tomography (PET).*

I. Introduction

Brain tumor develops because of unusual cell growth within the brain. Brain Tumor generally classified into two types benign and malignant tumors. Malignant Tumors are fast growing cancerous tissues. Benign are slow growing, stagnant cancerous tumor. Most of the tumors are life threatening, brain tumor being one among them. Primary brain tumors originate in the brain. In the Secondary type of brain tumor, the tumor expansion into the brain results from other parts of the body. Imaging tumors with more accuracy plays pivotal role in the diagnosis of tumors. It involves high resolution techniques like MRI, CT, and PET etc. MRI is an important mean for studying the body's visceral structures. MRI is widely used because it gives better quality images of the brain and cancerous tissues compared with the other medical imaging techniques such as X-Ray or Computed Tomography (CT). As being a non-invasive technique MRI are majorly used. The basic principle behind MRI is to generate images from MRI scan using strong magnetic field and radio waves of the body which helps in investigating the anatomy of the body.

1.1 Diagnose

A brain tumor is usually identified by a neurological examination, brain scans and / or an analysis of the brain tissue. A neurological examination is a test to measure the function of the patient. A brain scan is a picture of the internal structures in the brain. The common scans used for diagnosis are as follows:

MRI: Magnetic Resonance Imaging (MRI) is one type of scan. It scan can be used to examine any part of the body, and it diagnose a variety of conditions, from ligaments to tumors. This scan is painless, but it makes a lot of noise. This scan doing the take a long time.

PET: Positron Emission Tomography (PET), It scan can show how body tissues are working. It usually takes between 30 to 60 minutes. A PET scan can help to view a cancer, find out the stage of cancer, show whether a cancer has spread to other parts of the body.

CT: Computerised Tomography (CT) scan uses X-rays and a computer to create detailed images of the inside of the body. CT scan sometimes referred to as CAT scans. It can be used to diagnose conditions, monitor conditions and guide further tests or treatments

1.2 Image Acquisition

First considered that the MRI scan images of a given patient are either color, Gray-scale or intensity images herein are displayed with a default size of 220×220. If it is color image, a Gray-scale converted image is

defined by using a large matrix whose entries are numerical values between 0 and 255, where 0 corresponds to black and 255 white for instance. Then the brain tumor detection of a given patient consists of two main stages namely, image segmentation and edge detection.

1.3 Pre-processing stage

Pre-processing stage consists of Noise removal this can be done by using various spatial filters linear or nonlinear filters (Median filter). Other artifacts like text removed by some morphological operations. RGB to grey conversion and reshaping also takes place here. It includes median filter for noise removal. The possibilities of arrival of noise in modern MRI scan are very less. It may arrive due to thermal Effect.

1.4 Image Segmentation

The image segmentation is one part of the fundamentals of digital image processing. This process is used to detect the tumor location of the brain. The segmentation technique is widely used by the radiologists to segment the input medical image. These problems are lead to a need of computerized and automated processing technique, that will make the analysis of medical images are easier. Segmentation is the solution for this problem.

