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Automatic Brain Tumor Detection using Deep Learning

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ABSTARCT:

The field of medical imaging is gaining importance with an increase in the demand for automated, reliable, fast and efficient diagnosis which can provide insight to the image better than human eyes. Brain tumor is the second leading cause for cancer-related deaths in men in age 20 to 39 and fifth leading cause cancer among women in same age group. Brain tumors are painful and may result in various diseases if not cured properly. Diagnosis of tumor is a very important part in its treatment. Identification plays an important part in the diagnosis of benign and malignant tumors. A prime reason behind an increase in the number of cancer patients worldwide is the ignorance towards treatment of a tumor in its early stages. This paper discusses such an algorithm that can inform the user about details of tumor using basic image processing techniques. These methods include noise removal and sharpening of the image along with basic morphological functions, erosion and dilation, to obtain the background. Subtraction of background and its negative from different sets of images results in extracted tumor image. Plotting contour and c-label of the tumor and its boundary provides us with information related to the tumor that can help in a better visualization in diagnosing cases. This process helps in identifying the size, shape and position of the tumor. It helps the medical staff as well as the patient to understand the seriousness of the tumor with the help of different color-labeling for different levels of elevation . A GUI for the contour of tumor and its boundary can provide information to the medical staff on click of user choice buttons.

Keywords: CNN,Brain Tumor **,**Deep Learning, Machine Learning.

I. INTRODUCTION

1.1 General

The driving force of this project is to create a transparent environment where medical staff and patient can work in complete cooperation to achieve better results. This transparent environment will help the patient to feel secure as they will understand the treatment-process choice, which in turn will help the medical staff to handle the situation in a calm order giving them more time to think and work.

1.2 Motivation

A brain tumor is defined as abnormal growth of cells within the brain or central spinal canal. Some tumors can be cancerous thus they need to be detected and cured in time. The exact cause of brain tumors is not

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clear and neither is exact set of symptoms defined, thus, people may be suffering from it without realizing the danger. Primary brain tumors can be either malignant (contain cancer cells) or benign (do not contain cancer cells) [7].

Brain tumor oc372curred when the cells were dividing and growing abnormally. It is appear to be a solid mass when it diagnosed with diagnostic medical imaging techniques. There are two types of brain tumor which is primary brain tumor and metastatic brain tumor. Primary brain tumor is the condition when the tumor is formed in the brain and tended to stay there while the metastatic brain tumor is the tumor that is formed elsewhere in the body and spread through the brain [4].

The symptom having of brain tumor depends on the location, size and type of the tumor. It occurs when the tumor compressing the surrounding cells and gives out pressure. Besides, it is also occurs when the tumor block the fluid that flows throughout the brain. The common symptoms are having headache, nausea and vomiting, and having problem in balancing and walking. Brain tumor can be detected by the diagnostic imaging modalities such as CT scan and MRI. Both of the modalities have advantages in detecting depending on the location type and the purpose of examination needed. In this paper, we prefer to use the CT images because it is easy to examine and gives out accurate calcification and foreign mass location [4].

The CT image acquired from the CT machine give two dimension cross sectional of brain. However, the image acquired did not extract the tumor from the image. Thus, the image processing is needed to determine the severity of the tumor depends on the size [4].

The reasons for selecting CT images upon MRI images are as follows:

1. CT is much faster than MRI, making it the study of choice in cases of trauma and other acute neurological emergencies. CT can be obtained at considerably less cost than MRI.
2. CT can be obtained at considerably less cost than MRI.
3. CT is less sensitive to patient motion during the examination.
4. The imaging can be performed much more rapidly, so CT may be easier to perform in claustrophobic or very heavy patients.
5. CT can be performed at no risk to the patient with implantable medical devices, such as cardiac pacemakers, ferromagnetic vascular clips and nerve stimulators.

