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Brain Tumor Detection using Infrared Thermography and Convolutional Neural Network

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Abstract - *A human brain is centre of the nervous system; it is a collection of white mass of cells. A tumor of brain is collection of uncontrolled increasing of these cells abnormally found in different part of the brain namely Glial cells, neurons, lymphatic tissues, blood vessels, pituitary glands and other part of brain which lead to the cancer. Cancer of Brain is of two types-1)Primary Brain Tumor- i)Benign which is not cancerous no danger at all, other one is ii) Malignant which is cancerous tumor; it grows abnormally by multiplying the cells rapidly, which leads to the death of the person if not detected. Manually it is not so easily possible to detect and identify the tumor.*

2)Metastatic Brain Tumor - The metastatic brain tumor is the tumor that is formed elsewhere in the body and spread through the brain.The segmentation, detection, and extraction of infected tumor area from magnetic resonance (MR) images are a primary concern but a tedious and time taking task performed by radiologists or clinical experts, and their accuracy depends on their experience only. So, the use of computer aided technology becomes very necessary to overcome these limitations. We estimate the brain tumor severity using Convolutional Neural Network algorithm which gives us accurate results.

Keywords-Tumor Detection, Convolutional Neural Network, IRT Images, brain tumor, computer vision, bioinformatics, segmentation, medical images, review.

1. INTRODUCTION

With the improvement of modern medical standards, medical imaging technology plays an increasingly important role in daily medical diagnosis and medical research. Therefore, research on medical diagnostic image data is very important. As a tumor disease with frequent occurrence and complexity, brain tumor has become a key research topic in the medical field. The diagnosis of brain tumors is usually based on imaging data analysis of brain tumor . The need for the consideration of thermography increases as it deals with better features like Digital Infrared Thermal Imaging (DITI) that records the thermal pattern of the body without involving radiations using functional image rather than structural image unlike other screening tools. Effectiveness of the dense tissues and the thermography is not affected even due to hormonal changes. Thermography has 83% of sensitivity alone and 95% of sensitivity while combined with MRI. This also has high false-positive rate and false-negative rate but can be reduced further by using enhanced methods. Brain thermography works by finding an increase in surface temperature on brain. The approach leads to analyze the brain using various techniques like color analysis, asymmetric analysis, artificial neural networks, feature extraction, data mining techniques, segmentation approaches, sequential feature selection technique etc., Brain cancer detection using thermography begin with the screening of brain and analyzing thermal changes in obtaining thermogram. The image is observed, and further processing begins with the ordered sequence like pre-processing, segmentation, feature extraction, classification and post procession.

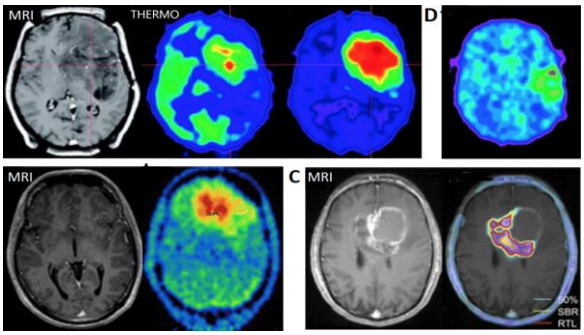

Fig -1: IRT Images

2. LITERATURE SURVEY

Matthew C. Clark et.al [1] in the year of 2015 has developed this methodology using unsupervised clustering algorithm. In this article classification stage are five they are a) pathology detection, b) building intracranial mask c) multispectral histogram thresholding, d)‖ density is screening —in feature space, e) Region Analysis & labelling. The new tumor types are (i) lower grade gliomas will also be considered as labelling of all remaining tissues. (ii) Newer MRI systems it has additional feature such as diffusion images or edge strength to estimate tumor boundaries. An essential use of MRI data is track the size of brain tumor as it

responds (or does not) to treatment. To conclude kb paradigm allows easy addition of new domain information and processing tools. However it does not clearly diagnosis tumors.

