

Deep Feature Learning for Medical Image Analysis for Detection of Brain Tumor

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ABSTRACT: Magnetic resonance imaging (MRI) is widely used to assist disease diagnosis. It is a great challenge to establish a brain data set for MRI analysis assistance, due to the privacy and security issues. We will work on MRI scan medical images of human brain. First we will apply image pre-processing steps on input medical image. If the noise are present in given image then we will removed this noise using median filter technique. In addition, using deep learning, that is machine learning approach that is k-means clustering techniques, fuzzy c means clustering techniques for medical image segmentation. After that image feature extractions using image thresholding to find the brain tumor and also detection of range and shape of tumor in brain MR images and predicts the another disease risk details from the given area of tumor.

KEYWORDS: Deep Learning, Machine Learning, Medical image segmentation, k-means clustering, fuzzy c means clustering;

I. INTRODUCTION

A. BACKGROUND

Deep learning concept is a subset of machine learning. It is a machine learning concept and functions in a similar way, but its abilities are different. Deep learning is a specially of machine learning concept that ac hive great power and insensibility by learning to display the world as nested order of concepts, with each concept defined in relation to easy concepts, and more abstract representations measure in terms of less abstract ones.

Magnetic resonance imaging (MRI) is an effective approach to diagnose disease, by which the doctor can intuitively examine a patients body structure and efficiently analyze the possibility of illness. However, each patient have hundreds of medical images, so it is a great dare to process and analyze the large amount of medical image data. Therefore, creative health care is an important research direction to help doctors in control medical big data. Especially, it is difficult to find the images containing nodules, which should be analyzed for helping early brain cancer diagnosis, from a large number of MRI scan images.

In this work, here two techniques are used for brain image segmentation, K-means clustering algorithm and Fuzzy C algorithm. So this technique gives the accurate and clear result for brain tumor detection and segmentation. Tumor is due to the uncontrolled progress of the tissues in any part of the human body. The tumor may be primary or secondary. If it is a basis, then it is known as primary. If the part of the tumor is expand to another place and build as its own then it is called as secondary. The specialist gives the treatment for tumor. So detection of tumor is very important for that further future treatment. The lifetime of the patient who affected by the brain tumor will grow if it is detected at current stage. That will grow the lifetime about 1 to 2 years. Normally the brain tumor cells are of two types specially that are Mass and Malignant. The detection of the malignant brain tumor is most hard to mass tumor because it can be spread of the tissues in any part of the human body. In this proposed work we build an application on detection of brain tumor with the help of Brain MRI images and predict the disease details from the given area of tumor.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 5, May 2019

B. MOTIVATION

MR imaging has become a broadly-used concept of high quality medical imaging, particularly in brain imaging where MR's soft tissue difference are clear advantages. With the help of MR images can also to calculate the size of a brain tumor as it responds to future treatment. A reliable approach using deep learning for detecting and segmenting brain tumor would positively be a useful tool.

C. OBJECTIVES

1. To use deep learning of medical image analysis
2. To use MRI scan medical image dataset
3. To detect the brain tumor in MRI image
4. To calculate the area of brain tumor
5. To identify the stage of brain tumor
6. To predict the disease risk based on area of tumor

II. REVIEW OF LITERATURE

This work presents to learn a set of high-level feature representations over deep learning, mention to as Deep hidden Identity features (Deep ID), for face verification. Author argue that Deep ID can be efficiently learned through challenging multi-class face detection and identification step, whilst they can be establish to other tasks (such as verification) and new characters unseen in the training set [1].

Presented work of image registration and data fusion theory which is suitable for the segmentation of MR images. This system provides an effective and fast way for analysis of the brain tumor using K-means technique [2].

Presented approach of Spatial Fuzzy C means (PET-SFCM) clustering technique on Positron Emission Tomography (PET) scan image datasets. Proposed technique is included the spatial neighborhood information with traditional FCM and renovating the objective function of each cluster. This technique is executed and tested on large amount of patients data collection with brain neuro degenerative disorder such as Alzheimers disease. It has determines its effectiveness by testing it for real world patient data sets. [3].