The focus of this project is CT brain images' tumor extraction and its representation in simpler form such that it is understandable by everyone. Humans tend to understand colored

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images better than black and white images, thus, we are using colors to make the representation simpler enough to be understood by the patient along with the medical staff. Contour plot and c-label of tumor and its boundary is programmed to give 3D visualization from 2D image using different colors for different levels of intensity. A user-friendly GUI is also created which helps medical staff to attain the above objective without getting into the code.

1.3 Aim & Objective – Problem Description

The aim of the paper is tumor identification in brain CT images. The main reason for detection of brain tumors is to provide aid to clinical diagnosis. The aim is to provide an algorithm that guarantees the presence of a tumor by combining several procedures to provide a foolproof method of tumor detection in CT brain images. The methods utilized are filtering, contrast adjustment, negation of an image, image subtraction, erosion, dilation, threshold, and outlining of the tumor.

The focus of this project is CT brain images' tumor extraction and its representation in simpler form such that it is understandable by everyone. Humans tend to understand colored images better than black and white images, thus, we are using colors to make the representation simpler enough to be understood by the patient along with the medical staff.

The objective of this work is to bring some useful information in simpler form in front of the users, especially for the medical staff treating the patient. Aim of this paper is to define an algorithm that will result in extracted image of the tumor from the CT brain image. The resultant image will be able to provide information like size, dimension and position of the tumor, plotting contour and c-label of the tumor and its boundary provides us with information related to the tumor that can prove useful for various cases, which will provide a better base for the staff to decide the curing procedure. Plotting contour-f plot and c-label plot of the tumor and its boundary will give easy understanding to the medical staff because humans comprehend images better with the help of different colors for different levels of intensity, giving 3D visualization from a 2D image.

1.4 Related Work

According to Mustaqeem, Anam, et.al, in "An efficient brain tumor detection algorithm using watershed and thresholding based segmentation" published in "International Journal 4" in 2012 [7], benign also can be growth as malignant which is consists of cancerous cells. Malignant is the rapid growing tumor which is invasive and life threatening. It is also called as brain cancer since the malignant contains cancerous cells that able to destroy any nearby cell.

The paper "Tumor Detection using Threshold operation in MRI Brain Images"

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by Natarajan P. et.al, [10] states that Primary brain tumors include any tumor that starts in the brain. Primary brain tumors can start from brain cells, the membranes around the brain (meninges), nerves, or glands. Tumors can directly destroy brain cells. They can also damage cells by producing inflammation, placing pressure on other parts of the brain, and increasing pressure within the skull. A metastatic brain tumor is a cancer that has spread from elsewhere in the body to the brain.

According to R. Rajeswari, P. Anadhakumar, in "Image segmentation and identification of brain tumor using FFT techniques of MRI images", published in "ACEEE International Journal on Communication, Vol. 02" [6] the conventional definition of brain tumor includes neoplasms originating from brain parenchyma as well as from meninges and even tumors of the pituitary gland or of osseous intracranial structure that can indirectly affect brain tissues [4].

In the paper "A novel anatomical Structure segmentation method of CT head images" by X. Zang et.al [12] Histogram contains intensity value of 0-255. The zero value is the darkest part while the 255 was the white or the brightest side. Using the histogram analysis approached used the mixture Gaussian filter for the extracted part pixel intensity.

However, most of the technique used is more on MRI modality compared to CT images because it is higher resolutions. CT images of human body parts help medical doctors in diagnosing illness like brain tumor, colon cancer, lung cancer and so forth. However, it is quite difficult to obtain the important features in the images because it is limited by the image processing level and also doctor's experience. This is expressed in "Automatic Classification and segmentation of brain tumor in CT images using optimal dominant gray level run length texture features," by A. Padma and R. Sukanesh [13].

Deep Learning

The idea of profound acing is comparative with what's more removing capacity from the previous trademark. Through removing commonly, profound learning will accomplish better dimensional capacity for type. Up until this point, profound learning has an incredible outcome in picture class, sound or home grown language preparing programs.

