Detection and Measurement of Brain Tumor using LabVIEW

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Abstract— **Tumor identification and evaluation requires Magnetic Resonance Imaging (MRI) scan and image processing in the medical diagnosis. Unconventional growth of cells in the brain which is called as the tumor, damages the other cells that are important for functioning and proper working of human brain. The measurement technique used here helps in identifying the exact area and location dimensions) of tumor. Time consumption and non-reliability are the drawbacks of manual method of detection. To get the accurate and precise result different approaches and techniques can be used for the detection and quantification of tumor from one's MRI scan.**

Keywords - MRI scan, Segmentation, Image processing, Sobel fiter, LabVIEW

I. INTRODUCTION

Detection of tumor from MRI is primary concern or task, performing biopsy, which is one of the diagnostic test to recognize tumors should be performed by radiologist or clinical experts in pathology lab and it also depends on one's experience. Manual assessment of pathological changes is leading to human errors and time consuming. It is time consuming process and it lead to some of human error. The average human brain is 167 mm long. The "TUMOR" is synonyms for "NEOPLASM" word which is produced by unusual enlargement of tissues. According to the report of WHO (world health organization), nowadays tumor is the most common brain disease and it is classified into two types:
(1) Malignant or cancerous (2) Benign or non-cancerous.
A malignant tumor is also called as cancerous whereas benign is known as non-cancerous. These can be irregular in shape or can be same as the shape of other normal cells, which makes them difficult to identify.

Cancerous tumor is classified as primary and secondary tumors. Primary are the ones which emanate from brain tissues and secondary tumors spread from other parts of body to brain. This is called the brain metastasis. Malignant tumor is more harmful as compared to benign tumor as it spreads rapidly in irregular shapes. If the growth of extra cells becomes more than 50%, then possibility of recovery of patient is optimum. Development in medical imaging technique provides the more opportunity to detect the problem. MRI and CT scan are the most frequently used imaging technique in neuroscience which provides the deep structure of the brain by creating the 3D images.

LabVIEW - Laboratory Virtual Instrument Engineering Workbench is a graphical programming language that interfaces with the real world data for creating custom applications. IMAQ Vision in LabVIEW is a part of the Vision Development Module, which is a library of LabVIEW VIs that are used to develop machine vision and image processing applications. As LabVIEW is a visual programming language it has many advantages such as Graphical user interface which makes an easy drag-and-drop built-in functions, cost is reduced and preserves investment is minimal, it is also flexible and scalable and the use of compiled language makes it execute faster [15]. The purpose of this project is to detect the brain tumor, where the images are acquired from MRI scan and also to measure the area of the tumor using IMAQ (Image Acquisition) Vision and NI (National Instruments) Vision Assistant toolkits of Lab VIEW. Here we compare the abnormal cells with normal cells and exact location and area will be found using NI LabVIEW software. First step is to obtain image from MRI scan images and applying suitable filter technique and measurement technique to find out exact location of the tumor. Thresholding is the simplest technique of image segmentation by which we can be able to detect the tumor region. Development in medical imaging techniques provides the more opportunity in detecting the problems. Here we are developed a script in LabVIEW to detect area and length of the brain tumor in MRI scan images Color plane extraction technique is applied to remove red plane and thresholding and filters are used to find the exact orientation of brain tumor and measurement techniques are used to quantify the area and dimensions of tumor i.e. width and height. Using this, one can calculate the different grades of tumor.