II. Related Work

In this system approach for brain tumor detection and classification is proposed. The approach works in two main parts; the first part view the stages of detection the brain tumor from MRI images according to the segmentation tumor from normal tissues and extract feature, the second part use ANN to recognize the type of tumor based on feature extraction. [1] The Brain Tumor is affecting many people worldwide. It is not only limited with the old age people but also detected in the early age. Brain Tumor is the abnormal growth of cell inside the brain cranium which limits the functioning of the brain. Early detection of the brain tumor is possible with the advancement of machine learning (ML) and image processing (IP). In this paper stages of image processing are discussed and overview of the analogous papers are quoted by analyzing several research papers. This paper provides gist of technologies which can be used to predict brain tumor [2]. This algorithm is used to detect the range and shape of the tumor in brain MRI images. CT scan or MRI that is directed into intracranial cavity produces a complete image of a brain. This image is visually examined by the physician for detection and diagnosis of brain tumor. However, this method of detection resists the accurate determination of stage and size of a tumor. To avoid that it uses computer-aided method for segmentation of brain tumor based on the combination of two algorithms. As compared to manual segmentation it provides segmentation of tumor with accuracy and reproducibility. It reduces the time for analysis. The tumor is extracted from MRI image and its exact shape and position are determined. The amount of area calculated from the cluster is used to display the size of the tumor [3]. This concept for automatic brain tumor segmentation. Normally the anatomy of the brain can be viewed by the MRI scan and CT scan. A new method for estimating the right number of segments and automatic segmentation of human normal and abnormal MR brain images. The purpose of automatic diagnosis of the segments is to find the number of divided image areas of an image according to its entropy and with correctly diagnose of the segment of an image also increased the precision of segmentation. If there is any noise are present in the MR image it is removed before the K-means process. The noise free image is given as an input to the k-means and tumor is extracted from the MRI image. And then segmentation using Fuzzy C means for accurate tumor shape extraction of malignant tumor and thresholding of output in feature extraction. Finally, approximate reasoning for calculating tumor shape and position calculation. The experimental results are compared with other algorithms. The proposed method gives more accurate result [4]. Medical imaging techniques are used to image the inner the portions of the human body for medical diagnosis. Brain tumor is a serious life altering disease condition. Segmentation of the brain MRI images for detection of tumors using clustering techniques. K-means clustering algorithm for segmentation of the image followed by morphological filtering is used for tumor detection from the brain MRI images. The proposed a computer aided system for brain MR image segmentation for detection of tumor location using K - means clustering algorithm followed by morphological filtering. Able to segment tumor from different brain MRI images from our database [5]. The brain tumor suffering from many people. Brain tumor have mass tumor cells and malignant tumor cells. In this paper proposed two algorithms. These two techniques are used to detect the location of the tumor in brain MRI images. The K-means algorithm is used to find the affected brain cells. And the fuzzy C means algorithm is used to segmentation for accurate tumor shape of malignant tumor and calculate the area of brain tumor [6]. A brain tumor is defined as an abnormal growth of cells within the brain. This paper proposed the two efficient algorithm for segmentation. The two algorithms are K- means and region growing techniques and compare the two algorithms and determine the best one. K- means method is easy and efficient, it is not as accurate as region growing method. Region growing method proved to be more accurate than k-means, giving a satisfiable

segmentation and also proved to be one of the best region based segmentation methods [7]. The brain tumor detection based on digital image segmentation. In this paper proposed an Artificial Neural Network Approach for Brain Tumor Detection, which gave the edge pattern and segment of brain and brain tumor itself. Segmentation is a process of identifying an object or pattern in the given work space. The main objective of the digital image segmentation is the partition of an image into mutually exclusive and exhausted region such that each region of interest is spatially contiguous and the pixels within the regions are homogeneous with respect to a predefined criterion [8]. the brain tumor detection based on digital image segmentation. We proposed an Artificial Neural Network Approach for Brain Tumor Detection, which gave the edge pattern and segment of brain and brain tumor itself. Segmentation is a process of identifying an object or pattern in the given work space. The main objective of the digital image segmentation is the partition of an image into mutually exclusive and exhausted region such that each region of interest is spatially contiguous and the pixels within the regions are homogeneous with respect to a predefined criterion [9]. The detection and segmentation of tumor region in brain image is a critical task due to the similarity between abnormal and normal region. The system proposed the discovery of a mechanism by which normal brain cells regulate the expression of the NFIA gene, which is important for both normal brain development and brain tumor growth, might help improve treatments to treat brain tumors. NFIA is important for glioma formation Gene expression, the process by which genes produce proteins, is regulated at different levels, in a coordinated fashionthree levels of gene regulation coordinated their activities to regulate NFIA gene expression. The DNA loops they had observed in normal glial cells also were present in glioma cells. When disrupted the DNA loops in normal glial cells, the cells did not express the NFIA gene and did not fulfill their expected development. If disrupted the DNA loops in glioma cells, the cells decreased the expression of NFIA and reduced proliferation. The system using the gene expression easily identified the tumor the imaging techniques help to identify the tumor cells. Tumors affecting the glial portion of brain parenchyma are termed glioma and constitute the most frequent and lethal cancers affecting the central nervous system. [10]. The brain image segmentation approach using K-means clustering technique integrated with Fuzzy C-means algorithm. It is followed by thresholding and level set segmentation stages to provide an accurate brain tumor detection. The proposed medical image segmentation system consists of four stages: pre-processing, clustering, tumor extraction and contouring, and validation stages. The main idea of doing the integration is to reduce the number of iterations done by initializing the right cluster centers to Fuzzy C-means clustering techniques that, of course, minimizes execution time and give qualitative results [11]. An effective NN based brain tumor detection technique with MRI images. The efficiency is achieved with brain tissue and tumor segmentation, feature extraction of the segmented regions and the classification based on NNs.The performance of the proposed technique is evaluated by means of the QR for all the segmented tissues. As well, the results for the tumor detection are validated through evaluation metrics namely, sensitivity, specificity and accuracy [12].