This work directs the problem of segmenting an image into different regions. Author study two unsupervised learning techniques namely the K-means technique and EM technique and compare it with a graph based technique, the Normalized Cut technique. The K-means technique and EM technique are clustering techniques, which partition a data set into clusters according to some defines distance measure [4].

This work has mainly focused consideration on Clustering techniques, specifically k-means and fuzzy c-means clustering techniques. These both techniques were combined together to come up with another method called fuzzy k-c-means clustering technique, which has a better result in terms of time usage. These both techniques have been executed and tested with Magnetic Resonance Image (MRI) images of Human brain and the results have been examine and stored [5].

The K-means technique and Fuzzy C-means technique are two techniques to detect the iron in brain using SWI technique. An accurate result of iron accession is required for diagnosis and therapy of iron burden in various neurodegenerative diseases. Susceptibility Weighted Imaging (SWI) mean information about any tissue that has a different perceptively than its neighbouring structures. [6].

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Vol. 8, Issue 5, May 2019

Presented deep study of brain tumor explained different type of diagnosis techniques. This work presents a systematic Type-II fuzzy expert approach for diagnosing the human brain tumors (Astrocytoma tumors) using T1-weighted Magnetic Resonance Images with difference. The work Type-II fuzzy image processing technique has four distinct steps: Pre-processing, Image Segmentation, Image Feature Extraction, and Approximate Reasoning. [7].

Different fuzzy techniques have been used as a suitable alternative and pattern recognition to the fundamental quandary of human idea and defect of standard mathematics to deal with its complex and unclearly defined work [8].

Presented work has denoted a cooperative and an effective technique for the detection of brain tumors based on median filtering, K Means Segmentation, FCM Segmentation, and finally, threshold segmentation techniques. This approach improves the quality of the tumor images acquired by the aid of MRI and then to detect the size of the tumor [9].

Presented work is a study of the various techniques that are available for color images, text and gray scale images. The result of image segmentation is a set of image segments that all together cover the image, or a set of contours obtained from the image. Each of the pixels in a region is same with respect to some representative or computed features, such as color, intensity, or texture [10].

III. PROPOSED METHODOLOGY

This approach is based on deep learning so we work on MRI scan medical images of human brain using k-means clustering and fuzzy c means clustering techniques.

First, image preprocessing step, we check the presence of noise in input medical image. If the noise is present in given image then we removed this noise using median filter technique. To remove the noise from image for further processing, we use median filter technique.

After that additionally, the image segmentation is carried out by using K-means and Fuzzy C-means techniques. Then the feature are extracted by using image thresholding and finally, approximate reasoning step to recognize the tumor area and stage in MRI image and also predict the disease risk from result area of brain tumor.

Advantages of Proposed System:

1. This system will use median filter for noise removal so will get accurate clear image.
2. This work on deep learning using k means clustering and fuzzy c means clustering.
3. It consist two algorithms for clustering which effectively able to extract tumor from image and gives the actual final result.
4. This proposed system effectively able to extract all the spatial characteristics of an Image.
5. This proposed system accurately calculate the brain tumor area and stage of an Image.