II. LITERATURE SURVEY

In the paper Annisa Wulandari, Riyanto Sigit, Mochamad Mobed Bachtiar [1], the procedure for segmentation of brain tumor consists of median filtering, thresholding, contour, segmentation which is done by watershed, and cropping. Then the system is examined for its performance and for calculation of brain tumor. The experimental results shows that the skull of the brain should be separated before segmentation, this is because of its similar color with the tumor. This method is carried out by watershed segmentation method and proceeded by thresholding method. After the threholding results, the next step is largest contour method, which is a search to distinguish the tumor with other tissues. From the system test obtained, the average error rate of the system is around 10%. Grade identification plays a vital role in brain tumor recognition, as the grade of the tumor is the one that identify the type of treatment to be given to the patient. In this work, two different approaches are given for the categorizing the grades. M.Monica Subashini, Indra Gandhi V [2], different approaches are used to process the MRI image of the brain tumor and then it is classified as low and high grade tumors using the graphical language called LabVIEW. The resultant grades which are obtained are first clustered and then compared with the pre-determined tumor grade confirmed by radiologists. This method determines the accuracy of the tool used. Thus it shows that the performance of the whole process is faster and accuracy.

Parveen, Amritpal singh [3] in this work uses a hybrid technology. Support vector machine (SVM) and fuzzy c means (FCM) are used as this technology. FCM is used for classification along with the data mining used to collect the data from the large data set. K. Sudharani, Dr.T.C. Sarma, Dr. K. Satya Rasad [4], KNN algorithm is used on the pictures of tumor to detect and finding the abnormal grown part in the brain tissues. Depending on the minimal number of samples used KNN gives good and accurate result, but it relatively slow. Garima Singh, Dr. M.A. Ansari [5] shows the study on pre-processing, which is done before the segmentation process, segmentation, where it uses k –means clustering algorithm and classification of tumor image. The tumor tissues from the scanned image is segmented and compared analysis is done with Median filter, Adaptive filter, Averaging filter, Gaussian filter and Un-sharp masking filters but as this method has some limitations i.e. the tumor images at the result is unclear and is not accurate. This approach could not detect the exact region or the boundary of tumor. Mahesh Kurnar, Aman Sinha and Nutan V Bansode in their paper [6] also uses K-means clustering algorithm for classification. The presence of noise or any unwanted signal is removed and is converted to the gray scale image. This uses an open source software called SciLab for morphological operation.

Mircea Gurbin, Mihaela Lascu, and Dan Lascu in paper [7], the brain tumor identifying and grouping system is done using SVM (support vector machine) and utilise different intensity for wavelets for high precision. This prevents the loss of contour in segmentation and the result reveals that SVM has the conventional sets of trained data to differentiate between anomalous and normal tumor locations and classify them correctly as a benign tumor, malign tumor or healthy brain. T. A. Jemimma, Aman Sinha and Y. Jacob Vetharaj [8], used diifernt approach to segment and classify i.e. Watershed Algorithm (WSA), for classification and Dynamic Angle Projection Pattern features for clustering technology. These featured vectors given to the input for CNN classifier which performs the classification. The project on "optimization of visual presentation of MRI image for accurate detection of tumor in human brain using virtual instrument" by Pavani Lakshmi.A, Samata P [9] is a system which uses an image processor can be simply installed and can be applied in any medical field i.e. biomedical. This process is pertained to MRI image data for more precise and cost effective way. The intensified approach gives the estimated value of tumor along with area and other dimensions required for the diagnostic analysis of tumor and the calculated time is less than other methods to perform and examine and time is acquired from the performance meter using LabVIEW tool.

G Rajesh Chandra, Dr. Kolasani Ramchand H Rao [10], paper focused on the interest of soft thresholding for enhancement and genetic algorithms for image segmentation and showed that this kind of ,method can be used either for grey-level MRI images. The developed method achieved signal to noise ratio (SNR) value from 20-44 and segmentation accuracy of 82% is detected in tumor cells. Pavani lakshmi.A in paper [11] inferred that the application has a success rate of 85% and this is efficient for the tumors. The advantages of implementing this project is to reduce the manual labour required in doing a biopsy i.e. a diagnostic test for tumor and inspecting it in the pathology lab. In paper [11-13], describes about different thresholding methods and operators for detection and shows an improvement of 82.5% in percentage of exact identification.