III. Proposed System

In this paper proposed immune system and KFCM algorithm. Using the immune cells, the growth of the brain tumor cells is find. MRI, CT and PET images used to find the tumor location and sizes, for the immune system to analysis the development stage of tumor. The KFCM algorithm is used to identify the small distances in the data point in images. So, the system has discovered that could lead to better treatment for patients suffering from brain tumor. Human brain tumor samples and discovered that specialized immune cells in brain tumor patients, and identified a drug that is able to re-activate those immune cells and reduce brain tumor growth. The image technique helps to view the cells in the brain and extract the location of tumor is detected.

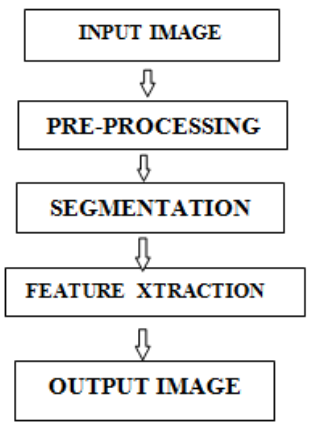

Fig:1 Proposed Method

IV. Clustering Algorithms In Data Mining

The fuzzy c-means clustering algorithm for data clustering to do the improvement in the field of data mining puts forward the fuzzy c-means clustering algorithm based on multiple kernel function (MKFCM) algorithm. Under fully unsupervised learning method, a set of Gaussian kernel function combination are assigned different weights resolution to a new multiple kernel function, through application of the single fixed kernel function of the fuzzy c-means clustering algorithm (KFCM algorithm) has obvious advantages and reliability in the clustering class compared. The simulation results indicate that the MKFCM algorithm can be size and a few kinds of density difference very big bunch of good classification, compared KFCM algorithm of the phenomenon of the overlap between in data clustering have significant performance advantages, also has a better application prospect in the field of datamining. The application of clustering optimization in data mining based on multiple kernel function FCM algorithm.

V. KFCM Algorithm

In traditional FCM algorithm the distance between the pixel and the center of the cluster is calculated by Euclidean distance. The kernel fuzzy c-means algorithm uses kernel function in calculating the distance of data point from the cluster center. The Kernel-based Fuzzy c-means (KFCM) clustering method was proposed by Zhang based on FCM. It used a kernel function Φ(x) instead of the original Euclidean norm metric in typical FCM algorithm. The objective function of the KFCM is

$$J_m(\mathrm{U},\mathrm{V}) = \sum_{i=1}^{c}\sum_{j=1}^{N} u_{ij}^{m} ||\,\Phi(x_j - \Phi(v_i))||^2 \text{……..……………... (1)}$$