Koen Van Leemput et.al [2] this paper presented on brain tumor segmentation is used for algorithm of segment single and multispectral MR image. Their involve white matter, gray matter, and cerebrospinal al fluid (CSF) in MR images, large amount of data. To be estimated show on large intra and inter observer changeability. The parameterized model is used for MR images the automated of this brain of estimation process. The particular is called as Chien model is proposed on better adapted to medical images structures linear shapes. Further improve the segmentation by incorporate related for during classification. Further work includes adapting the algorithm is applied to fully automated segmentation of multiple sclerosis lesions in the brain for during drug treatment. However it does not uses more accurate brain atlas.

Meritxell Bach Cuadra et.al [3] The presented on segmentation of brain tumor in this paper used for demons and SAD algorithm is both tumor growth modeling and atlas similar deformations. It is advancing any where equally the brain tumor deformation. The brain tumor models is introduce imitation lesion voxels in the atlas MRI. The important application of medical field in radio surgery, neurosurgery, and radiotherapy. The approach brain atlas deformation of space occupying tumor is based on Dawant's SAD algorithm different in three points (i) patient's lesion is performed automatically as a replacement for manually (ii) a priori model of radial tumor growth is useful lesion part (iii) adaptive Gaussian filtering in a single step for implemented. Further development segmentation from the computerization of the patient's lesion. The proposition a new support method using a imitation patient-specific atlas. However it does not use accurate brain atlas.

Ayse Demirhan et. Al [4] The proposed work of brain tumor segmentation tissue using neural network. This paper presented used for learning vector quantization (LVQ). The perform neural network classification by learning data. Thework for include other features prior knowledge, models.In this model develop accurate and segmentation. However it does not considered improving the segmentation accuracy of the system by using additional features such as prior knowledge, shape, and models.

Marcel Prastawa et.al [5] ,In this study for framework based on brain tumor segmentation is use fast algorithm for computing the Minimum Covariance Determinant (MCD). The application is used for clinical applications. The present algorithm different brain tumor segmentation including predictable methods, classification and clustering methods, and deformable model methods. In this segmentation model based with parametric and geometric deformable models. However the potential issue that is not handled by the proposed Method.

Annemie Ribbens et.al [6] The proposed work for brain tumor segmentation in unsupervised and clustering populations of brain MRI images. In this algorithm used for Expectation maximization (EM) algorithm. Their application for multiple application for regrouping images and clinical sub groups. The most approach of classification is identify the image are quality for the disease specific morphological different advance to classified images of training set. In this model are build absolutely or implicitly by the segmentation algorithm. However, as important will be exploring the potential contribution of the presented method in multiple applications.

3. METHODOLOGY

1. Image acquisition **:**

In this step we use special type of camera which is use to convert the infrared radiation emitted from the skin into electrical pulses that are visualized in color on a monitor in an adequateroom with homogenous temperature. Captured images are converted to 24-bit RGB images.

2. Pre-processing stage **:**

In this step, we remove noise using a median filter . The original images are converted into grayscale . Next we separate the regions of left and right brain from the human body.

3. Feature Extraction and classification :

In this phase we perform feature extraction on the segmented thermogram. First and second order statistical features are extracted by histogram and gray-level Co-occurance matrices(GLCM) of the segmented image. Since the growth of the cancer in the brain is chaotic,we calculate the average value of features obtained from GLCMat the four directions.

These features are used to find the absolute difference between the left and right brain,which is then normalized to the feature vector and then fed to the back-propagation neural network(BPNN) classifier.

CNN Architecture:

Convolutional neural network are the leading architecture in deep learning that are used to solve an image classification problem. The goal of this paper is to tell which class the input image belongs to.