III. THE PROPOSED METHOD

The proposed system is summarized in the Fig.1. The first step is to acquire the MRI images and perform pre-processing technique. In pre-processing, the image is enhanced to remove the undesirable pixels from the image. This process is also called as the edge detection. Segmenting required brain portion from the non-brain region (or unwanted pixels) in MRI. This is a major technique called image processing. Sectioning the brain tissues is often essential for analysing the neuro image data. In MRI, the images are displayed along with the skull and other tissues present in the brain region, to remove this region we use edge detector. Brain position should be isolated and then other methods namely tissue classification, brain segmentation are to be used. After the execution of pre-processing step, brain extraction is usually performed before a full segmentation of the brain region. In our paper we are using sobel filter. After the enhancement process the next step is tumor extraction, here the tumor cells are differentiated from other normal cells by applying thresholding. By using appropriate measuring operators we get the area and dimensions of tumor and detect the type of tumor occurred. Finally it is given to the physician for further diagnosis.

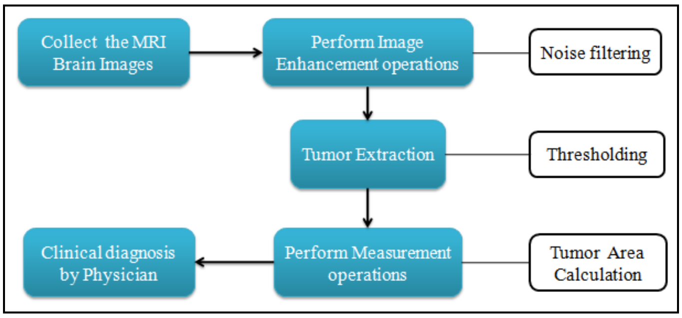

Fig.1 Flow diagram

In our work, we have developed an application for effective detection of tumors present in specific location using LabVIEW software.

IV. IMPLEMENTATION

A. *Acquire the brain image:*

First step in this process is a acquiring the image of brain that stored in database or in image file and displayed the equivalent as a grey scale image. As we are using LabVIEW platform, for extracting the image we made use of the dialog box. IMAQ vision toolbox , which is used here gives a complete set of (DIP) digital image processing and acquisition functions that are more efficient and reduce the time.The two blocks which is used for processing are IMAQ Create and IMAQ Read Image. The former is positioned at Vision and Motion >> Vision Utilities >> Image Management. This block is used to create a new image in a different location known as memory with a specified image type such as RGB (red green and blue), Grayscale (binary image), HSL(hue saturation and luminance). The latter block is the IMAQ Read Image which is situated in Vision and Motion >> Vision Utilities >> Files, the purpose of this is to open the image file which is given in the previously in the file path of the block.

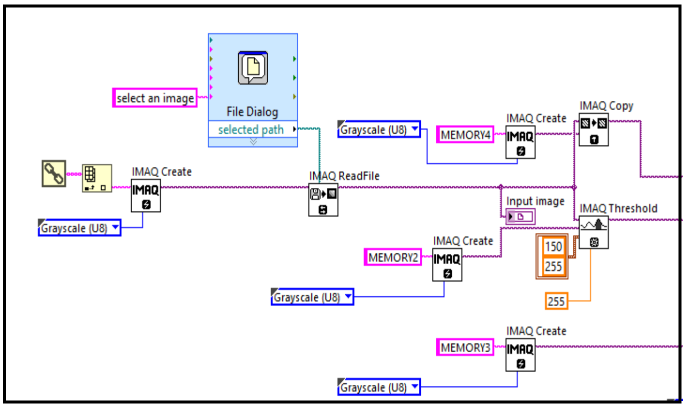

Fig.2 Acquiring the image

B. *Image thresholding*

Image enhancement or thresholding converts the image according to the need for the next stage. It converts the from grayscale to binary color form i.e. 0 and 255, where 0 is black and 255 is white. Thresholding is defined as the average of all the pixels present in the image, thus here the thresholding is gives as 150 pixels.