whereΦ is an implicit nonlinear map, and

$$||\Phi\left(x_j - \Phi(v_i)\right)||^2 = K\left(x_i, x_j\right) + K(v_i, v_i) - 2K(x_j, v_i) \text{ …… (2)}$$

where$K(x, y) = \Phi(x)^T \Phi(\mathrm{y})$ is an inner product kernel function. If adopt the Gaussian RBF kernel i.e$K(x, y) = \exp(||x - y||^2/\sigma^2)$,thenk(x, x) = 1.

The simplified objective function becomes:

$$J = 2\sum_{i=1}^{c}\sum_{j=1}^{N} u_{ij}^{m}(1 - K\left(x_j, v_i\right))\text{…………………………….. (3)}$$

whereu_{ij} is membership function and $v_i$is cluster center will be obtained as the following

$$u_{ij} = \frac{(1-K\left(x_j - v_i\right))^{-1/(m-1)}}{\sum_{k=1}^{c}(1-K(x_j - v_k)^{-1/(m-1)}}\text{…………………………………….(4)}$$

$$v_i = \frac{\sum_{k=1}^{N} u_{ij}^{m} K(x_j, v_i) x_j}{\sum_{k=1}^{N} u_{ij}^{m} K(x_j, v_i)} \text{ …………………………………………..(5)}$$

The above iteration will stop when {J (i) – J (i −1)} < ε, where ε is a termination criterion.

The full description of KFCM algorithm is as follows:

Step 1: fix c, t_{max} , m > 1and $\varepsilon > 0$ for some positive constant;

Step 2: Initialize the memberships u_{ik}^{0};

Step 3: for t=1, 2, ….., t_{max} , do;

(a) Update all prototypes v_i^t with eqs. (4);

(b) Update all memberships u_{ik}^t with Eqs.(5);

(c) Compare $E^t = max_{i,k}\,|u_{ik}^t - u_{ik}^{t-1}|$, if $E^t \leq \varepsilon$,
Stop; else t=t+1.

VI. Brain Tumor Detection

Brain tumor is collection or mass of abnormal cells in brain. Presently medical fields are using medical imaging techniques such as MRI, PET and CT. It is necessary to detect the exact location of tumor and its type. For locating tumor in magnetic resonance image (MRI) segmentation of MRI plays an important role. This paper includes survey on different segmentation techniques applied to MR Images for locating tumor. It also includes a method for the same using Fuzzy C-Means algorithm and an algorithm to find area of tumor which is useful to decide type of brain tumor.

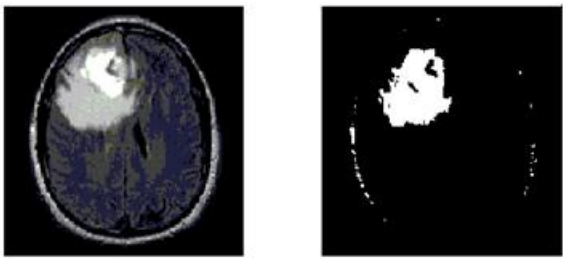

Fig:2 Original Image Output Image

VII. Conclusion

Brain tumors is an uncontrolled mass of tissue may be embedded in the regions of the brain that makes the sensitive functioning of the body to be disabled. A new approach for brain tumors detection and classification is proposed by using immune system. The proposed approach we combine the imaging techniques and KFCM algorithm to provide the information about the tumor. We start by a pre-processing stage consisting of bias field correction, intensity and patch normalization. After that, the number of training patches is artificially augmented by rotating the training patches, and using samples of PET, CT and MRI images. The proposed method must help to provide the awareness of the tumor cells and to give the information for the tumor treatment MICCAI Brats 2017 dataset is used for testing the proposed technique and experiments are performed based on the immune system with datasets.

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