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Vol. 8, Issue 5, May 2019

A. Architecture

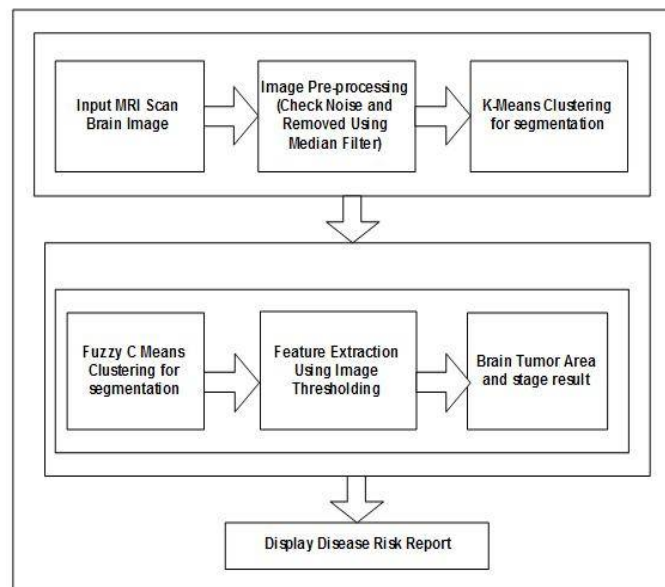


Fig. 1. Proposed System Architecture

Explanation:

Image Pre-processing

In this step here, we used median filter for brain image noise removal. The possibilities of present of noise in modern MRI scan are very less. It may present due to the thermal effect. The main aim of this work is to detect and segment the tumor cells in image. But for the complete system it needs the process of noise removal.

Segmentation using K-means

Steps:

- 1) Give the number of cluster value as k.
- 2) Then randomly select the k cluster centers
- 3) After that calculate the mean or center of the cluster
- 4) Also calculate the distance between each pixel to each cluster center
- 5) If this distance is near to the cluster center then move to that cluster.
- 6) Otherwise move to next cluster.
- 7) Re-estimate the cluster center.
- 8) Repeat the process until the cluster center doesn't move.

Segmentation using Fuzzy C means

The fuzzy logic is a method to processing the data by giving the partial membership value to each pixel in the image.

The membership method value of the fuzzy set is ranges from 0 to 1. Fuzzy C Means clustering is originally a multi valued logic that allows middle values i.e., member of one fuzzy set can also be member of other fuzzy sets in the same image. There is no suddenly transition between full membership and non-membership.

The membership method defines the fuzziness of an image and also to define the information contained in the image.

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Approximate reasoning

In the approximate reasoning step, the brain tumor area is calculated using the image thresholding method. That is the threshold image having only two values either black value or white value (0 or 1). And then classify the stage of tumor from the given area of tumor.

B. Algorithms

1. K-means Algorithm:

K-Means is the one of the unsupervised learning technique for clusters.

Clustering the image is grouping the pixels according to the some characteristics.

In the k-means technique initially we have to define the number of clusters, i.e. value k. Then k-cluster centers are chosen randomly.

The distance between the each pixel to each cluster centers are calculated. The distance may be of simple Euclidean function.

Single pixel is compared to all cluster centers using the distance formula. The pixel is moved to particular cluster which has minimum distance among all. Then the centroid is re-calculated. Again each pixel is compared to all centroids. The procedure nonstop until the point that the middle merges.

2. Fuzzy C-Means Algorithm:

The Fuzzy C-means is an unsupervised clustering technique which can be applied to several issues involving feature analysis, clustering, medical diagnosis and image segmentation. Fuzzy C-means clustering (FCM) technique was proposed by Bezdek et.al in which each data point related to a cluster to a degree described by a membership grade. The FCM technique make smaller the objective function for the division of data set, $x = [x_1; x_2; \dots; x_d]^T$

C. Mathematical Model

1. Mathematical equation in K-means clustering:

$$1. M = i: \frac{\sum_k X_i}{k}, i=1,2,\dots,K.$$

$$2. D(i) = \arg \min_k X_i \quad M_k^2; i = 1; 2; \dots; N;$$

2. Mathematical equation in Fuzzy-C means clustering:

$$Y_m = \frac{\sum_{i=1}^N \sum_{j=1}^C M_{ij}^m X_i}{\sum_{j=1}^C C_j k^2}$$

Where,

m = any real number greater than 1,

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

X_i = data measured in d -dimensional, R_j = d -dimension center

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of the cluster, The update of membership M_{ij} and the cluster centers R are given by:

$$M_{ij} = \frac{1}{\sum_{k=1}^P \frac{1}{\left(\frac{X_i - C_{j,k}}{X_i - C_{k,m}}\right)^2}}$$

$$R_{ij} = \frac{\sum_{i=1}^N X_i M_{ij} m}{\sum_{i=1}^N M_{ij} m}$$

IV. RESULT AND DISCUSSION

Experiments are done by a personal computer with a configuration: Intel (R) Core (TM) i5-6700HQ CPU @ 2.60GHz, 16GB memory, Windows 8, MySQL Server 5.1 and Jdk 1.8. Some functions used in the algorithm are provided by Opencv2.4.7.

In below MRI scan brain image, containing the tumor in figure 2. Median filtering is implemented on the acquired images to get rid of the unwanted noises. The outcomes are displayed in the figure 3. K means technique is implemented

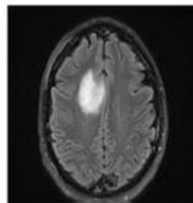


Fig. 2. Brain Tumor Image

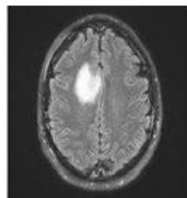


Fig. 3. Median Filtering Outcome

on noise removed image containing brain tumors. In figure 5, a white spot is seen, which is outcome of the application of image threshold segmentation on the input image. This region is the area having higher intensity values compared to the defined threshold. Areas with higher intensity values mostly contains ulcer. The outcomes of image thresholding segmentation are shown below in figure 4. Once the K Means Clustering technique gets over, Fuzzy C-Means segmentation technique is eventually implemented on the resulted image procured from K Means segmentation. The

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region affected by ulcer is highlighted in this process. The outcome of the watershed segmentation is shown below in figure 5. The image thresholding segmentation is implemented, once the FCM segmentation is completed. The outcomes are spectacular and

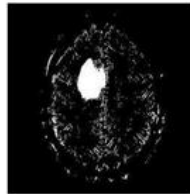


Fig. 4. K Means Clustering

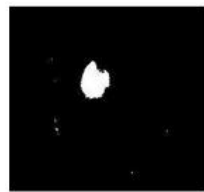


Fig. 5. FCM Segmentation

intended approach is efficacious in nature to an extent. Figure 6 shows the resultant image procured after the implementation of thresholding segmentation. The output is displayed above

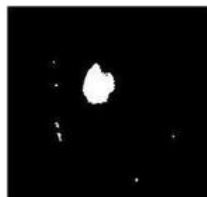


Fig. 6. Thresholding Segmentation



Fig. 7. Output Images Of Tumor Area Estimation

in figure 6. The presented work is also very sensitive to the errors, because the small error will take the situation in ambiguous state which is not good for diagnosis of tumor. Again same FCM mean and k means algorithms are use to compare individual performance with the proposed method and the result of all are compare and we find that the proposed system having less errors in the system.

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V. CONCLUSION

Proposed work is a new variation global and selective segmentation system suitable for segmenting a range of medical images based on deep learning. We remove the noise of images using median filter technique. This technique is very effective to remove the noise from image. The successful noise removal image is given as an input to the k-means clustering method and tumor is detected from the input MRI image.

Also then using Fuzzy C means technique used for accurate brain tumor shape extraction and then thresholding in feature extraction. Finally approximate reasoning step for calculating brain tumor area and stgs and finally shows the disease risk from resultant area of tumor.

ACKNOWLEDGMENT

The authors would like to thank the researchers as well as publishers for making their resources available and teachers for their guidance. We are thankful to the authorities of Savitribai Phule University of Pune and concern members of cPGCON2019 conference, organized by, for their constant guidelines and support. We are also thankful to the reviewer for their valuable suggestions. We also thank the college authorities for providing the required infrastructure and support. Finally, we would like to extend a heartfelt gratitude to friends and family members.

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