The process of building a convolutional neural network always involves 4 major steps

Convolution
Pooling
Flattening
Fully connected layer Types of layers: All neurons in one layer, do similar kind of mathematical operations that is how that layer gets its name.

1. Convolution layer:

Convolution is the mathematical operation that is used in image processing to filter signal, find pattern in signal etc. All neurons in this layer perform convolution on inputs. The most important parameter in a convolutional euron is the filter size. We shall slide convolution filter over whole input image to calculate this output across the image and here we slide our window by 1 pixel at time this number is called Stride. Typically we use more than 1 filter in one convolution layer.

2. Pooling layer:

Pooling layer is mostly used immediately after the convolutional layer to reduce the spatial size(only width and height, not depth). This reduces the number of parameters, hence computation is reduced. Also, less number of parameters avoid over fitting. The most common form of pooling is Max pooling where we take a filter of size 3X3 and apply the maximum operation over the 3X3 sized part of the image.

3. Fully Connected Layer:

If each neuron in a layer receives input from all the neurons in the previous layer, then this layer is called fully connected layer. The output of this layer is computed by matrix multiplication followed by bias offset.

4. Training and Testing the CNN using original data was of size 1024-by-1024. We performed Training by first dividing the dataset into 2 classes as normal and abnormal. Filters were used of different sizes (2, 3, 5). The data trained randomly yield better results as compared to without randomizing it automatically. Proposed method is good and it has introduced deep learning for breast cancer detection. It is an ongoing research and further developments are underway by optimizing the CNN architecture and also employing pre- trained networks which will probably lead to higher accuracy. Dataset was pre-processed where the images were of size 1024-by-1024 were resized to 224-by-224. Dataset was further divided into 7 sub-classes, 6 among them included different types of abnormalities and 1 class containing normal images. The classes were named according to abnormalities like architectural distortion, asymmetry, calcification, spiculated masses, circumscribed masses and miscellaneous (images which were neither recognized as benign or malignant). Here we trained and tested the pre-processed dataset with same 3 filter sizes (2,3, 5) where we

4. Adavantages

It is simple
It is 100% safe
Thermography is ideal for preventive medicine is effective for men, women and children
It is the ideal tool for early health screening
It is painless and inexpensive

5. Future scope and enhancement

There is a wide scope for future implementation of "Brain Tumor Detection using Convolutional Neural Networks" towards an interesting experience of modern technologies. Digital Platform is a 'one stop shops' for all kinds of Hospitals to serve the domestic and international users at any time, any moment and anywhere in any parts of the world. Not being sticky to make packages within India only, it can be global - a "global platform" through a comprehensive.

In present days, modern technologies have made treatment more pleasure comprising speed with comfort. So, people are not willing to be bound within only a small geographical area, so there is place to make them experience the taste of "Global Platform".

It can be enhanced into a Mobile Application. And also in future we can create an Artificial Intelligence Deep Neural Network Model for the evaluation for all other kind of diseases and even we develop in such a way that all the small kind of diseases can be cured without contacting a doctor and by spending lot of money.

6. Conclusion

The study reveals the effectiveness of thermography over other diagnosing techniques and also surveyed about various segmentation and classification methods used for the detection brain tumor. Thermography provides functional information on thermal and vascular conditions of the tissue rather than structural characteristic like any other brain tumor detection techniques. There is no screening tool currently available that provides 100%predictability unless biopsy.The limitations of thermography like false positive and false negative can be reduced further by using appropriate combinations of the feature extractions technique ,type of the segmentation and classifications algorithm. As we know that the data plays a crucial role in every deep learning model, if the data is more specific and accurate about the symptoms of the brain tumor then that can help in reaching greater accuracy with better results in real-time applications.

1. "Brain Tumor Detection using Convolutional Neural Networks" simplifies the management process of brain tumor check-up by deploying a web interface to the users.
2. Fast processing and immediate results with high security.
3. Minimizing human effort and cost efficient databases.
4. Navigation through the site is easy.

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