In the beginning, the possibility of profound finding a workable pace into proposed by Lecun, Y in 1989. Lecun furthermore completed [14] and [15] contemplates. In any case, profound contemplating transformed into intense to use as it invested parts energy to set up the model. In 2006, Hinton, G.E's examination ,[16][x][17], set an accentuation on profound adapting again inside the scholarly world, and characterized that profound contemplating utilized over the top measurements work, that may procure the more class precision. Profound learning is the mix of regulated finding a workable

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pace solo figuring out how to separate trademark from more profound structure.

Profound picking up information on examines were posted might be isolated into segment, hypothesis and application. In principle component, the essential objective situated in an approach to quicken the picking up information on schedule and improve order [16]-[23]. In utility part, profound finding a good pace in previews, PC dreams, printed content, and different attributes of more prominent complex insights to learn[24]-[28][32][33].

Convolutional Neural Networks

In the gadget learning field, not best profound considering transforms into an expanding number of well known, however moreover convolutional neural network (CNN) is pulled in premium as of late. CNN is specifically executed in picture notoriety, demonstrated in Figure 1[14]. To take care of two-dimensional records as information, and framework with multi-layer of convolution. Each layer of convolution will get the yield of the first layer of convolution as the information. CNN keeps up pooling and convolution to extricate valuable capacity for each layer lastly accomplish eminent capacity, that may get a positive limit of photo clarification.

III. METHODOLOGY

2.1 Introduction of problem

The CT image acquired from the CT machine give two dimension cross sectional of brain. However, the image acquired did not extract the tumor from the image. Thus, the image processing is needed to determine the severity of the tumor depends on the size [4].

3.2.1 System Architectural Design

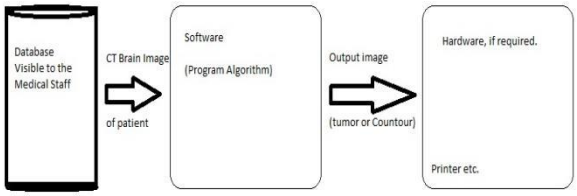

Fig 3.2.1.1.System Architectural Description

2.2 Gaps identified in existing system

In the existing solution of extraction of brain tumor from CT scan images tumor part is detected from the CT scan of the brain. The proposed solution also do the same thing , inform the user about details of tumor using basic image processing techniques. The methods include noise removal and sharpening of the image along with basic morphological functions, erosion and dilation, to obtain the background. Subtraction of background and its negative from different sets of images results in extracted tumor image. The difference in the proposed solution with existing solution is plotting contour and c-label of the tumor and its boundary which provides us with information related to the tumor that can help in a better visualization in diagnosing cases. This process helps in identifying the size, shape and position of the tumor. It

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helps the medical staff as well as the patient to understand the seriousness of the tumor with the help of different color-labeling for different levels of elevation

2.3 Proposed solution

The algorithm is a set of image processing fundamental procedures. A set of noise-removal functions accompanied with morphological operations that result in clear image of tumor after passing through high pass filter is the basic idea behind the proposed algorithm. The set of morphological operations used will decide the clarity and quality of the tumor image.

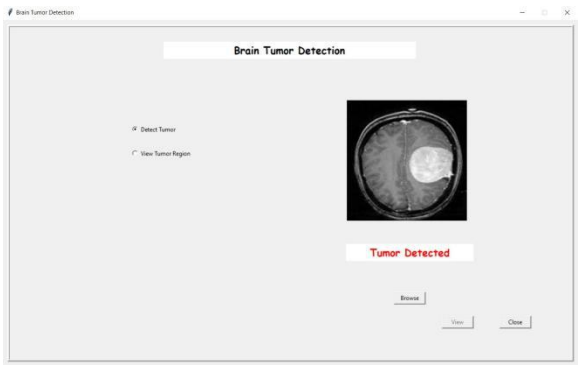
A GUI is created in the Python offering the proposed application of extracting the tumor from selected brain image and its visualization using contour plot. Without having to deal with the code, medical staff can select the CT image and study the extracted tumor along with its boundary from contour and c-label options. The GUI also contains options for zoom-in, zoom-out, data cursor for co-ordinates, and prints the selected image.