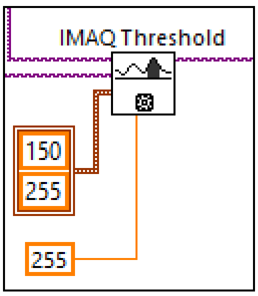

Fig.3 Thresholding operator

C. *Segmentation*

In this step, the image is segmented and classified. In LabVIEW we use IMAQ GrayMorphology, which performs grayscale morphological transformations. These use different operations to remove and add the pixels. This process that is adding or removing the pixels depends on the size and shape of structuring element. This element can be 3 × 3 or 5 × 5 depending on the border. Following are the operations performed by this GrayMorphology:

AutoM – This operation is called as Auto median

Close – This operation first does dilation and then erosion

Dilate – Dilation is a process opposite to that of erosion. Here, the image pixels are added i.e. noise is added.

Erode – This function is erosion which removes the pixels and is opposite to dilation.

Open – Open is a function erosion and dilation.

Pclose – Seven cycles of close and open operation.

Popen – a seven cycles of open and close operations.

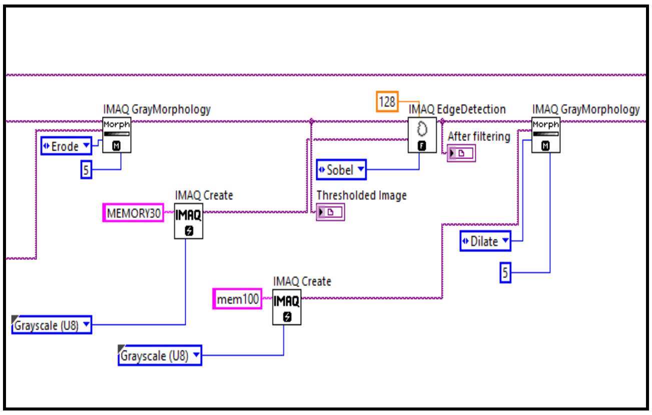

Fig.4 Segmentation method

D. *Filtering*

Here the filtering method used is IMAQ Edge Detection.

It is located in Vision and Motion >> Image Processing >>

Filters >> IMAQ Edge Detection. It extracts the contours (detects edges) in gray-level values and it is 8-bit.

Sobel is a non-linear filter. A nonlinear filter assigns a value to P(i, j) that is not a linear combination of the surrounding values, where P(i, j) represents the intensity of the pixel P with the coordinates (i, j).

For example:

$$P_{(i,j)} = \max(P_{(i-1,j-1)}, P_{(i+1,j-1)}, P_{(i-1,j+1)}, P_{(i+1,j+1)})$$

It operates on a 2-D spatial gradient measurement on an image and then highlights the regions of high frequency that correspond to boundary of the image. Basically, it is used to find the applicably absolute gradient magnitude at each point in an input grayscale image [16].

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Fig.5 Sobel convolution kernels

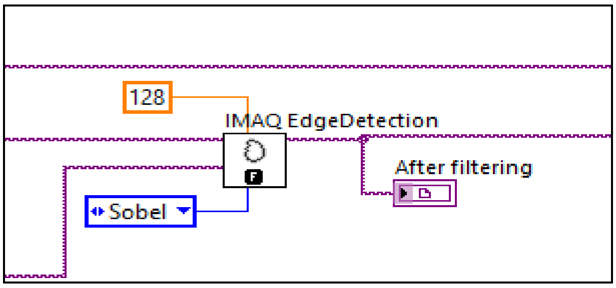

Fig.6 Filtering

E. *Tumor extraction*

After applying the mask, the result will be the dark pixel become darker and white becomes brighter. By using overlay function which is extracted from Vision and Motion >> Vision utilities >> Overlay >> IMAQ Overlay Oval. This function gives the particle report and gives the desired output.