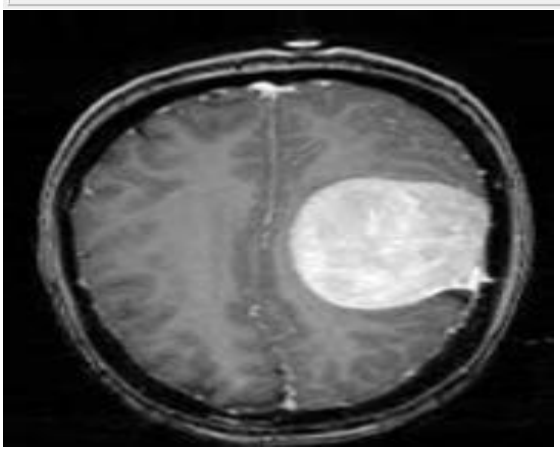
Results and Discussion

This paper focuses upon the detection and visualization of a tumour in the brain from CT images. By developing the proposed architecture, the demarcation of the tumour in the CT image is obtained. The following results showcase the outputs received after each step in the algorithm.

After the original image undergoes pre-processing transformations we get figure 5.2 from figure 5.1. These basic pre-processing transformations include:

1. Changing the image to greyscale, as we need to find contour of the final image which works on greyscale images.
2. Applying low pass filter, to remove any noise, if present, in the image.
3. Applying high pass filter, to obtain sharpened image with clear-defined boundaries.





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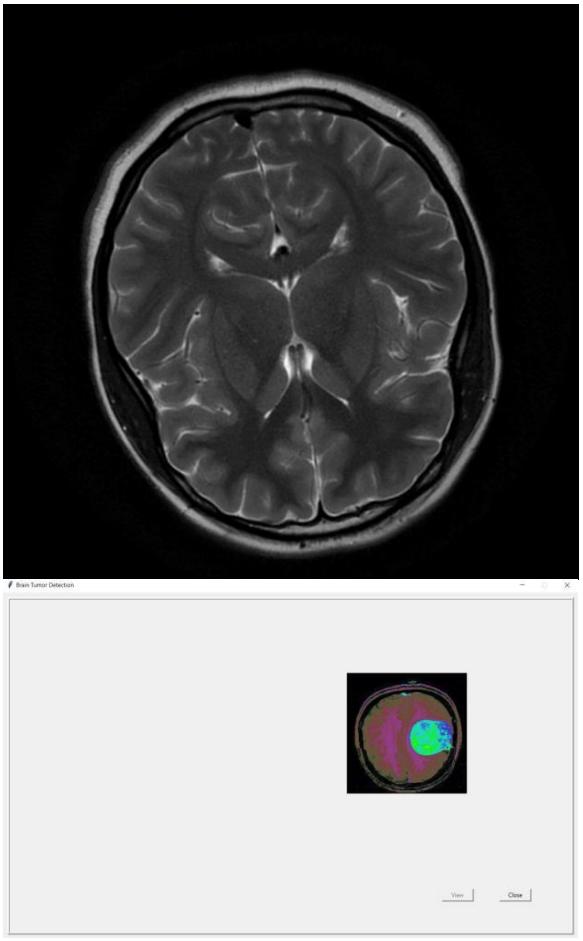

V CONCLUSION

The proposed algorithm is inputted with gray scale images of brain that contain tumour/s. The image is processed through various stages of morphological operations like filtering, contra adjustment, erosion, dilation etc. through Python programming. Hence, the tumour is outlined in the original image and clearly demarcated. Contour plot and c-label plot is created to provide 3D visualization from the 2D image. A GUI is also developed which enables the above application with a user friendly interface.

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