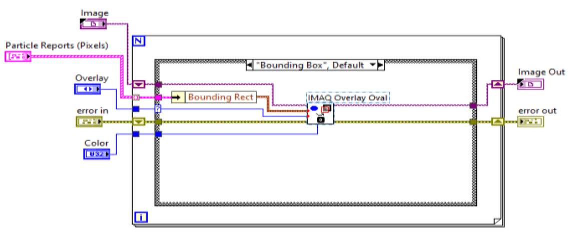

Fig.7 Extraction

F. *Measurement*

After completing the above given operations, we can perform the measurement operation to find the area and dimensions of the tumor. The output of the tumor extraction is given to the tumor area calculation block where tumor area is calculated. After this, the cluster containing an area of interest (tumor) is selected. After comparing with the standard dimensions, it is categories as Grade I, II, III and IV.

G. *Clinical Diagnosis by physician*

After acquiring the Grades, the report can be given to the physician for the better treatment of the patient.

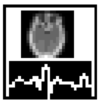

Fig.8 Application for Brain tumor

V. RESULT

We have developed an application for the above method. The below figures shows step by step of execution of brain image.

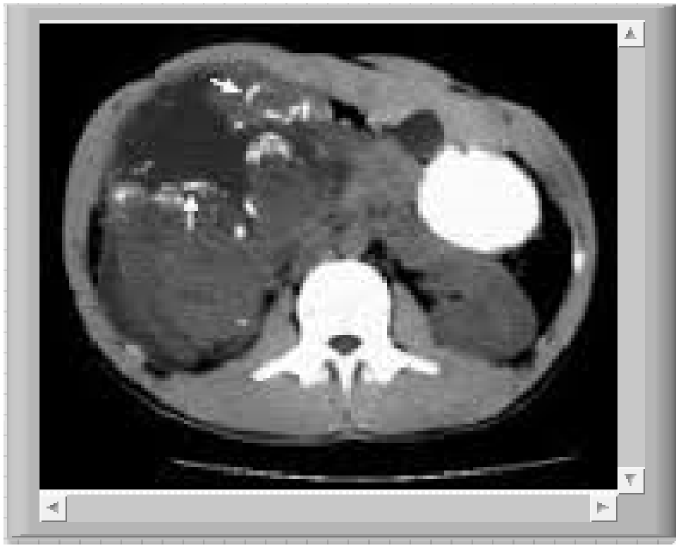

Fig.9 Input image

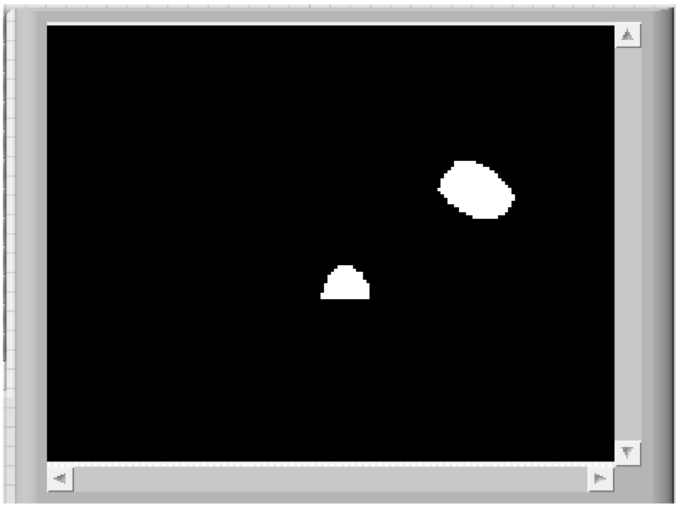

Fig.10 Thresholded image

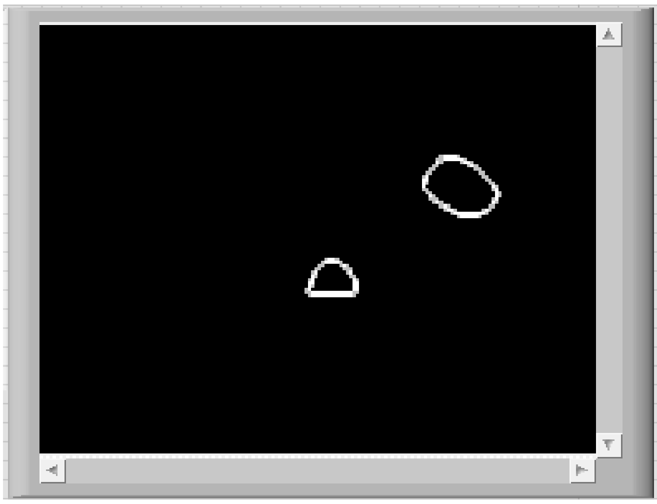

Fig.11 The image after filtering

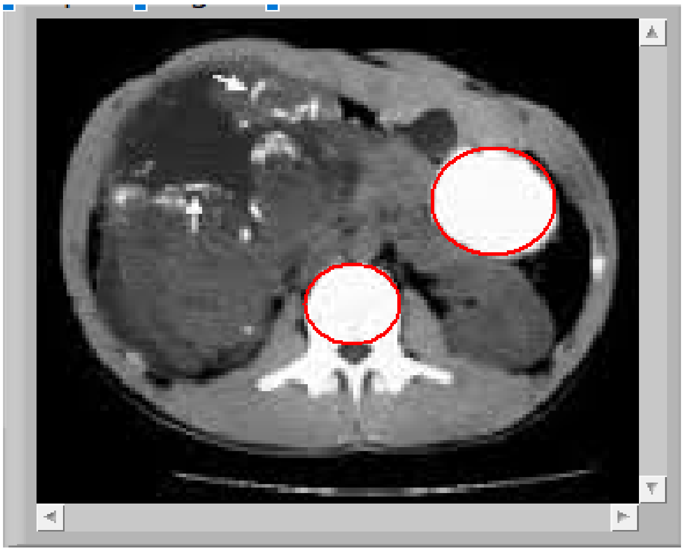

Fig.12 Output image

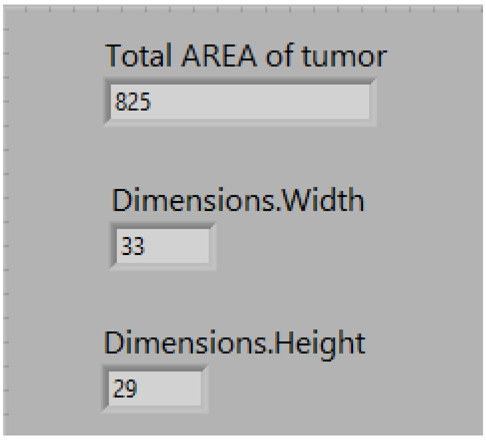

Fig.13 The area and length of tumor is determined by measurement operation

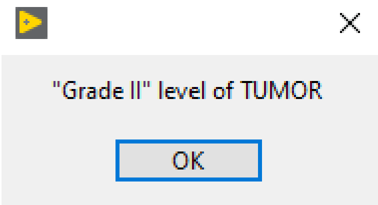

Fig.14 Output showing the type of Grade

VI. CONCLUSION

Image processing tools in LabVIEW are used to extract tumor region of MRI brain image. For accurate analysis of tumor patients, suitable filtering and thresholding method is necessary to be used for MRI images to carry out a superior diagnosis and treatment. In order to measure the area and length of the tumor, we apply measurement operations in LabVIEW. After the measurements of length and area of the tumor, report is given to the physician for the better treatment of the patient.

Our proposed project has a good success rate compared to other methods. We have seen more than 92% of accuracy. The advantages of implementing this project is that it decreses the human labor which is used to perform biopsy. Also, it saves the cost and time which can be used for treating the patient.

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